Mersea Harbour and Tollesbury Wick
Climate change adaptation recharge project:
Environmental Statement

Mersea Harbour Protection Trust

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Author: Carol Reid BSc (Hons)

Maps prepared by Jim Pullen

Photographs: Carol Reid and Jim Pullen

Project Manager for the Mersea Harbour Protection Trust: Mark Dixon

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The Mersea Harbour Protection Trust is a registered charity no: 1159088

http://savemerseaharbour.org/

Front cover painting by Kirsty Hosking: View north over Mersea Harbour showing new recharge in place at three of the proposal sites: Cobmarsh Island, Packing Marsh Island and Old Hall.

‘What’s the use of having developed a science well enough to make predictions if, in the end, all we’re willing to do is stand around and wait for them to come true?’

F. Sherwood Rowland

Executive summary

The Mersea Harbour Protection Trust (MHPT) is a charitable trust which was formed in 2014 by a group of local waterfront interest groups, oystermen, sailors and fishermen with a shared objective to protect the Mersea Harbour from the impacts of climate-change induced sea level rise. The MHPT is planning to secure dredgings from the proposed deepening of the Harwich and Felixstowe Approaches - expected to start in 2018 - to use for intertidal recharge to defend the Mersea Harbour, and its associated commercial interests and internationally important wildlife habitats, against tidal and wave erosion. The project will revisit locations recharged in the 1990s by the Environment Agency at: Cobmarsh and Packing Marsh Islands, Old Hall (Eastern Quarters) and Tollesbury Wick foreshore. These sites have demonstrated the following successful outcomes: protecting saltmarsh and mudflats, promoting silt deposition and mudflat creation, creating nesting opportunities for the rare little tern, a vulnerable species listed under Annex 1 of the European Birds Directive, and providing a substrate for the growth of high saltmarsh species generally restricted to the face of sea walls in Essex. The current proposal will both extend and top-up the existing recharge and effectively enhance and increase the environmental benefits associated with it.

The performance of the earlier recharge has provided a real-time model on which to predict accurate results for the current proposal. Introduced sands and gravels, of a similar grading and provenance as the wave-built spits and beach ridges which occur naturally within the estuary mouth, have been shown to respond to hydrodynamic processes in the same way - absorbing tidal and wave energy and forming a protective wavebreak defending the coastline, while at the same time responding to natural tidal forcing.

The strategic positioning and configuration of the recharge has been designed to deliver both immediate and wider flood defence benefits to internationally important habitats and species in the Blackwater Estuary Special Protection Area for Wild Birds and Wetland of International Importance (Ramsar site); the Essex Estuaries Special Area of Conservation; and the Blackwater, Crouch, Roach and Colne Marine Conservation Zone. It will also offer enhanced storm protection to the harbour's fleets and creeks benefiting local marine-based commerce, including the local native oyster fishery, the fishing fleet and water-based leisure and tourism. The protective influence of the recharge will also extend to shore-based marine businesses, the historic Mersea waterfront, residences and farmland. Topping up and extending the existing 'barrier beach' fronting Tollesbury Wick Marshes and placing recharge material in alignment with the existing sea defences protecting Old Hall Marshes National Nature Reserve, will help to sustain fresh and brackish water grazing marshes within the Blackwater Special Protection Area and Ramsar site. The Environment Agency, in the Essex and South Suffolk Shoreline Management Plan (2010), has scheduled these sites for realignment in epoch 3 (2055 to 2105). However, by using coarse material recharge to effectively reinforce the hard defences, there is the possibility that the current policy may be deferred or reversed, avoiding a challenging mitigation scenario.

The direct impact of placing the recharge at the proposal sites has been considered and potentially adverse effects have been identified. The placement will result in the burying of relatively small areas of actively eroding foreshore of the Special Area of Conservation feature 'intertidal mudflats and sandflats', but will be introducing sands and gravels which are naturally an intrinsic feature of the intertidal flats. The littoral marine communities immediately supplanted by the recharge are assessed in relation to their known distribution in the estuary and their diversity and abundance, and in terms of their importance to overwintering birds of international importance. The capacity to increase turbidity in the water column, during delivery of material, possibly leading to silt settlement on native oyster beds - a protected feature of the Marine Conservation Zone - is also considered, as well as the potential to disturb breeding and overwintering birds. These issues have been examined in detail and any detrimental impacts associated with the deposit and operational phases

can be modified by integral mitigation measures reducing the residual effects to negligilble or acceptable. The timing and methodology for placement of the recharge, the limited delivery window, and a short-run or staggered work schedule, are key factors in avoiding or lessening potentially harmful consequences. The project has the full co-operation of the Blackwater Oystermen's Association and the Tollesbury and Mersea Native Oyster Fishery Company who will carry out monitoring during the disposal operation.

In the operational phase, over time, the scheme will provide mitigation for the erosion and displacement of mudflats, as previously demonstrated by the build up of silts behind the existing recharge bund at Tollesbury Wick. The lengthening of the bund at this location and the design of the bunds at Old Hall and Cobmarsh Island, proposed by the current scheme, will create new mud flats in their lee. Pre and post placement bathymetry and current velocity monitoring will record any changes in water flow and movement of material, which are not predicted to be significant due to the small amount of material involved. Silt build-up, on the protected intertidal flats, and invertebrate colonisation will also be recorded post-placement.

Overall it is concluded that the recharge proposal will have a major beneficial impact on the European Marine Site and the Marine Conservation Zone. With mitigation in place during both the placement and operational phases, there will be no significant adverse impact on the integrity of the European Marine Site.

The scheme offers medium to longer term beneficial outcomes in terms of ecological gains, coastal protection and estuary sustainability, specifically:

- the protection of saltmarsh and intertidal mudflat habitats
- the creation of new mudflats and saltmarsh - in the lee of the linear recharge bunds
- the creation of high saltmarsh habitat at the upper limit of tidal inundation, including transitions to dune-type vegetation
- the extension of suitable nesting habitat for the Annex 1 species, the little tern, and for ringled plover and oystercatcher
- the extension of high tide roosting sites providing safe refuge
- the protection of commercial native oyster beds in the Mersea Harbour creeks
- enhanced storm and flood protection to freshwater wetlands within the Blackwater Estuary Special Protection Area for Wild Birds and Ramsar site
- enhanced storm and flood protection to the Mersea Harbour, safeguarding marine–based industry, leisure boating, fishing interests and the historic waterfront

The combined aspect of the proposal in seeking to safeguard the nature conservation, cultural heritage, and socio-economic resources of the Mersea Harbour area meets with sustainable management principles embodied in the UK government's marine planning policy ([1]Defra, 2011) and the National Planning Policy Framework (2012).

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Abbreviations

BAP	Biodiversity Action Plan
BCR&C Estuaries MCZ	Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone
BOA	Blackwater Oystermen's Association
BTO	British Trust for Ornithology
CBC	Colchester Borough Council
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CHaMP	Coastal Habitat Management Plan
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EC	European Commission
ECC	Essex County Council
EIA	Environmental Impact Assessment
ES	Environmental standards
ES	Environmental statement
EU	European Union
EWT	Essex Wildlife Trust
HAT	Highest Astronomical Tide
HHA	Harwich Haven Authority
HRA	Habitats Regulations Assessment
JNCC	Joint Nature Conservation Committee
K & E IFCA	Kent and Essex Inshore Fisheries and Conservation Authority
MCZ	Marine Conservation Zone
MDC	Maldon District Council
MHWN	Mean high water neap tides
MHWS	Mean high water spring tides
MMO	Marine Management Organisation

NE	Natural England
NNR	National Nature Reserve
ODN	Ordnance Datum Newlyn
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SMP	Shoreline Management Plan
SPA	Special Protection Area (for Wild Birds)
SSSI	Site of Special Scientific Interest
THC	Total hydrocarbons
WFD	Water Framework Directive

1. Introduction

1.1 Project objectives

The Mersea Harbour Protection Trust (MHPT) propose to undertake a programme of sand and gravel foreshore recharge to address coastal erosion in the Mersea Harbour area and Tollesbury Wick frontage in order to protect both commercial interests, dependent on a coastal location, and internationally important conservation features.

The MHPT was formed in 2014 by a group of local people with a stake in the future of the harbour and the Mersea waterfront. The Trust acquired charitable status on 6 November 2014 and is raising funds to undertake the acquisition of dredgings from the proposed Harwich Haven Approaches dredge; obtain the necessary permissions and licences; direct and supervise the delivery of the recharge material to the target sites; and to monitor the effect of the recharge placement.

The MHPT's remit is to pursue the objectives listed below:

> To promote, for the benefit of the public, the conservation, protection and improvement of the physical and natural environment in the area of West Mersea Harbour, Essex, in particular, but not exclusively, by:

- protecting West Mersea Harbour, including the native oyster (*Ostrea edulis*) beds, from excessive erosion by climate-change induced storm waves, but still allow natural coastal processes to apply and impact. Native oyster beds are a feature of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ). The species itself is protected under the MCZ designation and it is also a priority marine species under the UK Biodiversity Action Plan (UK BAP).

- providing new and robust nesting sites for the little tern, a Schedule 1 species under the Wildlife and Countryside Act 1981, and an Annex 1 species under the European Birds Directive.

- enhancing, wherever possible, the conservation features and the integrity of the European marine sites: the Blackwater Estuary Special Protection Area (SPA) for Wild Birds and Wetland of International Importance (Ramsar site) and the Essex Estuaries Special Area of Conservation (SAC).

Residual outcomes:

- To preserve the long term viability of the harbour for maritime commercial and leisure activities.
- To preserve the character of the Mersea waterside area.

1.2 Location of proposal site

Mersea Harbour is situated on the north shore of the Blackwater estuary, at West Mersea, in Essex (Figure 1).

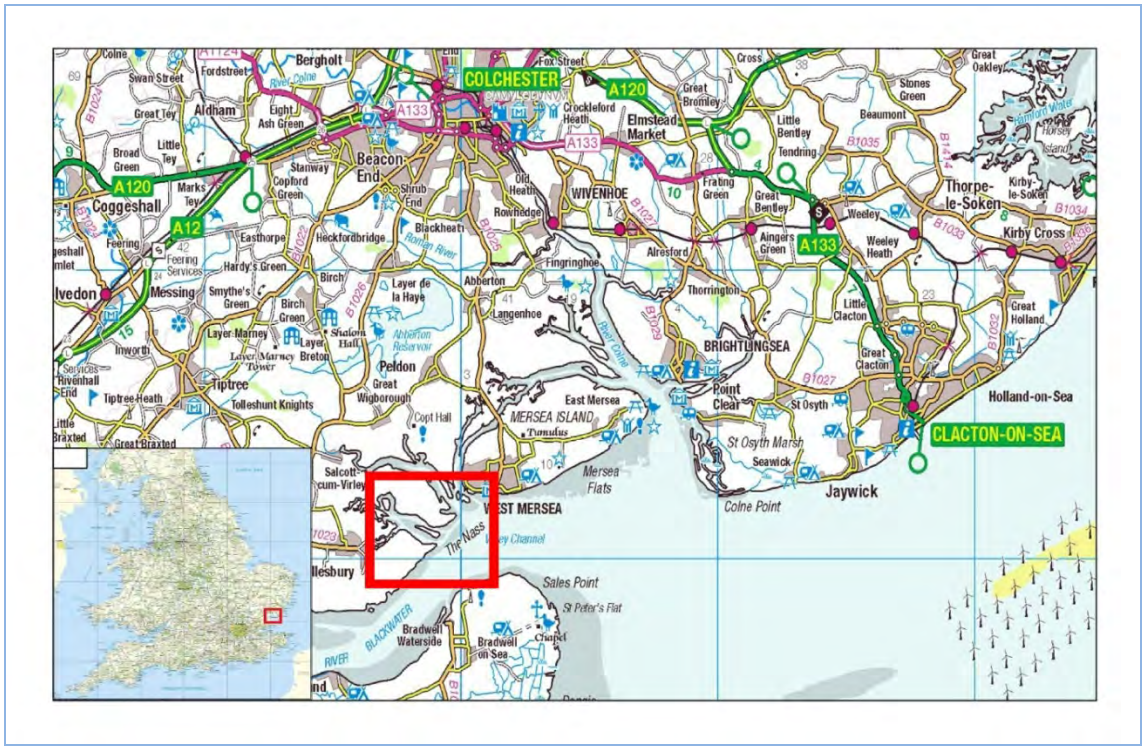

Figure 1. Site location – central grid reference TL9934811214 [(c) Crown Copyright OS 250k Road Atlas 2013].

The harbour mouth lies between the Quarters Spit (Old Hall Point) and the Kings Hard and is protected by Cobmarsh and Packing Marsh Islands. The Quarters Spit marks the divide between the Mersea and Tollesbury channels and also has a protective influence on the harbour area. The Tollesbury channels are bound to the north by Old Hall Marshes, owned and managed by the Royal Society for the Protection of Birds (RSPB), and to the south by Tollesbury Wick Marshes nature reserve, owned and managed by the Essex Wildlife Trust (EWT). The Tollesbury Wick frontage is situated to the south-west of Tollesbury South Channel (Figure 2).

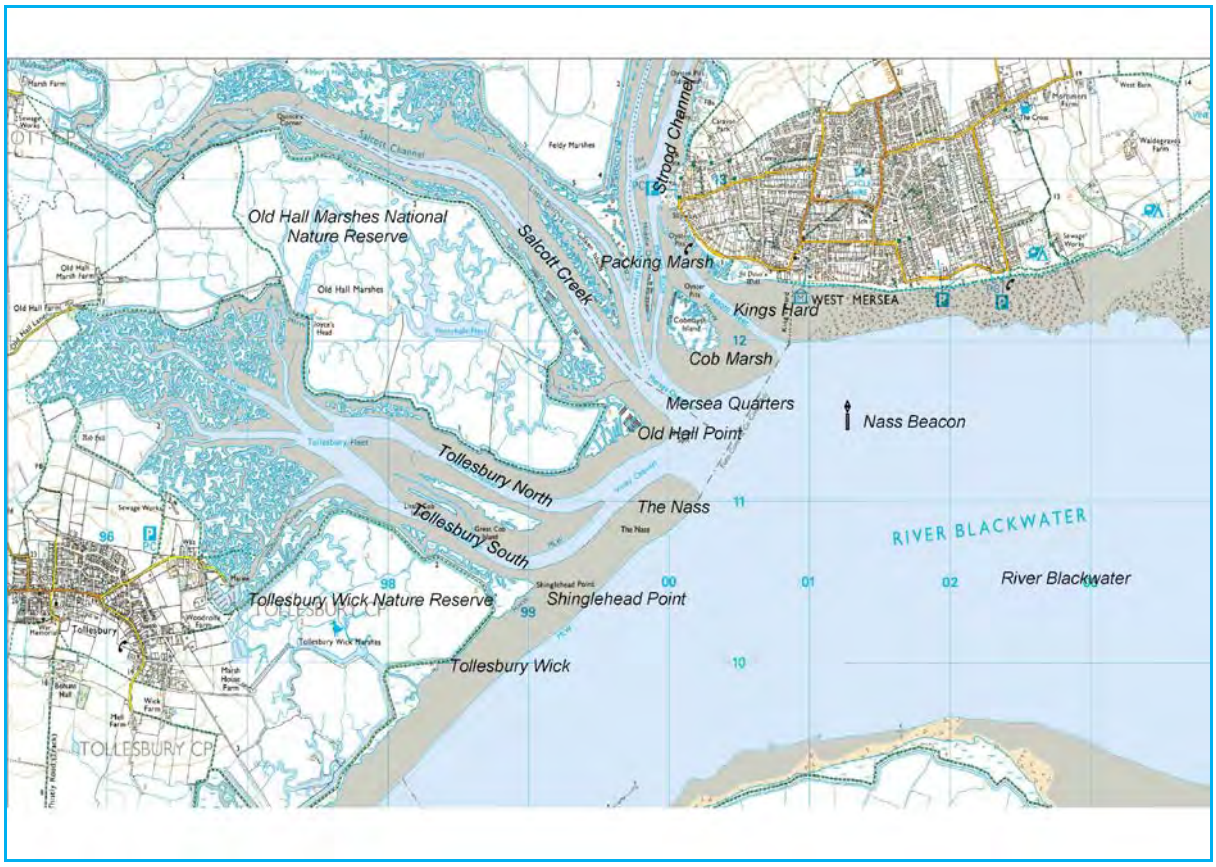

Figure 2. Mersea Harbour [(c) Environment Agency 1997].

The locations of the proposed recharge placements are indicated in Figure 3 and involve the following sites: Cobmarsh Island, Packing Marsh Island, Old Hall (south-west of Old Hall Point) and Tollesbury Wick frontage.

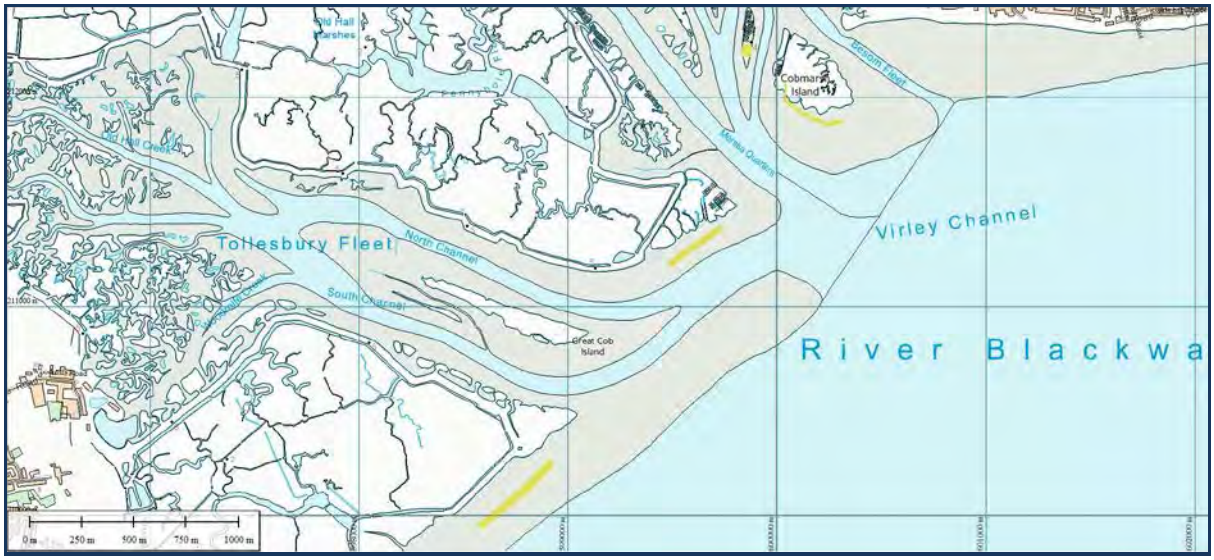

Figure 3. Location of proposed recharge placement areas [Jim Pullen, 2014; (c) Crown Copyright OS opendata 50k vector mapping 2015].

1.3 Consultation and support

Consultation with commercial, leisure and residential groups, and conservation organisations with interests in the area was carried out during 2014 on 27 March; 10, 12, 24, 26 April; 6 May; and on 26 February, 15 September and 1 December in 2015, to present the recharge proposals and address queries and concerns. Following a front page article in the local press, public exhibitions were held on 10, 12, 24, and 26 April 2014 and a fund raising public meeting was held on 1 December 2015. Comments made by those who attended the public exhibition are listed in Appendix 1.

The Royal Society for the Protection of Birds (RSPB), the Environment Agency (EA), and the Essex Wildlife Trust (EWT) became formal support partners to the project following the early consultation meetings. Officers from Natural England's marine team and the Marine Management Organisation were invited to attend site visits in spring/summer 2014 to view the recharge placement areas. Natural England subsequently provided advice through the Discretionary Advice Service commenting on a report accompanying a request for a screening and scoping opinion submitted in May 2015. Discussions have been ongoing with the Chair and Chief Engineer of Harwich Haven Authority (HHA) regarding the acquisition of dredgings, with meetings held on 17 January 2014 and 15 September 2015. The Environment Agency has been fully appraised of the proposals and officers have attended site meetings.

The MHPT has received financial backing from the Environment Agency, the Essex Community Fund, and the Essex County Council (ECC) Community Initiative Fund, and has been chosen by Colchester councillors to be the recipient of funding from Colchester Borough Council's Community Budget. Local funders include the Mersea Moorings Association, and much support is given in kind by members of the local community, the RSPB and EWT.

The project is endorsed by Bernard Jenkin, MP for Harwich and North Essex, and Priti Patel (MP for Witham).

Expressions of support have been received in writing from the Environment Agency, Essex County Council, the Haven Gateway Partnership (a public and private partnership), the RSPB, Priti Patel (MP), and the Royal Yachting Association (Appendix 2).

1.4 Foreshore interests

The proposed placement of recharge to Old Hall south shore lies within the National Nature Reserve on foreshore owned by the Crown Estate and leased to Natural England. The permission of Natural England will be required to deposit material. All interests over the other proposal sites have been identified with permissions granted for some areas and currently under discussion on the remainder.

1.5 Screening and scoping

A report was prepared to accompany a screening opinion and scoping request and submitted to Natural England's Discretionary Advice Service on 9 April 2015. Natural England's comments, received on 28 May 2015, indicated that an Environmental Impact Assessment (EIA) would be required, as outlined within the Marine Works Regulation (Environmental Impact Assessment Regulations) 2007 (amended in 2011). They considered that the works could be defined as a 'sea defence' project, and as such would fall under the infrastructure project remit within No. 10 of Annex II of the regulations:

> 'Coastal work to combat erosion and maritime works capable of altering the coast through the construction, for example, of dykes, moles, jetties and other sea defence works, excluding the maintenance and reconstruction of such works.'

They further advised that whilst a Habitats Regulations assessment will cover any potential impacts to either the Special Protection Areas (SPAs) or the Essex Estuaries Special Area of Conservation (SAC) an EIA may be triggered to assess any potential impacts to either the Marine Conservation Zone (MCZ) or Sites of Special Scientific Interest. Natural England concluded that given the size of the proposed works and proximity to designated sites, these works were likely to require an EIA.

Natural England also stated that the proposal in its current form would be likely to have a significant effect on the interest features of the above mentioned sites and would therefore require an Appropriate Assessment in accordance with Regulation 61 of the Conservation of Habitats and Species Regulations 2010. They added that: *'given the temporal extent of the project, we would also advise that you undertake a shadow HRA for the additional SPA features to future proof your application.'*

Natural England also advised on the scope of the EIA requesting clarification on information supplied in the report accompanying the scoping request and outlining key issues to be addressed (see Table 1).

Table 1. Natural England: issues to address in the EIA.
The intertidal section of the works, as set out in the information supplied by the applicant, is situated within the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ). This site was established to afford protection to Native Oysters (*Ostrea edulis*), the Native Oyster beds and intertidal mixed sediment. We would recommend that a much more comprehensive assessment of the site is presented in the final application. This should include information on the underpinning legislation (Marine and Coastal Access Act, 2009), information on the site's features and their conservation objectives (Native Oyster – recover to favourable status, Native Oyster beds – recover to favourable status and intertidal mixed sediment – maintain at favourable status), and an assessment of the potential impacts and mitigation. It would also be beneficial to include a map illustrating the key oyster grounds in relation to the proposed works.
Please clarify the process by which the Trust will be assured of the compatibility of the sediment deriving from Harwich harbour with the in-situ sediment.
We understand that the rainbow discharge mechanism has been used previously and evenly distributes the sedimentation. However, it would be useful to hear more about this within the application.
The description of the timing and location of the works could benefit from some greater clarity. Specifically, could you please confirm whether the works will occur at mean low water springs or neaps, and at either high or low water? Also, are the works going towards the subtidal or back up towards the shore. We would recommend that the works took place during calm weather, so to ensure that risk of sediment loss through run off was minimised.
We understand that this is a temporary solution but agree that this is the most desirable one going forward given the sympathetic nature of the material with the site. However, it would be useful to provide more information about the longer term solutions currently under consideration.

Table 1. Natural England: issues to address in the EIA.
It would be useful to have the oyster beds overlaid onto a map.
Following the identification of mitigation, several risks are only lowered to a medium level. Further information around these residual levels are required, especially an analysis of what these mean in the context of overall impacts to the designated sites.
We understand that one such risk is that the grading curve of material makes it unsuitable for placement. If advice concerning the grading curve is adhered to, could the risk be downgraded to low?
There is a risk that the recharge may migrate and impact on the SAC and MCZ features. Particular features at risk are the intertidal mixed sediment and the native oysters. Please identify where these features are in relation to the works, together with an assessment of the potential impacts and any proposed mitigation. It would be worth exploring the benefit of installing further preventative fencing to help lower the risk to low, instead of erecting them retrospectively. Looking at the current document, one such risk could be the smothering of invertebrates. With this in mind it would be useful to pull in the latest invert survey to explain the associated low risk.
There is currently a risk to bird nesting and breeding seasons as well as bird overwintering (please note we count the over wintering period to last from October to March). Please explain that you will be timing the works to sit outside of these sensitive times or identify ways to minimise any disturbance. For example, if the works must take place during the breeding season (as you are tied to the Harwich schedule), by scheduling the recharge to be delivered on a high tide, the birds are unlikely to be disturbed as the areas marked for recharge are unlikely to be used as roost sites at high tide.
Cumulative impacts - Please ensure that this is up-to-date at the time of application.
This risk assessment does not currently assess the risk of introducing invasive species through the imported sediments or how to avoid introducing contaminated sediment. Both of these should be assessed and mitigation (if required) outlined to bring the risk down to low.
Water quality monitoring – We understand that the proposed project has the potential to reduce water quality through sediment suspension. We would like to see more about how often and at what point of the tide these surveys will take place. Furthermore, are these going to be undertaken by the EA as part of their Water Framework Directive (WFD) responsibilities?
Slippage – we would like you to outline how the sediment will be monitored in order to identify slippages which may trigger further protective fences being erected. We would initially suggest bi-monthly walks round the site to see if any of the sediment is slipping and if so, further fences built. It would also be useful to have this take place directly after any large weather events.
Impact to oyster beds - It would also be useful to formalise monitoring to assess any potential impacts to oyster beds.
On page 9, please amend Essex Estuaries marine SAC to Essex Estuaries Special Area of Conservation (SAC).

2. Options appraisal

Four options have been considered to combat future erosion: do nothing; construction of a fixed off-shore wavebreak; silt recharge; and, the chosen option, mixed shell, sand and gravel foreshore recharge.

2.1 Do nothing

The do nothing option is likely to result, at some time in the next 50 to 100 years, in the irreversible loss of the quality and extent of designated intertidal conservation habitats and commercial oyster layings, the demise of West Mersea Harbour as a yachting and sailing centre, increased flood risk to a significant number of residential and commercial properties and a decline in local employment opportunities. In addition there will be an increased flood risk, and potential habitat loss, to freshwater wetlands at Old Hall Marshes National Nature Reserve and Tollesbury Wick Nature Reserve.

2.2 Fixed wavebreak

Fixed wavebreaks using old Thames lighters have been effective in combating erosion on the Dengie peninsular at Sales Point and the Marsh House outfall. However, there is the potential for scour around the structures and at the Mersea Harbour location they would present a hazard to navigation. The importation of rocks to build fixed wavebreaks would be prohibitively expensive, costing in the order of £10 million to provide and place to Old Hall, Cobmarsh and Packing Marsh Islands. Furthermore, this material does not occur naturally within the estuary system.

2.3 Silt recharge

The beneficial use of fine-grained material is inadvisable due to the predominant wave size and tidal currents operating around the proposal areas, which have the capacity to entrain fine-grained materials and carry them seaward.

2.4 Sand and gravel recharge

Coarser and denser materials are required to provide a more resilient solution to protect finer sediments from being undermined by eroding forces. The function of the recharge is to alter the morphology to one that will cope better with the natural forces in the estuary system, allowing coastal processes to continue to operate, but at a slower rate. The earlier recharge campaign carried out in the mid to late 1990s, at or adjacent to the current proposed locations, has demonstrated that sand, shell and gravel can remain relatively in situ on a steepening foreshore and resist erosion. The material emulates the Pleistocene gravels which form natural beach ridges in the Blackwater as a consequence of erosion and landward transgression. Where there is some degree of energy dissipation in the lee of the recharge ridge, fine sediments will be deposited, as evidenced at the Tollesbury Wick frontage. This method presents the best outcome offering a robust, more congruous and longer term solution to sustaining the social and economic fabric and environmental features of the harbour area.

3. Description of the proposed foreshore recharge scheme

3.1 Project background and rationale

The islands of Cobmarsh and Packing Marsh, at the entrance to the Mersea Quarters, and the Quarters Spit (Old Hall Point) act as natural wavebreaks protecting Mersea Harbour from storm events. These sites, along with the Tollesbury Wick foreshore, fronting the Essex Wildlife Trust's grazing marsh reserve, were included in a National Rivers Authority/Environment Agency recharge campaign carried out in the mid to late 1990s (Hesp and Dixon, 1998). Over the last 18 years, the recharge has safeguarded the vulnerable shoreline at these locations combating climate-change induced storm waves and erosion. The current proposal would revisit the original sites to either extend or supplement the earlier placements in order to maintain the integrity, in the medium term to longer term, of: 16 km² of Natura 2000[1] habitat, a 25 hectare commercial oyster fishery operating in the harbour creeks - including cultivation grounds of the native oyster (*Ostrea edulis*) - and the cultural heritage of the harbour.

In the 1990s, the recharge was chiefly sourced from the deepening of the approaches to the ports of Harwich and Felixstowe carried out by Harwich Haven Authority (HHA). For the current proposal, it is intended to obtain up to 98,000m³ of suitable material from a new capital dredge, scheduled to start in the Approaches in early 2018, and distribute to the receptor sites as outlined in Table 2. The table also indicates the location and amount of material placed to these sites in the late 1990s from the Approaches dredge, and trial placements carried out in 1995 with material sourced from HHA maintenance dredges.

Table 2. Recharge volumes – current proposals and mid/late 1990s placements.

Location	**Cobmarsh Island - south shore**	**Packing Marsh Island – southern point**	**Old Hall Point – south shore**	**Tollesbury Wick frontage**
Amount of recharge current proposal (m³)	48,000	5,000	40,000	5,000
Location	**Cobmarsh Island – south-east**	**Packing Marsh Island – southern point**	**Old Hall – Point and east shore and Tollesbury north channel**	**Tollesbury Wick frontage**
Amount of recharge placed in the mid/late 1990s (m³)	15,000 (1995 trial) 30,000 (1998)	6,000 (1998)	Unknown amount (1995 trial) 36,000 (1998)	50,000 (1999)

[1] Natura 2000 – a European network of sites established under the Birds and Habitats Directives. The Blackwater Estuary is a Special Protection Area for Wild Birds and is part of the Essex Estuaries Special Area of Conservation.

3.1.1 Habitat creation

The scheme will deliver up to 1.7ha of potential nesting habitat for little tern, adding to the 1.9ha currently available. High saltmarsh plant species are likely to colonise the recharge bunds where conditions favour their development. The configuration of the new recharge placed onto the mud flats at Cobmarsh Island, Old Hall and Tollesbury Wick would be expected to encourage silt deposition in the lee of the bunds over an area of approximately 3.4ha, leading to a reversal of foreshore erosion at these locations. The effectiveness of this technique has already been demonstrated leeward of the recharge aligned with the shoreline at Tollesbury Wick. Since placement in 1999, a 1 metre depth of sediment has built up over a 6.29ha area of formerly eroded mudflat, with pioneer saltmarsh establishing on the inner fringes. With the continuing defence of the Tollesbury Wick foreshore, ensured by recharging the existing gravel bund and extending north-eastward, overall, the total area of mudflat that will be both protected and developed by the present proposal would be approximately 9.7ha.

3.1.2 Coastal defence objectives

The Essex and South Suffolk Shoreline Management Plan (SMP; Environment Agency, 2010) has identified opportunities for the beneficial use of dredgings within the SMP project area; both Cobmarsh and Packing Marsh Islands have been highlighted as potential receptor sites for inclusion in any future study. This work is scheduled prior to the 2020 SMP review and would be subject to funding.

The SMP has programmed Old Hall Marshes National Nature Reserve for realignment in Epoch 3, which extends between 2055 and 2105 (3a 2055 – 2085; 3b 2085 – 2105; EA, 2010E). Realignment would help to absorb the energy of long fetch waves driven by north-easterly winds which impact the current defence line. However, it is acknowledged that the negative effect of allowing flooding over 390ha of historic grazing marsh would be difficult to mitigate and the policy may revert to ‘hold the line’ in future reviews of the SMP.

The most exposed areas of saltmarsh at Old Hall Point and the vulnerable easterly point of the sea defence have been successfully protected from wave attack by the 1995 and 1998 placements of recharge material. The extension of recharge protection to the southern marsh edge would be expected to reinforce sea wall protection here too, extending the life of the embankment and possibly influencing SMP policy in the future. In view of the flood defence benefits recharge will provide to Old Hall Marshes, the EA have offered the MHPT substantial funding for recharge at this location.

It is evident that the recharge deposited in 1999, aligned with the sea wall at Tollesbury Wick, has reduced tidal energy allowing silts to build up landward of the recharge bund leading to the reinstatement of intertidal mud flat to a 1 metre depth over an area of 6.29ha. The SMP policy for this frontage is for managed realignment in epoch 3, with reservations about the timing of this proposal due to the difficulty of mitigating for the loss of 200ha of freshwater grazing marsh. A reversal of the current policy to ‘hold the line’ in future reviews of the SMP is anticipated. Raising and extending the recharge bund at this location could drive a policy change.

3.2 Physical form of the proposal

The capital dredge of the approaches channel to the ports of Felixstowe and Harwich will mainly raise glacial outwash deposits (or earlier geological period) consisting of a mix of stone, sand and shell. Based on previous capital dredge works, the majority of material is likely to range from fine sand to 100mm stone with occasional 200mm large stone. Particle size analysis carried out on surface samples obtained from the receptor sites has been shown to contain gravels within the size range 2mm to 16mm, comparable with the size description for trial pit 7 taken from the Harwich Approaches (see Section 5.2.2.1). Pollution levels in this type of substrate would normally be expected to be very low or insignificant and chemical analysis has confirmed this (see Section 5.2.2.1i).

It is intended to obtain 98,000m³ of dredged material, to deliver to the locations shown in Figures 4 and 5.

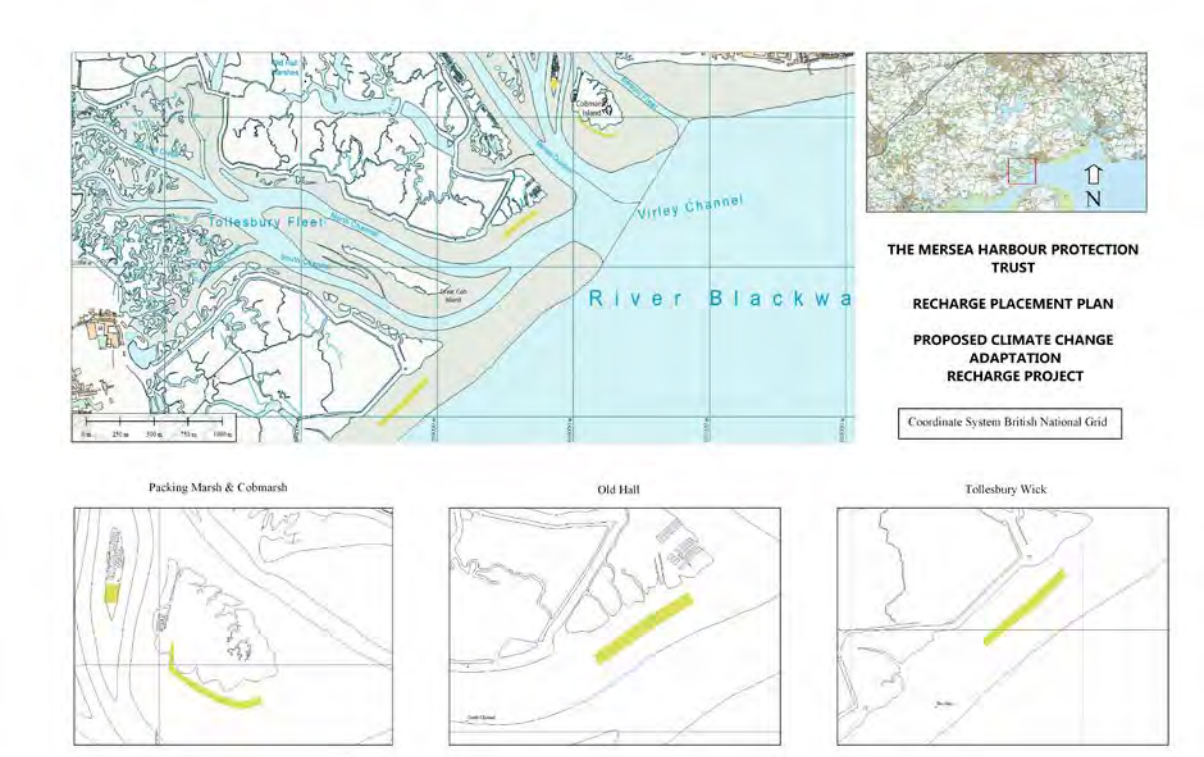

Figure 4. Plan diagram showing proposed recharge placement locations [Jim Pullen, 2014; (c) Crown Copyright OS opendata 50k vector mapping 2015 - OS 50k Great Britain 2013].

The placement locations, design profile of the recharge and method of delivery have been formulated by the MHPT Project Manager, Mark Dixon, in consultation with members of the Mersea community, including representatives of the oyster fishing industry, with specialist knowledge of the physical conditions operating in the Blackwater estuary. In the project planning process full consideration was given to avoiding or reducing any potential negative impacts of the recharge.

Figure 5. Footprint of recharge material. The location of retaining fences at Cobmarsh and Packing Marsh Islands is indicated by a brown line (Jim Pullen. Source: ArcGIS World Imagery base map).

At Cobmarsh Island It is intended to place 48,000m³ of recharge material onto the foreshore, mostly centred around MLWN level and following the curve of the saltmarsh edge for a length of 410 metres. At the north-western end, the bund will run perpendicular to the shore to tie in with the existing saltmarsh, separated by a retaining fence (refer to Figure 5). A further fence would be erected west of this section as a failsafe to prevent strong easterly winds moving the recharge towards the Mersea Fleet. On Packing Marsh Island, 5,000m³ of recharge will be placed onto a central spine of existing sand and shingle recharge flanked by abraded saltmarsh platforms. Natural processes have moved this material shoreward following placement at the southernmost tip of the island in 1998. At its northern extremity it has formed an embankment, stabilised by the growth of saltmarsh scrub, which protects the central part of the island and the disused oyster pits. A retaining fence will be constructed inside the embankment to check landward movement (refer to Figure 5). The dredger will discharge 40,000m³ to Old Hall south at around MLWN to create a 308 metre long single bund parallel to the saltmarsh edge. The material delivered to Tollesbury Wick will significantly reinforce the protection afforded to the sea defence by the existing bund, set at MLWN, and extend its protective influence at the north-eastern end. The proposed location and foreshore levels (ODN) at the point of placement are outlined in Table 3 and illustrated in Figure 6.

Table 3. Location and distribution of material across proposed recharge sites.

Site	Cobmarsh Island - south shore	Packing Marsh Island – southern point	Old Hall Point – south shore	Tollesbury Wick frontage
Co-ordinates	**West to east 51° 46.26376' N, 0° 53.86025' E to 51° 46.19201' N, 0° 54.10913' E**	**North to south 51°46.39617' N, 0° 53.72737' E to 51° 46.36455' N 0° 53.72062' E**	**West to east 51° 45.83978' N, 0° 53.36117' E to 51° 45.92791' N, 0° 53.59151' E**	**West to east 51° 45.15254' N 0° 52.64474' E to 51° 45.31154' N 0° 52.95829' E**
Amount of recharge (m^3)	48,000	5,000	40,000	5,000
Recharge length & elevation of placement site	To be placed between -1.95 and +0.100 to +2.5 ODN. Recharge to form a single bund along a 410m length of the foreshore.	To be placed between -0.49 and +2.5 ODN extending 45m W to E. Natural processes to move material shoreward (as previous recharge).	To be placed between -1.5 and +0.149 ODN to form a single bund along a 308m length of the foreshore.	To be placed onto 441m length of existing bund of height between -0.95 to +3.3 ODN. To extend existing bund by 45m at NE end placing onto mud flat between -0.85 and +1.5 ODN.
Area of foreshore covered by recharge	1.66ha (16,600m^2)	0.30ha (3,000m^2)	1.47ha (14,700m^2)	Area of existing bund raised: 2.36ha (23,600m^2) Extension to NE end of current recharge 0.19ha (1,900m^2)

Where replenishing existing recharge, in some areas placement may be to levels above MHWS tides.

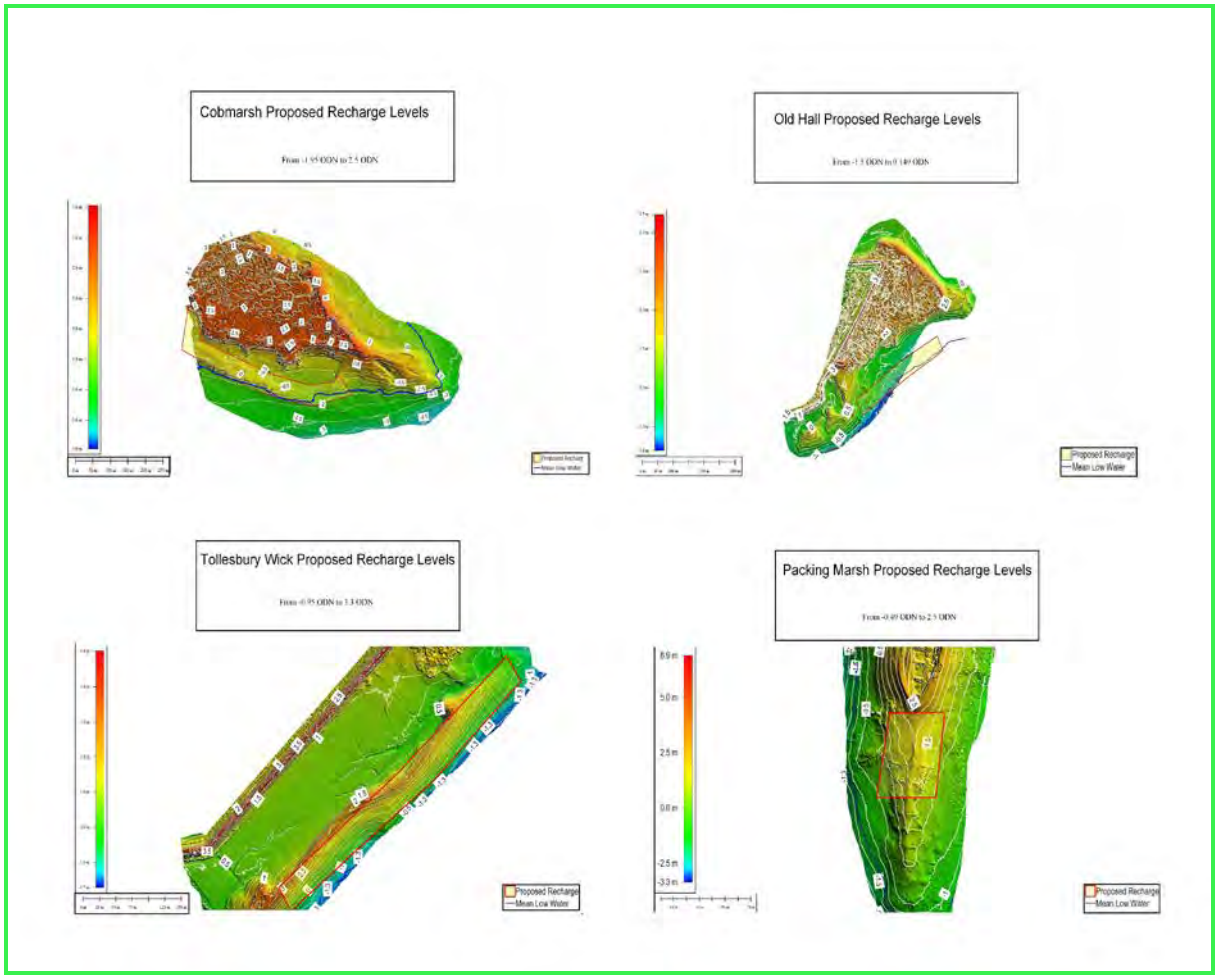

Figure 6. Elevation maps with recharge footprint superimposed.

3.2.1 Design of the recharge bund

The current design has been developed by the MHPT Project Manager, Mark Dixon, and is based on Mark's previous experience of undertaking recharge at the Mersea Quarters locations and other sites in Essex, incorporating lessons learned from the earlier Environment Agency recharge project. The recharge embankment will be approximately 50 metres wide at the base achieving a crest height of +3.5 metres ODN and a 1:4 slope (Figure 7). The alignment at Cobmarsh Island and Old Hall south, and the extension to the bund at Tollesbury Wick, will protect the eroding saltmarsh margins while allowing sediment to accrete in the lee to develop mudflats and ultimately encourage saltmarsh growth. The recharge profile is designed to provide a resilient barrier with the ability to respond to wave and tidal energy forces (Figure 8).

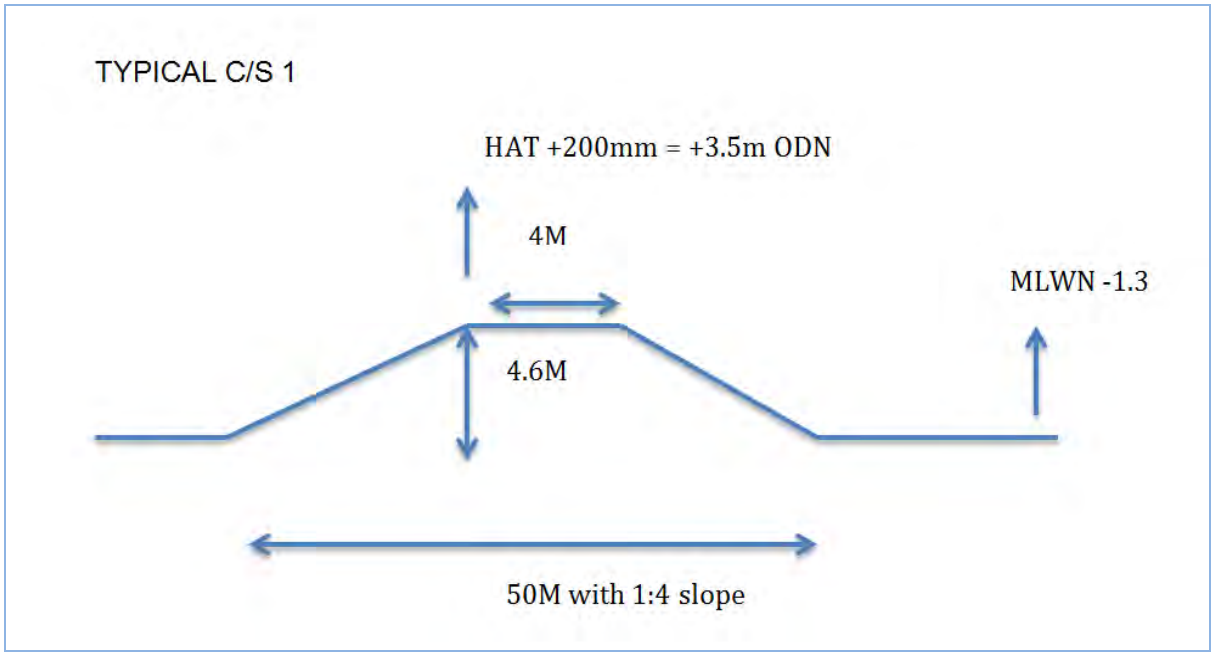

Figure 7. Typical cross section of recharge bund.

Figure 8. Sediments have accumulated to 1 metre height behind the recharge ridge at Tollesbury Wick (viewed from the north-eastern end).

3.2.2 Design of retaining fences

Brushwood retaining fences will be constructed prior to placement at Cobmarsh Island and Packing Marsh Island at the locations indicated in Figure 5. The fencing will consist of two rows of 100mm width non-pressure treated pine stakes with a 250mm channel between, infilled with brushwood (Figure 9). The height will be 1000mm above saltmarsh level to HAT + 200mm. This should stabilise the recharge material preventing rollover onto the saltmarsh. Additional brushwood fences will be constructed if monitoring demonstrates the need.

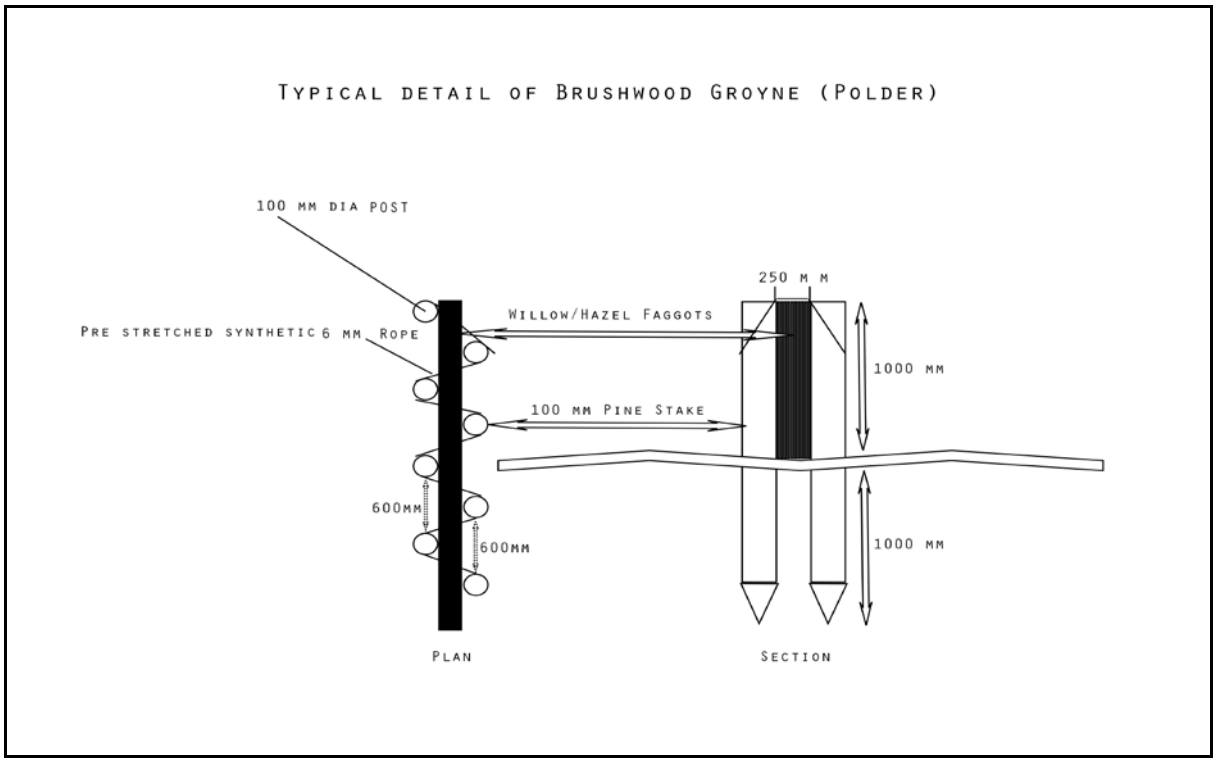

Figure 9. Retaining fence design (drawing by Jim Pullen).

3.2.3 Method of delivery and schedule of works

A shallow-draft, trailing suction hopper dredger will transport material from the dredge site to the placement areas. Foreshore recharge material, comprising a mix of stone, sand and shell, will be discharged at high tide to the defined locations by 'rainbowing', whereby a high velocity water cannon sprays the contents of the hopper over the bow of the dredger directly to the location site (Marine Traffic, 2016). Delivery would commence as the tide begins to ebb. The placement method has been tried and tested on the Essex and Suffolk coast, including the earlier campaign at Mersea Harbour, Horsey Island (Hamford Water SSSI) and the Orwell Estuary SSSI.

A maximum of two cargoes could be delivered per 24 hours to the target site within the proposal area, taking 40 minutes to fully discharge between 1,000 to 1,500m³ of material. To accommodate the 3m working draft of the dredger when fully loaded, delivery to Old Hall and Cob Marsh Island can only be achieved over the spring tide cycle, with the dredger positioned up to 100 metres from the shoreline. Delivery to Tollesbury Wick and Packing Marsh Island would be reserved for the neap tide period, as these sites are immediately adjacent to deep navigable water.

The MHPT committee would be responsible for all aspects of health and safety during material placement, including public safety.

3.2.4 Work programme

The timing of the work will be dependent on Harwich Haven Authority's dredging schedule for the Approach channel deepening project, currently programmed to commence in early 2018 and extend over a period of two years. If deliveries were to be carried out continuously over the neap/spring tidal cycle the recharge campaign could be completed in approximately 12 weeks (Table 4). However, there may be periods of downtime in the schedule. In total, 67 cargoes will be delivered taking a total of 44.5 hours to discharge to the placement sites.

Table 4. Work programme for foreshore recharge campaign.

Site	Cobmarsh Island - south shore	Packing Marsh Island – southern point	Old Hall south shore	Tollesbury Wick frontage
Amount of recharge (m³)	48,000	5,000	40,000	5,000
Total no of cargoes	32	4	27	4
Total discharge time during recharge campaign – approx hrs	21.50	2.5	18	2.5
Approx no of cargoes per tidal cycle	10 (spring tide cycle only)	4 (neap tide cycle)	10 (spring tide cycle only)	4 (neap tide cycle)
Approx time scale for recharge campaign	12 weeks if back to back deliveries, ie 2 per 24 hours. However, there may be periods of downtime depending on HHA's dredging schedule.			

4. Legislative framework and policy context

4.1 Legislation – marine and coastal

4.1.1 Marine and Coastal Access Act (MCAA) 2009

The Marine and Coastal Access Act 2009 made provision for an improved system of management and protection of the marine and coastal environment in order to balance conservation requirements with social and economic needs. Part 4 of the Act introduced new marine licensing measures, designed to streamline the process of consenting activities below the level of mean high water spring tides (MHWS), and created the Marine Management Organisation - an executive non-departmental public body - to implement them. Through the mechanism of marine licensing, the government seeks to promote sustainable management of the marine environment (²Defra, 2011). The present marine licensing structure has been in operation since 6 April 2011 and assimilates and replaces previous legislation including:

- Licences under Part 2 of the Food and Environment Protection Act (FEPA) 1985.
- Consents under Section 34 of the Coast Protection Act 1949 (CPA).

The Mersea Harbour Protection Trust intends to apply to the Marine Management Organisation (MMO) for a marine licence under the MCAA 2009 for:

- Placement of foreshore recharge (reuse of dredgings) below MHWS tides.
- Construction of retaining fences below MHWS tides.

4.1.2 OSPAR regulations

As a contracting party to the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, the UK is obliged to take measures to protect the maritime area against the adverse effects of human activities to safeguard human health and to conserve marine ecosystems. Part 4 of the MCAA permits a licence to be granted for disposal at sea following a detailed assessment of the risk to the environment. The assessment process is undertaken in compliance with OSPAR guidelines.

4.1.3 Marine Conservation Zones

Part 5 of the Marine and Coastal Access Act 2009 makes provision for the designation of Marine Conservation Zones (MCZs). The current proposal lies within the Blackwater, Crouch, Roach and Colne Estuaries (BCR&C) MCZ. It is designated under The Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone Designation Order 2013.

MCZs have been established to conserve the diversity of nationally rare, threatened and representative habitats and species while taking social and economic factors into account. They will form part of a network of Marine Protected Areas established by the existing suite of European Marine Sites [Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)]. The BCR&C Estuaries MCZ is important for the habitats: ‘intertidal mixed

sediments' and 'native oyster (*Ostrea edulis*) beds'; and the native oyster as a species. It also contains the geological feature 'Clacton Cliffs and Foreshore'.

Natural England and the Joint Nature Conservation Committee (JNCC) provide advice to marine regulators both on the vulnerability of the features included within the MCZ designation order, and current activities that are likely to have a negative impact on the protected features. It is then the responsibility of the marine regulators to implement management measures tailored to individual sites.

An Environmental Impact Assessment (EIA) under the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended in 2011) and/or under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011 may be required to address any potential impacts to the MCZ.

4.1.4 Environmental Impact Assessment - Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended in 2011)

The MMO need to ensure that the procedures for considering marine licence applications comply with the EIA Directive 2011/92/EU. This Directive came into being in 2012 and brings together the inaugural EIA Directive (85/337/EEC) and its revisions (97/11/EC; 2003/35/EC and 2009/31/EC). It is the duty of the regulator to determine whether the proposal falls into a listed category in the Annexes of the EIA Directive.

Where an EIA is required an environmental statement evaluating the impacts on features of environmental importance has to be prepared. This should consider both the potential positive and negative effects, as well as short and long-term outcomes. Where significant adverse impacts are anticipated, compensation or mitigation measures will be required to address any residual effects.

A screening opinion was requested from Natural England through their Discretionary Advice Service for the current proposal. Following consultation with the MMO, Natural England determined in a letter dated 28 May 2015 that the project *'could be defined as a 'sea defence' project, and as such will fall under the infrastructure project remit within No. 10 of Annex II of the regulations. Whilst an HRA assessment will cover any potential impacts to either the SPA's or the SAC's, an EIA may be triggered to assess any potential impacts to either the MCZ or SSSI. We can advise that given the size of the proposed works and proximity to designated sites, these works are likely to require an EIA.*'

There may be an overlap with areas administered by other competent authorities, for example, the local planning authority, and land-based EIA regulations may also apply.

4.1.5 Town and Country Planning Act 1990

The Town & Country Planning Act 1990 gives local authorities powers to grant planning permission for development within their administrative area. Under the Act, development includes '*carrying out of building, engineering, mining or other operations in, on, over or under land…*'

4.1.6 Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011

These Regulations replace the Town and Country Planning (Environmental Impact Assessment (England and Wales) 1999 and apply the EIA Directive 2011/92/EU to the planning system in England. Development listed in Schedule 1 of these Regulations requires an EIA in all cases, while development listed in Schedule 2 requires an EIA if it is likely to have significant effects on the environment due to factors such as its size, nature or location.

The EIA process requires that all relevant authorities, community groups and members of the public are fully consulted. The results of the wider consultation will be taken into account as part of the decision-making process within the licensing, permissions and consent procedures.

4.1.7 Marine Strategy Framework Directive

The Marine Strategy Framework Directive (MSDF) requires all EU Member States to take measures to achieve Good Environmental Status (GES) in their seas by 2020. The MSFD came into force in 2008 and the requirements of the Directive were transposed into national legislation through the Marine Strategy Regulations 2010 (covering England, Scotland, Wales and Northern Ireland). The Directive provides the wider mechanisms needed to achieve clean, healthy, safe, productive and biologically diverse oceans and seas for the UK.

4.1.8 Water Environment (Water Framework Directive) (England and Wales) Regulations 2003

The current proposal must take account of the requirements of the Water Framework Directive (WFD; 2000/60/EC) which sets objectives to prevent deterioration and enhance the status of aquatic ecosystems throughout the EC within a specified time frame. The Directive was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 and the Environment Agency is the competent authority responsible for its delivery. It applies to all water bodies including estuaries (transitional water bodies), and coastal waters from low water extending out to one nautical mile.

The key objective of the WFD assessment is to consider whether a new activity will have a non-temporary effect on status, at the water body level, on attaining the objectives defined in the Anglian River Basin Management Plan (Environment Agency, 2015). The Mersea Harbour Protection Trust will be required to assess the impact of the recharge on biological, physico-chemical and hydromorphological quality elements, defined for the Blackwater Estuary, against EA guidelines for protected areas. The Blackwater is classified as a highly modified water body due to its sea defences. If it can be demonstrated that the disposal activity will not affect status at the water body level, or if a potential effect on status can be mitigated, the proposal would be considered to be WFD compliant.

4.1.9 Shellfish Protected Areas

These areas are designated by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 as amended. Designated shellfish waters are required to meet physical, chemical and microbiological water quality standards to support shellfish life and growth.

4.1.10 EU Bathing Water Directive (2006/7 EC)

The EU Bathing Water Directive sets quality standards for bathing waters, based on scientific knowledge, to protect health and the environment. There is a requirement to monitor bathing waters annually and classify the waters according to the level of bacterial quality.

4.1.11 Waste England and Wales Regulations 2011

The Waste England and Wales Regulations 2011 transpose the Waste Framework Directive (2008/98/EC) into national law. Dredgings for disposal at sea are defined as waste. A hierarchy of waste management options for sea disposal is outlined in the Regulations which classifies the treatment of waste in order of environmental preference. After prevention, reuse – finding an alternative beneficial use for waste material – is the most environmentally acceptable solution for dealing with waste.

4.1.12 Water Resources Act 1991 – Flood Defence Consent

The Water Resources Act 1991 (WRA) defines the Environment Agency's role in regulating water resources, water quality and pollution, and flood defence.

Under the terms of the Act and associated byelaws, consent from the Environment Agency is normally required for works in, under, over or near the bank of a main river. Disposal of dredgings within nine metres of the landward toe of a flood defence embankment will require a flood defence consent under Section 109 of the WRA 1991. A consent under the Flood Defence (Land Drainage) Byelaws/Sea Defence Byelaws will also be needed. The applicant would need to demonstrate that the work is compliant with the Water Framework Directive, and show how any possible impacts on a marine protected site have been addressed. Natural England is a consultee in the consenting process. As the proposed disposal to Old Hall south shore is adjacent to the sea wall the opinion of the Environment Agency will be sought.

4.1.13 Conservation of Habitats and Species Regulations 2010

The 'Habitats Regulations' transpose Council Directive 92/43/EEC on the Conservation of Natural habitats and of Wild fauna and Flora ('the Habitats Directive') and aspects of Directive 2009/147/EC on the Conservation of Wild Birds ('the Birds Directive') into UK law.

The competent authority is required to follow the process outlined under Section 61 of the Habitats Regulations before issuing a disposal licence (MMO) or planning permission (local authority) for an activity on a European site. European sites are defined as Special Protection Areas for Wild Birds (SPAs), as classified under Council Directive 79/409/EEC (the Wild Birds Directive), and Special Areas of Conservation (SACs), as designated under

the Habitats Directive (Council Directive 92/43/EC). As a matter of government policy potential SPAs, candidate SACs, and sites on the Ramsar list (Wetlands of International Importance), are subject to the same legal process where they may be affected by development proposals.

In accordance with the Habitats Regulations, the Competent Authority/ies (CA/s) will be required to undertake a 'Habitats Regulations Assessment' (HRA). This is a stepwise process. In the first instance the CA(s) will need to determine whether the proposal is likely to have a significant effect (LSE) on a European site (if it is not connected with or necessary to site management). If it is concluded that there will be no LSE then permission for the proposal may be granted. However, should there be a risk or probability of a LSE then an 'Appropriate Assessment' must be carried out. This must determine the potential impacts of the scheme in view of the site's conservation objectives, which apply to the classified interest features. The CA(s) can instruct the applicant to provide the relevant information for the assessment. The CA(s) must ascertain that the proposal will not adversely affect the integrity of the site, alone or in combination with other plans or projects, before permission can be given. The integrity of a site is defined as: 'the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified' (Office of the Deputy Prime Minister, 2005).

Suitable mitigation measures which remove any adverse impacts should be taken into account during the assessment. If it cannot be demonstrated that there will be no adverse effect on integrity then the project must be refused, unless there are alternative solutions or imperative reasons of overriding public interest.

During the HRA, the CA(s) will consult with Natural England.

The current study area lies within the: Blackwater Estuary Special Protection Area for Wild Birds SPA and Ramsar site, and the Essex Estuaries Special Area of Conservation. In their screening response, Natural England has advised that:

> *'In Natural England's opinion this proposal in its current form is likely to have a significant effect on the interest features of the above sites and therefore requires appropriate assessment in accordance with Regulation 61 of the Conservation of Habitats and Species Regulations 2010. Given the temporal extent of the project, we would also advise that you undertake a shadow HRA for the additional SPA features to future proof your application.'*

4.1.14 Section 9A of The Conservation of Habitats and Species (Amendment) Regulations 2012

Section 9A of The Conservation of Habitats and Species (Amendment) Regulations 2012 directs the competent authority in the marine area to take steps to: preserve, maintain and re-establish a sufficient diversity and area of habitat for wild birds in the United Kingdom, including by means of the upkeep, management and creation of such habitat, as appropriate, having regard to the requirements of Article 2 of the new Wild Birds Directive (2009) which states:

> 'Member States shall take the requisite measures to maintain the population of the species referred to in Article 1 at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level.'

4.1.15 Wildlife and Countryside Act 1981 (as amended)

Under the terms of Section 28 I of the Wildlife and Countryside Act 1981, as amended by Schedule 9 of the Countryside and Rights Of Way Act (CROW) 2000, a statutory authority is required to give notice to Natural England before permitting the carrying out of operations likely to damage the special interest features of a Site of Special Scientific Interest, and take Natural England's advice into account in its decision-making process.

The proposed project has the potential to impact a Site of Special Scientific Interest protected under the W&CA 1981 (as amended). This will be assessed through the Environmental Impact Assessment process [under the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended in 2011) and under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011].

4.2 Marine and coastal planning and policy context

The licensing system requires that decisions taken in the marine area are compatible with Marine Policy Statements and the relevant Marine Plan(s).

4.2.1 UK Marine Policy Statement

The UK Marine Policy Statement is regarded as a key driver to achieving the vision shared by the UK Administrations of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' ([1]Defra, 2011). It provides a reference frame for the preparation of Marine Plans defining policy objectives for marine-based activities and providing guidance on their impacts.

The UK Marine Policy Statement acknowledges that dredging is an essential activity and that alternative use of dredgings can have social and economic benefits:

> 3.6.3 Dredging is an enabling activity which is essential to the functioning of ports and marinas and the social and economic benefits which derive from these.
>
> 3.6.4 Appropriately targeted disposal of dredged sediment can have an ancillary benefit in maintaining sedimentary systems and, where the sediment is constituted appropriately, can have social and economic benefit in providing material for alternative uses such as construction, beach nourishment or salt marsh restoration.

The UK Marine Policy Statement sets high level objectives for achieving a sustainable marine economy:

- Infrastructure is in place to support and promote safe, profitable and efficient marine businesses.
- The marine environment and its resources are used to maximise sustainable activity, prosperity and opportunities for all, now and in the future.
- Marine businesses are taking long-term strategic decisions and managing risks effectively. They are competitive and operating efficiently.
- Marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the marketplace.

4.2.2 Marine plans

Marine plans provide detailed spatial guidance to allow licence applicants to consider where their proposal might best be located and/or developed in relation to other marine activities and Marine Protected Areas. The plans also help applicants to understand where their proposed activity sits in terms of government policy objectives. The current proposal follows the guiding principle of marine plans and seeks to contribute to economic growth and benefit the local community, while protecting the marine ecosystem.

The South East Marine Plan, which applies to the proposal area, is in preparation. In the absence of a Marine Plan, licensing decisions are guided by the UK Marine Policy Statement and will take into account the policy objectives in the draft Marine Plan.

4.2.3 Shoreline Management Plan

The proposal area lies within the Essex and South Suffolk Shoreline Management Plan (SMP) area (EA, 2010). A SMP is a non-statutory, high-level policy document which aims to identify the best ways to manage flood and erosion risk to people and the developed, historic and natural environment over the longer term. It also identifies opportunities where shoreline management can work with others to make improvements.

Shoreline Management Plans are an important part of the Department of Environment, Food and Rural Affairs (Defra) strategy for managing flooding and coastal erosion. The strategy has two key aims:

- To reduce the threat of flooding and erosion to people and their property.
- To benefit the environment, society and the economy in line with the government's sustainable development principles:
    - Living within environmental limits.
    - Ensuring a strong, healthy and just society.
    - Achieving a sustainable economy.
    - Using sound science responsibly.
    - Promoting good governance.

The SMP identifies the coastal management policies for management units adjacent to the study area (EA, 2010E). Mersea Island lies within Management Unit E, Policy Development Zone E3, where no active intervention is proposed for the harbour frontage currently protected by the islands in the Mersea Quarters. Old Hall Marshes and Tollesbury Wick defences are situated within Management Unit F: Blackwater Estuary. Old Hall Marshes lie within Policy Development Zone (PDZ) F3: South bank of the Salcott Channel to Tollesbury Fleet, and Tollesbury Wick Marshes are situated at the eastern end of PDZ F5: Tollesbury Wick Marshes to Goldhanger. Though the policy for these zones is to undertake managed realignment, concerns over the replaceability of these internationally important freshwater marshes move this option into the third time-period of the SMP - Epoch 3, between 2056 and 2105. There is, however, the acknowledgment that future reviews of the SMP may revert this policy to Hold the Line.

4.2.4 National Planning Policy Framework

The National Planning Policy Framework (2012) outlines the government's planning policies for England and how these are expected to be applied. It states that the purpose of the planning system is to contribute to the achievement of sustainable development by fulfilling an economic, social and environmental role. The planning system is required to contribute to protecting and enhancing the natural environment through the improvement of biodiversity, the prudent use of natural resources, the minimisation of waste and pollution, and mitigating and adapting to climate change. The Framework instructs local planning authorities to take account of the UK Marine Policy Statement and marine plans and apply Integrated Coastal Zone Management across local authority and land/sea boundaries, ensuring integration of the terrestrial and marine planning regimes.

The National Planning Policy Framework replaces Planning Policy Statement 9 - Biodiversity & Geological Conservation.

4.2.5 Local Development Plans

The recharge proposal crosses two local planning authority areas. Cobmarsh Island and Packing Marsh Island are located within Colchester Borough Council's plan area, while Old Hall and Tollesbury Wick fall within Maldon District Council's administration.

4.2.5.1 Colchester Borough Council – Local Development Framework (2008)

Colchester Borough Council's Local Development Framework (LDF) replaces the 2004 Local Plan. The LDF strategy and policies are designed to steer development to 2021 and beyond.

4.2.5.1i Policy DP21: Nature Conservation and Protected Lanes

This policy seeks to fulfil Colchester Borough Council's legal duties under the Natural Environment and Rural Communities Act 2006 and states that:

Development proposals where the principal objective is to conserve or enhance biodiversity and geodiversity interests will be supported in principle…and will only be supported where the proposals:

(iii) Maximise opportunities for the restoration, enhancement and connection of natural habitats in accordance with the Essex Biodiversity Action Plan; and

(iv) Incorporates beneficial biodiversity conservation features and habitat creation where appropriate.

4.2.5.1ii Policy DP23: Coastal Areas

Mersea Harbour lies within the Coastal Protection Area and the majority of the estuarine frontage makes up the West Mersea Conservation Area. The waterfront is designated as a Waterside Area of Special Character, as defined by Colchester Borough Council's Local Development Framework (2008) and shown on the Local Plan Proposals Map (2010). The Core Strategy spatial vision states that: 'The West Mersea waterfront will be conserved for its historic maritime character and distinctive maritime-related local businesses.'

Approximately 40 residential and commercial properties are located on the waterfront including a public jetty, two boatyards, four restaurants, a sail-maker, a yacht chandler, public house hotel, two sailing clubs, two engineering companies, a publisher and a local shop. There is also a thriving commercial oyster cultivation industry and a commercial fishing fleet, with 19 boats registered and licensed (Marine Management Organisation, May 2016). Eighteen shore-connected houseboats are berthed in the saltmarsh creeks, and around 550 moorings line the Salcott and Strood fairways. It is estimated that approximately 80 full-time jobs rely directly on the harbour throughout the year (MHPT, 2014).

Policy DP23 aspires to balance environmental protection obligations against the wider socio-economic needs of coastal communities. It acknowledges that climate change, including sea level rise, is likely to place increasing pressure on the management of coastal habitats and coastal communities which will need to adapt to changing local climatic conditions. The policy document makes particular reference to the Essex and South Suffolk Shoreline Management Plan (EA, 2010) which has demonstrated the vulnerability of the West Mersea coastal frontage to coastal processes and the effects of climate change.

Within the Coastal Protection Belt and along the undeveloped coast an integrated approach to coastal management will be promoted and, development will only be supported where it can be demonstrated that it:

- (ii) Will not be significantly detrimental to conserving important nature conservation, historic environment assets, maritime uses and the landscape character of the coast;
- (iii) Will deliver or sustain social and economic benefits considered important to the wellbeing of the coastal communities; and
- (iv) Provides opportunities and scope for adaptation to climate change….

4.2.5.2 Maldon District Council Replacement Local Plan (2005)

4.2.5.2i Policies CC1 and CC2

These policies are in place to protect internationally and nationally important designated sites from the direct and indirect effects of developments.

4.2.5.2ii Policy CC7: Special Landscape Areas (SLA)

The proposal site is located in the Blackwater – Colne Special Landscape Area. Planning permission for development proposals in the SLA will not be granted unless the siting, design, materials and landscaping of the development conserve or restore the character of the area.

4.2.5.3 Maldon District Council Submitted Local Development Plan (2014)

The 2014 submitted plan will cover the period 2014 to 2029.

4.2.5.3i Policy N2: Natural Environment, Geodiversity and Biodiversity

Policy N2 states that development proposals which help to improve the condition of existing international, national or local designations will be encouraged. It also requires that all development should seek to deliver net biodiversity and geodiversity gain where possible.

5. Existing environment

The baseline environmental conditions which define the Mersea Harbour study area are described. Key parameters relevant to both the natural and the human environment are detailed and the status of each is evaluated. This appraisal will inform the assessment of the potential impacts of the recharge proposal, but will also serve to highlight the current pressures that the proposal area is subjected to.

A variety of sources have been used to obtain Information on the existing environment including: site visits; ground-based and aerial surveys; existing literature and reports; and consultation with local people who work on or adjacent to the Blackwater Estuary either in a professional or voluntary capacity.

5.1 Physical processes

The enwalling of the high water saline floodplains for agricultural development began from the 16th century onwards. This resulted in the loss of 40,000ha of saltmarsh in Essex and removed the sediment source that formed and replenished the deltas which shaped the spits and headlands. In the Mersea Quarters, the Nass Spit, Cobmarsh Spit, and the Quarters Spit (Old Hall Point) have undergone a gradual decrease in extent reducing the capacity of these features to act as natural wavebreaks.

The situation has become more acute in more recent history with the estuaries of the Greater Thames experiencing rapid lateral erosion and internal dissection of saltmarshes since the late 19th century, with the outer estuaries, particularly, being subject to significant erosion (van de Wal & Pye, 2004). Ordnance Survey maps show that the extent of saltmarsh in the Blackwater estuary reduced significantly after 1874. The rate of net saltmarsh loss between1874 to 1998 was circa 2 ha per year (van de Wal & Pye, 2004). However, this includes a period where the rate of net loss deviated from this average, increasing to 9ha per year between 1973 and 1988 (Burd, 1989). Wave exposed marshes, such as those found in the Mersea Quarters, suffered lateral erosion over this time as a result of sustained periods of strong winds and waves driven from the east and south-east (van de Wal & Pye, 2004). Though a recent study (Thomson et al, 2011) recorded an overall net gain of saltmarsh in the Blackwater Estuary SSSI over the period 1997/2000 to 2008, from 724.02ha to 724.96ha, this was mostly attributable to the extensive marsh development within the Orplands East realignment site. However, areas exposed to the North Sea, at the entrance to the Virley Channel and the Mersea Quarters, were described as vulnerable.

Coinciding with changes in saltmarsh extent, since 1900, sea level has been rising in the Greater Thames area at a rate of between 1 and 2mm per year due to natural and human-induced causes. This trend is set to continue as a result of further thermal expansion and the melting of land ice (Environment Agency, 2010). The retreat of glacial ice since the last ice age has triggered isostatic rebound with land uplift in the north and subsidence in the south, resulting in land in the south-east sinking at a rate of 1 - 2mm per year (Shennan, 1989). The combined effect of these changes gives a relative sea level rise estimate for southern England of between 2 and 4mm per year.

The collective influence of sea level rise and coastal squeeze is significantly affecting the morphology of the Blackwater Estuary leading to recession of the lower and upper intertidal

mudflats and saltmarsh. Unable to naturally migrate landward as sea levels rise, these habitats become fixed and 'squeezed' by an immobile sea wall. The changes taking place on the foreshore are resulting in loss of wave attenuation which, in turn, is exacerbating erosion; as the foreshore lowers so water depth increases allowing bigger more erosive waves to generate. The ebb dominance of the estuary means there is a net export of silt from the mouth, though some sediment is carried upstream on the flood tide and is deposited in the wider shallower reaches west of Osea Island. Overall, the pattern of sediment distribution is: siltation of the inner creeks and inner estuary and erosion at the outer and mid sections of the estuary. The Environment Agency predicts the potential loss of the entire saltmarsh of the estuary by 2050 as a result of coastal squeeze (EA, 2010F).

The regime model for the Blackwater Estuary shows that the mouth, which lies between Mersea on the north shore and Sales Point on the south, is constrained. There are also pinch points between Shinglehead Point (the eastern point of Tollesbury Wick Marshes) and Bradwell, as well as at the head of the estuary (Essex CHaMP, 2002). The constriction at the mouth is accounted for by Terrace Gravel deposits of the Thames system, which, combined with the large tidal prism (the volume of water exchanged over each tidal cycle), predispose it to bed scour as estuary processes try to widen the entrance to achieve a true equilibrium state (Pethick, 1993). Deposition does not take place here and the channel remains deep. Whereas the width constriction imposed by geological constraints at the mouth of the estuary leads to perceived overdeepening compared with the predicted depth, the constriction at Shinglehead Point, Tollesbury Wick, is due to the presence here of flood embankments, with no compensatory depth increase. Theoretically, this results in enhanced velocities and stresses on the flood defences in this section of the river (Essex CHaMP, 2002). However, south-easterly waves can have a far greater impact than any slight increase in tidal currents.

The situation is compounded by sea level rise which has led to an increase in high magnitude waves during high tide periods, which, coupled with up to 50km of fetch from open sea waves from the North Sea, is exerting a continual eroding impact on the mudflats and lateral edge of the saltmarshes, leading to steepening of the foreshore. Waves generated within the estuary and driven onshore by south-westerly, southerly and easterly winds are also having a geomorphological impact in the Mersea Quarters. Though relatively small, these waves are active over much of the tidal cycle and can have a significant cumulative effect, particularly during episodic storm events. These impacts are further exacerbated by the eroded almost vertical cliffed saltmarsh boundaries on the south shores of Cobmarsh Island and Old Hall which impact negatively on wave energy dissipation. The sheer face reflects wave energy causing rapid shoaling which elicits increased wave action immediately in front of these steep margins (Möller and Spencer, 2002).

Shell beach ridges (Chenier ridges) at Sales Point on the Dengie peninsular, some 3km to the south-east of Mersea Harbour, provide some protection to the Mersea Quarters and the harbour. However, with the continued erosion of the Nass spit (which stretches from Tollesbury to the Nass beacon), the islands at the entrance to the Strood, Thornfleet, Mersea and Besom Channels, along with the Quarters Spit, are exposed to wave attack from south-easterlies, as well as prevailing south-westerlies, and storm winds and waves from the east - the latter being likely to cause the most damage (Pye, 2000). The Essex and South Suffolk Shoreline Management Plan (EA, 2010F) recognises the strategic importance of Cobmarsh Island in safeguarding the Quarters but acknowledges that it is vulnerable to extreme erosion and that further losses will increase the risk of flooding to the protected hinterland in its lee.

5.1.2 Tidal flow velocity

Between 3 and 4 hours after high water, the ebb stream on spring tides runs between 1 and 2 knots and, generally, slightly under 1 knot over the same time interval on neaps (UKHO admiralty chart BA3741 Rivers Colne & Blackwater). These are typical rates for mid-Essex estuaries.

The strength of the ebb tide is reflected in local readings taken in the Mersea Quarters. Data collected in the Mersea Fleet over a single spring tidal cycle has demonstrated that current flow on the ebb reaches a maximum speed of 1 knot 70 minutes after high tide, due to several main channels draining through the Fleet. The ebb tide south-west of Old Hall Point reaches a maximum velocity twice the speed of the flood tide of 0.863 knots 60 minutes after high tide (refer to Appendix 3).

5.2 Sediment and water quality

The waters and sediments in the Essex estuaries are exposed to direct and diffuse pollution. Toxic hydrocarbons can enter the estuary system through accidental spillage or leakage of refined petrol or oil products and via sewage discharges and urban runoff. They attach strongly to suspended silt particles presenting a direct hazard to benthic invertebrates ingesting the contaminated sediment. Heavy metals are likely to derive from urban sewage and land runoff and agricultural soils, including atmospheric deposition. The build-up of contaminants in the food chain can lead to morphological or reproductive disorders in shellfish, fish and mammals.

5.2.1 Water quality

Water quality standards are set under The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015, for specific pollutants and priority substances; the Bathing Water Directive (2006/7 EC), and Directive 2006/113/EC on the quality criteria required for shellfish waters. Baseline water quality conditions for environmental parameters in the Mersea Quarters are summarised in Table 5. This information has been extracted from raw data collected by the EA as part of their statutory monitoring programme and covers the period 2013 to 2015 inclusive (Appendix 4). Sampling is undertaken regularly at three locations in the Mersea Quarters area: River Blackwater south-east of West Mersea, uptide of West Mersea, and in Tollesbury North Channel (off Great Cob Island).

The turbidity of the water column directly influences water quality and the productivity of marine invertebrates and microalgae. How much it impacts the water environment depends on the volume organic matter - algae, plankton and decaying material - and inorganic particles, such as silts and clays, in suspension. Suspended sediment transports and redistributes pollutants making them available to be taken up by animals and plants, with the potential to produce toxic effects.

Natural processes, such as erosion and resuspension of bottom sediment due to winds and tides, are a significant factor in causing turbidity and redistributing sediments in the Southern North Sea. Suspended fine-grained sediment concentrations in the Southern North Sea are estimated to be between 10-80mg/l (Essex CHaMP, 2002), but this is subject to seasonal variations and increases towards the coast, with higher concentrations recorded during the winter months. Within the Essex Estuaries volumes of between 100 and 1000mg/l have been recorded. These high estuarine concentrations are continuously maintained by tidal exchange with the waters of the Southern North Sea. In the Blackwater Estuary the baseline level of natural sediment in suspension is about 50mg/l but this can increase to 600mg/l if the wind is easterly.

The data presented in Table 5 indicates that sea water in the Mersea Quarters averaged 40.09 Formazin Turbidity Units over the recording period, classifying the degree of turbidity as intermediate, which would be expected for an estuarine environment. However, the sampling results demonstrate that this can range from clear (6 FTUs) to turbid (144.6 FTUs). Monitoring carried out in the Salcott Channel prior to breaching the sea wall at Abbott's Hall found suspended sediment concentrations over the winter period 2000/01 to range from 0 to 6,000 mg/l with mean values between 49 and 274mg/l. The exceptionally high levels recorded are likely to have been due to high rainfall and freshwater flow conditions at that time (Royal Haskoning, 2001).

Dissolved oxygen, as well as being essential for the survival of marine organisms affects a large number of other biochemical indicators of water quality. Dissolved oxygen levels expressed as percentage saturation levels range from 84.9% to 156.4%, averaging 95.34%, over the Environment Agency's three-year monitoring period. The higher percentage was noted in the water column uptide of West Mersea. Between 2000 and 2005 mean annual levels of dissolved oxygen ranged from 95% to 120% with the highest levels recorded in the Salcott Channel and Tollesbury North Channel (WRc Swindon, 1999). The recommended environmental standards for dissolved oxygen in saline waters is equal to or above 70% saturation for shellfish waters The estuary in the area of the recharge proposal sites maintains dissolved oxygen levels above the specified environmental standards. The upper end of the range suggests supersaturation occurs on occasions and this is likely to be associated with the photosynthetic activity of algal blooms.

The revised Bathing Water Directive (2006/7 EC) was implemented in March 2015 and sets standards for bathing water quality. The Environment Agency collects up to 20 water samples at West Mersea designated bathing water between May and September each year. The classification is calculated annually based on samples obtained from the previous four years and ranges from best to worst. The bathing water profile for West Mersea beach is reported as 'excellent' between 2012 to 2014 and 'good' for 2015 (EA, 2016).

The Blackwater and Osea Island is a designated shellfish water under the Surface Waters (Shellfish) (Classification) (Amendment) Regulations 2009 (Figure 10). The Centre for Environment Fisheries and Aquaculture Science (CEFAS) undertake sanitary surveys at West Mersea on a quarterly basis extracting samples from the Strood Channel, Salcott Channel and Tollesbury Channel. These sites, which experience similar environmental influences, were, overall, shown to have low average levels of faecal coliforms (CEFAS, 2013).

The concentrations of metals and hydrocarbons in the water samples, which were found to be above CEFAS Action Level 1 in the sediment samples, are compared with environmental standards, where available (Table 5). In the water medium, these substances are seen to be significantly below the environmental safe limits and would not be expected to be harmful to marine organisms.

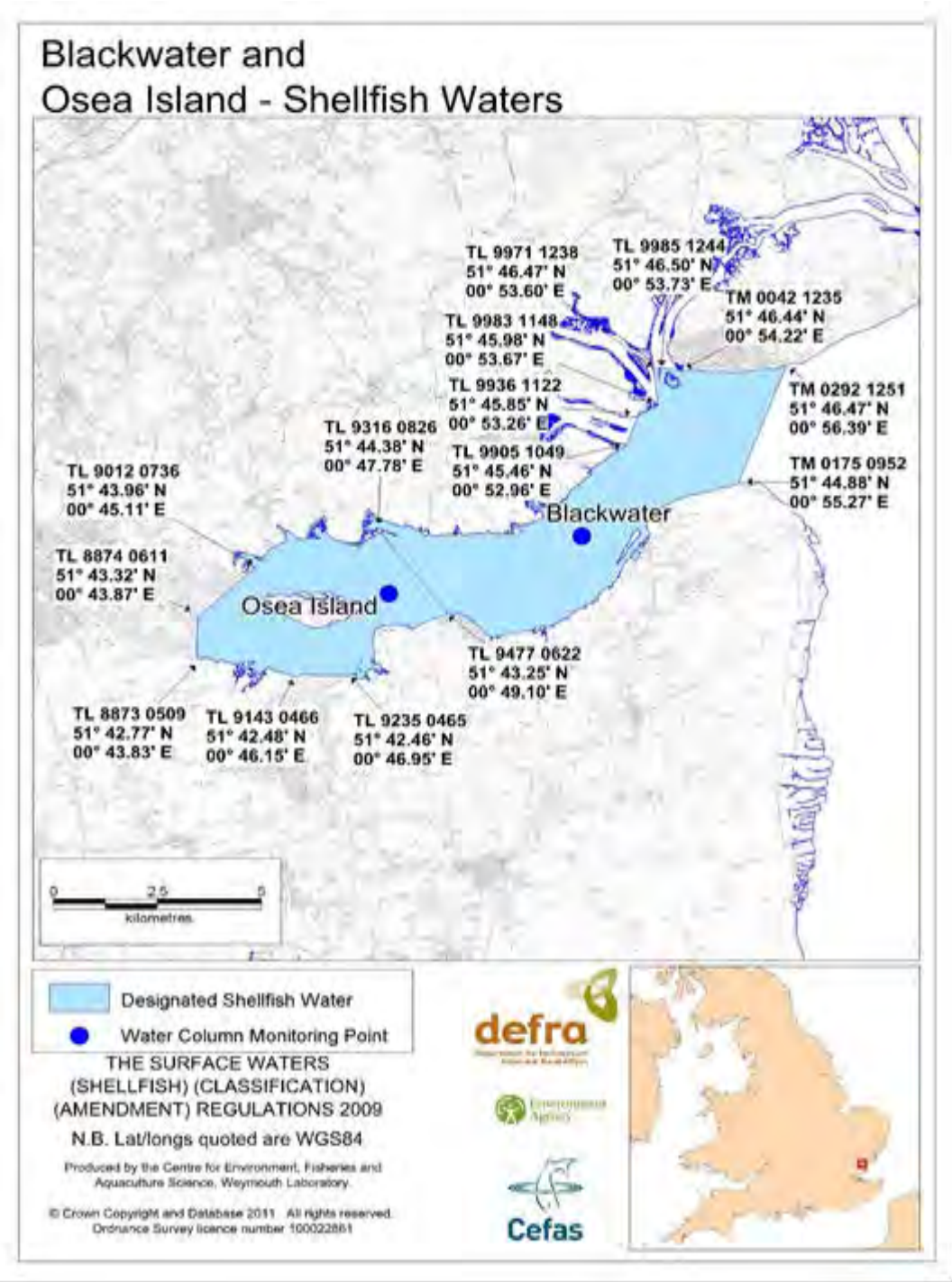

Figure 10. Blackwater and Osea Island designated shellfish water.

Table 5. Levels of pollutants and environmental parameters in the Mersea Quarters extracted from EA water quality data 2013 – 2015 (Appendix 4) compared with environmental standards (ES) for water quality. (**Note:** for chemical pollutants only those registering levels above CEFAS Action Level 1 in the sediment samples taken from the proposal sites are listed.)

Site / ES	Arsenic (µg/l)	Chromium (µg/l)	Nickel (µg/l)	THC	Fluoranthene (µg/l)	Phenanthrene (µg/l)	Pyrene (µg/l)	Napthalene C1 C2 C3 (µg/l)	Dissolved oxygen % saturation	Turbidity in situ (Formazin Turbidity Unit – FTU)	Faecal coliforms Confirmed (cfu - colony forming units/100ml)
	25 (long term mean) ◊	0.6 (long term mean) ◊	8.6 (annual average.) ◊	-	0.0063 (annual average) ◊	Insufficient data	Insufficient data	2 (annual average) ◊	>70% shellfish waters	<10 = clear 10 – 100 = intermediate; 100 – 300 = turbid◊	Good: *Escherichia coli* ≤500 Intestinal enterococci: ≤200
River Blackwater SE of West Mersea - average	1.33	0.5	0.95	-	-	-	-	-	93.73	42.12	12.66
Tollesbury North Channel off Great Cob Island – average	1.21	0.5	0.97	-	-	-	-	-	94.99	25.9	
Water column uptide of West Mersea (outer Blackwater) average	-	-	0.82	-	0.001	0.01	0.01	0.01 (1 record)	156.4 (1 record)	No record	
Average across all sites	1.30	0.5	0.94	-	0.001	0.01	0.01	0.01	95.34	40.09	12.66
Range across all sites	1.09 – 1.5	0.5	0.745 – 1.3	-	0.0005 – 0.0015	0.01	0.01	0.01	84.9 -156.4	6 – 144.6	10 - 18

◊ Chemical pollutants and turbidity environmental standards quoted follow those specified in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 http://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksiod_20151623_en.pdf or Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 as regards to priority substances in the field of water policy http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:226:0001:0017:EN:PDF
Dissolved oxygen ES as specified in Directive 2006/113/EC on the quality criteria required for shellfish waters http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32006L0113
Faecal coliforms ES as specified in the Bathing Water Directive (2006/7 EC) http://environment.data.gov.uk/bwq/profiles/help-understanding-data.html

5.2.2 Sediment quality

5.2.2.1 Trial pit samples – Harwich Approaches

The foreshore recharge material will be sourced from the Harwich and Felixstowe Approaches. A ground investigation of the approach channel was carried out between 23 August and 1 September 2013 under the direction of Harwich Haven Authority (HHA). One hundred and twenty trial pits were excavated by Geotechnical Engineering Ltd using a barge-mounted mechanical digger. The pits were dug between -14.5m and -17m Chart Datum and the soil profiles were described. A review of the report (Geotechnical Engineering Ltd, 2013) was undertaken by HHA to establish the location of material likely to be appropriate for reuse. The following trial pits indicated the presence of a significant proportion of sands and gravels:

7, 29, 30, 31, 31A, 32, 33, 36, 64, 65, 66, 67, 68, 72, 77, 80, 81, 82, 83, 84, 88, 89, 90, 104.

CEFAS (Centre for Environment, Fisheries and Aquaculture Science) sampled sediments in 30 of the trial pits to carry out chemical analysis and toxicity testing. This would determine whether the material proposed to be dredged from the channel would be suitable for dumping at sea. Of the 30 trial pits investigated only two, number 7 (off of The Guard), and number 81 (Harwich Deep), were located in areas containing potential recharge material.

The trial pit logs for pits 7 and 81 are described below (Tables 6 & 7).

Table 6. Log for Trial Pit 7: ground level -14.00m CD, depth 2.50m (Geotechnical Engineering Ltd, 2013).

Depth range - metres	Level - metres (Chart Datum)	Description of material
0.50 to 1.30	-14.50 to -15.30	Very soft dark grey locally black slightly sandy clayey SILT. 0.90 - 1.30m: Becoming sandy and slightly gravelly. Gravel is subangular and subrounded fine and medium shells and flint.
1.30 to 1.70	-15.30 to -15.70	Greyish brown gravelly fine and medium SAND. Gravel is subangular and subrounded fine to coarse flint and sandstone. 1.40m: Slightly sandy silty clay.
1.70 to 2.50	-15.70 to -16.50	Greyish brown gravelly fine to coarse SAND. Gravel is subangular and subrounded fine and medium rarely coarse flint. 1.90m: Silty fine sand. 2.30m: Slightly silty very sandy subangular and subrounded fine and medium gravel.

Table 7. Log for Trial Pit 81: ground level -14.00m CD, depth 2.50m (Geotechnical Engineering Ltd, 2013).

Depth range - metres	Level - metres (Chart Datum)	Description of material
0.05 to 1.50	-15.50 to -16.50	Dark yellowish brown gravelly fine and coarse SAND. Gravel is subangular and subrounded fine to coarse shells. Greenish grey slightly gravelly locally gravelly slightly silty fine to coarse SAND. Gravel is subangular and subrounded fine shells.

5.2.2.1i Results of chemical analysis from trial pit samples

Where the dredge arisings are almost exclusively made up of sand and gravel the contaminant load would be expected to be low: the silica in sands lacks the adhesive and absorption properties of silt/clay particles and the larger grain size limits the surface area that contaminants can adhere to. The analyses carried out by CEFAS on sub-surface samples taken from trial pits 7 and 81 have shown that polyaromatic hydrocarbons and metals are below CEFAS assessment criterion Action Level 1 (refer to Figures 11 to 14). Where contaminant levels are below Action Level 1 they would usually be considered to be of no concern. Where toxic substances are above Action Level 2 they are generally regarded as unsuitable for sea disposal. Where levels fall between Action Levels 1 and 2 further consideration and testing may be required to aid decision-making. Results for total hydrocarbons were significantly below Action Level 1. Polychlorinated biphenyls (PCBs) and organotins (TBT and DBT) were below levels of detection.

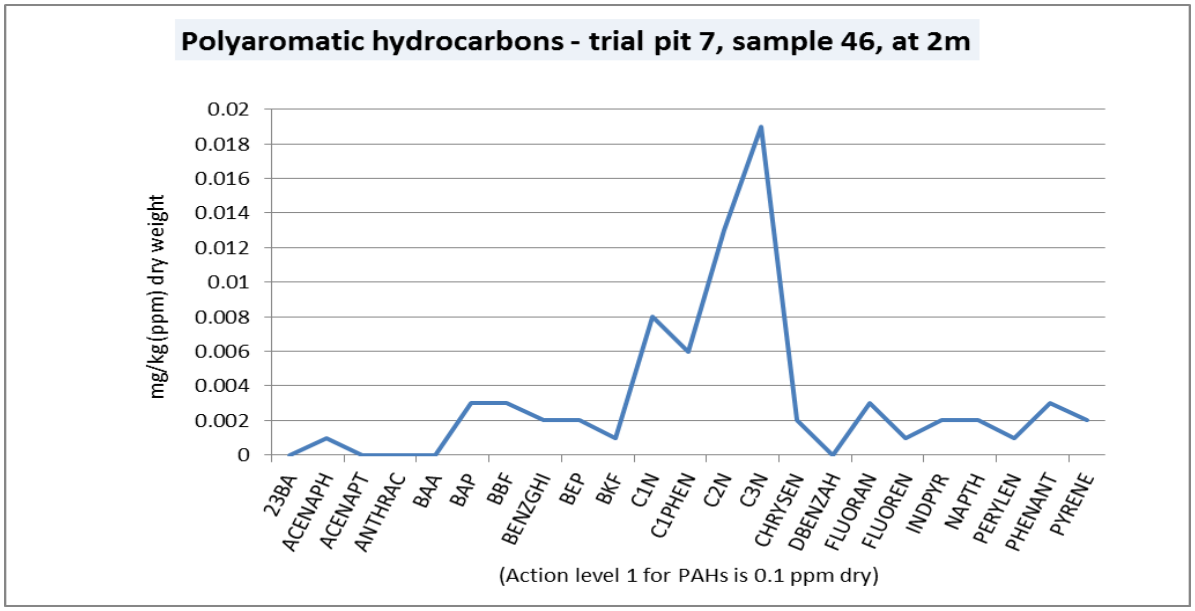

Figure 11. Levels of PAHs in sample obtained from trial pit 7, Harwich Approaches.

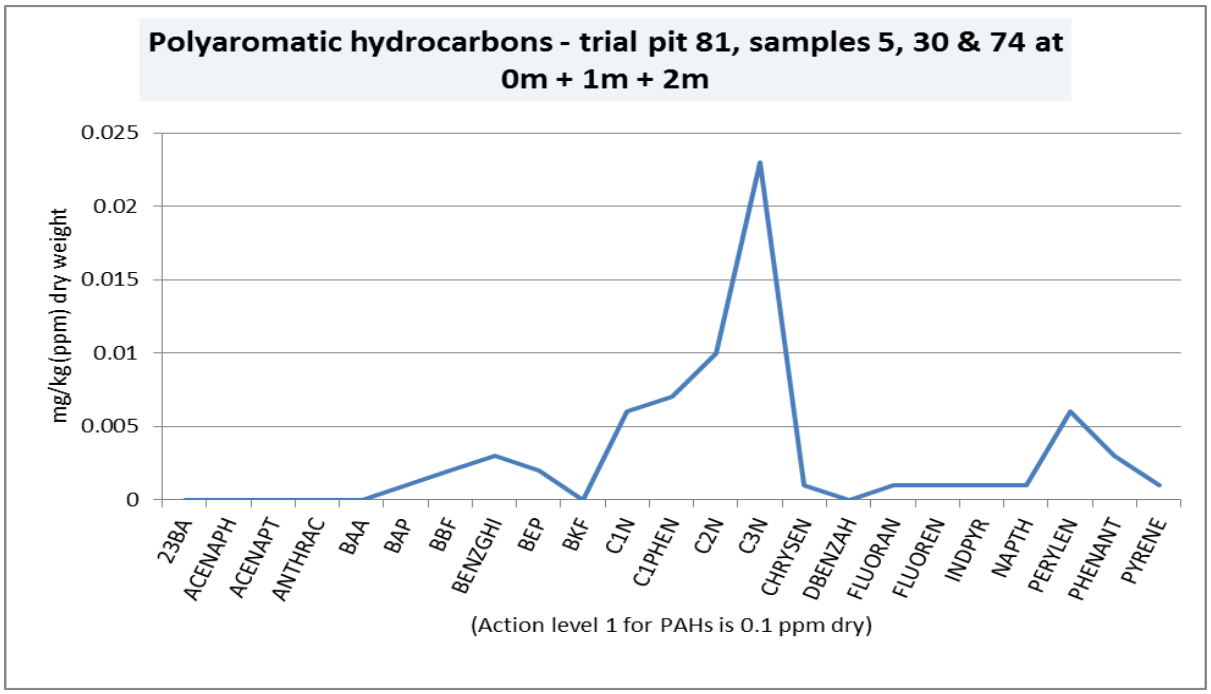

Figure 12. Levels of PAHs in samples obtained from trial pit 81, Harwich Approaches.

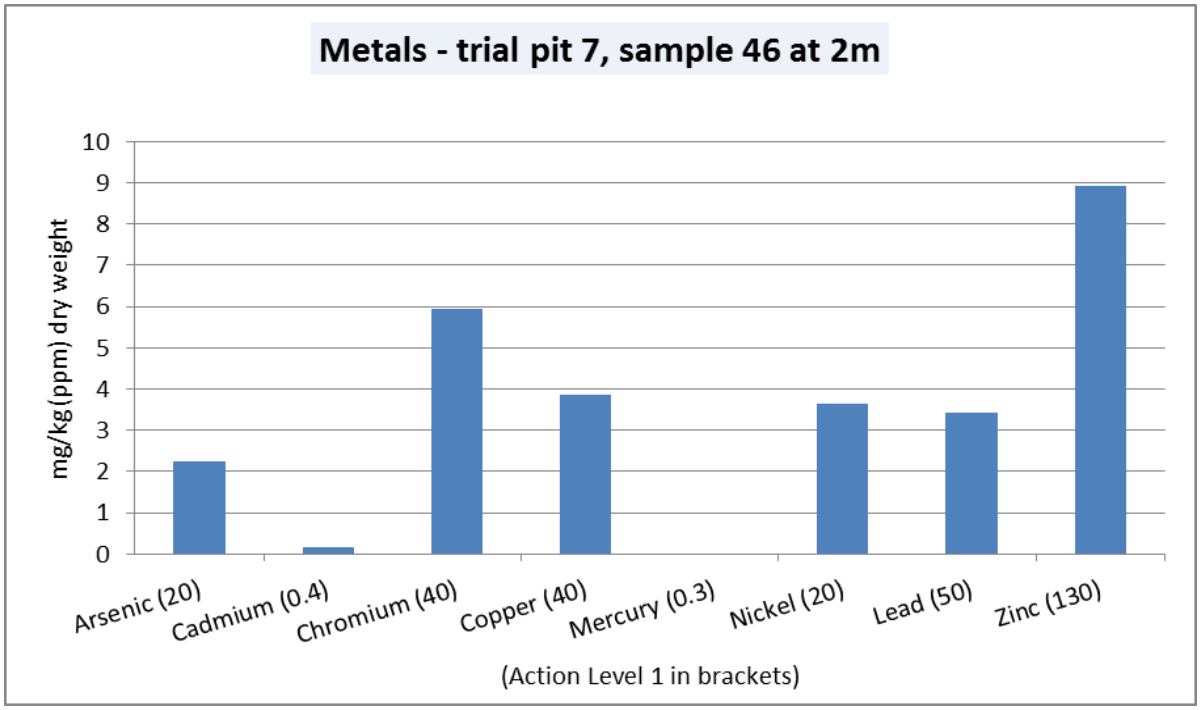

Figure 13. Levels of metals in samples obtained from trial pit 7, Harwich Approaches.

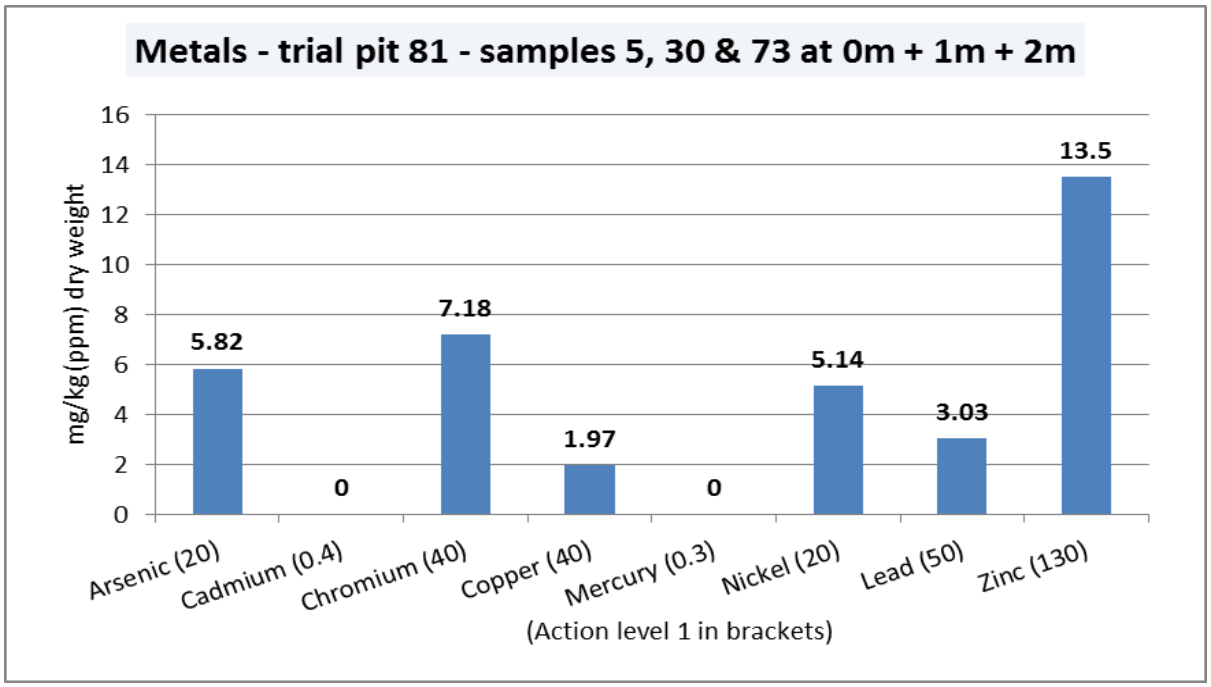

Figure 14. Levels of metals in samples obtained from trial pit 81, Harwich Approaches.

CEFAS analysis data is included in Appendix 5a.

5.2.2.2 Results of chemical analysis of Mersea Quarters and Tollesbury Wick sediment sampling

Samples for testing were taken from the recharge footprint areas (Figure 15).

Figure 15. Sediment sampling stations, Mersea Quarters and Tollesbury Wick (Jim Pullen; OS VectorMap District 1:50000).

The samples were tested for the presence of polyaromatic hydrocarbons (PAHs), total hydrocarbons and trace metals. CEFAS Action Level guidelines for assessing the suitability of sediments for disposal at sea have been applied to the results. Where contaminant leves are below Action Level 1 they would usually be considered to be of no concern. Where toxic substances are above Action Level 2 they are generally regarded as unsuitable for sea disposal. Where levels fall between Action Levels 1 and 2 further consideration and testing may be required to aid decision-making.

At Packing Marsh Island (sample 4) CEFAS Action Level 1 was exceeded by 14mg/kg (dry weight) for total hydrocarbons (Figure 16).

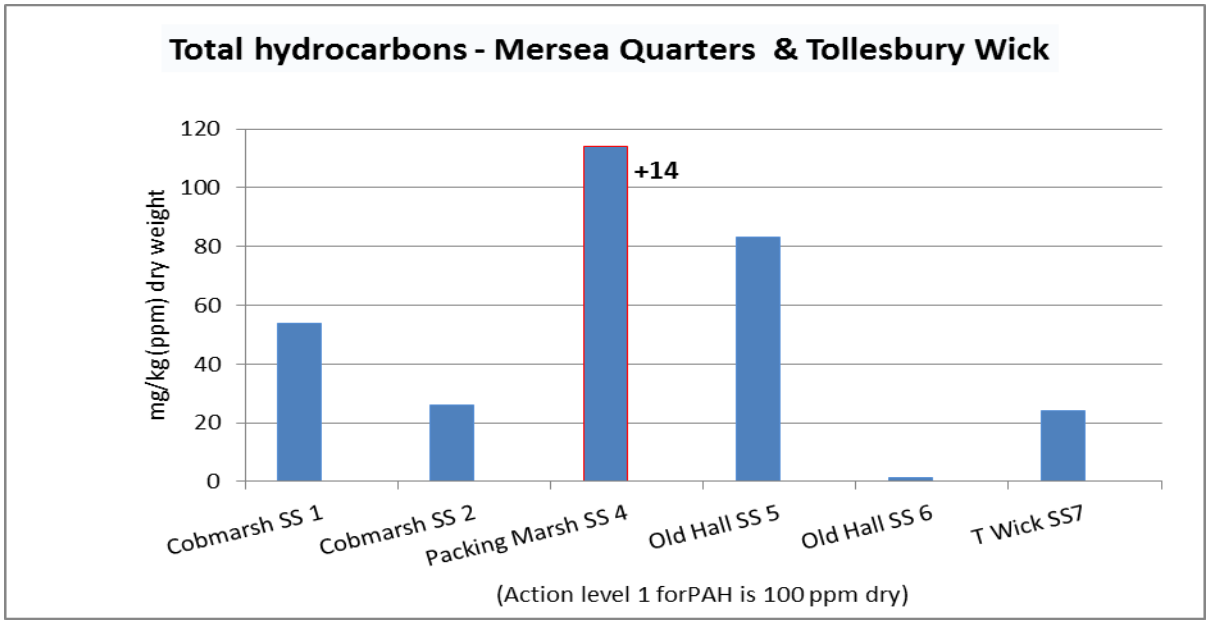

Figure 16. Levels of THCs in Mersea Quarters and Tollesbury Wick sediment samples.

Contaminant levels of polycyclic aromatic hydrocarbons (PAHs) found in surface sediments in the North Sea are typically in the range 200 to 280 ppb (CEFAS, 2001). PAHs were found in sediment samples in the proposed recharge areas at Cobmarsh Island, Packing Marsh Island and Old Hall (eastern end) registering levels between 108 to 232ppb (parts per billion) dry weight concentrations, above CEFAS Action Level 1 (100ppb). At Packing Marsh Island, total hydrocarbons (THCs) were also raised above Action Level 1.

Exceedances for PAHs above CEFAS Action Level 1 are shown in Table 8 – note these are given in parts per million.

Table 8. Levels of polyaromatic hydrocarbons (PAHs) above Action Level 1 in Mersea Quarters samples [(Action Level 1 = 0.1 mg/kg (ppm)].

Site / PAH	C1 - Napthalenes (ppm dry)	C2 – Napthalenes (ppm dry)	C3 – Napthalenes (ppm dry)	Fluoranthene (ppm dry)	Phenanthrene (ppm dry)	Pyrene (ppm dry)
Cob Marsh Island – sample site 1	-	-	-	0.208	0.122	0.158
Packing Marsh Island – sample site 4	0.108	0.130	0.188	-	-	-
Old Hall south – sample site 5	0.131	0.156	0.231	-	-	-

Elevated levels of arsenic, nickel and chromium were detected in the sediments at three of the proposal sites: arsenic (Cobmarsh); nickel (Packing Marsh and Old Hall) and chromium at Packing Marsh (Figure 17), but these were not significantly above Action Level 1.

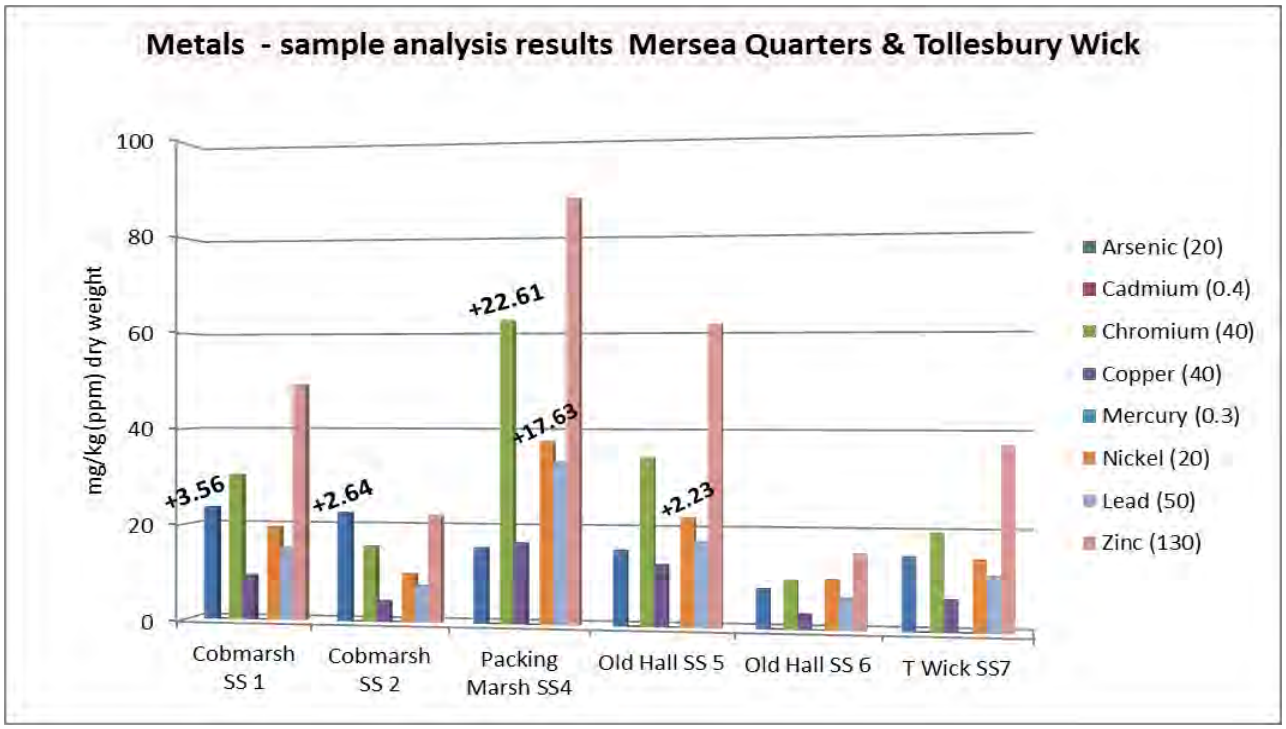

Figure 17. Trace metal test results for Mersea Quarters sites and Tollesbury Wick. Action level 1 is indicated in brackets in the legend and concentrations above these levels are shown on the bar chart.

5.2.2.3 Particle size analysis

Particle size analysis carried out on samples obtained from Cobmarsh Island (naturally occurring gravels), Packing Marsh Island (sample 3) and Tollesbury Wick contained gravels within the size range 2mm to 16 mm and comparable with the size description for trial pit 7 from the Harwich Approaches. Samples from Old Hall and Packing Marsh Island (sample 4) had smaller grain sizes averaging around 7mm.

The full scope of the CEFAS analysis data can be found in Appendix 5b.

5.3 Nature conservation and ecology

The following section describes the flora, fauna and habitats found within and adjacent to the proposal area and the nature conservation designations which protect them.

5.3.1 Protected habitats and species

5.3.1.1 Nature conservation designations

The Mersea Harbour area and Tollesbury Wick frontage are within the boundary of the following nature conservation designations covering the Blackwater Estuary (Figures 18, 19 & 20):

- Blackwater Estuary Site of Special Scientific Interest (SSSI)
- Blackwater National Nature Reserve – Old Hall Marshes, North NNR. (Salcott and Tollesbury Flats - South NNR, adjacent).
- Blackwater Estuary Special Protection Area for Wild Birds (SPA) and Wetland of International Importance (Ramsar site)
- Essex Estuaries marine Special Area of Conservation
- Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone

The mouth of the Blackwater estuary is contiguous with the Colne Estuary SSSI/SPA/Ramsar site and the Dengie SSSI/SPA/Ramsar site. These latter sites are also within the Essex Estuaries SAC and the Marine Conservation Zone MCZ.

Table 9 outlines the legal protective measures applying to the Blackwater Estuary designations, plus the relevant conservation features - which the recharge proposal could potentially impact - and conservation management objectives.

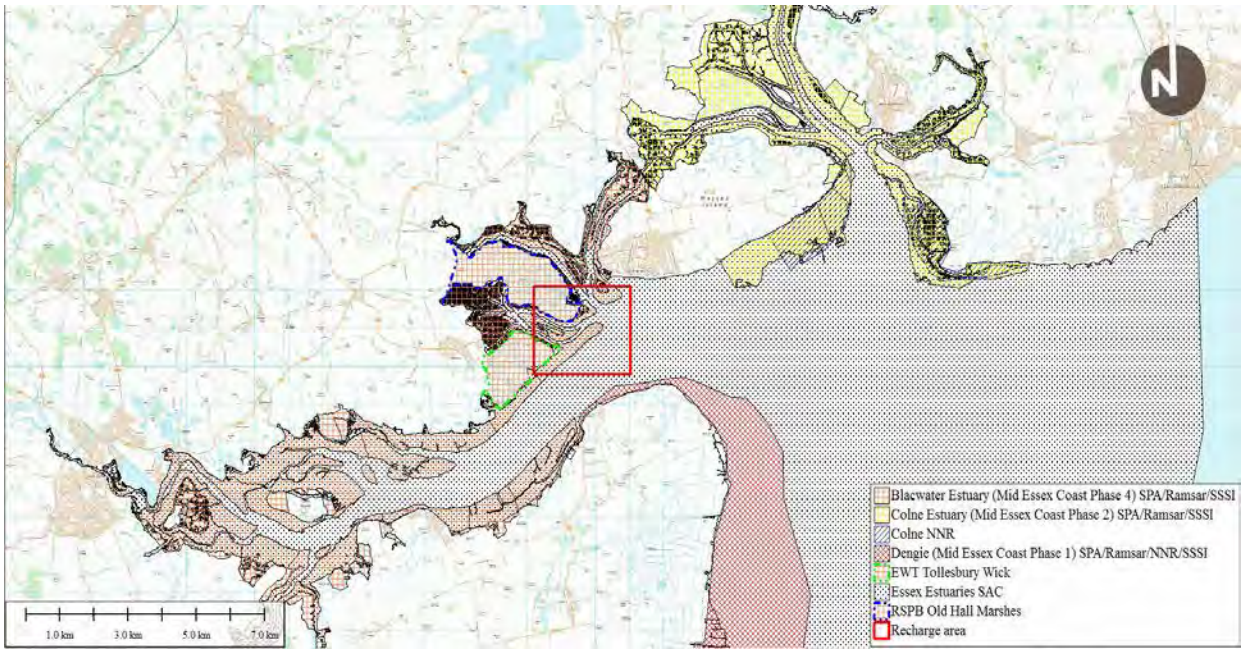

Figure 18. Designated nature conservation sites within and adjacent to the recharge proposal area (Jim Pullen. OS Vector Map District 1:50000.)

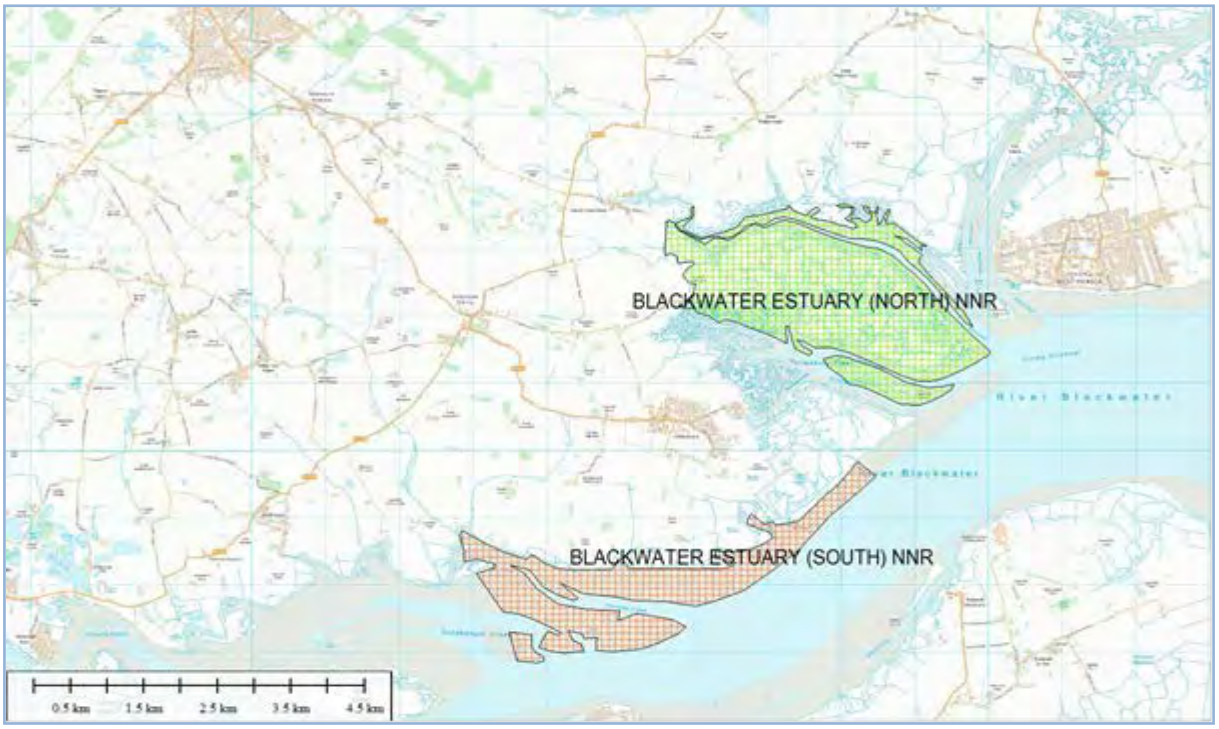

Figure 19. Blackwater Estuary National Nature Reserve comprises Old Hall Marshes (North NNR) and Salcott and Tollesbury Flats (South NNR). (Jim Pullen. OS Vector Map District 1:50000.)

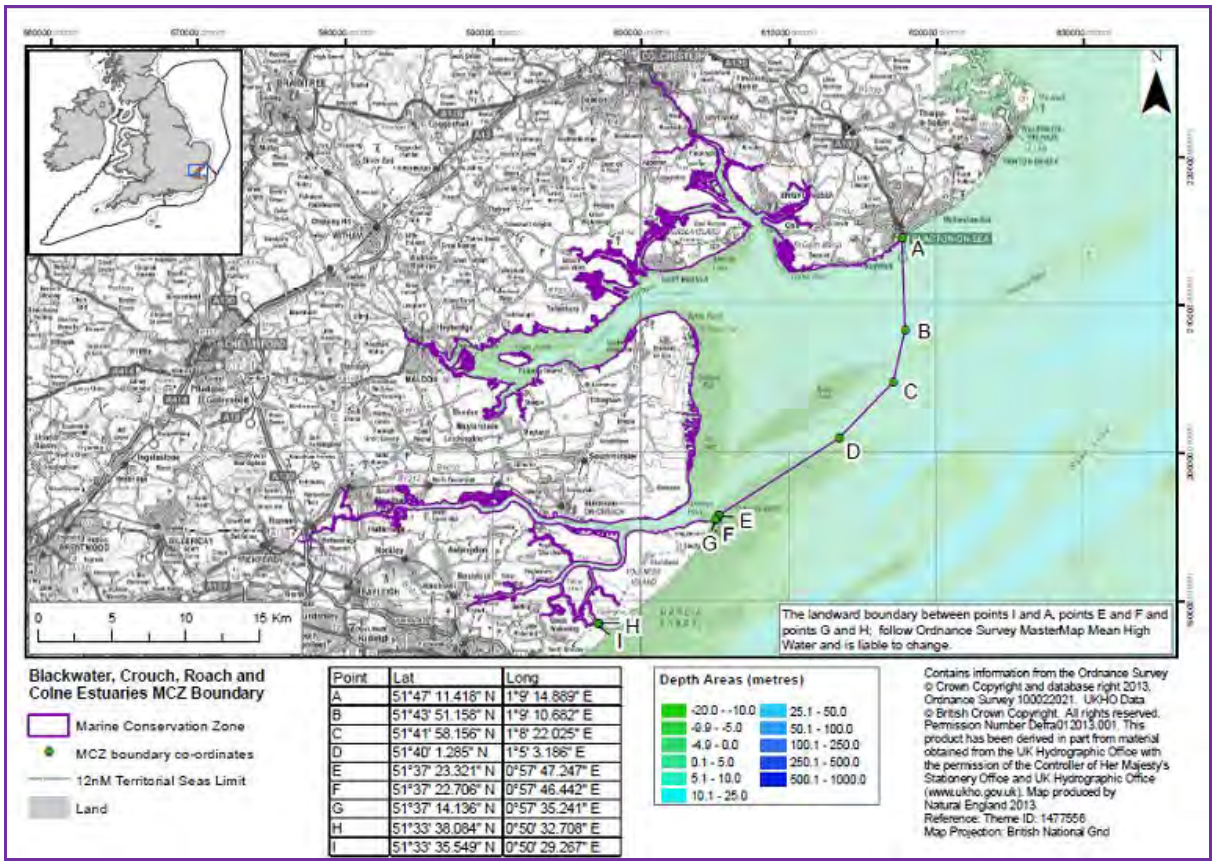

Figure 20. Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone.

Table 9. Blackwater Estuary site designations, conservation features and conservation/ management objectives.

Designation type	Conservation features		Conservation/management objectives
	Habitat	Species	
Blackwater Estuary Site of Special Scientific Interest [notified under Section 28 of the Wildlife and Countryside Act 1981, as amended by the Countryside and Rights of Way (CRoW) Act 2000]	Intertidal mudflats, sand and shingle beaches and shell banks; ancient and semi-improved grazing marsh, grazing marsh ditches, and linear coastal lagoons (borrow dykes)	Nationally scarce plants, rare and notable aquatic and terrestrial invertebrates. Internationally important numbers of brent geese, dunlin and ringed plover. Nationally important numbers of waders and wildfowl.	
Blackwater National Nature Reserve (Natural England, 2008) includes: Old Hall Marshes and Tollesbury and Salcott Flats (declared under Section 19 the National Parks and Access to the Countryside Act 1949)	Intertidal mud and sandflats. Saltmarsh. Freshwater & brackish water. Grazing marsh. Reed beds.	Old Hall Marshes NNR – supports up to 4000 brent geese in winter. Nationally important plant and invertebrate species. Tollesbury Flats – diverse invertebrate populations. Salcott & Tollesbury flats support feeding populations of: dunlin, redshank, curlew and greenshank, and waterfowl such as wigeon and goldeneye.	
Blackwater Estuary Special Protection Area for Wild Birds (SPA) – Mid-Essex Coast Phase 4. Classified under Article 4 of the European Commission Birds Directive (Council Directive 92/34/EEC). Legal provision for protection and management: The Conservation of Habitats and Species Regulations 2010. [The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)]	Sand and gravel shores. Shallow coastal waters. Saltmarsh. Intertidal mudflats and sandflats. Boulder and cobble shores.	Nationally important breeding populations of the regularly occurring Annex 1 species: little tern. Wintering population of Annex 1 species of European importance: hen harrier. During the breeding season regularly supports nationally important populations of: ringed plover and common pochard. Internationally important assemblage of waterfowl (wildfowl and waders). Internationally important populations of regularly occurring migratory species over winter – dark-bellied brent goose, grey plover, dunlin, black-tailed godwit and ringed plover.	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; ➢ The extent and distribution of the habitats of the qualifying features ➢ The structure and function of the habitats of the qualifying features ➢ The supporting processes on which the habitats of the qualifying features rely ➢ The population of each of the qualifying features, and, ➢ The distribution of the qualifying

Table 9. Blackwater Estuary site designations, conservation features and conservation/ management objectives.

Designation type	Conservation features		Conservation/manage-ment objectives
	Habitat	**Species**	
			features within the site.
Blackwater Estuary Ramsar site – classified as a wetland of international importance under the Ramsar convention. As a matter of policy, protected under The Conservation of Habitats and Species Regulations 2010. [The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)]	Extent and diversity of saltmarsh. Tidal flats. Salt marshes. Seasonally flooded agricultural land. Permanent freshwater marshes/pools: Coastal brackish/saline lagoons. Permanent rivers/streams/ creeks. Coastal fresh lagoons. Sand/shingle shores (including dune systems).	16 British Red Data Book invertebrate species: endangered, rare and vulnerable. Full and representative sequences of saltmarsh plant communities covering the range of variation in Britain. Waterfowl assemblages of international importance - species with peak counts in winter. Waterfowl - species/populations occurring at levels of international importance: dark-bellied brent goose, grey plover, dunlin and black-tailed godwit.	Refer to SPA conservation objectives above.
Part of the Essex Estuaries Special Area of Conservation. Designated under the EC Habitats Directive (92/43/EEC) Legal provision for protection and management: The Conservation of Habitats and Species Regulations 2010 [The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)]	*Salicornia* (glasswort) and other annuals colonising mud and sand; *Spartina* swards, Spartinion maritimae (small cord-grass); Atlantic salt meadows; Mediterranean and thermo-Atlantic saltmarsh scrubs; Estuaries; Mudflats and sandflats not covered by seawater at low tide; Non qualifying feature present: sandbanks which are slightly covered by sea water all the time		Subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring: ➢ the extent and distribution of qualifying natural habitats and habitats of the qualifying species ➢ the structure and function (including typical species) of qualifying natural habitats ➢ the structure and function of the habitats of qualifying species ➢ the supporting processes on which qualifying natural habitats and the

Table 9. Blackwater Estuary site designations, conservation features and conservation/ management objectives.

Designation type	Conservation features		Conservation/manage-ment objectives
	Habitat	**Species**	
			habitats of qualifying species rely ➢ the populations of qualifying species ➢ the distribution of qualifying species within the site
Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone - enabled by the Marine and Coastal Access Act 2009 and designated under The Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone Designation Order 2013. Extends from mean high water mark to where the four estuary mouths join the North Sea. It is the largest inshore MCZ covering an area 28,400ha.	Intertidal mixed sediments. Native oyster (*Ostrea edulis*) beds. Clacton Cliffs and Foreshore.	Native oyster (*Ostrea edulis*). (Important spawning and nursery ground for several fish species including: sand-smelt, bass and Blackwater herring (*Clupea harengus*) - a distinct breeding population, notably around Eagle Bank at the mouth of the Blackwater Estuary. Although not a protected feature, protection should be provided indirectly via direct protection of the broad-scale seabed habitats that support them.)	Protected features: 1. are maintained in favourable condition if they are already in favourable condition (intertidal mixed sediments; Clacton Cliffs and Foreshore). 2. be brought into favourable condition if they are not already in favourable condition (native oysters and native oyster beds). (Conservation advice for the native oyster features does not apply to oysters cultivated in private grounds.)

Reference sources: http://www.sssi.naturalengland.org.uk/citation/citation_photo/1004426.pdf http://publications.naturalengland.org.uk (SPA) ; https://www.gov.uk/government/publications/conservation-advice-for-marine-conservation-zone-blackwater-crouch-roach-and-colne-estuaries-bs03/blackwater-crouch-roach-and-colne-estuaries-mcz-site-information-draft; https://www.gov.uk/government/publications/marine-conservation-advice-for-special-area-of-conservation-essex-estuaries-uk0013690/essex-estuaries-sac-site-information-draft ; http://jncc.defra.gov.uk/pdf/RIS/UK11007.pdf (Information sheet on Ramsar wetlands.) https://www.gov.uk/government/publications/essexs-national-nature-reserves/essexs-national-nature-reserves

Note: Clacton Cliffs and Foreshore (a feature of the Marine Conservation Zone) is an internationally important geological site. It is situated on the open coast, east of the mouth of the Colne Estuary, some 13km from the proposal site. It will not be impacted by the proposal and has not been considered further in this assessment.

5.3.1.2 Species and habitats of principal importance in England - Natural Environment and Rural Communities Act 2006 – section 41

Following devolution and the development of new international requirements, the UK Biodiversity Action Plan was succeeded by the UK Post-2010 Biodiversity Framework, in July 2012, refocussing effort at a country level rather than a UK level (Joint Nature Conservation Committee, 2016). The England Biodiversity List has been developed to meet the requirements of Section 41 of the Natural Environment and Rural Communities Act (2006). This legislation requires the Secretary of State to publish a list of species of flora and fauna and habitats considered to be of principal importance for the purpose of conserving biodiversity.

Fifty-six habitats of principal importance and 943 species of principal importance are included on the S41 list. These are the species and habitats found in England which were identified as requiring action under the UK Biodiversity Action Plan and which continue to be regarded as conservation priorities under the UK Post-2010 Biodiversity Framework. The UK list of priority species and habitats remains an important reference source and has been used to produce the statutory inventory of priority habitats and species in England, Northern Ireland, Scotland and Wales. The S41 list replaces the list published under Section 74 of the Countryside and Rights of Way (CRoW) Act 2000, under which Defra published a list in 2002 which was identical to the UK BAP list at that time.

Protecting and enhancing England's S41 species is fundamental to delivering Outcome 3 of the Government's Biodiversity 2020 strategy which has an objective to ensure that 'By 2020, we will see an overall improvement in the status of our wildlife and will have prevented further human-induced extinctions of known threatened species' (Natural England, 2013).

The S41 list will be used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40 of the Natural Environment and Rural Communities Act 2006 'to have regard' to the conservation of biodiversity in England, when carrying out their normal functions.

The following species and habitats 'of principal importance for the purpose of conserving biodiversity' and listed under section 41 (England) of the NERC Act (2006) occur in the Blackwater Estuary and are of relevance to the current proposal:

- Native oyster (*Ostrea edulis*) – a conservation feature of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone.
- Dark-bellied brent goose (*Branta bernicla* subsp *bernicla*) – occur in internationally important numbers in the Blackwater Estuary SPA/Ramsar site
- Black-tailed godwit - occur in internationally important numbers in the Blackwater Estuary SPA/Ramsar site
- Lapwing (*Vanellus vanellus*) – part of the internationally important assemblage of waterfowl in the Blackwater SPA/Ramsar site
- Herring gull (*Larus argentatus subsp argenteus*) - part of the internationally important assemblage of waterfowl in Blackwater SPA/Ramsar site
- Coastal saltmarsh
- Intertidal mudflats

5.3.1.3 Protected species

Little Terns are listed in Schedule 1.1 of the Wildlife and Countryside Act 1981 (amended by the Countryside and Rights of Way Act 2000). Birds included in Schedule 1, as well as receiving the protection afforded to all wild birds, receive additional protection. It is an offence to intentionally or recklessly disturb a Schedule 1 species while it is in, on or near a nest containing eggs or young or whilst it has dependent young.

The little tern is listed as a threatened species under Annex 1 of the European Union Birds Directive, with habitat loss, human disturbance and predation by gulls at nest sites, understood to be contributory factors in the decline of the population (European Commission, 2015). The presence of a nationally important breeding population of the little tern was a key reason for classifying the Blackwater Estuary as a Special Protection Area.

5.3.2 Saltmarsh and intertidal mudflats and sandflats - historical change, physical processes and current condition

5.3.2.1 Introduction

The baseline condition of the saltmarsh and intertidal mudflats and sandflats at the proposal sites is described, as well as the physical processes acting upon these features. The fate and influence of the earlier recharge is also recounted.

The status of the saltmarsh at the proposal sites is given from a historical perspective. Time series analysis using historic map overlays illustrate the changing shoreline location at each of the sites being considered for recharge. The Ordnance Survey six inch map for 1888, an orthorectified aerial image flown in 1997 supplied by the Environment Agency, and a georeferenced aerial photograph, obtained in 2014, were scanned and amalgamated to assess the extent of saltmarsh loss over time. The maps also plot the movement of the recharge deposited in the mid to late 1990s.

5.3.2.2 Cobmarsh Island

Over the period 1888 to 1997, the saltmarsh at Cobmarsh Island underwent a 45% loss in area shrinking from 12.94 ha to 7.128 ha. The annual average rate of loss over this period was 533.2m². From 1997 to 2014 the saltings reduced further to 6.33 ha undergoing an 11% loss of 0.8 ha (8000m²; Figure 21).

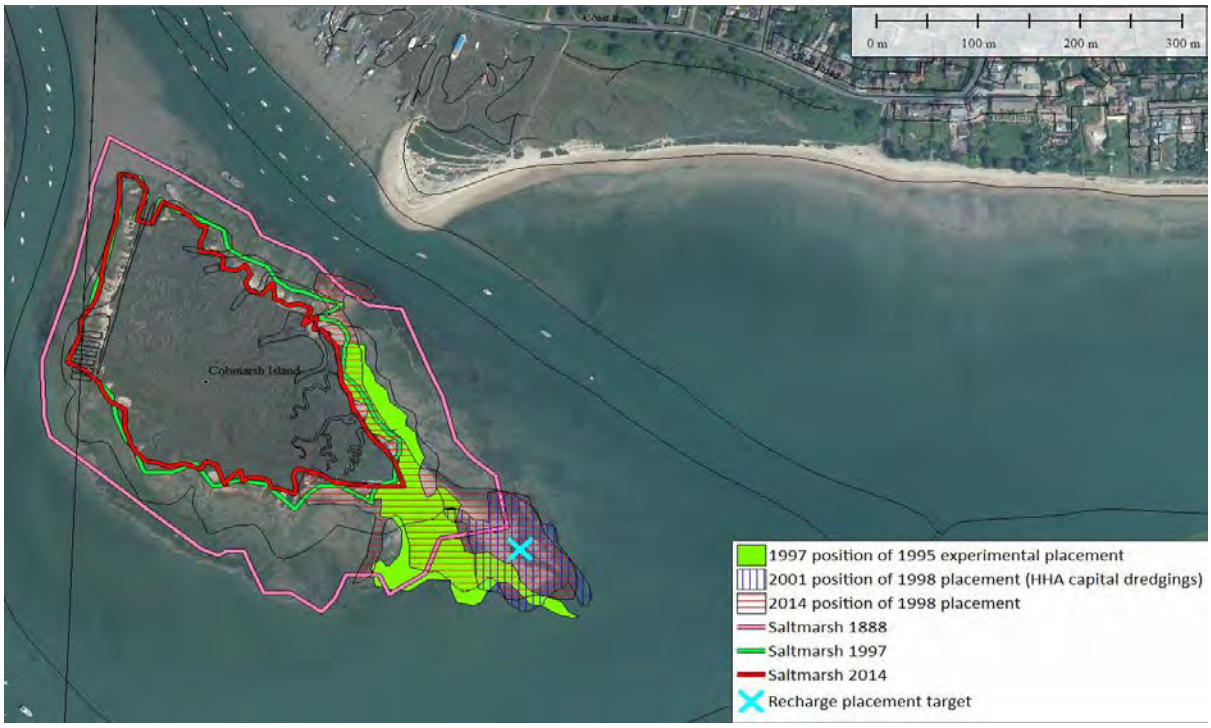

Figure 21. Shows the changing shoreline location at Cobmarsh Island over time and the distribution of recharge since placement. (Jim Pullen. Source: esri satellite map & OS 1:50000 vector mapping.)

5.3.2.2i Impact of foreshore recharge deposited in 1995 (trial placement) and 1998

Since the mid to late 1990s the island has been protected from storm wave erosion along its eastern and south-eastern margins by recharge material. In 1995, a trial placement of sands and gravels was deposited off the south-eastern point of the island. Natural processes rapidly distributed this material north-westwards along the eastern shoreline to achieve the configuration shown in Figure 21, in 1997. With the success of this trial, a greater volume of material was placed in 1998 at the same location. Wind and wave action has redistributed this material 320 metres along the eastern shoreline, following the course of the earlier placement. A creek located halfway along this edge is currently restricting further migration. This second placement took six years to reach the island's shoreline travelling at an average rate of 12.5m per annum. Tidal forcing has lifted the crest of the recharge along the saltmarsh margins above the level of mean high water spring tides to between +2.85 and +2.93 ODN (Figure 22). Movement along the western margins has been limited but has covered the brushwood fence constructed perpendicular to the shore, placed to restrict the spread of material. The development of shrubby sea-blite (*Suaeda vera*) along the recharge ridge has aided stability. This high marsh vegetation has increased its range at the south-east point of the island establishing over the new beach material. A small net loss of saltmarsh (832m²) is attributed to overwash of the recharge sands and gravels.

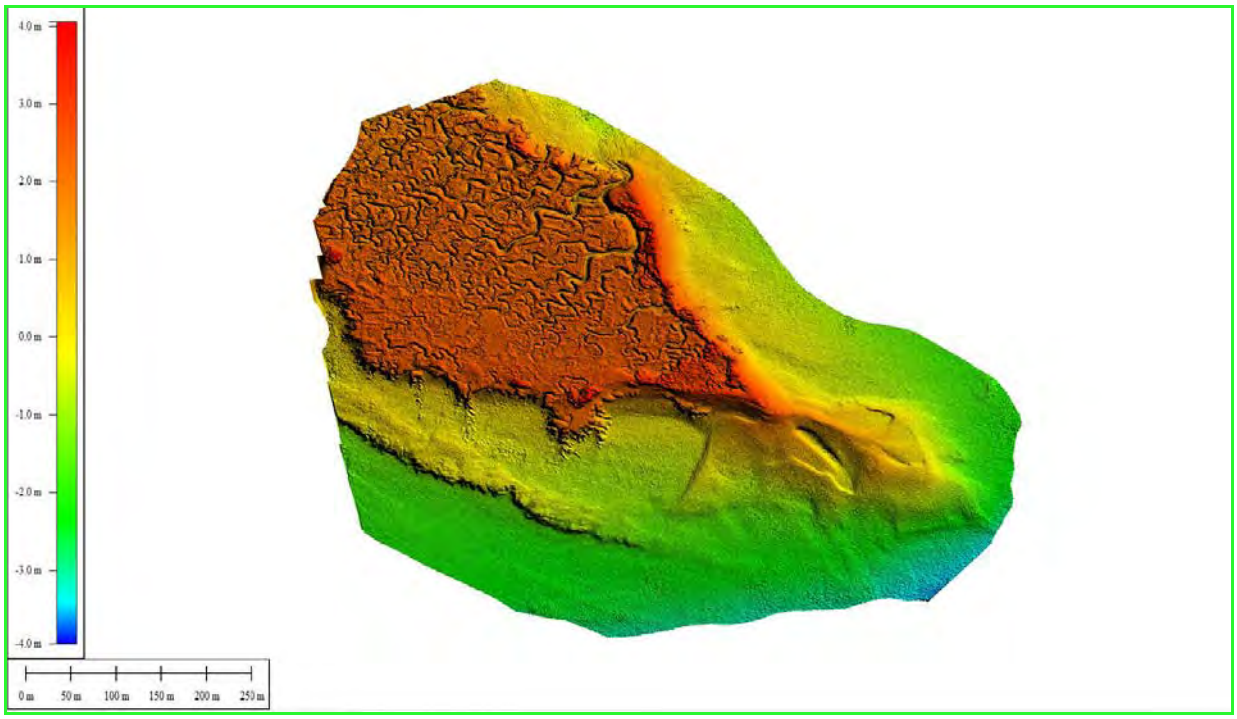

Figure 22. Digital surface model of Cobmarsh Island, collected March 2014, showing the heights of the recharge above Ordnance Datum Newlyn (ODN). (Jim Pullen)

5.3.2.2ii Foreshore condition at proposal site

The southern shore of Cobmarsh Island is subjected to sustained periods of strong winds and waves from the south. It once received protection from The Nass spit, which stretches east from Tollesbury across the Mersea Quarters to the Nass beacon. Now very little remains of this shingle spit leaving Cobmarsh vulnerable on its south side. The recharged Old Hall Point at least offers some protection from south-westerly gales. Over the period 1997 to 2014, between the western point and the westerly edge of the earlier recharge, saltmarsh loss has amounted to 3320m² (0.3ha) - an overall average rate of loss of 195m² per year. The average width loss during this period, of 17m, gives an average annual loss of 1 metre. However in a single year greater losses have been observed: in the winter of 2013/2014 sustained southerly gales led to the erosion of up to four metres of saltmarsh from the margins, at one location (Alan Bird, Blackwater Oystermen's Association, pers comm).

The saltmarsh on the south side of the island presents a scalloped, cliffed leading edge behind erosional cliff-foot platforms which are either unvegetated or support a patchy cover of pioneer saltmarsh species. There is evidence that landward erosion is undermining the cliff face, resulting in collapse, with toppled blocks of clay being scattered over the foreshore. This suggests that high energy events are episodically impacting the cliff face (Figure 23).

Figure 23. Wave eroded saltmarsh and mudflat with dislodged blocks of clay scattered over the foreshore. Erosional cliff foot platform in the foreground and saltmarsh edge behind (south shoreline, looking west).

Creeks cutting through the mud banks have transported outwash gravels and shell fragments to the base of the saltmarsh edge. This material is derived from underlying Pleistocene gravels exposed by erosion of the surface muds (Pethick, 1993). At locations around the island these gravels have been reworked and rolled over during storm events forming washover features burying areas of saltmarsh (Figure 24). These shingle formations raise the height of the marsh and provide a suitable substrate for the growth of high saltmarsh plants such as *Inula crithmoides* (golden samphire). Foreshore recharge with a similar grading curve, and of similar origin, has been shown to respond to high energy wave action in the same way as these naturally occurring glacial deposits (Figure 25).

Figure 24. Naturally superimposed Chenier bank derived from outwash gravels and shells which have been rolled over onto the saltmarsh during a storm event, burying the vegetation. It supports the growth of golden samphire which helps to stabilise the material (west shoreline Cobmarsh - view SE).

Figure 25. East shore of Cobmarsh Island where tidal forces have moved the recharge over the retaining fence onto the marsh. Shrubby sea-blite (*Suaeda vera*) has colonised and stabilised the recharge ridge both inside and outside the fence (view north). The similar grading curve of the imported material allows it to be reworked by wave action and storm events in the same way as the naturally occurring material (see Figure 24 above).

5.3.2.2iii Saltmarsh vegetation

An account of saltmarsh change between 1997 to 2008 reported that the internal marsh structure had remained stable during this period (Thomson et al, 2011). A survey visit during the summer of 2014 confirmed that the internal marsh appears to have kept pace, vertically, with sea level rise. The visit also confirmed the continued presence of the saltmarsh communities defined in a National Vegetation Classification survey undertaken in 2001/2002 for Natural England (Royal Haskoning, 2003). The marsh is dominated by communities of SM13 *Puccinellia maritima* (saltmarsh grass) and SM14 *Atriplex portulacoides* (sea purslane) and a mosaic of sub-communities and transitions associated with these vegetation types, ascribed to the Special Area of Conservation (SAC) feature, Atlantic salt meadows. The wide belts of SM25 *Suaeda vera* (shrubby sea-blite) driftline communities are also a protected SAC feature, Mediterranean saltmarsh scrub. The survey was able to establish that of the 2000m² of recharge that had transgressed over the saltmarsh margins on the east shore, almost 60 per cent had been colonised by the nationally scarce shrubby sea-blite. The Royal Haskoning report describes an abundance of *Inula crithmoides* (golden samphire), also a nationally scarce species, in the mid-level saltmarsh, frequently occurring with sea purslane (Figure 26). This was reaffirmed, and golden samphire was also observed both on natural shingle banks and clay banks overwashed with shell and gravel adjacent to the eroded oyster pits on the western shore.

Saltmarsh pools are more widespread at the southern end of the island associated with waterlogged vegetated pans supporting a further SAC feature characterised by pioneer species - SM8 annual *Salicornia* saltmarsh (glasswort). *Limonium vulgare* (common sea lavender) is also widely represented in these vegetated pans as part of a SM13 Puccinellia *maritima* sub-community.

Figure 26. Sea purslane marsh with golden samphire - west Cobmarsh Island, view SE

5.3.2.3 Packing Marsh Island

Formerly a centre for grading and packing oysters for export to London and Europe in the 19th century (Packing Shed website), Packing Marsh Island is essentially a series of oyster pits running perpendicular to the shoreline. The island underwent a 35% loss of saltmarsh from its margins between 1888 and 1997 from 1.825 ha to 0.632 ha (Figure 27). The shells of tons of slipper limpets (*Crepidula fornicata*), cleared from the adjacent oyster beds in the 1930s and 1940s, and sands and gravels washed northward from the 1990s recharge have helped to sustain the island, forming a protective beach around the southernmost fringes.

A further 13% decrease around the marsh perimeter occurred between 1997 and 2014. This is in part due to the shells and recharge overwashing the oyster pits in response to storm events.

5.3.2.3i Impact of foreshore recharge deposited in 1998

A combination of southerly winds and the flood tide has pushed the recharge shoreward over the centre of the island's eroded foreshore and around the eastern and western fringes. The defensive ridge formed by the recharge around the margins has obtained a height of +2.9m ODN and has redefined the 1888 shoreline (Figures 27 & 28). Brushwood fences failed to check the movement of the recharge, due to lack of maintenance (Figure 29). The shells and recharge support saltmarsh species at the upper limit of tidal inundation, these include shrubby sea-blite (*Suaeda vera*), perennial glasswort (*Sarcocornia perennis*) and maritime grasses. Saltmarsh is otherwise mostly confined to the banks of the oyster pits which support both pioneer and perennial species, the latter including golden samphire (*Inula crithmoides*).

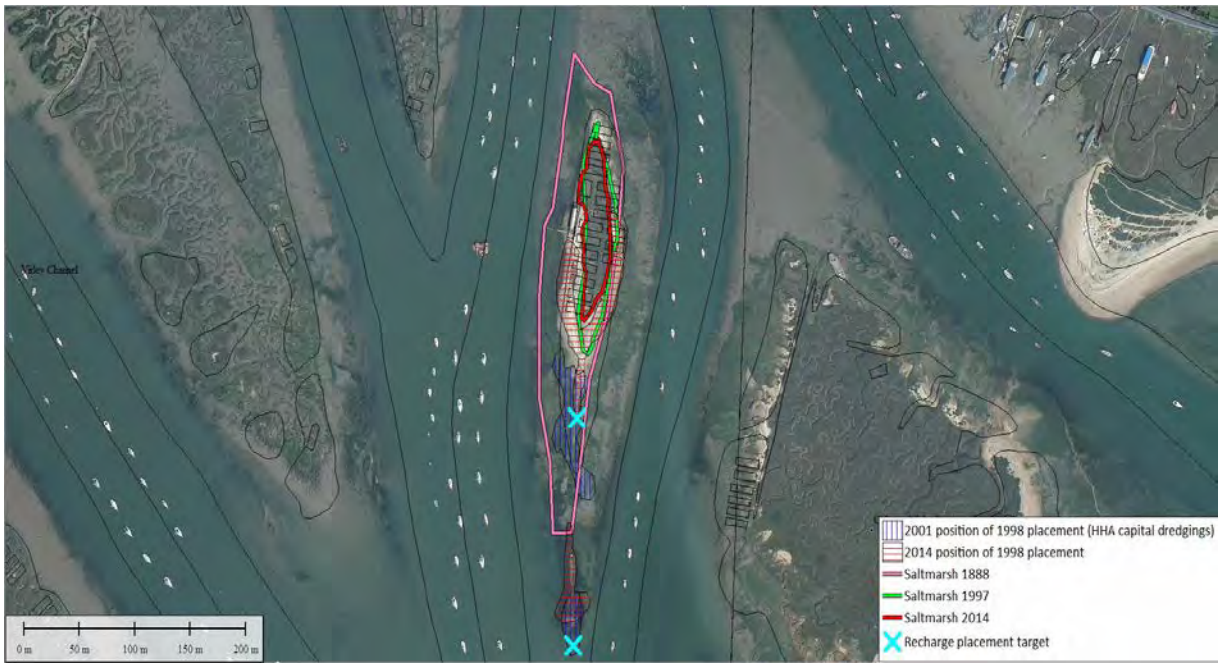

Figure 27. Shows the changing shoreline location at Packing Marsh Island over time and indicates the shoreward progress of material placed at the southern point of the island in 1998. (Jim Pullen. Source: esri satellite map & OS 1:50000 vector mapping.)

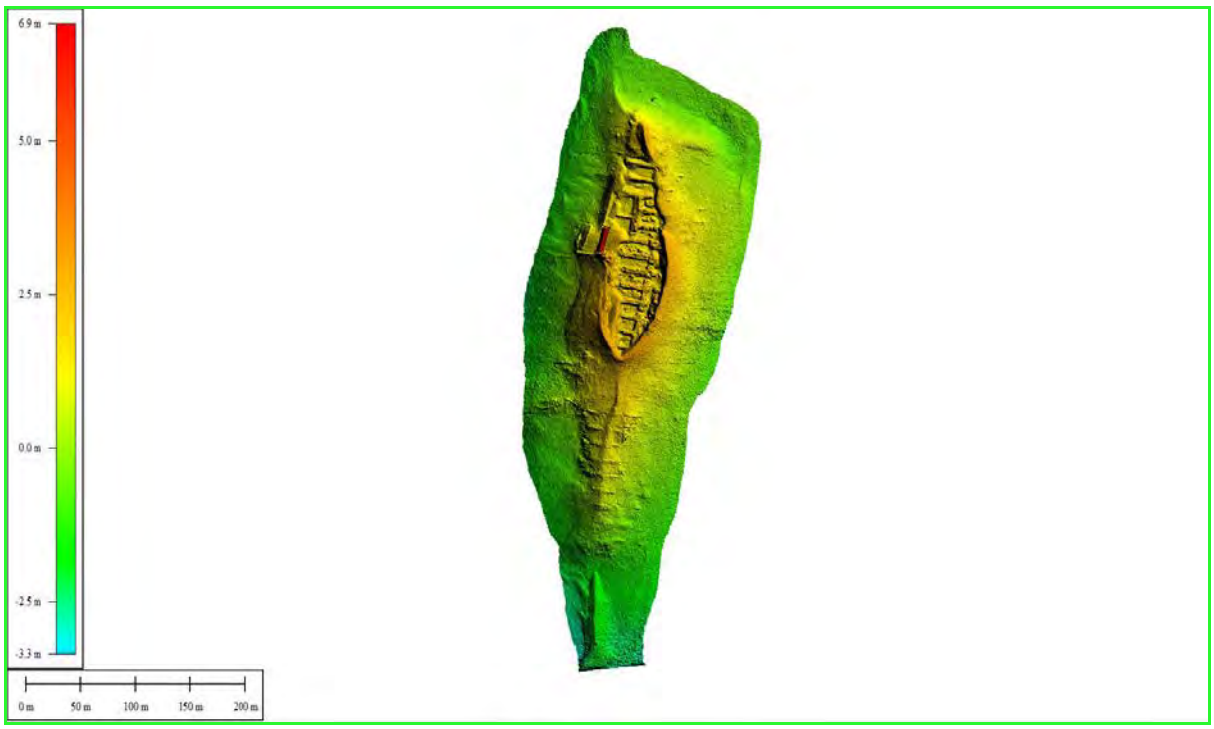

Figure 28. Digital surface model of Packing Marsh Island, collected in March 2014, showing heights of recharge above ODN (Jim Pullen).

Figure 29. Packing Marsh Island - 2015 distribution of EA recharge over foreshore south of the recharge ridge formed around the oyster pits. Eroded saltmarsh platforms are situated to seaward. This is the proposed deposition site for the new recharge. The photo also shows the remains of the brushwood fencing which was erected to retain the recharge (view towards southern tip of island).

5.3.2.4 Old Hall Point

The saltmarsh and existing recharge around Old Hall Point help to protect the ancient grazing marsh of Old Hall Marshes National Nature Reserve, most of which lies below sea level. The reserve is also part of the SSSI and SPA/Ramsar site. Inside the sea wall there are 287ha of unimproved grassland - representing the largest extent of this habitat remaining in Essex - 20ha of continuous reed bed, and 70ha of improved grassland, which supports up to half of the Blackwater estuary's internationally important wintering population of dark-bellied brent geese (RSPB, 2011). The grassland and ditch network support nationally important plants [one red data book (RDB) and 14 nationally scarce species] and invertebrates (17 RDB and 88 notable species).

In the 109 years from 1888 to 1997, the saltmarsh at Old Hall Point reduced in extent from 11.59ha to 8.96ha, exposing 2.6 ha of mudflat, and representing an annual average rate of saltmarsh loss of 241m (Figure 30). On the unprotected south shore, 1.61 ha of the marsh experienced losses at an average rate of 147m² per year during this period. A further 0.672 ha eroded between 1997 and 2014, with an annual rate of loss of width of between ½ m and 1 m.

Drying and shrinkage of the clay face of the exposed saltmarsh cliffs on the south shore, has led to the formation boulder and pebble-sized lumps of clay which eventually become dislodged by wave action (Figure 31). The new proposal would protect this eroding cliff face.

Figure 30. Shows the changing shoreline location at Old Hall Point over time and the current distribution of the recharge (2014) placed onto the eroded mudflats at the eastern quarters point and on the Tollesbury North Channel foreshore in 1998. (Jim Pullen. Source: esri satellite map & OS 1:50000 vector mapping.)

Figure 31. Unstable saltmarsh cliff face, Old Hall south. The new proposal would place recharge material to the lower shore to protect the eroding cliff face.

5.3.2.4i Impact of foreshore recharge deposited in 1995 (trial placement) and 1998

A trial recharge was undertaken by the National Rivers Authority in 1995 placing sand and gravel derived from Harwich Harbour maintenance dredgings, at Old Hall Point. By 1997 it was apparent that this material was being transported shoreward by hydrodynamic processes, and responding in the same way as naturally formed Chenier beaches in the Blackwater. On the basis of this evidence, and the behaviour of the experimental recharge placed at Cobmarsh Island, the EA obtained a larger volume of material from the Harwich Haven Approaches dredge to duplicate the trial placement. The dredgings were discharged in a mound, as before, to Old Hall Point.

Onshore waves and tidal currents have moved the recharge landward. The north-westward drift of the recharge along the north-eastern shore is influenced by an easterly wind over a strong flood tide. These conditions have carried the material 360 metres along the seaward edge of the marsh terminating in a recurve around the saltmarsh reinforcing protection of the eastern tip of the sea wall (refer to Figures 30 & 32). The recharge reached its current configuration between 1998 and 2005, giving an average annual rate of progress of 50m per year.

Recharge material continues to reinforce the Point and also offers protection to Cobmarsh Island from the impact of south-westerly gales.

Figure 32. North-western extent of recharge reinforcing protection of the eastern tip of the sea wall, Old Hall Point. Annual sea-blite (*Suaeda maritima*) is growing through the recharge, in places.

Where wind-blown sands have covered the existing vegetation, saltmarsh plants can continue to grow up through the finer layers. Figure 32 shows annual sea-blite (*Suaeda maritima*) on the landward aspect growing through the recharge. Otherwise, new growth develops on the crest and slopes where conditions are suitable.

Movement westwards from the Point is inhibited by strong prevailing south-westerlies combined with a strong ebb tide. Here, the recharge has extended just beyond the oyster pits (Figure 33) and some of the gravels have been washed into adjacent creeks.

Figure 33. South-western limit of recharge, Old Hall Point.

Rollover onto the saltmarsh has occurred along the full length of the recharge track covering around 2880 m² (0.28 ha) of saltmarsh. Shrubby sea-blite (*Suaeda vera*) has now established over an area of approximately 240m² (Figure 34).

Figure 34. Shrubby sea-blite (and linear-leaved orache, *Atriplex littloralis*) has established on the north-east recharge bank seaward of the retaining fence, with oyster pits behind (view SW). The fences have kept the recharge in check.

The recharge has formed a wide crest, currently maintaining a height of around +3m ODN (Figure 35), with a shallow seaward slope indicating a good dynamic equilibrium with the hydrodynamic forces acting upon it. Using aerial photographs to compare its present day spatial distribution over the marsh with that recorded in the Essex Estuaries saltmarsh change report, covering the period 2000 to 2008 (Thomson *et al*, 2011), there is no discernible change.

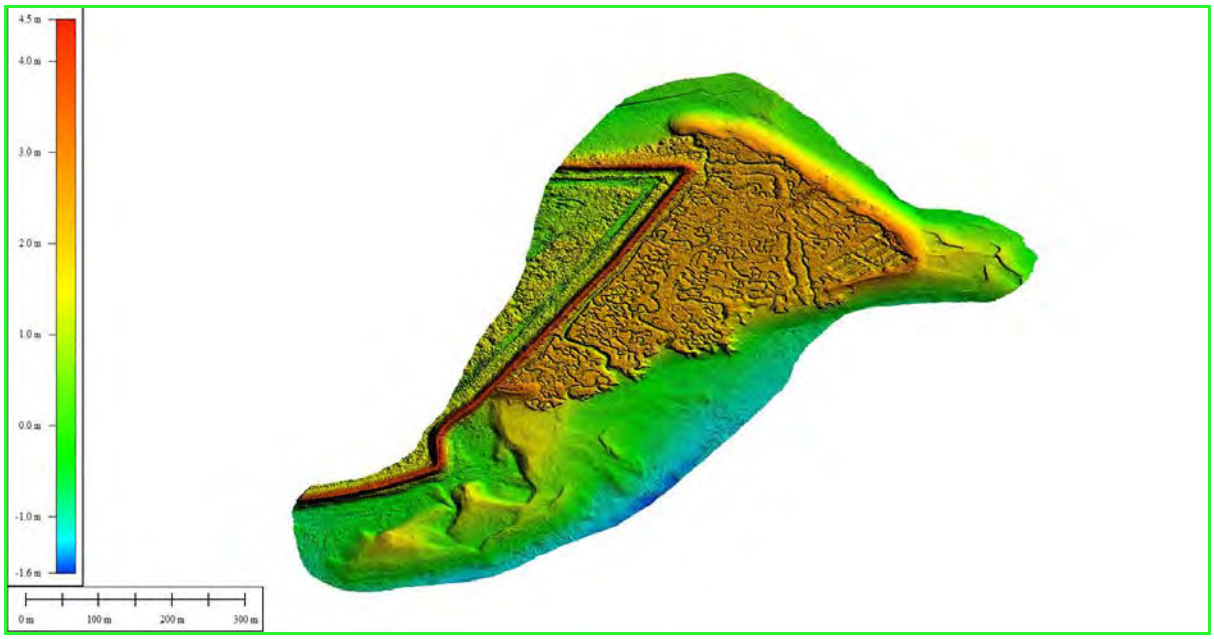

Figure 35. Digital surface model of Old Hall saltmarsh and foreshore, collected in March 2014**,** showing heights of recharge above ODN (Jim Pullen).

Sands and gravels were also deposited at the southern point of Old Hall Marshes (Tollesbury North Channel foreshore) in 1998 and these have mostly remained at the placement location, with limited movement shoreward and north-eastwards (refer to Figures 30 & 35). Saltmarsh coverage due to rollover here is 425m².

Internally, the saltmarsh at Old Hall Point is described as stable (Thomson et al, 2011) with no erosion or accretion recorded within the interior of the marsh between 2000 and 2008. This situation appears to have remained unchanged in 2014 with a short, tight sward of SM13 – *Puccinellia maritima* (saltmarsh grass) saltmarsh community with *Limonium vulgare* (sea lavender), *Atriplex portulacoides* (sea purslane) and *Salicornia* spp. covering much of the area.

The Environment Agency has programmed Old Hall Marshes grazing marsh for realignment in Epoch 3, which extends between 2055 and 2105 (3a 2055 – 2085; 3b 2085 – 2105; EA, 2010E). However, the complexities of mitigating for the loss of almost 400 ha of SPA freshwater habitat will keep this policy under review in future updates of the SMP with the potential to change to 'Hold the Line'.

5.3.2.5 Tollesbury Wick frontage

In 1999, sands and gravels were discharged along the southern shore of the Wick to protect Tollesbury Wick Marshes. This freshwater marshland covers 243 ha and is part of the Blackwater Estuary SSSI and SPA/Ramsar site and is owned and managed by the Essex Wildlife Trust. The entire stretch of saltmarsh along its frontage had been lost to erosion sometime between 1888 and 1997, exposing the sea wall to storm wave attack. The marshes and fleets regularly support around 1,000 brent geese, 1,500 wigeon and around 200 of the Annex 1 species, avocet, in winter (Smith, 2014). The grassland and ditch network are habitats for nationally important plants and invertebrates.

5.3.2.5i Impact of foreshore recharge deposited in 1999

The foreshore recharge delivered in 1999 was placed along a 730m stretch of foreshore at a distance of 150m from the base of the sea wall. The surveyor's drawing prepared during the placement campaign showed that the height at this time ranged from +2m ODN to +2.96m ODN at the south-west end (Figure 36).

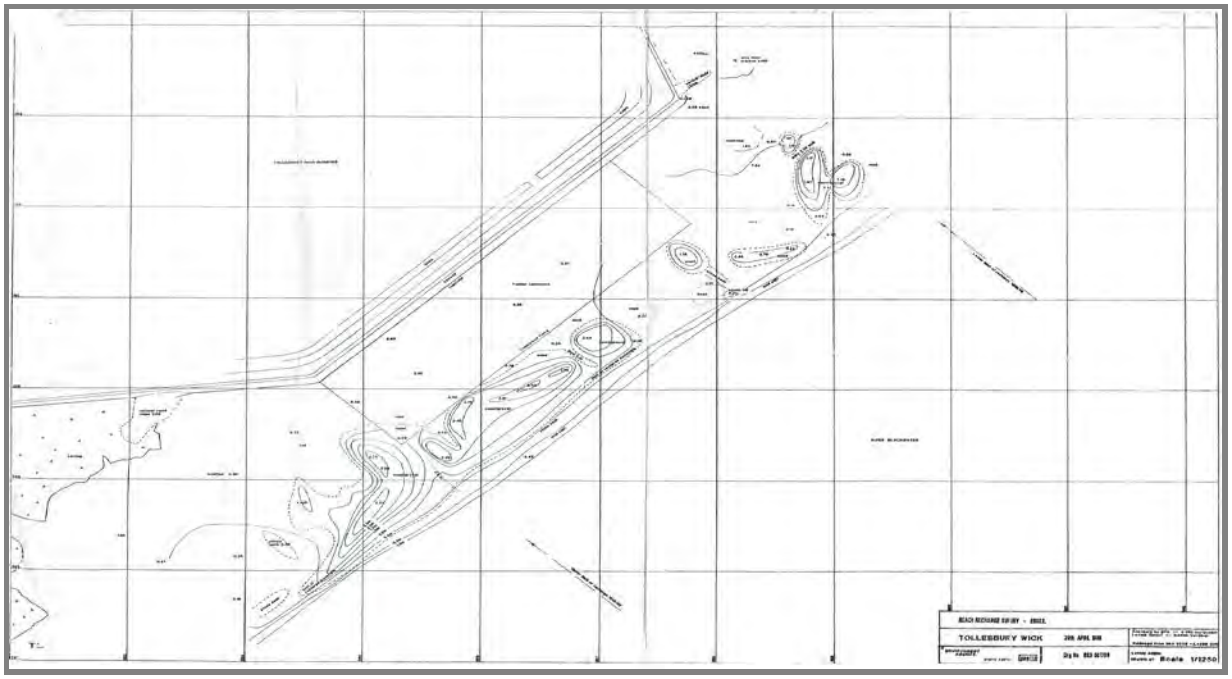

Figure 36. Survey drawing prepared during the Tollesbury Wick placement campaign indicates the levels of the recharge material (Source: Environment Agency, 1999. Surveyor: Bill Reed.)

The consolidated shingle bank configuration has effectively dissipated wave energy along this frontage over the last 17 years and has been fairly stable (Figure 37). There has been some slight shoreward movement and, although the ridge has extended marginally at the north-eastern end, stability in the linear plane has been maintained; any material moved upriver on the flood tide is returned by the stronger ebb current.

Figure 37. Indicates the shoreline along the Tollesbury Wick frontage in 1888 and compares the 2014 distribution of the recharge with the formation in 2001 following placement onto the eroded mudflats in 1999. Since 2001, though there has been some slight movement to landward, the material has remained relatively in situ. (Jim Pullen. Source: esri satellite map & OS 1:50000 vector mapping.)

The height has also remained fairly stable throughout this time withstanding the storm surge event in December 2013, described by the Environment Agency as the most serious coastal tidal surge for over 60 years. Figure 38 shows the 2014 levels above ODN.

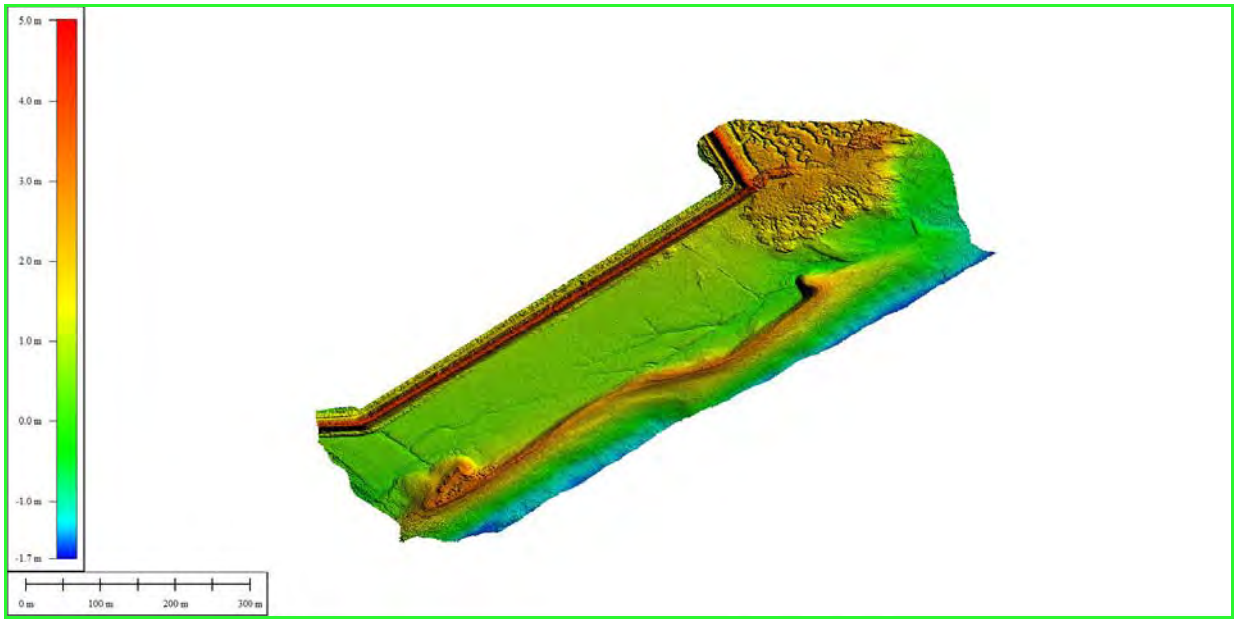

Figure 38. Digital surface model of Tollesbury Wick frontage, collected in March 2014, shows recharge heights above ODN (Jim Pullen).

The recharge spur, formed during placement at the south-western end of the foreshore, has achieved a maximum height of around HAT, at +3.4 ODN, averaging around +3m ODN, and it has retained its position (refer to Figures 36 & 38). The elevation and relative stability of the shingle bank at this location has favoured the development of an early successional driftline community, a nationally rare habitat type, which includes sea mayweed (*Tripleurospermum maritimum*), curled dock (*Rumex crispus*) and the nationally scarce yellow-horned poppy (*Glaucium flavum*) which is protected under the Wildlife and Countryside Act 1981 (as amended). In the depression behind the shingle ridge there is a transition to an intermediate grassland community. The vegetation here covers an area of approximately 350 square metres (Figure 39).

Figure 39. Vegetated shingle spur at the south-western end of the Tollesbury Wick recharge ridge (view north-east).

Silts have built up in the lee of the recharge bund at a rate of 66mm per year raising the height of the foreshore by 1 metre. Algae are developing over the surface muds and pioneer saltmarsh is establishing. This has stabilised the mud and will facilitate further growth of halophytic vegetation. Pioneer marsh is also colonising on the landward slope of the recharge, while the seaward face supports shrubby sea-blite (Figure 40).

Figure 40. Still images captured from video - show the development of pioneer saltmarsh vegetation on the inside face of the recharge and over the new mudflat, with shrubby sea-blite (*Suaeda vera*) on the seaward slope (to the right of the images). The new proposal will raise the recharge section shown in the lower image. (Jim Pullen.)

The saltmarsh south of Shinglehead Point is expanding seawards behind the north-eastern extent of the recharge with the development of *Spartina anglica* (common cord-grass (Figure 41) with *Atriplex portulacoides* (sea purslane) fronting the sea defence.

Figure 41. Ground and aerial views of common cord-grass (*Spartina anglica*) development behind the north-eastern limit of the protective recharge bund (view south-west). (Aerial photo: Jim Pullen.)

Around Shinglehead Point, the easterly point of the Wick, natural Chenier ridges are active over the saltmarsh diversifying the habitat (Figures 42 & 43).

Figure 42. Aerial flown in 2001 with the consolidated bund of the recharge in the foreground. The upper right of the photo shows a natural Chenier beach which has superimposed onto the saltmarsh margins at Shinglehead Point (source: Environment Agency). A close up of the south-western extent of the natural Chenier is shown in Figure 43 below.

Figure 43. A natural Chenier beach at Shinglehead Point has raised the level of the saltmarsh leading to diversification of the saltmarsh habitat. High saltmarsh species have colonised, including shrubby sea-blite (*Suaeda vera*) and *Atriplex portulacoides* (sea purslane). View north-west.

The sparsely vegetated sections of the recharge ridge have become important roost sites frequented by large flocks of oystercatcher and ringed plover (Figure 44).

Figure 44. North-eastern section of the recharge ridge supports a high tide roost and an occasional distribution of upper saltmarsh species.

The Environment Agency has programmed Tollesbury Wick Marshes for realignment in Epoch 3, ie between 2055 and 2105 (3a 2055 – 2085; 3b 2085 – 2105; EA, 2010E). However, the challenges associated with mitigating for the seawater flooding of this SPA freshwater habitat may lead to a review of this policy.

5.3.3 Intertidal mudflats and sandflats – marine communities

5.3.3.1 Introduction

Intertidal mudflats are a notified feature of the Blackwater Estuary Site of Special Scientific Interest and are a habitat 'of principal importance' listed under Section 41 (England) of the NERC Act (2006). 'Intertidal mudflats and sandflats' are an attribute of the Essex Estuaries Special Area of Conservation (SAC). Within the SAC this habitat covers an area of 17,598ha and the extent in the Blackwater is approximately 3,800ha (English Nature, 1998). The littoral sediment types range from: shingle, gravels, sand and mud and various combinations of these – muddy sand, sandy mud and mixed sediments. The distribution of sediment types and the marine communities they support can change in response to storm events with infauna being reduced or removed; they can alter naturally over time; and the exact location of sediment biotopes will shift, especially in dynamic environments (JNCC, 2004).

5.3.3.2 Intertidal survey

The English Nature Research Report (1998) on the Essex Estuaries marine habitats mapped the predominant biotope in the area of the proposed recharge placements as LMU.HedMac (*Hediste diversicolor* (ragworm) and *Macoma balthica* (Baltic tellin) in sandy mud shores. A recent survey commissioned by the Mersea Harbour Protection Trust showed that sandy muds prevail but with some variation in the foregoing community type (Appendices 6a & 6b). As the proposal sites are subject to storm wave action they do not form clearly definable biotopes; key species were not well represented in the survey and the assignment of the biotope was often based on the presence of two or three characterising species. Over the entire survey area the distribution pattern of the biotopes was similar, with species-poor communities on the upper shore and polychaete and bivalve communities on the mid to lower shore. At Cobmarsh Marsh Island the lower shore between the central and eastern transects had a covering of pebbles, supporting barnacles and periwinkles, with some evidence of blue mussel. With the exception of these boulder-type biotopes, the species complement was similar across the sites with variable diversity and abundance. The number of taxa in the core samples ranged from 0 to 20, with between 0 and 2029 individuals. The most abundant species was the marine snail *Peringia ulva*e, with the non-native barnacle, *Austrominius modestus*, the second most numerous.

5.3.3.2i Cobmarsh Island – (Figure 45)

The strandline at Cobmarsh was characterised by Talitrids (sandhopppers) and below this, across all transects, a species-poor community of oligochaete worms occurred (LS.LSa.MoSa.Ol) on this exposed, sandy upper shore. Wave energy in this area is causing considerable damage to saltmarsh and the adjacent foreshore was covered with lumps of clay cleaved from the saltmarsh cliff. On the mid to lower shore fine to medium sands cover silty clay and supported an often low population of marine worms, with marine snails and bivalves in greater abundance. This community was assigned to the biotope LS.LMu.MEst.NhomMacStr. The low shore, at the western end of the study area supported reasonable numbers of polychaete worms, including ragworms (Nereididae), and the sea slug, *Alderia modesta*, associated with the flood zone of saltmarshes. The findings most closely matched the classification, LS.LMu.MEst.HedMacScr. To the east, the littoral muds, dominated by marine worms and bivalves, transition into the lower eulittoral zone where pebbles and cobbles, colonised by the invasive barnacle, *Austrominius modestus*, and

periwinkles (*Littorina saxatilis*), overlie the flats (LR.FLR.Eph.BLitX). There is evidence of blue mussel beds, *Mytilus edulis* (LS.LBR.LMus.Myt.Sa) associated with this community.

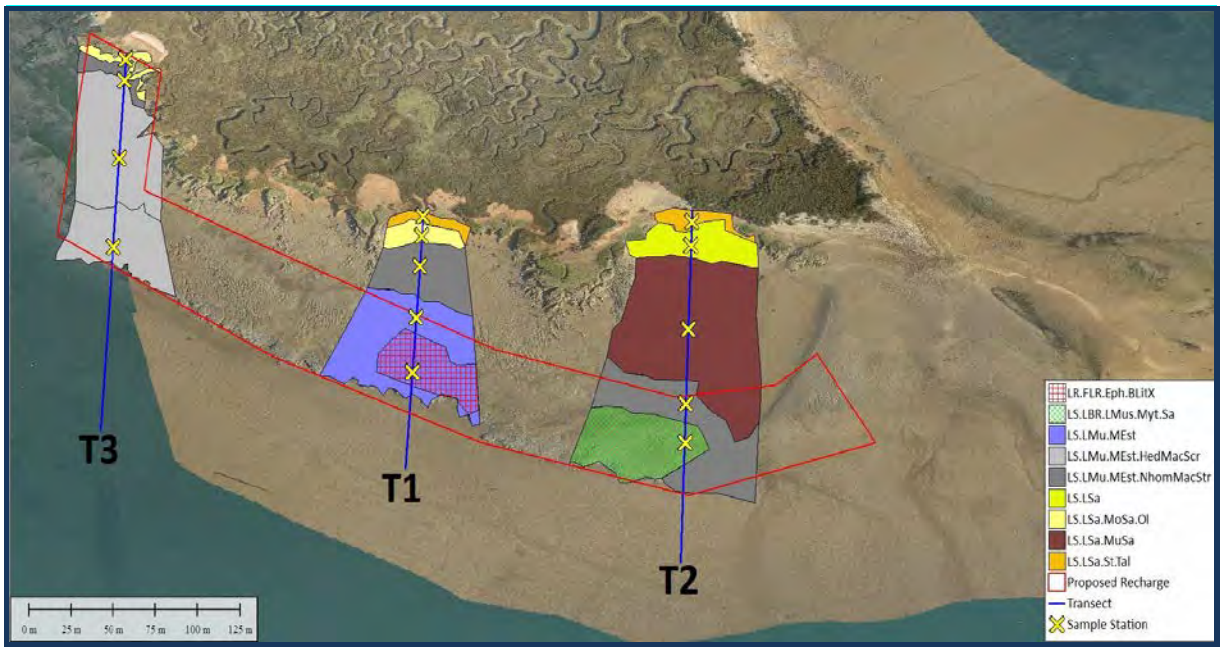

Figure 45. Cobmarsh Island – marine biotope distribution over the proposed recharge area and upper shore.

5.3.3.2ii Packing Marsh Island – (Figure 46)

On the Packing Marsh foreshore, the recharge from the earlier campaign has travelled shoreward from the southern point and now supports a strandline community LS. LSa.St.Tal. This is surrounded by abraded platforms of former saltmarsh.

Figure 46. Packing Marsh Island – biotope and habitat description within the proposed recharge footprint.

5.3.3.2iii Old Hall south – (Figure 47).

The eastern upper shore area was characterised by anoxic silty clay, covered by coarse sands and gravel likely to have been mobilised westwards from the present recharge. The infauna in this community, LS.LMu.UEst.Tben, was impoverished and likely to be influenced by the salt/freshwater drainage from a saltmarsh creek. Samples obtained below this were extremely poor and anoxic.

The mid-shore at Old Hall supported the biotope LS.LMu.MEst.NhomMacStr where sands, likely to have been swept from the previous recharge, cover the sticky silt/clays. A variety of oligochaete and polychaete worms were represented, along with marine snails and bivalves. Further down the shore, where ragworm (Nereididae) were found in the sample, the biotope LS.LMu.UEst.Hed.Str was described, and, where bivalves were present on the more exposed foreshore to the west, LS.LMu.MEst.HedMacScr was assigned.

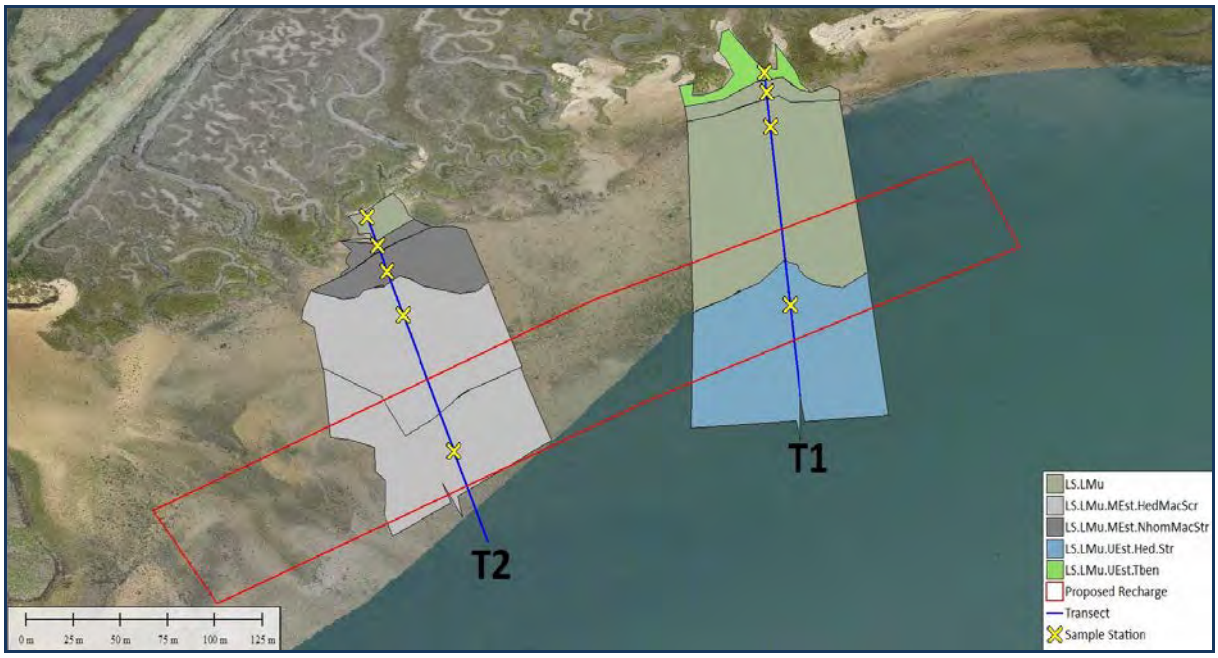

Figure 47. Old Hall south – marine biotope distribution over the proposed recharge area and upper shore.

5.3.3.2iv Tollesbury Wick – (Figure 48)

The upper shore is ascribed the biotope LS.LMu.UEst.Hed.Ol with ragworm ((Nereididae) and the oligochaete sludge worm. Species abundance was low, with marine snails making up the largest population. The mid-shore sample contained polychaete worms and bivalves associated with LS.LMu.MEst.NhomMacStr.

Figure 48. Tollesbury Wick - marine biotope distribution over the proposed new recharge area and upper shore.

5.3.4 Intertidal mixed sediment - Marine Conservation Zone feature

5.3.4.1 Introduction

Intertidal mixed sediment is a feature of the Blackwater, Crouch, Roach and Colne Marine Conservation Zone (2013). The management approach for this feature is to maintain it in favourable condition. It is an integral part of the EU Habitats Directive Annex I habitat 'mudflats and sandflats not covered by sea water at low tide' which is a designated feature within the Essex Estuaries Special Area of Conservation (JNCC, 2016). It is listed as a UK BAP (Biodiversity Action Plan) priority habitat (2008) as 'sheltered muddy gravels', a sub-feature of the broader habitat type 'Littoral Sediment'. It equates to the EUNIS (European Nature Information System, 2015) habitat description 'Littoral Mixed Sediments'.

The marine biotope classifications for this foreshore type are:

- LS.LMx - Littoral mixed sediment
- LS.LMx.GvMu - *Hediste diversicolor* (ragworm) dominated gravelly sandy mud shores
- LS.LMx.Mx - Species-rich mixed sediment shores
- LS.LMx.Mx.CirCer - Cirratulids (sedentary polychaetes - 'fringe' worms) and *Cerastoderma edule* (common cockle) in littoral mixed sediment

5.3.4.2 Distribution in the Blackwater Estuary

In the Blackwater estuary the majority of the known distribution of intertidal mixed sediment occurs in the mid to upper reaches of the estuary. It has also been recorded in the estuary mouth at the western end of Mersea Island. Specific sites are as follows (APEM & MESL, 2013, PMSL, 2013; Discretionary Advice Service, Natural England, 2015), referring to Figure 49:

- Mid to lower shore in the upper reaches – Decoy Point, Heybridge Basin
- North-west Ramsey, Ramsey Island, St Lawrence
- Mid-shore east of Osea Island, east of Gore saltings
- Western end of Mersea Island, below the Monkey Beach

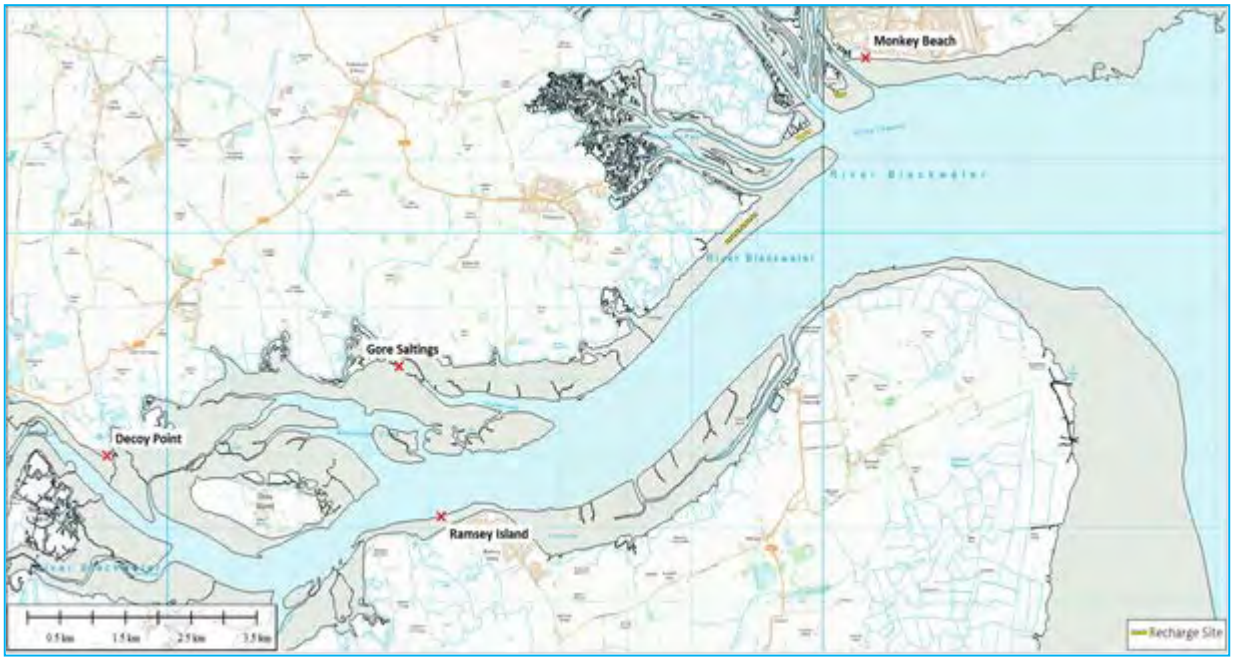

Figure 49. Locations of 'intertidal mixed sediment' recorded in the Blackwater Estuary (APEM & MESL, 2013; PMSL, 2013).

The EUNIS (2015) habitat classification acknowledges there are likely to be broad transitions from mudflat/sandy mudflats into mixed sediment biotopes, where the predominantly muddy sediments may contain significant amounts of gravel and sand. Gravelly mud may also have a patchy distribution on mudflats. In addition, stable large cobbles or boulders, more commonly found on rocky and boulder shores, may be present which support epibiota such as fucoids and green seaweeds. In the survey of the intertidal flats within and adjacent to the recharge proposal sites undertaken for this assessment (Appendix 6a), none of the samples obtained corresponded with the infaunal biotope descriptions for muddy gravels. The composition of the sediment cores taken in the study areas generally consisted of 'sandy mud' (Appendix 6b). However, frequently there were pebbles scattered over the foreshore or there were areas where gravel or shingle was well represented in the surface

sediments, arising from outwash gravels or former recharge deposits. Particle size analysis described 'gravelly muddy sand' or 'muddy sandy gravel' at four of the sample sites (Appendix 6b), which superficially suggests 'intertidal mixed sediment' but there was little or no mixing of material below the surface and analysis did not reveal the predominant infauna associated with this habitat description.

5.3.5 Native oyster (*Ostrea edulis*) and native oyster beds - Marine Conservation Zone features

5.3.5.1 Introduction

The native oyster is a Species of Principal Importance for the purpose of conserving biodiversity under the Natural Environment and Rural Communities Act 2006 and is included in the OSPAR (Oslo/Paris Convention for the Protection of the Marine Environment of the North-East Atlantic) List of Threatened and/or Declining Species and Habitats (Region II - Greater North Sea and Region III - Celtic Sea; JNCC, 2014). Both the native oyster species and the native oyster beds are features of conservation interest within the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ), the largest inshore MCZ (Natural England, 2015) and recognised as the most important area in the south-east for both cultivated and wild native oysters (Wiggins, 2014).

Native oysters are recognised as a keystone species because they exert significant impacts on other species in their environment (Coen et al, 1998). They filter water, suppress organic matter and phytoplankton, and they play an important role in nutrient dynamics. They are also an important food source for birds and crabs. Several marine species, such as sea snails, crabs and sea urchins inhabit oyster beds, while others, such as juvenile fish, use them for shelter. Live oysters and clumps of dead shells can support large numbers of organisms that attach themselves to the shell surface, such as ascidians (sea squirts), filter-feeding marine worms and seaweed turfs (JNCC, 2015), as well as young oysters (Haelters, 2009).

5.3.5.2 Status of the native oyster in the MCZ

The management objective for the native oyster in the MCZ is to recover a declining population to favourable condition (Natural England, 2013). Natural England's conservation advice for the native oyster features of the MCZ does not apply to oysters cultivated in private grounds (Natural England, 2015).

5.3.5.2i Kent and Essex Inshore Fisheries and Conservation Authority (K & E IFCA) survey

A recent survey conducted by the Kent and Essex Inshore Fisheries and Conservation Authority (K & E IFCA) in August 2014 (Wiggins, 2014) has established the distribution and abundance of native oysters in the subtidal area of the MCZ. The survey was confined to the public grounds as access to private fisheries, including the Tollesbury & Mersea several order and smaller private grounds, was not obtained.

Subdividing the survey area into a grid pattern, a standard oyster dredge was towed 100 metres over each rectangle in the grid and the dredge content was measured and recorded. The results showed a distribution in the most highly populated areas of less than one native oyster per square metre. In total, 235 samples were retrieved and the total native stock biomass was estimated to be 58 tonnes over the 160km² survey grid. This result confirmed earlier findings that areas that had once held sizeable populations of oysters now support low population levels (Figure 50).

Native oyster populations were recorded in the inner Blackwater, off Mersea shore, the Ray Channel, and the Crouch and Roach, with the highest concentrations located in the inner Blackwater and the entrance to the Crouch. The grid squares where natives were found are indicated on the map (Figure 50).

The survey also reported significant quantities of the non-native pacific rock oyster (*Crassostrea gigas*) and extensive populations of the non-native slipper limpet (*Crepidula fornicata*) in some areas. The estimated biomass of these species was 138 tonnes and 1330 tonnes, respectively.

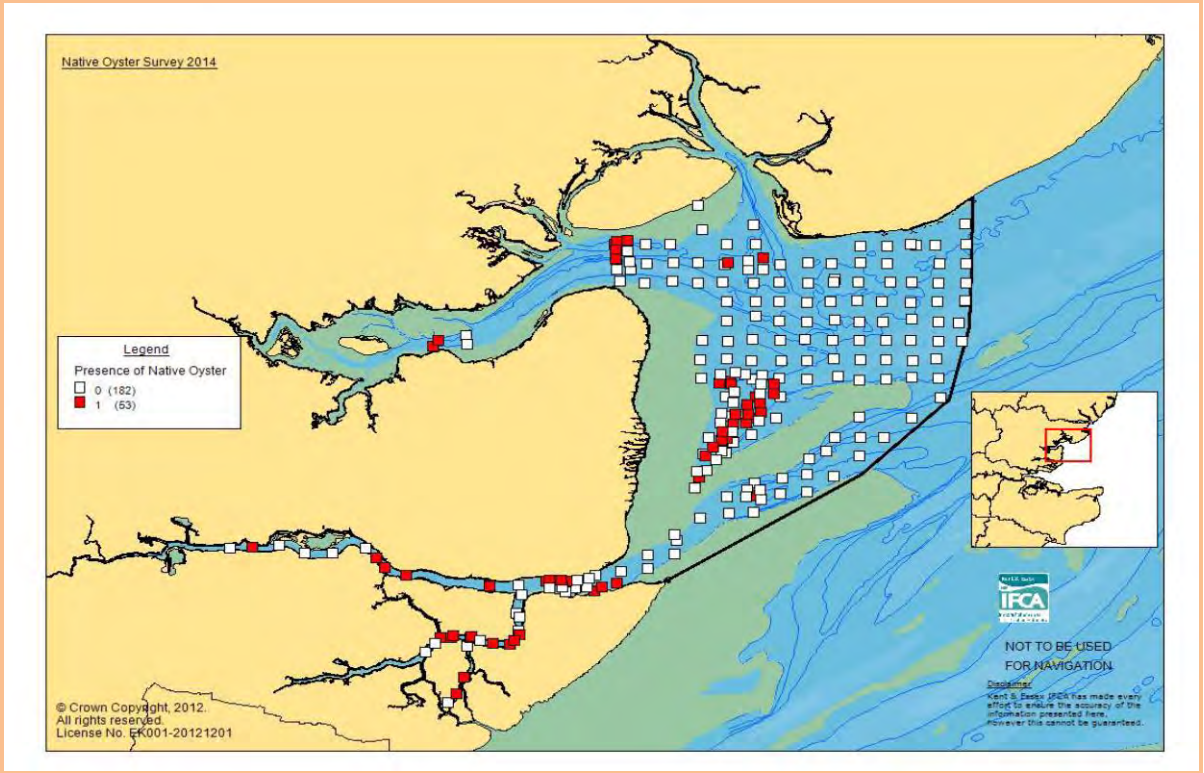

Figure 50. Map showing the presence of native oysters within the Kent and Essex IFCA survey area, excluding private grounds (reproduced with kind permission of the Kent and Essex IFCA).

5.3.5.2ii Essex Wildlife Trust (EWT) and Blackwater Oystermen's Association (BOA) survey

A representative survey of the MCZ was carried out jointly by the Essex Wildlife Trust and the Blackwater Oystermen's Association over both the private and public oyster grounds (EWT & BOA, 2012). The survey sought to identify the abundance, distribution and age class of native oysters to support the designation the MCZ. Four hundred and twenty 200m² grids were sampled by towing a standard 1m wide dredge over 100m of sea bed; the dredge

was fitted with a fine gauge (45mm) survey mesh designed to capture a range of age classes. The results clearly indicated a severe decline in the overall abundance and distribution of the native oyster and a reduction in the extent of oyster beds in the sample area (Figure 51). The survey report concluded that recovery of the population would be extremely unlikely without intervention, due to a severe lack of recruitment - the number of oysters in younger year classes was too low to provide future brood stock.

The information obtained from the K & E IFCA and the EWT/BOA surveys has been used to inform management measures and has led to a fixed-term closure of the public fishery under an emergency by-law. Work is currently progressing through the Essex Native Oyster Restoration Initiative - a partnership comprising the marine regulators, the oyster industry and conservation bodies, including EWT, to undertake stock restoration to reverse the decline (EWT, 2016).

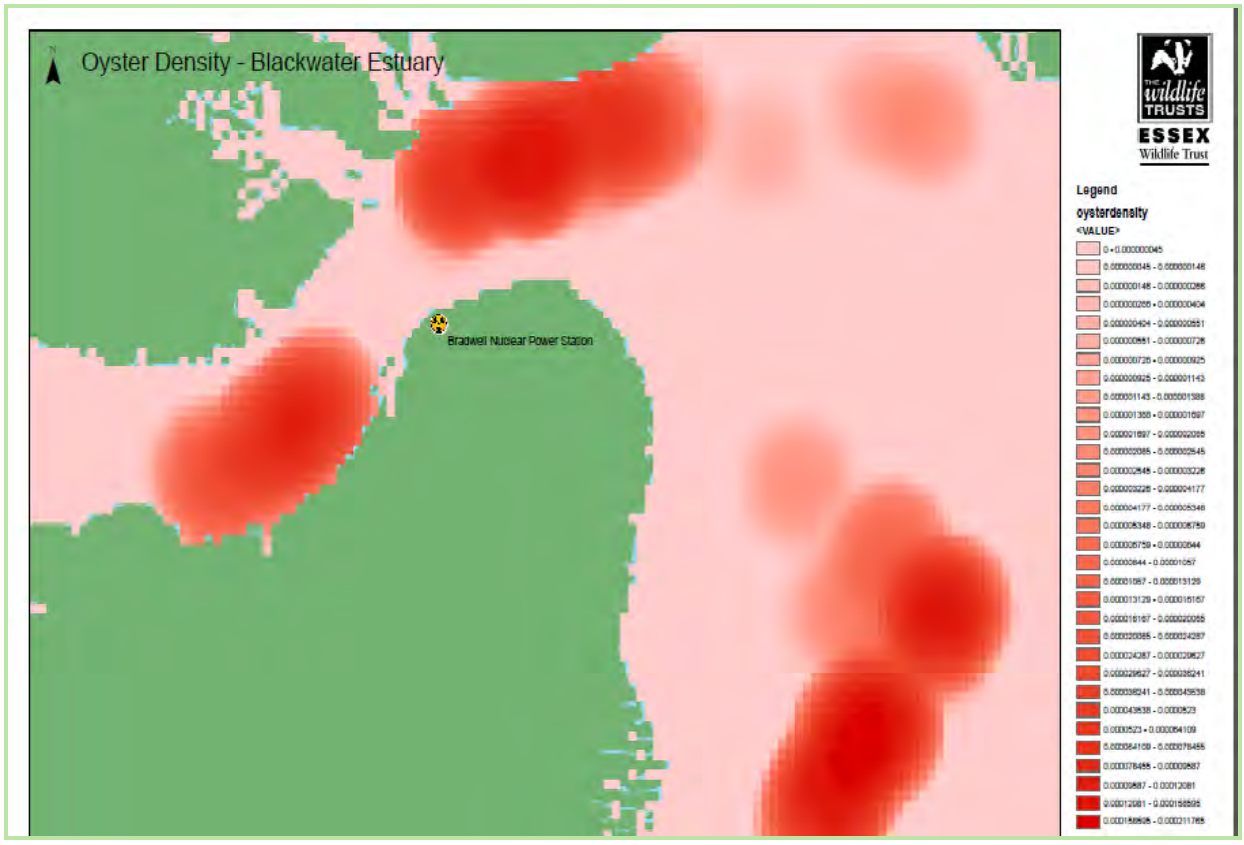

Figure 51. 'Heat' map indicates areas with the highest density of oysters in both the private and public grounds (reproduced with kind permission of the Essex Wildlife Trust and the Blackwater Oystermen's Association).

5.3.5.3 Threats to native oysters

Recruitment in the native oyster population is sporadic and subject to high larval and juvenile mortality. Settlement requires the presence of suitable substratum, particularly adult shells (cultch) - for which there is intraspecific competition between native oysters and competition with the non-native slipper limpet (*Crepidula fornicata*; Kennedy & Roberts, 1999). Oysters are susceptible to the disease Bonamiosis, spread by the parasitic protozoan, *Bonamia ostreae*, and juvenile oysters are preyed upon by the introduced American oyster drill (*Urosalpinx cinerea*). Historically, fishing effort led to over-exploitation, and declines were also attributable to cold winters and contamination with tributyltin (TBT).

5.3.5.4 Impacts of hydrodynamic and sediment regime

The hydrodynamic and sediment regime can impact both oyster growth and recruitment. The Blackwater Estuary is a dynamic environment with high levels of sediment in suspension. Suspended sediment concentrations in the Essex Estuaries typically range between 100 and 1000mg/l with higher levels experienced in the winter (Essex Estuaries CHaMP, 2002). Monitoring carried out by the Environment Agency (refer to Section 5.2.1) suggests that the waters around the Mersea Quarters area are, on average, of intermediate turbidity but experience a wide range of turbidities depending on ambient conditions. Levels of suspended solid concentrations have been shown to reach exceptionally high levels in the Salcott Channel and downstream to the Mersea Quarters (between the Quarter's spit – Old Hall Point – and Cob Marsh Island). In autumn 2000, HR Wallingford measured ongoing changes in suspended sediment levels at these locations, at all states of the tidal cycle, as part of the pre-monitoring programme for the Abbotts Hall realignment. Recordings taken in situ over one-minute periods every 10 minutes, between 0.1m and 0.5m above bed level, were found to range between 0 and 6,000mg/l (HR Wallingford, 2001). This maximum value was attributed to high rainfall and freshwater flow conditions. At the head of the Blackwater at Maldon, typical spring tide values of 50mg/l were recorded with occasional peaks between 100 and 150mg/l, while at Brightlingsea, on the Colne estuary, concentrations were always below 100mg/l. The Blackwater Management Plan draft (EWT & BOA, 2015) states that '*during periods of bad weather…the silt load will increase to a level sufficient to interfere with the normal functioning of adult oysters…*'

Oysters react to a rise in suspended sediment by increasing the production of pseudofaeces, to expel accumulated silt, expending valuable energy resources in the process. At the same time, filtration rates are reduced by higher levels of silt in suspension (Korringa, 1952; Hutchinson & Hawkins, 1992). Moore (1977) demonstrated that native oyster larvae survived seven day's exposure to up to 4,000 mg/l silt with little mortality. However, their growth was impaired at 750 mg/l and above. In adult oysters, reduced growth rate and shell thickening was observed. Despite this outcome, no serious impact on the normal functioning of native oysters was concluded as a result of occasional elevations of suspended sediment (Laing et al, 2005), leading to a low sensitivity rating (Jackson and Wilding, 2009).

As sessile organisms permanently fixed to the substrate, oysters are unable to migrate upwards through deposited silts to escape the impact. Small increases in sediment deposition have been found to reduce growth rates (Grant et al., 1990) and depths of 1-2mm have been reported to restrict recruitment of larvae (Galtsoff, 1964 cited in Wilbur, 1971) as shells become unsuitable for spat collection - impacts which could lead to longer-term effects on the population. Smothering by 5 cm of sediment will impede water flow through the gills and mantle preventing respiration, and will restrict filter-feeding and the removal of wastewater (Jackson & Wilding, 2009).

With a slow recoverability from smothering (Spärck 1951, in Jackson 2001) it is important to clean the cultch of deposited sediment. Historically, the cultivated native oysters in the Blackwater have fared better than those of the Colne, Crouch or Roach under the management of the Blackwater oystermen who undertake the cleaning of cultch to promote recruitment and the progression of year classes. However, on sites where there are tidal current flows of 1–2 knots (50-100 cm/sec) these impacts are likely to be averted (Laing et al, 2005).

A long-term increase in turbidity could reduce food availability to native oysters due to a decrease in primary production by phytoplankton. However, on return to normal levels, a rapid recovery in condition would be expected (Jackson & Wilding, 2009). Laing et al (2005)

concluded that relatively high levels of suspended sediment over short periods will probably only result in sub-lethal effects.

In processing large volumes of water during filter feeding, oysters are also exposed to sediment-bound contaminants, as well as water soluble contaminants, in the water column. These substances can bioaccumulate within the body tissue and could impact growth and result in mortalities.

5.3.6 Breeding birds

5.3.6.1 Little tern

5.3.6.1i Breeding status of little tern in the Mersea Quarters and Tollesbury Wick pre1990s recharge placement

A qualifying feature of the Blackwater Estuary Special Protection Area is the internationally important breeding population of little tern (*Sterna albifrons*), classified as a vulnerable species under Annex 1 of the European Birds Directive. Little Terns are listed in Schedule 1.1 of the Wildlife and Countryside Act 1981 (amended by the Countryside and Rights of Way Act 2000) and receive an amber rating in the UK Birds of Conservation Concern 4 (Eaton et al, 2015). Habitat loss, human disturbance and predation at nest sites have been cited as the reasons for the national decline in population since the 1990s (RSPB, 2013). Breeding colonies, already vulnerable to tidal flooding, will be more at risk in the future as sea level rises.

The islands and shingle spits in the Mersea Quarters have been used erratically by nesting little terns since at least the early 1950s (Woods, 2007). In 1986, the Essex Bird Report recorded a disastrous breeding season for little tern in Essex, with further poor breeding success in subsequent years reaching an all-time low of 67 breeding pairs in the county in 1990. Numbers began to pick up countywide in the early 1990s and this is reflected in the records for the Mersea Quarters, with 30 pairs nesting in 1993, 15 pairs at Packing Marsh Island in 1994, and 30 pairs counted on Cobmarsh Island in 1997 (Essex Bird Reports; RSPB, 2012). It has been suggested that little terns abandoned these sites in the late 1990s, due to an increasing population of breeding herring gull, and that these displaced birds may have colonised the trial recharge at Pewet Island, on the south side of the estuary near Bradwell (Charlton, 2003). Little tern first nested on Pewet Island in 1993 following the placement of a small volume of sand and gravel recharge at the south-western tip of the island in December 1992. With a further recharge in 1995, numbers continued to build and in 2001 a peak count of 130 pairs was recorded. Subsequent years have shown a decline in nesting pairs which may be attributable to interspecific competition with expanding breeding populations of herring gull, black-headed gull and common tern. Changes in the recharge profile over time and the establishment of saltmarsh vegetation, are also likely to be contributory factors in deterring little tern from nesting, while creating suitable nesting conditions for other species (Reid, 2015). Competition for the same breeding resource has also been noted in the south of the county, on the Maplin Bank; Essex Bird Report recorders noted that the larger terns - sandwich and common - had outcompeted little terns for nesting territory. On the Kent coast, larger gulls are considered a real threat to the productivity and survival of terneries of the common tern (Yates).

At Tollesbury Wick, the natural Chenier spit at Shinglehead Point - at the mouth of the Tollesbury south channel – supported seven successful breeding pairs of little tern between 1996 and 1999, however 17 nest failures occurred during this period (Figure 52). In 1999, when 14 out of 15 little tern nests failed, seven pairs of common terns bred.

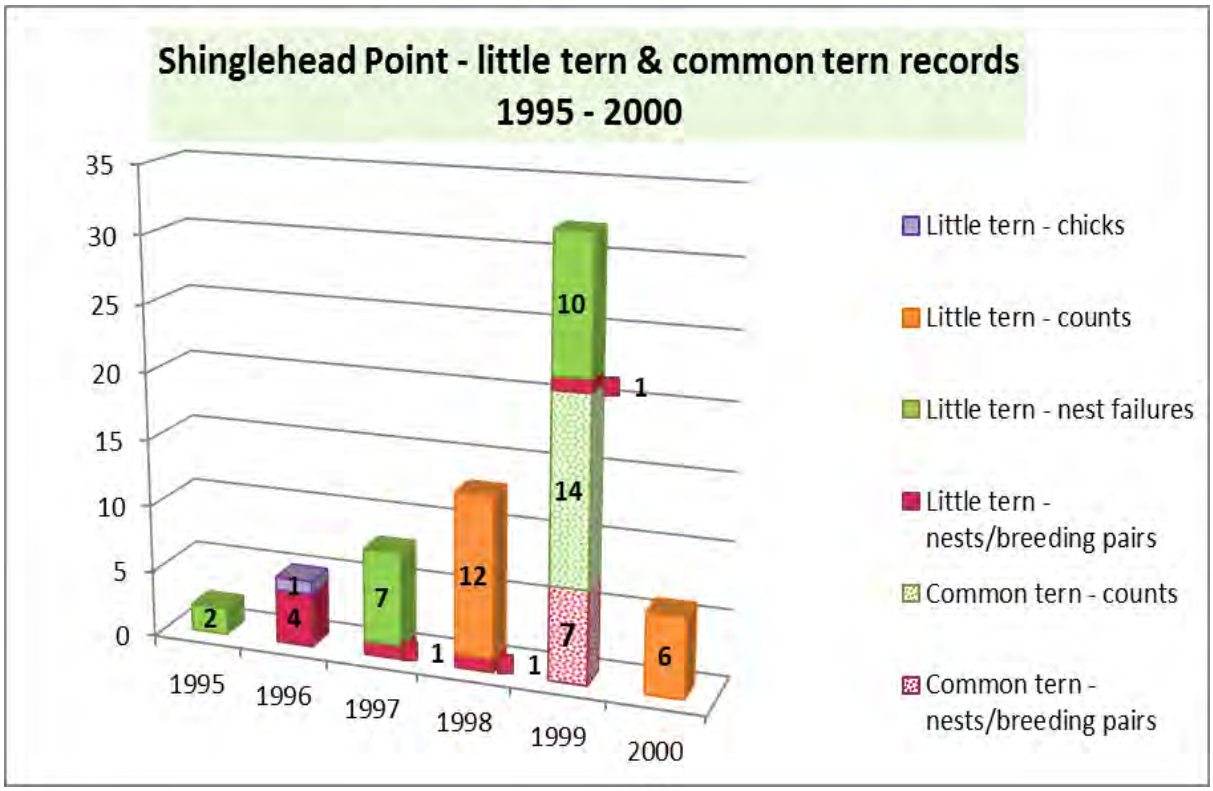

Figure 52. Little tern and common tern breeding records for Shinglehead Point (produced from raw data supplied by Smith, 2014).

5.3.6.1ii Breeding status of little tern in the Mersea Quarters and Tollesbury Wick post 1990s recharge placement

The recharge at Old Hall Point and Tollesbury Wick has supported breeding pairs of little tern over several seasons. Following the second recharge placement at Old Hall Point, in 1998, nesting was recorded for the first time since 1993, when two pairs nested on the recharge in 2002 (RSPB, 2011). This was repeated in 2003, and between 2007 and 2010 the number of breeding pairs ranged from 4 to 11 (Figure 53). Numbers fell subsequently but in 2016, following the placement of five decoys by the RSPB as part of the Little Tern Recovery Project (RSPB, 2016), two pairs nested and have successfully raised 3 chicks (Gareth Brookfield, RSPB, pers comm).

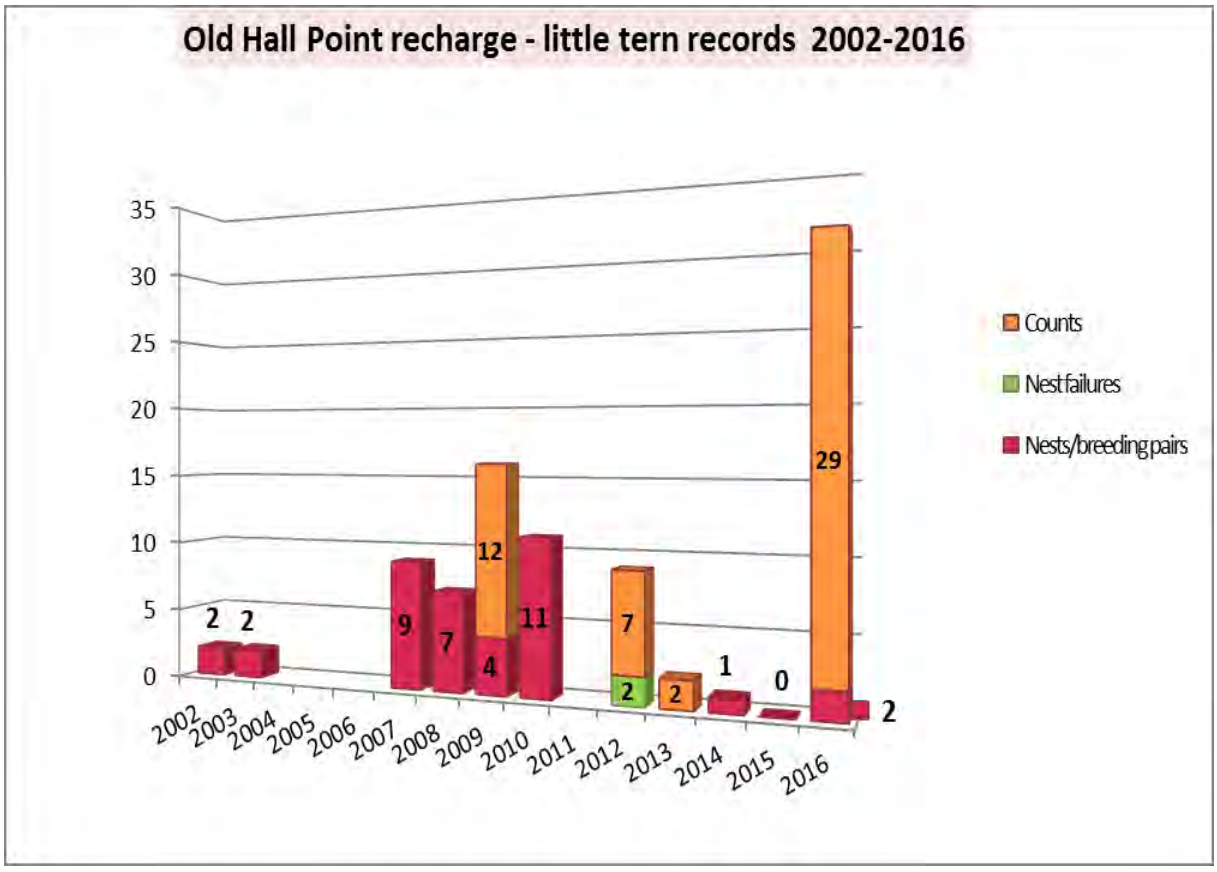

Figure 53. Little tern counts, breeding pairs and nest failures 2002 to 2014, Old Hall Point recharge (produced from raw data supplied by Natural England and RSPB - RSPB, 2009; 2011-2013; 2012 and Gareth Brookfield, RSPB, pers comm 2015, 2016).

Little tern first colonised the new shingle bar at Tollesbury Wick in 2001. Two consecutive peak breeding years occurred in 2005 and 2006 when 55 young were fledged from 60 pairs (Smith, 2014; Figure 54).

Common tern (*Sterna hirundo*) also had breeding success at this time, with a total of 32 young raised. Little terns have been sighted in the recharge area subsequently with eight pairs nesting unsuccessfully, in 2012, at the unvegetated north-eastern end of the recharge (RSPB, 2012). The spread of maritime grasses and drift-line vegetation has stabilised the south-western spur of the recharge and much of this area is now unsuitable habitat for nesting little tern.

Two nesting failures were recorded in 2016 on Cobmarsh Island (Gareth Brookfield, RSPB, pers comm). These failed attempts could be due to the nests being washed out or predation by herring gulls.

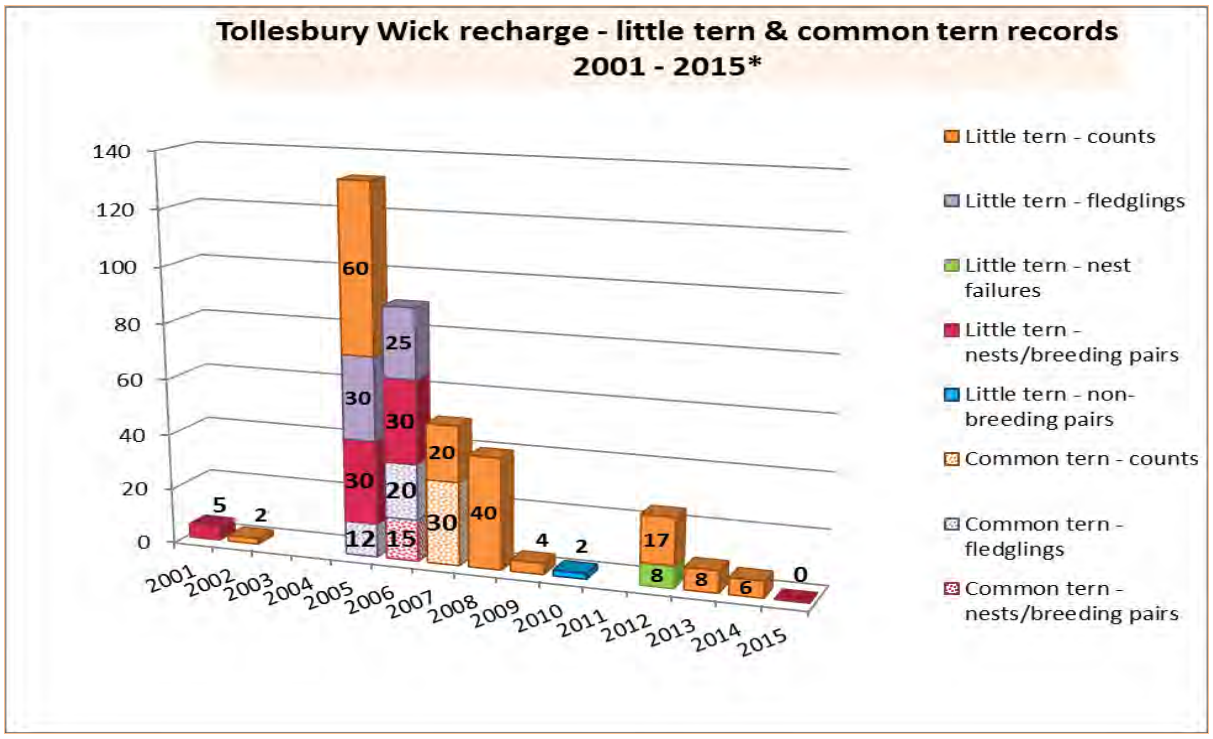

Figure 54. Little tern breeding records, Tollesbury Wick recharge (from raw data supplied by Smith, 2014; *pers comm RSPB, 2015). (**Note:** In 2007 & 2008 failure to nest possibly due to fox visit. In 2012 suspect nests washed out by unusually high tides. 5 - 6 pairs of common tern were noted at the south-western end of the recharge (RSPB, 2012) which has vegetated over, particularly on the crest and inside the recharge 'spur.')

The figures combined for the Tollesbury Wick and Old Hall recharge sites clearly indicate the downward trend in the population in the Mersea Quarters (Figure 55).

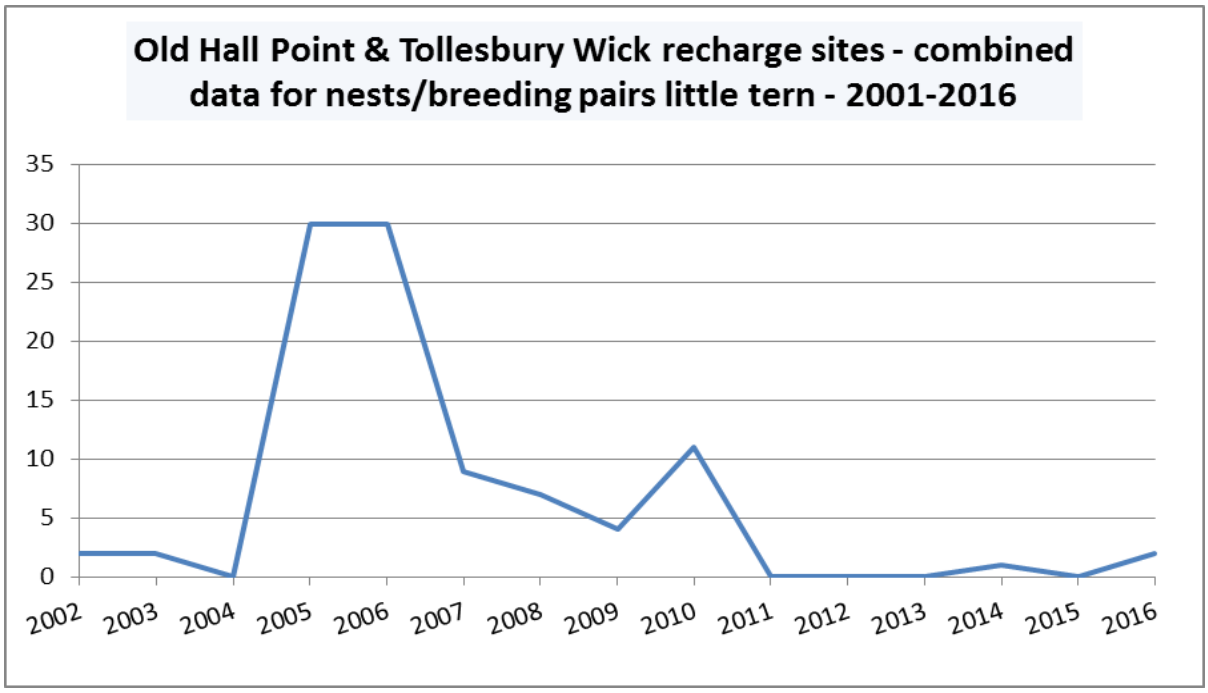

Figure 55. Little tern breeding population trend on recharge in the proposal area - combined results for Old Hall Point and Tollesbury Wick.

5.3.6.1iii Evaluation of 1990s recharge on the breeding status of little tern

The sand and gravel recharge placed in the Mersea Harbour area in the 1990s has been critical to sustaining the breeding population of little tern in the Blackwater estuary in recent years, particularly following the colonisation by herring gulls at the traditional nesting sites of Packing Marsh and Cobmarsh Islands (Charlton, 2003) .

The recharge in the Mersea Quarters and Tollesbury Wick has made available approximately 1.9ha of unvegetated shingle above bird tides (based on digital surface model data collected in March 2014).

The downward trend in breeding numbers at Old Hall and Tollesbury Wick could be partly due to local factors. Reprofiling of the recharge at Old Hall Point, due to natural processes, perhaps presents a less suitable habitat for nesting little tern, although the decoys placed in 2016 resulted in breeding success (refer to Section 5.3.6.1ii). At Tollesbury Wick, vegetation growth at the south-western end of the recharge bund may have rendered the site unsuitable for little tern nesting. Birds attempting to nest at the north-eastern end may potentially be more vulnerable to predation as this area is more accessible to land predators. Exceptionally high tides may also have influenced breeding success.

Nationally, productivity has reduced and this could also be impacting numbers locally. The Seabird Monitoring Programme has studied trends in productivity of English little tern colonies over the last 27 years and found these to be fairly low and likely to be contributing to a decline in abundance. Recent breeding seasons at monitored sites (2012 and 2013) have reported no breeding terns at 16% of locations and complete failure at around half of the sites (JNCC, 2013). Where colonies were successful, most fledged under 0.50 chicks per pair. High tides, poor weather, disturbance, and predation of eggs, chicks and adults by mammals, reptiles and birds, were factors leading to failure.

5.3.6.2 Breeding status of other bird species using existing recharge sites and saltmarsh protected by recharge

Other species of conservation concern have benefitted from the provision of the recharge as a nesting habitat, though herring gull nesting may have been to the detriment of little tern at Packing Marsh and Cobmarsh Islands (possibly enhanced by the recharge placement). A survey commissioned by the MHPT (RSPB, 2014) showed that the recharge supported: 27% of the herring gull population nesting on the Mersea Quarters' saltmarsh island sites; and 34% and 50% respectively of the oystercatcher (*Haematopus ostralegus*) and ringed plover (*Charadrius hiaticula*) breeding pairs, combined across Cobmarsh and Packing Marsh Islands and Old Hall Point (refer to Figures 56, 57 & 58). The figures also give an indication of nesting usage of the recharge by these species in 2009 (RSPB, 2009). Of these species, the herring gull has a red list classification in the 4th national assessment of Birds of Conservation Concern (BoCC; Eaton *et al*, 2015), due to a significant decline in the breeding population nationally; ringed plover is also assigned to the red list and oystercatcher has received an amber listing. Although oystercatcher numbers are increasing in England, the amber listing is influenced by the declining breeding populations in Scotland. The Blackwater supports a nationally important breeding population of ringed plover but its BoCC ranking is due to a downturn in the winter population in the UK. However, breeding birds nesting on recreational beaches will be vulnerable to disturbance and are mainly confined to wardened beaches (Prater, 1989; Liley & Sutherland, 2007).

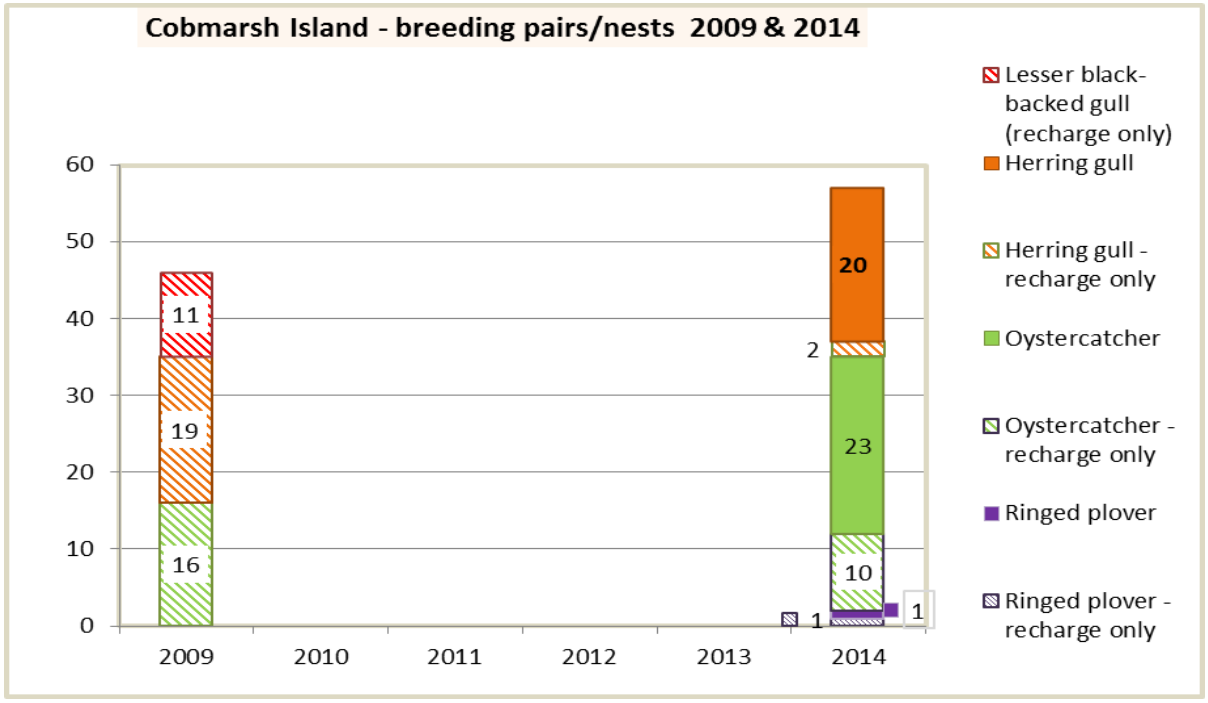

Figure 56. Cobmarsh Island breeding records of key species (RSPB, 2009 & 2014).

Note: The 2009 RSPB survey was undertaken specifically to count little terns nesting on recharge (of which none were present); herring gull and oystercatcher are noted in the survey record; these species may have been present during other years but are not listed. The 2014 survey undertaken by RSPB was commissioned by MHPT. It recorded key species nesting within the existing recharge at Cobmarsh and Packing Marsh Islands and Old Hall, as well as those nesting on the saltmarsh.

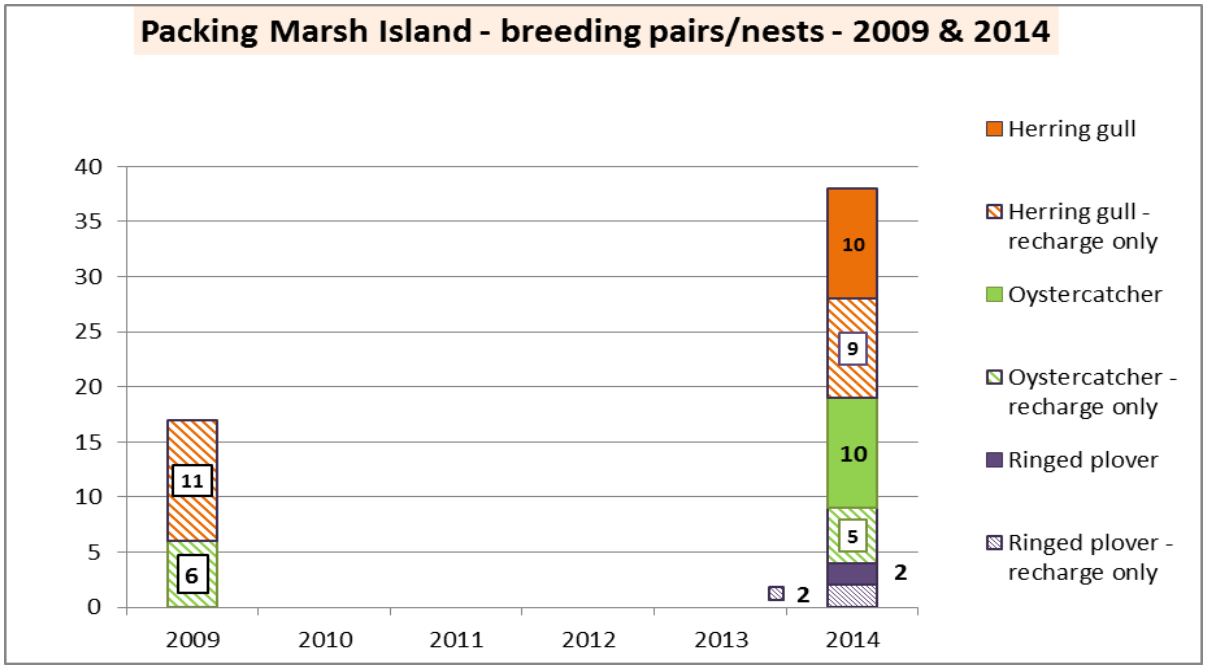

Figure 57. Packing Marsh Island breeding records of key species (RSPB, 2009 & 2014).

Note: The 2009 RSPB was survey undertaken specifically to count little terns nesting on recharge (of which none were present); herring gull and oystercatcher are noted in the survey record; these species may have been present during other years but were not recorded. The 2014 survey undertaken by RSPB was commissioned by MHPT. It recorded key species nesting within the existing recharge at Cobmarsh and Packing Marsh Islands and Old Hall, as well as those nesting on the saltmarsh.

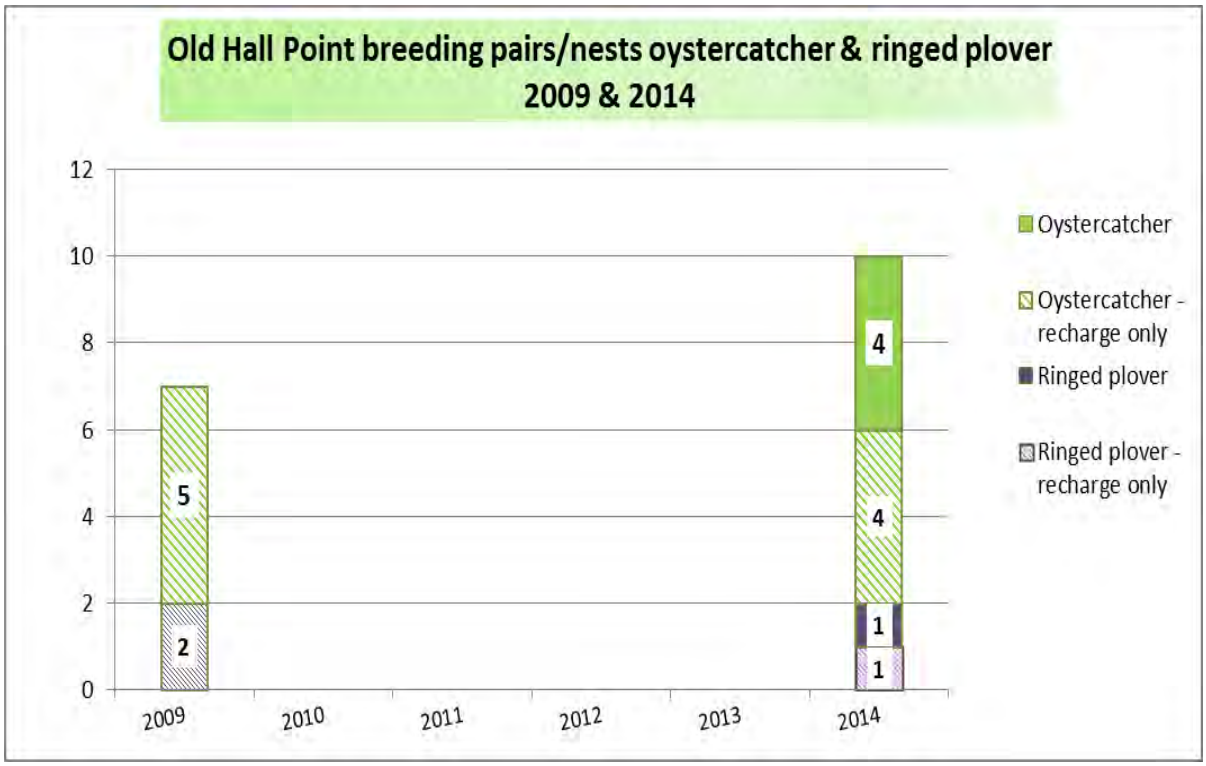

Figure 58. Nesting oystercatcher and ringed plover at Old Hall Point ((RSPB, 2009 & 2014).

Note: Oystercatcher and ringed plover are noted in 2009 field records taken during a little tern nesting survey of the recharge sites (RSPB, 2009; refer to Figure 54 for little tern records); these species may have been present during other years but were not recorded. The 2014 survey undertaken by RSPB was commissioned by MHPT to note key species nesting within the recharge areas, as well as those nesting on the saltmarsh.

5.3.6.3 Breeding status of birds on grazing marshes

A key purpose of the recharge is to help sustain protected nature conservation sites behind potentially vulnerable sea defences. Significant numbers of estuarine and non-estuarine species breed on the extensive freshwater grazing marsh inside the sea wall at Old Hall Marshes and Tollesbury Wick. Tollesbury Wick, in 2010, supported 13 pairs of breeding avocet and 11 pairs of lapwing, and, in 2011, 20 redshank nested (Smith, 2014). In 2016, following the construction of a shallow storage lagoon, ten nesting pairs of common tern and two pairs of Mediterranean gulls were recorded (Jonathan Smith, EWT, pers comm). Old Hall Marshes National Nature Reserve and RSPB reserve supports a nationally important breeding population of pochard (Natural England, 2014). Over the period 2006 and 2010 the RSPB reported stable breeding populations of oystercatcher, avocet and redshank, with pochard and lapwing pairs following an upward trend (Figure 59; RSPB, 2011).

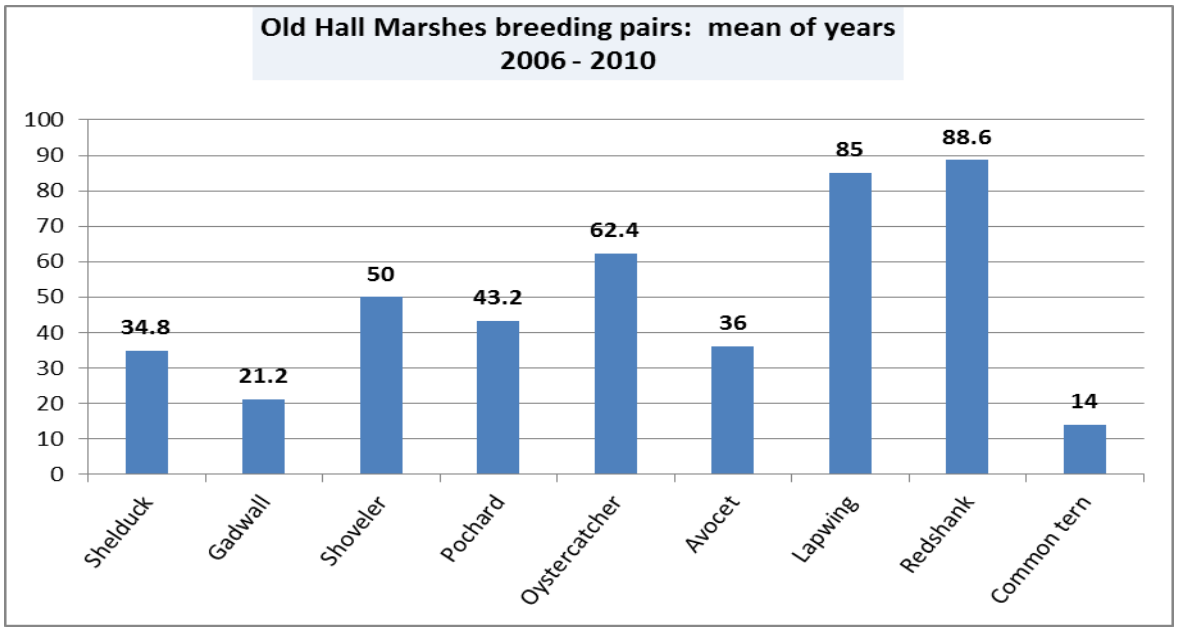

Figure 59. Breeding birds recorded at Old Hall Marshes RSPB reserve – numbers averaged over the period 2006 – 2010 (RSPB, 2011).

5.3.6.4 Outer Thames proposed extension to marine SPA

It is proposed to expand the existing Outer Thames Estuary marine SPA to include three new areas identified for foraging little terns breeding at classified SPA sites, namely part of the Rivers Yare and Bure, a small riverine section at Minsmere, and both estuarine and marine areas around Foulness. Generic foraging models indicate that little terns nesting in the Blackwater are unlikely to forage inside the extended marine SPA boundary (Natural England & JNCC, 2015).

5.3.7 Overwintering birds

5.3.7.1 Overwintering status of birds in the Mersea Harbour area

The Blackwater Estuary Special Protection Area (SPA) and Ramsar site ranks as the 15th most important site in the UK for supporting non-breeding waterbirds (Austin et al, 2014). The summed winter species maxima for the whole estuary, over the period 2008/09 to 2012/13, averaged 68,769 individuals. Of these over a quarter (29%) were recorded in the wetland bird survey (WeBS) count sectors for Old Hall - which includes the eastern edge of the Mersea Quarters - and Tollesbury Wick (refer to Figures 60[2] & 61). A further 9,324 individuals were recorded for the Mersea Island sector, though this lies just outside the proposal area and covers the open sea and creeks around the whole of Mersea Island, including the Pyefleet Channel and the fringing freshwater marshes of the Colne.

[2] Sector count data in this section were supplied by the Wetland Bird Survey (WeBS), a partnership between the British Trust for Ornithology, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee (the last on behalf of the statutory nature conservation bodies: Natural England, Natural Resources Wales and Scottish Natural Heritage and the Department of the Environment Northern Ireland) in association with the Wildfowl and Wetlands Trust.

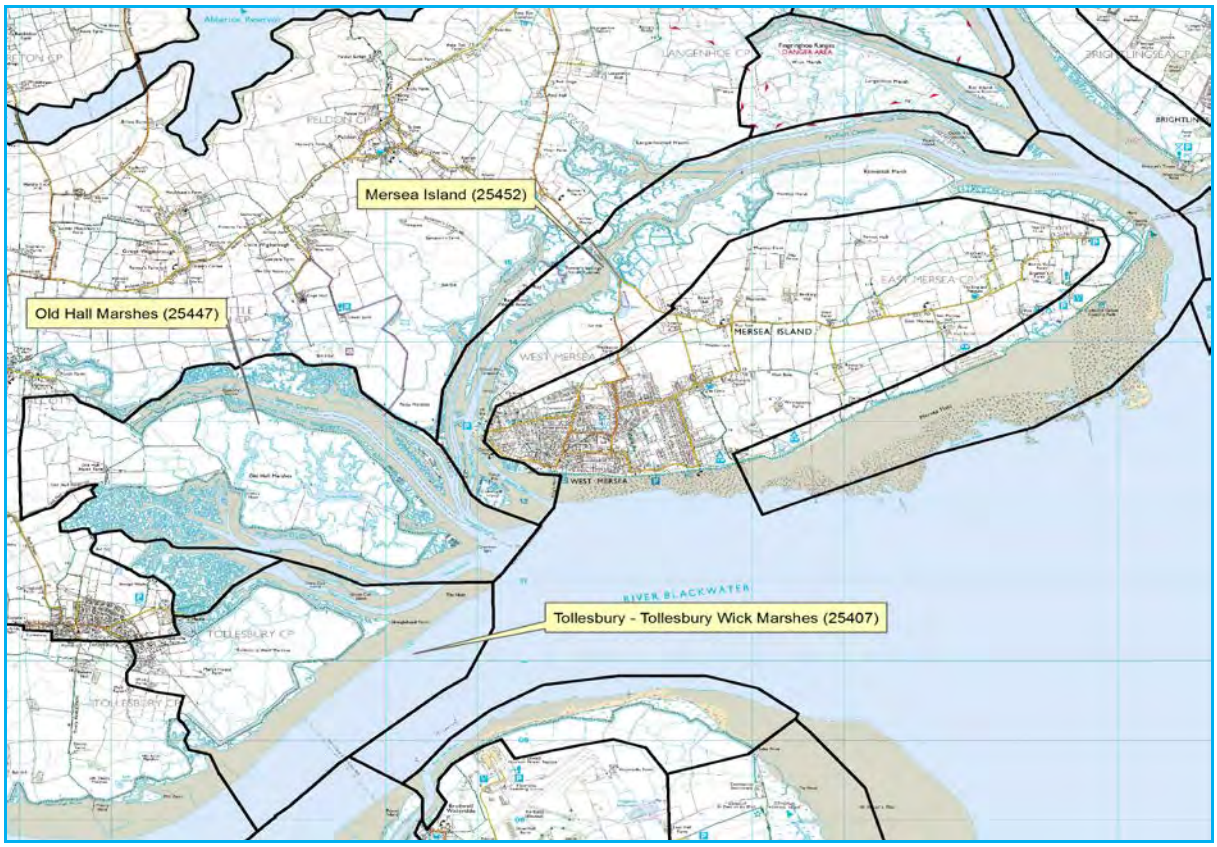

Figure 60. BTO count sectors at West Mersea. (Source: BTO, OS Explorer 1:25000 series).

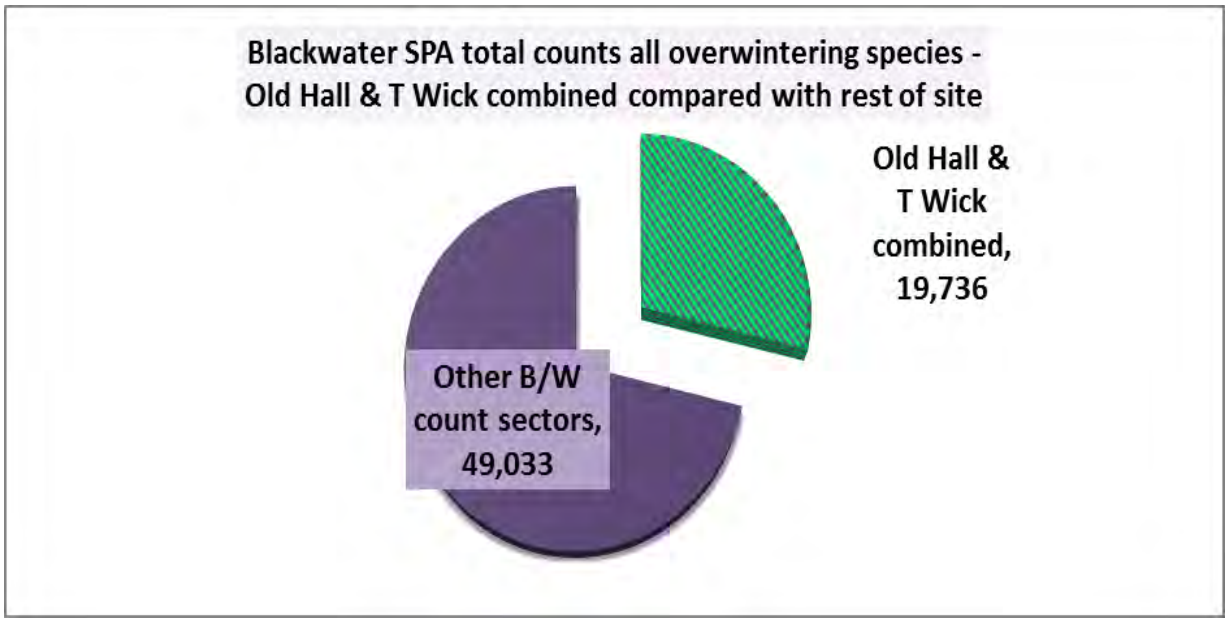

Figure 61. Consolidated winter counts for Old Hall and Tollesbury Wick sectors compared with the Blackwater whole site counts over the period 2008/09 to 2012/13.

5.3.7.1i Status of internationally important species in the Mersea Quarters area

The significance of the contribution made by the Old Hall and Tollesbury Wick sectors to the Blackwater SPA and Ramsar site is reflected in their support of migratory species which reach internationally important levels on the estuary over winter (Natural England, 2014). For the period 2008/09 to 2012/13, between them, Old Hall and Tollesbury Wick sustained: 38% of the dark-bellied brent goose (*Branta bernicla*) estuary population; 33% of the grey plover (*Pluvialis squatarola*) population; 22% of the dunlin population (*Calidris alpina*); and 10% of black-tailed godwit (*Limosa limosa*) individuals using the estuary (Figure 62).

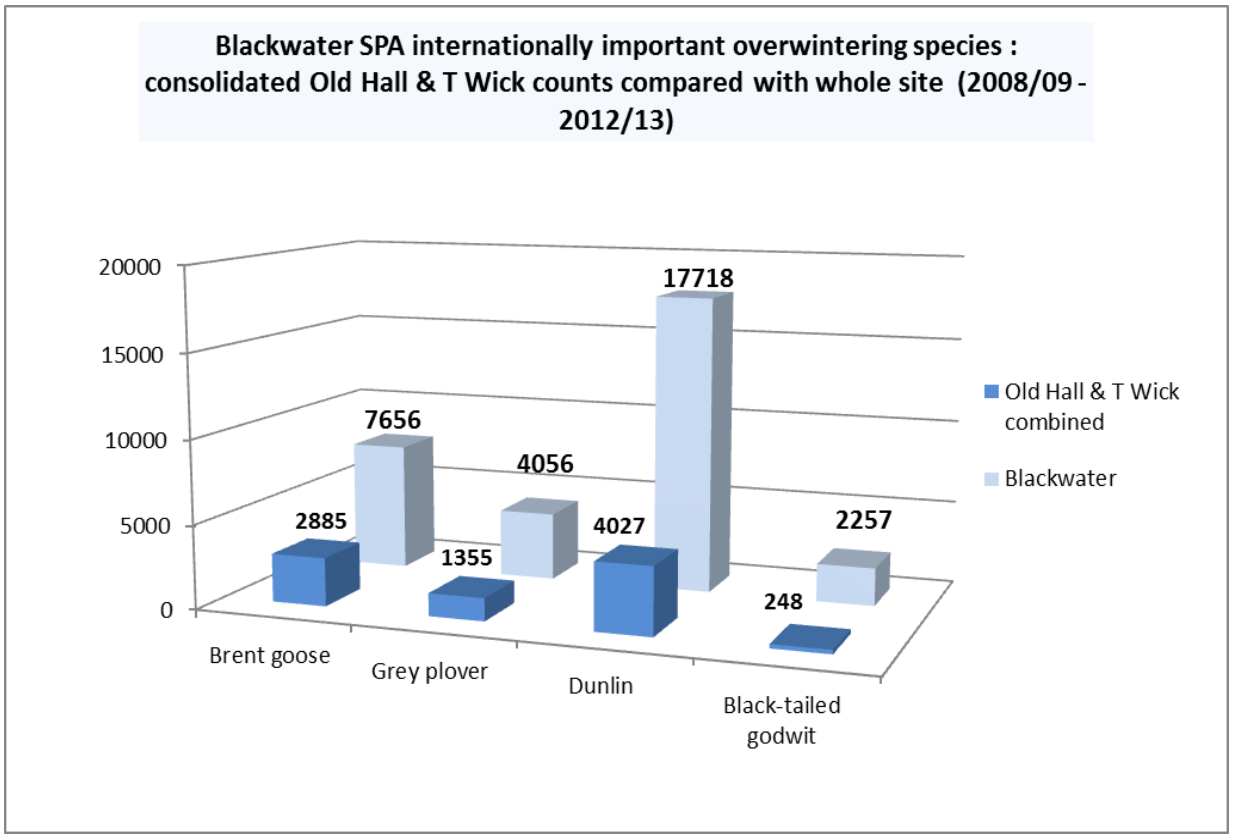

Figure 62. Old Hall and Tollesbury Wick sectors – counts of internationally important species combined compared with the Blackwater whole site counts over the period 2008/09 to 2012/13.

Internationally important species of the SPA/Ramsar site and assemblage species using the foreshore at Old Hall South and Cobmarsh Island foreshore are indicated in Tables 10 & 11. The most well-represented species are brent geese and dunlin. The 2016 count noted that birds were mostly distributed on the lower shore feeding in the soft mud near the waters' edge, below the recharge footprint. The only species noted on the abraded clay platform, which will receive recharge along the seaward margin, were ringed plover and some brent geese (Andy Field, pers comm). Further pre-placement counts are planned for winter 2016/17.

Table 10. Wader and wildfowl counts at Eastern Quarters Spit, Old Hall.					
Species	Date of count				
	7 Nov 13	4 Dec 13	3 Jan 14	3 Mar 14	16 Mar 16
Brent Goose	92	38	30	92	300
Wigeon	96	37	10	103	5
Teal	78	6	5		
Oystercatcher					2
Golden Plover		26	2	1	
Grey Plover	149	98	330	112	
Ringed Plover				9	
Curlew	4				3
Bar-tailed			10	1	
Turnstone	3	1	9	9	
Knot	10			2	
Ruff				33	
Sanderling				11	
Dunlin	170	85	500	500	150
Turnstone	3	1	9	9	
Knot	10			2	
Ruff				33	
Redshank		50		1	2

Source: Counts between 7 November 2013 and 3 March 2014 are taken from WeBS high tide count data for birds roosting on the saltmarsh at the Eastern Quarters Spit and likely to be using the adjacent foreshore at low tide (Recorder: Colin Mackenzie-Grieve.). The count on 16 March 2016 was undertaken at low tide (Recorder: Andy Field.)

Table 11. Cobmarsh Island - low tide count recharge proposal site, 16 March 2016	
Brent goose	300
Wigeon	5
Oystercatcher	2
Curlew	3
Dunlin	150
Redshank	2

Source: Andy Field.

5.3.7.2 Enhanced flood protection of grazing marshes at Old Hall and Tollesbury Wick

The former recharge has helped to protect sea defences enclosing freshwater grazing marsh. Grasslands inside the sea wall have become an important food resource for estuarine wildfowl in the last few decades. In 1976 a study of wigeon distribution found that although these birds spent a third of their feeding time on mudflats, inland pastures had become the most valuable habitat for sustaining them (Owen & Williams, 1976). Brent geese also adapted to feeding inside the sea wall in the 1970s (Williams & Forbes, 1980). The significance of grassland to these species is reflected in the Wetland Bird Survey count data from the Old Hall and Tollesbury Wick sectors. Reserve grassland management practices have been adapted to meet feeding requirements and non-WeBS counts further emphasise the importance of this habitat (Tables 12 & 13). At Old Hall, brent geese numbers for the period 2005/06 to 2009/10 were 40% above the qualifying level for international importance.

Table 12. Old Hall Marshes RSPB reserve - mean of peak winter counts on grazing marsh over the period 2005/06 to 2009/10 (RSPB, 2011).	
Dark Bellied Brent Goose	3360*
Wigeon	2706

Note: Qualifying level for international importance is 2,400 (Frost et al, 2016).

Table 13. Tollesbury Wick EWT reserve - mean of peak winter counts on grazing marsh over the period (2008/09 to 2013/14; Smith, 2014).	
Dark Bellied Brent Goose	1108
Wigeon	1408

5.3.7.3 Impact of former recharge – high tide roosts

The gravel bars and spits of the recharge at Cobmarsh Island, Packing Marsh Island and Tollesbury Wick have become established high tide roost sites both for internationally important species and for other species making up the bird assemblage in the estuary. The recharge regularly supports around 200 individuals at high tide of mainly oystercatcher and dunlin, with ringed plover, bar-tailed godwit, sanderling, curlew, turnstone, and brent geese (Figures 63 & 64). A winter count in 2010/11 on the Tollesbury Wick recharge recorded 180 oystercatcher and 220 ringed plover. This site has also been used as a summer roost by eider duck with 2 individuals noted in May 2009 and 12 in August 2011 (Smith, 2014)

Figure 63. Oystercatcher, ringed plover and brent geese on the recharge roost at Cobmarsh Island.

Figure 64. Dunlin, ringed plover, turnstone and curlew roosting at high tide on the Packing Marsh Island recharge.

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5.3.8 Marine mammals

5.3.8.1 Seals (*Phoca vitulina*)

Common or harbour seals are occasionally seen in the creeks in the Mersea Quarters and are likely to be present all year round. Their spatial distribution is unpredictable; they are likely to forage over a wide area throughout the Essex estuaries complex.

5.3.8.2 Harbour porpoise (*Phocoena phocoena*)

The Blackwater estuary lies approximately 60km from the inshore boundary of the proposed Southern North Sea Special Area of Conservation, described as being within the top 10% of persistent high density areas for harbour porpoise in UK waters (JNCC, 2015). Sightings of harbour porpoise have been reported in the Mersea Quarters (Iley & Merchant, 2009) and they have been observed in the Mersea Harbour among the moorings (Belbin, 2016).

5.3.9. Sea bed habitats supporting fish spawning and nursery grounds

Natural England (2015) in their draft site information for the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone specify that '*the MCZ is an important spawning and nursery ground for several fish species including: sand-smelt (Atherina presbyter), bass (Dicentrarchus labrax) and Blackwater herring (Clupea harengus) - a distinct breeding population, notably around Eagle Bank at the mouth of the Blackwater Estuary.'* Although these species are not protected features of the MCZ, NE advocate the protection of the broad-scale seabed habitats which support them.

Sand smelt use the estuary predominantly as a nursery ground and swim in shoals over sandy or muddy beds, with much of their adult life being spent at sea (IUCN, 2015). A fish survey conducted during the early development of the Tollesbury managed realignment site recorded sand smelt inside the breach at high tide. Sand smelt nurseries have been found in the Blackwater at Osea Island and off of Bradwell Power Station (Kent & Essex IFCA, 2015, citing Colclough et al, 2005). Juvenile bass have also been recorded at the Osea Island and Bradwell nursery sites. Spawning takes place in the open sea and the eggs hatch within a few days. The developing larvae mass together and move inshore, actively swimming to the estuary nursery sites where they will spend the first three to four years of their lives. Large numbers of very young bass fry have been found in the saltmarsh creeks and managed realignment sites on the Blackwater during surveys carried out since 2003. It is considered that saltmarshes provide the optimal conditions to support bass early in their development (Kent & Essex IFCA, 2015, citing Colclough et al 2005).

The Blackwater herring (*Clupea harengus*) spawn in the outer mouth of the Blackwater estuary between February and April (Fox et al, 1999). Eggs are laid on the Eagle Bank, and adhere to the surface of coarse pebbles, shell breccia, and gravels embedded in the muddy sands (Dempsey & Bamber, 1983). Limited spawning is also thought to occur at St Lawrence Stone, opposite Osea Island (Wood, 1981). The larvae hatch out after two to three weeks and remain in the estuary for up to two months (Fox et al, 1999).

5.3.10 Non-native species

On the lower shore at Cobmarsh Island cobbles and pebbles have been colonised by the invasive barnacle, *Austrominius modestus* (Appendix 6b). Part of this habitat lies within the footprint of the proposed recharge.

6. Commercial and recreational fisheries

The extent of the private oyster fishery in the Blackwater and Colne estuaries is shown in Figure 65.

In the proposal area oyster production takes place within the Tollesbury and Mersea (Blackwater) Fishery Order (1999), which spans 1266ha, and in the Strood and Salcott Channels, and the North Channel of Tollesbury Fleet (Figure 66). The public fishery lies to the east of the private fishery (refer to Section 5.3.5). Within the creeks around Mersea Harbour both the native oyster (*Ostrea edulis*) and the Pacific oyster (*Crassostrea gigas*) are grown on and harvested. Native oyster cultivation takes place over 702ha of the Tollesbury and Mersea Company grounds, leaving 564ha available for Pacific oyster management.

Figure 65. Location of private oyster fisheries in the Blackwater and Colne estuaries in relation to the recharge areas. (Jim Pullen. Source: OS Vector Map District 1:50000.)

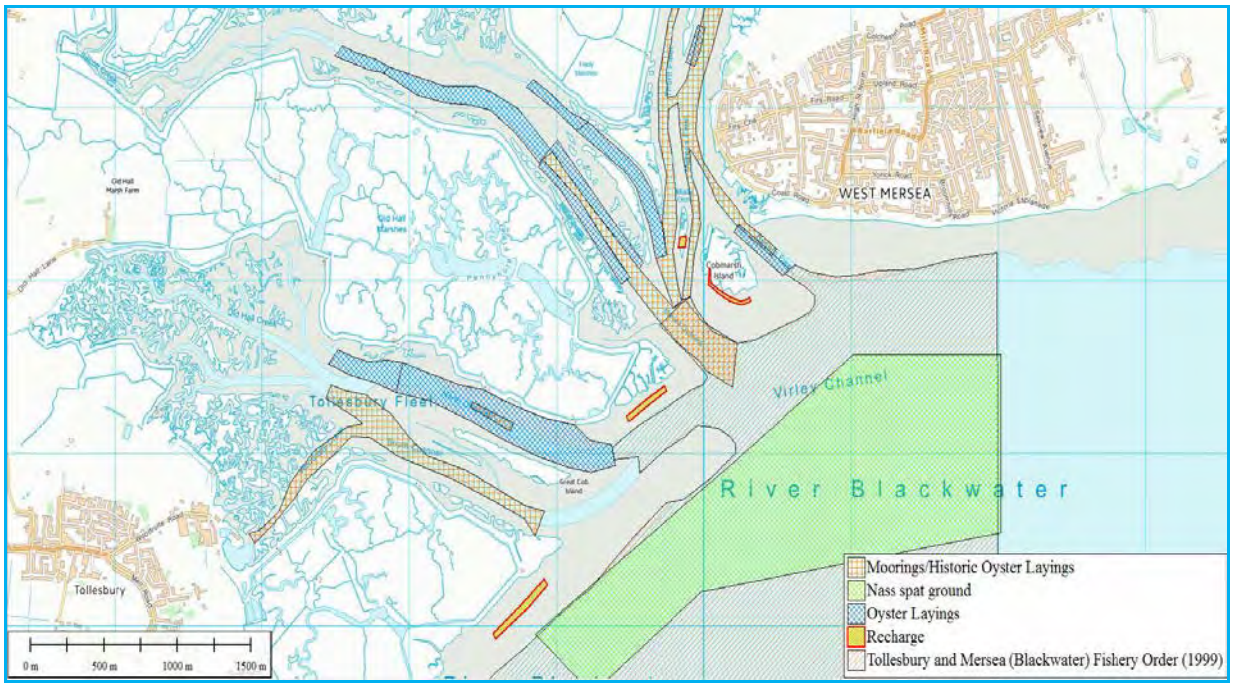


Figure 66. Private oyster layings and location of historic layings now utilised for moorings relative to the recharge areas. The map also shows the Nass spat ground within the Tollesbury and Mersea (Blackwater) Fishery Order (1999). (Jim Pullen. Source: OS Vector Map District 1:50000.)

Historically, fishing effort has led to over-exploitation, and declines have also been attributed to cold winters and contamination with tributyltin (TBT). Predation by the American oyster drill (*Urosalpinx cinerea*), unintentionally introduced to the UK in the early 20th century, has had an adverse effect on commercial oysters (Sweet, 2011). The slipper limpet (*Crepidula fornicata*), also an introduced species, competes for the same food and encroaches on the oyster beds. The introduction of seed oysters from the Solent, coupled with responsible husbandry, has helped revive native oyster production in the Blackwater estuary increasing the number and area of native oyster beds (EWT & BOA, 2012). Effective management may also have helped to reduce susceptibility to the disease Bonamiosis, spread by the parasitic protozoan, *Bonamia ostreae*, (Alan Bird, BOA, pers comm). Details of the baseline physical conditions which native oysters are exposed to are described in detail in Section 5.3.5.4.

West Mersea supports an inshore commercial fishing fleet of 12 registered and licensed vessels (Marine Management Organisation, May 2016). They engage in trawling in the mouth of the Blackwater and Colne estuaries, targeting sole, bass, cod and thornback ray. Other boats working the area are based at Brightlingsea, Wivenhoe, Tollesbury and Maldon. The bass fishery will be closed throughout 2016 to commercial fishing boats under the Kent and Essex Inshore Fisheries and Conservation Authority (IFCA) byelaws.

Recreational angling also takes place with charter boats running trips from West Mersea to both inshore and offshore sites. Ray, dogfish, whiting, cod, bass and tope are among the regular catch.

7. Marine heritage

In order to ascertain the marine heritage of the proposal sites a search of the Essex County Council (ECC) database was carried out (Essex Historic Environment Record online). This revealed the following listings:

- Eroding oyster pits at Cobmarsh Island and Packing Marsh Island.
- Roman, Medieval and post-Medieval pottery has been found on Cobmarsh Island

The oyster pits at Cobmarsh Island are located on the west shoreline, north of the recharge proposal site (Figure 67). Wave and tidal erosion is exposing the oyster shells in the sediment profile. Natural processes are transporting the exposed shells and shell debris deposits landward, and, along with naturally occurring sands and gravels, they have formed a protective ridge in front of the marsh (Figure 68).

Figure 67. Eroding oyster pit, Cobmarsh Island, view west.

Figure 68. Shell debris washed shoreward from the oyster pits is forming a protective barrier to the saltmarsh on the west side of Cobmarsh Island (view north).

At Packing Marsh the oyster pits are located north of the proposal site. They are protected by the previous recharge which has formed a ridge to the south, east and west of the pits (Figure 69).

Figure 69. Oyster pits, Packing Marsh Island showing protective recharge bund on the eastern boundary to the right of the photo.

8. Historic and cultural heritage resources

An important cultural and historic landmark in the Mersea Quarters is the Packing Shed on Packing Marsh Island. Between the late 19th century and the 1950s, the Packing Shed was the centre for oyster distribution where native oysters dredged from the creeks were graded, cleaned and packed ready to be shipped by Thames barge to London.

With the relocation of oyster processing to Mersea Island after the 1950s, the shed fell into disrepair. It has since been restored by the Packing Shed Trust who continue to maintain it. Nowadays it is a tourist attraction and a venue for local community functions.

Mersea Harbour lies within the Coastal Protection Area and the majority of the estuarine frontage makes up the West Mersea Conservation Area. The waterfront is designated as a Waterside Area of Special Character, as defined by Colchester Borough Council's Local Development Framework (2008). The Core Strategy spatial vision states that: 'The West Mersea waterfront will be conserved for its historic maritime character and distinctive maritime-related local businesses.'

9. Navigation and marine recreation

Mersea Harbour is an important commercial and leisure boating hub. Fishing boats operate out of Mersea Harbour as well as charter boats for angling and leisure trips. Recreational boating activities include yachting, dinghy sailing, and canoeing. The Mersea area is a popular venue for racing sailing with traditional, competitive and informal events run by West Mersea Yacht Club, Dabchicks Sailing Club and Tollesbury Sailing Club. There are an estimated 550 yacht and boat moorings, for vessels of up to 20m, lining the fairways of the harbour creeks. Most of the moorings are rented out by Mersea Haven Ltd and the Tollesbury and Mersea Native Oyster Fishery Company to the West Mersea Yacht Club and Maritime and Leisure Investments Ltd.

10. Air and noise quality

The proposed recharge placement will be taking place in a commercial harbour and recreational boating area. Residential properties and marine associated businesses are located immediately shoreward and house boats are moored in the saltmarsh creeks. Noise levels associated with water-based activities are part of the character and atmosphere of the area. Air quality with regard to emissions from boat engines and cars do not reach the levels associated with built-up areas.

11. Landscape and visual aspect

Wave-built landforms of sand and shingle or shell characterise the mouth of the Blackwater estuary providing a protective barrier around points and headlands. These Chenier beaches develop due to wave erosion of muddy sediments exposing underlying sands, shells and gravels. In this high energy environment the coarse sediments are transported shoreward and, under extreme dynamic conditions, such as spring tides and storm surges, washover processes lift the beach material onto the saltmarsh. Shingle ridges, derived from cliff erosion and the redistribution of older Chenier beaches, overlie the saltmarsh clays at Colne Point and extend northward into the Blackwater estuary (JNCC, 1980-2007). At the southern mouth of the estuary, at Sales Point, on the Dengie peninsular, erosion of the tidal flats has exposed the underlying cockle shells which have been transported landward to form shell Cheniers of up to 3m high between the upper tidal flats and the saltmarsh margins. Shingle ridges and spits have developed naturally around the islands and peninsulars in the Mersea Quarters. The process of longshore drift is active along the Mersea Island shoreline transporting sand and shingle westward and forming a spit at the entrance to the Besom Fleet, to the north-east of Cobmarsh Island.

12. Socio-economic status

It is estimated that approximately 80 full-time jobs rely directly on the harbour throughout the year: charter angling boats and tourist sight-seeing boats operate from the public jetty; there are two boatyards, a sail-making company, a yacht chandler, two sailing clubs, four restaurants, a public house hotel, two engineering companies, a publisher, and a shop. The thriving commercial oyster cultivation industry operates seven registered boats out of West Mersea employing over 30 people, from harvesting to preparing the oysters for market. Twelve vessels make up the Mersea inshore commercial fishing fleet. There are around 40 residential and commercial properties situated on the immediate waterfront and 18 shore-connected houseboats in full-time occupation.

13. Evaluation of impacts

This section describes the potential environmental impacts associated with the construction and operation phases of the proposed scheme.

The impacts which the proposed recharge could potentially exert on all aspects of the existing environment are identified in both the immediate and longer term. The significance of these impacts has been evaluated through site investigation, literature review or by comparison with standard guidelines. The significance definitions ascribed to the potential impacts are defined in Table 14.

Table 14. Classification of impact significance.

Impact significance	Impact definition
Negligible	Not of concern
Minor adverse	Undesirable but of limited concern
Moderate adverse	Of some concern but it is likely to be tolerable (depending on scale and duration)
Major adverse	Of serious concern and considered unacceptable
Minor beneficial	Of minor significance but has some environmental benefit
Moderate beneficial	Provides some gain to the environment
Major beneficial	Provides significant positive gain to the environment

The impacts of the proposals range from major beneficial to major adverse. However, the adverse impacts can be avoided or reduced to acceptable levels through the implementation of mitigation measures. A summary of the impact assessments is provided in Table15 followed by the comprehensive individual accounts.

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
Physical processes – SAC 'Estuaries' feature	Operational	Potential to alter tidal flow velocity.	Negligible	No mitigation required	Negligible
	Operational	Potential to modify coastal processes.	Major beneficial	No mitigation required	Major beneficial
Sediment and water quality	Construction	Potential to introduce contaminated sediment to the recharge proposal sites.	Negligible	No mitigation required	Negligible
	Construction	Potential to suspend sediments which could lead to changes in water quality by: mobilising sediment-bound contaminants, increasing turbidity, and reducing dissolved oxygen concentrations, resulting in harmful effects on marine life.	Localised minor adverse	A minor adverse impact on water quality is unavoidable in the immediate vicinity of the discharge location particularly during the disposal of the initial loads.	No long-term residual impact resulting in harmful effects on marine life.
	Operational	Potential to reduce the mobilisation and suspension of sediment and sediment-bound contaminants	Minor beneficial	No mitigation required	Minor beneficial
Saltmarsh - Annex 1 SAC, Ramsar and SSSI feature & intertidal mudflats and sandflats – SAC and SSSI feature	Construction	Burial of saltmarsh species growing on existing recharge face and crest at Tollesbury Wick.	Short-term minor adverse	Upgrading the existing recharge at Tollesbury Wick will provide a suitable substrate for regrowth of saltmarsh vegetation where conditions are favourable.	Negligible
	Operational phase	Potential for recharge material to migrate shoreward resulting in rollover onto saltmarsh.	Minor adverse	At Cobmarsh (north end) and Packing Marsh Islands brushwood fences will be constructed prior to recharge placement to a height of 1m above saltmarsh level (HAT). The design profile of the recharge bunds on the lower shore at Cobmarsh, Old Hall and Tollesbury Wick will provide resistance	Negligible

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
				to excessive landward migration on extreme tidal events.	
	Construction	Loss of intertidal mudflat.	Minor adverse	The recharge footprint will cover an area of 3.32ha of existing eroding foreshore, but offers the potential to protect and enhance 3.41 ha of degraded mudflat. The presence of the recharge bunds at Cobmarsh and Packing Marsh Islands will also help to protect the tidal flats in the fleets and creeks of the Mersea Quarters. At the NW end of the Cobmarsh recharge fencing will prevent material from spreading westward during storm events.	Negligible to minor beneficial
	Operational	Potential to create and/or sustain saltmarsh and intertidal mudflats/ sandflats, and sustain SSSI/SPA/Ramsar terrestrial habitats and species	Major beneficial	No mitigation required	Major beneficial
Intertidal mudflats and sandflats – marine communities	Construction	Reduction in area of representative marine communities.	Minor adverse	The immediate loss of sandy/mud biotopes will be mitigated by the promotion of natural silt settlement shoreward of the recharge bunds, over time. There is the potential to reverse foreshore erosion and associated habitat degradation over an area of 3.41ha in the lee of the proposed bunds at Old Hall south and Cobmarsh Island, and the extension of the existing recharge bank at Tollesbury Wick. Invertebrate abundance and biodiversity would be expected to increase over the newly protected mudflats.	Negligible to minor beneficial
Intertidal mixed sediment, feature of	Construction	Potential to smother intertidal mixed sediment	Negligible	No mitigation required	Negligible

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
the Marine Conservation Zone		communities.			
	Operational	Potential to alter tidal flow and modify intertidal mixed sediment marine communities.	Negligible	No mitigation required	Negligible
Native oyster (Ostrea edulis) and native oyster beds - Marine Conservation Zone features	Construction	Potential direct impact from smothering of native oyster or native oyster beds by recharge material.	No impact	No mitigation required	No impact
	Construction	Potential to smother native oyster beds and native oysters adjacent to the proposal sites by sediments circulated during recharge placement.	Minor adverse	The following mitigatory factors are incorporated into the methodology and timing of the work: the temporal nature of the disposal activity and the downtime - even within the short-run schedule; the release of recharge material on the ebb tide - working with natural dispersive processes; turbidity monitoring to check for any increases in excess of baseline readings, combined with inspection of the oyster beds for silt settlement above normal levels (relative to ambient conditions), with the option to temporarily halt the discharge programme to allow natural silt dispersal; suspension of commercial oyster dredging during the discharge of early loads, in consultation with the oyster fishermen.	Negligible
	Construction	Potential to cause an increase in the level of sediment-bound contaminants circulating in the water column which could bioaccumulate in native oysters.	Negligible	No mitigation required	No residual impact
	Construction	Potential to increase levels of suspended sediment leading to changes in water	Negligible	No mitigation required	No residual impact

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
		quality affecting turbidity and light-penetration, and dissolved oxygen concentrations, and impacting food availability for native oysters.			
	Operational	Potential to reduce the volume of suspended sediment in circulation.	Minor beneficial	No mitigation required	Minor beneficial
Breeding birds – Blackwater SPA feature	Construction phase	Potential to directly impact and disturb nesting birds.	Major adverse	A watching brief will be required, liaising with Natural England, the RSPB and the Essex Wildlife Trust, to establish the location of nest sites. A dialogue with HHA over dredger conveyancing schedules will be ongoing and the timing of delivery of dredgings to individual sites will be dependent on the outcome of site assessments with downtime required where any risks to nesting birds are identified.	Negligible impact
	Operational	Potential to extend nesting area for little tern and other species.	Major beneficial	No mitigation required	Major beneficial
	Operational	Potential to increase protection to saltmarsh breeding sites and terrestrial breeding sites, within the SPA, from erosion and climate-change induced sea level rise.	Major beneficial	No mitigation required	Major beneficial
Overwintering birds - Blackwater SSSI, SPA and Ramsar feature	Construction	Potential to impact birds roosting at high tide on the existing recharge at Tollesbury Wick, Packing	Minor adverse	During prolonged freezing conditions the operator will be required to observe Natural England's winter working guidelines.	Negligible

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
		Marsh Island and Cobmarsh Island.			
	Operational	Potential to increase in the area available for high tide roosts.	Moderate beneficial	No mitigation required	Moderate beneficial
	Operational	Loss of intertidal feeding area.	Minor adverse	The arrangement of the recharge bunds at 3 of the proposal locations will promote accretion of silts over the degraded mid to upper foreshore with the potential to enhance or re-establish feeding opportunities over 3.41ha of foreshore. This will mitigate for the loss of 3.32ha of mudflat covered by the recharge.	Moderate beneficial in the medium to longer term.
	Operational	Potential to increase protection to coastal grazing marsh.	Major beneficial over the medium to longer term	No mitigation required	Major beneficial over the medium to longer term.
Marine mammals – seals	Construction	Potential for dredger operating in the Mersea Harbour to disturb seals.	Negligible	No mitigation required	Negligible
Marine mammals - harbour porpoise	Construction	Potential for dredge disposal operation to disturb harbour porpoise and potential threat of collision while operating in the harbour area.	Negligible	No mitigation required	Negligible
Sea bed habitats supporting fish spawning and nursery grounds, within the Marine Conservation Zone	Construction	Potential to impact broad-scale seabed habitats which support fish spawning grounds.	Negligible	No mitigation required	Negligible
	Operational	Potential to impact broad-scale seabed habitats which support fish nursery grounds.	Minor beneficial	No mitigation required	Minor beneficial

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
Non-native species	Construction	Potential to introduce non-native species from the donor site.	Major adverse	The Mersea Harbour Protection Trust will require assurances from Harwich Haven Authority and the marine operator that strict biosecurity procedures are followed.	Negligible if biosecurity procedures are carried out.
Commercial and recreational fisheries	The impact of the proposal on commercially farmed native oysters is covered under 'Native oyster (*Ostrea edulis*) and native oyster beds - Marine Conservation Zone features', above, with an additional consideration outlined below.				
	Construction	Potential to smother commercial native oyster beds adjacent to the proposal sites by sediments circulated during recharge placement.	Minor adverse	An oysterman to be on board the dredger to advise on the timing of the commencement of the discharge on the ebb tide. This will give assurance to the oyster fishermen that any potential for sediment to travel upstream onto the commercial native oyster beds, in the Salcott Channel and Tollesbury North Channel, is avoided.	Negligible
	Construction	Potential for suspended sediments to impede respiratory mechanisms in juvenile fish.	Negligible	No mitigation required	Negligible
Marine heritage	Operational	Potential for historic oyster pits to be covered by recharge material.	Minor adverse	At Cobmarsh Island and Packing Marsh Islands recharge material will be prevented from migrating northwards by a brushwood fence 1m above the existing saltmarsh level (height of HAT). Overall, the recharge will have a protective influence.	Negligible
	Construction	Archaeological pottery artefacts may be buried beneath recharge material.	Moderate adverse	Advice on archaeological survey requirement to be sought prior to recharge placement to allow for items of historical interest to be recorded.	Negligible
Historic and cultural heritage resources	Operational	Potential to protect historic and cultural heritage resources.	Major beneficial	No mitigation required	Major beneficial
Navigation and marine recreation	Construction	Potential to impact navigation and marine recreation.	Negligible	No mitigation required	Negligible
	Operational	Potential for recharge placed to the north-western	Moderate	At the north-west end of the Cobmarsh recharge fencing will be erected 1m above saltmarsh level	Negligible

Table 15. Summary of the scale and significance of potential environmental Impacts.					
Environmental parameter	**Phase of proposal**	**Potential Impact**	**Scale and significance**	**Mitigation**	**Residual Impact**
		section of the Cobmarsh foreshore to migrate and obstruct navigation.	adverse	(height of HAT) to retain material which could be influenced by easterly winds.	
	Operational	Potential to influence hydrodynamic conditions impacting navigation and marine recreation.	Major beneficial	No mitigation required	Major beneficial
Air and noise quality	Construction	Potential to impact air and noise quality in the harbour area.	Negligible	No mitigation required	Negligible
Landscape and visual impact	Operational	Potential to impact the landscape character and visual aspect of the area.	Negligible	No mitigation required	Negligible
Socio-economic effects	Operational	Potential to impact social and economic interests.	Major beneficial	No mitigation required	Major beneficial
Policy objectives outlined in the UK Marine Policy Statement, the National Planning Policy Framework and local land use policy statements and spatial plans	Construction and operational	Potential to meet national marine policy and national and local land use policy objectives	No conflict with policy objectives identified	No mitigation required	Defined policy objectives met
In combination and cumulative impacts	Construction	Potential to cause impacts in combination and/or cumulatively with other plans or projects.	Minor adverse (with reference to commercial oyster dredging)	As a precaution, and in consultation with the oyster fishermen, it is advised that oyster dredging is avoided during the early phase of the recharge programme.	Negligible

13.1 Physical processes

This section considers the impact of the recharge on the 'Estuaries' feature of the Essex Estuaries Special Area of Conservation taking account of local shoreline hydrodynamics, specifically potential changes in tidal flows and coastal processes.

Impact identification - 1

Operational phase: Potential to alter tidal flow velocity

Impact assessment

Measurement of tidal flow velocity in the Mersea Fleet, off the southern shore of Cobmarsh Island and just south-west of Old Hall Point, has shown that maximum flow velocities occur around high tide (Appendix 3). Baseline data collected in June 2015, over a single spring tidal cycle, logged current flow in the Mersea Fleet reaching up to 0.434 m/s (0.843 knots) 45 minutes before high tide. The stronger flood tide reached a maximum speed of 0.157 m/s (1 knot) 70 minutes after high tide, and this is due to several main channels draining through the Fleet. A marked current 'edge' was noted 30 metres to the south of this station.

South-west of Old Hall Point current velocity attained a maximum speed of 0.243 m/s (0.472 knots), during the flood tide, approximately 35 minutes before high water. The ebb tide was much stronger achieving its highest speed of 0.444 m/s (0.863 knots) approximately 60 minutes after high tide. It was noted that the ebb flow at this location abated very quickly.

At each site, the recharge width exposed above a mean tide at high water will measure 10m, representing a 1:4 gradient extending from a 50m wide base at low water. With 80% of the total volume placed to the individual sites being subtidal at high water, the volume of recharge that could impact on tidal currents, as indicated in the recorded flow velocities above, is approximately 80,000m³. The swept tidal volume (tidal prism) of the Blackwater estuary, ie the volume of water that enters and leaves on a tide, has been estimated to be 142 million m3 on a spring tide and 76 million m³ on a neap (Estuary Guide, 2008) giving a mean tidal prism of 109 million m3. These amounts have been checked for accuracy for the project by ABPmer (pers comm). The quantity of recharge material therefore represents less than 1/10th of 1% (0.001m³) of the swept tidal volume.

The influence of the recharge on the swept tidal volume reduces further on taking into account the distribution of the material to the four locations in an area where the estuary is 2.5km wide and broadening to seaward. Any potential increase in flow speeds effected by the recharge are likely to occur on spring tides with a lower increase on neaps, and would only be likely to come about during times of peak flow rates. As such, if an increase occurs at all it is likely to be so short- lived that it would be indiscernible. There is also unlikely to be any detectable impact on bed shear stress.

The influence of the recharge on tidal flow velocity is therefore considered to be of **negligible** significance.

Mitigation
No mitigation is required.

Residual impact

Impact remains negligible.

Impact identification – 2

Operational phase: Potential to modify coastal processes

Impact assessment

The recharge material placed in the 1990s has been shown to emulate the movement and activity of natural Chenier beaches which derive from terrace gravels (glacial outwash) and form naturally within the mudflats and saltmarsh of the Blackwater estuary as a consequence of erosion and adjustment to rising sea levels. A full account of the performance of the earlier recharge and its response to natural coastal processes, over a period of 16 to19 years since placement, is given in Section 5.3.2. It is the study of this real-time model that has informed the current design making it possible to accurately predict the outcome for the new placements. By obtaining information by direct observation in situ the project has been able to avoid the risks associated with theoretical model outputs. Based on the CEFAS analysis, the grain size from the trial pits in the Harwich Approaches compares favourably with naturally occurring sands and gravels and the constituents of the former recharge. The dredged material will therefore be expected to interface with hydrodynamic processes in the same way as the existing sands and gravels derived from a similar location in the Harwich approaches.

Once the recharge material has been deposited onto the foreshore it will have an immediate impact of managing existing erosion. It will be subject to tidal forcing which will allow migration shoreward during on-shore storm events. The impact of this depends on the distance the material is placed from the saltmarsh edge and the frequency of high energy wave events. In order to prevent high tide waves from overtopping the recharge, and control shoreward movement, at placement the crest height will be elevated to 3.5m ODN (HAT + 200mm). This design feature should present a more robust barrier to extreme tidal events, while allowing natural coastal processes to create a dynamic equilibrium. With increased forces ensuing from predicted climate-change induced sea level rise, the recharge material will continue to respond and function naturally. At Tollesbury Wick some slight landward transgression of the recharge bund has occurred, as indicated in Figure 37, Section 5.3.2.5i. However, over the 17 years since placement, the material has remained relatively in situ, allowing silts to build up to leeward (landward) raising the formerly eroded foreshore by 1m. This, in turn, is providing further stability. Movement in the linear plane has been checked by the tidal current: any material entrained and transported upriver on the flood tide is returned on the stronger ebb current. Replenishing the existing bund and extending it with the small quantities proposed at this location is unlikely to change the status quo. The proposal at Cobmarsh Island and Old Hall south is to follow the same fringing beach layout, as demonstrated at Tollesbury Wick, with the bund located mainly around MLWN level. This will provide protection to the eroding leading edge of the saltmarsh and fronting mudflats and

promote silt deposition inside the recharge bund. Retaining fences at Cobmarsh Island will be erected at the north-western end of the recharge footprint, prior to placement, and are designed to prevent rollover onto the saltmarsh and check movement in a westerly direction toward the Mersea Fleet. Recharge delivery to Packing Marsh Island will be as a single mound between -0.5 ODN and +2.5m ODN. The sands and gravels will be expected to perform in the same way as the earlier recharge - moving northwards and hugging the eastern and western shoreline, maintaining the present configuration. The revised initial placement and retaining fence heights (HAT +600mm) are designed to offer more resistance to shoreward movement driven by wind generated waves from the south. As has been observed from the earlier deposition there would be no interruption to tidal flow in the Mersea or the Thorn Fleets which discharge into the Mersea Quarters either side of the island.

The recharge will allow natural processes to continue to operate, but at a slower rate that can manage the detrimental impacts of climate-change induced sea level rise and a potential increase in storm frequency. Consequently, the operational phase of the recharge placement is likely to be of **major beneficial** significance, in the medium to longer term, to the areas it is designed to protect**.** It has the potential to influence coastal defence outcomes at designated SPA freshwater marshes, Old Hall and Tollesbury Wick, and could lead to a deferral or a reversion of the current managed realignment policy.

Mitigation
No mitigation is required.

Residual impact

An impact of **major beneficial** significance remains.

13.2 Sediment and water quality

Impact identification - 1

Construction phase: Potential to introduce contaminated sediment to the recharge proposal sites

Impact assessment

Sediment analysis of the trial pits identifying recharge-winning areas suggest that further investigation for contaminants should not be necessary and that the material would be suitable for reuse. Furthermore, particle size analysis found the the silt component to be very low, representing only 2.85% of the sample taken from trial pit 7. These results suggests that the potential for introducing contaminated sediment to the proposal sites is **negligible**. However there is the possibility that testing may be required by CEFAS (Centre for Environment, Fisheries and Aquaculture Science) from other areas within the dredge footprint with the potential for beneficial reuse.

Mitigation
No mitigation required.

Residual impact

Impact remains negligible.

Impact identification – 2

Construction phase: Potential to supsend sediments which could lead to changes in water quality by: mobilising sediment-bound contaminants, increasing turbidity, and reducing dissolved oxygen concentrations resulting in harmful effects on marine life.

Impact assessment

The act of discharging the dredged sands and gravels onto the placement sites will disturb finer surface sediments and any associated contaminants, which can then be conveyed by tidal currents into the surrounding environment. Sediment analysis by CEFAS of samples taken at the proposal sites recorded levels of polycyclic aromatic hydrocarbons (PAHs) above Action Level 1 but within the range typically found in surface sediments in the North Sea (200 to 280 ppb; CEFAS, 2001). The heavy metals, arsenic, nickel and chromium were not significantly raised above CEFAS Action Level 1.

The movement of sediments occurs naturally in the dynamic areas of the propoosal sites as cyclical patterns of erosion and accretion redistribute surface material. The impact of depositing material on the sea bed will be limited to the initial loads discharging onto fine surface silts (where the foreshore is not covered by earlier recharge or natural occurring sands and gravels) which will become entrained in the water column. Where fine surface silts are present they have been found to have a shallow distribution over the adhesive silt/clay subsurface (Appendix 6a). Of the 88,000m³ to be placed directly onto the exposed

foreshore, only the initial 5,000m³ will descend onto bare intertidal flats – an area of around 3.22 ha. Once the foreshore is covered, subsequent loads will be deposited on top of the placed sands and gravels effectively burying any polluted sediment making it unavailable for resuspension. At Packing Marsh Island the silty/clay fraction is mostly buried below the existing recharge and locally derived sands and gravels overlie the north-western stretch of the Cobmarsh Island recharge proposal site. The majority of the Tollesbury Wick recharge is to be placed on top of the pre-existing recharge. It has already been stated that the silt component of the recharge will be very low. However, a small amount of silt is likely to be released from the downdraught as the discharged material falls through the water column.

Mobilisation and suspension of small quantities of sediment and sediment-bound pollutants is likely to occur during each disposal event resulting in a concentrated column of turbid water, accompanied by reduced dissolved oxygen levels, in the immediate vicinity of the dredger. As the disposal plume moves through the water it will undergo significant dilution by the surrounding sea water in the Mersea Quarters and is unlikely to significantly influence background levels of contaminants in the water column. Recent water quality monitoring in the Mersea waters (Environment Agency, Appendix 4) indicates that contaminants identified at the receptor sites found to be above CEFAS Action Level 1 are well within environmental standards in the water samples. Analysis of dissolved oxygen recorded percentage saturation levels above those required for shellfish waters (refer to Section 5.2.1). It is concluded that there is likely to be a short-term, localised impact of **minor adverse** significance on water quality particularly during deposition of the early loads.

Mitigation
A minor adverse impact on water quality is unavoidable in the immediate vicinity of the discharge location particularly during disposal of the initial loads.

Residual impact

Environmental standards are unlikely to be exceeded following dilution of contaminants in the water column. On this basis, long-term residual impacts on water quality, which could lead to harmful impacts on marine life, are ruled out.

Impact identification - 3

Operational phase: the potential to reduce the mobilisation and suspension of sediment and sediment-bound contaminants

Impact assessment

The present erosive environment will change to a depositional one over 3.42ha foreshore inside the recharge bunds at Cobmarsh, Old Hall, and the extension at Tollesbury Wick, effectively reducing the amount of contaminants potentially in circulation. in this part of the estuary. These areas will act as a sediment sinks burying contaminated sediment over time. This outcome will confer a **minor beneficial** impact.

Mitigation
No mitigation required.

Residual impact

The residual impact is of **minor beneficial** significance.

13.3 Nature conservation and ecology

13.3.1 Saltmarsh - Annex 1 SAC, Ramsar and SSSI feature, and intertidal mudflats and sandflats – SAC and SSSI feature

Impact identification - 1

Construction phase: Loss of saltmarsh species which have developed on the existing recharge at Tollesbury Wick

Impact assessment

Saltmarsh plants which have colonised parts of the inner and outer crest face of the existing recharge may be smothered by the deposition of the new recharge. The temporary loss of saltmarsh vegetation is judged to be of **minor adverse** significance.

Mitigation
Upgrading the existing recharge at Tollesbury Wick will provide a suitable substrate for regrowth of saltmarsh vegetation where conditions are favourable.

Residual impact

With the opportunity for regrowth of vegetation there is a residual risk of **negligible** significance.

Impact identification - 2

Operational phase: Potential for recharge material to migrate shoreward resulting in rollover onto saltmarsh

Impact assessment

At Cobmarsh Island the sands and gravels will be placed immediately adjacent to the saltmarsh edge at the north-western end to form a closure wall, running perpendicular to the shore. At Packing Marsh Island placement will be onto existing recharge and abraded former saltmarsh platforms south of the oyster pits. Tidal forcing would be expected to drive the material abutting the saltmarsh edge landward leading to rollover onto the marsh as evidenced at Shinglehead Point, (Tollesbury Wick), and Cobmarsh, where naturally occurring beach material has superimposed onto the saltmarsh. Where the earlier recharge at Cobmarsh and Packing Marsh Islands, and Old Hall, has formed a protective band around the saltmarsh margins, some of the material has impinged over the marsh surface. The impact of the current proposal could be considered to be of **minor adverse** significance.

Mitigation
At Cobmarsh and Packing Marsh Islands, to prevent rollover of material onto saltmarsh vegetation, brushwood fences will be constructed prior to placement to a height of +1m above saltmarsh level to HAT (highest astronomical tide) + 200mm (refer to Section 3.2). The design height is informed by lessons learned from the original foreshore recharge schemes. Building above HAT will help to reduce the risk of storm waves lifting material above the retaining fence and smothering the saltmarsh plants behind. Additional brushwood fences will be constructed should monitoring demonstrate the need. (It should be noted that the encroachment of recharge onto the marsh margins has resulted in saltmarsh growth on the recharge, and where shallow coverage with fine sands has occurred, pre-existing plants have grown through the material.) The design profile of the recharge bunds at Cobmarsh, Old Hall and Tollesbury Wick will provide resistance to inundation and excessive landward migration on extreme tidal events and allow some degree of energy dissipation in the lee where fine sediments can deposit. The recharge will develop a good dynamic equilibrium with the natural processes operating within the estuary system and will also respond and adapt naturally to climate-change induced sea level rise.

Residual impact

By taking the measures outlined above the impact is reduced to **negligible**.

Impact identification - 3

Construction phase: Loss of intertidal mudflat

Impact assessment

The building of natural Chenier beaches, derived from local sands and gravels, is essentially a natural dynamic of the intertidal mudflat feature and the recharge will emulate these beach ridges. Nevertheless, placement of recharge directly onto the mudflat will cover and area of approximately 3.32ha (this excludes the sites where material will augment existing recharge). The loss is unavoidable and will result in the smothering of finer surface sediments and the underlying adhesive silts and clays which are currently subject to severe erosion. The 1.66ha recharge footprint at Cobmarsh represents approximately 14% of the 11.31ha of intertidal flats exposed at low tide at this location. At Old Hall south the recharge will cover 23% (1.47ha) of the 6.15ha area of foreshore within and landward of the recharge footprint. At Packing Marsh the new recharge will be deposited on the pre-existing recharge sands and gravels and on top of exposed London clay. The proposed recharge extension at Tollesbury Wick will cover sands washed from the earlier recharge fronting saltmarsh and mudflat.

There is the potential for the recharge placed to the north-western section of Cobmarsh Island to be borne westward by strong easterly winds driving material over the mudflats toward the Mersea Fleet.

The direct and potential loss of intertidal flats constitutes an impact of **minor adverse** significance.

A detailed assessment of the recharge on the sub-features of the intertidal flats at the proposal sites, taking account of the marine communities, is provided in Section 13.3.2.

Mitigation
The creation of the recharge bunds at Old Hall south and Cobmarsh Island and the extension of the bund at Tollesbury Wick will facilitate the deposition of silts inside the bunds, reversing the current erosive phase. The buildup of silts at Tollesbury, during the 17 years since placement, has raised the foreshore by 1m over an area of 6.29ha of former degraded mudflats. Overall, the new recharge has the potential to enhance an area of 3.41ha of eroding foreshore (with the loss of 3.32 ha of eroding foreshore). The presence of the recharge bunds at Cobmarsh and Packing Marsh Islands will also help to protect the tidal flats in the fleets and creeks of the Mersea Quarters. At the north-west end of the Cobmarsh recharge fencing is proposed to retain material which could be influenced by easterly winds.

Residual impact

With the opportunity for the development of mudflat over currently eroded foreshore, the inclusion of fencing to prevent the spread of recharge material seaward, and the protective influence of the recharge over the foreshore in the wider harbour area, a residual impact of **negligible** to **minor beneficial** significance is concluded.

Impact identification - 4

Operational phase: Potential to create and/or sustain saltmarsh and intertidal mudflats/sandflats, and sustain SSSI/SPA/Ramsar terrestrial habitats and species

Impact assessment

The recharge will safeguard the currently eroding saltmarsh providing a front-line of defence with the capacity to work with natural processes and respond over the longer term to increases in high energy wave events. It will help to mitigate the loss of saltmarsh (and mudflats) to coastal erosion, by promoting silt settlement to shoreward, at the relevant proposal locations, helping to re-create qualifying features of the SAC. With the crest height of the recharge raised above highest astronomical tide this would favour the establishment of a Mediterranean saltmarsh scrub community – a high saltmarsh feature of the SAC – where the constituents of the shingle matrix provide a suitable substrate for establishment. The spread of this species is artificially restricted by sea walls. Annual driftline communities may also develop over the shingle. The scheme overall will be of **major beneficial** significance. A further important benefit of the scheme is the assurance of continued flood defence protection to the Essex Wildlife Trust reserve at Tollesbury Wick - the original purpose of the initial recharge here - and the protection of Old Hall Marshes, a RSPB reserve and National Nature Reserve. Together these sites represent an extensive area of freshwater grazing marsh and associated ditch networks - including coastal lagoon habitat - supporting SSSI/SPA and Ramsar-cited species.

Mitigation
No mitigation required

Residual impact

An impact of **major beneficial** significance remains.

13.3.2 Intertidal mudflats and sandflats – marine communities

Impact identification

Construction phase: Reduction in area of representative marine communities

Impact assessment

The most widespread marine biotopes at the proposal sites are bullet-pointed below and these will receive the greatest proportion of the dredgings (refer to Table 16 & Figure 70).

- LS.LMu.MEst.NhomMacStr - *Nephtys hombergii* (catworm), *Macoma balthica* (Baltic tellin) and *Streblospio shrubsolii* (polychaete worm) in (mid-estuarine) littoral sandy mud.
- LS.LMu.MEst.HedMacScr - *Hediste diversicolor* (ragworm), *Macoma balthica* and *Scrobicularia plana* (peppery furrow shell) in (mid-estuarine) littoral sandy mud.

Table 16. Biotope distribution over foreshore areas within and adjacent to proposed recharge sites. The most widespread biotopes are highlighted in yellow, and biotopes which will be directly impacted by the recharge are indicated 'R'.

Biotope	Cob-marsh	Packing Marsh	Old Hall	T Wick
LS.LSa.St.Tal - Talitrids (sandhoppers) on the upper shore and strandline	√	√		
LS.LSa – Littoral sand	√			
LS.LSa.MoSa.Ol - Oligochaetes in littoral mobile sand.	√			
LS.LSa.MuSa - Polychaete/bivalve dominated muddy sand shores	√			
LS.LMu - Littoral mud			√ R	
LS.LMu.UEst.Hed.Ol - *Hediste diversicolor* and oligochaetes in (upper estuarine) littoral mud				√
LS.LMu.UEst.Hed.Str - *Hediste diversicolor* and *Streblospio shrubsolii* in (upper estuarine) littoral sandy mud			√ R	
LS.LMu.MEst - Polychaete/bivalve-dominated mid estuarine mud shores/ LR.FLR.Eph.BLitX - Barnacles and *Littorina* spp. (periwinkles) on unstable eulittoral mixed substrata	√ R			
LS.LMu.MEst.NhomMacStr - *Nephtys hombergii*, *Macoma balthica* and *Streblospio shrubsolii* in (mid-estuarine) littoral sandy mud.	√ R		√	√ R
LS.LMu.MEst.HedMacScr - *Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana* in (mid-estuarine) littoral sandy mud	√ R		√ R	
LS.LBR.LMus.Myt.Sa - *Mytilus* edulis (blue mussel) beds on littoral sand	√ R			

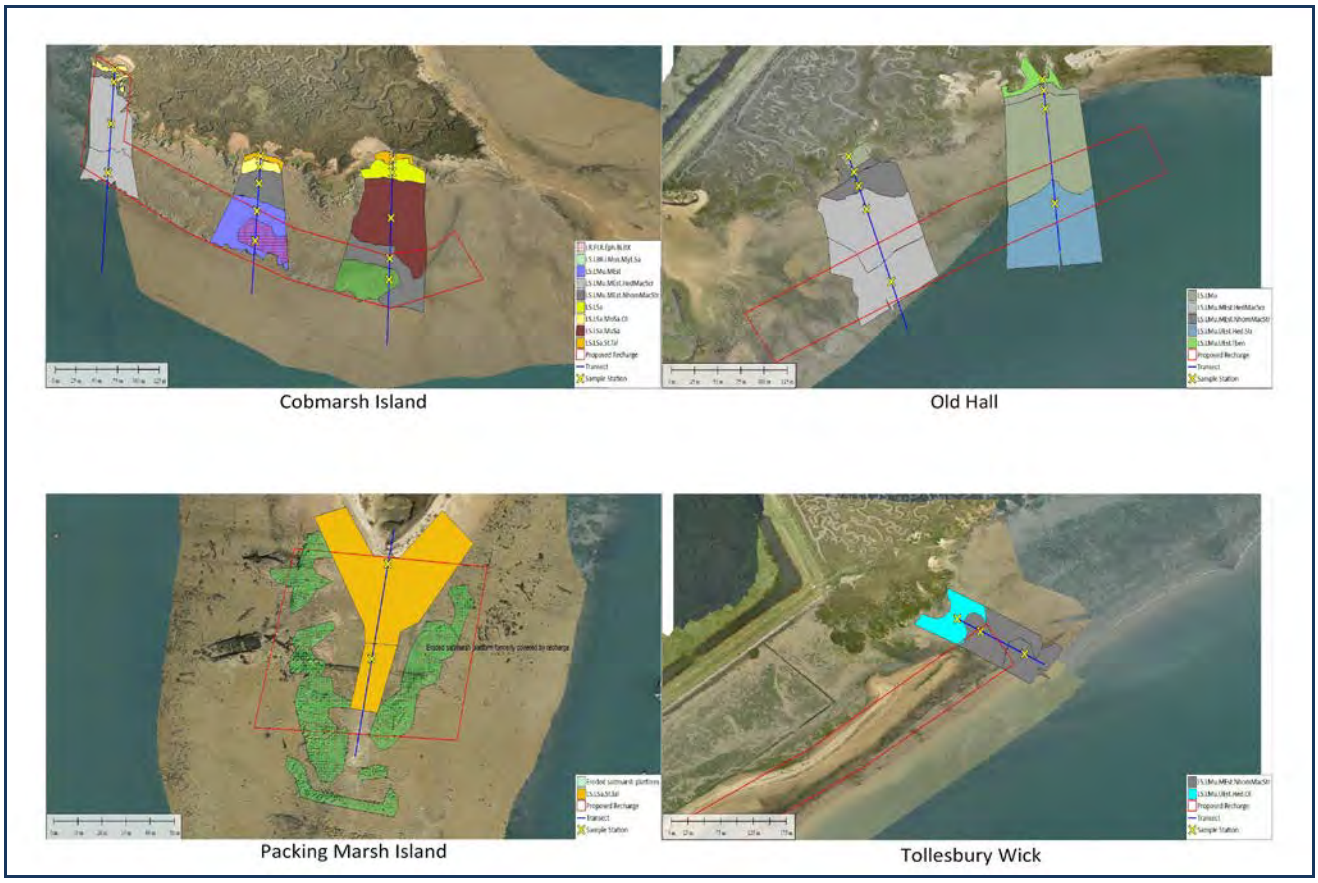


Figure 70. Distribution of marine communities (biotopes) over the recharge footprint at the individual sites.

The most well-represented sandy/mud biotopes in the current survey have also been described at St Lawrence Bay, on the south shore of the estuary, and between Tollesbury and Goldhanger (PMSL, 2013); and the boulder communities are widespread on the Mersea Island foreshore east of West Mersea (APEM & MESL, 2013). The recharge will be placed directly onto 3.32ha of mudflat supporting these biotopes (this does not include coverage over 2.66 ha which will be discharged onto the existing recharge base at Tollesbury Wick and Packing Marsh Island) and represents approximately 0.087% and 0.01% of the total littoral sediment area of the Blackwater Estuary and Essex Estuaries SAC respectively.

The recharge will not result in a change in extent of the intertidal mudflat and sandflat SAC feature or the range of biotopes represented but it will effect a relatively small change in the biotope quota. The Essex and South Suffolk Shoreline Management Plan (EA, 2010) describes the shingle banks of the Blackwater estuary as a feature of the tidal flats. The landward reworking of glacial outwash material by tidal and wave action form these characteristic ridges and spits (Pethick, 1993) which represent an ecologically important subfeature of the 'intertidal mudflats and sandflats' (English Nature, 2000). The material due to be dredged from the Harwich approaches is also derived from glacial deposits of the same geological period (or earlier) as the gravels overlying the London clay in the Blackwater estuary.

The change in marine biotope that will result from the placement of the recharge material approximates to barren littoral shingle. Subsequently, a talitrid (sandhopper) community would be expected to develop on the strandline.

Sediment deposition patterns, resulting from the plumes arising from the discharge of material onto the foreshore, are unlikely to disrupt those that occur naturally. Mud-dwelling invertebrates are adapted to natural sedimentary and dynamic processes and are able to burrow up or down through the sediment to maintain an optimum position.

Placed in the context of the extent of the intertidal mudflat and sandflat feature and the knowledge that the marine communities impacted by the recharge are represented elsewhere in the Blackwater estuary in the vicinity of the recharge sites, a significance impact of **minor adverse** is assigned.

Mitigation
The immediate loss of sandy-mud biotopes will be mitigated by the promotion of natural silt settlement shoreward of the recharge bunds, over time. There is the potential to reverse foreshore erosion and associated habitat degradation over an area of 3.41ha in the lee of the proposed bunds at Old Hall south and Cobmarsh Island, and the extension of the existing recharge bank at Tollesbury Wick. The persistence of this bund along the Tollesbury Wick frontage has led to the development of 6.29ha of mudflat to shoreward over the 17 years since placement, obtaining a depth of 1m. In the first year following placement, an invertebrate survey of the upper shore recorded a significant gain in biomass with numbers of individuals increasing by 249%, accompanied by a slight increase in species diversity (HR Wallingford, 1999). Invertebrate abundance and diversity would likewise be expected to increase over the newly protected mudflats. With the continuing maintenance of the Tollesbury Wick foreshore, ensured by recharging the existing gravel bank, overall, the total area of mudflat that will be both protected and enhanced by the present proposal is 9.7ha.

Residual impact

Considering that there is the potential for reinstating productive mudflats over currently impoverished, actively eroding areas, there will be a residual **negligible** to **minor beneficial** impact.

13.3.3 Intertidal mixed sediment - Marine Conservation Zone feature

Impact identification – 1

Construction phase: Potential to smother intertidal mixed sediment communities

Impact assessment

The majority of the known sites supporting intertidal mixed sediment occur in the mid to upper reaches of the estuary. This community type has also been recorded near the estuary mouth at the western end of West Mersea (refer to Figure 49; APEM & MESL, 2013; PMSL, 2013). The placement sites have not been found to support the marine communities associated with intertidal mixed sediment (refer to Section 5.3.4). Based on observations of the performance of the existing recharge over the period since placement, there is no indication that the sands and gravels have travelled beyond the areas targeted for protection

from onshore episodic storms (refer to Section 5.3.2) and these clearly lie outside the areas of known intertidal mixed sediments.

The marine communities ascribed to this description are not found within or adjacent to the placement sites and the significance of the impact is determined to be **negligible**.

Mitigation
No mitigation required.

Residual impact

The residual impact is **negligible**.

Impact identification - 2

Operational phase: Potential for recharge material to alter tidal flow and modify intertidal mixed sediment marine communities

Impact assessment

At Tollesbury, the material has remained relatively in alignment, and the proposed raising of the bund will add stability. The same configuration will be applied at Old Hall south shore and at Cobmarsh and would be expected to duplicate the spatial distribution pattern demonstrated at Tollesbury. A consideration of flow velocity suggests that there would be no detectable change in current flows in the recharge proposal areas that would have a wider impact (Section 13.1) – though there will be some reduction in flow in the lee of the bunds favouring silt deposition. The foreshore below the Monkey Beach at West Mersea includes infauna typical of intertidal muddy gravels consistent with the marine biotope description LS.LMx.GvMu.HedMx - *Hediste diversicolor* (ragworm) in littoral gravelly muddy sand and gravelly sandy mud, with transitions to LS.LMx.Mx - species-rich mixed sediment shores (PMSL, 2013). The Monkey Beach is located on the northern shore of the Besom Fleet. The recharge placement sites at Cobmarsh and Packing Marsh Islands are situated to the west of Cobmarsh on the shores of the Mersea Fleet. Tidal waters flowing through Mersea Fleet exit the estuary mouth via the Mersea Quarters, approximately 1km south of the intertidal mixed sediment location (refer to map, Figure 49). It is also clear from the map that the main channel, which will receive a further recharge beach along its margins, at Old Hall, with supplementary material placed to the existing recharge at Tollesbury Wick, drains south of the Quarters.

It is not anticipated that the recharge would modify current flows or lead to changes in sedimentary conditions outside the immediate placement areas which could impact 'intertidal mixed sediment' at the known locations. The impact significance is therefore considered to be **negligible**.

Mitigation
No mitigation required.

Residual impact

The impact remains **negligible**.

13.3.4 Native oyster (*Ostrea edulis*) and native oyster beds - Marine Conservation Zone features

Impact identification - 1

Construction phase: Potential direct impact from smothering of native oyster or native oyster beds by recharge material

Impact assessment

The marine invertebrate survey carried out on behalf of the Mersea Harbour Protection Trust in the summer of 2015 found live native oysters to be absent in the proposed recharge placement areas (Appendices 6a & 6b). It can be concluded therefore that there will be **no direct impact** on native oysters.

Mitigation
No mitigation required.

Residual impact

There would be **no residual impact** on native oysters.

Impact identification - 2

Construction phase: Potential to smother native oyster beds and native oysters adjacent to the proposal sites by sediments circulated during recharge placement

Impact assessment

The impacts of the dredger discharging onto the foreshore are considered within the context of natural variations in suspended sediment and current oyster management and harvesting practices in the vicinity.

The recharge will contain a high proportion of washed sands and gravels. There is the potential for disposal plumes to develop from fine sediments released from the downdraught as the recharge material falls through the water column. CEFAS (Centre for Environment, Fisheries and Aquaculture Science) analysis carried out in 2014 of trial pits from suitable donor sites in the Harwich Approaches has shown that the percentage of silt in the samples is low. In trial pit 7 silts constituted 2.85% of the sample and in trial pit 81 the sample contained 9.70% of silts. During the first 15 minutes of the discharge of early cargoes fine surface sediments will become entrained into the water column as the recharge impacts the sea bed. Over the subsequent 25 minutes the remaining cargo will be deposited onto coarse sands and gravels already laid down, continuing until the design profile is attained. Excluding areas with pre-existing recharge or natural sands and gravels or clay, of the 88,000m³ to be placed onto the muddy foreshore, only the initial 5,000m³ will descend onto bare intertidal flats.

To quantify, the dredger placement operation could, for initial cargoes only, potentially impact an area of approximately 33,200m² (this figure does not include topping up onto the existing recharge at Tollesbury Wick and Packing Marsh Island). However, the depth of finer

surface sediments overlying the foreshore is superficial. The intertidal survey undertaken in the summer of 2015 (Appendix 6a) found shallow silt layers averaging 3mm and light sands of 5mm depth on the surface overlying adhesive silty/sandy clays. Elsewhere course sands and bed clays presented at the surface and subsurface. Using the area calculation above, and assuming a worst case scenario, whereby the deposition of material directly onto the foreshore removes a 0.01m depth of sediment, this could release 320m³ of material into the water column during the unloading of the initial five cargoes over the recharge footprint at Cobmarsh Island, Old Hall south and the Tollesbury Wick extension. The maximum delivery rate of one cargo every 12 hours - with the potential for much larger gaps in the timetable - would further modify the volume of sediment circulating in the water body during one discharge event.

Disturbance from the propeller will only occur as the dredger is moved into position to commence operations and when it reverses off at the end of the discharge period – a maximum of five minutes for each manoeuvre. While unloading the cargo the dredger will be stabilised by the hydraulic spud.

It is helpful to consider the disposal impacts in the wider context of natural fluctuations in the area of the Mersea Quarters. An easterly wind will have a far greater influence on sediment redistribution than disposal plumes generated during the recharge disposal operation. When a strong easterly to southerly wind is blowing onshore, wave action will impact over 6km of the south Mersea foreshore. Where the foreshore averages 1km in width then erosional disturbance will occur over 6km² with the potential to send 600,000m³ of sediment into suspension during one tidal cycle. So the sediment circulated during the recharge operation represents 0.005% of the sediment dispersed into the water column during a naturally occurring storm event.

Monitoring data gathered by HR Wallingford in the Salcott Channel in autumn 2000 showed that the level of suspended solids fluctuated by up to approximately 10,000% of the mean values. At this time, there was no reported decline in the productivity of the oyster beds. This would suggest that the oysters within the Salcott Channel are able to tolerate large variations in suspended sediment levels. Guidance on the Shellfish Regulations, issued by the Environment Agency, indicates that:

> 'The failures for suspended solids or salinity may be considered less serious than failures against metals or dissolved oxygen as shellfish waters are typically silty and muddy, or sandy, with variable salinity and may experience high turbidity, low temperature or low oxygen levels through natural processes alone.'

Recent water quality monitoring undertaken in the Mersea Quarters by the Environment Agency, between 2013 and 2015 inclusive, supports this statement with turbidity levels averaging 'intermediate' and ranging from clear to turbid (refer to Section 5.2.1).

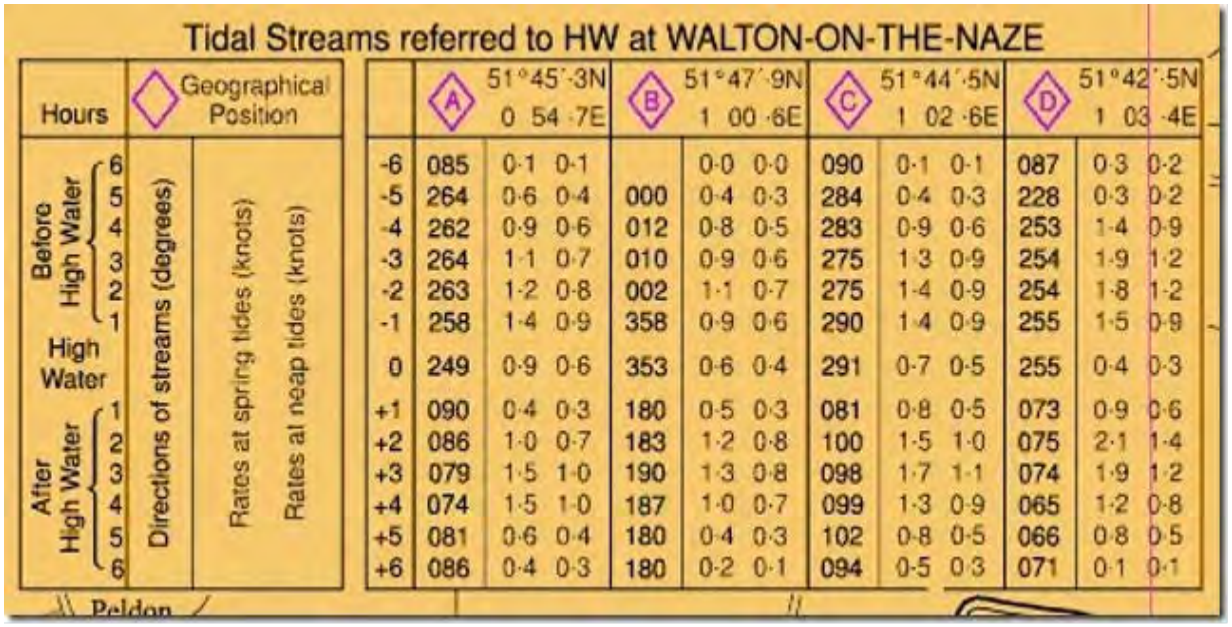
Adjacent oyster harvesting and cultivation practices create sediment plumes that may be smaller than those likely to derive from the recharge disposal but are continuous throughout the year. The oystermen have recently started to 'cultivate' the soft mud foreshore to the south of West Mersea in the private shellfishery. This involves the use of oyster dredges to harvest Pacific oysters (*Crassostrea gigas*) which have colonised immediately adjacent to the natural native oyster beds. Up to three boats will work this area at certain times of the year, while water depths allow, entraining clouds of sediment in the water column over the duration of the tide. The area worked is approximately 10 times the footprint of the recharge.

A potential short-term impact of **minor adverse** significance is assigned as the act of depositing the recharge will release low volumes of sediment.

Mitigation
Depending on the availability of dredgings, the recharge work could take place continuously over a short time frame (12 weeks) or delivery could be staggered over a longer time span with extended periods of downtime. Material will be discharged from the hopper during the first 40 minutes of the ebb tide (ie over 11% of the ebb tide cycle), with only the initial cargoes having the potential to disturb finer sea bed sediment. On a spring tide the velocity of the ebb flow in the area of the Mersea Quarters peaks at around 1 knot 60 - 70 minutes after high tide (Appendix 3). Between three to four hours after high water, tidal streams on the spring and neap tides run at around 1 knot exiting the mouth (Figures 71 & 72). These current velocities favour the advection of sediment in suspension out of the estuary (Laing et al, 2005), but this will be influenced by ambient conditions. Turbidity monitoring will be conducted during the discharge of the early loads to check for any increases in baseline conditions and the potential for settlement, along with inspection of the oyster beds. Should the oyster fishermen report any exceedances in silt settlement above levels normally experienced, the delivery programme would be temporarily halted to allow silts to disperse. As a further precautionary measure, and in liaison with the oyster fishermen, the harvesting of Pacific oysters (*Crassostrea gigas*) in the soft mud foreshore to the south of West Mersea would be suspended during the early stages of the recharge programme.

Residual impact

With the measures in place to minimise the volume of sediment in circulation and potentially available for settlement, the residual impact on native oysters or the native oyster beds is considered to be of **negligible** significance.



Tidal Streams referred to HW at WALTON-ON-THE-NAZE

Hours	Geographical Position		A 51°45′·3N 0 54 ·7E			B 51°47′·9N 1 00 ·6E			C 51°44′·5N 1 02 ·6E			D 51°42′·5N 1 03 ·4E		
Before High Water 6	Directions of streams (degrees)	Rates at spring tides (knots)	-6	085	0·1	0·1		0·0	0·0	090	0·1	0·1	087	0·3	0·2
Before High Water 5			-5	264	0·6	0·4	000	0·4	0·3	284	0·4	0·3	228	0·3	0·2
Before High Water 4			-4	262	0·9	0·6	012	0·8	0·5	283	0·9	0·6	253	1·4	0·9
Before High Water 3			-3	264	1·1	0·7	010	0·9	0·6	275	1·3	0·9	254	1·9	1·2
Before High Water 2			-2	263	1·2	0·8	002	1·1	0·7	275	1·4	0·9	254	1·8	1·2
Before High Water 1			-1	258	1·4	0·9	358	0·9	0·6	290	1·4	0·9	255	1·5	0·9
High Water			0	249	0·9	0·6	353	0·6	0·4	291	0·7	0·5	255	0·4	0·3
After High Water 1			+1	090	0·4	0·3	180	0·5	0·3	081	0·8	0·5	073	0·9	0·6
After High Water 2			+2	086	1·0	0·7	183	1·2	0·8	100	1·5	1·0	075	2·1	1·4
After High Water 3			+3	079	1·5	1·0	190	1·3	0·8	098	1·7	1·1	074	1·9	1·2
After High Water 4			+4	074	1·5	1·0	187	1·0	0·7	099	1·3	0·9	065	1·2	0·8
After High Water 5			+5	081	0·6	0·4	180	0·4	0·3	102	0·8	0·5	066	0·8	0·5
After High Water 6		Rates at neap tides (knots)	+6	086	0·4	0·3	180	0·2	0·1	094	0·5	0·3	071	0·1	0·1

Peldon

Figure 71. Tidal stream table indicating flow rates and direction. (UKHO admiralty chart BA3741 Rivers Colne & Blackwater.)

Figure 72. Direction of tidal streams on the ebb and approximate reference position (as indicated in the tidal stream table – Figure 71) in and around the Mersea Quarters. (CR. Source: ArcGIS World Imagery base map.)

Impact identification – 3

Construction phase: Potential to increase suspended sediments leading to changes in water quality affecting turbidity and light-penetration, and dissolved oxygen concentrations, and impacting food availability for native oysters

Impact assessment

The volume of material thrown into suspension from the disposal operation is likely to have a short-term localised effect on turbidity and dissolved oxygen levels in the vicinity of the dredger. However, because of the natural dispersal mechanisms, described earlier in this section, an extended impact is ruled out. As such, there would not be a sustained effect on marine benthos leading to reduced food availability. The outcome is therefore deemed to be **negligible**.

Mitigation
No mitigation is required.

Residual impact

There would be no residual impact.

Impact identification - 4

Construction phase: Potential to cause an increase in the level of sediment-bound contaminants circulating in the water column which could lead to bioaccumulation in native oysters

Impact assessment

As suspension feeders, oysters filter organic and inorganic particles from the water column. They are therefore at risk of ingesting both water-soluble contaminants and contaminants adsorbed onto particulate matter which can bioaccumulate within the body tissue.

Chemical analysis undertaken by CEFAS indicates that the silt component of the sands and gravels being introduced from the donor site does not contain contaminants above levels that would preclude reuse. Contaminant levels at the receptor sites are within the range experienced in estuarine silts (refer to Section 13.2). Where contaminants were found to be above CEFAS Action Level 1 in the sediment, water quality sampling in the Mersea Quarters has found these pollutants to be well within environmental standards (refer to Section 5.2.1). Nevertheless, It is anticipated that there will be a short-term localised impact on water quality in the vicinity of the dredger. However, natural dispersal mechanisms and the temporary nature of the discharge activity, with periods of downtime - even during a short-run schedule - will not result in sustained levels of water soluble or sediment-bound contaminants in suspension. This leads to the conclusion that the potential for contaminants arising from the disposal operation to impact native oyster populations is deemed to be **negligible**.

Mitigation
No mitigation is required.

Residual impact

The residual impact would be **negligible**.

Impact identification - 5

Operational phase: Potential to reduce the volume of suspended sediment in circulation

Impact assessment

Coverage of the eroding foreshore by the recharge material and its capacity to protect the mudflat and saltmarsh against erosional forces will reduce the volume of sediment circulating in the water column over the native oyster beds. This is considered to be of **minor beneficial** significance.

Mitigation
No mitigation is required.

Residual impact

A residual impact of **minor beneficial** significance persists.

13.3.5 Breeding birds – Blackwater SPA feature

Impact identification - 1

Construction phase: Potential to directly impact and disturb nesting birds

The bird breeding period covers the period between April/May and June/July. The timing of the recharge work has yet to be confirmed by Harwich Haven Authority. As the work is reliant on HHA's dredge schedule the MHPT have to be prepared to receive the dredgings as the material becomes available.

Impact assessment

Digital surface modelling indicating recharge heights above ODN and information on the distribution of nests (RSPB, 2014), suggest there is the possibility that breeding birds will utilise areas adjacent to the proposed depositional sites at Cobmarsh and Packing Marsh Islands and Tollesbury Wick. There is the potential for birds to nest within the recharge footprint at Tollesbury. At Packing Marsh Island, material is due to be placed onto existing recharge and connect with the recharge ridge protecting the interior. This latter site offers nesting opportunities for herring gull, oyster catcher and ringed plover. The recharge closure wall at Cobmarsh ties in to the saltmarsh cliff edge at the western limit of placement; the RSPB (2014) survey noted nesting along the saltmarsh edge at this location. At Tollesbury Wick the recharge will replenish existing material in areas where little terns have not attempted to nest since 2012. At the Old Hall south location placement to MLWN runs approximately 50 to 70 metres below the existing recharge and saltmarsh margins and would not impact breeding birds. Placement during the nesting season could potentially be of **major adverse** significance as nests could be damaged or destroyed, and, in the case of little tern, a Schedule 1 species under the Wildlife and Countryside Act 1981 (as amended), there is the potential to disturb adults while they are brooding eggs or young, or while they have dependent young.

Mitigation
A watching brief will be required, liaising with Natural England, the RSPB and the Essex Wildlife Trust, to establish the location of nest sites. A dialogue with HHA over dredger conveyancing schedules will be ongoing and the timing of delivery of dredgings to individual sites will be dependent on the outcome of site assessments with downtime required where any risks to nesting birds are identified.

Residual impact

The MHPT will ensure that an impact of major adverse significance will be avoided and reduced to **negligible**.

Impact identification - 2

Operational phase: Potential to extend nesting area for little tern and other species

Impact assessment

Increasing the height above the earlier recharge design specification will provide sustainable nesting sites for little tern, and other species, in the medium to longer term and offer security

against land predators at the island sites. The new recharge will expand the current shingle recharge nesting surface by approximately 1.38ha, extending to 1.70ha with the top-up at Tollesbury Wick (based on bird tides). Some loss of habitat may occur where conditions favour the growth of shingle vegetation. The recharge proposal presents an outcome of **major beneficial significance** for breeding little tern and other shingle nesting species.

Mitigation
No mitigation is required.

Residual impact

There will be a residual impact of **major beneficial significance**.

Impact identification - 3

Operational phase: Potential to increase protection to saltmarsh breeding sites and terrestrial breeding sites, within the SPA, from erosion and climate-change induced sea level rise

Impact assessment

The recharge will arrest erosion of the leading edge of the saltmarsh at the proposal sites which, combined with the protection secured by the existing recharge, will retain the marshes as a nesting habitat for species such as oystercatcher, ringed plover, black-headed gull, herring gull (RSPB, 2014).

The new proposal will reinforce the protection conferred by the existing recharge to extensive freshwater grazing marsh inside the sea wall at Old Hall and Tollesbury Wick. This will benefit significant numbers of breeding birds including avocet, lapwing and redshank at Tollesbury Wick marshes and a nationally important breeding population of pochard at Old Hall (Natural England, 2014).

These sites are programmed for managed realignment in the 3rd epoch (2055 to 2105; EA, 2010E) and the 'upgrade' provided by the recharge could trigger a review of this shoreline management plan policy.

Given the potential for a positive outcome, the recharge proposal is likely to be of **major beneficial** significance to breeding birds utilising habitats both inside and outside the sea defences.

Mitigation
No mitigation required.

Residual impact

An outcome of **major beneficial significance** remains in place.

13.3.6 Overwintering birds - Blackwater SSSI, SPA and Ramsar feature

Impact identification - 1

Construction phase: Potential to impact roosting birds

Impact assessment

Placement onto the existing recharge will occur at Tollesbury Wick and Packing Marsh on high neap tides and will displace roosting birds during the first 40 minutes of the ebb tide in the immediate deposit area. Delivery to Cobmarsh Island and Old Hall south will take place on high spring tides. At this point of the tide, birds at Cobmarsh Island are likely to be roosting on the saltmarsh or possibly on the recharge ridge on the east side of the island so disturbance-free areas are likely to be available; the south-eastern recharge spit will be under water. The disposal footprint is some distance from the roost at the Eastern Quarters spit at Old Hall and the disturbance impact may be insignificant. As the new recharge is placed and built to the design height, new roosting areas will be created which will remain uncovered on the higher spring tides. There is the potential to have a **minor adverse** impact on roosting birds during cold spells when bird energy reserves are likely to be compromised.

Mitigation
The operating times of the vessel will be governed by Harwich Haven Authority's dredging timetable. During prolonged freezing conditions the operator will be required to observe Natural England's winter working guidelines.

Residual impact

The impact will reduce to **negligible** significance provided that winter working guidance is followed.

Impact identification - 2

Operational phase: Potential to increase the area available for high tide roosts

Impact assessment

The existing recharge potentially offers a total roosting area of around 1.90 ha and has proved to be important for roosting at favoured locations, but most of the area becomes covered on high spring tides. The new recharge will make available an additional roosting surface of 1.2 ha on an average tide, of which approximately 40 to 50% of this area would be exposed on the highest tides. This represents a **moderate beneficial** outcome.

Mitigation
No mitigation is required.

Residual impact

The residual impact reflects the impact assessment and is of **moderate beneficial** significance.

Impact identification - 3

Operational phase: Loss of intertidal feeding area

Impact assessment

Due to the actively eroding foreshore, there is a very shallow layer of silts (or sand) overlying the adhesive mud/clay subsurface so waders generally feed on the softer silts to seaward below the recharge proposal areas at Cobmarsh Island and Old Hall. The 1.66ha recharge footprint at Cobmarsh represents approximately 14% of the 11.31ha of intertidal flats exposed at low tide at this location. At Old Hall south the recharge will cover 23% (1.47ha) of the 6.15ha area of foreshore within and landward of the recharge footprint. At Packing Marsh the new recharge will be deposited on the pre-existing recharge sands and gravels and on top of exposed London clay. The proposed recharge at Tollesbury Wick will cover sands washed from the earlier recharge fronting mudflat and saltmarsh and does not represent a significant feeding area. The loss of feeding area at Cobmarsh and Old Hall is unavoidable and is of **minor adverse** significance.

Mitigation
The arrangement of the bunds at three of the recharge locations will promote accretion of silts over the degraded mid to upper foreshore, improving an area of 1.73ha at Old Hall and 1.04ha at Cobmarsh. This will create more productive mudflats benefitting species such as dunlin and oystercatcher. At Tollesbury Wick the new recharge will protect a further 0.5ha of foreshore. As the sediment stabilises and algae begin to establish, teal, wigeon and brent geese may utilise the area for sheltered feeding. In total, the losses represent 3.32ha of mudflat area but there is the potential to enhance or re-establish feeding opportunities over 3.41ha.

Residual impact

With the potential to develop and protect the foreshore currently impoverished by erosion, there will be a **moderate beneficial** benefit in the medium to long-term**.**

Impact identification - 4

Operational phase: Potential to increase protection to coastal grazing marsh

Impact assessment

The coastal protection offered by the recharge bunds at Old Hall and Tollesbury Wick will extend the protective influence of the earlier recharge. This will help to reduce the risk of future defence failure and the inevitable loss of grazing marsh which supports internationally important numbers of waterfowl. This would provide a medium to longer term **major beneficial** impact.

Mitigation
No mitigation is required.

Residual impact

There will be a medium to longer term **major beneficial** residual impact.

13.3.7 Marine mammals

13.3.7.1 Seals (*Phoca vitulina*)

Impact identification

Construction phase: Potential for dredger operating in the Mersea Harbour to disturb seals

Impact assessment

The recharge receptor sites are not used by seals as haul out areas. Given the short-term nature of the recharge works, both in terms of the campaign itself and the load discharge times, the low concentration of seals in the area and that seals co-exist alongside shipping activity in the Essex estuaries, the impact on this species is likely to be of **negligible** significance.

Mitigation
No mitigation required.

Residual impact

A residual impact of **negligible** significance is recorded.

13.3.7.2 Harbour porpoise (*Phocoena phocoena*)

Impact identification

Construction phase: Potential for the dredge disposal operation to disturb harbour porpoise and potential threat of collision while operating in the harbour area

Impact assessment

Collisions between harbour porpoise and vessels are not considered a significant pressure for the species (JNCC, 2016). Dredge disposal operations have the potential to cause disturbance leading to physical and acoustic behavioural changes to harbour porpoise, however, due to delivery to shallow waters, the limited working window and temporary nature of the works, the risk to this species is considered to be of **negligible** significance.

Mitigation
No mitigation required.

Residual impact

A residual impact of **negligible** significance is recorded.

13.3.8 Sea bed habitats supporting fish spawning and nursery grounds

Impact identification - 1

Construction phase: Potential to impact broad-scale seabed habitats which support fish spawning grounds (Natural England, 2015)

Impact assessment

The act of discharging the sands and gravels is unlikely to generate significant sediment plumes which could then settle onto the Eagle Bank and disrupt the spawning activity of the Blackwater herring. The following elements lead to this conclusion: the short delivery period during the early stages of the ebb when the tidal currents reach their maximum velocity; the dilution of material in suspension as it travels offshore; the early coverage of bare mudflats by the discharged material, reducing further the small amounts of surface silts available to be transported in the water column; and the low volume of silt in the sand and gravel dredgings.

Due to the limited potential for the placement of the recharge to lead to silt settlement on the spawning grounds of the Blackwater herring, the impact on this species is judged to be of **negligible** significance.

Mitigation
No mitigation required.

Residual impact

A residual impact of **negligible** significance is recorded.

Impact identification - 2

Operational phase: Potential to impact broad-scale seabed habitats, within the Marine Conservation Zone, which support fish nursery grounds (Natural England, 2015)

Impact assessment

There will be a direct loss of very small areas of ‘sandy mud’ sea bed habitat in exposed, impoverished areas, representing approximately 0.087%, and less than 0.01%, of the total littoral sediment area of the Blackwater Estuary and Marine Conservation Zone, respectively. The recharge proposal locations are not identified as nursery areas for sand smelt or bass which are specifically referred to in the draft site information for the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (Natural England, 2015). Surveys investigating fish utilisation of both intertidal habitat creation sites and established saltmarsh on the Blackwater have stated the importance of these habitats in supporting bass fry (Kent & Essex IFCA, 2015, citing Colclough et al 2005). The recharge will safeguard the saltmarsh at the immediate placement sites and, by reinforcing the protective influence of the Eastern Quarters spit and islands, which naturally shelter the harbour from storm tides,

this will help to protect the fringing marshes on the Strood Channel, Salcott Creek and Tollesbury North Channel. The proposed recharge bunds at Tollesbury Wick, Old Hall south and Cobmarsh Island will create sheltered areas to leeward with the potential to build mudflats, and saltmarsh. With consideration of the local and wider favourable effects of the recharge it is likely to confer a **minor beneficial** impact to juvenile fish.

Mitigation
No mitigation required.

Residual impact

A residual impact of **minor beneficial** significance is recorded.

13.3.9 Non-native species

Impact identification

Construction phase: Potential to introduce non-native species from the donor site

Impact assessment

The introduction of non-native species to the proposed disposal areas could potentailly have an adverse biological effect on the native marine fauna or flora. It will need to be demonstrated that material earmarked for beneficial use does not contain potentially harmful non-native species. Of particular recent concern is the carpet sea-squirt (*Didemnum vexillum*) which has been assigned a 'species alert' status by the GB non-native species secretariat. It is thought to originate from Japan and has recently been found in marinas in England and Wales, transported on boat hulls. This is a highly invasive species growing in shallow water to depths of up to 80m, generally in the form of thin, flexible sheets smothering marine life on the sea bed. Reproduction and spread is rapid and it would present a threat to the native oyster, and other species, and to the commercial oyster industry in the Mersea area. The impact is therefore assessed as **major adverse**.

Mitigation
The Mersea Harbour Protection Trust will require assurances from Harwich Haven Authority and the marine operator that strict biosecurity procedures are followed.

Residual impact

With the above mitigation in place, this would allow the residual impact to be assessed as being of **negligible** significance.

13.4 Commercial and recreational fisheries

The impact assessment undertaken for native oysters and native oyster beds, designated features of the Marine Conservation Zone, is also relevant to commercially produced native oysters (refer to Section 13.3.4). However, the impact identified below is considered to require additional mitigation to take account of commercial oysters farmed in the creeks of Mersea Harbour.

Impact identification - 1

Construction phase: Potential to smother commercial native oyster beds adjacent to the proposal sites by sediments circulated during recharge placement

There is the potential for a **minor adverse** impact on the commercial native oyster beds.

Additional mitigation
An oysterman to be on board the dredger to advise on the timing of the commencement of the discharge on the ebb tide. This will give assurance to the oyster fishermen that any potential for sediment to travel upstream onto the commercial native oyster beds, in the Salcott Channel and Tollesbury North Channel, is avoided.

Residual impact

The residual impact is assessed as **negligible**.

Impact identification - 2

Construction phase: Potential for suspended sediments to impede respiratory mechanisms in juvenile fish

Impact assessment

There is the potential for silts to become trapped in the gills of juvenile fish should the waters become heavily turbid during disposal. Though sediment plumes are likely to form in the immediate area of the dredge, dispersion on the ebb tide is likely to be fairly rapid. Furthermore, the amount of sediment released into the water will decrease once the initial loads have covered the exposed bare mud surfaces at the disposal sites. The impact is therefore of **negligible** significance.

Mitigation
No mitigation required.

Residual impact

A **negligible** residual impact remains.

13.5 Marine heritage

Impact identification - 1

Operational phase: Potential for historic oyster pits to be covered by recharge material

Impact assessment

The oyster pits at Cobmarsh Island lie immediately north of the proposed 'limit wall' of the recharge. The height of the recharge and the volume of material are likely to provide a relatively stable structure. However, as has been demonstrated by the shell debris being eroded from the oyster pits, should any material enter the pits it is likely to be transported shoreward by natural processes (refer to Figure 68, Section 7).

Recharge material placed to Packing Marsh will be deposited on top of the earlier material to the south of the oyster pits and could potentially move northward.

The impact outcome is of **minor adverse** significance.

Mitigation
At Cobmarsh Island recharge material will be prevented from migrating northwards by a 1m high brushwood fence constructed on the outside of the recharge 'limit wall'. At Packing Marsh brushwood fences, will be erected to a height of 1m above the existing saltmarsh level (height of HAT tides) to promote stability and prevent movement over the oyster pits (refer to Figure 5). The fence would effectively reinforce the defensive recharge ridge that has formed around the pits from the previous placements. Overall, the recharge will help to protect the oyster pits.

Residual impact

The residual impact is reduced to **negligible**.

Impact identification - 2

Construction phase: Archaeological pottery artefacts may be buried beneath recharge material.

Impact assessment

With regard to the pottery artefacts recorded at Cobmarsh Island, advice would be sought from Essex County Council's Historic Environment team before work commences to allow a survey to take place and finds to be recorded; it is possible that erosive processes have uncovered further artefacts. Searches may also be relevant at Old Hall foreshore, Packing Marsh Island and the extension to Tollesbury Wick. The loss of the archaeological resource in the absence of obtaining records is considered to be of **moderate adverse** significance.

Mitigation
Advice on archaeological survey requirement to be sought prior to recharge placement to allow for items of historical interest to be recorded.

Residual impact

The residual impact is reduced to **negligible** significance.

13.6 Historic and cultural heritage resources

Impact identification

Operational phase: Potential to protect historic and cultural heritage resources

Impact assessment

The proposal will be of **major beneficial** significance in terms of protecting the historic and cultural heritage resources of the Mersea waterfront from increased flooding and erosion due to sea level rise. This would realise Colchester Borough Council's Core Strategy spatial vision (2008) to conserve the West Mersea waterfront for its historic maritime character and maritime-related businesses. There will also be direct benefits to Packing Marsh Island allowing access to continue to maintain the historic oyster shed for the benefit of tourism and the community.

Mitigation
No mitigation required.

Residual impact

A residual impact of **major beneficial** significance is concluded.

13.7 Navigation and marine recreation

Impact identification - 1

Construction phase: Potential to impact navigation and marine recreation

Impact assessment

During the construction phase a 'Notice to Mariners' advising of the timing of the disposal activity will be issued and information posters will be displayed at all the local sailing clubs. The dredger will be clearly displaying navigation lights and shapes indicating she is engaged in an activity and restricted in her ability to manoeuvre. The impact is considered to be of **negligible** significance.

Mitigation
No mitigation required.

Residual impact

A residual impact of **negligible** significance is concluded.

Impact identification - 2

Operational phase: Potential for recharge placed to the north-western section of the Cobmarsh foreshore to migrate and obstruct navigation

Impact assessment

There is the potential for the recharge placed to the north-western section of Cobmarsh Island to be borne westward by strong easterly winds driving material over the mudflats toward the Mersea Fleet. The impact is judged to be of **moderate adverse** significance.

Mitigation
At the north-west end of the Cobmarsh recharge fencing to a height of 1m above saltmarsh level will be erected to retain material which could be influenced by easterly winds.

Residual impact

A residual impact of **negligible** significance is concluded.

Impact identification - 3

Operational phase: Potential to influence hydrodynamic conditions impacting navigation and marine recreation

Impact assessment

In view of the limited scale of the proposals, changes to water flow and creek and channel morphology are not expected to affect navigability in the creeks and estuary channel. If the natural wavebreaks protecting the harbour continue to erode, the harbour will be exposed to wave and weather events and become unviable for moorings, the operation of the public jetty, and commercial and leisure activities. The recharge, by significantly slowing down erosive processes, will help to safeguard the harbour. In this respect, the proposal is considered to be of **major beneficial** significance.

Mitigation
No mitigation is required. The influence of the recharge on hydrodynamic conditions, in working with and slowing down natural processes, is positive.

Residual impact

A residual impact of **major beneficial** significance remains.

13.8 Air and noise quality

Impact identification

Construction phase: Potential to impact air and noise quality in the harbour area

Impact assessment

Significant impacts to noise and air quality conditions will be avoided as there is no requirement for large-scale importation of material by road. The dredgings will be brought in by sea and the capacity of the dredger's hopper is such that the number of trips required to deliver material are minimised.

Local residents are unlikely to be significantly affected by noise during the recharge placement. The nearest residences are the house boats, located around 500m from the Cobmarsh and Packing Marsh Island recharge sites, with the properties on Coast Road over 650m away. The dredger will be deployed in the Quarters for short periods at a time. The whole operation could, potentially, be completed within a minimum of three months, if working at capacity of two loads per 24 hours. However, deliveries may be spaced out over a longer period depending on the dredging timetable. Information will be circulated to local residents advising of the work schedule. The impact is therefore considered to be of **negligible** significance.

Mitigation
No mitigation required.

Residual impact

The residual impact is of **negligible** significance.

13.9 Landscape and visual impact

Impact identification

Operational phase: Potential to impact the landscape character and visual aspect of the area

Impact assessment

The placement of sands and gravels to form beach ridges to protect the saltmarsh will be of **negligible significance** in the context of the landscape and visual aspect of the estuary. The recharge will mimic both the appearance and behaviour of natural wave-built beach ridges (Chenier beaches) active in the mouth of the estuary.

Mitigation
No mitigation required.

Residual impact

A residual impact of **negligible** significance is concluded.

13.10 Socio-economic effects

Impact identification

Potential to impact social and economic interests

Impact assessment

The protection of West Mersea Harbour is vital to the local infrastructure, employment and housing. The proposal will enhance the sustainability of Mersea Harbour. Without improved defences the harbour frontage and hinterland will be at greater risk of flooding in the future. Significant erosion of the creeks and fleets and changes in channel morphology could severely impact shellfish mortality, which would threaten commercial oyster cultivation. The inshore fishing fleet and the leisure boating industry would also be significantly impacted.

It can be concluded, therefore, that the proposal would be of **major beneficial** significance in socio-economic terms.

Mitigation
No mitigation required.

Residual impact

A residual impact of **major beneficial** significance is recorded.

13.11 National and local planning policy statements and spatial plans

13.11.1 UK Marine Policy Statement

The UK Marine Policy Statement (MPS) sets out a framework for the development of marine planning. With the South East Marine Plan currently at the evidence gathering stage, the current proposal is assessed against the policy objectives outlined in the MPS.

The UK MPS sets out high level marine objectives for achieving the UK vision for the marine environment for 'clean, healthy, safe, productive and biologically diverse oceans and seas':

- Achieving a sustainable marine economy
- Ensuring a strong, healthy and just society
- Living within environmental limits
- Promoting good governance
- Using sound science responsibly

Detailed considerations outlined in the UK MPS

Marine ecology and biodiversity

Paragraph 2.6.1.1 explains that the UK government aims to ensure the halting and, if possible, the reversal of biodiversity loss. Paragraph 2.6.1.4 recognises that a development may benefit marine ecology and biodiversity interests and that these benefits may outweigh potential adverse effects.

Climate change adaptation and mitigation

Paragraph 2.6.7.3 states that adaptation in the marine environment will be necessary to deal with the potential impacts of climate change, which include coastal erosion and increased intensity of weather events.

Seascape

The MPS stresses that developments in the marine area must take account of the existing quality and character of the seascape. New proposals should also consider the reasons for statutory protection and seek to include mitigatory elements in the development design.

Policy objectives for the disposal of marine dredgings

The reuse of dredgings is the primary option in an internationally agreed waste hierarchy for disposal of 'waste' at sea cited in Paragraph 3.6.8 of the MPS: 'Wastes should not be accepted for disposal where appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to either human health or the environment, or disproportionate costs'.

Paragraph 3.6.4 advises that 'Appropriately targeted disposal of dredged sediment can have an ancillary benefit in maintaining sedimentary systems and, where the sediment is constituted appropriately, can have social and economic benefit in providing material for alternative uses such as construction, beach nourishment or salt marsh restoration.'

Paragraph 3.6.7 highlights the importance of making a detailed evaluation of the potential adverse effects of a deposit activity on the marine ecosystem and others using the sea.

Impact identification

Construction phase: Potential to meet objectives defined in the UK Marine Policy Statement during the construction phase of the proposed development.

Impact assessment

The proposals are in accordance with the stated policy objectives for disposal of dredgings outlined in the MPS. The Mersea Harbour Protection Trust has had detailed discussions with Harwich Haven Authority to obtain material dredged from the planned deepening of the Approaches channel for reuse. The risks to marine life, from the release of sediments during disposal have been assessed taking account of the resuspension of chemical pollutants and increases in turbidity. Measures have been proposed to avoid or minimise any potentially adverse impacts to protected marine habitats and species and enable compliance with the Water Framework Directive as well as the Birds and Habitats Directives. As such the proposal will meet the objectives of the UK MPS during the construction phase.

Mitigation
No mitigation required.

Residual impact

A residual impact of meeting the objectives of the UK MPS remains.

Impact identification

Operational phase: Potential to fulfil the requirements of UK Marine Policy Statement

Impact assessment

The Mersea Harbour recharge proposal has been designed to take account of the economic, social and environmental needs of the Mersea Harbour area working within the framework outlined for these interests in the MPS.

It meets with the following high level objectives defined in the policy statement for attaining sustainable development in the marine area:

Achieving a sustainable marine economy

The Mersea Harbour Protection Trust (MHPT) is supported by marine businesses including those representing commercial fisheries interests and the leisure boating industry. The proposal, by protecting the Mersea Harbour from storm surges, will enable the marine environment and its resources to continue to be used to maximise sustainable activity.

In pursing the current proposal the MHPT has taken a long-term strategic approach to managing the risks posed by climate-change induced sea level rise and seeks to manage the risks effectively. This will allow marine enterprises to continue to operate efficiently and competitively.

Ensuring a strong, healthy and just society

With the convening of the Mersea Harbour Protection Trust to drive forward the recharge proposals, responsibility is being taken at the community level to mitigate climate-change induced sea level rise in the harbour area. The proposals aim to address coastal erosion and flood risk while fully respecting the diversity of the marine environment, the natural processes which operate in the area, and the cultural heritage of the Mersea Harbour.

Living within environmental limits

The proposal seeks to both protect and recover the loss of biodiversity resulting from coastal erosion within and adjacent to the Mersea Harbour. The importation of sand and shingle dredgings of a similar grain size to those found naturally at the estuary mouth, will slow down, but work with, dynamic processes and will support the continued functioning of the marine ecosystem at this location in the medium to longer term.

Promoting good governance

The MHPT is an example of stakeholders promoting and developing sustainable coastal management working alongside marine and coastal regulators, including the Environment Agency, Essex County Council, Colchester Borough Council, and with Harwich Haven Authority.

Using sound science responsibly

The current recharge design proposal is based on a sound understanding of the natural dynamic processes operating in the harbour area and how these have interacted with earlier recharge placements and enabled the protection of important scientific features. The social

and economic needs of the local community have also been fully researched with sustainable use at the forefront of the proposal.

The Mersea Harbour recharge proposals accord with the detailed considerations outlined in the MPS:

Marine ecology and biodiversity

The proposed scheme design, developed from the study of earlier recharge schemes in the Mersea Harbour area, will benefit marine habitats and species, and has a principal aim to halt and reverse biodiversity loss.

Climate change adaptation and mitigation

The scheme proposal offers a resilient solution to climate change in the medium to longer term, working with natural processes to address coastal erosion.

Seascape

The proposed recharge will not impact the existing visual quality of the seascape in the estuary mouth. Wave-built sand and shingle beaches are characteristic features of the proposal area and important sub features and supporting features of the designated sites.

The Mersea Harbour recharge proposals meet the MPS objectives for the disposal of marine dredgings:

The recharge development will deliver environmental benefits by protecting the saltmarsh and foreshore, while offering the potential to restore mudflats as well as providing nesting and roosting opportunities for sea and wading birds. Social and economic benefits will derive from the protection of the harbour from high energy wave events.

The burial of seabed flora and fauna, hydrological effects, interference with other marine activities, and potential adverse effects on features of designated nature conservation areas and heritage assets have been evaluated. Measures have been proposed to avoid or minimise any potentially adverse impacts on protected habitats and species and to enable compliance with the Water Framework Directive and the Birds and Habitats Directives.

As such the proposal will **meet the objectives** of the UK MPS during the operational phase.

Mitigation
No mitigation required.

Residual impact

A residual impact of **meeting the objectives** of the UK MPS remains.

13.11.2 Land use policy statements and spatial plans

National Planning Policy Framework

The National Planning Policy Framework (2012) outlines the government's planning policies for England and how these are expected to be applied. It states that the purpose of the planning system is to contribute to the achievement of sustainable development by fulfilling an economic, social and environmental role.

Colchester Borough Council - Local Development Framework (2008) development policies

Policy DP21: Nature Conservation and Protected Lanes

This policy seeks to fulfil Colchester Borough Council's legal duties under the Natural Environment and Rural Communities Act 2006 and supports, in principle, development proposals where the key objective is to conserve or enhance biodiversity and geodiversity interests.

Policy DP23: Coastal Areas

Policy DP23 aspires to balance environmental protection obligations against the wider socio-economic needs of coastal communities.

Maldon District Council Replacement Local Plan (2005) – development policies

Policies CC1 and CC2

These policies are in place to protect internationally and nationally important designated sites from the direct and indirect effects of developments.

Policy CC7: Special Landscape Areas (SLA)

The proposal site is located in the Blackwater – Colne Special Landscape Area. Development proposals in the SLA will need to demonstrate that the siting, design, materials and landscaping will conserve or restore the character of the area.

Maldon District Council Submitted Local Development Plan (2014) development policies

Policy N2: Natural Environment, Geodiversity and Biodiversity

Policy N2 encourages development proposals which help to improve the condition of existing international, national or local designations. It requires that all development should seek to deliver net biodiversity and geodiversity gain where possible.

Impact identification

Construction phase: Potential to meet the objectives of national and local development policies

Impact assessment

No conflicts with national or local policies have been identified.

Impact identification

Operational phase: Potential to fulfil the requirements of national and local plan development policies

Impact assessment

The current proposal offers the prospect of meeting the requirements of the NPPF by:

- Contributing to the protection and enhancement of the natural environment through the improvement of biodiversity.
- Minimising waste – by reusing dredgings.
- Mitigating and adapting to climate change.

The proposal meets the conditions stipulated by Colchester Borough Council's Local Development Framework (2008) Policy DP21: Nature Conservation and Protected Lanes, in:

- Maximising opportunities for the restoration, enhancement and connection of natural habitats in accordance with the Essex Biodiversity Action Plan.
- Incorporating beneficial biodiversity conservation features and habitat creation.

The recharge proposal demonstrates that it satisfies Policy DP23: Coastal Areas, of Colchester Borough Council's Local Development Framework (2008), meeting the following criteria:

- It will not be significantly detrimental to conserving important nature conservation, historic environment assets, maritime uses and the landscape character of the coast.
- It will sustain social and economic benefits considered important to the wellbeing of coastal communities.
- It will provide opportunities and scope for adaptation to climate change.

The recharge proposal satisfies Policy CC7, Special Landscape Areas, of Maldon District Council's Replacement Local Plan (2005) by helping to conserve and restore the character of the area, typified by saltmarsh, mudflats, shingle spits and beaches.

The current proposal meets the brief outlined in Policy N2, Natural Environment, Geodiversity and Biodiversity, of Maldon District Council's Submitted Local Development Plan (2014), to improve the condition of existing international, national or local designations and deliver net biodiversity gain.

It can be concluded that the proposed scheme will **meet the objectives** outlined in the National Planning Policy Framework and the local development plan policies.

Mitigation
No mitigation required.

Residual impact

A residual impact of **meeting the objectives** of the NPPF and local development plan policies applies.

13.12 In combination/cumulative effects

13.12.1 In combination effects

Under the Conservation of Habitats and Species Regulations 2010 it is a requirement to consider the effects of all development proposals in the area which, in combination with the current proposal, could potentially impact the same interest feature(s) of the European site. The in combination assessment should take account of projects of a similar nature.

13.12.2 Cumulative effects

Cumulative effects need to be addressed under The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended). This requires the assessment of incremental effects whereby the current project could compound the residual effect of another project(s), via the same impact pathway.

Impact identification

Construction phase: Potential to cause in combination and/or cumulative impacts with reference to the activities described below

Impact assessment

Dredging over the soft mud foreshore south of West Mersea to harvest Pacific oysters (*Crassostrea gigas*) creates plumes of sediment over the duration of the tide. This practice is continual throughout the year.

In the Essex and South Suffolk Shoreline Management Plan (Environment Agency, 2010), it is proposed to hold the line until 2025 in Management Unit E, Mersea Island, which includes defences to landward of Packing Marsh and Cobmarsh Islands, and Management Unit F, the Blackwater Estuary, which includes Old Hall and Tollesbury Wick marshes. Work proposed for the period up to March/April 2017 in the Mersea Island Management Unit includes grass control and structural inspections. In Unit F, operational checks and grass control is planned with repairs to the sewage treatment works counterwall at Tollesbury, involving earthworks and reprofiling.

Magnox Ltd have submitted a licence application to the Marine Management Organisation regarding options for a new permanent access to the barrier wall off of Bradwell Power Station, in the Blackwater estuary (MMO public register ref: MLA/2015/00265). This will involve removing old and temporary structures and replacing with a staircase or pontoon. The application is currently on hold.

There is no significant evidence of any cumulative and/or in-combination effects arising with regard to the sea defence and power station activities currently listed. However, there is the potential for an in combination/cumulative effect of **minor adverse** significance if oyster beds are worked during the early phases of the recharge operation which could potentially add to the volume of sediment circulating in the water column.

Mitigation
As a precaution, and in consultation with the local oystermen, it is advised that oyster dredging is suspended during the early phase of the recharge programme.

Residual impact

The residual impact is considered to be of **negligible** significance.

The current proposal, either individually or cumulatively, would not inhibit the achievement of Good Environmental Status in the marine environment, at the regional or subregional scale, as required under the Marine Strategy Framework Directive.

Both the in combination and cumulative effects assessment will need to be reviewed prior to the scheduled Harwich Approaches dredge.

14. Monitoring

The schedule for pre and post placement monitoring is outlined in Table 17. Data collection for some of the parameters has already been completed while other features will continue to be monitored seasonally prior to the recharge placement. During the early delivery phase, the turbidity of the water column and silt settlement will be checked and compared with baseline data. Post recharge placement, monitoring will be mainly centred on hydrodynamic processes including gathering data on the elevation, configuration and spatial distribution of the material and information on tidal velocity at established locations. Bird usage, particularly focussing on little tern (see below), and changes in the foreshore protected by the recharge bunds will also be investigated. These surveys will generally be carried out within a three-year time scale, with the exception of surface elevation of the recharge which will continue for five years. Monitoring reports will be compiled annually and submitted to the regulating bodies.

14.1 Monitoring of breeding little tern

In order to address the specific threats to nesting colonies of little tern, the RSPB and wildlife trust partners were granted LIFE funding from the European Union in 2013 to co-ordinate a five-year national programme of action (RSPB, 2016). This is focussing on 15 Special Protection Areas, including the Blackwater Estuary. The principle objective is to increase the population of little tern by: improving the management of existing breeding sites; supporting the restoration and creation of recently abandoned nesting sites, to help offset the loss of breeding habitat due to sea level rise; protecting little terns, and their nests and eggs from disturbance and predation; and gaining a better understanding of population movements. A further key aim is to seek to ensure that conservation actions are aligned with long term policy frameworks such as Shoreline Management Plans. A co-ordinated programme of site monitoring is underway and this will inform project management. The RSPB and Essex Wildlife Trust have formed a Little Tern Group on the Blackwater estuary which aims to work with the local community and the sailing clubs to control recreational access at the recharge nesting sites. Both the RSPB and Essex Wildlife Trust have given their support to the Mersea Harbour Protection Trust proposals to secure the viability of breeding little tern in the Mersea Quarters and Tollesbury Wick.

Table 17. Proposed monitoring programme pre and post placement.				
Monitoring parameter	**Purpose**	**Location**	**Pre-placement survey**	**Post placement monitoring - timing and frequency**
Current speed and direction	To monitor any changes in tidal flow velocity and direction.	South shore, Old Hall Point and Mersea Fleet, Cobmarsh Island	16 June 2015 Carried out during a spring tide at 30 minute intervals 2 -3 hours before and after high tide.	Immediately post placement then annually for 3 years.
Surface elevation	Digital surface modelling to monitor any changes in surface elevation above ODN level and any spatial redistribution of material.	All recharge sites	2014	Immediately post-placement then at annual intervals for 5 years.
Bathymetry	To monitor any changes in surface elevation below ODN level and any spatial redistribution of material.	All recharge sites	Data to be collected.	Immediately post placement then annually for 3 years.
Silt deposition	To measure build-up of silts inside the recharge bunds.	Cobmarsh, Old Hall and Tollesbury Wick	-	At 6-monthly intervals for 1 year then annually for 3 years.
Intertidal marine communities	To record any changes in abundance of marine invertebrates and community types, and to record presence of invasive species.	All recharge sites repeating 2015 transect survey.	August/September 2015	Once, in August/September, 3 years post placement.
Bird feeding - overwinter	To monitor bird usage of intertidal flats.	Cobmarsh Island and Old Hall foreshore inside recharge bunds.	Over at least 2 seasons prior to placement, recording on 2 separate occasions between October and March.	Over 3 seasons.
Bird nesting	To monitor nesting of all bird species, with particular focus on the Annex 1 species, the little tern, counting nests and young.	All recharge proposal sites (and earlier recharge sites).	Further monitoring of current recharge sites for at least one season prior to new	Annually over 3 years, with 2 counts each season in June and July.

Table 17. Proposed monitoring programme pre and post placement.				
Monitoring parameter	**Purpose**	**Location**	**Pre-placement survey**	**Post placement monitoring - timing and frequency**
	Monitoring of little tern in the Blackwater Estuary is already underway through the little tern recovery project (RSPB, 2016) and data is being shared with the MHPT.		recharge placement.	
Bird roosting	To monitor bird usage of new recharge.	All recharge proposal sites (and earlier recharge sites).	-	Annually over 3 years – 2 counts between October and March.
Turbidity as a surrogate for considering potential for sedimentation on oyster beds	To assess any increases in turbidity, from an established baseline and the potential for silts to settle on private oyster beds and the free grounds during discharge of early loads.	Private oyster beds in the harbour creeks and the grounds south of West Mersea.	Water samples will be taken at fixed locations for testing within 2 hours of the start of an ebb tide during calm conditions and during easterly winds, to obtain a baseline.	Sampling during the early discharge of material to compare with baseline along with monitoring, by the oystermen, of oyster beds for silt settlement. Any significant increases above baseline levels may require a change to the discharge regime. No monitoring would be required post placement.
Retainment of recharge	To ensure material is retained where considered to be more vulnerable to wind and wave events.	Cobmarsh and Packing Marsh Islands	To construct fences prior to placement: work will be timed to avoid the breeding bird season and overwintering season.	Checks to be carried out monthly for the first 3 months post-placement. Subsequently monitoring to be carried out quarterly to check condition and repair as required; further fences to be constructed should monitoring demonstrate the need for this. Additional checks to be undertaken prior to predicted severe weather events and post severe events. Ongoing.

15. Conclusion and recommendations

The proposal design has benefitted significantly from the application of a predictive modelling approach based on the real-time performance of the earlier recharge. By drawing on observations of the previous scheme it has been possible to reduce any latent significant risks allowing potential impacts to be fully anticipated and appraised. Operationally, the new recharge would be expected to respond naturallly to wave and tidal forces to reach a dynamic equilbrium. It will form a protective barrier from erosion while remaining relatively stable whether aligned along the foreshore - as proposed at Cobmarsh Island, Old Hall and the upgrade at Tollesbury Wick – or placed as a single agglomeration at Packing Marsh Island. The scheme methodology and the mitigatory elements in place, both during the construction phase and operationally, will avoid any significant adverse impacts on estuary processes, water quality and the conservation features of the designated sites. The capacity for habitat creation has been demonstrated by the pre-existing recharge; the new recharge will also provide habitat suitable for supporting breeding little tern, developing nationally scarce high saltmarsh; and facilitating the establishment of mudflats over currently heavily eroded foreshore.

The proposal has been discussed in relation to its potential to manage the impacts of climate change and in the context of a 'do nothing' scenario. The Environment Agency predicts the loss of the entire saltmarsh of the Blackwater Estuary, as a result of coastal squeeze, by 2050 (EA, 2010F). The Essex and South Suffolk Shoreline Management Plan recognises the strategic importance of Cobmarsh Island in safeguarding the Mersea Quarters but acknowledges that it is vulnerable to extreme erosion and that further losses will increase the risk of flooding to the land behind (EA, 2010F). For this reason the SMP highlighted the need to identify opportunities for the beneficial use of dredgings within the SMP project area (EA, 2010). Both Cobmarsh and Packing Marsh Islands have been suggested as sites for inclusion in any future study to identify good receptor sites for reuse of dredgings. Without the earlier recharge (and the proposed reinforcement) the sea wall at Tollesbury Wick would be vulnerable to the impact of south-easterly waves. Both Tollesbury Wick Marshes and Old Hall Marshes – both within the SPA and Ramsar site – are scheduled for realignment in Epoch 3 of the SMP, between 2055 and 2105. The recharge offers the chance to increase storm and flood protection at these sites and possibly defer, or reverse, the current policy. It is with this in mind that the EA are contributing considerably to the cost of the recharge at Old Hall.

The Blackwater estuary is part of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone, the most important site for both wild and cultivated native oyster (*Ostrea edulis*) in the south-east region (Defra, JNCC & Natural England, 2016). The continued operation of the commercial beds is dependent on the sheltering effect of the islands in the Mersea Quarters and it was concern over the disappearance of the islands, due to erosion, which led the local native oyster fishermen to instigate the current recharge project. The general management approach for both the species itself and the oyster beds within the MCZ is to recover to favourable condition. However, this is only likely to be possible if the private fishery persists and is viable in the area providing resources in the form of manpower, boats and equipment, and knowledge and expertise passed down through generations, to manage and restore the species in the wider MCZ.

This is likely to be the last opportunity to obtain suitable grade dredgings for reuse at this location. By enabling the management of climate-change induced sea level rise, the scheme is anticipated to demonstrate significant social and economic benefits as well as being a conservation asset helping to sustain marine and coastal habitats in the lower Blackwater Estuary.

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Yates, B. Terns of Rye Bay.

List of Appendices

Appendix 1 - Consultation comments.

Appendix 2 - Letters of support.

Appendix 3 - Current Monitoring - Old Hall Point and Cobmarsh Island, 16 June 2015. Author: Jim Pullen.

Appendix 4 - Water quality data – Environment Agency

Appendix 5a - Sediment analysis data, Harwich Approaches, Harwich Haven Authority – Centre for Environment, Fisheries and Aquaculture Science (CEFAS)

Appendix 5b - Sediment quality data for recharge proposal sites, Mersea Harbour Protection Trust - CEFAS

Appendix 6a - Marine biotope survey of the intertidal flats at the recharge proposal sites: Mersea Quarters and Tollesbury Wick. Report prepared for the Mersea Harbour Protection Trust (2015). Author: Carol Reid.

Appendix 6b - Mersea Quarters Benthic Faunal Analysis and Particle Size Analysis. Report prepared by Thomson unicomarine for the Mersea Harbour Protection Trust (2015). Authors: Charlotte Newberry and Sajan Sebastian.

Appendices are available in a separate folder.