



## **Supplementary Environmental Information**

*Able Marine Energy Park & Habitat Compensation Scheme  
Water Framework Directive Assessment*

*Supplementary Report EX 8.12*

June 2012  
Revision: 0  
HR Wallingford

# **Able Marine Energy Park and Habitat Compensation Scheme**

## **Water Framework Directive Assessment**

### **Technical Note DHM6835-02**



**HR Wallingford**

**Address and Registered Office:** HR Wallingford Ltd. **Howbery Park, Wallingford, OXON OX10 8BA**  
**Tel:** +44 (0) 1491 835381 **Fax:** +44 (0) 1491 832233

Registered in England No. 2562099. HR Wallingford is a wholly owned subsidiary of HR Wallingford Group Ltd.

## Document information

<b>Project</b>	Able Marine Energy Park & Habitat Compensation Scheme
<b>Technical subject</b>	Water Framework Directive Assessment
<b>Client</b>	Able UK
<b>Client Representative</b>	Richard Cram
<b>Project No.</b>	DHM6835
<b>Technical Note No.</b>	DHM6835-02
<b>Project Manager</b>	Samantha Dawson
<b>Project Director</b>	Nicola Clay

## Document history

Date	Release	Prepared	Approved	Authorised	Notes
28/06/12	1.0	NC	KLH	NC	

**Prepared** .....

**Approved** .....

**Authorised** .....

© Able UK

*HR Wallingford accepts no liability for the use by third parties of results or methods presented in this report.*

*The Company also stresses that various sections of this report rely on data supplied by or drawn from third party sources. HR Wallingford accepts no liability for loss or damage suffered by the client or third parties as a result of errors or inaccuracies in such third party data*

## *Acronyms and abbreviations*

AWB	Artificial Water Body
BWD	Bathing Waters Directive
EA	Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
GCS	Good Chemical Status
GEP	Good Ecological Potential
HD	Habitats Directive
HMWB	Heavily Modified Water Body
HRA	Habitats Regulations Assessment
MEP	Marine Energy Park
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SPA	Special Protection Area
SWD	Shellfish Waters Directive
UKTAG	United Kingdom Technical Advisory Group
WFD	Water Framework Directive



# Contents

<i>Document information</i>	<i>ii</i>
<i>Acronyms and abbreviations</i>	<i>iii</i>
<i>Contents</i>	<i>v</i>

1.	Introduction.....	1
1.1	Reclamation .....	1
1.2	Capital dredging .....	1
1.3	Disposal of dredged material .....	1
1.4	Habitat Compensation Scheme .....	1
1.4.1	Cherry Cobb Sands.....	1
1.4.2	Little Old Humber Farm .....	2
1.5	Water bodies .....	2
2.	WFD Assessment Methodology .....	3
2.1	Potentially affected water bodies .....	3
2.1.1	Adjacent water bodies .....	3
2.1.2	North Killingholme Haven Pits.....	4
2.1.3	Keyingham Drain, Otteringham Drain, Burstwick Drain .....	4
2.1.4	Hull and East Riding Chalk Ground water body.....	5
3.	Humber Lower Water Body .....	5
3.1	Characteristics .....	5
3.2	Current status .....	5
3.3	Scope of WFD Assessment.....	7
3.4	Deterioration or other effect on WFD status .....	12
3.4.1	Hydromorphological conditions .....	12
3.4.2	Physico-chemical conditions and chemical status .....	13
3.4.3	Biological quality elements .....	14
3.4.4	Protected areas .....	20
3.4.5	Effect on mitigation measures ‘not in place’ .....	20
3.4.6	Contributing to improvements in WFD status.....	20
4.	Little Humber Area Water Body.....	21
4.1	Characteristics .....	21
4.2	Current status .....	21
4.3	Scope of WFD Assessment.....	22
4.4	Deterioration or other effects on WFD status .....	24
4.4.1	Biological quality elements .....	24
4.4.2	Hydromorphological conditions .....	24
4.4.3	Physico-chemical conditions and chemical status .....	25
4.4.4	Contributing to improvements in WFD status.....	26
5.	Conclusion .....	27
6.	References .....	28

## Tables

Table 1	Port related mitigation measures in the Humber RBMP .....	6
Table 2	Protected area status.....	7
Table 3	Scope of WFD Assessment.....	8

## Figures

Figure 1	WFD water bodies within and adjacent to the compensation site .....	2
Figure 2	Benthic Invertebrate Status.....	16



# 1. Introduction

Able UK Ltd. proposes to construct a Marine Energy Park (MEP) near Immingham on the southern bank of the Humber estuary. The MEP will provide a facility for the marine energy sector, initially for the construction of offshore wind turbines and other activities associated with renewable energy generation.

The key features of the development are:

- Reclamation
- Capital dredging
- Disposal of dredged material
- Habitat compensation scheme

Environmental Impact Assessments (EIA) have been carried out and Environmental Statements (ES) prepared for both the MEP and the habitat compensation scheme. Water Framework Directive (WFD) Assessments have also been prepared for the project. Able UK Ltd. has been asked by the Environment Agency (EA) to update the WFD Assessments to incorporate the results of recent studies and to consider the combined effects of the MEP and the habitat compensation scheme. **This overarching WFD Assessment (TN-DHM6835-02) replaces the existing separate WFD Assessments (TN-DER 4712-03 and TN-DHM6835-01).**

## 1.1 RECLAMATION

The reclamation area is located within the footprint of the quay and will affect both intertidal and sub-tidal estuary habitat. It is anticipated that the total dredge quantities for the reclamation area will be 294,500 m<sup>3</sup>.

## 1.2 CAPITAL DREDGING

Capital dredging will be carried out to create a berth pocket and manoeuvring area. Dredging will affect sub-tidal estuary habitat. The total capital dredge will be approximately 1,935,500 m<sup>3</sup>.

## 1.3 DISPOSAL OF DREDGED MATERIAL

Dredged material will be disposed of within the estuary in a number of disposal sites which will maintain the sediment supply. Sites are divided between erodible and non-erodible deposits. Approximately 954,350 m<sup>3</sup> of erodible material will be placed at HU082 and ~981,150 m<sup>3</sup> of non-erodible material will be placed at HU080.

## 1.4 HABITAT COMPENSATION SCHEME

The habitat compensation scheme comprises two parts 1) managed realignment to create an intertidal area and wet and 2) wet grassland.

### 1.4.1 *Cherry Cobb Sands*

The intertidal compensation site, Cherry Cobb Sands, will be developed in a 100 ha plot, located on the north bank of the Humber Estuary, opposite the MEP, approximately 4 km south-west of Keyingham and north of Stone Creek. The site currently comprises Grade 2 arable fields bounded by drainage ditches and a flood defence embankment.



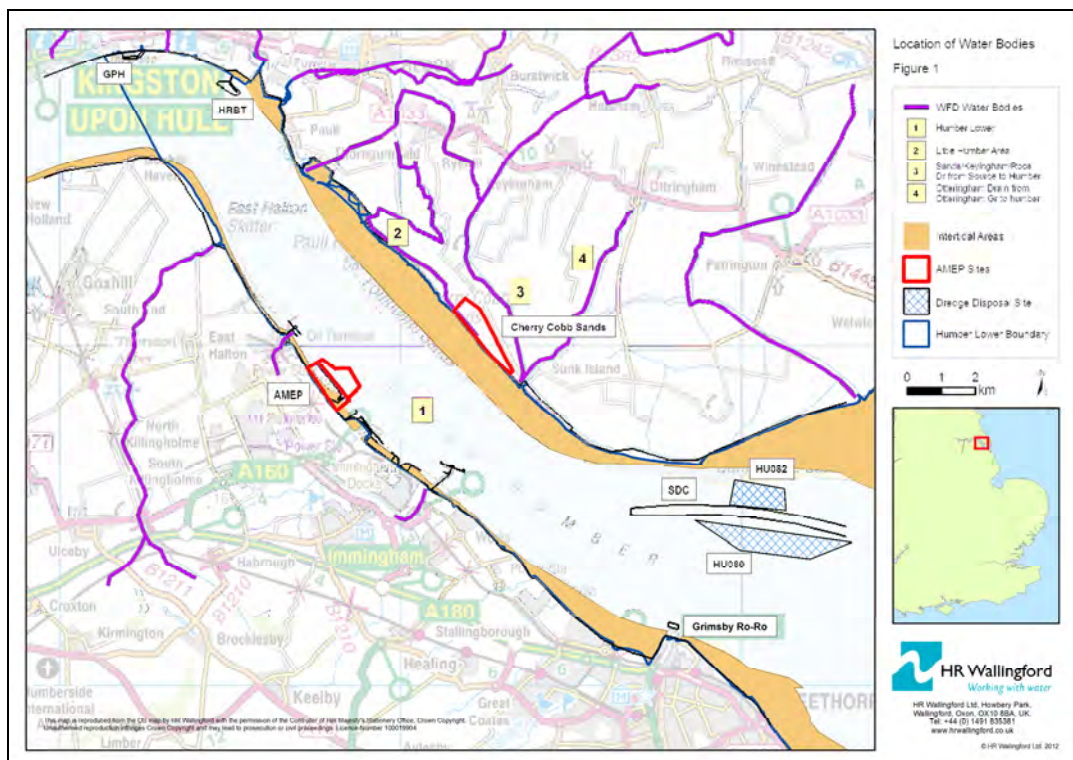
### 1.4.2 Little Old Humber Farm

The managed wet grassland compensation site, Little Old Humber Farm, will be developed on a plot of four existing arable fields, located between Newlands Lane and the South Ends and Thorney Crofts Drain. The existing hedge crossings and ditches bordering the land are not proposed to be disturbed.

## 1.5 WATER BODIES

Figure 1, adapted from the ES (insert ref), shows the location of the various aspects associated with the development of the MEP, the habitat compensation scheme and the proximal water bodies, which include the following:

- Humber Lower (transitional water body);
- Little Humber Area (freshwater artificial water body);
- Keyingham Drain (part of Sands/Keyingham/Roots Drain from Source to Humber artificial water body);
- Otteringham Drain;
- Burstwick Drain;
- Hull and East Riding Chalk (ground water body).



**Figure 1 WFD water bodies within and adjacent to the compensation site**

This report presents the WFD assessment of the MEP and habitat compensation scheme on the water bodies listed in Section 1.5.

## 2. *WFD Assessment Methodology*

Presently, there is no specific guidance about the application of the WFD to marine/estuarine construction projects or managed realignment schemes. This WFD assessment is, therefore, based upon the philosophy set out in existing EA and other guidance for transitional waters (including the 'Clearing the waters' guidance and relevant UKTAG standards). The principles and concepts described in these documents have been applied to the WFD compliance assessment.

The WFD assessment has been informed by the Environmental Statements prepared for the MEP (Able UK Ltd and habitat compensation scheme (Able UK Ltd and Black & Veatch 2011) in addition to discussions with the Environment Agency and Defra as well as the expert opinion of the HR Wallingford-led project team.

HR Wallingford has not undertaken a peer review or quality audit of the ES or the associated technical reports. While we have drawn our conclusions making reference to the ES, in cases where the ES conclusions may be unclear or the reasoning behind the impact assessment is not explained we have used our experience to assess the likelihood of an effect on WFD parameters at water body level.

During the assessment it was necessary to make a number of assumptions, as follows:

- The scope of the Environmental Impact Assessment (EIA) had previously been agreed with the appropriate regulators including the EA (and that the EA response highlighted the issues of potential relevance to the WFD).
- The Habitats Regulations Assessment (HRA) compensation proposal will 'sign off' the HRA (i.e. no outstanding issues regarding effects on the SPA-SAC).
- Where the River Basin Management Plan (RBMP) contains insufficient data for a parameter, for the freshwater water body we have used information from the adjacent water body while for the transitional water body we have assumed the parameter is at good status unless indicated otherwise in Annex B of the RBMP.
- For the transitional water body where data are not available for certain specific pollutants or hazardous priority substances due to their not forming part of routine sediment analysis for dredged material, we have based our assessment on our prediction of the likelihood of them being present at levels above CEFAS Action Level 1.

### 2.1 POTENTIALLY AFFECTED WATER BODIES

The water bodies in the vicinity of the habitat compensation scheme are listed in Section 1.5 and shown on Figure 1. Of these water bodies a detailed assessment of WFD compliance has been carried out for Humber Lower transitional water body (Section 3), and the Little Humber Area fresh water body (Section 4). The other water bodies were excluded from the detailed assessment for the reasons given below.

#### 2.1.1 *Adjacent water bodies*

The Humber Lower water body becomes the Humber Middle water body upriver, whilst to seaward it becomes the Yorkshire South/Lincolnshire coastal water body. The closest part of the project to the boundary with the Humber Middle water body is the MEP at >10 km. Moving seaward, the disposal sites are located closest to the coastal water body at a distance of approximately 10 km. The Humber Middle Water Body is considered to be sufficiently distant that it should not form a part of this WFD assessment. The coastal water body, while closer, is a very large water body extending from Flamborough Head in the north to the Wash. This water body is heavily modified and at moderate ecological potential with nitrogen and phytoplankton being identified as the cause of the failure to meet good ecological potential. There is no indication that the

sediment from the MEP that will be disposed of at the sites has a high nitrogen content. It can be concluded, therefore, that the use of these existing disposal sites is not considered likely to cause deterioration in the Yorkshire South/Lincolnshire water body or affect its ability to move towards good potential.

The approach taken in the WFD assessment is, therefore, to assume that as long as there are no effects on the Humber Lower water body that are considered significant at water body level then there will equally not be any significant effects on these adjacent water bodies. This working assumption is reviewed in the overall conclusions (Section 5).

### *2.1.2 North Killingholme Haven Pits*

The North Killingholme Haven Pits transitional water body (ID GB560402916700) is located in the vicinity of the proposed development. There is occasional direct hydraulic connectivity via a sluice between the Humber Lower and the North Killingholme Pits water bodies; however, this sluice is opened only at certain periods during the year. If the water in the lagoon is too high then the sluice is opened at low tide to allow water to flow from the lagoon to the Humber. If the water in the lagoon is too low then at high tide the sluice is opened to allow water to flow from the Humber to the lagoon. The location of the sluice gate itself is on the Humber side of the seawall in the north-west corner of the area, just outside the site. The water from the Humber already contains a high suspended sediment load: the increases in suspended solids associated with the dredging activity will be temporary and within the envelope of normal background levels. Further, there does not appear to be any mechanism by which on site construction activities (including drainage) or the subsequent operation of the site would affect this water body. HR Wallingford's report on dispersion modelling (EX6503) around the E.ON intake and outfall concludes that under existing conditions the plume from the outfall is rapidly dispersed so that water abstracted at the intake is less than 0.1 °C above ambient temperature. The presence of a quay will force the plume from the outfall offshore parallel to the side of the quay in the direction of the intake. There is, therefore, no obvious mechanism by which the development of the MEP could have a non-temporary effect on the status of North Killingholme Haven Pits at water body level. No further assessment has been undertaken for this water body.

### *2.1.3 Keyingham Drain, Otteringham Drain, Burstwick Drain*

These water bodies lie outside the boundaries of the habitat compensation site and will not be directly affected by any of the works to create the new habitats (for example the closest water body Keyingham Drain, which is part of the 'Sands/Keyingham/ Roos Drain from Source to Humber' artificial water body, lies 100 m outside Cherry Cobb Sands to the north). However, each drain discharges to the Humber Lower water body. The potential for an effect is therefore related to construction activities at the Cherry Cobb Sands site resulting in sediment-laden or contaminated water entering the drains. Keyingham Drain discharges from an outfall via a sluice at Stone Creek and Otteringham Drain discharges via the same outfall and sluice. Burstwick Drain also discharges into the Humber via a sluice that only opens at low tide. As the sluices are closed, except for at low tide, this prevents any estuarine water from entering these water bodies, thus there is no mechanism for potential impacts associated with temporary increased suspended sediment concentrations sourced from these artificial water bodies entering the adjacent Humber Lower transitional water.

The EA is, however, concerned that siltation may occur in front of the sluices that could prevent these water bodies from discharging to the Humber Lower water body. This could lead to additional deposition in areas of reduced velocity behind the sluice gate which could in time affect the status of the artificial water bodies. This issue is recognised in the ES: Section 36.6.1 refers to 'Construction activities' being 'managed to ensure drainage of surrounding land is not compromised at any time'. This assessment

therefore assumes that this includes ensuring that the current deposition levels in front of the sluice gates are not exacerbated and no further investigation has therefore been carried out

#### *2.1.4 Hull and East Riding Chalk Ground water body*

Section 33 of the habitat compensation scheme ES concludes that there will be no impact from the habitat compensation scheme on the Hull and East Riding Chalk ground water body, in part because of the depth of this primary chalk aquifer which is overlain by around 20 to 25 m of marine and estuarine alluvium and 1 to 5 m of more recent deposits (Black and Veatch, 2012). The ES further concludes that there are no source protection zones within 2 km of the proposed compensation site and it is therefore considered that no source protection zones will be affected by the works at either Cherry Cobb Sands or Old Little Humber Farm. Based on the conclusions of the ES, no further consideration of ground water is included in this WFD assessment.

### *3. Humber Lower Water Body*

The dredging, reclamation and disposal will all take place in the same water body – the Humber Lower transitional water body (ID GB530402609201). The proposed Cherry Cobb Sands compensation site will, once the sea wall is breached, become part of the Humber Lower transitional water body (ID GB530402609201). The WFD assessment for the Little Humber Area water body is presented separately in Section 4.

#### **3.1 CHARACTERISTICS**

Reference to the 2009 Humber RBMP indicates that the Humber Lower water body is designated as a heavily modified water body (HMWB), with both flood protection and navigation (i.e. dredging) cited as the reasons for this designation. The WFD ecological target for the water body is therefore good ecological potential (GEP) and, as with all surface water bodies, the default chemical status objective is good chemical status (GCS). The water body is large, covering an area of 247 km<sup>2</sup>.

#### **3.2 CURRENT STATUS**

Annex B of the Humber RBMP confirms that the Humber Lower water body is at moderate ecological potential overall. According to this Annex, the water body is currently failing to meet its WFD objectives in respect of dissolved inorganic nitrogen, zinc and tributyltin. It is also at moderate potential in terms of invertebrates but the MS (morphology sensitive) exemption is applied which overrides the GEP target. No measures are, therefore, required to improve the status of this parameter.

The Humber Lower water body is also currently at moderate ecological potential because several technically viable mitigation measures are recorded as being 'not in place'. These are all related to the flood risk management element of the HMWB designation, and comprise measures to preserve and enhance marginal habitats, promote managed realignment, and replace hard defences with soft engineering solutions. Notwithstanding that these measures are related to flood risk management modifications, there may nonetheless be opportunities for other types of development to contribute to improving the ecological potential of the water body.

With the exception of zinc (where the Environment Agency anticipates that the closure of the point source causing the problem will lead to an improvement from moderate (uncertain) to high status), the 2015 WFD target in respect of the other currently failing ecological and chemical parameters is unchanged from the present situation. The reasons cited for this continued failure include disproportionate cost and technical

infeasibility – however, it is anticipated that the water body will meet its WFD objectives by 2027.

There are a number of mitigation measures relating to port activities (including dredging and disposal, structures and vessel movement) and according to the RBMP, all measures which are relevant with regard to existing navigation activities are already 'in place'.

Table 1 lists the mitigation measures used in the GEP assessment that may be relevant to the development and operation of the MEP; this is included here to ensure that all measures which may be relevant to the various project elements can be identified as these may differ from the measures relevant to ongoing maintenance dredging and disposal operations.

**Table 1 Full list of Port related mitigation measures**

<b>Mitigation Measure</b>
<b>Dredging</b>
Avoid need to dredge (e.g. by use of fluid mud navigation)
Prepare dredging strategy (includes disposal strategy)
Reduce impact of dredging (shallower depth, choice of dredger type)
Reduce sediment re-suspension
Alter timing of dredging (includes disposal)
Sediment management (by-passing, recharge, beneficial use) (26)
<b>Disposal</b>
Avoid sensitive sites in disposal site selection
Manage (limit) physical disturbance
Prepare disposal strategy
Alter timing of disposal
<b>Structures</b>
Remove obsolete structures
Modify structures to reduce effect on natural processes
Manage flows
Sediment management

Insofar as protected areas are concerned, Annex D of the RBMP records the status of protected areas as shown in Table 2.

**Table 2 Protected area status**

Protected Area	Relevant Legislation	Status
Humber South East Shellfish Water	Shellfish Waters Directive (SWD)	Guideline fail, imperative pass
Cleethorpes Recreational Bathing Water	Bathing Waters Directive (BWD)	Guideline pass; predicted compliance assessment under revised BWD, excellent
Humber Estuary Special Protection Area (SPA) and Special Area of Conservation (SAC)	Birds and Habitats Directives	Humber Estuary SPA not currently meeting water quality objectives; Humber Estuary SAC not meeting abstraction, by-catch, coastal squeeze, diffuse pollution or water quality objectives (however, both are due to meet their Article 4(1c) objectives by 2015)

Nitrate Vulnerable Zones exist within the vicinity of both the MEP site and the Cherry Cobb Sands site.

Annex D of the RBMP does not make clear why protected areas under the Freshwater Fish and Urban Waste Water Treatment (UWWT) Directives are listed in Annex B for the Humber Lower transitional water body. As there is no obvious mechanism for the project to affect the areas that are designated under the UWWT Directive, no further assessment of this protected area characteristic was deemed necessary. The Freshwater Fish Directive is considered as part of the assessment on the WFD fish parameter.

### 3.3 SCOPE OF WFD ASSESSMENT

The potential impacts associated with the MEP and habitat compensation scheme at Cherry Cobb Sands that may affect the Humber Lower water body are considered to be:

- Removal of aquatic flora which is protected under the SAC, SPA and Ramsar designations; but note the predicted medium-long term gains of saltmarsh in the compensation area;
- Changes to morphology, water depth and bed substrate;
- Changes in current speeds and consequent changes to erosion or deposition patterns;
- Temporary increases in suspended sediment levels;
- Disturbance to fish and ecology (throughout life cycle);
- Remobilisation of contaminated sediments within the soil of the compensation site and flushing of pollutants into the estuarine waters after the breach;
- Reduction in levels of dissolved oxygen;
- Changes to the intertidal zone structure during operation of the Cherry Cobb Sands compensation site;
- Local siltation in front of the sluice affecting adjacent water bodies - discussed in Section 2.1.3.

It is noted that other construction activities may be associated with environmental effects for example, noise, however noise is not within the scope of the WFD. Noise is within the scope of the Marine Framework Strategy Directive but it is understood that compliance with this Directive can be demonstrated via the EIA process. Noise impacts should, therefore, be progressed through that route and are not considered in this report.

Using a combination of the thresholds and triggers in 'Clearing the waters' (which are specifically designed for transitional and marine water bodies) and UKTAG standards, the WFD assessment for the Humber Lower water body has, therefore, been scoped to include the WFD parameters in Table 3.

**Table 3 Scope of WFD Assessment**

WFD Parameter (quality elements, specific pollutant priority substance, Protected Area)	Reclamation	Capital Dredging	Disposal of Dredged Material	Intertidal Compensation Site (Cherry Cobb Sands)
<b>Biological elements</b>				
Phytoplankton	Most phytoplankton are confined to the outer limit of the estuary with the plume extending into coastal waters (Section 10.5.22 ES) i.e. not in the vicinity of the MEP development. There is no clear mechanism for any of the aspects of the project to affect phytoplankton.			
Other aquatic flora (e.g. saltmarsh and seaweed)	The reclamation, dredging and disposal activities are not predicted to have a significant direct effect on aquatic flora including saltmarsh (Figure 10.2 ES). There will be the loss of a few individual saltmarsh plants in the vicinity of the site (Section 10.6.10 ES) The indirect effects of these activities may result in the creation of saltmarsh however flow modelling does not predict any potential erosion of saltmarsh (or any intertidal) areas (Table ES1 and ES 2 in Exec Summary of JBA supplementary report to section 8.1 of ES)			The creation of the breach at the Cherry Cobb Sands site will affect saltmarsh. Guidance indicates that any loss of saltmarsh requires should be assessed for its significance.
Benthic invertebrate fauna	The combined footprint of the activities and their zone of effect indicates that a WFD assessment is required.			No affect on subtidal inverts.
Fish fauna (transitional only)	The combined footprint of the activities and their zone of effect indicates that a WFD assessment is required.			
<b>Hydromorphological elements supporting biological elements</b>				
<b>Morphological conditions</b>				
Depth variation	The combined effect of the activities on bathymetry produces localised increases and decreases in depth affecting (<1% of the water body area).			
Bed	The combined footprint of the activities and their zone of effect indicates that a WFD assessment is required.			
Intertidal zone structure	The reclamation will result in a loss of intertidal habitat. The Clearing the waters guidance indicates that any	The capital dredging will not directly or indirectly impact intertidal habitat.	The existing disposal sites are sub-tidal and are not located within 10m of the intertidal area	The creation of the breach at the Cherry Cobb Sands site will result in a loss of intertidal area.

WFD Parameter (quality elements, specific pollutant priority substance, Protected Area)	Reclamation	Capital Dredging	Disposal of Dredged Material	Intertidal Compensation Site (Cherry Cobb Sands)
	loss of intertidal requires should be assessed for its significance.		(the Clearing the waters trigger for assessment)	Guidance indicates that any loss of intertidal requires should be assessed for its significance.
<b>Tidal regime</b>				
Dominant currents (coastal water bodies only)	The Humber Lower water body is not a coastal water body therefore this parameter is not applicable.			
Freshwater flow (transitional water bodies only)	There is no mechanism for the activities associated with the MEP development to affect freshwater flow in the transitional water body.			
Wave exposure	Modelling of changes to wave height has indicated that there are no predicted impacts due to increases in wave height (Section 3.3.1 JBA supplementary report to section 8.1 of ES)			
<b>Chemical and physico-chemical elements supporting biological elements</b>				
Transparency	There is no obvious mechanism for the reclamation to have a non-temporary effect on transparency.	The combined effects of the dredging, disposal and discharge from the compensation site exceed the Clearing the waters trigger for assessment.		
Thermal conditions	There is no obvious mechanism for the activities associated with the MEP development to have a non-temporary effect on thermal conditions.			
Oxygenation conditions	There is no obvious mechanism for the reclamation to have a non-temporary effect on oxygenation conditions.	The combined effects of the dredging, disposal and discharge from the compensation site taken with the presence of a dissolved oxygen sag in the proximal part of the Humber Lower water body indicate that an assessment of the effects on oxygenation conditions is necessary.		
Salinity	There is no obvious mechanism for the activities associated with the MEP development to have a non-temporary effect on salinity.			
Nutrient conditions (e.g. nitrogen)	There is no obvious mechanism for the activities associated with the construction of the MEP development to have a non-			The compensation



WFD Parameter (quality elements, specific pollutant priority substance, Protected Area)	Reclamation	Capital Dredging	Disposal of Dredged Material	Intertidal Compensation Site (Cherry Cobb Sands)
	temporary effect on nutrient conditions.			site will be developed on arable land with a potential for elevated nutrient content. An assessment of this parameter is required.
<b>Specific Pollutants</b>				
Arsenic	There is no obvious mechanism for the reclamation to affect specific pollutants.	Levels of specific pollutants exceed CEFAS Action Level 1 therefore an assessment is required.		
Chromium				
Copper				
Zinc				
PCBs (congeners to be confirmed by EA & CEFAS)				
<b>Selected Priority Substances</b>				
Anthracene	There is no obvious mechanism for the reclamation to affect priority substances.	Levels of priority substances exceed CEFAS Action Level 1 therefore an assessment is required.		
Hexachlorobenzene, Hexachlorobutadiene and Hexachlorocyclohexane				
Penta Bromodiphenyl ethers				
Cadmium and its compounds				
Fluoranthene				

WFD Parameter (quality elements, specific pollutant priority substance, Protected Area)	Reclamation	Capital Dredging	Disposal of Dredged Material	Intertidal Compensation Site (Cherry Cobb Sands)
Lead and its compounds				
Mercury and its compounds (PHS)				
Napthalene				
Nickel and its compounds				
Polyaromatic hydrocarbons (Benzo(a)pyrene) (Benzo(b)fluoranthene) (Benzo(g,h,i)perylene) (Benzo(k)fluoranthene) (Indeno(1,2,3-cd)pyrene) and benzo(g,h,i)perylene)				
Tributyltin compounds				
Protected Areas				
Areas designated for the protection of economically significant aquatic species (shellfish waters, freshwater fish)	As the fish fauna parameter forms part of the scope of the assessment the Freshwater Fish Directive will be considered as part of that assessment.			
Bodies of water designated as recreational waters (bathing water)	There are no bathing waters within 2km of the MEP site or Cherry Cobb Sands site.			
Nutrient-sensitive areas including Nitrate Vulnerable Zones, polluted Waters and Sensitive Areas	There is no obvious mechanism for the activities associated with the construction of the MEP development to have a non-temporary affect on nutrient conditions.			As nutrients form part of the assessment for the compensation site, nutrient sensitive areas will be considered.
Protected Areas				
Areas designated for the protection of habitats or species where maintenance or improvement of the status of water is an important factor in their protection, including Natura 2000 sites (Special Areas of Conservation and Special Protection Areas)	The MEP development will result in the loss of habitats designated as part of Natura 2000 sites. A Habitats Regulations Assessment (HRA) has been prepared which, if accepted, will meet the requirements of the WFD. The requirements of the Birds and Habitats Directives are usually more stringent than the requirements of the WFD and, therefore, it is assumed that acceptance of the HRA will be satisfy the relevant protected area objectives.			

The following sections consider each of these parameters in turn in order to determine whether there might be deterioration in water body status (defined as a non-temporary effect on status at water body level) or an effect which prevents the water body meeting its WFD objectives).

### 3.4 DETERIORATION OR OTHER EFFECT ON WFD STATUS

The discussion in this section is based *inter alia* on the information provided in the ES which overall is considered sufficient to identify whether or not there is likely to be a non-temporary effect on status at water body level.

#### 3.4.1 *Hydromorphological conditions*

##### **Bed**

The bed of the Humber Lower water body will be altered at each of the locations associated with the MEP components. At the reclamation site the change to the bed will be permanent as the existing intertidal and sub tidal habitat will become land. This permanent change is not considered to be significant at water body level (comprising significantly less than 1% of the water body area). The intertidal area adjacent to the MEP site is likely to see increased accretion but is predicted to remain intertidal. The activities associated with the dredging and disposal will result in slight changes to bathymetry but will not significantly change the form or structure of the bed. The bed in these areas will remain able to support the sub tidal biological elements. An assessment of the effects of bed changes on the biological elements is provided in Section 3.4.3.

Bed level changes (erosion/deposition) within the compensation site will begin to occur over the first months of operation. The north end of the site is anticipated to be affected by deposition of sediments due to low velocities. At the southern end of the site in the vicinity closest to the breach, local erosion of the bed will occur due to high velocities (Section 32.6.19 of the ES).

##### **Intertidal zone structure**

The construction of the reclamation will result in a direct loss of intertidal habitat as well as the conversion of mudflat to saltmarsh. These effects are in a Natura 2000 site and are significant in the context of the Habitats Directive – a HRA has been prepared and it is assumed that acceptance of the HRA will satisfy the relevant requirements of the WFD. A detailed discussion of the biological function is provided in the HRA and is not repeated in this report.

Excavation of saltmarsh to enable the breach at the Cherry Cobb Sands site will result in permanent local loss of existing habitat and its associated benthic communities. Section 34.6.3 in the ES states that this impact has been assessed to be of a local scale restricted to the zone of influence (i.e. the saltmarsh and intertidal habitat within the excavated footprint).

During the majority of the construction process, the creation of the Cherry Cobb Sands site will not have any impacts on the intertidal zone structure as the new embankments will be built behind the existing flood embankments: the implications of the construction for the Little Humber Area artificial water body are discussed in Section 4. The creation of the breach site will initiate an effect on the hydrodynamic and sediment regime along the frontage of the site as foreshore levels will be lower. A maximum velocity of 2.4 – 2.6 m/s has been predicted in section 32.6.7 of the ES within the first two weeks after the breach. Any saltmarsh remaining near the mouth of the breach will be eroded by the high velocity flows. Local erosion is expected to be 0.5 m over a 5 year period close to the breach (section 32.6.19 of the ES). Over the initial months of operation the north end of Cherry Cobb Sands will encourage deposition of sediments due to lower velocities which will raise bed levels by 0.8 m in 5 years. In itself the processes described above represent a change to the morphology of the intertidal zone. It is understood that even after the breach the bed levels at the frontage of the Cherry Cobb Sands site will remain intertidal. There is therefore no permanent loss of intertidal zone

and as the biological effects are not considered to be significant at water body level then the effects on the intertidal zone structure supporting element are also not considered to be significant at water body level.

All the species recorded in the vicinity of the reclamation site and Cherry Cobb Sands are typical of the benthic community within the Humber Estuary, with moderate abundance and diversity of mostly common species with low sensitivity. There are no species of particular conservation importance.

#### **New Intertidal Habitat**

Whilst construction of the Cherry Cobb Sands site will result in a loss of intertidal habitat in the area of the breach it is expected that the area immediately around the breach in the set-back site will become colonised quickly by the opportunistic benthic species which are present in the Humber. Within approximately six months pioneer communities should be established and after 12 months more stable communities potentially mimicking those found in the Humber may be present. Colonisation will be incremental with areas nearest to the breach being colonised first and the communities slowly spreading out to the furthest edges of the site. The outer edges of the set back site, and the points furthest from the breach, will take the longest to colonise and it is not expected that many species will be present in these areas for several years.

As intertidal invertebrates do not currently form part of the benthic invertebrate parameter then the timescale associated with the development of this additional habitat does not affect the status of the biological quality element.

#### **Conclusion**

The WFD assessment concludes that there is not likely to be a non-temporary effect on hydromorphological WFD parameters of the Humber Lower water body at water body level.

### **3.4.2 Physico-chemical conditions and chemical status**

#### **Transparency**

The Humber is one of the most turbid estuaries in England (Section 9.5.14 ES). Increases in suspended sediment concentrations can affect light penetration, however, as indicated in section 33.6.4 of the ES, the Humber Lower water body has a low sensitivity to an increases in suspended sediment concentration due to the existing high concentrations of suspended sediment and the size of the water body. Losses of suspended sediment from the dredging and disposal activities and from the reclamation run-off would be temporary (~6 weeks). Suspended solids levels decay relatively quickly as the material is dispersed by the currents and levels are likely to fall back to background within a short period of the dredging or disposal ceasing. With respect to the run-off from the compensation site the impact would be low given the size of Cherry Cobb Sands and the localised area that would be affected compared to the size of the water body.

#### **Dissolved oxygen**

High levels of suspended sediment in the water column can cause dissolved oxygen levels to decrease and, in extreme cases, this can result in a dissolved oxygen sag. However such effects are generally associated with material containing high levels of organic material for example plant material or sewage. Estuary muds, silts and sands are not usually associated with effects on dissolved oxygen. The ES highlights the presence of a dissolved oxygen sag in the Humber Lower water body and at section 33.16.15 suggests that there may be a small decrease in dissolved oxygen associated with the increases in suspended sediment. However, this decrease is described as being associated with a decrease in primary production caused by a reduction in light attenuation. There is no indication that the material to be dredged or disposed of contains high levels of organic matter thus no effect is considered likely. Such an effect, should it occur, would be highly localised and temporary and therefore it is not considered to be significant at water body level.

## Nutrients

Nutrients were scoped into the assessment due to the conversion of previous agricultural land which may contain high levels of nutrients. Nutrients are discussed along with Specific Pollutants and Priority Substances in the following section.

## Specific pollutants and priority substances

### Capital Dredging and Disposal of Dredged Material

Contaminant levels in the material to be dredged and disposed of are elevated (particularly PAHs and metals) but are considered likely to be in line with the status of the Humber as a heavily industrialised estuary. There is no significant TBT or PCB contamination. The ES states that contaminant levels are lower than contaminant levels in material that is currently dredged and disposed of in the Humber Estuary (Section 9.5.28 ES). The ES describes that contaminants remain attached to suspended sediment during dredging activity and concludes that “Resuspension of contaminated sediments due to dredging is therefore assessed to have an insignificant impact on water quality” (Section 9.8.18).

### Cherry Cobb Sands Intertidal Compensation Site

In areas of erosion potential contaminants within the soils of the site could remobilise and enter the water body from this “grade 2 agricultural land” site (Section 31.5.16 of the ES). This could lead to flushing of pollutants into the estuarine waters after the breach and discharge into the Humber during the first few tidal floods. The Ground Investigation Study carried out in August 2011 (Section 33.5.16 of the ES) highlighted that although the 12 samples inside the Cherry Cobb Sands site contained contaminants below the CEFAS guideline Action Level 1 required standard, two nearby (outside the site in the north western fields) samples contained levels of contaminants (zinc, copper, lead and total petroleum hydrocarbons) above the standard level (Section 33.5.16 of the ES). Furthermore, the sampling “did not analyse the presence of pesticides and fertilisers” (Section 33.8.4 of the ES) and “samples taken were limited to a certain extent due to restricted access to land during the survey” (Section 33.5.16 of the ES). In general the site is not thought to have levels of contaminants present higher than the CEFAS Action Level 1 but there is a data gap relating to pesticides and fertilisers.

## Conclusion

Sediment quality levels of the material to be dredged are considered to be within acceptable levels and the temporary nature of the dredging and disposal activity limits the potential for any effects. The ES does not predict breaches in WFD water quality elements.

There is no evidence to suggest that the erosion of soil from the Cherry Cobb Sands site presents a pollution risk to the Humber Lower water body. However it is noted that the soil survey was constrained due to access restrictions and that there is a data gap with respect to pesticides and nutrients. The interim conclusions are that it is unlikely that specific pollutants would have a non-temporary effect on the Humber Lower water body that is significant at water body level and that it is also very unlikely that release of soil-bound pollutants would affect chemical status. However, it is recommended that the WFD assessment is updated once the secondary ground assessment has taken place prior to the commencement of works at the site.

### 3.4.3 *Biological quality elements*

#### **Aquatic flora (saltmarsh)**

The effect on saltmarsh is related to the creation of the compensation site at Cherry Cobb Sands. None of the other elements of the MEP development directly or indirectly impact saltmarsh (although there is a potential for saltmarsh to be created). With respect to the compensation site there is no mechanism for an impact on any of the WFD elements in the Humber Lower water body until the breach is made in the flood defence. This is confirmed in Section 32.6.2 of the ES which states that during the construction phase of the project the habitat creation site will not have an impact on the hydrodynamics and sedimentary regime of

the estuary until the final stage when the flood defence is breached. At this point the aquatic flora (saltmarsh) (included in the aquatic flora WFD parameter) will be removed. Construction of the breach in the flood defence requires the removal of 2 ha of saltmarsh: this includes both direct removal and any additional loss due to scour around the mouth of the breach. Although saltmarsh is part of the designated nature conservation sites (SPA, SAC and Ramsar) the area lost equates to 0.3% of the total saltmarsh habitat in the Humber Estuary (627 ha). Section 34.6.1 in the ES states that the loss of saltmarsh will be compensated for and will eventually become part of the Lower Humber water body once new saltmarsh habitat forms. In this instance the consideration of deterioration relates to the effect on the protected area rather than the effect at water body level. It is understood that this issue is being addressed through the Habitats Regulations Assessment (HRA) which is the appropriate vehicle for assessing the impacts on Natura 2000 sites. Assuming the HRA is accepted by Natural England then the loss of designated saltmarsh habitat will be also considered as acceptable in terms of the WFD: indeed, in the longer term the compensation scheme may well provide a net benefit in terms of the status of saltmarsh in the Lower Humber water body.

### **Benthic invertebrate fauna**

Benthic invertebrates are currently at moderate status but are close to the boundary with good. The Environment Agency has advised that it expects benthic invertebrates to achieve good status in 2012 (letter dated 29<sup>th</sup> May 2012). The WFD Assessment should, therefore, consider whether the activities associated with the MEP development are likely to:

- a) cause deterioration to the status of benthic invertebrates (i.e. cause the status to change from moderate to poor); and
- b) Prevent the benthic invertebrates from achieving good status (i.e. affect the ability to deliver mitigation measures that are 'in place' and 'not in place' or otherwise promoted in the RBMP).

It should be noted that the WFD is concerned with deterioration between status classes; the WFD accepts that there may be variation including deterioration within a status class.

The benthic invertebrate parameter is currently based on sub tidal monitoring (pers. comm. Sue Manson) and therefore the assessment of the effects should consider sub tidal benthic invertebrates. The effect of the projects on intertidal habitats is considered in Section 3.4.1.

Analysis of the Environment Agency's monitoring data indicates that the diversity and abundance of the sub tidal benthic invertebrates of the Humber Lower water body are related to a number of factors including natural factors such as particle size and the mobility of sediment in the areas as well as anthropogenic factors such as disturbance and pollution. The data indicate that the status of benthic invertebrates sampling sites ranges from poor to high. In general good and high sites are located away from the edges of the estuary (where it is assumed there is significant disturbance and pollution). Moderate status sites away from areas of disturbance appear to correlate with areas of highly mobile coarse sands which will constrain the potential species diversity due to the limited number of species that are able to tolerate these conditions. Figure 2 shows the status of the benthic invertebrate sites as well as the components of the Able site.



### Dredging and Reclamation

It can be seen from Figure 2 that the benthic invertebrate status in the vicinity of the MEP site is poor and moderate, probably reflecting the existing disturbance associated with the port activities in this area. The effects on benthic invertebrates arising from the dredging and reclamation activities are as follows:

- Loss of approximately 10 ha due to the reclamation of sub tidal habitat;
- Temporary, local loss of species and habitat due to capital dredging; and
- Temporary local deposition of sediment associated with overflow during the trailer suction hopper dredging.

The loss of 10 ha of poor to moderate benthic invertebrates relates to <0.001% of the total sub tidal habitat in the Humber Lower water body (16,800 ha). This is not considered to be significant at water body level. The habitat to be lost does however form part of a Natura 2000 site and Section 5.4.14 of the Habitats Regulations Assessment notes that the proposed intertidal compensation site at Cherry Cobb Sands will provide compensatory habitat to negate this impact. It is therefore assumed that the HRA will consider the issues related to the effect on the Natura 2000 site.

The capital dredging will remove poor/moderate habitat but the resulting berth pocket will still provide sub tidal habitat (of the same or similar substrate) that will quickly be colonised by opportunistic species that are already present in the water body. This temporary loss is not considered to be significant at water body level and the resulting habitat is likely to remain at poor or moderate status. With respect to future maintenance dredging, it is assumed that the application of the existing dredging related mitigation measures for the Humber (Table 1) may make it possible for the status of this habitat to improve.

The dredging of finer seabed material using a trailer suction hopper dredger will result in the overflow of suspended sediment into the water body. Modelling of the dispersion of the plume indicates that deposition levels beyond the immediate vicinity of the site are low to negligible. Deposition is predicted on the intertidal areas up and down stream of the MEP site however these areas do not form part of the assessment of the (sub-tidal) benthic invertebrate parameter. Figure 14 in Annex 8.4 shows temporary deposition levels of 1 – 5 mm in parts of the water body. The capital dredging activity using a trailer suction hopper dredger is a relatively short term activity that will be concluded within a five to six week period. Backhoe dredging does not generally result in inputs of large quantities of fine material so does not require further consideration. It is anticipated that once dredging ceases these low levels of temporary deposition will be redistributed throughout the estuary. Temporary deposition of 1-5mm is not considered likely to affect any of the benthic invertebrate species in the Humber which are well adapted to this type of effect. It is assumed that the dredging mitigation measures (Table 1) will be applied to the dredging method statement. Therefore, the temporary effects of the short term capital dredging activity are not considered likely to affect status at water body level.

### Disposal of Dredged Material

There are two types of dredged material that will be disposed of at existing disposal sites in the Humber Lower water body. Erodible material will be placed at the dispersive site HU080 while non-erodible material will be placed at the capital site HU082. Interestingly the Environment Agency's monitoring data indicates that several sites of the high status benthic invertebrates monitoring locations are in the vicinity of the existing dispersive disposal site. As this site is used on a regular basis for very large quantities of dredged material (licence for 7.8 million tonnes in 2008, Humber Estuary Baseline Document) it can be concluded that disposal activities are not adversely affecting the benthic invertebrates in this area. The site was in use during the water body classification period of 2006-08 and disposal activities at this site can be considered to form part of the baseline. The site has previously received 8.9 million tonnes therefore it is reasonable to assume that the placement of the material from Able is within the capacity of the site and that any effects will be temporary (i.e. weeks). The disposal of the



erodible material at the HU080 disposal site is not, therefore, considered likely to have a non-temporary effect on the water body that will affect status at water body level.

The non-erodible material will be placed at the existing capital disposal site (HU082) (as required by the MMO). The monitoring location within this site indicates that benthic invertebrates are currently at moderate status. When placed at this site material will remain *in situ* with gradual erosion occurring over a period of months to years. It is understood that one of the aims of this site is to provide a structure that aids in managing the maintenance dredging requirements within the adjacent Sunk Dredged Channel. Slow erosion is therefore a feature of the material that is permitted for disposal. There will therefore be a local, temporary loss of benthic invertebrates during the placement of material at the site: however the dominant species present at the site (*Aphelocheata marioni*, *Nephtys hombergii* and *Aricidea minuta*) are opportunistic and will recolonise the site over a period of weeks to months.

The placement of the dredged material may result in a local change in current speeds in the vicinity of the disposal site. Strictly, the WFD 'currents' parameter relates to coastal waters and is not relevant to transitional water bodies. However, figures 4-5 and 4-6 in JBA report 8.1 supplementary annex to the ES show that the effects on current speeds will be localised to the area around the disposal site and do not extend into the coastal water body. The changes in current speed are minor (<5%) and – importantly given the intention of the WFD supporting elements – are not considered likely to affect the status of the existing benthic invertebrate communities.

The disposal of dredged material at the existing disposal sites is not considered likely to have a non-temporary effect on the status of the Humber Lower water body at water body level.

#### Cherry Cobb Sands Intertidal Compensation Site

During operation, soils from the agricultural land will enter the water column in the local vicinity of the compensation site, however, the input rate is considered likely to be relatively low as the managed realignment site should be designed to promote deposition rather than erosion. While there is the potential for increases in suspended sediment to result in deposition and smothering of benthic communities outside of the Cherry Cobb Sands site, in practice this is considered unlikely due to the low level of erosion once the site has settled. Further, the sensitivity of the intertidal habitat in the Lower Humber water body is low due to the very high concentrations of suspended sediment already present in the Humber Lower water body.

During construction, the creation of the breach will result in the scouring of a channel immediately in front of the breach location (section 32.6.7 of the ES). Material within this channel is likely to be dispersed into the Humber Lower water body. This process usually takes place over a relatively short period (days to weeks) in response to the discharge of water from the new habitat compensation site. It is assumed that this material will comprise fine muddy sediments that are similar to the large quantity of suspended sediment that is carried in suspension in the Humber. The release of sediment will only occur on the ebb tide as water flows out of the estuary and will therefore be carried seaward, dispersed and deposited in the existing sediment sinks in the Humber. Given the very high volume of dredged material that is disposed of into the Humber as well as the high natural suspended sediment concentration and bedload, this temporary addition of a relatively small quantity of material is not considered to be significant for any of the biological elements at water body level (section 34.6.8 of the ES).

## **Conclusion**

In summary the components of the Able scheme that will affect sub tidal benthic invertebrates are not considered likely to have a non-temporary effect on the status of the Humber Lower water body at water body level. Therefore, no deterioration in status is predicted. This conclusion is reinforced by the statement in the HRA that: "The temporary loss of sub-tidal habitat is not expected to be an issue for the Humber Estuary in the longer term given the predicted effects of rising sea levels over the next 50 years (CHaMP, 2005) which will lead

to the creation of several hundred hectares of new sub-tidal habitat within this site alone.”

It is also concluded that the MEP project will not affect the ability of the benthic invertebrates to reach good status. Consideration of this issue requires an assessment of the effect of the project on the measures included in the RBMP which should facilitate the progression toward good status. However, it is understood that the benthic invertebrates are subject to the MS exemption which overrides the failure and thus no measures are required. Notwithstanding this it is concluded that the MEP activities will not affect the ‘in place’ mitigation measures relevant to dredging and disposal activities in the Humber. It is also assumed (and confirmed in the ES) that these measures will be applied to the MEP development.

## **Fish fauna**

### Reclamation, Dredging and Disposal of Dredged Material

The Humber estuary acts as an important migratory route for a range of species between coastal waters and their spawning areas. Some species are thought to migrate up along the banks of the estuary and may be more vulnerable to localised habitat disturbance at the shoreline. However, there have been a number of previous developments as well as ongoing disturbance along the banks of the Humber and fish is presently at good status, indicating an ability to tolerate and adapt these pressures. As fish are able to make use of both banks of the estuary as well as the main channel the localised nature of the effects of this scheme and the temporary nature of the dredging and disposal activities are not considered likely to have a non-temporary affect at water body level.

The Environmental Statement also states that migration routes and foraging areas are considered unlikely to be significantly affected during operation of the AMEP site.

### Cherry Cobb Sands Intertidal Compensation Site

Fish fauna in the Humber Lower water body may use intertidal and shallow subtidal areas as spawning or nursery grounds. There is nothing in the ES to suggest that the intertidal area in front of Cherry Cobb Sands is of any greater interest for fish than the many other intertidal areas of the water body and there is therefore no indication that there will be any effect on the status of the fish at water body level associated with the changes in front of the compensation site. The seabed in front of the breach will remain available to fish for resting and fish living in the highly turbid Humber Lower water body will be adapted to transient increases in suspended sediments. Given the immediate additional shallow water area that fish may use for sheltering, the overall impact will be beneficial.

The compensation site will provide a benefit of resource of food and shelter for the fish as well as providing nursery grounds. Although some benthic species may be lost due to smothering, many of those found in the Humber (e.g. cockle and ragworm) are relatively tolerant. As there is not thought to be any significant impacts on fish at water body level resulting from the impacts of the capital dredge programme, it is not considered likely that there will be significant effects from the maintenance dredge programme as the duration and suspended sediment volumes will be less.

As no non-temporary effects on fish that are significant at water body level are predicted then there is no requirement for further consideration of the Freshwater Fish Directive protected area.

## **Conclusion**

Subject to confirmation through the HRA that the loss of designated intertidal and sub tidal habitat is acceptable in the context of the agreed compensation package, the WFD assessment concludes that there will not be a deterioration on status of the biological quality elements (i.e. there will not be a non-temporary effect on status at water body level). Further, it is not considered that the MEP development or the habitat compensation scheme will prevent the biological quality elements from reaching or remaining at good potential.

### 3.4.4 Protected areas

#### **Natura 2000 designated sites**

The loss of designated estuary habitat that forms part of the Natura 2000 site is considered in detail in the HRA. The WFD assessment has concluded that, with respect to the protected area, the consideration of deterioration relates to the effect on the protected area rather than the effect at water body level. It is assumed that the loss of these designated habitats is being addressed through the HRA which is the appropriate vehicle for assessing the impacts on Natura 2000 sites. Assuming the HRA is accepted by Natural England then the loss of designated habitat will be also considered as acceptable in terms of the WFD.

### 3.4.5 Effect on mitigation measures 'not in place'

The Humber RBMP identifies the requirement for mitigation measures related to the flood protection aspect of the HMWB designation. These measures are to preserve and enhance marginal habitats, promote managed realignment, and replace hard defences with soft engineering solutions etc. With respect to engineering solutions for hard defences, although the MEP extends riverwards beyond the present land boundary it does not alter significantly the length of frontage that will be subject to hard defences. The MEP will affect marginal habitats but is compensating for this impact through the provision of a managed realignment site.

It is considered that the Cherry Cobb Sands site (which at ~100 hectares is significantly greater than the area of intertidal habitat lost within the water body) will complement and support the achievement of the proposed mitigation measures. Further managed realignment is one of the identified mitigation measures not in place and the breach in the flood defences will reduce the amount of hard defences which also directly contributes to the mitigation measures that are not in place. The habitat creation site at Cherry Cobb Sands will not, therefore, compromise the mitigation measures 'not in place' for the Humber Estuary; rather it will make a direct contribution to the achievement of those measures.

The MEP will not affect any actual projects that the Environment Agency may have to alter its flood defences in accordance with the mitigation measures 'not in place' (in breaching the flood defence at Cherry Cobb Sands in accordance with the measures Able UK Ltd would, in effect, be acting as a co-deliverer). The MEP will not, therefore, compromise the mitigation measures 'not in place' for the Humber Estuary.

### 3.4.6 Contributing to improvements in WFD status

In addition to determining whether or not there will be an effect on status at water body level, it is also necessary to consider whether it is possible for a development (in this case the dredging, reclamation or disposal) to be carried out in such a way as to contribute to improving the status of failing WFD parameters in a cost effective and not disproportionately costly manner. This requires consideration of the failing parameters as to whether the development as planned (or with suggested modifications) might contribute to realising the wider WFD water body objectives.

With regard to the currently failing WFD parameters, the assessment identified the following:

- Benthic invertebrates (although failure is overridden by the MS exemption): application of relevant dredging and disposal measures for the Humber.
- Dissolved inorganic nitrogen: there are no opportunities associated with the development to improve this parameter.
- Zinc: there are no opportunities associated with the development to improve this parameter, and the development will not impact upon other proposed measures aimed at such improvement.
- GEP/mitigation measures assessment: both the disposal method (i.e. retaining sediment within the system) and the intertidal habitat creation will contribute to some improvements

by benefiting marginal aquatic habitats; the compensation site will also help to realise the opportunities associated with managed realignment albeit that the driver in this case is not flood defence.

- Tributyl-tin: there are no opportunities associated with the development to improve this parameter.

The Cherry Cobb Sands reclamation site has been chosen based on the ability to provide a 2:1 ratio of creation:loss and therefore provide an overall benefit to the Lower Humber water body as it will contribute to some improvements by benefiting marginal aquatic habitats and also help to realise the opportunities associated with managed realignment (albeit that the driver in this case is not flood defence). While the creation of this habitat will not currently contribute to the benthic invertebrate parameter (as intertidal benthic invertebrates are not included in this parameter) should the monitoring method be revised then, once established, the site could contribute to some improvement towards the failing benthic invertebrate parameter. In addition it will contribute to a continuing improvement in the ecological value for fish fauna.

## 4. *Little Humber Area Water Body*

### 4.1 CHARACTERISTICS

The Little Humber Area water body (ID GB104026066550) is a freshwater surface water body in the Hull and East Riding catchment. It is designated as an artificial water body (AWB) as it is a man-made drainage ditch designed to capture seepage (through the flood embankment) and surface water runoff. As such, in WFD terms, the ecological objective for the water body is to meet good ecological potential (GEP) rather than good ecological status.

The water body is described in the river basin management plan as being 12 km in length and 9.7 km<sup>2</sup> in area.

According to Annex B of the Humber RBMP, the only protected area designation associated with this water body is a designation under the Nitrates Directive. However, the ES (Section 33.5.14) states that there are no nitrate (nutrient) sensitive areas (or Nitrate Vulnerable Zones) in the area surrounding the compensation site. However the nitrate vulnerable zone map provided by the Environment Agency (personal communication, 2012) indicates a nitrate vulnerable zone to the rear of the Cherry Cobb Sands site.

### 4.2 CURRENT STATUS

Annex B of the RBMP records the ecological potential of the Little Humber Area AWB as being moderate with a target of moderate ecological potential by 2015 (because measures are disproportionately expensive and technically infeasible) but reaching good ecological potential (GEP) by 2027. However, the RBMP provides very little information on the ecological characteristics and status of the water body. The current status is moderate potential (uncertain) although it is noted that the quality and dynamics of flow 'supports good'. Chemical status 'does not require assessment': this can be interpreted as meaning that – in the absence of data showing otherwise – the water body is considered to be at relatively low risk of failing to meet good chemical status with regard to contamination by priority or priority hazardous substances.

Section 35.8.28 of the ES describes the pattern of terrestrial habitat and estuarine fringe in the vicinity of the Little Humber Area water body as being 'characteristic of Holderness' and 'of relatively low ecological importance'. In the absence of water body-specific information, the status of the adjacent water body (Keyingham Drain, part of the 'Sands/Keyingham/ Roos Drain from Source to Humber' artificial water body; ID GB104026067230) was therefore reviewed to provide some insight into the likely ecological status of the Little Humber Area AWB. It is acknowledged, however, that adjacent water bodies can be very different in

character and it is therefore stressed that this overview is designed to provide an indication only.

The Sands/Keyingham/Roos Drain from Source to Humber AWB is classified as being at moderate ecological potential overall (very certain). It is listed as being at bad potential due to the status of macroinvertebrates, but no measures are required because the 'bad' status is directly related to the designation of the water body as a AWB (i.e. the nature of its drainage purpose is not compatible with achieving a higher status in this regard). The AWB is also at moderate physico-chemical potential due, *inter alia*, to issues with dissolved oxygen (poor), phosphate (poor), and ammonia (moderate; specific pollutants). According to the RBMP measures to deal with these failures would be disproportionately expensive; no improvement is therefore foreseen in this water body before 2015. However, whereas the Little Humber Area AWB is described as being 'high' for hydrology, the Sands/Keyingham/Roos Drain AWB is described as being 'not high'. Two mitigation measures which are currently 'not in place' but which could contribute to improving its status notwithstanding the designation of the Sands/Keyingham/Roos Drain as an AWB are: structures or mechanisms to enable fish to access the water body; and a sediment management strategy. Finally, as with the Little Humber Area AWB, chemical status in the Keyingham Drain area 'does not require assessment'.

### 4.3 SCOPE OF WFD ASSESSMENT

Before carrying out the scoping exercise for the WFD compliance assessment for the Little Humber Area water body, it was necessary to establish the basis for the assessment. Specifically, it had to be decided whether the managed realignment of the flood defence and the diversion around 1.5km of the soke dyke AWB to its rear constitutes 'deterioration' in WFD terms and/or whether there is a water body 'type change' insofar as the current location of the soke dyke is concerned. In both cases, water body boundaries will need to be amended accordingly.

The European Commission's recent FAQ paper on the relationship between the WFD and the Birds and Habitats Directives<sup>1</sup> points out that there are certain situations in which changes to the characteristics of a water body represent a change in water body type rather than a deterioration in status. The three examples given are:

- when restoring a WFD water body to make it 'more natural' would lead to the loss of protected habitats or species which have developed in an artificially modified or managed environment (e.g. cut off ox-bows or freshwater marshes in a reclaimed area protected by an artificial flood bank);
- when a compensation requirement under HD Art. 6.4 will lead to a water body type change (e.g. from a freshwater marsh to a tidal lagoon);
- when managed realignment promoted by a shoreline management plan would lead to a change from an impounded (low turbidity freshwater) river to a saline, high turbidity transitional water body.

Taking into account the comments made in the FAQ paper together with relevant aspects of the CIS Guidance Document Exemptions to the (WFD) Environmental Objectives<sup>2</sup>, and following discussions with Defra and the EA, this assessment assumes that the diversion of the Little Humber Area water body does not represent deterioration in status *per se*. The background to this assumption is as follows:

<sup>1</sup> [http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework\\_directive/thematic\\_documents/biodiversity\\_water/faq-wfd-bhd\\_20dec2011/ EN 1.0 &a=d](http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/biodiversity_water/faq-wfd-bhd_20dec2011/ EN 1.0 &a=d)

<sup>2</sup> [http://circa.europa.eu/Members/irc/env/wfd/library?l=/framework\\_directive/guidance\\_documents/documentn20\\_mars09pdf/ EN 1.0 &a=d](http://circa.europa.eu/Members/irc/env/wfd/library?l=/framework_directive/guidance_documents/documentn20_mars09pdf/ EN 1.0 &a=d)

- both the WFD and the Habitats Directive accept and make provision for the physical modification of water bodies subject to certain criteria being met;
- the Cherry Cobb Sands compensation site is being proposed, along with the temporary site at Old Little Humber Farm, to meet the requirements of the Habitats Directive;
- managed realignment is the accepted/preferred approach to the creation of new intertidal habitat;
- most managed realignment projects involve retreat onto low lying land that would originally have been a part of the wider estuarine system;
- managed realignment typically involves modification to or the loss of the drainage ditch (soke dyke) to the rear of the existing flood defence;
- the WFD recognises and makes provision for situations where the requirements of other environmental Directives are different to or more stringent than those of the WFD;
- in a situation where the WFD could compromise the requirements of the Habitats Directive a balance has to be achieved/a pragmatic solution sought;
- in this case, it is impossible to progress the managed realignment and to maintain the relevant length of the Little Humber Area AWB body *in its current position*; the affected stretch of the AWB will necessarily become a part of the adjacent Lower Humber transitional water body (a type change), and a new length of AWB will need to be constructed to fulfil the soke dyke drainage function to the rear of the new flood defence. In both cases, existing water body boundaries will need to be amended in the RBMP.

This approach corresponds to the internal position taken by the EA for their own managed realignment schemes (EA, personal communication, 2012): where realignment is needed under the Habitats Directive, the requirements of the WFD should not prevent or unduly hinder this action from being taken. The EA internal approach further accepts that, whilst the new ecology will take time to adjust, the focus must be on delivering the environmental objectives of the WFD in the longer term. In this case, this will apply to both the Lower Humber (transitional) and the Little Humber Area freshwater water bodies.

The scoping process identified a possible causal link in respect of the following WFD parameters in relation to the Little Humber Area:

- Biological quality elements:
  - Macrophytes and phytobenthos
  - Benthic invertebrate fauna
- Hydromorphological conditions:
  - Hydrological regime (quantity and dynamics of flow; connection to ground water bodies)
  - River continuity
  - Morphological conditions (river depth and width; river bed structure and substrate; riparian zone structure)
- Physico-chemical conditions:
  - Oxygenation conditions
  - Salinity
  - Nutrient conditions.

Further, whilst the RBMP concludes that the chemical status of the Little Humber Area AWB 'does not require assessment' for the purposes of the classification, the potential for contamination as a result of the proposed development (realignment of the flood embankments, diversion of the soke dyke and creation of the temporary compensation area) nonetheless needs to be considered.

The following sections consider each of these parameters in turn in order to determine whether there might be deterioration (defined as a non-temporary effect on status at water body level) or whether the initiative might prevent improvement in status.

## 4.4 DETERIORATION OR OTHER EFFECTS ON WFD STATUS

Given the lack of data in the RBMP, the ES provided a key source of information in assessing whether the proposed diversion of the Little Humber Area AWB might cause deterioration (i.e. a non-temporary effect on status at water body level) or otherwise affect the ability of the water body to meet its WFD objectives.

### 4.4.1 *Biological quality elements*

Taking into account (i) adjacent and surrounding land uses (ii) the comment in the ES about the area in the vicinity of the Little Humber Area AWB being of low ecological interest and (iii) the documented conditions in nearby water bodies, it seems unlikely that either the macrophytes and phytobenthos or benthic invertebrate fauna are currently at good status in the section of the Little Humber Area water body which is to be diverted. In the meantime, Section 33.8.7 of the ES confirms that the intention for the newly diverted soke dyke is to achieve similar or improved conditions compared to those existing (to be based on advice from the EA, during detailed design stage, on measures to maintain or improve water status).

The WFD is particularly concerned with preventing deterioration in the status of water bodies over the medium-long term. In determining what constitutes a 'temporary' effect on status (e.g. due to construction activities) the CIS Environmental Objectives paper (*op.cit*) suggests that reference be made to the frequency of monitoring of (the relevant) WFD quality elements. For macrophytes/phytobenthos and for benthic invertebrate fauna, the monitoring frequency indicated in the Directive is every three years. Assuming, therefore, that the measures to be taken to ensure the diverted water body achieves similar or improved conditions are effective within three years, it can be concluded that there will be no deterioration in status in the new (diverted) stretch of the AWB.

Section 4.4.2 and 4.4.3 further confirm that there will be no deterioration in the WFD physico-chemical and hydromorphological supporting elements affecting the upstream part of the existing Little Humber Area AWB, not least because of the north-west to south-east direction of flow in the water body. Given also that there will be no deterioration (and possibly an improvement) in the WFD status of the new (diverted) soke dyke, it can be concluded that there will be no overall deterioration in the biological quality elements of the existing AWB and that there will be no effect on the ability of the water body to meet its WFD objectives.

### 4.4.2 *Hydromorphological conditions*

#### **Hydrological regime and river continuity**

According to Section 36.5.6 of the ES, the existing soke dyke runs behind the entire length of the flood defence embankment. However, it is only identified as a WFD water body over part of its length. In other words, the length of AWB which is to be diverted in fact continues, as a non-WFD ditch, out of the site and past the radar mast before turning northwards and connecting in to Cherry Cobb Sands Drain, just prior to it discharging into Stone Creek. Given that the diverted soke dyke will therefore connect into the existing drainage system at both ends, the flow from the upstream (unaffected) part of the Little Humber Area AWB will pass through the diverted channel and into Stone Creek as it does at present. There will therefore be no deterioration insofar as hydrological regime and river continuity are concerned, and the ES similarly concludes that there will be no implications for ground water.

#### **Morphological conditions**

With regard to morphological conditions (river depth and width; river bed structure and substrate; riparian zone structure), the ES identifies an existing problem with siltation affecting the drainage ditches and other water bodies in the study area. The construction process (i.e. the construction of the new embankment, the excavation for the diversion of the soke dyke, and the soil moving works at the terrestrial compensation site at Old Little Humber Farm) all have the potential to exacerbate this problem. Section 36.6.1 of the ES, however, confirms that management measures will be put in place to ensure that the drainage function of the

various water bodies is not compromised: this implies that measures will be taken to reduce the sediment load in run-off from the construction site. Assuming that such measures are agreed in advance with the EA and implemented in an effective manner, there is no reason to expect a non-temporary deterioration in status in either the diverted section of the AWB or the upstream length of the Little Humber Area AWB.

As indicated earlier, appropriate measures will also need to be put in place to prevent accumulation of sediment on the estuary side of the sluice affecting the discharge from Stone Creek, so as to ensure that these AWBs are not detrimentally affected by conditions in the adjacent transitional water body. Again, assuming these mitigation measures are included as part of the works, there should be no residual effect on the ability of the AWBs to meet their WFD objectives.

#### **4.4.3 Physico-chemical conditions and chemical status**

##### **Oxygenation**

With regard to oxygenation issues, increased suspended sediment concentrations can affect light penetration and can depress oxygen levels. However, as indicated above, Section 36.6.1 of the ES implies that measures will be taken to reduce sediment in run-off from the construction site – if this is the case, any temporary effects on oxygen levels should be minimised. Further, there should be no effects on the remainder of the Little Humber Area AWB as the flow direction is from NW to SE (i.e. away from the unaffected stretch of water body). In the medium-long term, the ES confirms the intention that the diverted soke dyke will be no worse and ideally improved in status from the current situation. Assuming measures are put in place both to minimise temporary construction-related run-off or resuspension of sediments and to maintain or improve post-construction water body status, deterioration in water body status would not be expected.

##### **Salinity**

The ES (Section 33.6.17) reports that any saline influence affecting the diverted AWB will be minimised through careful design of the embankment. However, given that the function of both the existing AWB and the new diversion will be to capture seepage and surface water runoff, some saline influence is likely to be unavoidable. The RBMP already recognises this in the adjacent water body insofar as no measures are proposed (e.g. to improve macroinvertebrates) because these would not be compatible with the function of the water body as a soke dyke. No deterioration from the current status of the Little Humber Area AWB is therefore anticipated.

##### **Nutrients**

With regard to nutrients, no water body specific data are available. However, the current 'intensive arable' use of the surrounding area (including the temporary compensation site at Old Little Humber Farm) suggests that there is potential for nutrient enrichment. Whilst there may be some local, temporary reduction in fertiliser inputs, etc. during the period that the Old Little Humber Farm site is being used for compensation, overall the diversion of the soke dyke is unlikely to affect the long-term nutrient status at the level of the water body. Neither significant improvement nor deterioration from the current status is therefore anticipated. Consequently there is no predicted effect on the nitrate vulnerable zone adjacent to the Cherry Cobb sands site.

##### **Conclusion**

Taking into account all the above, it is not expected that the realignment of the embankment and the associated diversion of the soke dyke will cause deterioration in or otherwise affect the ability of the Little Humber Area artificial water body to reach its ecological status (potential) objectives (i.e. as no measures for this AWB are discussed in the RBMP, there is similarly no likelihood that the proposed works will prevent other planned WFD measures from achieving improvements). Article 4(7) of the WFD does not therefore need to be applied because the



diversion will fulfil the same function as the current AWB and the status of the water body will be maintained or improved.

The section of the Little Humber Area water body that will become part of the compensation site will undergo a type change from the freshwater AWB to the adjacent Lower Humber (transitional) heavily modified water body (HMWB). As discussed above, this type change does not represent deterioration: rather the area will in future need to meet the relevant transitional water body objectives discussed and assessed in Section 3.

### **Specific pollutants and priority substances**

The RBMP reports that the chemical status of the Little Humber Area AWB 'does not require assessment'. The potential for the construction of the embankment and the diversion of the soke dyke to cause deterioration nonetheless needs to be assessed.

The ES highlights a number of potential issues with regard to possible deterioration in chemical status. Whilst the effective management of plant and equipment during the construction process described in Section 33.8.2 of the ES should ensure that there is no deterioration due to pollution from these sources, of more concern is the possibility that some of the existing ditches in and around the Cherry Cobb Sands compensation site may previously have been land-filled. Information presented in the ES indicates that:

- elevated levels of copper, lead, zinc and total petrol hydrocarbons are present in the north-western fields just outside the proposed compensation site (Section 33.5.16);
- a geophysical survey (Annex 40.3) indicates magnetic anomalies in areas where old creeks used to exist: some of these channels appear to have been backfilled with highly magnetic material; and
- access restrictions meant that not all parts of the site could be sampled.

The proposed risk management strategy described in the ES is to carry out a secondary ground investigation prior to commencement of the works (section 33.5.18). If evidence of contamination is identified, the material will be removed and will be subject to bio-remediation. Even if no contamination is found in the additional surveys, machine operators will still be instructed to stop work if contamination is encountered subsequently.

The ES also highlights the possibility of contaminated material being encountered during construction of new flood embankments or wet grassland at Old Little Humber Farm (i.e. due to pesticides or fertilisers having been used on agricultural land). However, the site investigation did not analyse the presence of pesticides and fertilisers. These parameters will therefore need to be included in the proposed pre-construction site investigation discussed in Section 33.8.4 of the ES.

### **Conclusion**

The focus of the ES is primarily on the potential effects of any contaminants present in the compensation area on the Lower Humber transitional water body. The fresh water bodies are not fully considered. However, assuming the same approach to potentially contaminated land is adopted for the construction of the realigned embankment and the diverted soke dyke as is proposed for the compensation site (i.e. more site investigations plus mitigation as necessary), it is not expected that there would be any deterioration in the ecological potential or chemical status of the Little Humber Area AWB.

#### **4.4.4 Contributing to improvements in WFD status**

In addition to determining whether or not there will be an effect on status at water body level, it is also necessary to consider whether it is possible for a project (in this case the diversion of part of the Little Humber Area AWB) to be carried out in such a way as to contribute to an improvement in the parameters for which the water body is failing.

Whilst there is very little information in the RBMP to indicate exactly which parameters are currently failing to meet their WFD objectives for the water body, the ES does confirm that advice will be sought from the EA on the measures required to maintain or improve the status of the soke dyke. Whilst it is unlikely that the diversion of the AWB would be able to deliver any significant improvement in terms of nutrients, it may be possible to design the embankment so as to reduce the likelihood of saline seepage or to incorporate buffer strips thus reducing the local runoff of sediment. Other opportunities for improvement of physico-chemical or hydromorphological characteristics may be identified which in turn could contribute to improvements in biological elements such as macrophytes and phytobenthos or benthic invertebrate fauna.

## 5. Conclusion

HR Wallingford has reviewed the relevant ES chapters and associated technical reports prepared for the MEP and the habitat compensation scheme and concluded that the project components (alone and in-combination) are not likely to have a non-temporary effect on the status of WFD parameters that is significant at water body level. This conclusion is subject to confirmation of the following:

- the acceptability of the HRA;
- confirmation of a lack of contamination from the secondary ground assessment at the Cherry Cobb Sands site.

The project is not predicted to cause deterioration to the current status of the Humber Lower water body nor should it prevent it achieving its future status objectives. Further, the intertidal habitat creation is likely to contribute to future improvements in WFD status as the site, once established, could improve the ecological value for saltmarsh communities and fish.

Insofar as the Little Humber Area artificial water body is concerned, there should similarly not be any deterioration in status or any effect on the ability of the water body to meet its WFD objectives assuming that the following mitigation measures discussed in the ES are effectively implemented:

- the intention, stated in Section 33.8.7 of the ES for the newly diverted soke dyke to achieve similar or improved conditions compared to those existing (to be based on advice from the EA, during detailed design stage, on measures to maintain or improve water status);
- measures to manage sediment run-off and accumulation indicated in Section 36.6.1 of the ES including appropriate measures to prevent the exacerbation of the accumulation of sediment on the estuary side of the sluice affecting the discharge from Stone Creek;
- measures to reduce saline seepage mentioned in Section 33.6.17 of the ES;
- measures to manage plant and equipment to avoid pollution during the construction process described in Section 33.8.2 of the ES.

The WFD assessment also assumes that there will be a satisfactory outcome of the proposed pre-construction site investigation discussed in Sections 33.5.18 and 33.8.4 of the ES and any additional associated mitigation measures.

Finally, with respect to adjacent water bodies, the WFD assessment concludes that there is no mechanism for any effect of the MEP or habitat compensation scheme or associated works in the Humber Lower transitional water body, on the status of the adjacent Humber Middle transitional and Yorkshire South/Lincolnshire coastal water bodies. As previously stated measures will, however, need to be put in place to prevent the exacerbation of local accumulation of sediment on the estuary side of the sluice at Stone Creek detrimentally affecting the discharge of the adjacent artificial water bodies.

## 6. *References*

Clearing the waters: marine dredging and the Water Framework Directive

[www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

[www.wfduk.org](http://www.wfduk.org)

Able UK Ltd and JBA Consulting (June 2012), AMEP Supplementary Report – Modelling of final quay design (Supplement to Annex 1 of the ES)

Able UK Ltd (April 2011), Environmental Assessment, Chapter 4: Description of Development (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Able UK Ltd (April 2011), Environmental Assessment, Chapter 7: Geology (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Able UK Ltd (June 2010), Phase 1 Geoenvironmental Assessment. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Able UK Ltd (April 2011), 7.6 Dredging Strategy. Provided by Able UK Ltd to HR Wallingford Ltd

Able UK Ltd (May 2011), Environmental Assessment, Chapter 9: Water and Sediment Quality. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Able UK Ltd (April 2011), Environmental Assessment, Chapter 10: Aquatic Ecology (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Able UK Ltd (May 2011), Environmental Assessment, Chapter 12: Commercial Fisheries (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 28: Description of Development (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 32: Hydrodynamic and Sedimentary Regime (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 33: Water and Sediment Quality (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 34: Aquatic Ecology (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 35: Ecology and Nature Conservation (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 36: Drainage and Flood Risk (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd and Black & Veatch (December 2011), Environmental Statement Vol 2, Chapter 44: In-Combination (Draft). Provided by Able UK Ltd to HR Wallingford Ltd (March 2012)

Able UK Ltd (2011) Habitats Regulations Assessment Report

ABPmer 2008, Humber Maintenance Dredging Baseline Document

Buro Happold (November 2010), Annex 7.6 South Humber Channel Marine Studies: Ground Engineering Interpretive Report. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

ESI Ltd (April 2011), Hydrogeological, Piling and Dredging Risk Assessments. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

HR Wallingford (March 2011), 9.3, Assessment of proposed reclamation impact on recirculation at Centrica intake/outfall. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

HR Wallingford (March 2011), 9.4, Assessment of proposed reclamation impact on recirculation at E.ON intake/outfall. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

Soil Engineering (January 2011), Report on a Ground Investigation for South Humber Channel Marine Studies. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)

The Institute of Estuarine and Coastal Studies (IECS) (September, 2010), South Humber Channel Marine Studies: Water and Sediment Quality. Provided by Able UK Ltd to HR Wallingford Ltd (May 2011)