



HR Wallingford  
*Working with water*

HRPP 418

## RSPB Wallasea Island wild coast project - Lessons for designing managed realignment sites

Adrian Wright, Ian Townend, and Colin Scott

Reproduced from a paper presented at:  
44th Defra Flood and Coastal Management Conference  
Telford, UK  
30th June - 2nd July 2010





# **RSPB WALLASEA ISLAND WILD COAST PROJECT - LESSONS FOR DESIGNING MANAGED REALIGNMENT SITES**

**Adrian Wright<sup>1</sup> Ian Townend<sup>2</sup> and Colin Scott<sup>1</sup>**

<sup>1</sup>*ABP Marine Environmental Research Ltd*

<sup>2</sup>*HR Wallingford, Wallingford*

## **Key Words**

Wallasea Island, Managed Realignment, Regulated Tidal Exchange, Numerical Modelling

## **Abstract**

On the 23<sup>rd</sup> April 2009, planning consent was obtained for the Royal Society for the Protection of Birds' (RSPB's) Wallasea Island Wild Coast Project. This project represents one of the largest coastal wetland schemes of its type in Europe and the application area covers 677ha of Wallasea Island which lies at the confluence of the Crouch and Roach Estuaries in Essex (Figure 1).

The design for this scheme includes both Managed Realignment (MR) and Regulated Tidal Exchange (RTE) areas as well as an area set aside for the creation of mitigation habitats and visitor access facilities. Central to the whole design will be the importation of a large amount (7.5 Million m<sup>3</sup>) of inert recovered fill material which will be obtained predominantly from the Crossrail link tunnelling. These materials will be used raise the land levels, which have sunk greatly since the island was claimed, and to landscape the site in a way that manages the volumes and direction of the tidal exchanges from the site.

The final design is one that not only delivers large amounts of intertidal habitat in contribution to Biodiversity Action Plan (BAP) targets but also performs a critical flood protection need at a location where, if there is no intervention, there is an imminent risk of a damaging unmanaged breach in the near future (Halcrow 2006). Once the island has been landscaped and the sea walls are breached (a process that will take place in a phased way) the volumes of tidal water that it will exchange with the Roach Estuary will be around 2.1 Million m<sup>3</sup> on a spring tide. This is a substantial reduction when compared against an unmanaged breach scenario which, given the low elevations and flat topography throughout the island, would exchange around 11 million m<sup>3</sup>.

The mechanism for designing this scheme, understanding how it would function and assessing its hydrodynamic effects on the estuary system was pursued as an integrated and iterative process. This ensured that the key issues, constraints and stakeholder requirements were foreseen and addressed as required. For this design and assessment work, the lessons learned from previous intertidal habitat creation projects (especially those from the Defra MR on the north bank of the island) were taken on board alongside available guidance and new modelling techniques. This iterative process, and the principles and tools that were applied, are outlined here as a guide for implementing future projects although it is recognised that the work required for all future schemes will need to be evaluated on a case-by-case basis.

## INTRODUCTION

Since they were first implemented in Europe in the late 1980s, around 91 MR and RTE schemes have been undertaken across North-West Europe (ABPmer 2009) employing a variety of techniques and creating a range of habitats. Of these, there have been 30 MR and 11 RTE schemes in the UK alone, mainly within estuaries in order to create compensatory habitat, improve biodiversity and/or enhance estuary sustainability. The first MR in the UK occurred at Northey Island (Blackwater Estuary) in 1989 but it wasn't until the mid 1990s that the next schemes were implemented (e.g. Tollesbury and Orplands, Essex). In many cases, the design and assessment work for these schemes has had to be underpinned by a robust understanding of the changes that will take place to the hydrodynamics and morphology of the adjacent estuary. This understanding is vital given the wide range of interests to be found in and around most estuaries, ranging from industrial plants to sites of conservation importance. The lessons learned from these projects and the monitoring which accompanied them has provided coastal managers with increasing confidence about the effectiveness of such measures.

In 2007, the RSPB announced that they were planning to undertake a large-scale coastal habitat creation project on Wallasea Island (which lies at the confluence of the Crouch and Roach Estuaries in Essex. On the 23rd April 2009, planning consent was obtained, from Essex County Council, this project which is referred to as the 'Wallasea Island Wild Coast Project' represents one of the largest wetland schemes of its type in Europe. The application area for this scheme covers 677ha of Wallasea Island within which 133ha of mudflat and 276ha of saltmarsh will be created among other supralittoral and terrestrial habitats (including a range of mitigation habitat that are designed to offset the impacts to freshwater and terrestrial species).

## WALLASEA ISLAND STUDY AREA

Wallasea Island is situated on the Crouch and Roach Estuaries (Figure 1) together; these represent a macrotidal, coastal plain system. The typical characteristics of such estuaries include a large width-depth ratio (dependent on rock type); low river flows relative to the volume of the tidal prism and low fluvial sediment transport. Low freshwater flows and tidal dominance are certainly key characteristics of both the Crouch and Roach Estuaries, which have large tidal ranges, reaching up to 5.7m at Burnham on a mean spring tide (Pethick and Stapleton, 1994). Both estuaries have a well-mixed and vertically homogenous hydrography (i.e. with no major change in the salinity, temperature etc. through the water column).

The Crouch and Roach Estuarine system is considered to be ebb dominant overall (ABPmer, 2004a; 2004b), and therefore, acts as a weak source of fine sediment to the coast. Tidal flow conditions in the Roach typically reach 1m/s (2 knots) with a mean flow of 0.43m/s. The combined spring tide prism for the Crouch and Roach Estuaries has been calculated as 82Mm<sup>3</sup> based on a detailed terrain model specially constructed for the project. Of this spring tide volume, the Roach Estuary has a tidal prism of 16.5Mm<sup>3</sup>.

## PROJECT RATIONALE

There are several motives for, and benefits of, the Wallasea Island Wild Coast Project and they include socio-economic and educational objectives. However, the two central aims are to offset historical losses of coastal habitats on this island and across the rest of Essex (and therefore contributing to UK BAP targets for coastal saltmarsh, mudflat and saline lagoons) while also addressing the flood protection risks in the estuary in keeping with the recommendations within the Environment Agency's Flood Management Strategy (Halcrow 2006). It has also been designed to act as a major contribution to adapting to climate change on the coast.

The application area of Wallasea Island is considered to be an ideal site for such a habitat creation project because it is a large area of low-lying, former intertidal land that is entirely within the coastal flood plain and where there is no pre-existing infrastructure. On this island there is an extant policy of no active coastal defence intervention in the (i.e. there will be a cessation of seawall maintenance by the Environment Agency or the landowner). This means that there is a real risk of natural unmanaged breaching occurring in the short to medium-term because approximately 5% of the seawalls around the proposed site have a less than 10 year residual life. Furthermore, the height of the majority of the seawalls is such that there is a high (20%) annual probability of the lower stretches being overtopped/breached during storm surges (also expressed as '1 in 5' years).

The flat terrain across the site and the low/sunken land levels across the island (which are some 1.5m below the external marshes) also mean that following such a breach the island would accommodate an estimated 11m million m<sup>3</sup> on a spring tide (which represents 70% of the tidal prism of the Roach Estuary). This risk is recognised within the flood management strategy (Halcrow, 2006) which highlights that natural breaching could lead to significant flooding of the island and adverse impacts on the hydrodynamics of the estuary and increased stress on the existing estuary defences. Such a scenario and the pressures that it would place on the estuary system are analogous to the effects of unmanaged breach(s) that occurred in the Blyth Estuary (Suffolk) in the middle of the 20<sup>th</sup> century that has resulted in the distinct morphology and management issues associated with this system as described by French (2005). The strategy therefore recommends managed realignment as the long-term flood management policy for the majority of Wallasea Island, subject to economic viability and further assessment.

## OUTLINE SCHEME DESIGN AND IMPACT ASSESSMENT PROCESS

Understanding the coastal process and hydrodynamic effects of the proposed scheme were the key design considerations for this project. The whole process was predicated on the need to ensure that the volumes of tidal water accommodated and the resulting changes in the tidal prism of the Roach would not have a significant adverse effect on the system. It was also crucial that the increase in tidal prism was not so great that it compromised the potential for future management interventions and strategic developments within the estuary that may be required. Finally it was also essential that the site was sustainable in its own right (i.e. that it included accommodation space and resulted in sedimentation that would allow it to cope with rising sea mean sea levels and addressing the risk of a possible unmanaged breaching scenario

Planning and construction criteria which should be considered when planning a MR scheme have been listed below; these key design criteria are based on the Wallasea Island RSPB scheme case study and include:

1. Conceptual estuarine model and initial tidal prism capacity review
2. Simplified hydrodynamic investigation to verify capacity review
3. Site Visit to identify core design requirements and constraints
4. Progressive scheme design development informed by modelling
5. Development of stable breach design
6. Development of functional dendritic creek system
7. Detailed hydrodynamic assessment of the final scheme design
8. Dissemination and Communication

## **Stage 1 - Conceptual estuarine model and initial tidal prism capacity review**

In order to establish the potential long-term morphological effects of various increases in tidal prism brought about by the inundation of Wallasea Island a number of conceptual model approaches and estuary statistics were undertaken. In addition to providing an understanding of morphological change the conceptual models provide an indication of the long-term sustainability of the system under different scheme designs. The conceptual models included a hybrid Regime model and an ASMITA (Aggregated Scale Morphological Interaction between Inlets and Adjacent coast) Stive *et al*, 1998) model. Both of which were developed under the current phase of the UK estuaries research program and both allow for the evolution of the estuary due to some change in the forcing condition. Both these methods provide a broad scale assessment of estuary capacity brought about by the implementation of the proposed MR scheme. The limitations of these methods is that they assume the system is in some equilibrium form and have a higher level of uncertainty, however, they do provide an initial basis on which to undertake further detailed modelling.

For the conceptual modelling a number of simulations were carried out to describe the morphological effect of a range of different scheme designs for the Wallasea Island Wild Coast study. Each of the simulations assessed the morphological change within the Crouch and Roach Estuarine system in response to different tidal exchange volumes (from 1 to 11.5Mm<sup>3</sup>). The results from this conceptual analysis provided an indication of the potential long-term (decades to centuries) change in morphology. In general the key conclusion that can be drawn out from this exercise was that higher tidal exchanges exceeding 5Mm<sup>3</sup> resulted in a 'behavioural shift' in the response of the estuary (seen as substantial erosion and accretion within the Roach Estuary). As such 5Mm<sup>3</sup> was viewed as a critical threshold leading to the recommendation that tidal exchanges

greater than 5Mm<sup>3</sup> should be excluded from further analysis. Furthermore, tidal exchanges of 3Mm<sup>3</sup> resulted in some minor changes in estuary morphology; however, a 2Mm<sup>3</sup> scenario provided almost no discernable change and therefore was deemed as the most appropriate choice.

## **Stage 2 - Simplified hydrodynamic investigation to verify capacity review**

At this stage of the feasibility phase of work, hydrodynamic modelling was carried out in order to understand the effects of a theoretical MR scheme. This MR scheme was essentially a semi-circular area representing a highly theoretical MR site (Figure 2). The site was designed with 3 breaches which were designed to be wide enough so that they did not restrict the flow into or out of the scheme. The size of the realignment area was determined only to ensure that for a mean spring tide (MHWS of 2.85mODN) it would have a tidal exchange of around 2Mm<sup>3</sup>.

The results from this investigation showed that the conceptual MR scheme does not produce large changes to the hydrodynamic parameters within the estuarine system (water levels, flow speeds and bed shear stresses). The effects of the site are concentrated around the breaches on the Roach Estuary, and generally decrease in magnitude with distance from the site, except at the confluence with the Crouch, where the extra volume of water from the scheme combines with the flows to produce higher peak flows on both the flood and ebb within the Crouch.

## **Stage 3 - Site Visit to identify core design requirements and constraints**

Having made an initial estimate about the estuary's capacity and the likely tidal exchange volumes of the scheme, a site visit was undertaken to develop some of the detail of the design features to include in further modelling. The process of designing a scheme is most effectively begun with a walk-over of the site and an interrogation of the topographic maps. Carrying out a site visit with this

topographic data, both at high and low water, is valuable for reviewing; seawall integrity; identifying breach locations; assessing patterns of erosion and accretion and most importantly considering how the site needs to be realigned (Figure 3).

Considering the placement of the breach sites was the pivotal consideration alongside a review of how to divide the site into cells in order to facilitate the construction and to manage the flows into and out of the scheme (Figure 4). In particular, there was a need to ensure that the majority of the tidal exchange occurred in the lower reaches of the Roach towards the confluence with the Crouch Estuary, this area of the Roach has the largest cross-section area and is better suited to cope with larger tidal exchange volumes away from local oyster fisheries. Other factors that aided in the on-site scheme design included the location of relict creeks; the alignment of subterranean power cables and the need to try to minimise the losses of saltmarsh and mudflat outside the site and the effects on the hydrodynamics of the Roach Estuary. Overall, the site visit provided an opportunity to create and inform an initial scheme design that was based on the features of the site which may not have been easily achieved using topographic maps and images alone.

#### **Stage 4 – Progressive scheme design development informed by modelling**

Based on the initial design (Stage 3) a detailed terrain map was created and the tidal exchange volumes were calculated. Thereafter, there was a progressive revision of this design in order, mainly, to reduce the tidal exchange to the desired level (based on the conceptual understanding) but also to accommodate other practical aspects until the final scheme design had been selected (Figure 5). This approach represented the most effective way of developing the scheme while also being minded to the key design objectives and especially to the process of marrying the key water exchange volumes against the amount of fill available and the habitat

creation targets. The final key design criteria and construction methods included:

- Fill material will be imported to raise the levels within the site. To achieve the currently estimated requirements for a tidal exchange of around  $2.1\text{Mm}^3$ , a total of about  $7.5\text{Mm}^3$  of imported fill material would be needed. Land heights will be adjusted to generate suitable habitats inside the seawalls and to enhance seawall integrity.
- The site design must function in order to let water into and around the MR site, based on predicted tidal elevations (inside and outside the site) the MR, breach widths and location around the system.
- The site is to be divided into separate cells with the division achieved through the construction of internal bunds. Build material for the internal bunds that separate the cells will be sourced from the re-profiling of the site and the necessary channel and lagoon excavation works.
- The cells, shown in Figure 4, will be constructed independent of each other and, aside from tidal control structures at three points (into cell 3), will be hydrodynamically separate from each other. Three of the five cells would be subject to full realignment and the remaining two cells to RTE to allow for saline habitat development.

#### **Stage 5 - Development of stable breach design**

A distinct and crucial element of the design phase was the development of the breach design configuration. It is important that the breaches of the MR scheme are stable and that the nature of the openings to the site will depend on the type of habitat to be created. Based on the method described by Townend (2005), a breach model was used to calculate the width required to achieve a stable 'Regime' entrance i.e. not liable to erode. Hypsometry data (volume and area

data at regular intervals from low water to high water), as well as sediment data was used to calculate breach dimensions for the scheme based on this detailed information, other methods exist based on more simplistic models Burd *et al* (1994) and Inglis & Allen (1957) however, these methods rely on a limited data source.

For this scheme the resulting breach widths based on the Townend (2005) method varied from 55 to 70m with a depth of up to 1m per breach, which for the 6 breaches gives a total length well within the proposed total breach length of 600m. A comparison against the Defra MR site which has a total breach width of 590m for a tidal exchange volume of 2Mm<sup>3</sup> shows a stable breach channel. Flow speeds have been measured through the Defra breaches at <1m/s and bathymetric survey have not revealed any change to the breach morphology in front or adjacent the breach positions. Overall, the 600m proposed breach width for the Wallasea Island Wild Coast project seems reasonable given these methods (empirical and observed) of analysis and also incorporates a degree of safety to ensure the site functions correctly.

### **Stage 6 - Development of functional dendritic creek system**

An further critical stage in the construction and planning criteria particularly for a scheme design of this size and magnitude is the inclusion of a dendritic creek network, this network of small creeks (<5m in width) are essential to ensure that tidal water reaches as far into the site as possible. This transport network serves a number of functions, the major ones being; supply and dispersal of fine sediment; provide efficient drainage and de-watering of sediments and dissipate tidal energy inputs.

The creek design approach developed for dendritic creeks, assumes that channels or creeks within a saltmarsh can be designed using the surface drainage plan area of the marsh, that the marsh has an approximately constant depth relative to HW and that the velocities are approximately uniform

(Townend *et al*, 2009). In order to assess the effectiveness of this approach a model simulation was setup in which there was no more than a 70m distance placed between creek channels. The model results were compared with and without the creeks in place. The results showed that the tides penetrated further into the site carrying fine sediment and distributing this further around the scheme. The major advancement of this approach is that it increased the extent of intertidal habitat within the scheme with only a small increase in the tidal prism.

Fundamentally, over time proto-creeks will develop on their own accord, following lines of weaker consolidated material, vegetation and so on. Designing the MR with the dendritic creeks in mind, using the approach outlined, helps to improve site function and maximise the amount of intertidal habitat created.

### **Stage 7 - Detailed hydrodynamic assessment of the final scheme design**

To assess the immediate or 'short term' hydrodynamic effects of the RSPB Wallasea Wild Coast, Project the outputs from a detailed hydrodynamic modelling work were used to calculate the net changes in the hydrodynamic and sediment regime of the site and wider environment.

The detailed modelling review found that the levels of change predicted to occur within the Crouch and Roach estuary and within the proposed realignment site were marginal and within tolerable limits. Specifically, the modelling showed that the 2Mm<sup>3</sup> scheme results in no change in the height of the tide within the system, albeit there is a small change in the time of high and low water. Flow speeds and stresses applied on the intertidal seabed are also small or not distinguishable from the natural variability of the system. A thorough review of these effects have shown that the proposed scheme results in a small increase in the ebb flow speeds local to the breach sites within the Roach and that these increases are small and occur within the main subtidal areas and will not



effect the existing intertidal of the system. Figure 6 shows the predicted maximum changes in flow speeds with the system at peak ebb. Again, these maximum changes are located close to the breach location and occur in the subtidal regions at the upstream sections of the Roach.

These results have to be compared against a likely condition of an unmanaged breach scenario. The detailed model was designed with multiple breaches under existing land elevations which could result in a tidal exchange in excess of 11Mm<sup>3</sup>. The resulting changes in water levels downstream of the Roach Estuary at the confluence to the Crouch are some 3 to 5cm higher; with significant water level reductions upstream of Wallasea in the Roach of up to 30cm. Equally, peak flow speeds are some 40% higher in the downstream reaches of the Roach and Crouch Estuaries. Bed shear stress values over the intertidal area are predicted to far exceed the erosion threshold resulting in erosion of the intertidal margins in the Roach around Wallasea Island and the downstream section of the Crouch Estuary.

In summary, the hydrodynamic results from the unmanaged breach scenario are consistent with the findings from the conceptual model suggesting that large tidal exchanges into and out of Wallasea Island would result in a significant behavioural shift of the system. Downstream sections of the estuarine system would be liable to increased deposition and upstream areas subject to an increase in the erosion. These findings support the requirement for a managed and sustainable approach to the management of Wallasea Island.

## **Stage 8 - Dissemination and Communication**

A further role of the modelling work, and of the associated EIA process, was to contribute to the RSPB's consultation work for this project. A detailed Communication Strategy was pursued that represented a fundamental element of this project. Through this process, RSPB have sought the involvement of the whole community

(including interested individuals, district/parish councils, relevant organisations and businesses). Ultimately this strategy is considered to have contributed significantly to the project's successful path through to planning consent (by Essex County Council).

Led by the scheme's project manager, communication was undertaken through written correspondence, meetings and three public exhibition/consultation meetings (that were each widely promoted using posters, leaflets and local media). This was in addition to the series of communications with statutory consultees that were undertaken by the project team as part of the EIA process. The RSPB furthermore made every effort to make the wider public aware of the project, through excellent coverage by local, regional and national media, the RSPB's own website and a widely circulated project leaflet. In addition, a Technical Advisory Panel was also instigated to oversee the project throughout its lifetime and this included representatives from the District Council Planning Office, Natural England, CEFAS, the Environment Agency, the Harbour Authority and the landowner.

To feed into the community engagement process, ABPmer provided technical support as required but also produced visual outputs from the modelling that were designed to clearly describe the scheme function to demonstrate the rationale for it and to show the effects that it will have on the estuary. In particular, high-quality photorealistic 3D video and still images were produced by integrating aerial photographs, model outputs and bathymetric data to create a visualisation of the site. This visualisation illustrates how the site will look (Figure 7), how it will continually change appearance as the tide enters and exits the site and how it will integrate with the surrounding environment.

## **SUMMARY**

The RSPB scheme is the UK's largest proposed habitat creation project and represents the biggest inshore design in the

context of what is a clear trend for the creation of larger and more complicated managed realignments. The iterative processes described above, and the principles and tools that were applied for

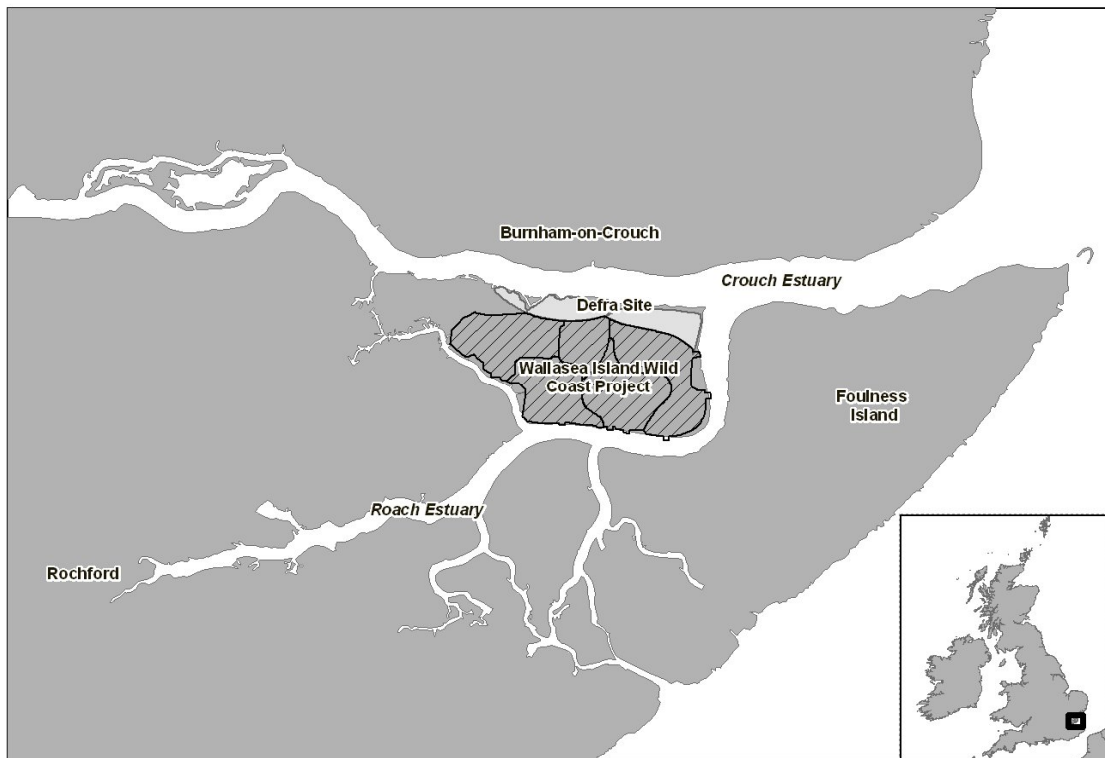
application are outlined here and build upon many of the lessons of the last 20-years, these iterative steps form a guide for implementing future MR projects within estuarine environments.

## REFERENCES

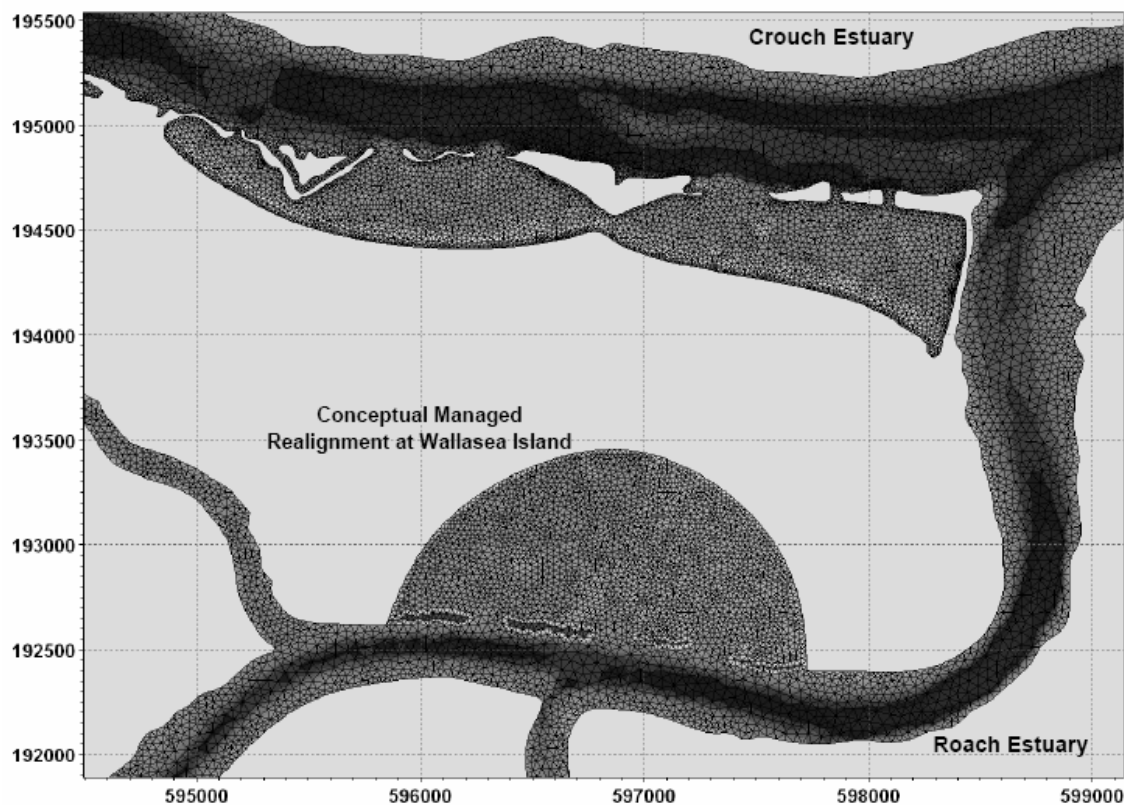
- ABPmer (2009) Online Managed Realignment Database at [www.abpmer.net/omreg](http://www.abpmer.net/omreg)
- ABPmer (2004a) Lappel Bank and Fagbury Flats Compensatory Measures: Phase 2 – Detailed Hydrodynamic Model of Proposed Realignment Scheme on North Bank of Wallasea Island. ABP Marine Environmental Research Ltd, Report No. R.1115.
- ABPmer (2004b) Lappel Bank and Fagbury Flats Compensatory Measures: Phase 2 - Preliminary Hydrodynamic Modelling of Possible Realignment Schemes at Weymarks and Wallasea. ABP Marine Environmental Research Ltd, Report No. R.1059.
- Burd, F., Clifton, J. and Murphy, B. 1994. Sites of Historical Sea Defence Failure: Phase II Study. *Institute of Estuarine and Coastal Studies*, University of Hull, Hull, Report No. ZO38-94-F, 100pp.
- Defra (2002) Future coast. Halcrow Group for Defra, CD-Rom.
- French, J.R. (1996) Function and design of tidal channel networks in restored salt marshes. In: TIDAL'96 - Interactive Symposium for Practising Engineers, University of Brighton, UK, 128-137
- Halcrow (2006) Roach and Crouch Flood Management Study. Report to the Environment Agency.
- Inglis, C.C. and Allen, F.H. 1957. The Regime of the Thames Estuary as Affected by Currents, Salinities and River Flow. *Proceedings of Civil Engineering Division Meeting*, 7: 827.
- Pethick, J. and Stapleton, C. (1994) Essex Seawalls Management Strategy: Geomorphology. Institute of Estuarine and Coastal Studies, University of Hull. Report No. SO15-94-D.
- Stive M.J.F, Capobianco M, Wang, Z.B, Ruol, P, Buijsman, M.C. (1998) Morphodynamics of a tidal lagoon and adjacent coast, In *Physics of Estuaries and coastal Seas: 8<sup>th</sup> International Biennial Conference on Physics of Estuaries and Coastal Seas*, 1996. A. A Balkema, Rotterdam, pp 397-407.
- Townend, I. (2005) An examination of empirical stability relationships for UK estuaries. *Journal of Coastal Research* 21(5):1042-1053
- Townend, I., Scott C. and Dixon M. (2009), *Submitted*, Managed realignment. Flood Risk Science and Management. Pender G *et al.* (Eds) Blackwells, Oxford
- Wright, A. P and Townend, I.H (2006). *Predicting Intertidal Change in Estuaries*. 41<sup>st</sup> Defra Flood and Coastal Management Conference 2006.

## ACKNOWLEDGMENTS

The Authors would like to thank the following people for their contribution to the project Mark Dixon, Jeff, Kew, John Sharpe, Graham Hirons and Malcolm Ausden of the RSPB for valued input to throughout the project.



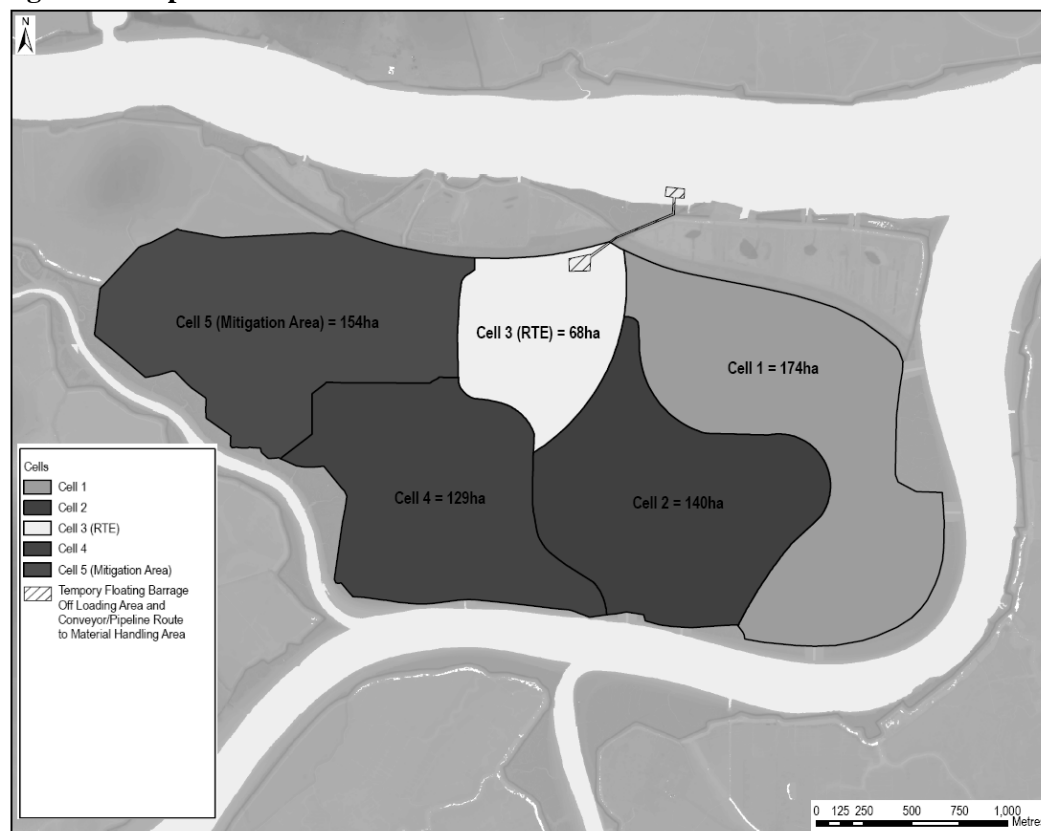
**Figure 1 Site location for Wallasea Island, Crouch Roach Estuaries.**



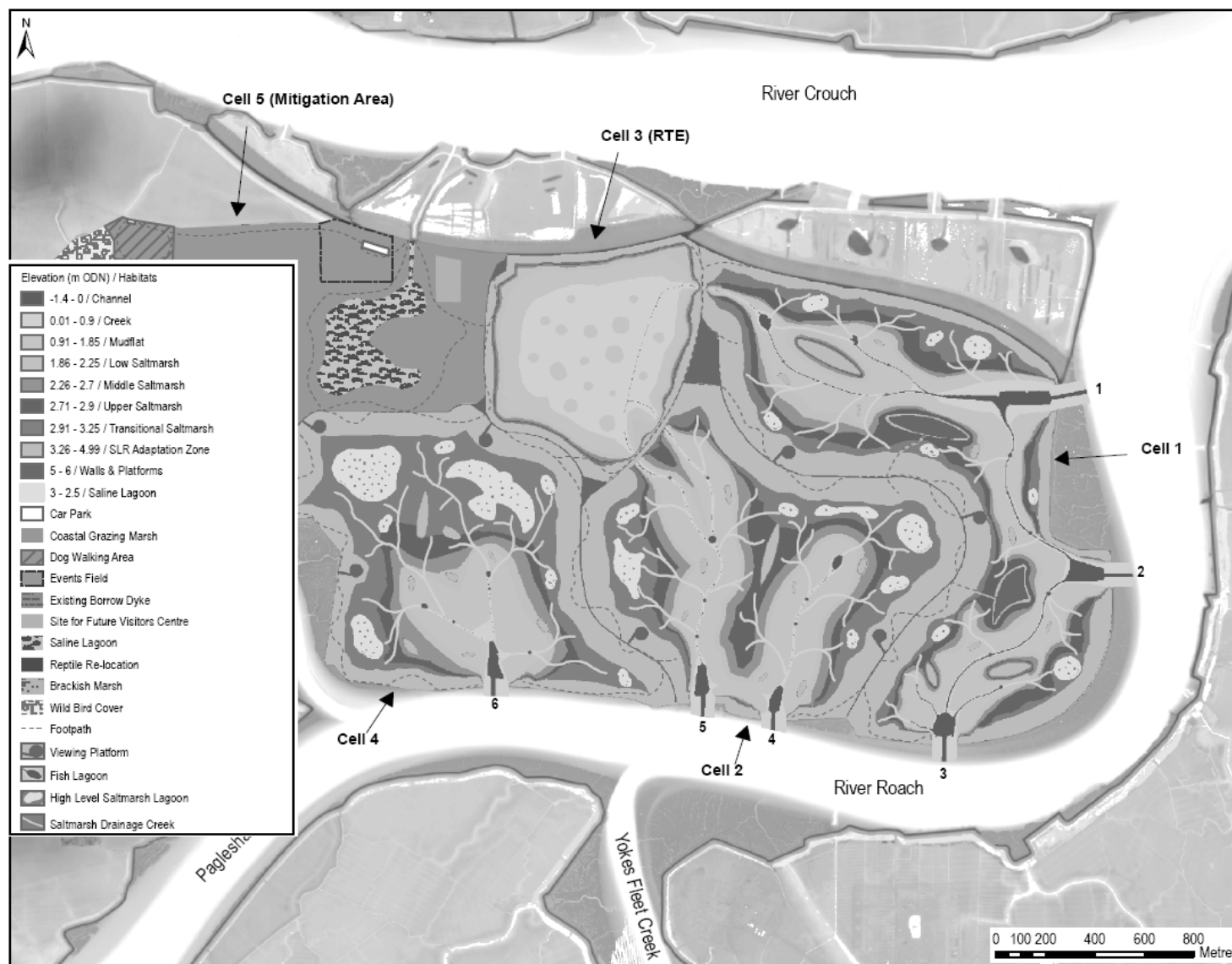
**Figure 2 Highly Conceptual Managed Realignment Scheme at Wallasea Island, Designed to Inform Estuary Capacity Study.**

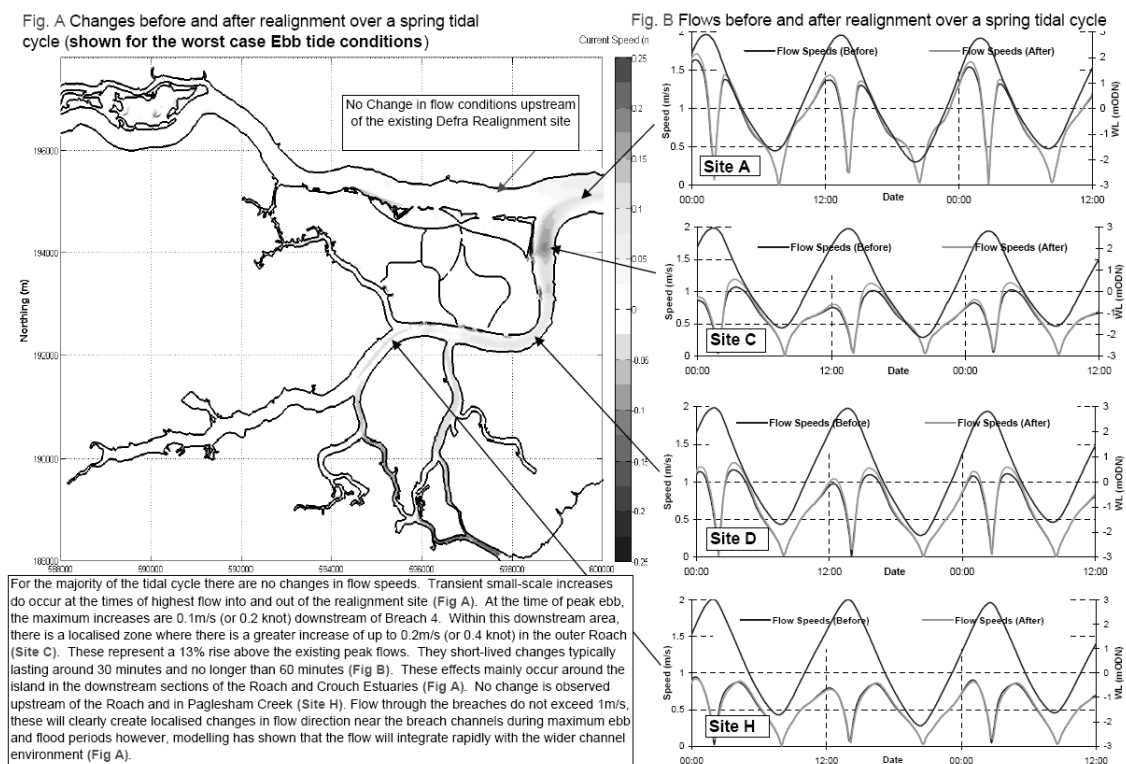


**Figure 3 Site pictures at Wallasea Island.**



**Figure 4 Wallasea Island Proposed Cell Division within the proposed RSPB Wallasea Island Scheme**





**Figure 6 Flow Speed Changes as a Result of the Proposed Realignment**



**Figure 7 Aerial View Visualisation of the Wallasea Island Wild Coast Scheme at Mean Low Water**





## Fluid thinking...smart solutions

HR Wallingford provides world-leading analysis, advice and support in engineering and environmental hydraulics, and in the management of water and the water environment. Created as the Hydraulics Research Station of the UK Government in 1947, the Company became a private entity in 1982, and has since operated as a independent, non profit distributing firm committed to building knowledge and solving problems, expertly and appropriately.

Today, HR Wallingford has a 50 year track record of achievement in applied research and consultancy, and a unique mix of know-how, assets and facilities, including state of the art physical modelling laboratories, a full range of computational modelling tools, and above all, expert staff with world-renowned skills and experience.

The Company has a pedigree of excellence and a tradition of innovation, which it sustains by re-investing profits from operations into programmes of strategic research and development designed to keep it – and its clients and partners – at the leading edge.

Headquartered in the UK, HR Wallingford reaches clients and partners globally through a network of offices, agents and alliances around the world.



**HR Wallingford Ltd**  
Howbery Park  
Wallingford  
Oxfordshire OX10 8BA  
UK

tel +44 (0)1491 835381  
fax +44 (0)1491 832233  
email [info@hrwallingford.co.uk](mailto:info@hrwallingford.co.uk)

[www.hrwallingford.co.uk](http://www.hrwallingford.co.uk)

