

A winning formula for port development in a sensitive environment

M. Simpson, Senior Environmental Scientist, Royal Haskoning, **S. John**, Director, Environment UK, Royal Haskoning, **J. Brien**, Harbour Engineer, Harwich Haven Authority, & **A. Birchenough**, Marine Environmental Impact Assessor, CEFAS

Background to major recent and proposed port development in the Harwich Haven

The Harwich Haven, in England, is formed by the confluence of the estuaries of the River Orwell (Suffolk) and River Stour (Essex) (see Figure 1). The area has a long maritime history, with the last century seeing significant development of port facilities, most notably at Felixstowe and Harwich. In terms of volume of container handling, the Port of Felixstowe is the largest container port in the UK and has a total berth length of over 4,100m. Harwich International Port currently has a total berth length of over 1,600m.

The scope of the discussion in this paper focuses on those major port expansion and capital dredging projects that have been undertaken in the Harwich Haven area since 1998, in particular the deepening of the dredged approach channel by the Harwich Haven Authority (HHA) in 1998–2000. This capital dredging project comprised dredging approximately 18Mm³ of material and deepened the channel by 2m to -14.5m Chart Datum (CD).

In addition, in 2003 construction commenced on a 270m extension to the Trinity III Terminal at the northern end of the Port of Felixstowe to create additional deep-water berthing facilities. Capital dredging of approximately 900,000m³ of material was associated with this extension. This construction work was completed in late 2004.

Furthermore, there are currently two proposed port developments in the Harwich Haven; the Bathside Bay Container Terminal and the Felixstowe South Reconfiguration. Both proposals involve reclamation of intertidal and subtidal areas and capital dredging of the approaches and berths. These proposals were both the subject of local Public Inquiries in 2004. In December 2005, the Bathside Bay Container Terminal proposal was granted a 'minded to approve' decision and in February 2006 the Felixstowe South Reconfiguration was fully approved.

Designated sites within the Stour and Orwell estuary system

There are a number of sites designated for their nature conservation importance within the Stour and Orwell estuary system. Both estuaries are designated as separate Sites of Special Scientific Interest (SSSI) under the Wildlife and Countryside Act 1981. These two SSSIs form the Stour and Orwell Estuaries Special Protection Area (SPA) (classified under the 'Wild Birds Directive') and Ramsar site.

Environmental studies in the Stour and Orwell estuary system

As a consequence of the presence of major ports in the Stour and Orwell estuary system and the various proposals for development, the estuary is one of the most intensively studied systems in the UK and, arguably, in Europe. In particular, knowledge of the hydraulic processes and sediment budget of the estuary has been built up over a number of decades, resulting in well calibrated and validated numerical models of the system. Such knowledge



Figure 1. The Stour and Orwell estuaries and the Walton Backwaters.

Source: HR Wallingford

is fundamental in that it provides the ability to predict the likely effects of development on the hydraulic and sediment regime of the estuary system with a high degree of confidence. These predictions are crucial in enabling detailed environmental assessment of the potential impacts of development on, for example, the morphology of intertidal areas to be undertaken and for informing the development of practicable mitigation measures to offset the predicted impacts of development, where required. Such environmental effects and mitigation measures have been reported through the Environmental Impact Assessment (EIA) process that has been undertaken for each of the proposed developments in Harwich Harbour.

In view of the designated status of the estuary system and the nature of the environmental impacts predicted to arise from each of the port developments and capital dredging projects described above, each project has, as part of EIA, also been subject to 'appropriate assessment' in accordance with Regulation 48 of the Conservation (Natural Habitats &c.) Regulations 1994. The purpose of appropriate assessment is to assess the implications of a proposed development for the designated status of any relevant 'European sites' (e.g. SPA), as defined through the sites conservation objectives (which derive from the reasons, or qualifying features, for which the site was originally classified). In essence, it is the appropriate assessment process which has driven the need to develop appropriate mitigation and compensatory measures in light of the various predicted effects of development on the habitats and species for which the Stour and Orwell estuary system is designated.

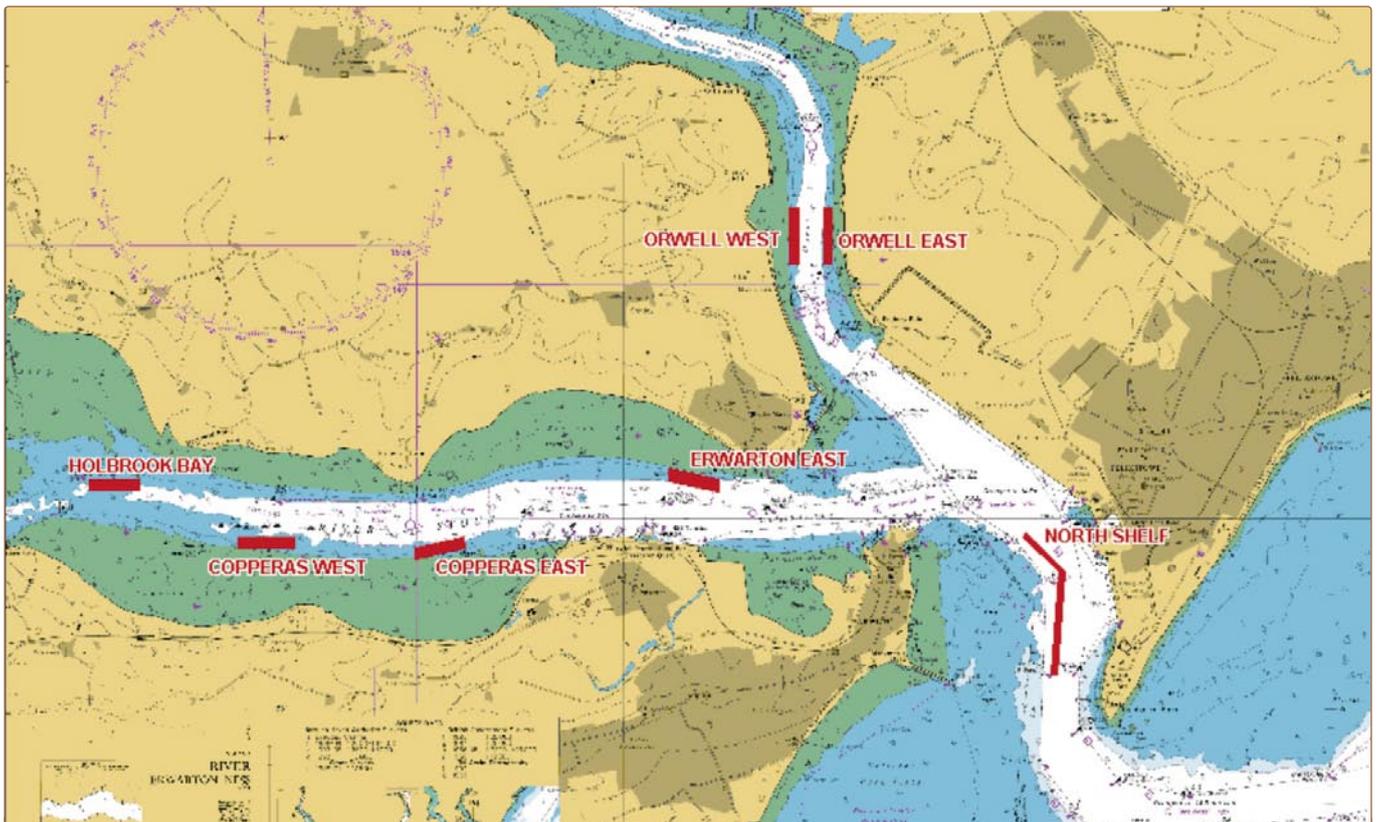


Figure 2. Location of sites currently licensed for the placement of maintenance dredged material as part of the sediment replacement programme.

Harwich Haven approach channel deepening

Introduction

In 1998, work commenced on a project to deepen the approach channel into the Harwich Haven from its existing depth of -12.5m CD to -14.5m CD to improve navigation. The capital dredging would give rise to approximately 18Mm³ of sediments, comprising a mixture of mud, sand and gravel and clay, most of which was unusable (clay) and was disposed of offshore in a designated disposal ground. Royal Haskoning (previously Posford Haskoning and Posford Duviervier), in association with HR Wallingford, undertook an EIA for the proposed channel deepening [HR Wallingford, Posford Duviervier Environment, (1998), 'Harwich Haven Approach Channel Deepening – Environmental Statement', January 1998.].

Overview of key predicted impacts

The environmental studies concluded that the channel deepening would give rise to a number of effects on the hydraulic and sedimentary regime of the Stour and Orwell estuary system. It was predicted that the effect of the channel deepening on tidal propagation would result in an increase in the level of the low water mark on spring tides (i.e. there would be a decrease in the tidal range) which, when the slope of the intertidal throughout the system was taken into account, notionally equated to the decreased exposure of approximately 4ha of intertidal area. In terms of the area of intertidal exposed for feeding waterbirds, this effect is viewed as a loss of intertidal area in the system; in reality, it is the conversion of intertidal habitat to shallow subtidal for a majority of tides. It is not possible to mitigate this effect.

In addition to the above, it was predicted that the rate of intertidal erosion within the estuary system would increase by approximately 2.5ha per annum. This effect was predicted to arise as a result of the trapping of muddy material in the deepened channel which would previously have been transported further into the estuary system and been deposited onto the intertidal

areas. The trapped material would then be dredged during routine maintenance dredging campaigns (undertaken on an approximately 12 week basis by the HHA) and disposed at a designated site offshore. The maintenance dredging would, therefore, represent a mechanism by which fine material is lost from the estuary system. It should be noted that the Stour and Orwell estuary system is currently an eroding system, with an estimated background rate of intertidal erosion in the order of approximately 10ha per annum overall.

Mitigation solutions

In order to mitigate the predicted increase in the rate of intertidal erosion of approximately 2.5ha per annum, a number of different approaches were explored, as summarised below (collectively termed 'sediment replacement'). Over time, and based on the results of trial placements of sediment and monitoring, the overall mitigation strategy has evolved into an approach that is considered to be the most effective (relying substantially on water column recharge; see below). The locations that are currently licensed for the placement of maintenance dredgings are shown in Figure 2.

- **Subtidal placement of fine material**

Fine sediments that are dredged during the maintenance dredging campaigns are placed on the seabed and act as a feed of material into the estuary system.

- **Water column recharge**

Maintenance dredgings are discharged from the dredger at certain defined placement locations within the estuary system adjacent to intertidal areas. Placements are made under specific tidal conditions that encourage material to disperse over intertidal areas. This represents a novel approach that has been proven to be successful.

- **Increased overflow during maintenance dredging**

During maintenance dredging, overflow can be increased above the normal rate. This represents a further method of returning fine material within the estuary system.

Source: HHA



Figure 3. Aerial view of the 16.5ha Trimley managed realignment scheme on the eastern shore of the Orwell estuary, looking south.

Compensatory measures

In addition to the mitigation of the predicted increase in the rate of erosion of the intertidals in the estuary system described above, it was also necessary to take measures to address the effect of the proposed capital dredging on tidal propagation.

The approach to compensating for the 4ha of unmitigable 'loss' of intertidal area due to the effect on tidal range was, therefore, to create additional intertidal area within the estuary system. This was achieved through the managed realignment of a seawall on the eastern shore of the Orwell estuary near Trimley (see Figure 3). However, in addition to the 4ha of unmitigable loss, a precautionary approach was applied and it was necessary for the HHA to create an additional area of intertidal area. This allowed for the possible failure of the mitigation measures described above for a period of 5 years (i.e. enhanced erosion of intertidal area at 2.5ha per annum, or a total area of 12.5ha). Therefore, the area of intertidal created at Trimley through managed realignment was 16.5ha (4ha plus 12.5ha).

Beneficial use of dredged material

A required part of the process for obtaining the necessary license for the disposal of dredged material (under the Food and Environment Protection Act 1985 [FEPA]) is to explore options for the use of the dredged arisings in a beneficial manner. Under FEPA, the licensing authority must 'have regard to the practical availability of any alternative methods of dealing with them (disposed materials)'. The aim of seeking the beneficial use of dredged material is to limit, as far as possible, the volume of dredged material to be disposed offshore (in essence, reducing the amount of waste that is generated).

In addition to the use of fine-grained maintenance dredged material for water column recharge and subtidal placement, a number of other possible beneficial use schemes were identified within the Stour and Orwell estuarine system and within and adjacent to an estuary complex to the south (the Walton Backwaters) in association with the Channel Deepening. These various proposed schemes used clay, sand and gravel and included beach recharge between the Naze and Stone Point (see Figure 4) and the creation of mudflat and saltmarsh habitat on the Shotley foreshore on the western shore of the Orwell estuary (see Figures 5 and 6).

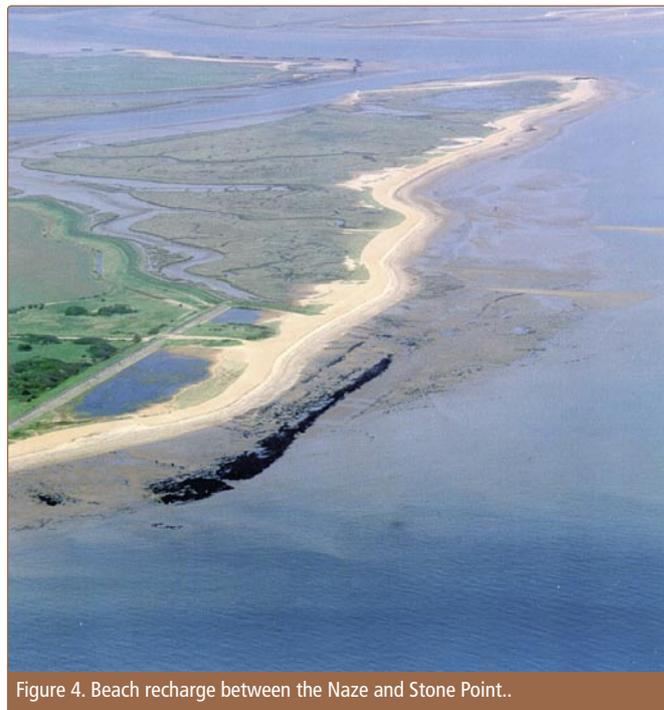


Figure 4. Beach recharge between the Naze and Stone Point..

Source: HHA

Monitoring

A comprehensive estuary-wide monitoring programme was established which encompasses a wide range of parameters, with specific monitoring of the Trimley managed realignment scheme. Although details of the monitoring is outside the scope of this paper, it includes the following parameters:

- Bathymetry, including foreshore and drying areas
- Benthic invertebrate communities (biotope mapping)
- Saltmarsh vegetation and extent
- Waterbird counts (low water)
- The fisheries resource – fish, shrimp and plankton diversity and numbers
- Suspended sediment concentrations and intertidal deposition.

The monitoring is undertaken based on a rolling programme with the frequency of monitoring varying between parameters (e.g. waterbird counts are undertaken four times a year whereas



Figure 5. Water column recharge in the lower Orwell estuary.

Source: HHA

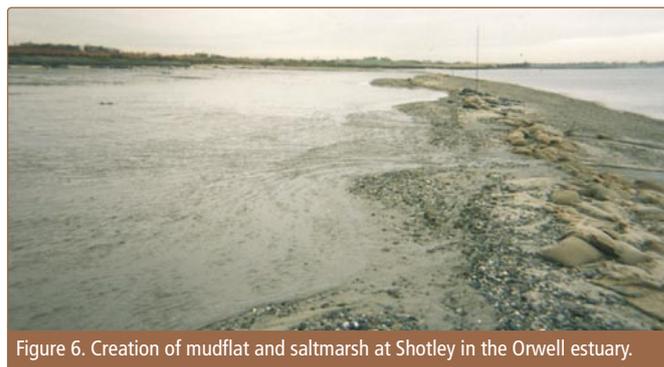


Figure 6. Creation of mudflat and saltmarsh at Shotley in the Orwell estuary.

Source: HHA

Source: HHA



Figure 7. Habitat enhancement scheme on the Trimley foreshore, looking north.

bathymetric surveys are undertaken once every five years on a rolling programme).

Other development in the Stour and Orwell estuary system

As mentioned in the introduction, there are a number of other recently constructed and consented developments within the Stour and Orwell estuary system; the Trinity III Terminal Extension (consented and recently completed) and the Bathside Bay Container Terminal ('minded to approve') and Felixstowe South Reconfiguration (consented). The environmental studies associated with these initiatives have predicted that they would give rise to effects of a similar nature to those described above for the Approach Channel Deepening, albeit the impacts are of a different magnitude. An important difference is that the port development schemes all comprise, to varying extents, the reclamation of both intertidal and subtidal areas and, therefore, give rise to direct losses of habitat.

Where possible, the various environmental studies undertaken for each of the proposed developments recommended compensation (where appropriate) and mitigation measures to offset any adverse impacts on the habitats of the Stour and Orwell estuary system. With respect to the implications of the various developments on the estuary-wide rate of intertidal erosion, it was agreed that the effects could be mitigated via the enhancement of the sediment replacement programme that was established following the Approach Channel Deepening in 2000.

In addition, specific measures were proposed to address the localised erosion of intertidal areas predicted to arise largely due to local changes in wave energy over certain intertidal areas. It is partly because of such predicted effects that 'habitat enhancement schemes' were proposed in the lower Orwell estuary on the Trimley foreshore (see Figure 7) and the Shotley foreshore (see Figure 8). These schemes comprised the placement of dredged clay and gravel at around the mean low water mark to form bunds (as shown on Figures 7 and 8) which were backfilled within mud. These schemes served a number of functions; namely they provided intertidal habitat of higher ecological value (e.g. a mixture of mudflat and, over time, saltmarsh) than that which was formerly present and they increased the stability of existing flood defences in the lower Orwell estuary. In addition, they represent the beneficial use of dredged material. Crucially, the schemes were

Source: HHA



Figure 8. The habitat enhancement scheme on the Shotley foreshore in the lower Orwell estuary, looking south.

recognised by the regulators as not necessarily being permanent structures and they would erode and evolve over time. This was considered desirable as the habitat enhancement schemes would not constrain future options for the sustainable management of flood defences and habitats in the estuarine system.

Management of the mitigation and monitoring commitments

Establishment of a Regulators Group

The management of the mitigation and monitoring programme, agreed as a consent condition for the Approach Channel Deepening, has a number of key features which have evolved and been refined in response to the findings of monitoring and the requirement to consider the implications of subsequent proposed schemes. From the outset, a 'Regulators Group', with the authority to make decisions regarding the refinement of the mitigation and monitoring programme, was established. This Group represents the forum through which the programme is delivered. The Group comprises a number of bodies including English Nature, Defra (represented by CEFAS), the Environment Agency, the Department of Transport (Ports Division) and non-statutory organisations including the Wildlife Trusts (Essex and Suffolk) and the RSPB. With the addition of organisations without a regulatory function, the group is now more appropriately described as an 'Advisory Group'; where decisions are subsequently put to the Regulators for consent.

A by-product of this collaborative approach that has partly arisen as a result of the HHA inviting other operators in the estuaries to also attend the meetings, has been an attempt to co-ordinate all mitigation and monitoring activities in the estuary system. This has derived from the open exchange of information and the establishment of a consultative forum. A culture of shared responsibility, between operators, regulators and NGOs, has consequently arisen.

Compliance monitoring and annual reporting

In order to assess the HHA's compliance with the large number of mitigation and monitoring commitments a process of 'compliance monitoring' was also established. This is overseen by an independent auditor (Royal Haskoning). The process involves documenting actions and commitments to be undertaken during and following completion of capital works. A compliance report

is produced which describes work that has been undertaken with respect to each of the commitments and records when a commitment has been fulfilled. The process is overseen by the Regulators Group and the annual compliance reports are circulated to this Group.

In addition to compliance monitoring, an Annual Report is produced which details the findings of the research and monitoring that has been undertaken during the previous year and considers the ongoing consequences, if any, of development for the health, state and integrity of the estuarine system. This report is presented at an annual meeting attended by the Advisory Group members to ensure that there is an open exchange of information between the HHA and the Group. This is an important process as the findings of the annual report and the discussions held at the annual meeting inform any changes to the programme of monitoring that may be required. Managing the process in this manner is the most effective approach to obtaining agreement from the various Regulators as to the way forward with respect to the mitigation and monitoring.

In essence, the process is intended to be flexible and responsive. For example, the monitoring and mitigation package will be adapted/extended to accommodate the requirements (and/or conditions) associated with the recently consented developments. This has happened in the past, when the Trinity III Terminal Extension was consented following the 1998/2000 Channel Deepening and has involved the extension of the Group to include other relevant bodies (such as the Sea Fisheries Committees). This flexible, monitoring based approach to management also allows the Advisory Group (and through them, where required, the Regulators) to agree to modify the mitigation programme in response to monitoring results or other concerns. For example, as a precautionary measure, water column recharge was suspended at one receiving site (Holbrook Bay) when native oyster beds were found to be present and proposals put forward for the introduction of material elsewhere.

Dealing with uncertainty and consideration of 'risk'

The estuarine environment is inherently variable and in managing such a dynamic environment the requirement to accept some degree of measured risk is unavoidable. It is vital to recognise that there will be an element of uncertainty associated with predicting both the functioning of a natural system and the extent of any disturbances likely to arise as a result of development.

In the case of the Stour and Orwell estuaries this uncertainty (albeit limited) relates particularly to the ability of an artificial sediment bypassing system to efficiently replicate nature; the relevance of the placement locations; and the potential effect of sediment replacement on the benthic ecology and fish resources of the estuaries. These issues, however, can be informed through monitoring and a review of monitoring data. It is for this reason that the adoption of an iterative, flexible approach to mitigation, informed by good data, appropriate monitoring and an open exchange of information with stakeholders, is essential.

This is achieved in the Harwich Haven through a system of monitoring, reporting and response with a single point of responsibility. In addition, the mitigation is conditioned (and thereby any risk is reduced) through four steps, where a procedure is in place for each step to be taken sequentially should the previous step prove to be inadequate. That is:

- 1) A broad, estuary-wide sediment replacement programme, as described above
- 2) Sediment replacement specifically targeted towards areas of 'need'
- 3) Direct placement onto the intertidals (with appropriate consent)
- 4) If all else fails, compensation

It has to be accepted that such a process cannot be predetermined and that an element of uncertainty will remain as to the measures that will eventually have to be adopted and the cost to the developer. The only real alternative to this would be to fully agree what measures would be adopted before the works are carried out; a situation in which the conservation bodies would have little choice but to take a cautious view and require maximum compensation. Overall, the flexibility and consultation built into this approach ensures that a well informed decision making process exists and successful mitigation is delivered.

This is an abridged version of a paper originally presented at CEDA Dredging Days 2005, Dredging: The Extremes, and is reprinted with kind permission.

ENQUIRIES

M Simpson

Royal Haskoning

Tel: +44 1392 447999

Fax +44 1392 446148

Emails: m.simpson@royalhaskoning.com

s.john@royalhaskoning.com

Website: www.royalhaskoning.com

Harwich Haven Authority

Tel: +44 1255 243030

Fax: +44 1255 241302

E-mail: harbour.engineer@hha.co.uk

CEFAS

Tel +44 (0)1621 787200

Fax +44 (0)1621 784989

Email: a.birchenough@cefass.co.uk

Website: www.cefass.co.uk