Drogheda Port Company

Boyne Entrance Channel Dredging  
Impact on Sediment Cell

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## CONTENTS

1.0 Introduction .............................................. 1

2.0 Data Sources ........................................... 1

3.0 Analysis .................................................. 2

   3.1 Transport from the offshore dump site ............... 2
   3.2 Net sediment transport into the sediment sub cell at the Boyne 3
       3.2.1 Sediment distribution .......................... 3
       3.2.2 Net sediment movement ....................... 4

4.0 Conclusions ............................................. 7

5.0 References ............................................ 7
1.0 Introduction

The entrance to Drogheda Port is located on a shallow shoaling coastline and is subject to rapid siltation from easterly and south easterly gales. Drogheda Port Company, the port authority and regulator of safe navigation to and from Drogheda Port, dredges the entrance channel to the Boyne Estuary to maintain safe access for shipping to and from Drogheda Port particularly following an easterly gale event. Although the quantities of dredging vary from year to year, the average over an eleven year period was about 90,000 m$^3$ per annum of sand from the entrance channel. Historically the port has disposed of the material to an offshore dump site located about 2.5 nautical miles north east of the entrance to the Boyne where the water depth is greater than about 14m.

Dredging at Drogheda Port is a licenced activity. The dredging at the entrance is primarily driven by weather events that affect safe navigation depths. Meeting the licence conditions, the Port has brought a portion of the dredged sand ashore for use in the aggregate industry under a trial beneficial reuse scheme.

The Port Company is now preparing to renew its maintenance dredging licence and is anxious to ensure that its proposed dredging procedures are sustainable in terms of the impact on the coastal processes of the adjoining areas. Thus RPS was commissioned to estimate how much of the spoil disposed of at the offshore dump site would return to the inshore sediment regime and in addition to investigate the average annual quantity of sediment entering the sediment sub cell adjoining the Boyne to assess what quantity of material could be beneficially reused in a sustainable manner.

2.0 Data Sources

The data sources used in the study consisted of 3 hourly wind and wave data for the offshore area derived from the UK Met Office European waters wave model together with bathymetric survey and sediment data derived from surveys undertaken for various coastal process studies commissioned by Drogheda Port for the period 1994 to 2008 and carried out by RPS formally Kirk McClure Morton.

In addition to the basic hydrodynamic and sediment data, information regarding the sediment transport regime in the area was taken from the following study reports.

- Beach Restoration at Laytown/Bettystown studies by RPS Kirk McClure Morton 2005$^{(3)}$.
3.0 Analysis

3.1 Transport from the offshore dump site

The assessment of the movement of dredged material from the offshore dump site area which is centred at 6° 10.5’W, 53° 44.5’N, was simulated by computing the sediment transport rates for every 3 hours through a typical year. The wave climate at the site was established by modelling the transformation of the 3 hourly offshore data set to the site using RPS Mike21 SW wave model and the tidal currents were extracted from the RPS Irish Coastal tidal and surge model. The extent of the wave and tidal models is shown in Figure 1.

![SW wave model and Irish coastal tide and surge model](image)

**Figure 1** Extent of wave and tidal models used for dump site analysis

The results of the sediment transport simulations for the offshore dump site showed that sediment would only move at the site during significant storm events when the larger waves with the longer wave periods could disturb the seabed sediment at this location. However the amount of dredged material which would be moved towards the beaches by these events was very small and generally less than about 500 m$^3$/annum. The analysis was also checked against the bed load transport results shown in the MarCon 3D morphodynamic modelling of the Irish Sea[6]. Although the size of the grid spacing in this model is rather large (2km x 1.6km) compared to the Mike21 models, the results of the bed load transportation are of the same order of magnitude with transport rates of about 1,500m$^3$ per annum in the area around the offshore dump site. Thus it is concluded that only about 1% of the dredged material dumped on the offshore dump site is likely to find its way back onto beaches of Counties Louth or Meath.
3.2 Net sediment transport into the sediment sub cell at the Boyne

3.2.1 Sediment distribution

The distribution of non cohesive sediment (mainly sand) around the Irish Sea is shown in Figure 2 which is taken from Figure 9 of the report of the Morphodynamic Modelling in the Irish Sea\textsuperscript{(5)}. It will be seen from this diagram that the sea bed to the west of a line from about Clogher Head to east of Skerries, including the coasts of Co Meath and Louth around Drogheda is comprised of sand. Sediment sampling undertaken as part of the Kirk McClure Morton studies\textsuperscript{(1)}\textsuperscript{(2)} indicates that the median sediment size is about 0.13 to 0.15 millimetres. The sea bed to the north east of this area becomes more cohesive as the tides become more dominated by the central part of the western Irish Sea gyre.

Figure 2  Distribution of non cohesive sediments in the Irish Sea
(taken from Figure 9 of Morphodynamic Modelling of Irish Sea\textsuperscript{(5)})
3.2.2 Net sediment movement

The net sediment drift around the coastal sub cell which includes the entrance to the Boyne runs north west to north along the coast from Skerries to Clogher Head. Thus the main source of sediment supply to the coastal cell comes from the south past Skerries and to seaward of Bremore Point. A Hydraulic and Coastal Engineering report by DHI, estimated the annual net drift quantities along the coast as shown in Figure 3 below (taken from Figure 5-27 of the report). It will be seen that these net rates are in the region of 30,000 m$^3$ at Bremore Point to 90,000 m$^3$ at the entrance to the Boyne.

![Figure 3 Estimated annual net sediment drift rates](image)

The net annual drift rates calculated were based on the synthesizing of seven years of wave data applied to a single coastal profile with tidal data based on Howth. The KMM reports give the same general movement of sediment but with somewhat higher rates as they had a more extensive time series of events and used a variation in profiles along the coast. The rates derived during the KMM studies$^{(1)}$ $^{(2)}$ have been calibrated against the dredging records for the Boyne entrance. The 2002 KMM report showed that there was a total of about 350,000 m$^3$ of sediment moving both north and south across the entrance to the Boyne with more going north than coming south. Comparison of the drift rates between the various reports suggests that the rates in the DHI Coastal Engineering report are low. The DHI report also notes that there is some uncertainty about their estimated drift rates past Bremore Point due to the two dimensional nature of the drift in this area.
The 3 dimensional morphological modelling of the Irish Sea undertaken as part of the Interreg IMAGIN study \(^{(5)}\) shows a similar north westerly movement of bed sediment into the Co Meath and Louth coastal areas around the Boyne. The morphodynamic modelling considered two formulations for the bed sediment transport, one based on the Bagnold formula and the other based on the formula of Meyer-Peter and Mueller. The predicted transport vectors for an average month are shown for the two formulations in Figures 4 and 5.

**Figure 4** Predicted average monthly bed-load transport vectors (after Bagnold) from MarCon study\(^{(5)}\)
Output from the two methodologies cannot be directly compared as the bed load transport is expressed in different units in the two formulas. However it will be seen from the diagrams that there is a similar direction of transport into the Boyne Estuary area with both formulations.

The vector results for an average month have been used to calculate the net sediment transport into the Boyne coastal sub cell. As expected the two different formulations yield somewhat different average annual transport rates but the average of the two values at 60,000 m$^3$ per annum is in line with the drift rates from other studies and is in accord with the overall sediment transport mass balance for the area.
4.0 Conclusions

The work undertaken for this study indicates that there is only a small movement of the dredged sand which has been deposited in the offshore dump site area back towards the beaches around the Boyne entrance. Consequently dredged material dumped at this offshore site contributes very little to the inshore coastal processes along the Co Meath and Co Louth beaches adjacent to the Boyne Estuary. Beneficial re-use of this material is wholly appropriate in lieu of disposal at the offshore site given the insignificant movement of this material.

The sediment movement into and around the coastal sub cell at the Boyne entrance has been studied in various reports. The most recent report on the hydraulic and coastal engineering by DHI indicated a net north going sediment bypass of 30,000m$^3$ at Bremore Point. However the drift rates in this report had been calibrated against a drift rate across the Boyne entrance given in a study by KMM in 1994 which was subsequently found to be too low by a factor of about 2.

The analysis of the results of the modelling undertaken for the IMAGIN project indicates a net annual bed sediment transport into the Co Meath and Co Louth beach system from the south east of 60,000m$^3$ per year. This figure is consistent with the historical dredging practices and the changes observed on the beaches around the entrance to the Boyne Estuary.

On the basis of the information available at the time of this study it is concluded that, in order to ensure there are no impacts on the overall coastal cell from the dredging operations, not more than an annual average quantity of 60,000m$^3$ of dredged sand should be brought ashore for beneficial reuse. The remaining 30,000 m$^3$ of material that is required on average to be dredged from the Boyne Estuary entrance is only equivalent to about 0.6mm sand depth over the active beach area. Nevertheless, the 30,000m$^3$ (average) of additional material to be dredged should be retained within the coastal cell, either within the active system (dumped at the northern or southern dump sites) or placed in the offshore dump site.

5.0 References