Coastal Defence

Report on the evolution of the Ribble Estuary, with particular reference to the north Sefton coast.

Version 1.1

March 2008

Sefton Council

Prepared by:

Vanessa Holden
Natural, Geographical & Applied Sciences
Edge Hill University
St Helens Road
Ormskirk
Lancashire
L39 4QP
Email: holdenvj@edgehill.ac.uk
<table>
<thead>
<tr>
<th>Title</th>
<th>Report on the evolution of the Ribble Estuary, with particular reference to the north Sefton coast.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creator/Author/Originator/</td>
<td>Vanessa Holden</td>
</tr>
<tr>
<td>Publisher</td>
<td>Sefton Council</td>
</tr>
<tr>
<td>Date of publication</td>
<td>March 2008</td>
</tr>
<tr>
<td>Contact name or title of Location</td>
<td>Coastal Defence, Sefton Council</td>
</tr>
<tr>
<td>Subject - Category</td>
<td>Coast</td>
</tr>
<tr>
<td>Subject - Project</td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
</tr>
<tr>
<td>Rights - Copyright</td>
<td>O/S maps reproduced under licence number LA 076317 by Sefton Metropolitan Council from the Ordnance Survey’s 1:50,000 map with the permission of the controller of Her Majesty’s Stationary Office Crown Copyright reserved</td>
</tr>
<tr>
<td>Rights - EIR disclosability indicator</td>
<td></td>
</tr>
<tr>
<td>Rights - EIR exemption</td>
<td></td>
</tr>
<tr>
<td>Rights - FOIA disclosability indicator</td>
<td></td>
</tr>
<tr>
<td>Rights - FOIA exemption</td>
<td></td>
</tr>
<tr>
<td>Postal address of location</td>
<td>Ainsdale Discovery Centre, The Promenade, Shore Road, Ainsdale-on-Sea, Southport</td>
</tr>
<tr>
<td>Postcode of location</td>
<td>PR8 2QB</td>
</tr>
<tr>
<td>Telephone number of location</td>
<td>+44 (0)151 934 2960</td>
</tr>
<tr>
<td>Fax number of location</td>
<td>+44(0)1704 575628</td>
</tr>
<tr>
<td>Email address of location</td>
<td><a href="mailto:coastaldefence@technical.sefton.gov.uk">coastaldefence@technical.sefton.gov.uk</a></td>
</tr>
<tr>
<td>Online resource</td>
<td><a href="http://www.sefton.gov.uk">www.sefton.gov.uk</a></td>
</tr>
<tr>
<td>Date of metadata update</td>
<td></td>
</tr>
</tbody>
</table>

This report should be referenced as:
Sefton Council accepts no liability for the use by third parties of results or methods presented in this report. Sefton Council also stresses that various sections of this report rely on data supplied by or drawn from third party sources. Sefton Council 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.
Contents

Section                                       Page

1.0  Introduction                              1

2.0  Background to the Sefton Coast            1

3.0  Secondary Data Available                  1

3.1  Secondary Data Confidence                 3

4.0  The Ribble Estuary                        4

4.1  Human Impacts on the Estuary              6

4.1.1  Developments Relating to the Port of Preston  6

4.1.2  Land Reclamation in the Ribble Estuary   12

4.1.3  Other Developments                     15

5.0  The Environmental Response of the Ribble Estuary  34

5.1  Pre-Industrialisation                    34

5.2  Training of the Navigable Channel and its Implications  42

5.3  Sediment Accretion Along the Southern Estuary Foreshore  50

5.4  Changes in the Bog Hole Channel           57

6.0  Summary                                  67

7.0  References                               68
1.0 Introduction

This report is part of a series designed to give a detailed account of a particular feature on the Sefton Coast as part of the process of updating the Sefton Coast Database. Updating of the database includes analysis and interpretation of existing materials held by the Council which will identify gaps in knowledge and future works that could be undertaken to improve our understanding of the geomorphology of the Sefton Coast. This particular report discusses the evolution of the Ribble Estuary in North West England through time from the early 1800’s to the present day. By using various forms of secondary data, a picture of the development of the location can be built up, providing a basis for understanding the present day situation.

2.0 Background to the Sefton Coast

The coast is a long wide arc of sand with a hindshore dune system, which at one time would have stretched from the Mersey Estuary to the Ribble Estuary. Human use of the dune system over several centuries has created a dune landscape of great variety. To the north of the Sefton Coast is an extensive area of Saltmarsh extending into the Ribble estuary; other smaller areas of Saltmarsh also occur at the River Alt and Smiths Slack (located on the foreshore between Birkdale and Ainsdale). Several towns have developed along the coast; at Crosby, to the south, and Southport, to the north, artificial defences have been put in place. In between these areas towns such as Formby rely upon the sand dunes to provide protection from the sea.

The sand dunes, beaches and marshes of the Sefton Coast are one of the most important areas for nature conservation in Europe. The entire Coast is designated as either Special Protection Area (SPA) to the north of the pier at Southport or Special Area of Conservation (SAC) to the south of the pier, notable species include Sand Lizards and Natterjack Toads with the estuarine area being very important for birds. The Sefton Coast is also an important visitor destination with popular bathing beaches, open countryside, and the seaside resort of Southport.

3.0 Secondary Data Available

Much of the information regarding the estuary originates from the archives of the Borough Engineers, with a great deal of the literature around the time of the major engineering works being written by:

- The Engineer and General Superintendent of the Ribble Navigation 1901-1933 (James Barron);
- Southport Borough Engineer, early 1900s (Mr A.E. Jackson);
- Engineer for Preston Corporation, 1890 until 1900, and later consulting engineer to Mersey Estuary (Mr Alexander F. Fowler);
- Ribble Engineer 1933 to mid 1900s (Mr A.H. Howarth, successor to James Barron);
- Consulting engineers (Mr L.F. Vernon-Harcourt, early 1900s, and Commander F.W. Jarrad, 1907).

It is for this reason that the evidence surrounding the development of the location is centred on the three main issues of navigation, reclamation, and the urban development of Southport. Similarly, there is significant emphasis on the development of the Bog Hole Channel, as this was an area of increasing concern during the first half of the twentieth century; hence issues around it were recorded in relative prevalence. Table 1.1 shows the main types of secondary data that are available and which were utilised to construct the picture of the evolution of the estuary.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Format</th>
<th>Date Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial Photographs</td>
<td>Digital and printed original</td>
<td>1945 to present</td>
</tr>
<tr>
<td>Ordnance Survey Maps</td>
<td>Digital and printed original</td>
<td>1843 to present</td>
</tr>
<tr>
<td>Navigation &amp; Bathymetric Charts</td>
<td>Digital and printed original</td>
<td>1736 to 1937</td>
</tr>
<tr>
<td>Historic Photographs</td>
<td>Digital and printed original</td>
<td>c.1900 onwards</td>
</tr>
<tr>
<td>Unpublished Reports / ‘Grey’ Literature</td>
<td>Original</td>
<td>c.1880 onwards</td>
</tr>
<tr>
<td>Published Books</td>
<td>Original</td>
<td>1888 onwards</td>
</tr>
<tr>
<td>Vegetation Survey Data</td>
<td>Original</td>
<td>1998 to present</td>
</tr>
<tr>
<td>Profile Survey Data</td>
<td>Digital</td>
<td>1913 to present</td>
</tr>
</tbody>
</table>

Table 3.1: Type and format of secondary data sources available within the Sefton Coast Database.
3.1 Secondary Data Confidence

Historic accounts and data provide an invaluable record of the developments that have taken place along the coastline, without which, the significance and reasoning of many events would be lost, facts obscured, or simply forgotten. However, it is important to remember that most records are subject to the opinions and observations of the individuals making them, which can in some circumstances, give little indication of the accuracy of the data. The accuracy of early charts may be questionable, particularly as they would potentially have been drawn up for specific purposes, hence certain channels or features that were not considered by the surveyor to be important may have been recorded in much less detail, or even omitted. However, that said, as a certain level of accuracy would have been required for navigation purposes, the charts can be assumed to be representative of general episodes within the estuary. As the charts of Mackenzie, Belcher, Williams and Webb, and Calver (Section 5.1) were made and published by the Admiralty (Barron, 1938), so some degree of data confidence can be attributed to their provenance.

Discrepancies between certain channel depths and low water marks may have potentially arisen between texts due to the variance between datums used for soundings. During the Nineteenth Century, the datums referred to are generally those of the ‘Old Dock Sill’ at Liverpool (from the first enclosed Liverpool Dock built in 1715 (Cashin, 1949)). From around 1844, Ordnance Datum referred to the mean sea level at Liverpool, which was 4.67 feet (1.42 m) above the Old Dock Sill. From around 1933, Ordnance Datum was based upon mean sea level at Newlyn, which was 14.54 feet (4.43 m) above the Old Dock Sill (Barron, 1938; Cashin, 1949; Gresswell, 1953). The level of the Old Dock Sill was believed to be 7ft. 9in. (2.36 m) above the level of Low Water at Southport (Jarrad, 1907), with the Ribble being calculated as 12.37 feet (3.77 m) below Ordnance Datum (Liverpool) in 1890 (Barron, 1938). Similarly, early Ordnance maps based the High and Low Water Marks around surveys taken at times when the Admiralty informed them that there were expected to be ‘ordinary’ tides, which when combined with weather conditions, may produce misleading levels on flat stretches of coastline such as in the Ribble Estuary (Barron, 1938). Ordnance Survey maps, similarly, showed a low water mark of a ‘Mean Spring Tide’ in 1845, whereas later revisions show a low water mark of an ‘Ordinary Tide’, which is the actual low water level on a day between a spring and a neap tide (Gresswell, 1953).

No specific records exist as to the reasons behind the siting of the original locations of the profile lines. However, it is known that the contemporary profiles are based upon shore profiles that have always been surveyed by the Borough of Southport (Smith, 1982), with grid references identifying the locations. Data is therefore considered sufficiently accurate to allow direct comparison of the contemporary data with the historic data. The topographic data used to construct the profile lines were not adjusted for changes in datums. However, any
variations due to this reason would be barely discernible in the graphical representations used in this report. The accuracy of secondary data from the late 1990s is assured, following the use of GPS systems to ensure accurate consistency in data collection. As with all amalgamated data sets, differences can also arise from operator error, different methods of data collection, and different interpretations.

### 4.0 The Ribble Estuary

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td>70-100 km² at low water.</td>
</tr>
<tr>
<td></td>
<td>10.75 km across mouth (between Southport &amp; St. Anne’s Pier).</td>
</tr>
<tr>
<td></td>
<td>20 km length (inner point of Preston Dock and Ribble Bar).</td>
</tr>
<tr>
<td><strong>Tidal Range</strong></td>
<td>Macrotidal.</td>
</tr>
<tr>
<td></td>
<td>Mean Spring Tidal Range 8.0 m at Formby, 3.6 m at Preston.</td>
</tr>
<tr>
<td></td>
<td>Mean Neap Tidal Range 4.4 m at Formby, 1.6 m at Preston.</td>
</tr>
<tr>
<td></td>
<td>Maximum wave fetch c.200 miles.</td>
</tr>
<tr>
<td><strong>Source and River Tributaries</strong></td>
<td>Source of River Ribble at Ingleborough, West Yorkshire.</td>
</tr>
<tr>
<td></td>
<td>River Douglas (Asland in older texts), and River Yarrow flow into estuary west of Preston.</td>
</tr>
<tr>
<td><strong>Freshwater Input</strong></td>
<td>33 – 44 m³/s.</td>
</tr>
<tr>
<td></td>
<td>Maximum 200 m³/s between October and March.</td>
</tr>
<tr>
<td><strong>Prevailing Wind Direction</strong></td>
<td>West and Southwest</td>
</tr>
<tr>
<td><strong>Bathymetry</strong></td>
<td>Shallow, maximum depth in Liverpool Bay of 50 m.</td>
</tr>
<tr>
<td><strong>Geology</strong></td>
<td>Incised within a late-Pleistocene glacial till cover over Permo-triassic rocks.</td>
</tr>
<tr>
<td></td>
<td>Marine sediments of Liverpool Bay are fine to medium sand-sized sediment, localised mud and gravel.</td>
</tr>
<tr>
<td><strong>Channels</strong></td>
<td>Ribble ‘Navigation’ Channel, runs west to east, flanks north shore of estuary.</td>
</tr>
</tbody>
</table>
Report on the Evolution of the Ribble Estuary

Table 4.1: Key characteristics of the Ribble Estuary.

<table>
<thead>
<tr>
<th>Channel/Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinfold Channel</td>
<td>northeast to southwest through outer estuary.</td>
</tr>
<tr>
<td>Bog Hole Channel</td>
<td>northeast to southwest, parallel with Southport foreshore, now blocked at northern limit.</td>
</tr>
</tbody>
</table>

Plate 4.1: Annotated aerial photograph of present day conditions in the Ribble Estuary, 2002, with features discussed in detail in the text shown. Aerial photograph courtesy of SMBC © Cities Revealed.
4.1 Human Impacts on the Estuary

The Estuary first began to experience significant human activities at the beginning of the 19th century. Many of these activities were recorded due to being large engineering works. Reclamations by landowners were recorded to a lesser degree. Changes in the estuary during the 1800’s, through into the 1900’s, led to an increasing awareness of the relatively temporary nature of many of the Estuary’s features, and subsequently the impact of human activities upon the natural processes. The increasing manipulation of the estuary coincided with the development of the town of Southport as a bathing resort on the southern shore of the estuary.

4.1.1. Developments Relating to the Port of Preston

One of the first major recorded activities within the Ribble Estuary was the Parliamentary Act of 1806, obtained by a Company of Proprietors, which allowed works to be undertaken to improve the Ribble Channel for navigation between The Naze on the north shore of the estuary and Preston. Although the works were started, and jetties installed, the Company failed, with debts of £4,000 (Wheeler, 1893). In 1837, a new company formed, which was granted permission in 1853 to undertake a number of works, including dredging the navigable Ribble channel in order to deepen it; the construction of 4.5 miles of training walls from Preston to The Naze (further extension was opposed by landowners on both shores of the estuary); quay walls to be built at Preston; and a lighthouse constructed at St. Anne’s. The cost of the dredging and training walls alone was recorded by Wheeler (1893) to be the considerable sum of £47,000. The undertaking of these first Companies up to 1883 is recorded in great detail by Barron (1938).

In 1883, the Corporation of Preston obtained Parliamentary powers to purchase the rights of the Ribble Navigation for the sum of £72,500. They were allowed to build the docks at Preston (initially 36 acres, later extended to 40 acres), to dredge the channel between Preston and Lytham, and to extend the training walls by another 3.5 miles (Wheeler, 1893). The docks subsequently opened on 25th June 1892.

In 1889, a commission was established to investigate the various options of which channel in the outer estuary to adopt as the main navigable channel. A consulting engineer advising the Corporation of Southport at the time, Mr Vernon-Harcourt, advised that the Bog Hole (or South Channel) should be adopted as the main navigable approach to Preston (Figure 4.2). However, the Corporation of Preston were successful in their aim to adopt the central channel in the estuary as the navigable channel. Wheeler (1893) outlined the reasons for this choice being: i) the central channel was 3 miles shorter than the South Channel; ii) a hard material on which to build training walls was nearer the surface in the central channel; iii) the presence of a sharp curve in the South Channel near the Bog Hole; iv) the direction of the South Channel would require training walls to be
built across the direction of the tide; and v) higher walls would be required on the inland side of the South Channel to prevent sand being deposited.

Figure 4.1: Map of the Ribble Estuary, 1889, drawn by Archdeacon, Taylor and Crabtree. (Document held in SMBC archive).
Figure 4.2: Plan by Vernon-Harcourt of the proposed navigable channels of the Ribble Estuary, 1891. (Document held in SMBC archive).
Subsequently, when the Corporation of Preston proposed extension of the central channel training walls in 1904 (the 1905 Act), the Corporation of Southport became increasingly concerned about the potential siltation and shallowing of the Crossens Channel, which at the time was the main drainage channel from the land that fed into the Bog Hole Channel, which was already beginning to show signs of siltation. In his report of 1905 on the proposed training wall extension, Vernon-Harcourt anticipated the following impacts:

"...inevitably extend[ing] the zone of accretion on the southern side of the estuary considerably seawards... the gradual obliteration of the Bog Hole Channel... the open sea to recede further from the town [of Southport] by the growth of the Horse sands seawards... the raising of the foreshore by accretion on the southern side of the estuary... impeding the discharge from the Crossens outfall, and will probably divert the Crossens channel to a northerly course." [Vernon-Harcourt, 1905, Report on the extension of the Ribble training walls proposed in the Ribble Navigation Bill of 1905 p.3]

The proposal was passed, with a further proposal to extend the walls being made by the Corporation of Preston in the 1931 Act. Figure 4.3 illustrates the development of the training walls from 1840 through to 1937 as drawn by Barron (1938).
Figure 4.3: Development of the Ribble training walls from 1840 to 1937. (Source: Barron, 1938).
The earliest recorded dredging of channels in the Ribble were made in the late 1800s and deposited on the southern side of (what was at the time) the end of the main navigable channel training walls (Messent, 1888; Anon, 1896). In a report, commissioned by Southport Corporation and the Lords of the Manor of North Meols, into the effects of the Ribble navigation works, Messent (1888) details the dredging and depositing of material that is capable of being suspended may “… affect or alter (not favourably) the character of the sand [foreshore], and perhaps induce vegetation or growth undesirable, unless the land is to be reclaimed.” (Messent, 1888, p.12).

It is recorded by Wheeler (1893) that the training walls were constructed from stone quarried from within the Ribble catchment, red sandstone from the excavation of the docks, and ‘hard clay’ dredged from the Ribble, faced with stone. Although Wheelers’ account would appear to indicate that the majority of the training walls were constructed of material that would not be taken into suspension, it is highly possible that the ‘dredgings from the Ribble’ would have a proportion of finer material, which may have led to Messent’s prediction of induced vegetation growth. However at this time, reclamation was prevalent, so enhanced salt marsh expansion would not necessarily have been considered unfavourable.

The Ribble Navigation Act of 1905 specified that all dredgings (except those used for construction of the training walls), should be deposited at sea “westward of a meridian drawn 3 degrees 9 minutes west of Greenwich”, or deposited above the Spring High Water Mark (Fowler, 1909b), to ensure that dredgings would not be just deposited in another part of the Estuary. In the mid 1960s a number of investigations were undertaken by the Hydraulics Research Station (HRS) for the Corporation of Preston in order to propose improvements to the navigable Ribble Channel. In their report of 1965, they concluded that over the period 1949 to 1962, 1.6 million cubic yards of material had been dredged per annum (HRS, 1965). At the same time, consulting engineers Rendel, Palmer and Tritton (1967) were in general agreement regarding the transport of material within the estuary, being that sediment was carried up the South (or New) Gut on a flood tide, and moved down the Navigation Channel on the ebb tide. However, the proposal of Rendel, Palmer and Tritton that this material was subsequently deposited on Salter’s Spit (an area of sedimentation at the seaward end of the training walls), but with the Spit being largely formed by littoral drift from north to south was questioned by the Hydraulics Research Station in their later report of 1968 (HRS, 1968).

Around 1974, Fairhurst quoted an annual total of 875,000 cubic metres of sediment was being dredged to maintain a navigable depth of 21 feet at high tide. By 1982, the Port of Preston had closed to commercial traffic (Mamas et al., 1995), with a subsequent cessation of the dredging activities of the main channel. The maintenance of the training walls was also discontinued. Therefore, the sediment dynamics of the estuary can be anticipated to be undergoing further
changes that may have implications for the future evolution of the area. The beginning of these anticipated changes are demonstrated by changes in the channels and sand banks in the outer estuary (Hansom et al., 1993), notably Salter’s Spit now extending southwards beyond the end of the previous navigation channel (see aerial photograph, Plate 4.1) since the cessation of the dredging (Rainfords, 2005). In addition, the Penfold Channel has gradually shallowed over recent years (Rainfords, 2005).

4.1.2. Land Reclamation in the Ribble Estuary

Until the beginning of the Nineteenth century, the salt marshes on the southern side of the Ribble Estuary experienced relatively little human activity. However, from the middle of the century onwards, reclaimed salt marsh became deemed as valued agricultural land. In 1838 the Ribble Navigation Reclamation Plan was made (Figure 4.4) (Barron, 1938). It was during the second half of the nineteenth century that a significant number of embankments were constructed on the southern shore of the estuary, being recorded by Gresswell (1953) as 1860; 1863; 1880; 1891; 1892; and 1895 (Figure 4.5). The scale of the reclamation was recorded by Gresswell (1953) when he calculated that between 1830 and 1880 over a mile in width of salt marsh had been reclaimed.

In 1932, to further enable reclamation, ‘saltings’ or evenly spaced clumps of Spartina townsendii were planted to promote sedimentation and encourage new salt marsh formation at Marshside (Gresswell, 1953; Berry, 1967), (Plate 4.2). However, not all sedimentation seemed desirable, as only five years later an article from the Southport Visitor newspaper of February 1937 recording that the Borough Engineer, Mr Jackson, stated that the build up of sand on the foreshore at Southport was due to the presence of “...the Ribble training walls, the diversion of the Crossens Channel from the South Channel into the Pinfold [Penfold] Channel, land reclamation and the growth of salt marshes, and the Mersey sand dredgings".
Figure 4.4: The Ribble Navigation Reclamation Plan. (Source: Barron, 1938, p.341).
Figure 4.5: Map showing embankments and probable dates of reclamations on the southern shore of the estuary. Image produced by SMBC. (Barron, 1938; Gresswell, 1953).
4.1.3. Other Developments

SOUTHPORT

The town of Southport, did not come into being until the start of the Nineteenth century, when in 1798 a hotel was built by William Sutton. It is recorded that at the opening of the hotel, a Dr Barton declared the area be called Southport (Cameron, 1996). Prior to the town developing, there was believed to be very little habitation in the area that was then known as ‘North Meols’, with only isolated fishermen’s cottages, which are now a considerable distance from what is now the foreshore (Tovey, 1965). By the time of the publication of the first edition of the Ordnance Survey map of 1849, developments were apparent at the town of Southport, notably the building of the main street of Lord Street, to a significant average width of 240 feet (73 m) between building lines (Tovey, 1965). Although the width of the street suited the propensity of the Victorians to ‘promenade’, it was, however, built to such dimensions as at that time the ground in the middle of Lord Street was still liable to flooding, hence the buildings on either side of the main street being built on the slightly higher ground to either side, (the issue of flooding in fact continued to some degree until the construction of the Esplanade Pumping Station in 1951) (Tovey, 1965). The first Promenade (running parallel with Lord Street) was constructed in 1834 effectively on the
beach at the point of the Ordinary High Water Mark, reclaiming an area of land on which was constructed the Victoria Baths (SD 333631, 417713), which had a reservoir out on the beach. Southport still only comprised a few streets at this point, and remained completely separate from the neighbouring village of Churchtown. Previous visitors to the town had predominantly travelled via canal, but following the opening of a railway line from Liverpool to Southport in 1848, and a line from Wigan to the town in 1855 (Freeman et al., 1966), so the town further increased in popularity, receiving 10,000 visitors a year by 1850 (Gresswell and Lawton, 1964). In 1860, the Pier was constructed leading out from the promenade to a distance of 1,100 metres (Smith, 1982), built by private enterprise, with the support of the Improvement Commissioners that then governed the town (Tovey, 1965). It was further extended in 1868 to a length of 1,335 metres (Smith, 1982).

A northern extension to the promenade was made between 1879 and 1881 (Borough Surveyor’s Office, 1906; Gresswell, 1953), reclaiming 45 acres of land. The south Marine Lake (13 acres) and Marine Park (6.5 acres) that fronts the original promenade was constructed following reclamation in 1887. Notes of the Borough Surveyor’s Office of 1906 states that the area was above the High Water Mark of ordinary tides, was already grassed over and was “little better than a swamp” prior to the works. Following “enormous quantities” (Borough Surveyor’s Office, 1906) of sand having built up near the Promenade, the North Marine Lake (26 acres) and Park were constructed in 1892. The two lakes were joined in 1895, along with the construction of Marine Drive (SD 333561, 418436), enclosing 59 acres, which were above the High Water Mark of ordinary tides, but which were subject to High Spring tides (Borough Surveyor’s Office, 1906). The notes of 1906 go on to say that large quantities of sand were removed from inside and outside the lake due to the build up of wind blown sand, which were deposited to the north east of the promenade (indicating land that has now been reclaimed at Marshside), which was already above the limit of ordinary high tides.

Some of the accumulation of sand around the original promenade was attributed by the Borough Surveyor’s Office (1906) to be due to the construction of the 1883 Southport and Cheshire Lines Railway that enclosed an area of foreshore to the south of the town. This enclosure was necessary for the railway line to allow the trains to manoeuvre, allowing the correct approach to the town’s station. The railway extension subsequently closed in 1952 (Jones et al., 1991).

In 1907, the Bank End Sewage Treatment Works (SD 336948, 420736) were built to serve the expanding population of Southport (Tovey, 1965), with a population of 52,000 recorded in 1906 (Borough Surveyor’s Office, 1906). This works, situated on the coastline to the north of the town, discharged purified effluent into the estuary just north of Marshside at Crossens. The treatment works were extended in 1912, to meet the demands of the growing population.
The Ordnance Survey map of 1931 (Figure 4.6), shows an ‘aerodrome’ (SD 334773, 419000) located on Southport sands in the vicinity of Marshside. Aerial photographs from 1945 show this to be the case (Plates 4.2 and 4.3), with the land it is situated on being reclaimed initially around 1892, and being extended seaward around 1930 (Gresswell, 1953). The site is now part of the Southport Municipal and Hesketh Links golf courses, with the site of the former aerodrome buildings now occupied by private houses (Plate 4.4).
Figure 4.6: Ordinance Survey map of 1931. See also Plates 4.2, 4.3 and 4.4.
Plate 4.2: Aerial photograph of 1945 showing aerodrome. See also Plates 4.3 and 4.4. (Image held in SMBC archive).
Plate 4.3: Photograph of 1963, showing site of aerodrome; low building in middle ground, with slipway on left down to beach. (Image held in SMBC archive).
Plate 4.4: Aerial photograph of the previous aerodrome site in 1992. Houses now occupy the site of the former buildings, with the slipway now being a road. (Image courtesy of SMBC).
SEA WALL / COAST ROAD

Construction of the sea wall fronting the Marine Lake began in the mid 1960s, and was initially only a mile in length (Plates 4.5 to 4.7). During this time an additional 90 acres of land were reclaimed, including a further extension to the Marine Lake (Tovey, 1965). The two islands in the lake at the point where the old northern lake and the extension join were constructed around remnants of the original 1892 boundary wall, as the wall was built of ‘very solid construction’ (Tovey, 1965), hence by creating the islands, less of the original wall had to be removed. The sea wall was constructed to a depth of 3 feet (0.9 m) with a width of 50 feet (15 m) (Tovey, 1965) (Plate 4.8). During its construction, the majority of the infill was comprised of household waste, with many of the adjoining reclamations along the foreshore also being infilled with waste (see Figure 4.7 and Plate 4.9). The late 1960s saw an extension to the sea wall (the ‘Coast Road’) as far as Marshside Road, with the final extension to Crossens cutting across and enclosing a section of Marshside marshes completing the road in 1974. (Although the entire length of the sea wall fronting Southport is correctly called ‘Marine Drive’, it is locally referred to as the ‘Coast Road’).
Plate 4.5: Aerial photograph of Southport foreshore looking north west, pre construction of the Coast Road and reclamation to create the Marine Lake extension, estimated mid 1950s. (Image held in SMBC archive).
Plate 4.6: Photograph looking south east, of newly constructed Coast Road and Marine Lake, dated 30th June 1966. (Image held in SMBC archive).
Plate 4.7: Annotated photograph of Marine Lake, looking west, showing dates of construction, c.1966. (Image held in SMBC archive).
Plate 4.8: Photograph of construction of Marine Lake extension, with ground being de-watered during building of perimeter wall, looking west, dated 13th January 1962. (Image held in SMBC archive).
Figure 4.7: Cross section plan of the Coast Road construction fronting the Marine Lake extension. (Source: Tovey, 1965; p.77).
Plate 4.9: Photograph of the construction of Coast Road, looking south east, estimated mid 1960s. The black dots above the construction site are large numbers of seagulls in the picture due to the road being backfilled with household waste. (Image held in SMBC archive).
SAND WINNING

After a public Town Planning Enquiry in 1968, sand-winning began on Horse Bank in February 1972, operated by William Rainfords Ltd (Smith, 1982). The site (SD 335308, 420610) was at the end of the 1960s Coast Road, and adjoined the 1974 extension to the road. The sand was considered of an appropriate grade to be used in the glass industry. The licence for extraction covered an area of 200 hectares, with an annual amount of \(0.16 \times 10^6\) m\(^3\) per year. Over the subsequent few years, further permissions were granted to extend the areas available on Horse Bank for sand-winning, to increase tonnage and allow for the highest possible grade sand to be extracted. Between 1966 and 1994 this amounted to a total extraction of \(4.5 \times 10^6\) m\(^3\) (van der Wal et al., 2002). In their report of 2002, van der Wal et al. recorded that this volume of sand extracted was small compared to the changes in sediment movement seen across the estuary as a whole.

WASTE DISPOSAL

On a regional scale, from 1896, dumping of sewage sludge and industrial waste into Liverpool Bay has taken place (Allison, 1949; Murray and Norton, 1979; Norton et al., 1984; Jones et al., 1991; Jones, 2006), with some wastes and sludge being dumped at a site about 30 km offshore (Norton et al., 1984). Between 1973 and 1980, between \(15 \times 10^{-5}\) and \(20 \times 10^{-5}\) tonnes of sewage sludge and industrial wastes were dumped at this site per year (Norton et al., 1984). Between 1880 and 1953, Liverpool Corporation also dumped large quantities of domestic refuse into Liverpool Bay (Department of the Environment, 1972; Jones et al., 1991). In a study by Norton et al., (1984), the sludge and wastes contained organic matter, with the metallic contaminants of Mercury, Cadmium, Lead, Zinc, Copper, Chromium and Nickel.

During the peak of dumping of sludge and industrial wastes in the 1970s, concerns were raised for the Ribble Estuary that wastes dumped at the site in Liverpool Bay, due to the predominant currents, would return not only to the Mersey Estuary, but also to the Ribble. Ramster and Hill (1969) identified that 'fine suspended material in mid to surface waters tended to be more widely dispersed [away from the dumping site] with generally northwards residual movement' (Norton et al., 1984). The Department of the Environment, in 1972, reported that of the sludge dumped in Liverpool Bay, much of the solids reach the bed of the sea after 12 hours. They also reported that the upper layers of the sea have a general drift northwards, whilst near bed waters drift south and eastwards. It may therefore be reasonable to assume that during the initial few hours following the dumping of sludge, the finer material in suspension would have been carried predominantly to the north, potentially moving closer to the Ribble indraught than the Mersey indraught.
The dumping of sewage and waste at sea was, at the time, felt to be a feasible disposal option due to the ‘tremendous diluting and treatment capacity of the sea’ (Department of the Environment, 1972). Even with such tonnages being dumped, there was no formal routine monitoring in place regarding the effects of the dumping on the marine system. Ultimately, the concerns over pollution from dumping of sewage sludge and waste at sea led to the Food and Environment Protection Act of 1985, which since 1992 has prohibited the dumping of industrial waste at sea, and since 1998 has prohibited the dumping of sewage sludge (DEFRA, 2002).

DREDGING OF THE MERSEY ESTUARY

Deposition of dredgings from the River Mersey began in 1890 (Jarrad, 1907; Fowler, 1909a), with total amount dredged during the year 1905 being 9,119,100 tons (Jarrad, 1907). Accretion of sediment on the Southport foreshore, along with the growth of parts of Horse Bank, and the infilling of the Bog Hole, all permitted Jarrad (1907) to surmise that the large quantities of sediment involved were being brought into the estuary from a seaward direction. Jarrad investigated the location of the deposition of the Mersey dredgings, as he recorded that the area in which dredgings were deposited (at that time) were on the ‘dividing line’ between indraughts for the Mersey and Ribble estuaries (Figures 4.8 and 4.9). His investigations showed that the material was rarely deposited within the agreed area, and was generally dumped ‘anywhere within a mile westward’ of the boundaries, as in practice the larger dredgers could not approach the area for a considerable time before and after Low Water, nor in stormy weather. Jarrad (1907) further concluded that, based upon the depths of 1904, there had been ‘no appreciable diminution’ of the depth of the water over the area between surveys of 1889 and 1904, indicating that the 80 million tons of dredgings that had been dumped at the site during that period, had been removed elsewhere. (Thomas et al., (2002) recorded a maximum annual dredging of 17Mt between 1910 and 1917, with Ashton (1920) recording 12,769,409 tons annually).

Following further investigations, Jarrad concluded that if dredgings were deposited slightly westward and northward of the prescribed area, then there would be an equal chance of the material returning on a flood tide to either the Mersey or Ribble indraught, however, during prevailing wind conditions of south-westerly, the likelihood is that material would have been carried into the Ribble indraught. With regard to the condition of the Bog Hole Channel, Jarrad (1907) recommended deposition of the dredgings should be relocated to the area allocated for the ‘City Engineers refuse Liverpool and Manchester’. It is evidence along these lines, along with the generally held view that the accumulation of sediment on the foreshore and the infilling of the Bog Hole Channel became marked in 1890, when the Mersey dredging began, that led people at the time to believe that it was, in part at least, the Mersey dredgings that were leading to the accretion at Southport.
In contrast to this, Fowler (1909a) recorded that the Mersey dredgings had been deposited in the “...tideway about six miles south-west of Jumbo Buoy” and did not believe that the deposition of the Mersey dredgings had a significant effect on the deterioration of the Bog Hole Channel, as the depth of the outer bar (at the southern end of the Channel) had remained constant. Ashton (1920) however stated that “The ... highering up of the Ribble estuary banks... has its main source in the Mersey”.

Jones et al., (1991) reported that the peak in dredging of the Mersey was in 1924-25, when 25 million hopper tons per year were dredged. Dredged spoil was (and still is) dumped at ‘Site Z’, a site much further inland of the sludge dumping site, about 10 km due west of Formby Point, which in 1972 was receiving 15 million tonnes of dredged spoil per annum (Department of the Environment, 1972), and in 1992 was receiving 3 million wet tonnes of sediment (Rees et al., 1992). According to Rees et al. (1992) much of the considerable decrease in the quantities of dredgings dumped is due to changes in dredging practices. Disposal at the ‘new’ Site Z commenced in 1982 due to shoaling at the ‘old’ Site Z (Rees et al., 1992).
Figure 4.8: Position of the dumping ground for Mersey dredgings (1904), which at the time were close to the 'dividing line' between the Mersey and Ribble indraughts, from Jarrad, (1907). Document held in SMBC archive.
Figure 4.9: Current observations around the Mersey dredging dumping site, drawn by Jarrad, 1906. Document held in SMBC archive.
5.0 The Environmental Response of the Ribble Estuary

5.1 Environmental setting of the Estuary pre-industrialisation

From the chart of Fearon and Eyes (1736-7), (Figure 5.1), it is clear that navigation of the channels of the Ribble Estuary were important long before the training of the main navigation channel and the opening of the Port of Preston in 1892.

Figure 5.1: Navigation chart produced by Fearon and Eyes in 1737. Document held in SMBC archive.
The following Figures (5.2 – 5.7) are copies of original plans, re-drawn by an unknown source. However, when the first illustration of Fearon and Eyes 1737-7 chart (Figure 5.2) is compared to the ‘original’ chart (Figure 5.1), and those of others held within the Lancashire Records Office, then assuming the same accuracy has been applied to all the illustrations, then they appear to be more than sufficient for the general observations required here. The pertinent points of each chart are discussed within the box in each figure.
Chart of 1736-1737, Fearon and Eyes:
The main channel runs through the centre of the estuary, which diverts north and south at the mouth. Northerly, the channel ran between two banks, Butter Wharf and Stevens Wharf. To the south, it runs past sand banks called Packington, Old Bugg and New Bugg. At this time, Crossens was linked to the main central channel via a waterway called Robin Hood, (Dickson, 1893). The town of Southport did not exist at this point, with there only being mention of ‘Crossons’ and ‘North Meals’ (later being referred to as Meales (1761), then North Meols in 1850).
Chart of 1761, Mackenzie:
The only channel through the mid section of the estuary lies close to the north shore at Lytham, with the previous main channel through the centre of the estuary no longer being shown. At the mouth of the estuary, the northern channels are greatly reduced in width, with the south channel being less sinuous. Interestingly, the only soundings shown on the chart are in the (now) Bog Hole or South Channel, indicating that this was at the time an important channel for navigation. The soundings are at a similar level to those in the previous chart. A waterway linking ‘Crossons’ to the main channel is not recorded. The sand banks of Stevens Wharf and Dawsons Bank have apparently been replaced by South Bank.

Figure 5.3: Chart of the Ribble Estuary, 1761, original by Mackenzie. (Document held in SMBC archive).
Chart of 1820-1824, Brazier:
The main channel has migrated back to the centre of the estuary. The two channels that ran to the north of the mouth of the estuary now take a more central route to the sea. The previously straight south channel is now occupied by numerous sand banks, and diverges around the sand bank ‘Butter Wharf’, which has moved further south across the mouth of the estuary from the previous charts. Southport is shown, with a small, but presumably navigable channel leading to it. ‘Crossands’ once again has a major link with the sea, via the ‘Southport Channel’, but is no longer connected to the main channel in the mid section of the estuary, (Wheeler, 1893). The area that was previously Butter Wharf and South Bank are referred to as ‘Horse Sand’.

Figure 5.4: Chart of the Ribble Estuary, 1820-24, original by Brazier. (Document held in SMBC archive).
Chart of 1836, Belcher:
The main channel through the mid part of the estuary has split into two, skirting each of the shorelines; a mid channel also appears in this section. Where these three channels converge at Lytham, they once again split into two major channels that run across the mouth of the estuary, to the north and south. The Crossens link to the main channels is again not recorded, with only a minor waterway being shown in the general vicinity of the previous waterway. It is possible that a channel was still present at Crossens, but was not of navigable interest, so was not drawn on the chart. A small looped feature is shown linking Southport to the main south channel.

Figure 5.5: Chart of the Ribble Estuary, 1836, original by Belcher. (Document held in SMBC archive).
One main channel drains the mid section of the estuary to the north shore, with the channel that followed the southern shore now becoming disconnected from the other channels toward the landward end. The South Channel that runs past Southport is still sizeable to this point, but narrows considerably further into the estuary past the town. Crossens is linked to the sea by minor channels that join the North and South Channels. ‘The Horse Bank’ is now a major sand bank across the mouth of the estuary, with ‘Salthouse Bank’ separating the ‘North Channel’ that runs very close to Blackpool, and the ‘New Gut’ that takes a more central route to the sea. ‘The Penfold’ channel makes an appearance, cutting midway across Horse Bank. Fronting Southport is now called the ‘Bug Sands’.
**Chart of 1860, Calver:**

No channels are shown in the central and southern areas of the mid section of the estuary, with the main channel continuing to flank the northern shore. The Penfold now cuts completely through Horse Bank and joins the Bog Hole / South Channel. It becomes indicative from this chart that the Bog Hole was an area of deep water, having a depth of about 30 feet (9 m) at low water (Dickson, 1893) located in the South Channel. Crossens is linked by a waterway to the Penfold and South Channel.
5.2 Training of the navigable channel and its implications

Between 1904 and 1929, James Barron produced four surveys of the Ribble estuary, (with an additional surveys in 1935 and 1937 by A. Howarth), (Figures 5.8 – 5.14). Between the charts of 1904 and 1912 the extent of the additional training of the main navigation channel becomes very apparent, extending to the seaward edge of Salter’s bank and the Old Gut Channel. By 1925 the infilling and disappearance of the Bog Hole at the end of the South Channel is particularly marked, as is the virtual disappearance of the New Gut Channel that previously dissected Salter’s Bank to the north of the trained channel. The chart of 1929 shows sediment deposition had occurred around the end of the trained channel, with the southerly point of Salter’s Bank now extending beyond the training walls westwards towards the open sea. The chart of 1935 shows the changes around the trained channel, with small sand banks developing at the entrance to the main channel, (this chart used the same survey information as the chart of 1929 for all except the navigation channel between Lytham and the open sea, shown as a box on the chart). The final chart of 1937 shows further changes around the end of the trained channel, and also the virtual disappearance of the Bog Hole Channel.

The movement of sand banks and diverting of channels within the estuary can in part be explained by the rapidity of the flood (incoming) tide compared to that of the ebb (outgoing) tide (recorded as four hours and eight hours respectively by Dickson in 1893). As the faster flowing flood tide is capable of transporting a greater sediment load than the lower energy ebb tide, so material is moved into the estuary, with the resulting intertidal areas gradually infilling. The flood tide was still dominant over 60 years later, with Berry (1967) recording a flood tide of 7.9 feet (2.4 m) per hour (4.5 hours), with an ebb tide of 5.3 feet (1.6 m) per hour (7.5 hours). This trend of higher flood velocities than ebb velocities still remains (Lyons, 1997; van der Wal et al., 2002).

As the Navigation Channel was designed to concentrate the ebb flow to within the trained walls (HRS, 1968; van der Wal et al., 2002), the ebb flow was resultanty reduced outside the trained channels. The training of the channels to carry the ebb flow also explains the formation of sand banks at the seaward end of the main channel, as on reaching the un-trained end of the channel, so the ebb flow could disperse over a less confined area, losing energy, and hence depositing sediment. Ashton (1920) noted the area of the Estuary covered by water at low tide reduced from 30% in 1820 to only 5% in 1910. This reduction could be attributed potentially to the modification of the estuarine channels, with the main navigation channel being artificially deepened by dredging, so carrying a greater volume of water over a smaller surface area to the previously ‘natural’ channels. Thereby, leaving a larger proportion of the intertidal area drained of water during low tides. However, it is more probably due to the estuary gradually infilling with sediment, and so effectively raising more of the intertidal area of the estuary above the low water mark.
Figure 5.8: Survey of the Ribble estuary by Barron, 1904. Document held in SMBC archive.
Figure 5.9: Survey of the Ribble estuary by Barron, 1912. Document held in SMBC archive.
Figure 5.10: Survey of the Ribble estuary by Barron, 1924. Document held in SMBC archive.
Figure 5.11: Survey of the Ribble estuary by Barron, 1925. (Source: Barron, 1938).
Figure 5.12: Survey of the Ribble estuary by Barron, 1929. Document held in SMBC archive.
Figure 5.13: Survey of the Ribble estuary by Barron, 1935. Document held in SMBC archive.
Figure 5.14: Survey of the Ribble estuary by Barron, 1937. (Source: Barron, 1938).
5.3 Sediment accretion along the southern estuary foreshore

Accretion of sandy sediment along the Southport coast was considered by Dickson (1893), who suggested that the presence of (the relatively recent at that time) buildings along the coastline were impeding the movement of wind blown sand onshore, hence causing it to accumulate along the foreshore. Similarly, he proposed that the draining of the land under Southport town diverted water that would previously have flowed onto the beach, causing the sand to remain damp, however, once the sand dried out following drainage and culverting, so the sand could accumulate by the action of the wind.

In 1906, notes made by the Borough of Southport’s Surveyor’s Office records that:

"...although there had been erosion in many places the accretions facing the Borough exceed the erosion by many millions of cubic yards during the last 20 or 25 years. To the north-east of the Borough and higher up the Estuary enormous accretions have taken place... since the year 1839 above 5,000 acres have been grassed over."

[Borough Surveyor’s Office, Southport, 1906].

A study by the University of Liverpool in 1986 identified residual circulations were transporting material from the spoil ground at Jordan’s Spit onto Taylor’s Bank, then on to Formby, and subsequently into the drift feeding Horse Bank; hence the stability of Horse Bank may be linked to the dredging of the Mersey. Similarly, Pye and Neal (1994) determined that due to the dredging and subsequent spoil dumping of the Mersey, alterations were made to the wave regime around Formby Point, contributing to coastal erosion in this area, with much of the eroded material being moved towards the Ribble Estuary.

The presence of muddy fine sediment along the foreshore to the north of the Pier is evidently not a recent occurrence. Fowler (1910) reported it was almost impossible to walk to the Bog Hole Channel eastward of the Pier due to muddy patches with intermittent sand patches, with the whole of that area below the 9 feet (2.7 m) contour being in a “stagnant condition of wet sand and mud”. Fowler summarises the condition of the foreshore by saying:

"The contrast between the muddy beach above the Pier and the hard clean Beach extending from the Pier to Formby and down to spring low water contour is very marked."

[Fowler, Report to the Chairman and Members of the Improvement and Parks Committee, Southport, 1910].

Ashton (1920) also described the ‘clay beds’ near Crossens, and at low water on the landward side of the Bog Hole north of the Pier.

It is highly probable that the extensive reclamations within the estuary were a significant factor in the accretion of sediment along the foreshore. The
reclamation of land would reduce the tidal prism within an estuary (Long et al., 2006), and lower mean current velocities, resulting in sediment deposition (van der Wal et al., 2002). This deposition would have a consequential effect of establishing a positive feedback by further reducing the tidal prism, thereby promoting even more deposition, increasingly of finer sediment as the energy reduces (van der Wal et al., 2002).

Reclamations in the early part of the 1900s around Marshside and Crossens are reflected in the topographic survey data. Figure 5.15 shows the locations of established profile lines that have been used by Sefton Council (and it's predecessors) to gather topographic data. Between the surveys of 1937 and 1967 along Profile 26, the zero metres chainage moved seaward by approximately 300 metres (Figure 5.16); with the surveys of 1913 and 1927 along Profile 27 (Figure 5.17) showing the point of zero chainage moving seaward by 800 metres. This would correspond to an area of reclamation to the north of Marine Lake reclaimed around the time of the latter survey. Similarly, between the surveys of 1933 and 1968 along Profile 28, there was a seaward movement of the zero metres chainage point by 600 metres (Figure 5.18), relating to an enclosure of the marsh at Marshside during the construction of the penultimate section of the Coast Road.
Figure 5.16: Survey data for Profile 26, indicating reclamation, showing years 1937 and 1967. Data courtesy of SMBC.

Figure 5.17: Survey data for Profile 27, indicating reclamation, showing years 1913 and 1927. Data courtesy of SMBC.
During the early part of the 20th century, the combined issues of accretion along the foreshore, the seemingly continual availability of land for reclamation, and the infilling of the Bog Hole, potentially giving the appearance of the ‘sea going out at Southport’, was evidently giving cause for concern amongst those familiar with the town. In correspondence between the Southport Borough Engineer (A.E. Jackson) and a Preston resident in January 1926, when asked if the land was rising at Southport, Mr Jackson responded that “…the level of the coast has not risen. Owing, however, to deposits which are usual in estuaries the low water mark is receding”. Topographic survey data from the early to mid 1900s indicates no significant increase between 1916 and 1937 occurred along Profile 26 (Figure 5.19), with there in fact being a slight decrease to the seaward end of the profile around 1933 (although this was a much less comprehensive survey than the previous and subsequent ones). However, Figure 5.20 highlights the overall increase in elevation of the beach surface to the present day.

Coastal accretion rates have been recorded at various times, with some comparable results. Ashton (1920) recorded a rise at Southport equating to 12 feet net (3.7 m) (assuming 15 feet (4.6 m) accretion with 3 feet (0.9 m) of subsidence) over a century, which would relate to approximately 1.4 inches (3.6 cm) per year over the 50 years that he observed the changes. In line with this, Gresswell (1953) recorded a 19 inch (48.3 cm) rise in the level of the backshore between 1933 and 1949, (equating to an average rise in elevation of 1.2 inches (3.0 cm) per year) at a brick manhole at the south-west corner of the 1930...
embankment. Further north-west into the estuary, Berry (1967) recorded 1.4 inches (3.6 cm) of accretion occurring over two years on the salt marshes. Unfortunately, no specific details are recorded as to the exact locations where measurements were taken. This accumulation of sediment led to the belief that the sea was receding at Southport. The Southport Visitor newspaper in 1937 (reporting on a discussion by A.E. Jackson, the Borough Engineer) recorded the rate of recession of the High Water Mark close to the Pier was 96 feet (29.3 m) per annum between 1927 and 1937.

Figure 5.19: Topographic survey data of the Southport foreshore, Profile 26, 1916, 1927, 1933 and 1937. Data courtesy of SMBC.
Figure 5.20: Topographic survey data of the Southport foreshore, Profiles 26 and 27, showing overall increase in elevation between 1913 (P26) / 1916 (P27) and 2003. Data courtesy of SMBC.
Industrial growth further inland of the estuary was additionally potentially adding to the infilling of the estuary and sediment accumulation (Berry, 1967), with industrial growth in the catchments of the Ribble and other tributary rivers increasingly involving industry controlling the flow of the rivers. Peak flows from the Ribble into the estuary had previously been shown to occur in 'freshets' of water lasting a few days (Fairhurst, c.1974). These freshets effectively added water to the ebb flow, so producing a greater scouring effect than the ebb tide alone. The scour could result in fine material being resuspended, to be deposited during a lower energy flow, potentially, either in a seaward direction, or to remain in suspension until it is deposited at a point further inland than it was originally eroded. Controlled flow of the Ribble, however, removed the 'freshets' that produced the scour effect (Berry, 1967), potentially, facilitating further sedimentation in the drainage channels of the estuary.

The gradual increase in the elevation of the foreshore continued to be demonstrated by topographic survey data during the latter half of the 20th century. Figure 5.21 demonstrates how the elevation fluctuates over timescales of a few decades, but shows an overall increase in elevation when compared to the earliest profile data.

![Figure 5.21: Topographic profile data of Profile 26, showing changes in elevation of foreshore. Data courtesy of SMBC.](image)
5.4 Changes in the Bog Hole Channel

Changes in the morphology of the Bog Hole Channel have been recorded in relative detail, probably due to its proximity to the foreshore at Southport and its presence as a notable attribute providing the town with a constant marine feature even at low tide. As recorded by Gresswell in 1953:

“... the Pier stood in deep water at all states of the tide, and providing one looked westwards along the length of the [Bog Hole] channel one could feel that one had reached the sea. But in doing so, one ignored the several miles of sand in all other directions.” [Gresswell, R.K., (1953), p.59]

As Southport had developed as a tourist destination during the nineteenth century, so too the depth of the Bog Hole increased (Table 5.1 and Figure 5.22). The first Pier was erected at Southport in 1860 and, although there is no recorded evidence, it is likely that the location of the Pier advantageously coincided with the location of the ever present (at that time) Bog Hole.

<table>
<thead>
<tr>
<th>Nineteenth Century (Data from Wheeler, 1893)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>Depth (feet)</td>
</tr>
<tr>
<td>Depth (metres)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Twentieth Century (Data from Gresswell, 1953)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>Depth (feet)</td>
</tr>
<tr>
<td>Depth (metres)</td>
</tr>
</tbody>
</table>

Table 5.1: Changing depths of the Bog Hole channel, increasing through the 19th Century, decreasing through the 20th Century.
Figure 5.22: Plan showing the deepening of the Bog Hole Channel in the late Nineteenth Century, drawn by Jarrad, 1906. The comparative sections at the bottom show the deepening of the Bog Hole at the head of the Pier between 1859 (orange line), 1867 (green line), and 1906 (red line). Document held in SMBC archive.
In reports of 1888 and 1893, Messent and Dickson, respectively, surmised that the existence of the Bog Hole was due to it no longer being connected to the other channels, so the flood tide caused an eddying motion that kept the depression scoured and hence relatively deep. They suggested if the South Channel (containing the Bog Hole) were again to be connected to the main channels, that the Bog Hole would silt up and potentially disappear, however, the Bog Hole has never again has been connected at its inner point to any of the main channels, but has still continued to infill.

The Bog Hole was recorded as continuing to deepen and narrow up to 1893, at which point it started to deteriorate, with infilling being accelerated from 1904 (Fowler, 1909a; Fowler, 1910). Between 1896 and 1905 the Southport Corporation recorded a decrease of nearly 50% in the tidal volume of the channel, from 8,427,569 to 4,264,349 cubic yards (Fairhurst, c.1974). Where there had previously been frequent steamer excursions from Southport Pier to Lytham across the estuary, by 1913, there were very few steamers able to reach the Pier due to difficulties negotiating the accreting sand banks, with limited crossings until 1920 (Tovey, 1965). From the late 1920's, steamers were unable to sail from the Pier due to accretion of sand raising the level of the foreshore several feet higher than at the end of the nineteenth century (Tovey, 1965), and to the infilling of the Bog Hole channel. In addition, Figure 5.23 shows the topographic evidence of changes in the Bog Hole Channel, with data pre-1937 indicating the presence of the channel relating to the decrease in the profile from 500 metres chainage seawards. By 1996, the channel (its northern end by this time) is shown to have shallowed and narrowed considerably, with continued infilling by 2003.

Figure 5.23: Changes in the Bog Hole Channel over time as shown by changes in the topography of Profile 26. Data courtesy of SMBC.
It was not only the steamers that would have suffered because of the Bog Hole shallowing. Evidence of correspondence still exists from the ‘Southport and District Fishermen’s Association’, which was established in 1911 (e.g. Jackson, 1914; Marshall, 1914; Jackson, 1919), suggesting the number of local fishermen was significant, not only by the presence of an association, but because the correspondence regards the provision of leading lights to light the Southport (Bog Hole) Channel. In addition, Stammers (1999) recorded the building of boats at Shellfield Road in Marshside, which were moved by the local fishermen to be launched at Marine Drive, and records the presence of a shipyard being documented at Crossens, possibly from the 18th or 19th century. Plate 5.1 taken from Barron (1938) illustrates the use of the Bog Hole effectively as a ‘lay-by’ for boats.

Table 5.2 shows the changing characteristics of the Bog Hole at this time, as given by Ashton (1920), with Figure 5.24 visually showing the changes as redrawn by Barron (1938).

Plate 5.1: Photograph of the “view from the end of Southport Pier, showing vessels lightering in the Bog Hole”, c.1901. (Source: Barron, 1938).
Table 5.2: Changing characteristics of the Bog Hole Channel, 1871 – 1919; (data taken from Ashton, 1919 and 1920, formerly quoting data believed to have been collected by Fowler; and Fowler, 1910).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Year</th>
<th>Measurement</th>
<th>Measurement (metric conversion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of water/sand 1 mile above Pier</td>
<td>1871</td>
<td>9 feet of water</td>
<td>3 m</td>
</tr>
<tr>
<td></td>
<td>1905</td>
<td>9 feet of sand</td>
<td>3 m</td>
</tr>
<tr>
<td>Distance of head of channel from Pierhead (at Low Water)</td>
<td>1887</td>
<td>2700 yards</td>
<td>2469 m</td>
</tr>
<tr>
<td></td>
<td>1903</td>
<td>1200 yards</td>
<td>1097 m</td>
</tr>
<tr>
<td></td>
<td>1909</td>
<td>1000 yards</td>
<td>914 m</td>
</tr>
<tr>
<td></td>
<td>1919</td>
<td>900 yards</td>
<td>823 m</td>
</tr>
<tr>
<td>Length of channel at 15 feet depth</td>
<td>1904</td>
<td>2 miles</td>
<td>3.2 km</td>
</tr>
<tr>
<td></td>
<td>1910</td>
<td>1 mile 70 yards</td>
<td>1.67 km</td>
</tr>
<tr>
<td>Length of channel at 21 feet depth</td>
<td>1904</td>
<td>960 yards</td>
<td>878 m</td>
</tr>
<tr>
<td></td>
<td>1910</td>
<td>730 yards</td>
<td>668 m</td>
</tr>
<tr>
<td>Area of channel above Pierhead</td>
<td>1890</td>
<td>127 acres</td>
<td>51.4 ha</td>
</tr>
<tr>
<td></td>
<td>1913</td>
<td>47 acres</td>
<td>19.0 ha</td>
</tr>
<tr>
<td>Channel width, line from Pier to Horse Bank</td>
<td>1904</td>
<td>720 feet</td>
<td>220 m</td>
</tr>
<tr>
<td></td>
<td>1910</td>
<td>660 feet</td>
<td>201 m</td>
</tr>
<tr>
<td></td>
<td>1919</td>
<td>450 feet</td>
<td>137 m</td>
</tr>
</tbody>
</table>
Figure 5.24: Successive charts showing the changes in the South (Bog Hole) Channel, redrawn by Barron (1938).
In a report by Vernon-Harcourt (1905) regarding the proposed extension of the training walls in the Ribble Navigation Bill of 1905, he quotes the Commissioners Final Report of 1891, stating that the Bog Hole depends upon “… the set of the tides, and upon the drainage from the Crossens watershed”. Although previously in 1885, Southport Corporation had proposed a Parliamentary Bill to divert the flow of the Crossens Channel back into the Bog Hole, they were opposed by the riparian landowners whom claimed rights of accretion, with the Bill being dropped (Fairhurst, c.1974). Without the flow of drainage from Crossens, the surveys of Barron (1938), and the data from Gresswell (1953) demonstrate the continued shallowing of the Bog Hole, even though no connection was ever again made between it and the main channels, (which Dickson (1893) had suggested would be the main cause of shallowing). This would indicate some other factor being responsible, which Gresswell (1953) believed to be the presence of the training walls resulting in a lack of flow into both the Bog Hole and Penfold Channels. Evidence therefore suggests a major contributing factor to the infilling of the Bog Hole was, potentially, the diversion of Crossens Pool, as the channel that drained the adjacent land, away from the Bog Hole which it had previously flowed into, away towards the centre of the estuary and the Penfold Channel. This alteration of the course of the drainage water from Crossens may have reduced the flow in the Bog Hole sufficiently to allow sediment deposition.

Vernon-Harcourt (1905) proposed that should the extension to the training walls go ahead, that Preston Corporation should be responsible for the dredging of the inner sand bar to maintain the Bog Hole, or if this was considered too “onerous [an] obligation”, then to consider training the Crossens Channel into the Bog Hole to “preserve the latter channel from obliteration” (Figure 5.25). This approach was supported by Fowler in his report of 1910, who felt that should the Crossens Channel be diverted into the Bog Hole, then it would prevent any periods of still water, thereby preventing sediment deposition. Ashton, however, in his book ‘The Battle of Land and Sea’, quoted in Fowler (1910), disagrees with the proposal, believing the quantity of water flowing through the Crossens Channel to be insufficient to make a difference to the infilling of the Bog Hole. Potentially, in addition to the landowners opposition to training the Crossens Channel, some reluctance to its training across the foreshore at Southport may have been due to the fact that prior to the Banks Sewage Treatment Works, untreated sewage was discharged via the Crossens Channel, hence, the presence of this material would not have been agreeable either across the foreshore or within the Bog Hole Channel at Pierhead.

At around the same time, in his report of 1909(a), Fowler believed that trying to maintain the Bog Hole in its current position, in a state suitable for pleasure steamers, would be unsuitable in the long term. Instead, he proposed a one-off dredging operation to create a channel in line with the fetch of the flood tide to the south-west of the Bog Hole out into the open sea (Figure 5.26). Evidently, this plan was not considered feasible and was never carried out.
Figure 5.25: Plan of proposed diversion of Crossens Pool into the Bog Hole Channel, 1910, probably drawn by Fowler (Borough Surveyor). Text in red reads: “Line of revetted dredged channel 30ft bottom width”. Document held in SMBC archive.
Figure 5.26: Part of plan showing proposed dredging to maintain a navigable link between Southport and the sea, drawn by Fowler, 1909(a). (Document held in SMBC archive).
The general consensus during the early twentieth century was that the deterioration of the Bog Hole Channel was of great detriment to the town of Southport, as it resulted in the cessation of pleasure steamers operating from the pier, and resulted in very little standing water at Pierhead, so giving the impression that the 'sea was retreating' from the town. There was an overall agreement between the engineers of the time that the main causing factors for the infilling of the Bog Hole were predominantly; (i) the presence of the 1883 Ribble training walls (although this was always stated by engineers associated with Southport Corporation, and not Preston Corporation); (ii) to a lesser degree the reclamation of the foreshore on the southern side of the estuary, reducing the tidal capacity; and (iii) the effect of the deposition of Mersey dredgings since 1890, this factor however being contentious between different parties, some believing that the dredgings were deposited too far south to produce any significant effect, whilst others argued that it was in part the dredgings that were leading to an accretion of sediment on the Southport foreshore.

6.0 Summary

Throughout the last 200 years the Ribble Estuary has undergone continual change since the first available plans of 1737 illustrate. The estuary has experienced a net infilling, with evidence indicating that the natural processes of change have been exacerbated during the last 200 years by human activities (O' Connor, 1987) related to the development of the Port of Preston, and the evolution of the town of Southport; notably the construction of the Ribble training walls, land reclamation, and dredging of both the Ribble and Mersey Channels.

The Ribble Estuary is naturally subject to accretion from offshore sediments moved inland by tidal currents and the predominant west to west-south-west direction of onshore winds, with the area to the south of the estuary showing a strong littoral drift to the north (towards the estuary) (Smith 1982). The amount of sediment brought into the estuary by the River Ribble is very variable, with a very early tenuous estimation by Dickson (1893) of an annual contribution of 400,000 tons of ‘soluble solids’ to the sea from the River Ribble. Subsequent studies (e.g. Hydraulics Research Station, 1965; Smith, 1982; van der Wal et al., 2002) have shown the input of sediment from the River Ribble to the estuary to be negligible.

7.0 References


BOROUGH SURVEYOR'S OFFICE (1906) Royal Commission on Coast Erosion. Borough Surveyor's notes on questions framed by the Commission. Unpublished archive document, SMBC.


FOWLER, A. F. (1909 (a)) Report to the Chairman and Members of the Improvement and Parks Committee, Southport Corporation on the Bog Hole Channel. Unpublished archive document, SMBC.

FOWLER, A. F. (1909(b)) Letter to J.E. Jarrat (Town Clerk, Southport) regarding the Bog Hole Channel. Unpublished archive document, SMBC.


MARSHALL, J. (1914) Various letters to Mr Jackson, Southport Borough Engineer, from Southport and District Fishermen's Association, re: Lighting of Southport Channel. Unpublished archive document, SMBC.

MESSENT, P. J. (1888) Effect of the works now being executed in the Ribble by the Preston Corporation, a report to the Southport Corporation and the Lords of the Manor of North Meols. Unpublished archive document, SMBC.


