

THE
PORT of MOSTYN
LIMITED



MAINTENANCE OF NAVIGATION

Mostyn Channel Monitoring Protocols

June 2008

Shoreline Management Partnership

Maritime Civil Engineering; Marine Science; Economics; Conservation

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Port of Mostyn Ltd.**MAINTENANCE OF NAVIGATION**
MOSTYN CHANNEL, Monitoring Protocols**June 2008**

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1.0 INTRODUCTION

The Port of Mostyn has applied for consent to dredge the Mostyn Channel between Welsh Channel and the Port (2.5km approx.) down to 4.0m below CD, over an average width of 75m (70m wide in the straight section; 100m wide in the curved section) over a period of three years. The amount of dredging is limited by the rate of deposition at Site 'A' in Mostyn Deep which has been determined for the present application to be:

Year 1 :	500,000m ³
Year 2 :	450,000m ³
Year 3 :	450,000m ³

An allowance of 50,000m³ per annum is allowed for dredging at the berths, leaving a total channel dredge volume of 1.25 million m³ over the three-year period. The capital dredge to achieve a 4.0m below CD channel is estimated to be 580,000m³, which with a maintenance dredge of around 225,000m³/annum results in a 4.0m below CD channel being achieved near the end of Year 3. The maintenance dredge allowance is less than the upper limit calculated from model results. This is based upon maintenance dredging experience over the last seven years including the effects of regular vessel traffic. The effects of the proposed dredging and deposition have been extensively studied using numerical models and results of monitoring of previous dredge and deposition consents. These studies have been carried out in the context of overall estuary evolution over the last 120 years.

The overall conclusion of the studies is that dredging of the Mostyn Channel to a depth of 4.0m below CD will have:

- local effects: caused by the creation and maintenance of the channel disturbing the seabed to establish the required channel alignment and profile;
- ambient effects: caused by alterations to the tidal flow regime using the channel and adjacent banks with consequential effects on seabed levels.

The deposition of dredge arisings in Mostyn Deep at Site 'A' will result in:

- local effects: caused by the actual deposition covering the seabed;
- ambient effects: caused by alterations to the tidal flow regime and consequential sediment transport.

The physical process effects described above for the dredging and deposition operations will have consequential local and ambient biological effects.

The definition of the spatial extent and depth of the physical process effects are defined by the studies using recent and historical data from monitoring. It is important that context changes consequential to estuary evolution are also recorded so that any significant change due to natural estuary evolution can be reconciled with study forecasts of dredging and deposition affects as described above.

This report sets out the objective for monitoring of dredging and disposal operations to achieve a 4.0m below CD dredged channel to the Port and then presents a rationale for monitoring; reporting and consequential management of the operation.

2.0 MONITORING OBJECTIVES

- (i) To monitor the evolution of the estuary and local and ambient effects of the model studies of dredging and deposition;
- (ii) to compare monitoring results with the estuary basis used for model studies and the forecast effects of the dredging and deposition and quantify differences; to assess the significance of differences and review the scale of dredge and deposition effects on the integrity of the estuary;
- (iii) to initiate mitigation if necessary to avoid adverse impact on the estuary prior to such impact becoming significant;
- (iv) to inform future applications for maintenance of navigation to the Port.

3.0 RELEVANT INPUTS FROM OTHER STUDIES/CONSENTS

The consent to dredge the channel from Welsh Channel to the Port to a depth of 2.0m below CD with a base width of 70/100m with deposition of dredge arisings at Site 'A' in Mostyn Deep, was issued in August 2005 for a period of two years. The consent included a Monitoring Plan prepared by the Environment Agency and monitoring requirements prepared by Marine and Fisheries Agency. Both monitoring plan and requirements were conditioned within the consents. The monitoring plan and requirements are reproduced in Appendix 'A'. These monitoring conclusions have been observed over the period of the consent and beyond where such time extension was conditioned.

The principal tasks contained within the monitoring consent conditions were:

- 1) Dredged channel survey - monthly
- 2) Estuary transect survey - monthly
- 3) Estuary seabed level surveys - annual (Salisbury Bank cross-channel – monthly)
- 4) Salisbury Bank current monitoring - before and after a dredge campaign
- 5) Biological survey – invertebrates - annual
- 6) Biological survey – cockles - annual
- 7) Biological survey – saltmarsh - annual
- 8) Mostyn Deep seabed level surveys - variable (up to six surveys)
- 9) Mostyn Deep sediment sampling - variable (up to six surveys)

The results of the monitoring undertaken since August '05 have been reported by monthly progress reports and analysis and review reports of which there have been two to date issued in March '07 and April '08 respectively. The March '07 report included the following recommendations in respect of future monitoring:

- A) To place the dredged channel and flank surveys on to a two monthly interval rather than one month.

- B)** To place the estuary transect surveys on to a two monthly interval rather than one month.
- C)** To carry out a swathe bathymetry survey of Mostyn Deep and the deposition area in late April/early May of each year deposition takes place.
- D)** To alter the number of sample sites for the benthic communities assessment and the procedure for saltmarsh habitat assessment as set down in ABPmer report (April '08 – SMP Monitoring, 2008).
- E)** To ensure that LiDAR survey and swathe bathymetry surveys are coordinated in time and extent and take place in late April/May each year.
- F)** To move any future consent termination date to November so that a monitoring report can be prepared in advance using the April/May surveys of that year referred to above.

These recommendations were reported in section 11.3.2 of the EIS (ERM, 2007) together with a further recommendation of an annual re-run of the numerical model using updated bathymetry to assess natural process change in the estuary. The EIS also recommended an annual report reviewing monitoring results.

The April '08 monitoring report repeated the recommendations above and also included 'early-warning' parameters of significant estuary evolutionary change in respect of forecast dredging and deposition effects.

Primary parameters:

- Maintenance or further increase of tidal energy using the Welsh channel and maintenance or diminution of tidal energy using the Hilbre channel;
- Plan location and alignment of the low water channel off Greenfield.

Secondary parameters:

- Absence of channel(s) across the southern flanks of Salisbury Bank downstream of Greenfield;
- Sustained closure of Welshman's Gut;
- Maintenance of size and location or enhancement and eastward movement of Mid-Hoyle channel;
- Confinement of central estuary low water channels within the lateral limits described in this report.

At a technical meeting with the Regulators on 9th May '08 it was agreed that the changes to the Holocene clay bank in the centre of the estuary should be added explicitly to the list of secondary parameters. The report recommended that monitoring reporting should comment specifically on the primary and secondary 'early-warning' parameters.

4.0 MONITORING RATIONALE

The monitoring plan needs to contain tasks; frequencies and reporting arrangements such that there is 'early-warning' of any unforeseen adverse impact due to dredging and/or deposition becoming significant so that prior mitigation can be implemented and the integrity of the estuary safeguarded.

The monitoring plan is based upon the state of estuary evolution due to natural processes as defined by the 2006 seabed level survey and historical surveys. This basis may be summarised as follows:

- (A) the low water channel upstream of Greenfield is presently stable in location even in the vicinity of Flint Point;
- (B) the central estuary continues to be volatile but the twin (or more) major channels introduced in 2004/05 rather than one major channel previous arrangement are persistent;
- (C) the Holocene clay bank is actively eroding providing unique changes to seabed levels in the centre of the estuary;
- (D) the Welsh channel has increased its energy profile and the Hilbre channel has reduced its energy profile since 2003 with both channels relocating towards the centre of the estuary (as recorded by north transect off the Mostyn breakwater);
- (E) the Mid-Hoyle channel is migrating eastwards and is the only significant trend change within the estuary approaches;
- (F) there is a nett import of sediment into the estuary each year but the annual rate is variable.

If the estuary evolution is sustained as summarised above then the Monitoring Plan needs to examine the actual local and ambient effects of dredging and deposition compared to forecast effects from the numerical modelling.

If the estuary evolution changes from that summarised above then the Monitoring Plan needs to define the changes and examine effects on the estuary basis used for the forecasts of dredge and deposition local and ambient effects.

If the estuary basis changes significantly with regard to dredging and deposition effects then these effects will need to be re-assessed by further numerical modelling.

The Monitoring Plan needs to comprise two measurement components:

- measurement of local and ambient effects from the dredging and deposition operations;
- measurement of estuary evolution.

Each measurement needs to be defined by spatial extent; frequency; threshold level for action; action options; management protocol.

The model forecasts of dredging and deposition effects provide quantified prediction with the estuary basis fixed by the seabed level survey of 2006. The estuary basis in reality exhibits fluctuations in seabed level due to the tide range variation; climatic conditions and freshwater inflow to the estuary over any twelve-month period. This complicates discrimination of local and ambient effects due to dredging and deposition. These fluctuations of the estuary basis also complicate the discrimination of trend change of the estuary basis itself.

There exists now however an extensive monitoring database collected specifically for the dredging and deposition operation since 2001. Within this database there is information on a 'tipping-point change that occurred within the central estuary in 2004/5. This change is linked to the eastward migration of Mid-Hoyle channel and its effect on flood flow directions within Welsh channel. The change represents the most rapid and most significant alteration to estuary morphology over the last seven years of dredge and deposition monitoring. The available

historical evidence shows only one similar ‘tipping-point’ event in 1985 when the navigable channel upstream of the Port to Connah’s Quay changed from Mostyn Channel to Welsh Channel. This change is linked to the closure of Welshman’s Gut and redistribution of flood flows from the Hilbre Channel into the Welsh Channel. The relevant evidence is in the form of pilot charts reproduced in Appendix ‘B’ from which it is difficult to derive a timescale for the change. It would seem reasonable to conclude however that the flow regime alterations took place over at least a six to twelve-month period. Reference to the Middle transect data base shows that the central estuary channel development ‘tipping-point’ of 2004/05 was identifiable in June ‘04; reached its deepest profile in June ‘05 then transferred prominence to a further new channel in June ‘07.

It is concluded from the above evidence that the minimum period for estuary evolution change to be accommodated by the Monitoring Plan over the next three years is twelve-months. The available evidence shows other estuary evolution rates of change such as the easterly migration of Mid-Hoyle channel and the closure of Welshman’s Gut to take place over decadal timescales. The Monitoring Plan needs to demonstrate that evolution change can be detected and, if necessary, mitigated within a twelve-month window.

(There is no evidence of dredging or deposition causing a ‘tipping-point’ in estuary evolution, despite the original 4.5m below CD dredged channel established in 2001 and the channel realignment at the end of 2005).

The spatial extent of monitoring needs to be defined for:

- the estuary basis;
- the local effects of dredging and deposition;
- the ambient effects of dredging and deposition.

The spatial extent of the estuary basis covers the area defined by the present evolution summary – points ‘A’ to ‘F’ above. This area extends downstream from Connah’s Quay to an arbitrary straight boundary extending from Hilbre Point to Point of Ayr.

The local and ambient effect areas for dredging and deposition are defined as follows:

Dredging area defined westward by a line 250m west of the dredged channel centre line; northern limit at 384000; southern limit at 382000; eastern limit at 316500. This area covers the local and ambient areas of impact as defined by monitoring and modelling respectively. The area is shown in figures 1 and 2 against a backcloth of the 2007 seabed level survey and model forecast of impact area respectively.

Deposition rectangular area defined by the latitude and longitude of the four corners:

- 53 21.650 N 03 18.210 W
- 53 20.940 N 03 16.350 W
- 53 21.050 N 03 16.180 W
- 53 21.770 N 03 18.080 W

- plus a 250m additional strip around the rectangular area perimeter for the local area. The ambient area is defined by that area of Mostyn Deep that lies below the 1.0m above CD contour and upstream to 316500.

Biological monitoring is not now considered to be necessary for the monitoring of the estuary basis, which is adequately defined by physical process measurements for the purpose of numerical modelling of estuary change. This arises from the work on estuary evolution and the results of monitoring of the dredge and deposition operation. Under the previous consent the biological monitoring sites were distributed throughout the estuary as shown on figures 4 and 5 against a background of 2003 bathymetry; on figures 6 and 7 for 2006 bathymetry and figures 8 and 9 for 2007 bathymetry.

The bathymetry change plots for 2003/2006 and 2006/2007 are provided in figures 10 & 11 and 12 & 13 respectively, with the biological monitoring sites again overlaid.

The presentation of the biological monitoring sampling site locations for 2006 seabed levels bear comparison with the locations overlaid on the forecast area of impact for a 4.0m below CD channel using 2006 seabed levels, shown in figures 14 and 15.

Comparison of figure 6 with figure 14 shows that the majority of existing biological monitoring sites lie outside the model forecast area of effect of the dredged channel. An examination of figures 8 and 16 shows the ten relevant sites (A3, A4, A7, A8, B2, B3, B5, B6, C1 and D1) that need to be monitored to assist in the definition of consequential biological effects from seabed level change.

Figures 4 to 15 all include the locations of sampling stations for the annual 'takeable cockle surveys' of Salisbury Bank in 2007 and 2008. This work is carried out by EAW and provides more than adequate coverage of the important cockle beds of relevance to the dredging operation.

The monitoring rationale set out above provides a logical justification based on the available evidence for definition of the spatial extent of monitoring and for the determination of the critical timescale to be adopted within which the monitoring information needs to be appraised and action taken as appropriate to avoid environmental damage to the estuary.

5.0 MONITORING TASK DEFINITION

The Monitoring Plan for the estuary basis definition is set out below:

Task	Frequency	Spatial Extent	Analysis	Evolution Issues
EB1 LiDAR/Swathe Survey of seabed levels	Annual	Northern limit = straight line joining Hilbre Point to Point of Ayr. Southern limit = 369000	Contour plot; Difference plot to previous survey(s); Numerical model run of morphological tide	A, B, C, D, E, F
EB2 Estuary Transects	Bi-monthly	North, Middle and South transects as presently defined.	Channel/Bank parameters; Datum level area(s) above seabed	A, B, D(part)
EB3 Mid-Hoyle/Welsh channel confluence	Bi-annual with one survey coincident with LiDAR/Swathe survey)	Northern limit = 388000 Western limit = 312000 Eastern limit and southern limits to tie in with Mostyn Deep Survey.	Contour plot; Difference plot to previous survey; Integration with LiDAR/Swathe survey.	E
EB4 Mostyn Deep	Annual (Synchronous with Mid-Hoyle/Welsh channel confluence survey six months apart from EB1)	Flanks to 1.0m above CD and upstream limit to 316500.	Contour plot; Difference plot to previous survey; Comparison to LiDAR/Swathe survey.	C, E, D(part)
EB5 Holocene Clay Bank	Bi-annual (one survey to coincide with LiDAR/Swathe survey of seabed levels)	Area of exposed clay around (317300, 384400)	Plot extent of clay area exposed and overlay on previous surveys – assess the extent and status of piddock colonisation of the area and erosion rate of clay edge (if appropriate).	C

The Monitoring Plan for the local and ambient effects definition for dredging and deposition is set out below:

Task	Frequency	Spatial Extent	Analysis	Local/Ambient Issues
LA1 Dredged Channel Survey	Bi-monthly	Northern limit = 384000; Southern limit = 382000; Western limit = 250m west of channel centreline; Eastern limit = 316500. Survey lines to be 100m apart except for longitudinal sections A to K to be set 50m apart (see Figure 3). Survey spatial limits shown on Figures 1& 2.	Selected cross- section and longitudinal section profiles overlaid on previous surveys with correlation to dredge campaign locations and volumes.	Local – spatial extent and depth of dredging campaigns; lateral extent of profile changes due to dredging. Ambient – seabed level changes adjacent to channel over the area of impact forecast by the numerical model.
LA2 Mostyn Deep Site ‘A’ Deposition Area	Before/After each Dredge Campaign	Deposition Area (as defined by license) plus 250m around outside of area perimeter.	Selected cross- section and longitudinal section profiles overlaid on previous surveys.	Local – spatial extent and depth of deposition; spatial extent and depth of any dispersion outside deposition area. Ambient – using EB4 results to assess spread of deposition material.
LA3 Mostyn Deep Site ‘A’ Deposition Area Seabed Samples	Annual (Synchronous with EB4)	Six locations within the deposition area. Four locations outside the deposition area but within Mostyn Deep.	Visual description; Particle-size analysis; Comparison with previous PSA data.	Local – change in characteristics of seabed sediment in the deposition area. Ambient – change in characteristics of seabed sediment in Mostyn Deep.
LA4 Cockle Survey – Salisbury/ Mostyn Bank (to be supplied by EAW)	Annual	Within area adjacent to impact forecast by numerical model as shown in Figure 15.	Reconciliation of data with results of EB1 and LA1.	Local – effect of channel profile on cockle beds. Ambient – effect of channel changes to hydrodynamics on seabed levels in cockle survey area.
LA5 Benthic Survey Salisbury/ Mostyn Bank	Annual	Within and adjacent to area of impact forecast by numerical model as shown in Figure 15 at A3, A4, A7, A8, B2, B3, B5, B6, C1 and D1.	Reconciliation of data with results of EB1 and LA1.	Local – effect of channel profile on benthos of flanks. Ambient – effect of channel changes to hydrodynamics on seabed levels in forecast area of impact and on colonising benthos.

The critical timescale within which to monitor and mitigate (if necessary) changes in the estuary basis or in forecast effects of dredging and deposition was defined in section 4 as twelve months. The monitoring tasks LA1 and EB2 are proposed to be undertaken at two monthly intervals. This frequency has been derived from a consideration of monthly surveys for each of these tasks available from 2003 for EB2 and 2005 for LA1. The data sets have been analysed for monthly intervals; then for simulated two monthly intervals and a difference plot produced. The results are included in Appendix C. This work demonstrates that the physical changes over the period are adequately captured by the two-month interval adopted under the Monitoring Task definitions presented in the table above.

The annual interval for the LiDAR/Swathe seabed level survey (EB1) and accompanying numerical modelling is the same as the critical timescale. The monitoring tasks EB3, EB4 and EB5 provide a partial survey of the estuary at the six-month point between EB1 surveys.

The monitoring plan described above acknowledges the critical timescale operating an ‘early-warning’ on a two-month interval. Once a significant change in the estuary basis or significant deviation from forecast effects of dredging and deposition is flagged-up, then management (and mitigation, if appropriate) of the change can be enacted. Management and mitigation are presented in Section 7 below.

6.0 MONITORING REPORTING

The purposes of monitoring are:

- to avoid environmental damage to the estuary;
- to keep all relevant parties informed of monitoring results;
- to improve the available data base for forecasting future estuary evolution;
- to confirm or otherwise the model forecasts of dredging and deposition effects and to update model forecasts as appropriate;
- to review monitoring results against the primary and secondary ‘early-warning’ parameters regarding estuary basis changes.

In order to fulfil these purposes it is necessary to report progress on a regular basis to a level of detail that provides an alert of estuary behaviour outside forecast limits so that any necessary action can be implemented within the critical time period of twelve months. It is also appropriate to report in fuller detail on monitoring results on a less frequent basis including, within this report, a reconciliation to forecast behaviour of the estuary to dredging and deposition and a review of the ongoing relevance of the monitoring plan.

The minimum interval for monitoring task repetition is two months for dredged channel surveys (LA1) and estuary transects (EB2). Progress reports are therefore to be produced at two monthly intervals and pick-up all the other monitoring tasks (section 5 above refers) as they occur over any twelve-month period. The monitoring year extends from November to November so that the LiDAR/Swath seabed level survey undertaken in Spring can be reported by November. The report in November is therefore the fuller detail report. The typical annual timetable for monitoring tasks and reporting is provided in Table ‘AA’.

Progress reports to include cumulative analyses as defined in section 5 above with comparison against task thresholds (see section 7 below). Where a threshold is exceeded a short report is to be added describing the form of the exceedance; a rationale for the occurrence (where available) and a proposed course of action. The courses of action available are likely to vary considerably with the understanding of the causes for the threshold exceedance but a single page summary will be included with each progress report using a traffic light system against each monitoring task:

- RED - threshold exceedance alert, action required.
- AMBER - threshold exceedance recorded, under observation
- GREEN - satisfactory

The occurrence of a 'red' alert against a monitoring task would require consultation with the Regulators and action to be agreed. The occurrence of 'amber' alerts would enable consultation with the Regulators as deemed appropriate by them.

Progress reports to be circulated electronically within one month of last date of field data collection for task LA1.

The annual report in November of each year to include the results of the numerical model run of the morphological tide using the Spring seabed level survey with a reconciliation to the results produced in 2006. This report would also include the seabed level survey difference plot against the previous year with reconciliation to other monitoring results.

Table 'AA' Monitoring Timetable – Typical Year

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Task													
EB1					■	■							
EB2		▲		▲		▲		▲		▲		▲	
EB3					■	■					■	■	■
EB4											■	■	■
EB5					■	■					■	■	
LA1			□		□		□		□		□		□
LA2		←	(As appropriate) -----										→
LA3											■	■	■
LA4						(EAW to provide) ←-----→							
LA5											■	■	■
Progress Reports			○		○		○		○		○		○
Annual Report												●	

7.0 MONITORING MANAGEMENT/MITIGATION

The management of the monitoring plan comprises the reporting of monitoring results as described in section 6.0 and the reporting needs to apply threshold criteria to monitoring tasks to allow the ‘traffic light’ system of alerts to operate. The estuary is subject to continuous variation of seabed levels due to the large tidal range, climatic conditions and freshwater input. As a consequence the application of threshold criteria needs to be a two-stage process:

Stage I the measurement moves above a declared amount within a declared time interval;

Stage II the measurement continues to move and the trend of such movement is significant in respect of one of the ‘early-warning’ parameters set down in section 3 above or above the forecast level of ambient or local effects from the dredging and deposition within the ambient or local areas defined compared to adjacent estuary behaviour.

Stage I would trigger an ‘amber’ alert and Stage II a ‘red’ alert within the relevant progress report.

Significant change to the estuary basis might comprise:

- alteration to the location and alignment of the main low water channel off Greenfield;
- re-opening of the Salisbury Bank cross-channel or Welshman’s Gut;
- lateral shifting of the energy balance in the central estuary manifest by bank and channel relocations;
- reversal of the migration trend for Mid-Hoyle channel;
- lateral shifting of the location and relative location of Hilbre and Welsh channels.

Significant change to the dredging and deposition forecast effects might comprise:

- increases in seabed level within the ambient areas defined for dredging and deposition above forecast, not reflected outside these areas in general estuary behaviour;
- increases in seabed level outside but adjacent to the deposition area not reflected elsewhere in Mostyn Deep;

- non-dispersion of deposited sediments from Site 'A' over a six month period;
- seabed level changes outside the 300m wide dredged central corridor not reflected in general estuary changes in the area.

There would be less concern over changes to the estuary basis comprising:

- alterations to the minor banks and low water channels where change has been previously observed;
- seasonal changes to bank and channel seabed levels;

and changes to the dredging and deposition forecast effects comprising:

- non-dispersion of deposited sediments from Site 'A' over a period less than six months;
- increases in seabed level within ambient areas for dredging and deposition reflected in general estuary behaviour adjacent to these areas;
- increases in seabed level adjacent to the deposition area reflected in general estuary behaviour within Mostyn Deep.

In order to determine suitable Stage I thresholds for tasks EB2 and LA1 recourse was made to previous survey work between 2003 to present. For the past EB2 surveys the maximum and minimum values were calculated for the various channel and bank parameters collected along each of the three transects together with the maximum change over one month (i.e. between successive surveys) over the period of survey data available. The results of this work are presented on Table 'BB'.

The previous LA1 surveys are more difficult to analyse due to channel realignment and dredge campaign effects on channel behaviour. As a consequence recourse was made to the digital ground modelling presented in Annex A3 of the Environment Statement reproduced here as Appendix 'D'. These data show that the adjacent areas to the channel within the 500m wide corridor typically fluctuate by +/-0.5m over a monthly period.

The information derived from the past LA1 and EB2 monitoring was used to determine suitable Stage I thresholds which are set out in Table 'CC' below.

Table 'BB' Estuary Transect Surveys (2003 to 2008)

NORTH Transect																								
	Channel A			Channel D			Channel C					Channel B					Channel E				Channel F			
	Offset (m)	Width (m at CD)	Depth (mACD)	Offset (m)	Width (m at CD)	Depth (mACD)	Offset (m)	Width (m at CD)	Effective Width (m)	Depth (mACD)	Effective Depth (mACD)	Offset (m)	Width (m at CD)	Effective Width (m)	Max Depth (mACD)	Effective Depth (mACD)	Offset (m)	Effective Width (m)	Max Depth (mACD)	Effective Depth (mACD)	Offset (m)	Effective Width (m)	Max Depth (mACD)	Effective Depth (mACD)
MAX	3000	700	-9.50	3500	600	-2.00	4000	200	450	-3.00	5.00	4750	300	1000	-3.50	8.00	2200	500	+2.00	2.00	5550	650	+3.50	2.50
MIN	2750	500	-5.00	3300	350	-1.00	3650	100	250	-1.00	2.00	4600	150	800	-1.00	3.50	2000	200	+0.00	0.00	5500	400	+3.00	2.00
MAX monthly change between Surveys	100	100	0.50	100	50	0.50	50	75	50	0.50	1.00	100	100	100	0.50	1.50	100	100	0.50	1.00	50	100	0.50	0.50

MIDDLE Transect																													
	Channel A			Channel B				Channel B1			Channel C			Channel D				Channel E				Channel F1				Channel F2			
	Offset (m)	Width (m at CD)	Depth (mACD)	Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)	Offset (m)	Width (m at CD)	Depth (mACD)	Offset (m)	Width (m at CD)	Depth (mACD)	Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)	Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)	Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)	Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)
MAX	4750	350	-7.50	3850	800	-8.00	8.50	3400	800	-4.00	3850	750	-1.50	850	550	+3.00	3.50	1600	1000	+3.50	3.00	6300	500	+4.50	2.00	6800	550	+3.00	4.00
MIN	4500	200	-5.00	2900	100	+1.50	1.50	3150	200	-1.00	3550	50	-0.50	600	300	+2.00	1.50	1300	800	+2.00	1.50	6050	300	+3.50	1.00	6650	250	+1.00	2.50
MAX monthly change between Surveys	75	100	1.50	100	150	3.00	2.50	100	250	1.00	50	50	0.50	100	250	1.00	1.00	100	100	0.50	1.00	150	100	0.50	0.50	50	150	0.50	1.00

SOUTH Transect																
	Channel A1			Channel A2			Effective Width (m) A1 + A2 (at +4.0m ACD)	Effective Width (m) A1 + A2	Channel B				Channel B1			
	Offset (m)	Width (m at CD)	Depth (mACD)	Offset (m)	Width (m at CD)	Depth (mACD)			Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)	Offset (m)	Effective Width (m)	Depth (mACD)	Effective Depth (m)
MAX	1300	500	-2.00	1600	350	-1.50	1550	7.00	3700	900	+4.00	3.00	3750	300	+4.50	1.50
MIN	800	0	0.00	1300	150	-0.50	1100	4.50	2950	300	+3.00	1.00	3700	300	+4.00	1.00
MAX monthly change between Surveys	150	150	1.00	200	100	1.00	150	1.50	100	200	0.50	0.50	50	0	0.50	0.50

Table 'CC' Stage I Thresholds – Monitoring Tasks EB2 and LA1

Task	Parameter	Historic Monthly Variation (m)	Stage I Threshold Value (m)	Least Count (discrimination) of Task (m)	
EB2	Channel	Offset	500 – 50	150	50
		Width	50 – 250	150	50
		Depth	0.5 – 2.5	1.5	0.5
	Bank	Offset	(not separately assessed – channel values used)	150	50
		Width		150	50
		Elevation		1.5	0.5
LA1	Channel Flank – elevation	0.5	1.0	0.3	
	Direct Impact Corridor Width	200 – 400 (along channel length)	100	25	

The other monitoring tasks' Stage I thresholds are considered below in Table 'DD'

Table 'DD' Stage I Thresholds

Task	Parameter
EB1	Not applicable in progress reports since the model results will be subject to detailed assessment as a normal course within the annual monitoring report and thereby provide a culmination of the year's monitoring.
EB3	Any movement of Mid-Hoyle channel confluence with Welsh Channel westward.
EB4	Any nett accretion over the twelve month period that was equal to or greater than a mean depth change of 2.0m over the area of the 5.0m below CD contour.
EB5	Any mean monthly clay erosion of the south-western edge of the bank by more than 5.0m between successive surveys.
LA2	Not applicable.
LA3	Any change in particle-size analyses whereby any one of the following relationships is satisfied between successive samples from the same location: $d_{15} \geq d_{50}$; $d_{50} \geq d_{85}$; $d_{50} \leq d_{15}$; $d_{85} \leq d_{50}$.
LA4	Any significant change over a twelve-month period not reflected outside the forecast area of dredged channel ambient impact.
LA5	Any significant change over a twelve-month period not reflected outside the forecast area of dredged channel ambient impact.

The progress report 'traffic light' system flags-up Stage I exceedances and whilst such exceedance persists, each progress report will need to include a rationale based on the 'early-warning' parameters for not advancing the threshold status to Stage II. In the event of Stage I threshold exceedance for tasks LA1 and EB2, it would be normal practice to increase survey frequency to monthly whilst the rate of direction of change persists above threshold level. A specimen progress report is provided in Appendix 'E'.

There is no Stage I threshold for task EB1 but in the event of the model results showing any significant increase in dredge and/or deposition impact then a Stage II condition would immediately apply and be presented in the annual report.

Once a Stage II threshold exceedance is declared against a monitoring task such as when the direction and rate of change triggering the Stage I flag has persisted over three consecutive surveys it is necessary to decide if the recorded change is:

- localised and not reflected in other monitoring data; this would normally extend the observation period under Stage I;
- reflected in other monitoring task data albeit not above Stage I threshold level; this would normally require an appraisal of potential impact against 'early-warning' parameters and if concluded to be low risk then consideration of mitigation such as increased frequency and/or rescheduling of monitoring tasks;
- reflected in other monitoring task data albeit not above Stage I threshold level; this would normally require an appraisal of potential impact against 'early-warning' parameters and if concluded to be significant risk then consideration of a seabed survey (EB1) with numerical model analysis. If this confirmed the risk then consideration of further mitigation of dredging and deposition operations.

Because of the range of potential situations arising under the monitoring plan it is not feasible to develop management and mitigation arrangements in great detail. Each threshold exceedance event will need to be considered on its individual merits. The procedure outlined above can be carried out within the critical timescale of twelve-months, where required, thus safeguarding the estuary against damage arising from dredging and disposal operations.

8.0 CONCLUSIONS

In order to test the monitoring plan set out in this report, the plan has been examined against:

- A achievement of objectives
- B ability to inform early-warning parameter assessment

A: Objectives Test

- (i) To monitor the evolution of the estuary and local and ambient effects of the model studies of dredging and deposition;

This has been achieved by the task schedule presented in section 5 of the report.

- (ii) to compare monitoring results with the estuary basis used for model studies and the forecast effects of the dredging and deposition and quantify differences; to assess the significance of differences and review the scale of dredge and deposition effects on the integrity of the estuary;

This has been achieved by the analysis and reporting procedures set down in sections 5, 6 and 7 of the report.

- (iii) to initiate mitigation if necessary to avoid adverse impact on the estuary prior to such impact becoming significant;

This has been achieved in sections 6 and 7 of the report.

- (iv) to inform future applications for maintenance of navigation to the Port.

This has been achieved by the reporting described in section 6 of the report.

B: Early-Warning Parameter Test:

Primary parameters:

- Maintenance or further increase of tidal energy using the Welsh channel and maintenance or diminution of tidal energy using the Hilbre channel;

This has been achieved by the annual seabed level survey of the estuary and re-run of the morphological tide in the numerical model (EB1).

- Plan location and alignment of the low water channel off Greenfield.

This is achieved by the two-monthly estuary transect surveys (EB2).

Secondary parameters:

- Absence of channel(s) across the southern flanks of Salisbury Bank downstream of Greenfield;

This is achieved by the annual seabed level survey of the estuary and re-run of the morphological tide in the numerical model (NB. – this morphological change is linked to the location of the low water channel off Greenfield which is monitored on a two-month interval) (EB1).

- Sustained closure of Welshman's Gut;

This is achieved by the annual seabed level survey of the estuary and re-run of the morphological tide in the numerical model (EB1).

- Maintenance of size and location or enhancement and eastward movement of Mid-Hoyle channel;

This is achieved by the six-monthly surveys of the confluence area of Mid-Hoyle and Welsh channels and Mostyn Deep (EB3 and EB4).

- Confinement of central estuary low water channels within the lateral limits described in this report.

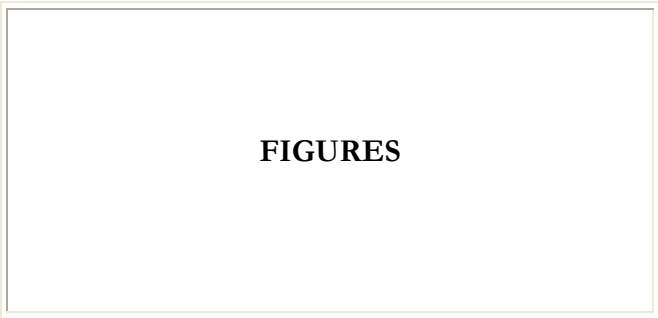
This is achieved by the two-monthly estuary transect surveys (EB2).

- Holocene Clay Bank Behaviour

This is achieved by the six-monthly surveys of the exposed clay bank and the Mostyn Deep/Welsh Channel (EB4 and EB5).

The primary purpose of the monitoring plan is to safeguard the integrity of the estuary against damage due to dredging and/or deposition. This has been achieved by specifying task frequencies and spatial extents with associated reporting whereby unforeseen and potentially damaging changes to the estuary basis and/or the local and ambient impacts of dredging and deposition are flagged-up promptly. The monitoring plan has been designed to flag-up such unforeseen changes; report the changes and allow for appropriate mitigation within the critical period of twelve months. This is the minimum period from available evidence over which significant changes in the estuary take place.

As a consequence it is concluded that the monitoring plan achieves the primary purpose of safeguarding the integrity of the estuary and thereby provides a no-real risk basis upon which the dredging of the 4.0m below CD channel with disposal of arisings in Mostyn Deep Site 'A' may proceed.



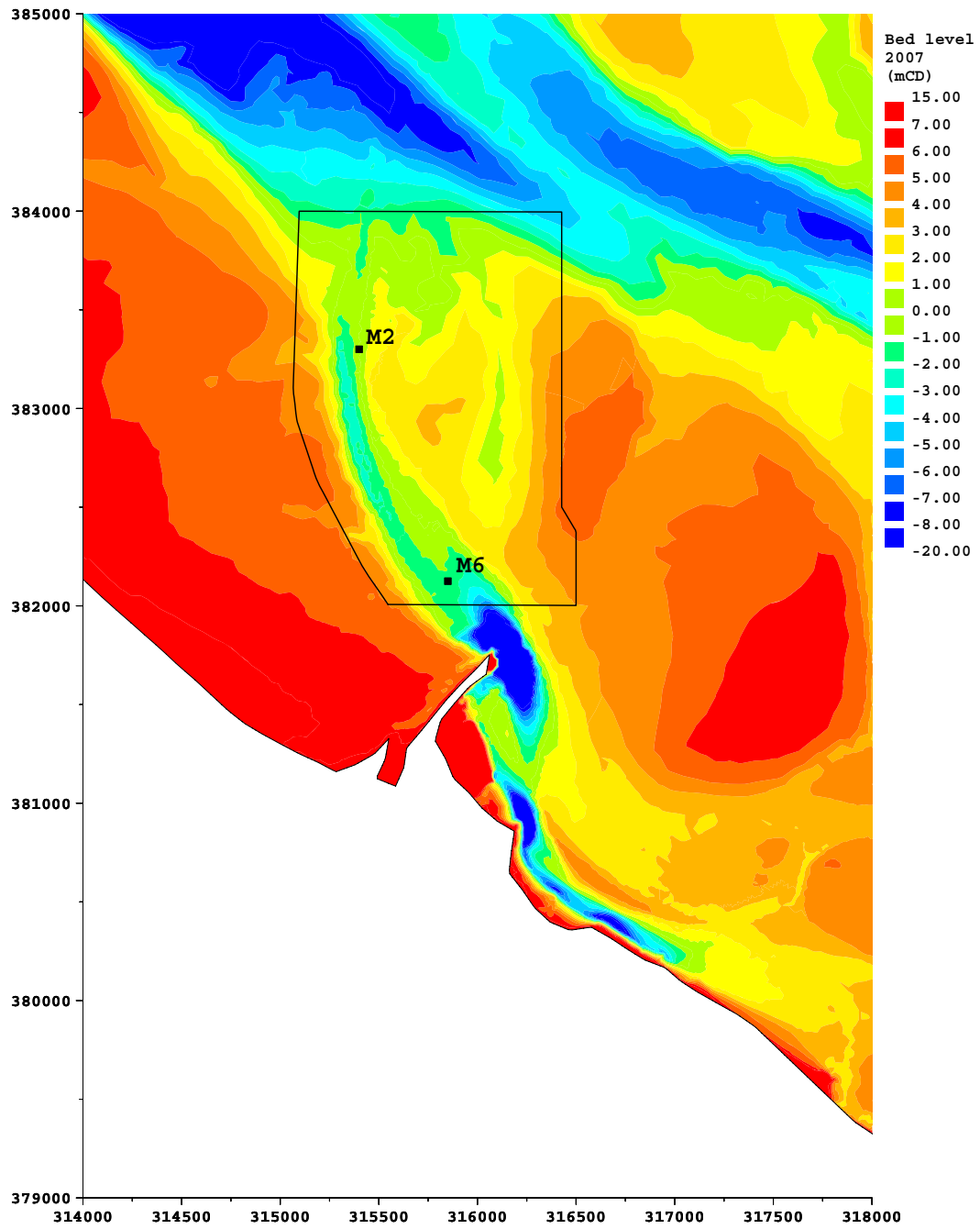


Figure 1: Baseline bathymetry for 2007– Port access channel, proposed Monitoring Area for 2008 and location of buoys M2 and M6

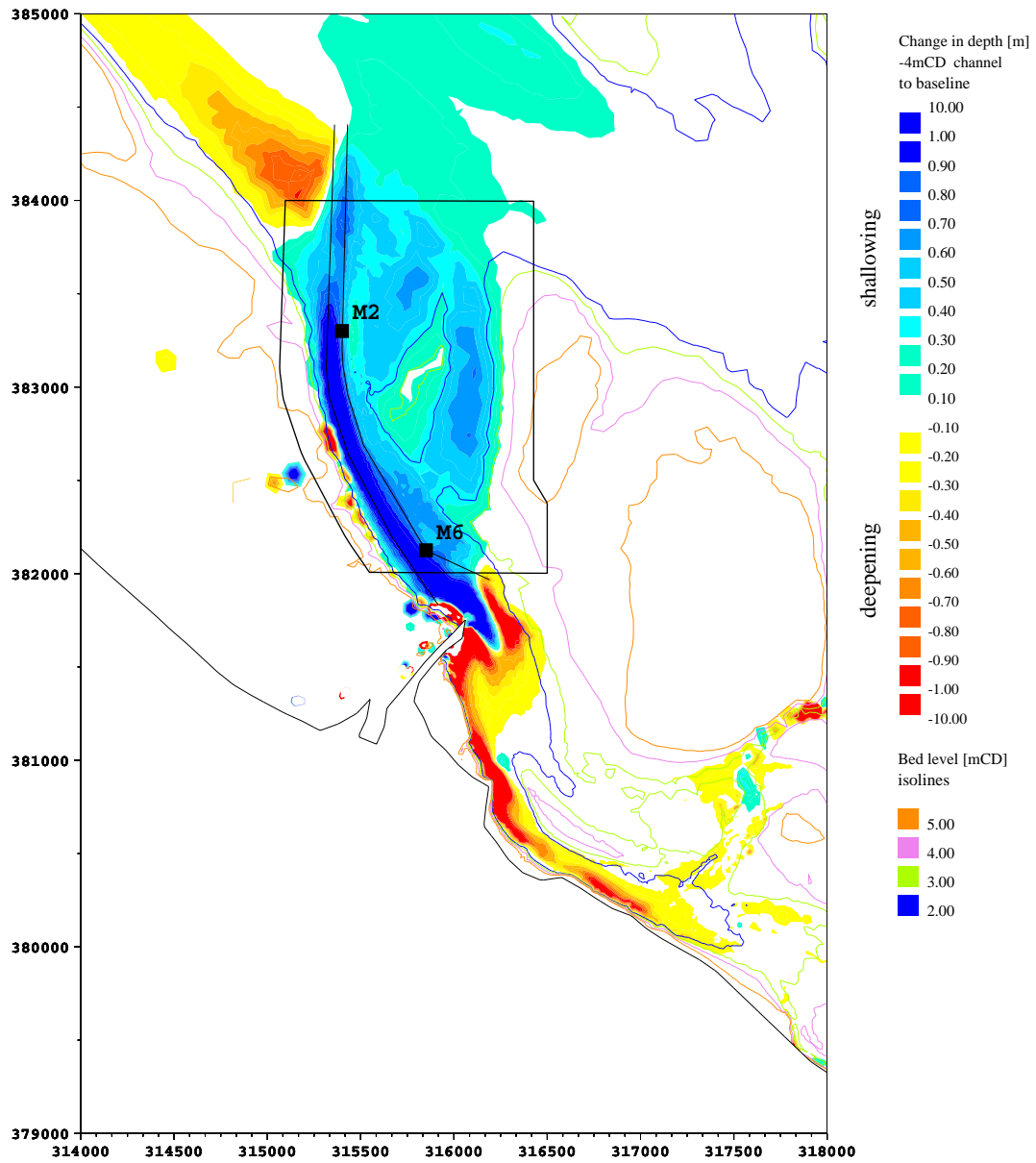


Figure 2: Estimate of the dredging-induced change in bed level due to -4mCD channel based on the change in the sediment flux – Port access channel (from Fig 9.5 in Port of Mostyn EIS), proposed Monitoring Area for 2008 and location of buoys M2 and M6

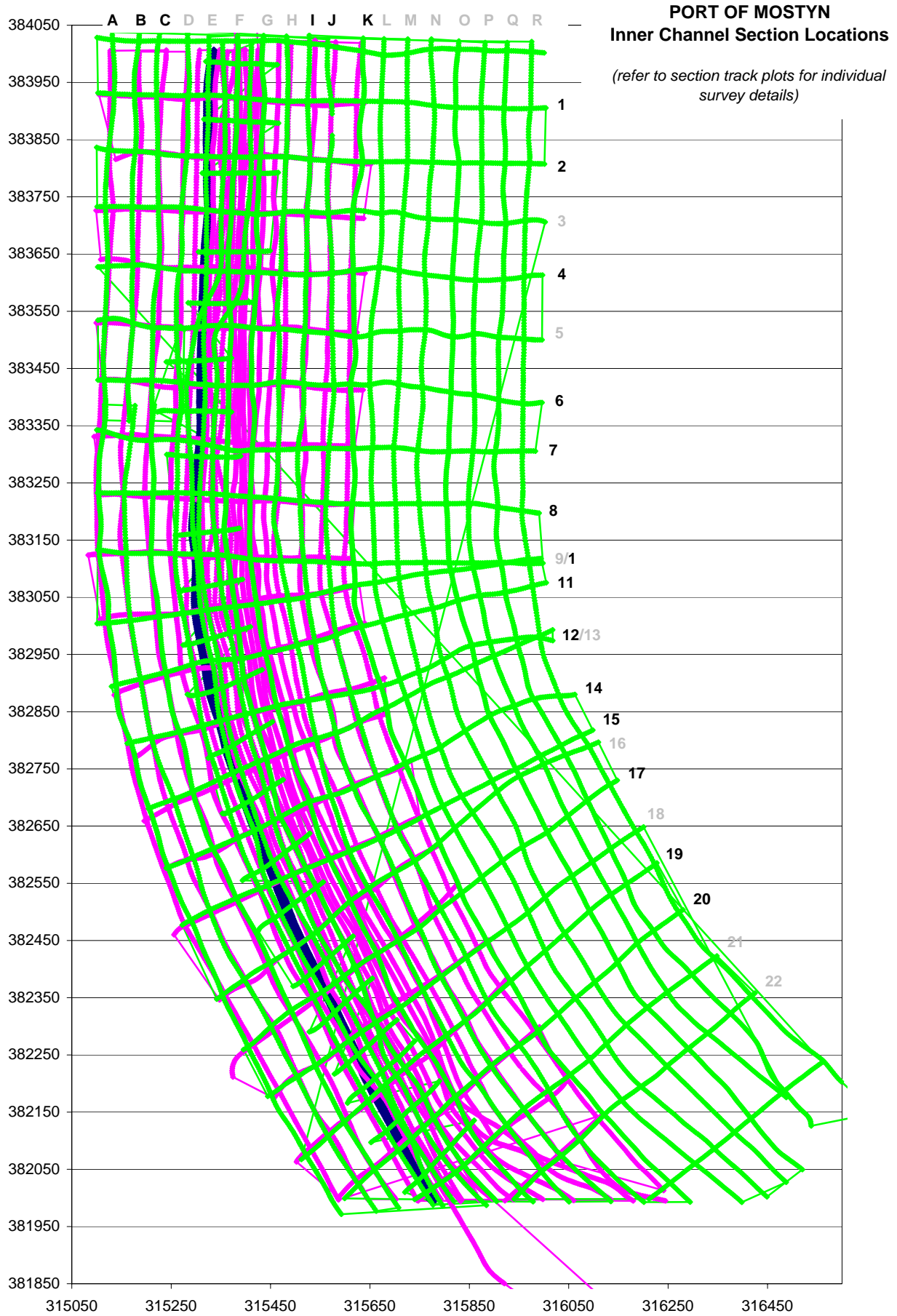


Figure 3

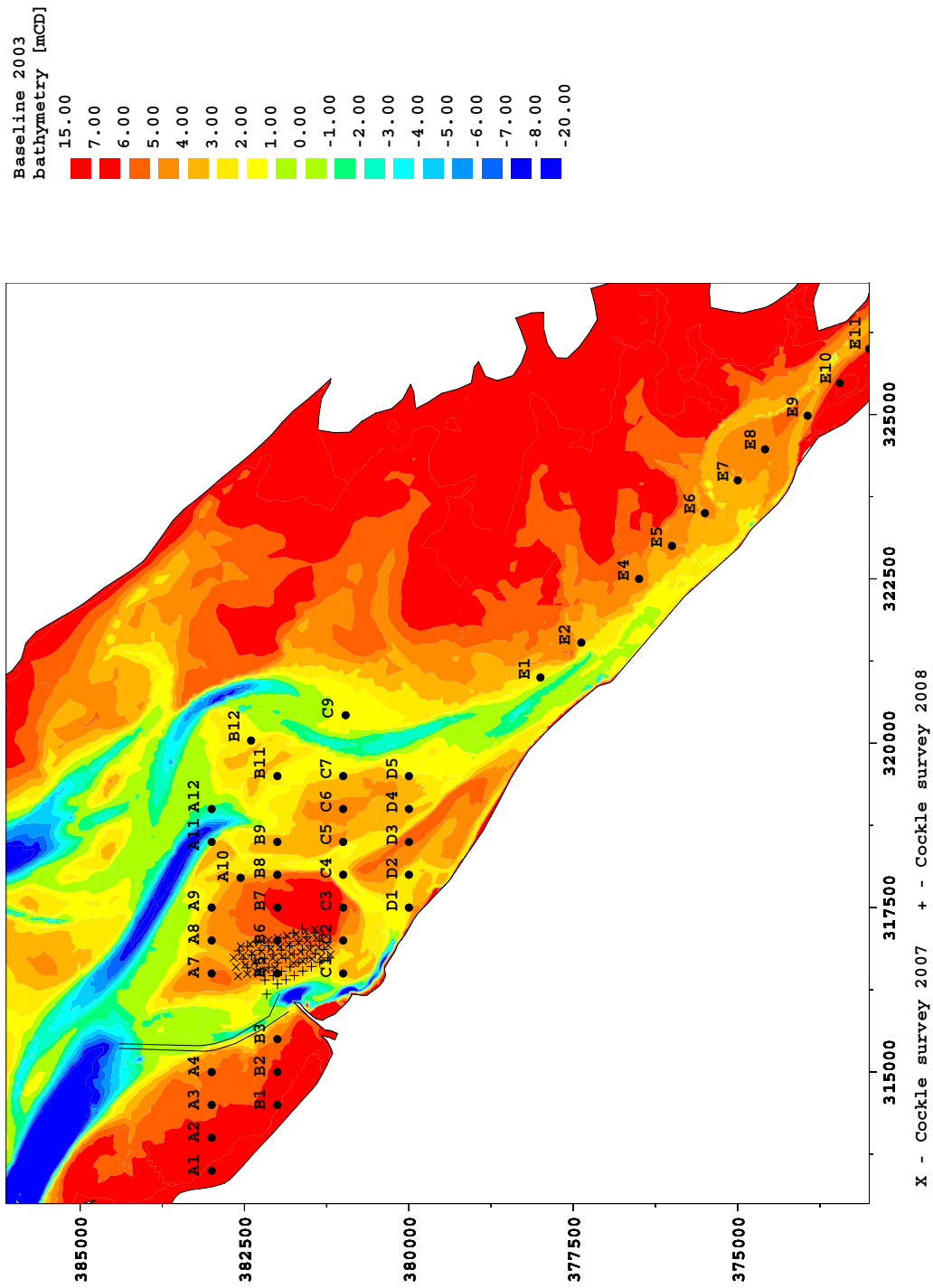


Figure 1: Baseline bathymetry for 2003 with location of benthic and cockle surveys – Dee Estuary

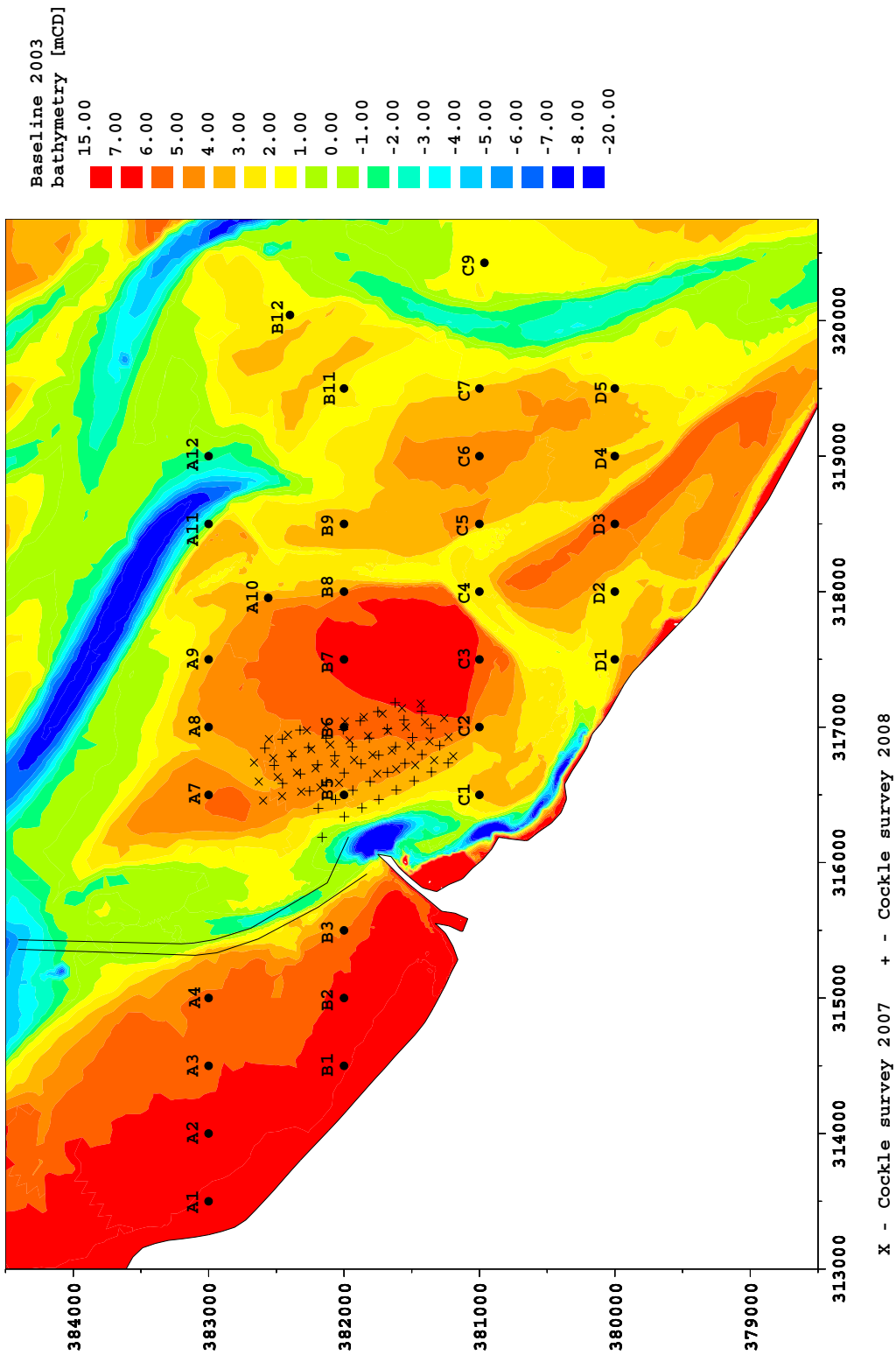


Figure 2: Baseline bathymetry for 2003 with location of benthic and cockle surveys – Port access channel

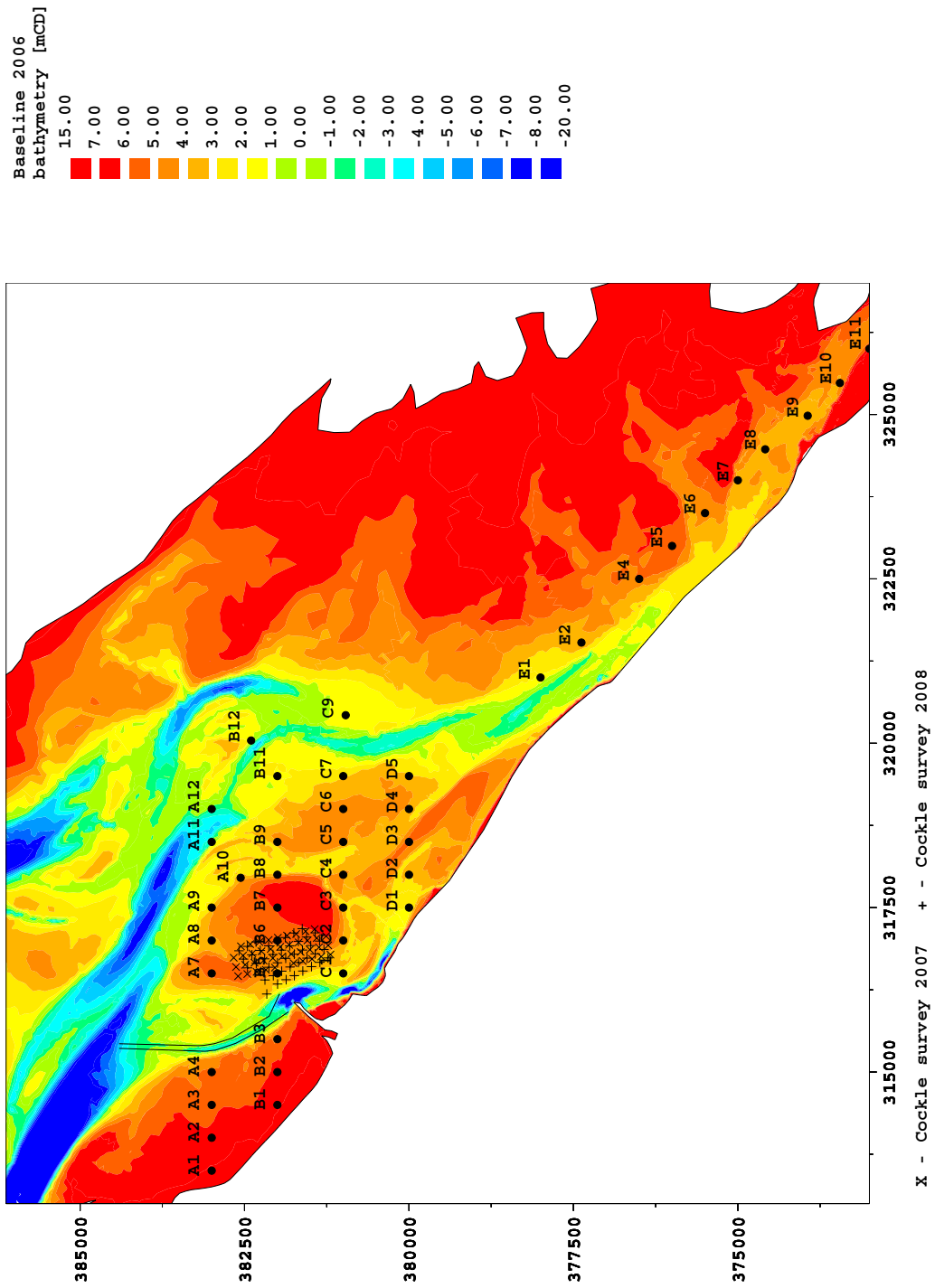


Figure 3: Baseline bathymetry for 2006 with location of benthic and cockle surveys – Dee Estuary

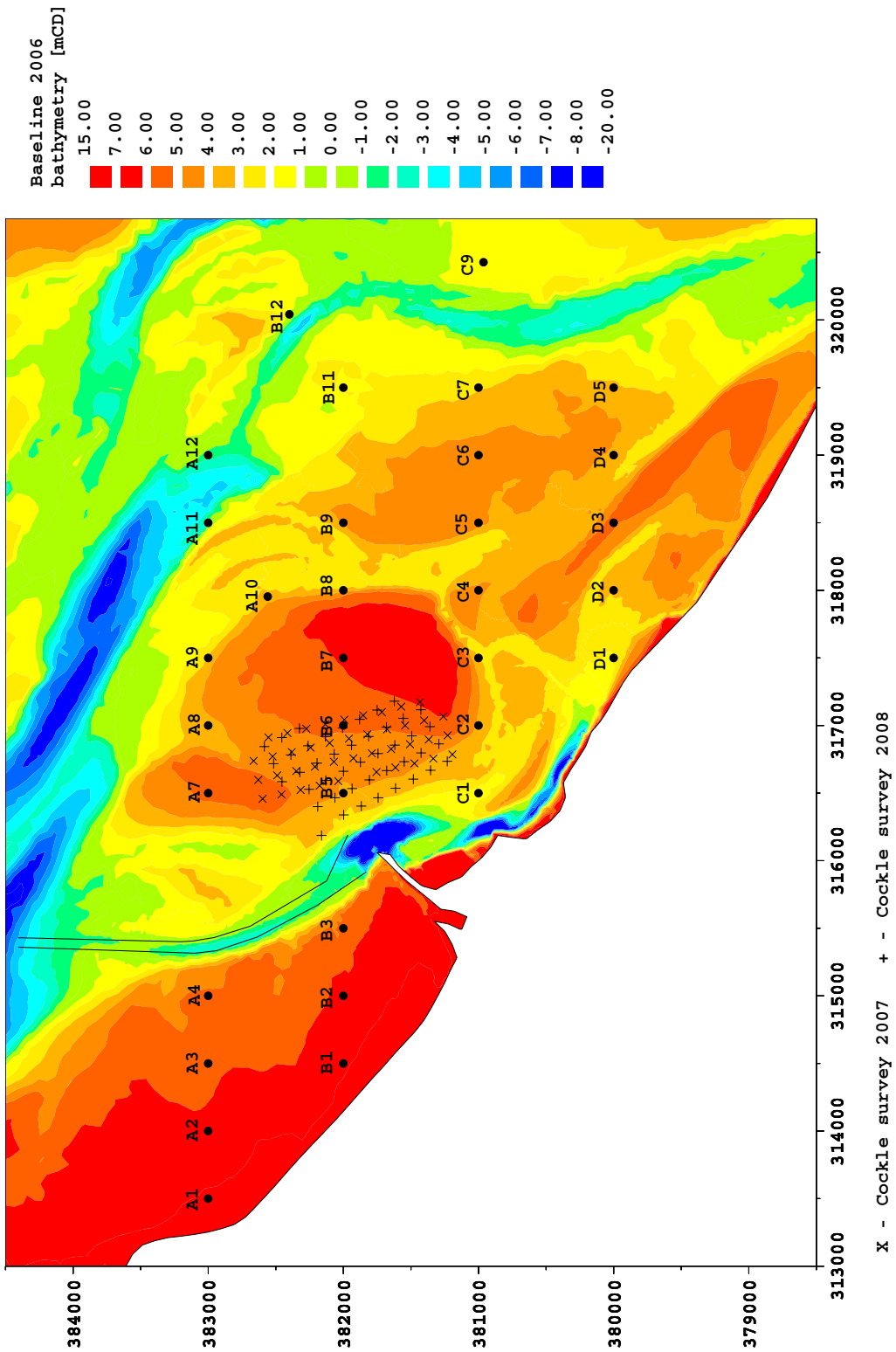


Figure 4: Baseline bathymetry for 2006 with location of benthic and cockle surveys – Port access channel

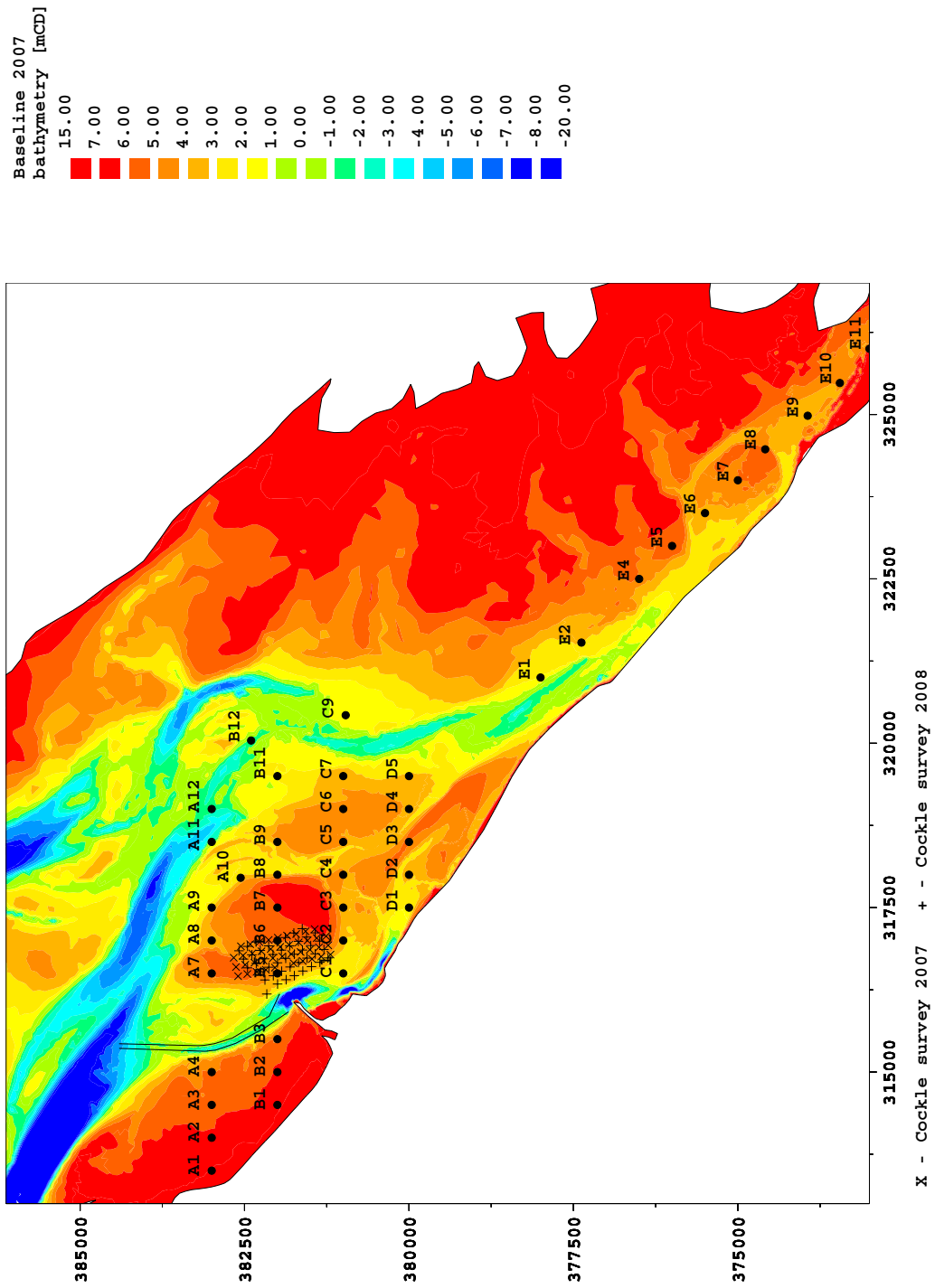


Figure 5: Baseline bathymetry for 2007 with location of benthic and cockle surveys – Dee Estuary

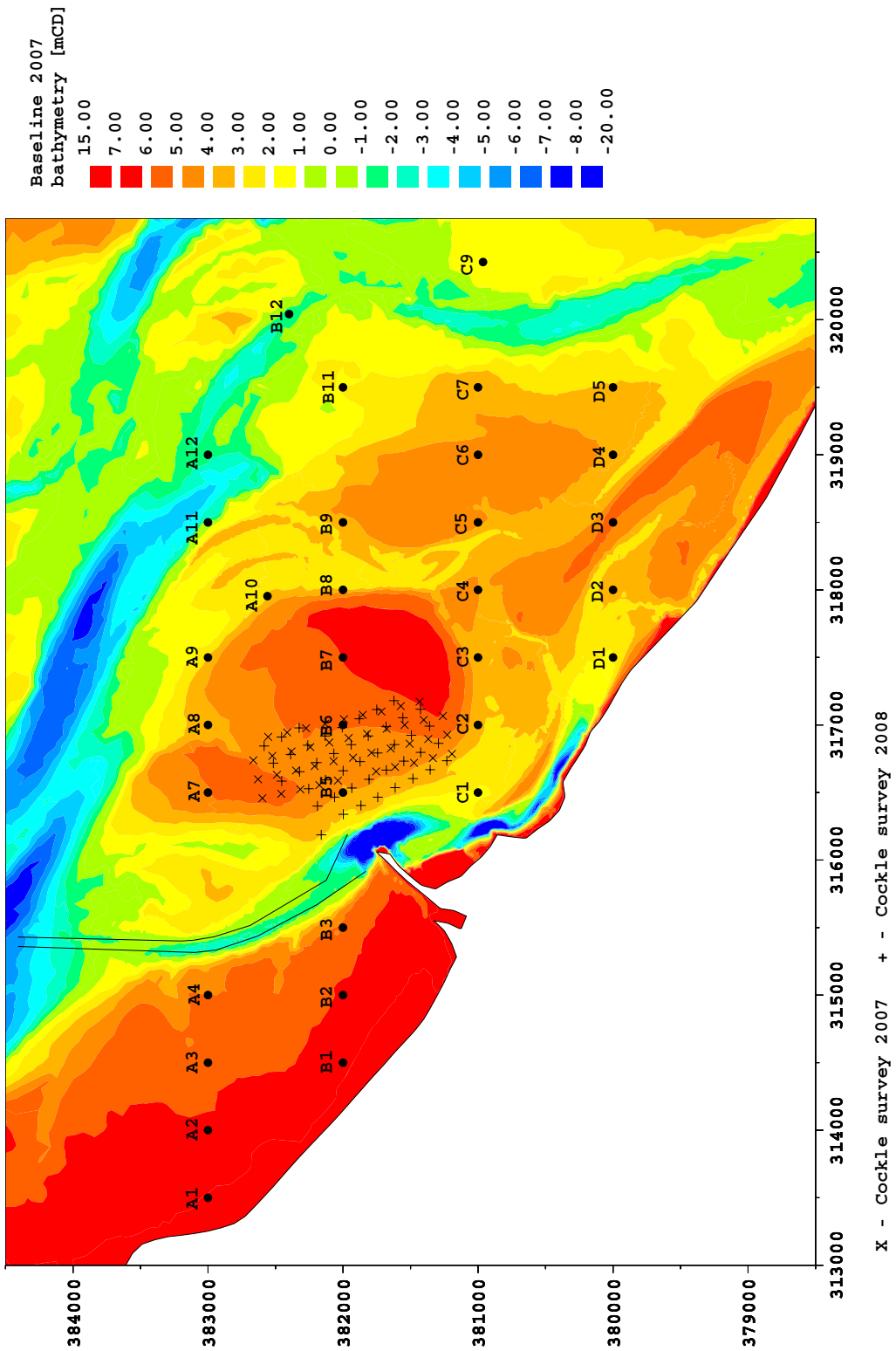


Figure 6: Baseline bathymetry for 2007 with location of benthic and cockle surveys – Port access channel

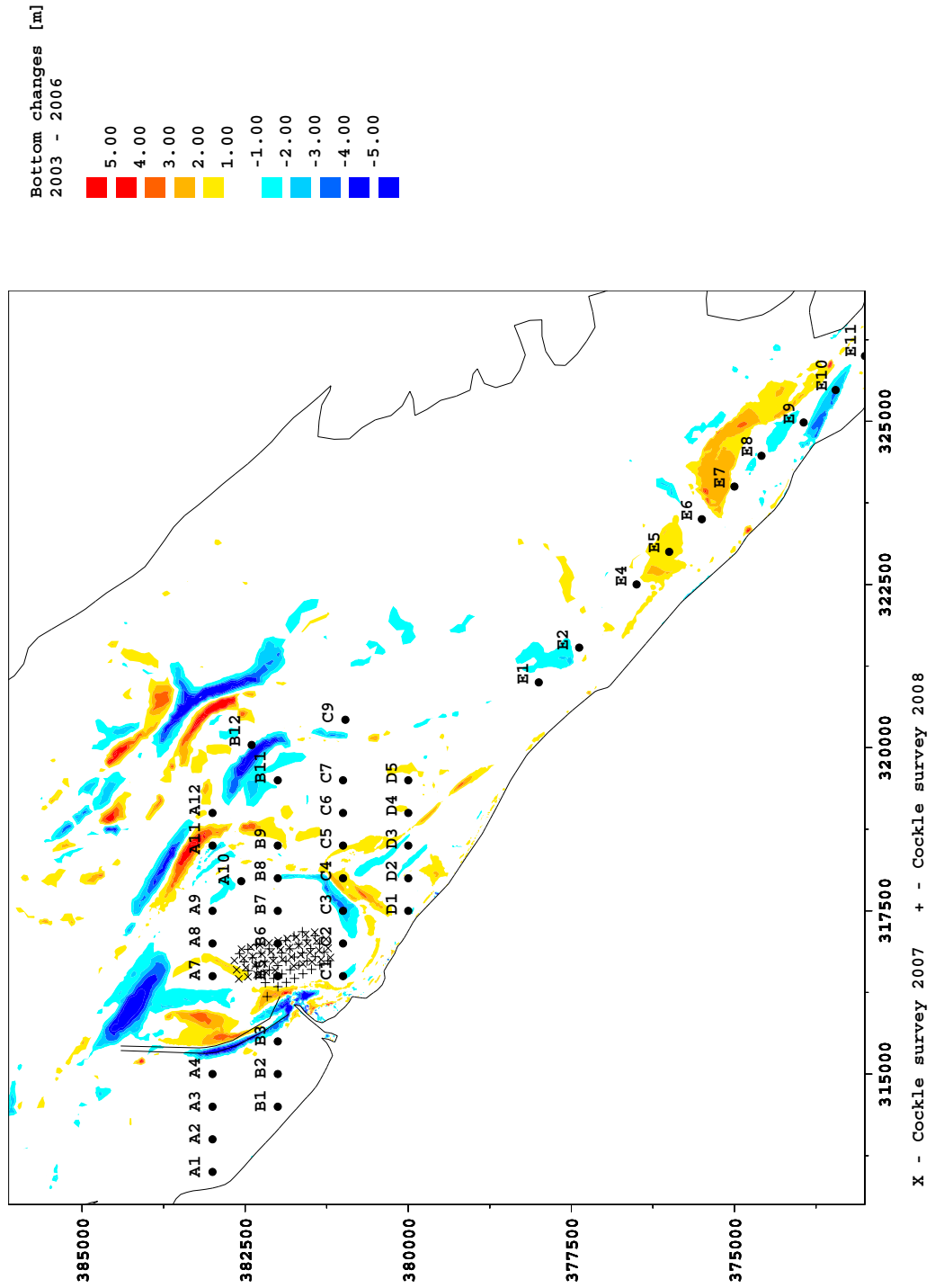


Figure 7: Change in bathymetry between 2003 and 2006, with location of benthic and cockle surveys – Dee Estuary

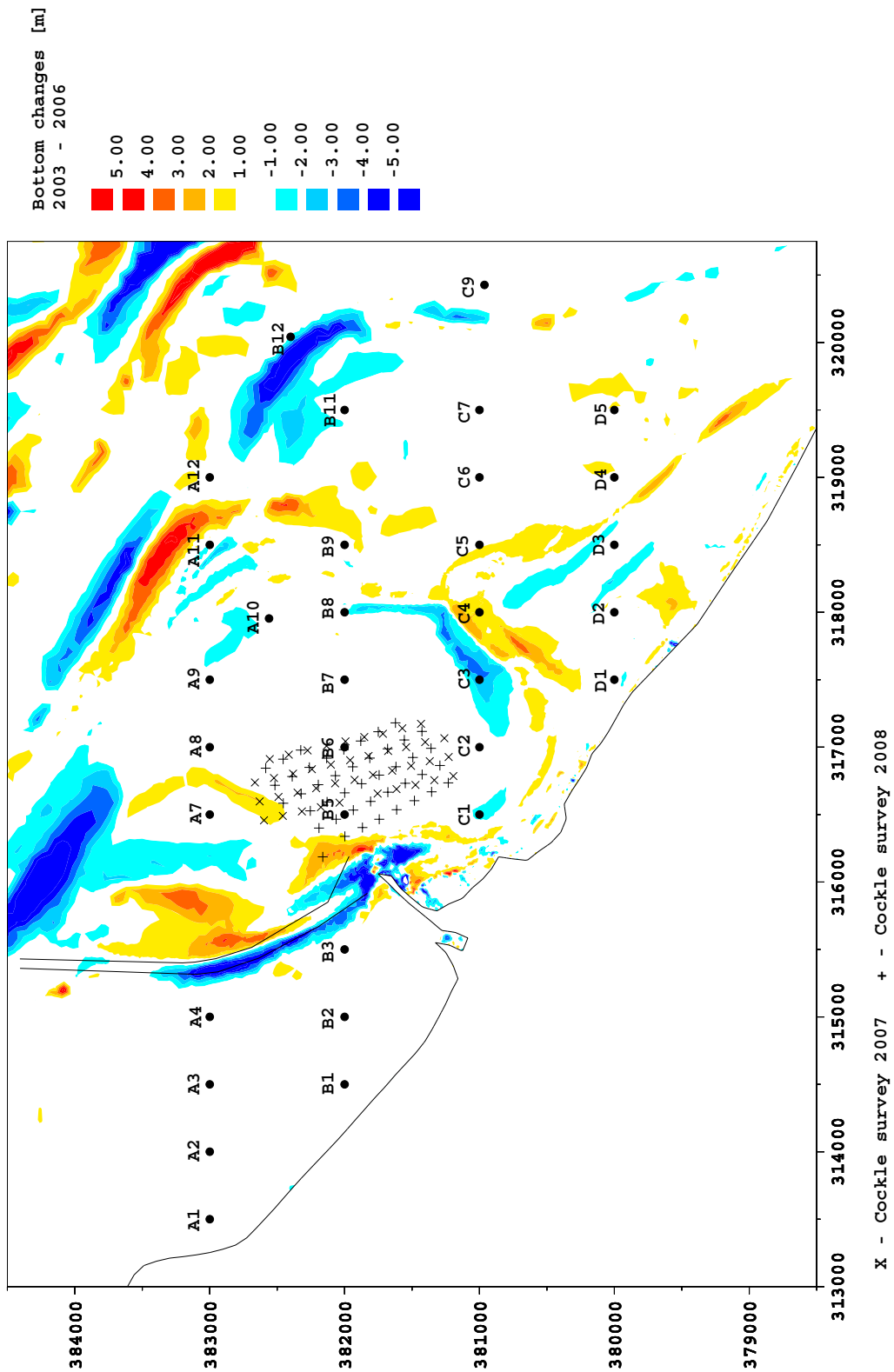


Figure 8: Change in bathymetry between 2003 and 2006, with location of benthic and cockle surveys – Port access channel

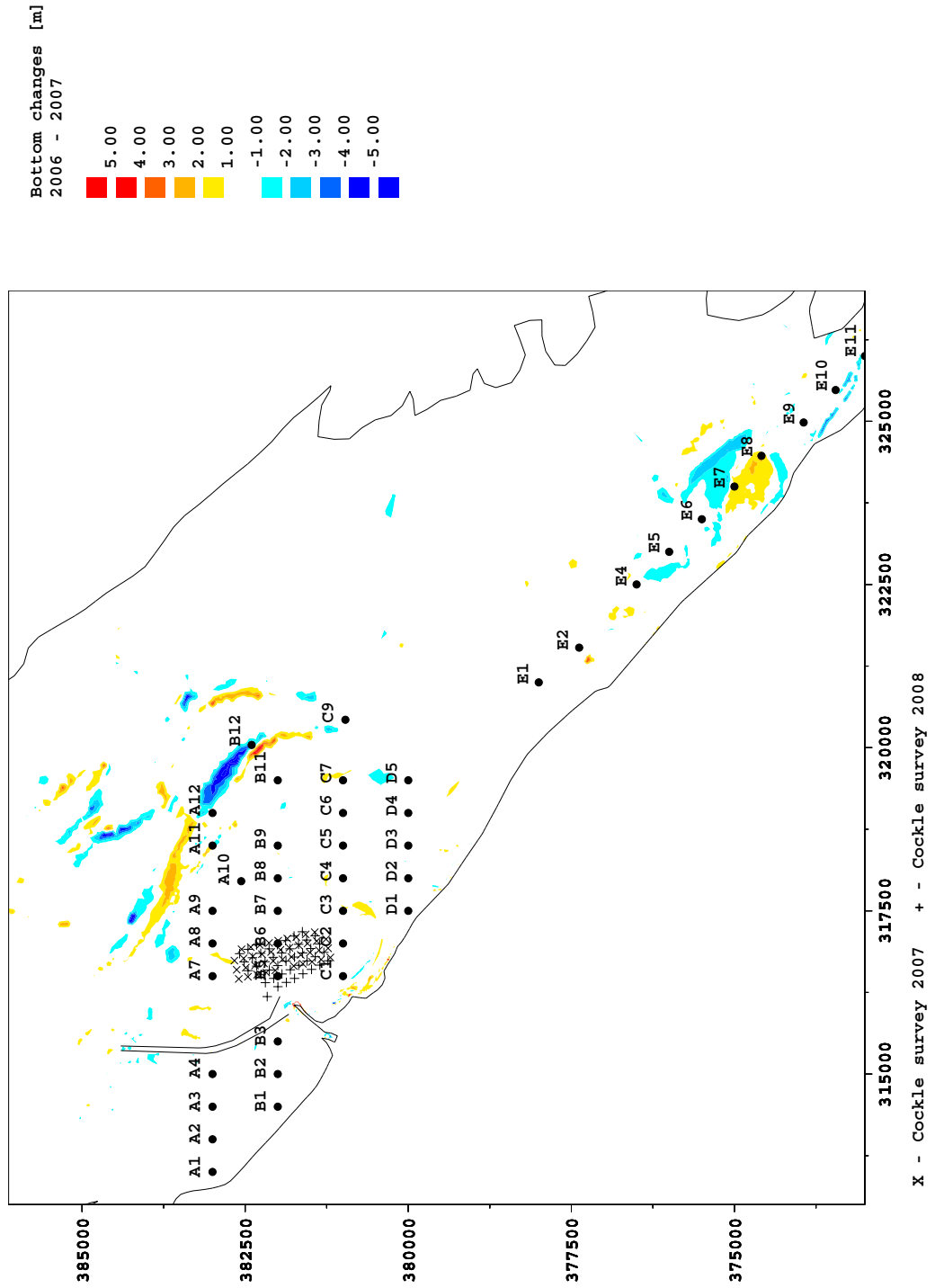


Figure 9: Change in bathymetry between 2006 and 2007, with location of benthic and cockle surveys – Dee Estuary

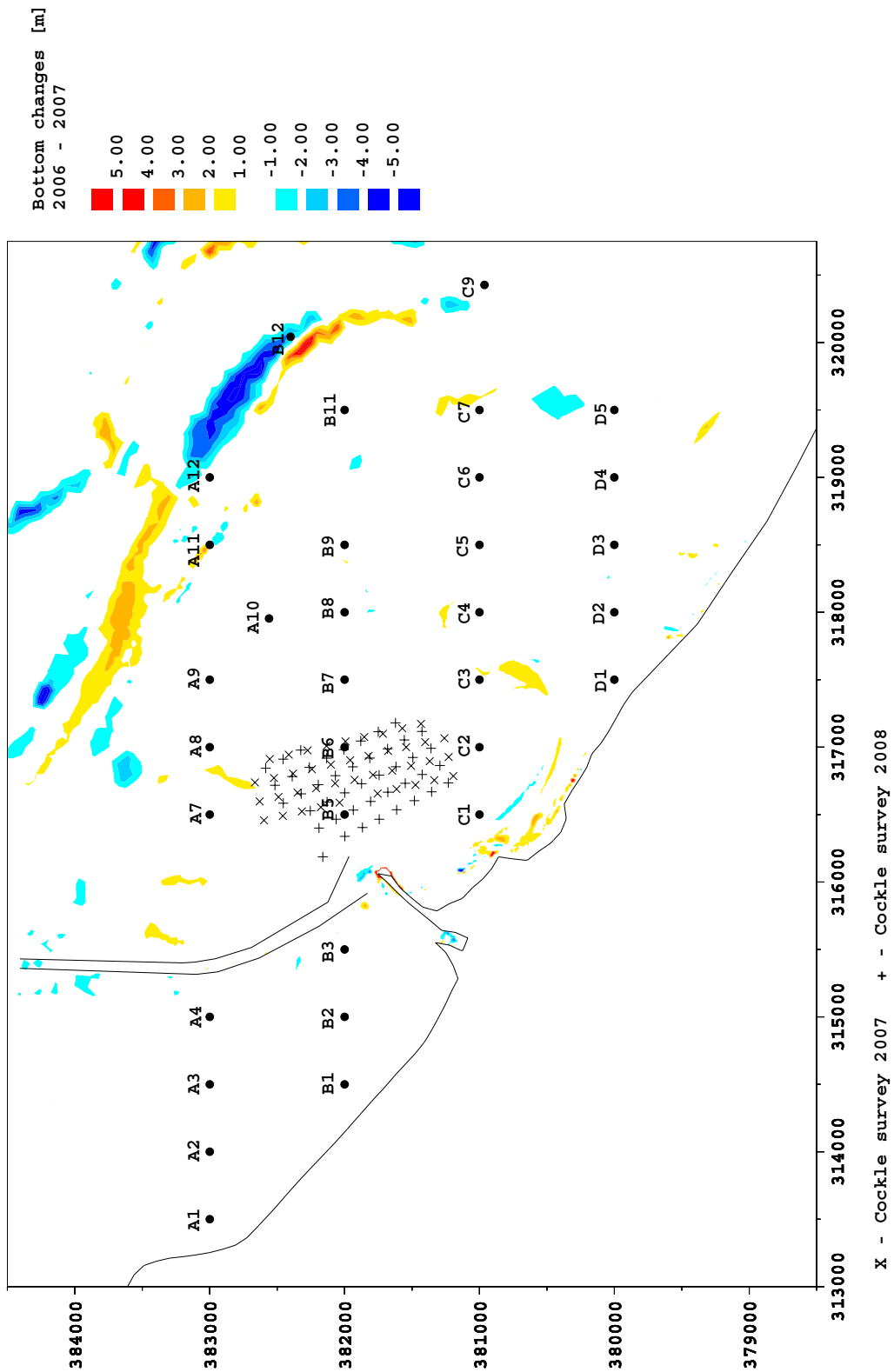


Figure 10: Change in bathymetry between 2006 and 2007, with location of benthic and cockle surveys – Port access channel

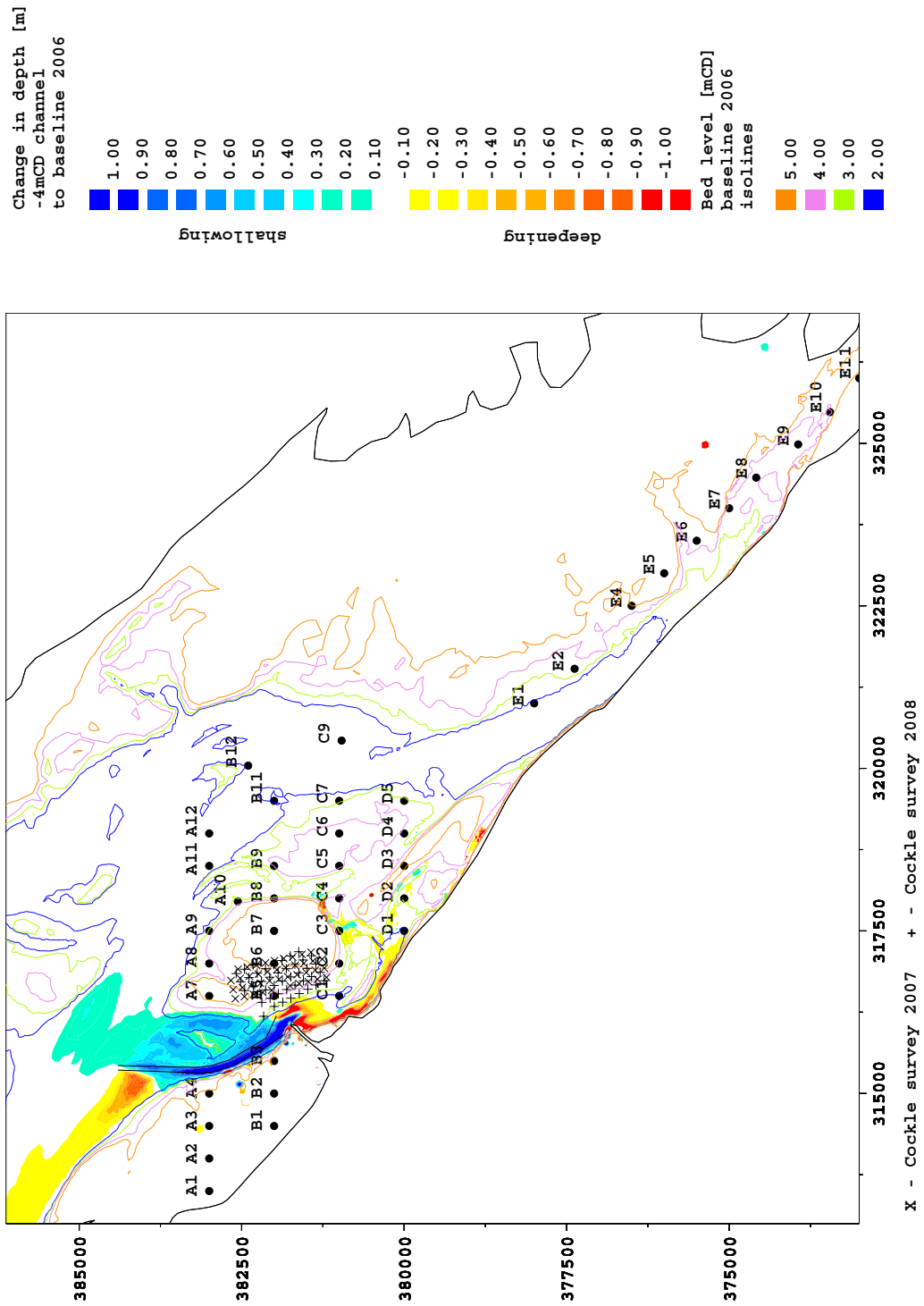


Figure 11: Estimate of the dredging-induced change in bed level due to -4mCD channel based on the change in sediment flux, with location of benthic and cockle surveys – Dee Estuary

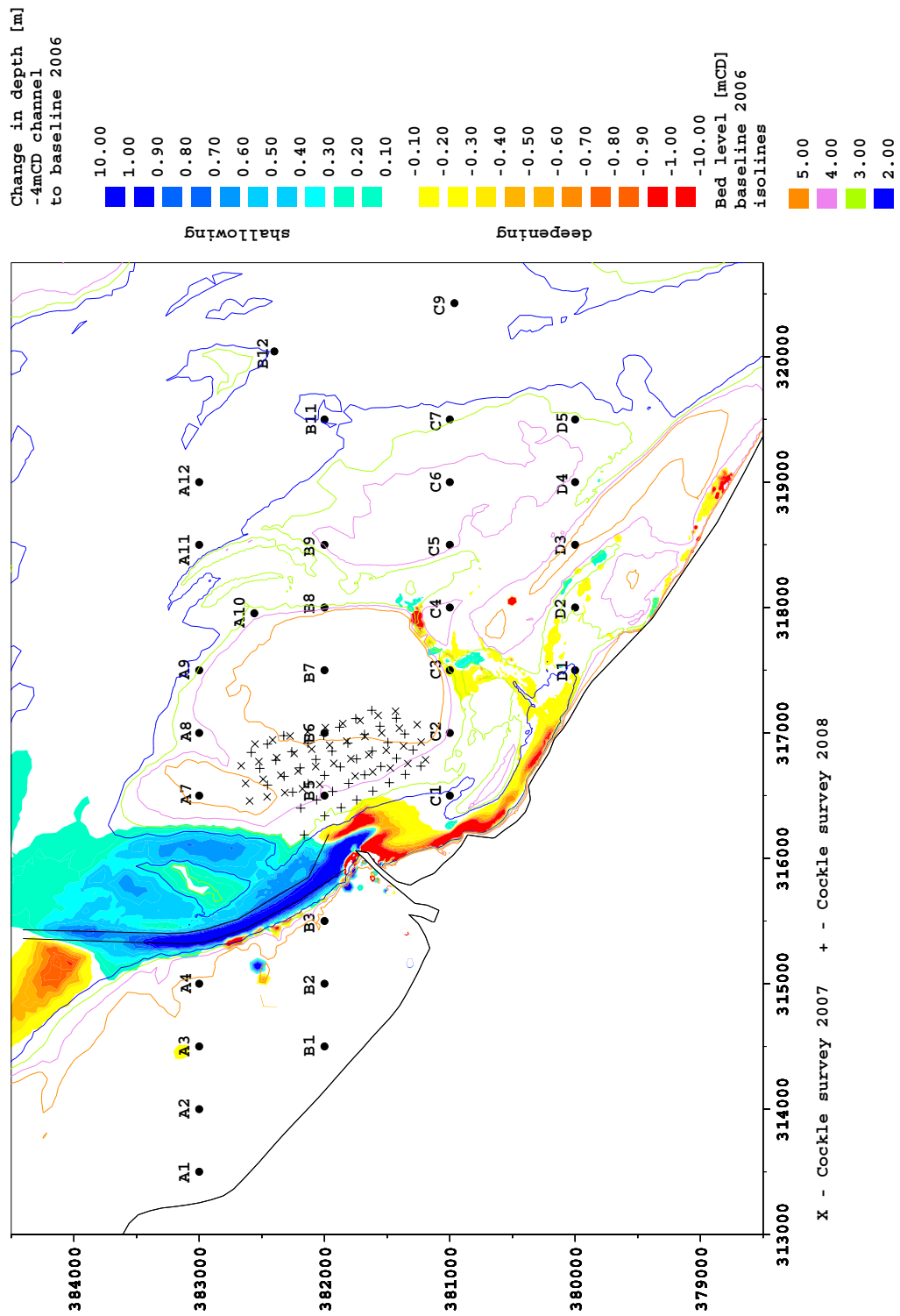


Figure 12: Estimate of the dredging-induced change in bed level due to -4mCD channel based on the change in sediment flux, with location of benthic and cockle surveys – Port access channel

APPENDIX 'A'

Monitoring Plan, August 2005 Consents

Appendix A – Monitoring

Monitoring of the following parameters will be undertaken according to the specification outlined in the attached monitoring plan. The rationale for these conditions, insofar as they meet the requirements of maintaining favourable conservation status for the interest features is described in appendix B.

CONDITION

1. Bathymetry of dredged channel (monitoring plan item 1)
2. Three cross estuary transects (monitoring plan item 2)
3. Topography of the banks and bathymetry of the channels within the vicinity of the Port (monitoring plan item 3).
4. Changes in tidal currents in the Salisbury cross bank channel. (monitoring plan item 4)
5. Distribution of invertebrate communities and changes in sediment type/particle size on the Salisbury and S.Salisbury banks (monitoring plan item 5).
6. Extent and biomass of cockle beds on Salisbury, S.Salisbury and Mostyn banks (monitoring plan item 6).
7. Changes in community composition and sediment accretion in saltmarsh habitat (monitoring plan item 7)
8. Actions within the monitoring plan may be extended as required at the discretion of the regulator.

MONITORING PLAN (including disposal)

Item	Action	Location	Frequency	By whom
1	Monitor bathymetry of dredged channel extending 250m either side of the centre line. Submit to EAW in digital format within one month of survey being undertaken.	Between buoys M3 (northing 384000) and M6 (northing 382000).	Monthly	PoM
2	Monitor bathymetry across the estuary at 3 locations.	As identified in plan A.	Minimum 10 times/annum, average of 12/annum over 2 years.	PoM
3	1) Contribute to the monitoring of the	Banks in the vicinity of	Annually, first flight	PoM and

	topography of sandbanks above mean low water level by LIDAR	the Port as identified in plan B	by March 2006	other beneficiaries within Tidal Dee Users Group.
	2) Undertake swathe bathymetry monitoring of estuary channels within defined area	All channels within plan B	Annually	PoM
	3) Monitor the bathymetry of the Salisbury cross bank channel and topography of adjacent banks for a distance of 200m either side of the centre line of the channel. (Significant channel movement will require this distance to be increased).	As identified in plan B	12 times/annum	PoM
4.	Monitor tidal currents pre and post dredging to seek to validate hydrodynamic model predictions.	Salisbury cross bank channel.	Once pre and post dredging, further monitoring dependent on preliminary results.	PoM
5.	Survey the distribution of invertebrate communities and map sediment characteristics (appendix C)	Intertidal areas as defined in CCW plan C.	Once initially as baseline and subsequently annually	PoM
6.	Survey extent, composition and biomass of cockle populations.	Mostyn, Salisbury and S. Salisbury banks	Annually (spring and subsequent to fishery opening) Baseline established April/July 2005.	EAW
7.	Survey composition of saltmarsh communities and elevation of substrate with reference to control site at Mostyn (appendix D).	Single site as identified in fig 103 Report EX5097, coordinates 325,000, 375,000	Annually	PoM
8.*	Undertake swathe bathymetry surveys vertical control by Kinematic GPS, any errors to be within +/- 10cm.	Mostyn Deep, coordinates defined in consent.	Pre dredging, two during dredging with up to further three depending on sediment dispersion	PoM
9.*	Particle size analysis coincident with swathe bathymetry.	As above	4-6 samples	PoM
10.	Reporting (appendix E)	N/A	See App 4 and consents.	PoM

* this relates to the FEPA licence and does not form part of this consent.

Appendix B

Listed are the relevant key interest features and their conservation objectives considered in the appropriate assessment. Appropriate monitoring requirements are listed (in parenthesis) against the favourable condition criteria.

1) SPA features and conservation objectives

The following SPA features need to be considered: Internationally important wintering populations of oystercatcher and knot.

The conservation objectives describe two supporting habitat attributes that should be monitored for impacts of dredging and disposal:

The feature will be considered in favourable condition when, subject to natural variation, the following conditions are met:

1. The extent of intertidal flats and spatial distribution of their constituent sediment community types is maintained. (Items 1,2,3,4,5)
2. The abundance and dispersal of prey species are maintained at levels sufficient to support the population size.(Item 6)

The above conditions also contribute to the conservation objective to maintain bird numbers. Bird numbers on the Dee Estuary are monitored annually by the Wetland Bird Survey (WeBS), but detailed bird monitoring in the vicinity of the channel is not required. Fine-scale bird distribution is subject to factors elsewhere in the estuary, as well as external factors. The SPA monitoring programme is therefore built around direct measurement of habitat extent and quality.

2) pSAC features

Interest feature 1: The conservation objective for the estuary

The conservation objective for the “estuaries” feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:

The “**estuaries**” feature will be considered to be in favourable condition when, subject to natural processes, each of the following conditions are met:

- i. the aggregate total extent of all estuarine communities within the site is maintained;(Items 5,6)
- ii. the spatial distribution of estuarine communities within the site is maintained;(Items 5,6)
- iii. the extent of individual estuarine habitat features within the site is maintained;(Items 2,3,5,6)

Interest feature 2: The conservation objective for mudflats and sandflats not covered by seawater at low tide

The conservation objective for the “mudflats and sandflats” feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:

The “**mudflats and sandflats**” feature will be considered to be in favourable condition when, subject to natural processes, each of the following conditions are met:

- i. the total extent of mudflat and sandflat communities within the site is maintained;(Items 3.1,4)
- ii. the proportions of individual mudflat and sandflat communities within the site are maintained;(Items 3.1,4, 5)
- iii. the topography of the intertidal flats and the dynamic processes of channel migration and sinuosity across the flats are maintained;(Items 1,2,3,4)
- iv. the abundance of typical species of the mudflat and sandflat feature within the site is maintained.(Items 5, 6)

Interest feature 3: The conservation objective for *Salicornia* and other annuals colonising mud and sand

The conservation objective for the “*Salicornia* and other annuals colonising mud and sand” feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:

The “***Salicornia* and other annuals colonising mud and sand**” feature will be considered to be in favourable condition when each of the following conditions (i) to (v) are met:

- i. the total extent of pioneer saltmarsh vegetation communities within the site is maintained;(Item 7)
- ii. the presence of pioneer saltmarsh vegetation communities as part of transitions from intertidal sediment communities to higher saltmarsh are maintained;(Item 7)
- iii. the abundance of the typical species of the pioneer saltmarsh vegetation communities is maintained;(Item 7)
- iv. the abundance of the notable species of the pioneer saltmarsh vegetation communities is maintained.(Item 7)
- v. the overall extent and abundance of common cord grass *Spartina anglica* is not increasing within the pioneer saltmarsh zone (Item 7)

Interest feature 4: The conservation objective for Atlantic salt meadow

The conservation objective for the “Atlantic salt meadow” feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:

The “**Atlantic salt meadow**” feature will be considered to be in favourable condition when, subject to natural processes, each of the following conditions are met:

- i. the total extent of Atlantic salt meadow vegetation communities within the site is maintained; **(Item 7)**
- ii. the proportions of individual Atlantic salt meadow vegetation communities within the site are maintained; **(Item 7)**
- iii. the zonation of Atlantic salt meadow vegetation communities and their transitions to fresh water and terrestrial vegetation are maintained;**(Item 7)**
- vi. the relative abundance of the typical species of the Atlantic salt meadow vegetation communities is maintained;**(Item 7)**
- vii. the abundance of the notable species of the Atlantic salt meadow vegetation communities is maintained. **(Item 7)**

Appendix C

Port of Mostyn monitoring for intertidal pSAC features in the Dee estuary.

pSAC features and conservation objectives:

In looking for impacts (on the marine biological communities) of the dredging and disposal of sediment from the dredge channel at Mostyn the following features and conservation objectives need to be considered:

- 1) Estuary Feature, CO's: (ii) spatial distribution of estuarine communities, and (vi) the extent of notable hard substrata communities.
- 2) Mudflats and Sandflats feature, CO's: (ii) the proportions of mud and sandflat communities, and (iv) the abundance of typical species.

The FCS tables in the Draft Dee pSAC package indicate that no change from an established baseline is the desired target for the above conservation objectives. For most of them however the baseline has not yet been established. For the sample sites proposed below the CCW intertidal Phase 1 Survey will act as a baseline for CO's 1(ii), 1(vi), and 2(ii), and a partial baseline for 2(iv).

SPA features, conservation objectives and baselines:

Oystercatcher and knot COs: intertidal extent and spatial distribution of sediment types; abundance and dispersal of prey species.

The Phase 1 intertidal survey provides a baseline for intertidal habitat extent, sediment types and abundance and distribution of intertidal species. EAW's cockle stock assessments and CCW's 2003 and 2004 cockle surveys provide a baseline for cockle surveys (which will be undertaken by EAW).

Monitoring strategy

Five transects and one survey station are proposed (see attached plan C);

Direct effects of the dredging

- 1) to monitor for loss of or changes to intertidal communities due (transects A and B).

Indirect effects of the dredging

- 2) to monitor the effects of the possible draw down on the intertidal communities (transects C and D)

- 3) to monitor changes in erosion/accretion of substrata in the vicinity of the Holocene clay (station F). A survey station positioned on the Holocene clay bank to monitor the erosion/burial of this bank and the presence of any piddocks. This will carry on from previous work that saw the burying of posts at regular intervals to a set depth on the bank and monitoring of the changing position and height of the bank.

Effects of the disposal of material in Mostyn Deep

- 4) to monitor changes in intertidal communities due to changes in height of the substratum or changes in the substratum (transect E). The positioning of transect E assumes that the modelling of the fate of the spoil is correct and that if the dredge spoil is disposed of in the southern half of the disposal box in Mostyn Deep the most likely area of impact will be the southern shore of the upper estuary.

Sampling strategy:

The transects will coincide with the bird food/cockle transects previously sampled on the Dee estuary or within a 5metre radius of the point and it is envisaged that any field work would be done in conjunction with the bird food/cockle surveys in August/September each year. A spring tide will be required to reach all of the sampling locations.

Sample stations to be 500 metres apart on transects A – D, and approximately 700 m apart on transect E due to its oblique nature (the sample points would still coincide with bird food/cockle survey transects). Should the sampling location be within a channel or on a feature that is significantly different from the sediment in a 5m radius (such as a swathe of washed in weed or a small temporal muddy hollow, etc), then the next nearest point that reflects the character of the sediment in the immediate vicinity should be sampled and a note made of the position using a GPS.

At each station, a surface description of the sediment is made, 8 cores are collected and pooled (standard MNCR methodology, Hiscock 1996) and one small core of material collected for Particle Size Analysis (PSA). Samples should be processed according to 'Procedural guideline 3-6' in Davies *et al*, 2001. Cockles should be sorted using a 20mm sieve (to retain cockles > 20mm). Numbers and density (cockles / m²) of cockles < 20mm and >= 20mm should be recorded.

Transect A = 9 sampling stations

Transect B = 10 sampling stations

Transect C = 8 sampling stations

Transect D = 5 sampling stations

Transect E = 11 sampling stations

Total No of samples = 43

Total number of PSA cores = 43

Survey at the Holocene clay bank would consist of a yearly return to the site on the outer Salisbury bank (see attached plan). The position of the bank in relation to the wooden stakes placed by CCW in March 2003 would be pinpointed using a GPS and the presence of any live piddocks noted. Details of former work completed are available from CCW.

Sampling timetable:

Sampling would be undertaken at the outset of dredging activity to provide an initial baseline of intertidal communities and subsequently once a year to coincide with the cockle/birdfood survey in August/September whilst dredging/disposal is taking place and for two years after dredging/disposal has ceased.

Appendix D- Saltmarsh monitoring

Measure accretion / erosion rates at test and control sites using the methodology of Gerardo et al 2003 (or other agreed methodology), number of samples to be agreed with regulators. Vegetation to be monitored along a 100m length of saltmarsh for a width of approximately 50m within both the potential impact zone and within a control area (possibly Mostyn Bank). These survey blocks will include the boundaries between Atlantic salt meadow, the Salicornia pioneer zone and the open mudflats, with a sampling regime to include no fewer than 100 quadrats per block.

Measurements will require a highly accurate GPS and an accurate measure of ground cover within the different vegetation types using a point quadrat within certain marked areas.

Reference.

Gerardo M.E. Perillo, Eder Paulo Dos Santos & M. Cintia Piccolo. 2003. An inexpensive instrument for sediment erosion-accumulation rate measurement in intertidal environments. *Wetlands Ecology and Management*, 11: 195-198.

Appendix E- Reporting

1. The licence holder must submit reports of the disposal operation to the licensing authority at 4 weekly intervals from the date of the first deposit during the disposal campaign and within 4 weeks of the last survey. Each report should include a description of the dredging activity, the positional log of the dredging vessel, date and time of each release, tidal state and weather conditions. GIS plots showing the swathe bathymetry, overlaid with the disposal grid and the release points should also be included in the report so that transport from the disposal site can be monitored. The LiDAR surveys of the estuary to review large-scale morphological change required for the dredging activity are also relevant to the assessment of the disposal operations and should be included with other bathymetry and biological data in an annual report to be discussed with regulators in mid 2006.
2. Surveys of all monitoring specific to the cross bank channel to be submitted digitally, changes analysed (erosion/deposition plots in plan and cross section) and reported to the Agency within 6 months of dredging.
3. Analysis of LiDAR and other bathymetric data to include erosion/deposition plots, annual change in position of Salisbury cross bank channel and conformity of estuarine behaviour to process hypothesis (SMP 2005).
4. Reporting of the intertidal community monitoring should include an analysis of the data and interpretation to:
 - Identify the intertidal biotope (biological community)
 - Identify changes in intertidal community for each sample using appropriate analytical techniques (e.g. DECORANA, MDS)
 - Draw any conclusions about broad scale changes using the data collected.
 - The Agency will expect the report to be with them within 3 months of the survey work, in order to allow review by CCW with respect to achieving the conditions of the Consent.
5. Analysis of changes in intertidal sediments, biotopes and cockle densities should be reported annually.

9. Supplementary Conditions

- 9.1 The Licence Holder must ensure that no disposal operations are undertaken between high water and 4 hours post high water on tides of amplitude greater than 4 metres above Ordnance Datum (AOD). Disposal operations may take place throughout the tidal cycle for tides of an amplitude of 4 metres AOD or less.
- 9.2 The Licence Holder is not permitted to deposit any maintenance dredging within the limits specified at paragraph 1.4 - 1.6.4 of this licence, if the dredging of those substances would cause the depth of the area being dredged to exceed that permitted by any other statutory consent in force during the period of this licence.
- 9.3 The Licence Holder must ensure that the quantity of material deposited does not exceed 24,000 tonnes (12,000m³) in any 24-hour period.
- 9.4 The Licence Holder must ensure that material is only deposited within the area of the Mostyn Deep (Maintenance) disposal site as defined by reference to the HR Wallingford Report EX5097 being an oblong joining points 1, 15, 31 and 45 at the following co-ordinates:

53 degrees 21.65N	03 degrees 18.21W
53 degrees 20.94N	03 degrees 13.35W
53 degrees 21.05N	03 degrees 16.18W
53 degrees 21.77N	03 degrees 18.08W

The disposal site, as described above, must be divided into 25 metre by 75 metre cells. The placement of material within these cells must follow a randomised sequence, excluding the perimeter cells designed to provide a safety margin. Each cell must initially only receive one 400 cubic metre load of dredged material; thereafter the sequence may then be repeated on a rolling basis.

The disposal grid is necessary to ensure that material is spread throughout the dispersive area of the Mostyn Deep (Maintenance) disposal site so as to optimise sediment remobilisation.

- 9.5 The Licence Holder must ensure that the co-ordinates of each deposit are recorded from the dredging vessels positioning system and are forwarded to the MCEU acting on behalf of the Licensing Authority on completion of the dredging campaign.
- 9.6 The Licence Holder must undertake a programme of monitoring to assess the effects of the disposal operations permitted by this licence as described at 9.7 - 9.9 below. These measures shall comprise part of the overall monitoring programme to be undertaken by the Port of Mostyn Ltd to assess the effects of the dredging operation as a whole referred to in the letter addressed to the Port from Glyn Perryman, Welsh Assembly Government, dated 16 August 2005 (a copy of the overall monitoring programme is at Annex A).
- 9.7 The Licence Holder must ensure that Swathe bathymetry of the dredge and disposal areas is undertaken to the following specifications:

- 100% coverage sweeps prior to any disposal operation commencing;
- 100% coverage sweeps 2 weeks after commencement of dredging;
- 100% coverage sweeps 6 weeks after commencement of dredging.

The results of these surveys to be sent to the MCEU no later than 12 weeks after the start of works authorised by this Licence.

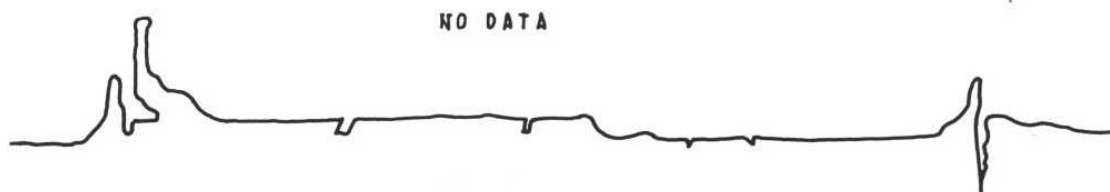
Dependent on the output of these surveys the Licence Holder may be required to carry out a further 2 - 3 survey in the 12 months following completion of the initial disposal campaign. The Licence Holder must ensure vertical control using either data from a deployed tide gauge or by the use of a Kinematics GPS and that all the equipment is fully calibrated with errors not expected to exceed ± 10

centimetres.

- 9.8 The Licence Holder must ensure that 4 -6 surface sediment samples are taken within the disposal site to monitor changes in seabed composition during the disposal operation. Samples should be collected to coincide with the swathe bathymetry surveys described in 9.7, i.e. pre-disposal, 2 - weeks after commencement of dredging and 6 weeks of commencement of the dredging. The position of each sample should coincide with the disposal positions and should be recorded. Samples should be taken from the same positions in each of the required surveys. Dependent on the output of these surveys, the Licence Holder may be required to carry out a further 2 or 3 survey in the 12 months following completion of the initial disposal campaign.
- 9.9 The Licence Holder must submit reports of the disposal operation to MCEU acting on behalf of the Licensing Authority at 4 weekly intervals from the date of the first deposit under this Licence, continuing throughout the disposal campaign and within 4 weeks of the last bathymetric survey. Each report should include a description of the dredging and disposal activity, the positional log of the dredging vessel, date, time and position of each release of dredged material, tidal state and weather conditions. GIS plots showing the most recent swathe bathymetry, overlaid with the disposal grid and the release points should also be included in the report so that transport from the disposal site can be monitored. The LIDAR surveys of the estuary to review large-scale morphological change required for the dredging activity are also relevant to the assessment of the disposal operations and should be included in the reports when available.
- 9.10 The Licence Holder should make use of ploughing / water injection dredging techniques wherever practicable to minimise the quantity of material requiring sea disposal.
- 9.11 The Licence Holder should continue desk-based investigations (including the use of numerical models) into alternative disposal operations that fulfil the conservation objective of retaining sediment in the estuary.
- 9.12 The Licence Holder must ensure that all reasonable precautions should be taken to prevent the disposal of man-made debris to sea.
- 9.13 In addition to the initial licence charge paid with the application (or application for renewal) relating to this licence, the Licence Holder shall pay further annual instalments of the licence charge in respect of the second period of twelve months of the licence (equivalent to the renewal charge in force from time to time at each due date). Payment of each annual instalment shall be due and be made to the Licensing Authority 28 days prior to the anniversary of the original start date of this licence (16 August 2004).
- 9.14 The licence shall be deemed to become invalid and shall be liable to be revoked in the event that the Licence Holder fails to make full payment of each annual instalment of the licence charge within a period of 28 days following the respective due date for payment.

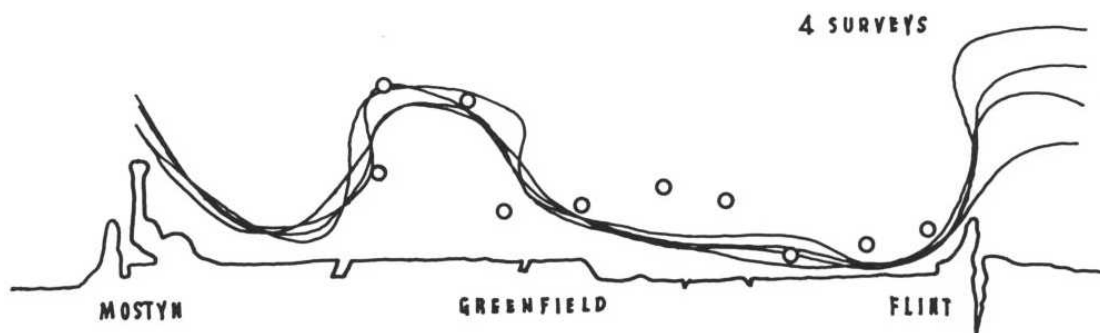
APPENDIX 'B'

Pilot Charts – 1984 to 1989



JANUARY - JUNE

FIRST SURVEY 17/10/84.



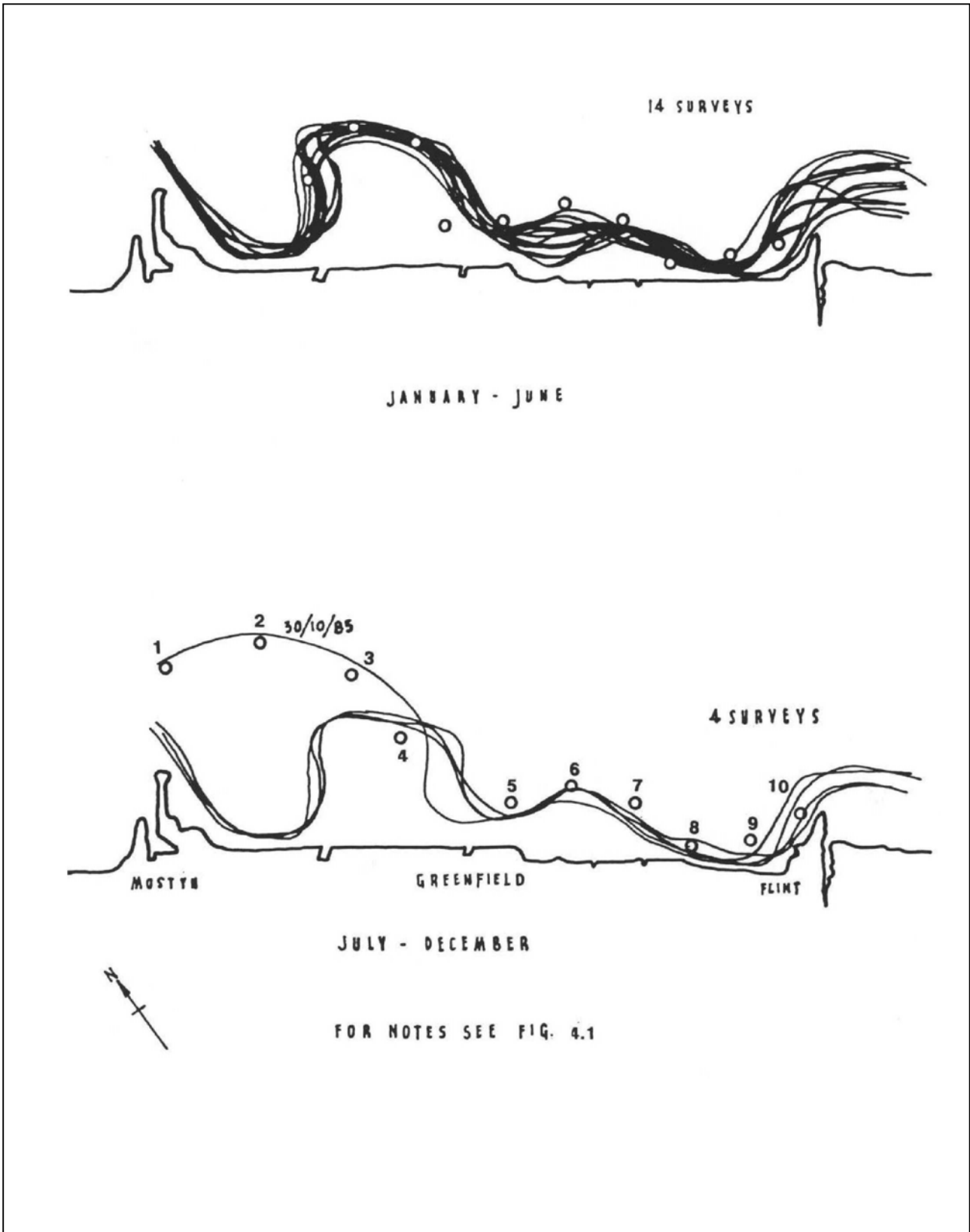
JULY - DECEMBER



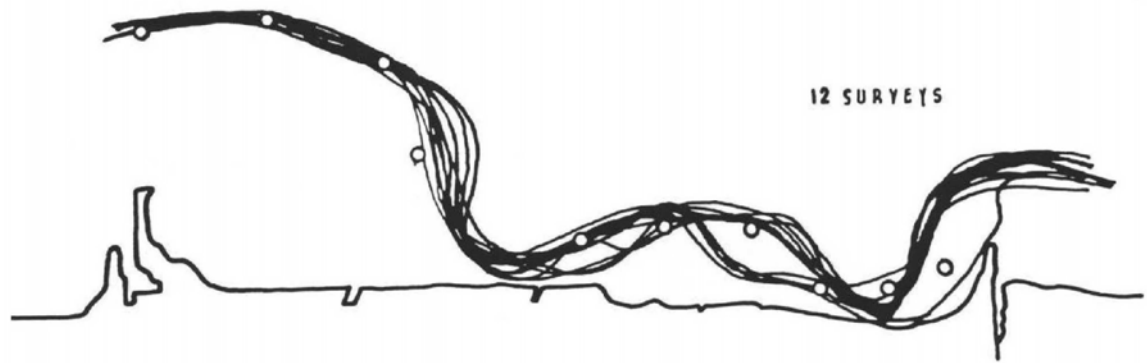
NOTES

1. LINES INDICATE $\frac{1}{2}$ OF NAVIGATION CHANNEL FROM VISUAL SURVEY BY DEE PILOTAGE.
2. PLOTS ARE INDICATIVE ONLY AND NOT TO SCALE
3. CIRCLES INDICATE POSITIONS OF TRINITY HOUSE BOOYS AT END OF SURVEY PERIOD.

PILOT CHART, Flint to Mostyn 1984

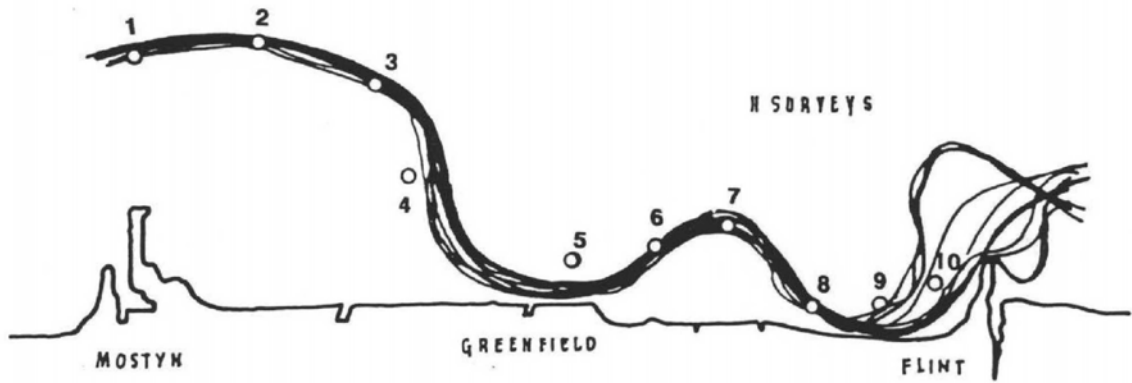


PILOT CHART, Flint to Mostyn 1985



12 SURVEYS

JANUARY - JUNE



8 SURVEYS

MOSTYK

GREENFIELD

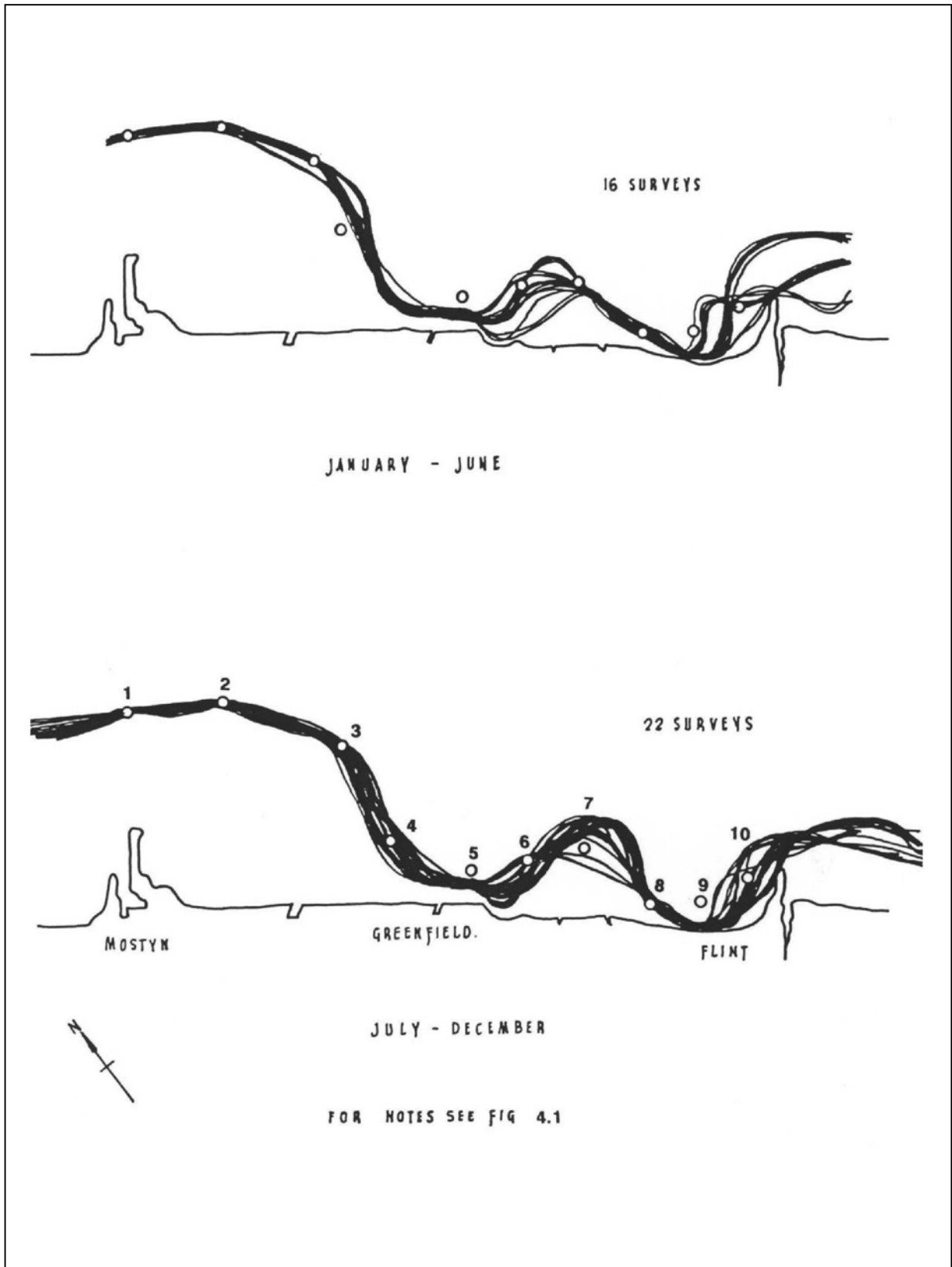
FLINT

JULY - DECEMBER

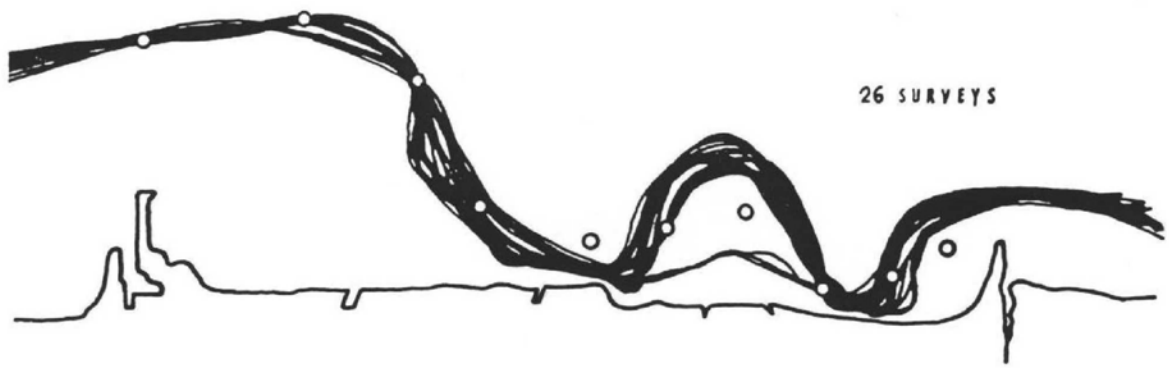


FOR NOTES SEE FIG. 4.1

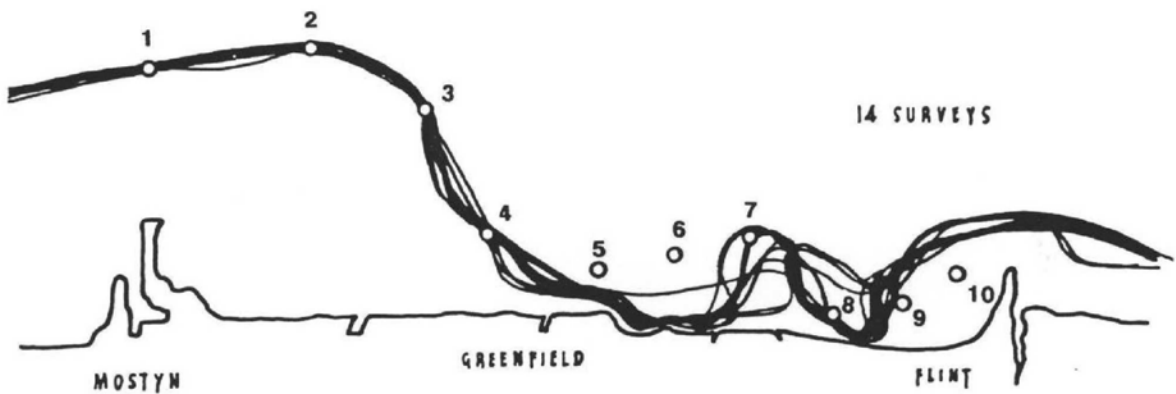
PILOT CHART, Flint to Mostyn 1986



PILOT CHART, Flint to Mostyn 1987



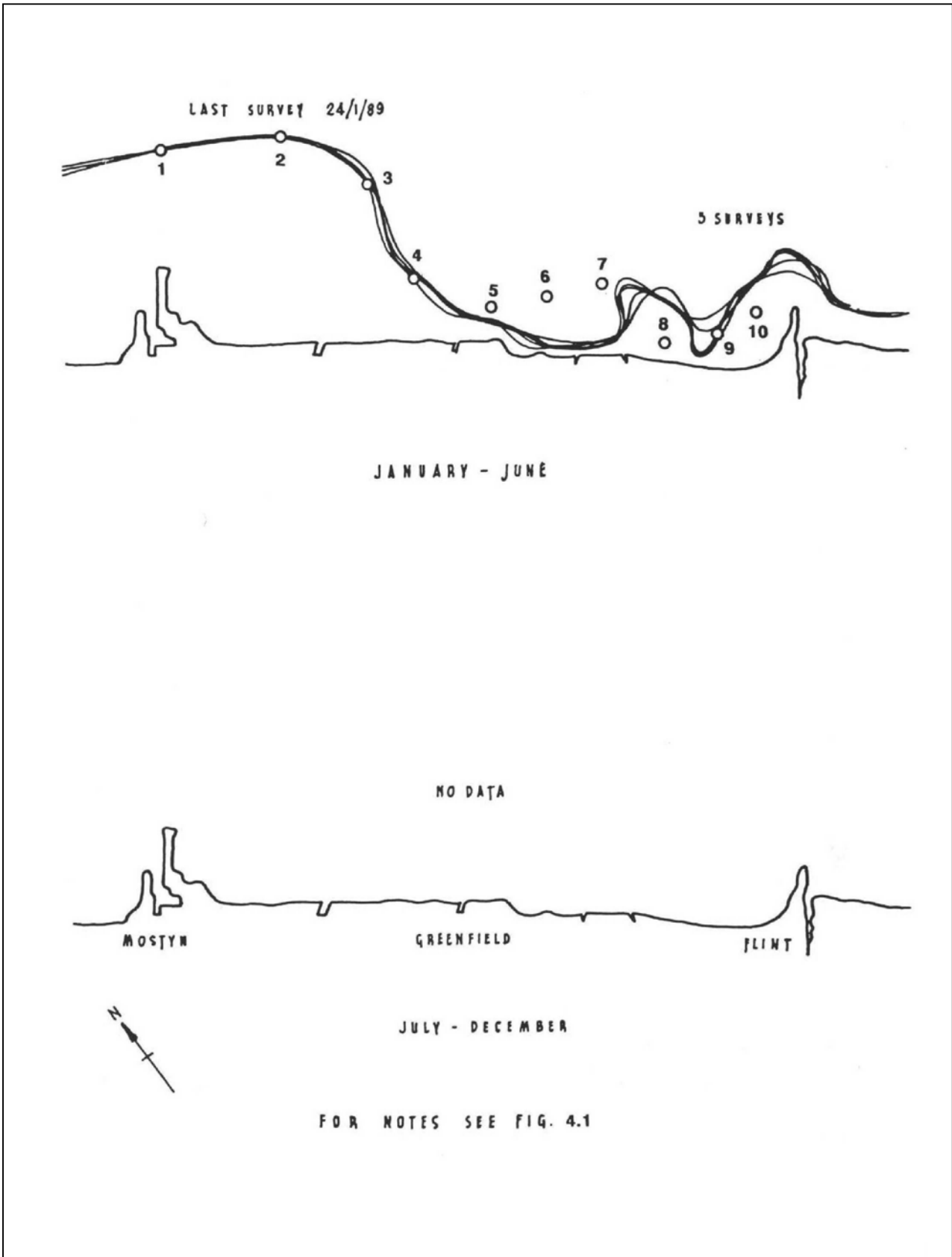
JANUARY - JUNE



JULY - DECEMBER

FOR NOTES SEE FIG 4.1

PILOT CHART, Flint to Mostyn 1988



PILOT CHART, Flint to Mostyn 1989

APPENDIX 'C'

Inner Channel Sections Survey

Frequency Assessment

APPENDIX 'D'

EIS Annex A3 Extract

APPENDIX 'E'
Specimen Progress Report

MONITORING BI-MONTHLY PROGRESS REPORT - Specimen for May (part completed)

Port of Mostyn				PROGRESS REPORTING			
Project				Period	From		To
To		From		Date		Report No.	Pg.

1) TRAFFIC LIGHT - MOVING SUMMARY

Monitoring Task	Two-Monthly						Threshold Exceedance Report
	-5	-4	-3	-2	-1	Current	
EB2	●	●	●	●	●	●	
LA1	●	●	●	●	●	●	

Monitoring Task	Bi-annual			Threshold Exceedance Report
	-2	-1	Current for this report	
EB3	●	●	N/A	
EB5	●	●	●	Enclosure 'A'

Monitoring Task	Annual		Threshold Exceedance Report
	Previous	Current for this report	
EB1	●	N/A	
EB4	●	N/A	
LA3	●	N/A	
LA4	●	N/A	
LA5	●	N/A	

Task LA2 (pre-post dredge deposition area monitoring) not included in this Table.

MONITORING BI-MONTHLY PROGRESS REPORT - Specimen for May (part completed)

Port of Mostyn				PROGRESS REPORTING			
Project				Period	From		To
To		From		Date		Report No.	Pg.

2) TIMETABLE CONCORDANCE													
	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Task													
EB1					■	■							
EB2		▲		▲		▲		▲		▲		▲	
EB3					■	■					■	■	
EB4											■	■	
EB5					■						■		
LA1			□		□		□		□		□		□
LA2		←----- (As appropriate) -----→											
LA3											■	■	
LA4						←----- (EAW to provide) -----→							
LA5											■	■	
Progress Reports			○		○		○		○		○		○
Annual Report												●	

MONITORING BI-MONTHLY PROGRESS REPORT - Specimen for May (part completed)

Port of Mostyn				PROGRESS REPORTING			
Project				Period	From		To
To		From		Date		Report No.	Pg.

3) MONITORING PLAN REQUIREMENTS				
Task Ref	Description	Reported Here (Y/N)	Status: (Red/ Amber/Green)	Threshold Exceedance Report
EB1	Estuary Seabed Level Survey	Y	Unknown, results awaited	N/A
EB2	Estuary Transects	Y	Green	N/A
EB3	Mid Hoyle/ Welsh Confluence	Y	Unknown, results awaited	N/A
EB4	Mostyn Deep	N		
EB5	Holocene Clay Bank	Y	Amber	Enclosure 'A'
LA1	Dredged Channel Survey	Y	Green	N/A
LA2	Mostyn Deep Site 'A'	Y	(Post-dredge campaign 'G') Green	N/A
LA3	Mostyn Deep Seabed Samples	N		
LA4	Cockle Survey	N	(EAW results awaited)	
LA5	Benthic Survey	N		



MONITORING BI-MONTHLY PROGRESS REPORT - Specimen for May (part completed)

Port of Mostyn				PROGRESS REPORTING			
Project				Period	From		To
To		From		Date		Report No.	Pg.

4) PROGRESS NARRATIVE		
Task Ref	Narrative	Annex
EB1	Fieldwork for LiDAR completed on and swathe bathymetry on Data processing ongoing - results awaited.	
EB2	Survey carried out on and results completed with commentary on changes.	I
EB3	Survey carried out on Data processing ongoing - results awaited.	
EB5	Survey carried out on Results-condition amber refer to Enclosure 'A'. Basic survey results/report presented in annex.	II
LA1	Dredged channel survey completed on Results present in annex.	III
LA2	Post-dredge campaign 'G' survey. Results presented in annex.	IV



MONITORING BI-MONTHLY PROGRESS REPORT - Specimen for May (part completed)

Port of Mostyn				PROGRESS REPORTING				
Project				Period	From		To	
To		From		Date		Report No.		Pg.

5) MONITORING OVERVIEW

Reconciliation of results in this report with 'early-warning' parameters and estuary basis summary as set out in SMP 'Mostyn Channel Monitoring Protocols' (2008).



MONITORING BI-MONTHLY PROGRESS REPORT - Specimen for May (part completed)

Port of Mostyn				PROGRESS REPORTING				
Project				Period	From		To	
To		From		Date		Report No.		Pg.

6) ACTIONS		
Task Ref	Action Description	To be initiated by