

East Channel association

EASTERN ENGLISH CHANNEL MONITORING REPORT 2008

Section 1. Seabed Sediment Characteristics

Volume I (Report)

East Channel Association

Report No. 09/J/1/03/1333/0871

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The East Channel Association (ECA) consists of companies developing marine aggregate extraction applications in the Eastern English Channel. This Regional Environmental Monitoring Report has been produced to fulfil the ECA's commitment to undertake regional environmental monitoring as outlined in the ECA Regional Monitoring Blueprint v0.3 (ECA & Emu, 2005).

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*Observational data to be completed – Charts will be provided in a subsequent revision of this report.

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- Appendix A Positions Sampled
- Appendix B Grab Survey and 2m Beam Trawling Operations Log
- Appendix C Grab Log and Inventory
- Appendix D Stills Images of Grab Samples Prior to Processing (CD)
- Appendix E Particle Size Analysis (CD)
- *Appendix F Static Image Physical Observations
- Appendix G Particle Size Analysis Summary

*Observational data to be completed – Appendix will be provided in a subsequent revision of this report.

1.0 INTRODUCTION

1.1 Study Background

The six companies of the East Channel Association (ECA) have all made applications or have been awarded licenses to extract marine aggregates (sand and gravel) from a region of the UK continental shelf known as the East Channel Region (ECR) (Chart 1.1).

During the application process for marine aggregate extraction and subsequent Regional Environmental Assessment (REA) the companies made a commitment to undertake assessment and monitoring of their activities using both licence specific and coordinated regional methods. As part of this approach the REA provided an assessment of the environmental conditions and sensitivities of the region and the likely cumulative and in-combination effects of extraction activities.

The recommendations of the REA included a requirement for the companies of the ECA to collaborate in undertaking a programme of regional monitoring. This monitoring programme was developed in consultation with the relevant regulatory bodies and technical specialists in order to provide data capable of identifying the impacts of extraction activities in the ECR.

The scope of monitoring was developed following extensive discussions with government scientific advisors and was progressively revised during development. The initial monitoring scope was presented in the ECA Regional Monitoring Blueprint v0.3 (ECA and Emu Ltd., 2005). The scope of analysis and reporting has been under continual review since the issue of the Blueprint v0.3 as issues have arisen during the monitoring activities.

1.2 Report Objectives

This report has been produced on behalf of the ECA by Emu Limited to describe the monitoring activities with respect to the sediment characteristics of the region for the year 2008. The report includes a description of the field methods used and the samples taken during the field work.

1.3 Survey Array for 2008

The 2008 survey array consisted of a total of 326 sites which included 32 replicate sites. At each of the selected sites, grab samples were attempted for the collection of both macrofauna and particle size analysis. At each site a drop down camera system was employed to collect both video footage and stills of the seabed.

1.4 Reporting of Biological Monitoring

This report is one of eight documents covering the biological monitoring undertaken within 2008. The ECR biological monitoring report schedule is listed in Table 1.1.

Report Title	Report Number
1. Seabed Sediment Characteristics	09/J1031333/0871
2. Benthic Communities and Habitats from Grabbing Surveys	09/J1031333/0872
3. Regional Habitats and Biotopes Based on Static Image Analysis	09/J1031333/0873
4. Regional Epifaunal Communities Derived from 2m Beam Trawls	09/J1031333/0874
5. Regional Fish and Associated Epifaunal Communities Derived from 4m Beam Trawls	09/J1031333/0875
6. Regional Shellfish Populations derived from Scallop Dredge Surveys and Beam Trawl Surveys	09/J1031333/0876
7. Example Habitat and Biotope Monitoring site Employing Hydrographic and Video Monitoring Methods	09/J1031333/0877
8. Comparative Analysis Including Theoretical Frameworks	09/J1031333/0878

Table 1. 1 ECR Biological Monitoring Report Schedule

2.0 METHODS

Seabed sediment samples were collected with the use of a 0.1m² Mini Hamon grab. The sampling operations were planned to target sites that would be both directly (Primary Impact Zones or PIZ) and indirectly (Secondary Impact Zones or SIZ) influenced by extraction operations. Within the PIZ active dredge zones (ADZ) were also targeted. In addition, reference areas and context sites were sampled to provide comparative sites that would allow natural variations in sediment character, similar to those in the PIZ and SIZ areas, to be investigated.

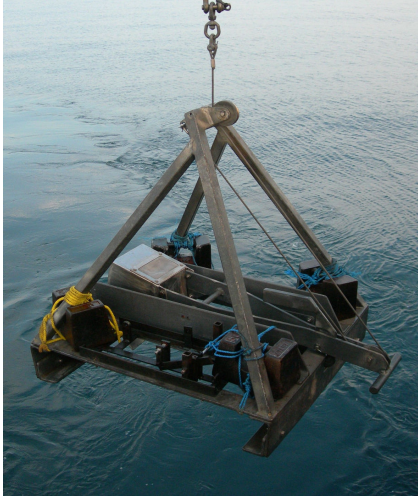
2.1 Field Methods and Operations Summary

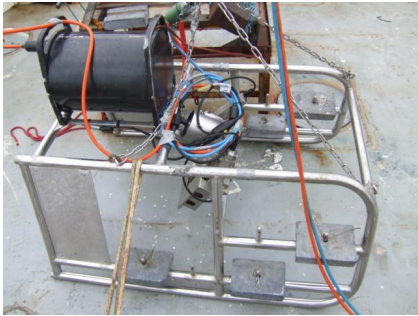
This section includes a summary of the survey operations and field methods employed during the grabbing survey carried out between August and December 2008 to achieve selected objectives of the ECA Regional Monitoring Blueprint v0.3: Section 4 (ECA and Emu Ltd., 2005).


Details of vessels, equipment and navigation are detailed in Table 1.2. Detailed descriptions of the methods employed in the field are documented in full within Sections 3 and 4, and Annex 3 of the ECA Regional Monitoring Blueprint v0.3 (ECA and Emu Ltd., 2005). Key points from these are summarised in sections 2.1.1 to 2.1.3, together with details of any deviations from those proposed within the Blueprint v0.3.

Vessel, Equipment and Navigation Information	
Vessel	FPV Clupea RV Discovery FPV Morven
Survey Dates	28 Days between 6/8/2008 to 16/12/2008 (Appendix A&B For full details)
Navigation Equipment	Liton LMX420 dGPS Lieca MX421B dGPS CSI Vector dGPS Mini-FOG Subsea Gyrocompass (Plate 2)
Sampling Equipment	Mini Hamon Grab (0.1m ²) with additional 100kg of ballast (Plate 1)
Digital Video and Stills Imaging	Chalco 12:1 digital zoom hyperdigital video camera. Konica Minolta Dimage X1 8MP Stills Camera. 3x LED units (90° beam, 120W). Camera umbilical (200m x 11mm diam). Sled-design frame with oblique-view video and stills mounting plate, additional 100kg of ballast. (Plate 2). Topside control unit (LCD monitor, Panasonic 400GB HDD (Plate 3). Sony GV-D1000E PAL MiniDV recorder.
Navigation Software	HYDROpro Navigation V2.30 Datum ETRS89 Spheroid WGS 1984 Projection UTM Zone 31
Position Accuracy	Samples within 10m radius of target position.

Table 1.2 Vessel, Equipment and Navigation Information

	<p>Plate 1</p> <p>Mini Hamon Grab (0.1m²) with additional 100kg of ballast</p>
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	<p>Plate 2</p> <p>Steel camera frame with oblique facing video and stills camera. Sub-sea gyrocompass mounted to rear. Additional 100kg of lead ballast.</p>
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	<p>Plate 3</p> <p>Topside control unit (LCD monitor, Panasonic 400GB HDD)</p>
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2.1.1 Field Methods

A combined grab sampling and drop down video survey at 326 predetermined locations was completed within the Eastern English Channel in and around the prospecting and permission areas (Chart 1.1). Details of sample positions are included in Appendix A. Daily logs of events were recorded and are detailed in Appendix B. Full details of methods can be found in the ECA Regional Monitoring Blueprint v0.3: Section 4 (ECA and Emu Ltd., 2005).

2.1.2 Drop Down Video

To avoid damaging environmentally sensitive habitats prior to sampling, video images of the seabed were reviewed on site. The video system was deployed either via the stern 'A' frame on the vessels *RV Discovery*, and *FPV Clupea*, or from the stern HiAb on the *FPV Morven*. Position of the video system was recorded via the HYDROpro software package and displayed on the video image. Digital still images with an oblique view of the seabed covering an area of 0.1m² (min. of 4 Mega Pixel resolution) were also taken to enable review of seabed upon recovery. Direction of the field of view was achieved using a Mini-FOG Subsea Gyrocompass, which was overlaid onto the video image.

2.1.3 Grabbing

The 0.1m² Mini Hamon grab was deployed via the stern 'A' frame on the vessels *RV Discovery* and *FPV Clupea*. Position of samples was taken via a manual fix using the HYDROpro software package (Appendix A). Records of sample size, sediment characteristics and conspicuous fauna were recorded (Appendix C). A photographic record was taken of the sample once transferred from the grab bucket to a sample hopper (Appendix D). As standard a 300ml sample was taken for PSA analysis but was increased to 500ml if samples contained, what were considered to be, high gravel content.

2.2 Laboratory Analysis of Samples

The method to be employed for the laboratory particle size analysis was not specified in the ECA Regional Monitoring Blueprint v0.3 (2005) and is, therefore, detailed below.

2.2.1 Wet Split and Dry Sieve

Methods for the analysis of samples submitted for particle size distribution were based on Emu Ltd. in-house procedures (Emu, 2005) based on BS1377: 1990 Parts 1 and 2. On return to Emu laboratories, representative sub-samples of each sediment sample were oven dried to constant weight and sieved through a series of mesh apertures corresponding to whole phi units described by the Wentworth scale. The weight of the sediment fraction retained on each mesh was measured and recorded. Sediment samples found to contain >5% fine material (particles of <63 µm diameter) were subjected to further analysis via laser diffraction to determine the proportion of the silt/clay components at 0.5 phi intervals. Outputs from this analysis include a phi-unit weight matrix for all samples and laser particle size data for relevant samples (Appendices E&G).

2.2.2 Laser Diffraction

The determination of <63µm particle size distribution by laser diffraction is carried out in accordance with Emu Ltd. in house procedures Emu MET/02, Issue 2, 2004. Malvern Mastersizer Micro laser diffraction determines particle distribution, based on the principal of laser ensemble light scattering and is equivalent to sedimentation by the pipette method (Emu MET/01, Based on

BS1377: 1990 Part 2). Prior to analysis by laser diffraction, sample preparation (wet split) is carried out in accordance with Emu MET/01, resulting in the splitting of samples on a 63µm sieve, leaving >63µm material to be analysed on a suitable set of test sieves. The Malvern Mastersizer Micro can analyse particles in the range 0.313-301µm at 0.5 phi intervals. The test result reported is volume based and is expressed in terms of equivalent spheres (Appendix E). Test results can also be integrated with particle size distribution results for sample fractions >63µm, (derived by dry sieving, Emu Met/01), to provide distributions for the full size ranges.

2.3 Video Analysis

The review of video data to determine sediment characteristics at each site (Appendix F) using percentage cover values (cobble, gravel, sand, shell etc.) is to be completed, and will be provided in a subsequent revision of this report. These values are employed in subsequent analysis and considered of importance as they generate data that cannot be acquired through normal PSA analysis, such as percentage cobbles and percentage shell material.

2.4 Analysis of Data

Sieve data were input into a standardised excel spreadsheet in order to determine the required percentiles necessary to calculate various statistical measures which are typically used to define grain size (Eleftheriou and McIntyre, 2005). Functions were applied to the raw PSA data (Table 1.3) to calculate histograms, cumulative frequency curves and pie charts depicting percentages of sand, gravel and silt. The results are contained as pdf files in Appendix E. Results of laser sizing, where samples contained >5% fines (<63 microns), are also included in Appendix E.

Distributional Statistic Measure	Description and Calculation Method (phi system)	
Median	Measures of central tendency expressed as:	$M d = \Phi_{50}$
Phi Mean Diameter		$M_{\phi} = \frac{\Phi_{84} + \Phi_{16}}{2}$
Sorting	Measure of scatter around a central value expressed as:	$\sigma_{\phi} = \frac{\Phi_{16} - \Phi_{84}}{2}$
Skewness	Measure of the degree of asymmetry expressed as:	$\alpha_{\phi} = \frac{M\Phi - Md\Phi}{\sigma_{\phi}}$
Kurtosis	Measures the degree of peakedness as expressed as:	$\beta_{\phi} = \frac{1/2(\Phi_{95} - \Phi_5) - \sigma_{\phi}}{\sigma_{\phi}}$

(where: Md = Median; M = Mean; MΦ = phi mean diameter; σ_φ = phi deviation measure; α_φ = phi skewness measure; β_φ = phi kurtosis measure)

Table 1.3 Summary of Statistical Measures Applied to PSA Data

3.0 RESULTS

3.1 General Description and Distribution of Sediments

The results of the particle size distribution analysis are presented for individual sites in Appendix E and include tabulated weight data for each whole phi mesh aperture, percentage fractional data and percentage cumulative data. Fractional histograms and cumulative charts have also been presented for each sediment sample. Summarised data for all sites is presented in Appendix G. The dredge zones within which the sites fall are also indicated in Appendix G. The current data set includes ADZ sites drawn from the most recent EMF data for the region.

Sediment across the survey area mainly comprised of gravelly sand, with sorting coefficients generally poorly-sorted to very poorly-sorted.

Proportions of gravel ranged from <1% at site 21 towards the north-eastern boundary of the survey area to 72% at site 256 to the south west of Area 478. In general, the sites with the largest percentage of gravel were found in the south west of the region extending from areas 461 to 475 and 478. Isolated patches of coarser sediment were also observed in reference areas 4 and 5. The lowest proportions of gravel were generally found in the north east of the region. (Chart No. 1.2).

Levels of sand ranged from 26% at site 256 to >99% at site 21. The percentage sand found at each site was effectively the reciprocal of the gravel, with the greatest proportions of sand found to the north east of the survey area (Chart No. 1.3).

Levels of fines were generally low across the survey area, with the highest percentage of 11% recorded at site 296 within reference area 4 towards the south western boundary of the survey area (Chart No. 1.4).

The median grain size represented by the d50 showed a concentration of the coarser sediment (d50>10mm) at sites which accounted for the largest percentage of gravel (>60%) (Chart No. 1.5). The data suggests a similar trend to the distribution of gravel, with an area to the south west generally supporting the largest median diameters, with a region of relatively coarse material (d50>5mm) extending north and east to area 478. Isolated patches of relatively coarse material were also observed in reference areas 4 and 5. The smallest median diameters were generally noted to the north east of the region, with site 339 at the north eastern boundary having the lowest d50 value (0.35mm).

The review of video data to determine quantities of cobbles and larger sized stones including small boulders, as well as percentage shell material (Charts No. 1.6 and 1.7 respectively) is to be completed, and will be provided in a subsequent revision of this report.

Sediment sorting was generally poor or very poor, reflecting the relatively high degree of heterogeneity of the sediment across the survey area. More homogeneous sandy sediments exhibited well sorted and moderately well-sorted coefficients and were generally limited to the north east of the region.

Results of the PSA analyses of replicate samples showed low levels of small scale variability (values of standard deviation consistently <15%). The highest degree of intra-sample variability was recorded at site 333 to the west of Areas 464-2 and 458 (West Bassurelle), where levels of gravel ranged from 12% to 43%. Similar levels of small-scale variability were also recorded at sites 334 within Area 474 and 361 to the east of Area 477.

3.2 Sediment Character within the Active Dredge Zone (ADZ), Primary Impact Zone (PIZ), Secondary Impact Zone (SIZ) and Reference Areas

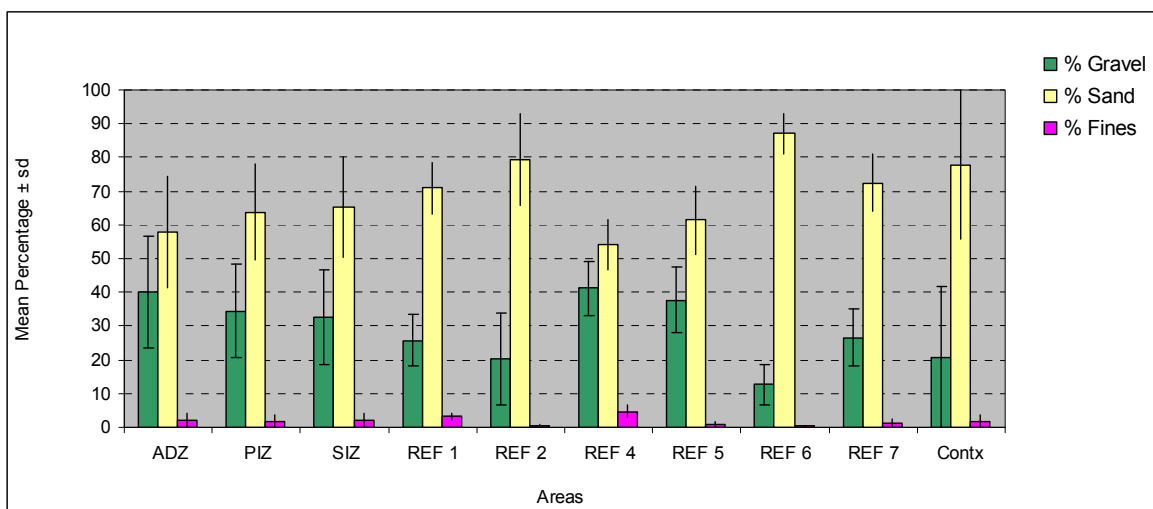
Summaries of the particle size distribution within the different collective impact zones (ADZ, PIZ and SIZ) as well as the individual reference areas and contextual sites are presented in Table 1.4 and Figures 1.1 and 1.2.

With the exception of reference area 6, all areas were characterised by gravelly sand, generally very poorly sorted. Reference areas 2, 5, and 6 comprised poorly-sorted sand. Sites within the primary and secondary impact zones (PIZ and SIZ) as a whole, and those within reference area 2 showed the highest degree of variability of the sediment composition. Within the primary and secondary impact zones, including the ADZ, levels of gravel ranged from 6% (replicate sample 340.4) to 70% (site 210), and <1% (site 21) to 72% (site 256) respectively. The highest mean levels of gravel in the impact zones were noted from the sites within the ADZ. Levels of gravels ranged from <1% (replicate site 327.1) to 55% (site 365) within reference area 2 (Fig. 1.1) with the highest mean level of gravel noted in reference area 4.

Area	Mean Percentages Main Sediment Fractions			Classification (Wentworth)	Sorting
	% Gravel	% Sand	% Fines		
ADZ	40.15	57.80	2.06	Gravelly Sand	Very poorly-sorted
PIZ	34.47	63.77	1.76	Gravelly Sand	Very poorly-sorted
SIZ	32.54	65.28	2.18	Gravelly Sand	Very poorly-sorted
REF 1	25.79	71.02	3.19	Gravelly Sand	Very poorly-sorted
REF 2	20.35	79.37	0.28	Gravelly Sand	Poorly-sorted
REF 4	41.16	54.12	4.71	Gravelly Sand	Very poorly-sorted
REF 5	37.78	61.54	0.68	Gravelly Sand	Poorly-sorted
REF 6	12.65	87.09	0.26	Sand	Poorly-sorted
REF 7	26.58	72.36	1.06	Gravelly Sand	Very poorly-sorted
Contx	20.59	77.73	1.67	Gravelly Sand	Poorly-sorted

Ref = Reference Area; SIZ = Secondary Impact Zone; PIZ= Primary Impact Zone; ADZ = Active Dredge Zone; Contx= Contextual Sites

Table 1.4 Summary of Particle Size Distribution of Main Sediment Fractions within each impact area, EEC 2008 survey

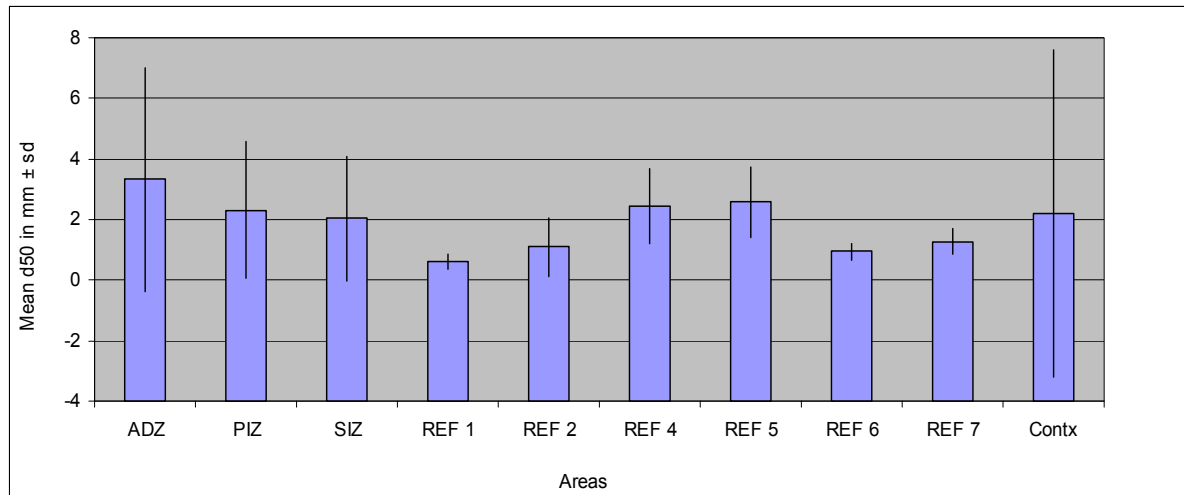


Ref = Reference Area; SIZ = Secondary Impact Zone; PIZ= Primary Impact Zone; ADZ = Active Dredge Zone; Contx= Contextual Sites

Figure 1.1. Particle Size Characteristics of Main Sediment Fractions within each Impact Area, EEC 2008 Survey

The median grain size represented by the d50 showed a concentration of the coarser sediment (Mean d50 > 2mm) in samples from sites generally within the active dredge zones the primary impact zones and the secondary impact zones, with particularly variable data evident from the ADZ. Of the reference areas, 4 and 5, to the south of the survey area (Figure 1.2) supported the sediment with the largest d50.

The contextual sites were characterised by poorly-sorted sand and showed a high degree of variability in relation to the sediment composition with levels of gravel ranging from <1% (site 43) at the north-eastern boundary of the survey area to 82% (site 390) at the south western-most boundary of the survey area.



Ref = Reference Area; SIZ = Secondary Impact Zone; PIZ= Primary Impact Zone; ADZ = Active Dredge Zone; Contx =Contextual Sites.

Figure 1.2. Mean Value of the Median Grain Size (d50) within each Impact Area, EEC 2008 Survey

3.3 Summary

The data indicate that a west to east gradient exists across the area with the coarsest sediments located in the south west and the finest, most well sorted sediments found to the north east. Distributions of cobbles, larger stones and boulders, as well as shell material will be reviewed on completion of video data observations for each site.

The general range of sediment sizes in the impact zones were also well represented in the reference areas, although reference area 6 generally contained reduced particle sizes compared to the impact zones.

The impact of dredging has not been measured against changes in particle size on its own; rather the data has been included within the analysis of the faunal components as a potentially influencing factor. However it is evident that the ADZ sites supported some of the largest grain sizes, with a large proportion of gravel present. Similar levels were found within the PIZ, SIZ and reference areas 4 and 5. The degree of variability within the ADZ was notably higher than in most other areas, which may be an indicator of dredging activity, although data in this instance were based on a smaller number of samples, which can lead to raised levels of variability.

4.0 REFERENCES

ECA and Emu Ltd, 2005. *Regional Monitoring Blueprint Related to Marine Aggregate Extraction Operations in the Eastern English Channel v0.3.* Emu Ltd. Durley.

Eleftheriou N.A. & McIntyre A.D., 2005. *Methods for the study of Marine Benthos.* Third Edition. Oxford, Blackwell Science Ltd.

Emu, 2005. *In-house methods for the determination of the particle size distribution.* Issue 9. Emu Ltd Method Statement 01 Based on BS1377: 1990 Parts 1 and 2. Emu Ltd, Durley.

5.0 AUDIT INFORMATION

Title: EASTERN ENGLISH CHANNEL MONITORING REPORT 2008 Section 1. Seabed Sediment Characteristics (Volume I, Report)			
Report No : 09/J/1/03/1333/0871 - Draft			
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CHARTS