

Drogheda Port Company
Maintenance Dredging Application
2013 – 2021



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Dr. Tara Higgins
Environmental Protection Agency
PO Box 3000,
Johnstown Castle Estate
Co. Wexford

30.03.12

Re: Drogheda Port Company – Maintenance Dredging Application 2013 – 2021

Dear Dr. Higgins,

Drogheda Port Company is the port authority for Drogheda Port as defined in Harbours Act 1996 and Harbours (Amendment) Act 2009.

Drogheda Port Company engages regularly in maintenance dredging at the river mouth and seawards approaches and within the full length of the commercial estuary.

Over the previous decade, Drogheda Port Companies held two five year maintenance Dump at Sea Permits, issued by the Marine Licence Vetting Committee of the Department of Communications Marine and Natural Resources and latterly the Department of Agriculture, Fisheries and Food.

Our current five year maintenance Dump at Sea Permit expires on the 12th February 2013.

To that end and in a timely manor, we herewith enclosed our new maintenance Dump at Sea Permit application and fee of €63.49 for your consideration.

Drogheda Port Company requests the Agency to consider the granting of an eight year Dump at Sea Permit 2013 - 2021, given that this application is a mirror application of the two previous five year applications.

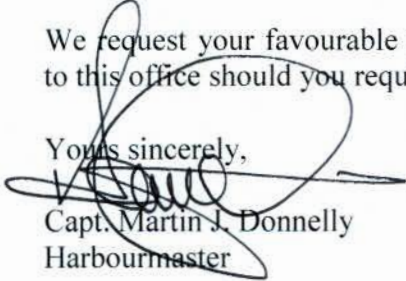
The annual quantity of material for disposal from the river mouth and seaward approaches is based on an average over the previous decade, however, we do seek an annual contingency for unforeseen circumstances.

A considerable quantity of technical and environmental information supports the application. Some of this material although historical supporting previous application is none the less appropriate, relevant and important to our application.

We declare that the content of the electronic files on the accompanying CD-ROM is a true copy of the original application form.

We request your favourable consideration of our application and request that you revert to this office should you require any additional information or seek any clarifications.

Yours sincerely,



Capt. Martin J. Donnelly
Harbourmaster

Cc: Ms. Aebhin Cawley Scott Cawley

Encl:

This is a draft document and is subject to revision.



Dumping at Sea Permit Application Form

EPA Ref. N^o:
(Office use only)

Environmental Protection Agency

PO Box 3000, Johnstown Castle Estate, Co. Wexford

Lo Call: 1890 335599 Telephone: 053-9160600 Fax: 053-9160699

Web: www.epa.ie Email: info@epa.ie

Tracking Amendments to Draft Application Form
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Version No.	Date	Amendment since previous version	Reason
V. 1.	07/09/2010	N/A	

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ABOUT THIS APPLICATION FORM

This form is for the purpose of making an application for a Dumping at Sea permit under the Dumping at Sea Acts, 1996 to 2009.

The application form **must** be completed in accordance with the instructions and guidance provided in the *Dumping at Sea Permit Application Guidance Note*. The guidance note gives an overview of Dumping at Sea permitting, outlines the permit application process (including the number of copies required) and specifies the information to be submitted as part of the application. The guidance note and application form are available to download from the Licensing page of the EPA's website at www.epa.ie.

A valid application for a Dumping at Sea permit must, as a minimum, contain the information set out in the First Schedule to the Dumping at Sea Acts, 1996 to 2009. This application form is designed to set out the relevant questions in a structured manner and not necessarily in the order presented in the First Schedule. In order to help ensure a legally valid application in respect of these requirements, please complete the checklist provided in Annex 2.

This application form does not purport to be, and should not be considered, a legal interpretation of the provisions and requirements of the Dumping at Sea Acts, 1996 to 2009. While every effort has been made to ensure the accuracy of the material contained in the application form, the EPA assumes no responsibility and gives no guarantee or warranty concerning the accuracy, completeness or up-to-date nature of the information provided herein and does not accept any liability whatsoever arising from any errors or omissions.

Should there be any contradiction between the informational requirements set out in the application form and any clarifying explanation contained in the accompanying guidance note, then the requirements in this application form shall take precedence.

PROCEDURES

The procedure for making and processing of applications for Dumping at Sea permits and for the processing of reviews of such permits is summarised below. The application fee that shall accompany an application is currently set at €63.49.

Within 21 days after the submission of an application to the Agency the applicant must publish in a newspaper circulating in the area, a notice of the application, in accordance with Section 5A of the Dumping at Sea Acts, 1996 to 2009. Following publication of the aforementioned notice, any persons who wish to do so may make a submission or comment on the permit application. The permit application and all submissions by third parties shall be put on public display in electronic format on the EPA website and be open to inspection by any person, as soon as reasonably possible by the Agency.

An application for a permit must be submitted on the appropriate form (available from the Agency) with the correct fee and should contain relevant supporting documentation as attachments. The application should be based on responses to the information requested in the form and include supporting written text and the appropriate use of tables and drawings. Where multiple loading or dumping sites are proposed in a single application, a system of unique reference numbers should be used to denote each loading and dumping site. These should be simple, logical, and traceable throughout the application.

The application form is divided into a number of sections of related information. The purpose of these divisions is to facilitate both the applicant and the Agency in the provision of the information and in its assessment. **Please adhere to the format as set out in the application form and clearly number each section and associated attachments accordingly.** Attachments should be clearly numbered, titled and paginated and must contain the required information as set out in the application form. Additional attachments may be included to supply any further information supporting the application. Any references made to publications should be supported by a bibliography.

All questions should be answered. Where information is requested in the application form which is not relevant to the particular application, the words "not applicable" should be clearly written on the form. The abbreviation "N/A" should not be used.

Additional information may need to be submitted beyond that explicitly requested on this form. The Agency may request further information if it considers that its provision is pertinent to the assessment of the application. Advice should be sought from the Agency where there is doubt about the type of information required or the level of detail.

Applicants should be aware that disposing of a substance or material at sea without a permit, or contravening the conditions of a Dumping at Sea permit, are offences under the Dumping at Sea Acts, 1996 to 2009. Offenders are liable upon conviction to a fine or imprisonment or both.

Note: Drawings and Charts: The following guidelines are included to assist applicants:

- *All drawings submitted should be titled and dated.*
- *All drawings should have a unique reference number and should be signed by a clearly identifiable person.*
- *All drawings should indicate a scale and the direction of north.*
- *All drawings should, generally, be to a scale of between 1:20 to 1:500, depending upon the degree of detail needed to be shown. Drawings delineating the loading boundary can be to a smaller scale of between 1:1000 to 1:10560, but must clearly and accurately present the required level of detail. All drawings should be A3 or less and of an appropriate scale such that they are clearly legible.*
- *The applicant should provide legends on all drawings and maps as appropriate.*
- *In exceptional circumstances, where A3 is considered inadequate, a larger size may be requested by the Agency.*

A signed original and 1 additional hardcopy of the application and accompanying documents/particulars in hardcopy format plus 2 copies of all files in electronic searchable PDF format on CD-Rom (OCR'd) or other format agreeable to the Agency shall be submitted to the headquarters of the Agency.

It should be noted that it will not be possible to process or determine the application until the required documents have been provided in sufficient detail and to a satisfactory standard.

SECTION A: GENERAL

Advice on completing this section is provided in the "Application Guidance Note".

A.1 Applicant's Details

Name and Address for Correspondence

Only application documentation submitted by the applicant and by the nominated person will be deemed to have come from the applicant.

Company Name:	Drogheda Port Company
C.R.O.^a No.:	262361
Address:	Harbourville House
	Mornington Road
	Drogheda
	Co. Meath
Tel:	041-9838378
Fax:	041-9832844
e-mail:	maritimehouse@droghedaport.ie

Nominated Contact Person

Name*:	Capt. Martin J. Donnelly
Company Name:	Drogheda Port Company
Address:	Harbourville House
	Mornington Road
	Drogheda
	Co. Meath
Tel:	041-9838378
Fax:	041-9832844
e-mail:	martindonnelly@droghedaport.ie

*This should be the name of a person nominated by the applicant for the purposes of the application. This person may be a company employee or a suitably qualified external consultant.

^a **Company Registration Office.**

A.2 Planning Authority

Planning Permission relating to the loading works which is the subject of this application: (tick as appropriate)

<i>has been obtained</i>		<i>is being processed</i>	
<i>is not yet applied for</i>		<i>is not required</i>	X

Local Authority Planning File Reference N^o:	Not Applicable
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Attachment A.2 should contain, where appropriate, ***the most recent*** planning permission, including a copy of ***all*** conditions, and where an EIS was required, copies of any such EIS and any certification associated with the EIS, should also be enclosed. Where planning permission is not required for the development, explain why not and provide relevant correspondence, etc.

Attachment A.2 included	Yes	No
		X

A.3 Other Authorities

A.3 (i) Shannon Free Airport Development Company (SFADCo.) area

The applicant should tick the appropriate box below to identify whether the loading or dumping operations are located within the Shannon Free Airport Development Company (SFADCo.) area.

Attachment A.3(i) should contain details of any or all operations located within the SFADCo. area.

Attachment A.3(i) included	Yes	No
		X

A.3 (ii) Health Services Executive Region

The applicant should indicate the **Health Services Executive Region(s)** where the loading and dumping operations are or will be located.

Name:	HSE Head Office
Address:	Oak House,
	Millennium Park
	Naas, Co. Kildare
Tel:	045-880400
Fax:	1890-200857
e-mail:	Infoline1@hse.ie

A.3 (iii) Harbour Authority/Local Authority

The applicant should indicate the **Harbour Authority/Local Authority** where the loading and dumping operations are or will be located. In the event that loading and dumping operations take place in separate functional areas, please provide details of all relevant authorities.

Name:	Drogheda Port Company
Address:	Harbourville House
	Mornington Road
	Drogheda, Co. Meath
Tel:	041-9838378
Fax:	041-9832844
e-mail:	maritimehouse@droghedaport.ie

Relevant Authorities Notified	Yes	No
		X

Attachment A.3(iii) should contain a copy of the correspondence issued to all relevant harbour authorities/local authorities.

Attachment A.3(iii) included	Yes	No
		X

A.4 Newspaper Advertisement

Section 5A of the Dumping at Sea Acts 1996 to 2009, requires all applicants to advertise the application in a newspaper (within 21 days following date of application). See *Guidance Note for full details*.

Attachment A.4 The original page of the newspaper in which the advertisement was placed must be submitted within 21 days of the advertisement being published.

Attachment A.4 included	Yes	No
		X

A.5 FEES

Class of Activity	Tonnage	Fee (in €)
Maintenance Dredging	1,536,000 (plus 160,000 annual contingency)	€63.49

Appropriate Fee Included	Yes	No
	X	

A.6 Foreshore Act Licences

Where applicable, provide a copy of the most recent Foreshore Act licence issued under the Foreshore Acts 1933 to 2009 in relation to relevant loading operations at the site. If an application for a Foreshore Act licence pertaining to the operations to which this application relates is currently under consideration by the Minister, outline details of the application should be submitted, including application file number, the date the application was submitted and a brief summary of the operation.

Attachment A.6 should contain the most recent relevant licence issued under the Foreshore Acts 1933 to 2009, including a copy of **all** conditions attached to the licence and any monitoring returns for the previous 12-month period, if applicable. Outline details of any existing permit applications should be submitted, if applicable.

Attachment A.6 included	Yes	No
		X

A.7 Current/Previous Permits

Provide details of any current or previous permits held by the applicant under the Dumping at Sea Acts, 1996 to 2009.

Attachment A.7 should contain the most recent permit issued under the Dumping at Sea Acts, 1996 to 2009, including any monitoring returns for the previous 12-month period, if applicable.

Attachment A.7 included	Yes	No
	X	

SECTION B: LOADING OPERATIONS

Advice on completing this section is provided in the accompanying guidance note.

Where development is proposed to be carried out, being development which is of a class for the time being specified under Article 24 (First Schedule) of the Environmental Impact Assessment Regulations, the information on the state of the existing environment should be addressed in the EIS. **In such cases, it will suffice for the purposes of this section to provide adequate cross-references to the relevant sections in the EIS.**

B.1 Alternative measures

Under the provisions of Section 5(2) of the Dumping at Sea Acts, 1996 to 2009, the dumping of substances or material at sea is only acceptable when the Agency is satisfied there is no suitable alternative means of disposal. Provide details of all investigations into alternative means of disposal or reuse of the substance or material. Applicants must also demonstrate that all necessary steps have been taken to minimise the quantity of material to be dumped or to render the material less harmful for dumping at sea. A complete and full answer must be provided.

Attachment B.1 should contain reports and supporting documentation with regard to the investigations into alternative means of disposal, treatment or reuse. Any associated drawings / maps should also be provided as geo-referenced digital drawing files (e.g. ESRI Shapefile, MapInfo Tab or other upon agreement) in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84).

Attachment B.1 included	Yes	No
	X	

B.2 Purpose of the operation

Provide details on the purpose of the operation, e.g., is the work proposed capital or maintenance loading work. Details of any previous loading at the proposed site(s) should also be included.

Attachment B.2 should contain any supporting documentation on the purpose of the loading operation and details of any previous loading. Any associated drawings / maps should also be provided as geo-referenced digital drawing files (e.g. ESRI Shapefile, MapInfo Tab or other upon agreement) in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84).

Attachment B.2 included	Yes	No
		X

B.3 Loading Area

Four sets of coordinates must be given in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84). If loading at more than one area is to occur, coordinates for additional areas should be appended.

Seaward Approaches			
Latitude		Longitude	ITM
(a)	53 43.36N	06 14.22W	716230.47, 776214.52
(b)	53 43.25N	06 14.26W	716311.10, 776018.36
(c)	53 43.24N	06 13.60W	717038.15, 776015.56
(d)	53 43.35N	06 13.60W	717033.06, 776219.54

Commercial channel, berths & swing basins from Drogheda town quays to the sea at Mornington			
Latitude		Longitude	ITM
(a)	53 42.81N	06 20.95W	708975.40, 775014.22
(b)	53 42.82N	06 20.96W	708963.36, 775036.39
(c)	53 43.36N	06 14.33W	716230.47, 776214.52
(d)	53 43.25N	06 14.26W	716311.10, 776018.36

Attachment B.3: Any associated drawings / maps should be provided as geo-referenced digital drawing files (e.g. ESRI Shapefile, MapInfo Tab or other upon agreement) in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84).

Attachment B.3 included	Yes	No
	X	

B.4 Details of the operation

Provide details on the following aspects of the operation:

- B.4 (I) Date of commencement of loading operations;
B.4 (III) Location and method of loading of the substance or material;
B.4 (IV) Total quantities (in tonnes and cubic meters) to be loaded:

- per load
- per week
- per month.

Attachment B.4 should contain any supporting documentation on the details of the loading operations. Any associated drawings / maps should also be provided as geo-referenced digital drawing files (e.g. ESRI Shapefile, MapInfo Tab or other upon agreement) in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84).

Attachment B.4 included	Yes	No
	X	

SECTION C: MATERIAL ANALYSIS

Advice on completing this section is provided in the accompanying Guidance Note.

C.1. Tabular data on Sampling Points

Applicants should submit the following information for each sampling point at the loading site(s), at which the material or substance for disposal has been analysed:

PT_CD	Latitude	Longitude	ITM
1	Site not suitable for sampling.		
2	53°43.10'N	006°20.28'W	709696.98, 775578.32
3	53°43.09'N	006°19.59'W	710456.39, 775577.59
4	53°43.18'N	006°19.20'W	710881.42, 775754.61
5	53°43.17'N	006°18.52'W	711629.81, 775753.81
6	53°43.22'N	006°18.54'W	711605.61, 775846.01
7	53°43.25'N	006°18.34'W	711824.26, 775906.88
8	53°43.26'N	006°18.24'W	711933.81, 775928.05
9	53°43.48'N	006°17.13'W	713144.83, 776365.32
10	53°43.90'N	006°16.24'W	714104.67, 777167.90
11	Site not suitable for sampling.		
12	Site not suitable for sampling.		
13	Site not suitable for sampling.		
14	53°43.30'N	006°14.15'W	716430.46, 776111.76
15	53°44.51'N	006°10.59'W	720288.32, 778454.42
16	53°45.80'N	006°13.40'W	717139.39, 780768.32
17	53°40.70'N	006°12.60'W	718256.66, 771333.00

An individual record (i.e., row) is required for each sampling point. Acceptable file formats include Excel, Access or other upon agreement with the Agency.

If more than one loading site is proposed, individual tables must be completed for each site.

C.2 Characteristics and Composition of the Substance or Material for Disposal

Give particulars of the nature, composition and quantity of the substance or material to be disposed.

At a minimum, sampling must be conducted for the physical and chemical parameters listed in Tables C.1 (I) and (II), located in Annex 1 to this application form. Details of all sampling results of the substance or material to be disposed should be supplied via Tables C.1(I) and (II).

Applicants must also address the following criteria relating to the composition of the substance or material to be disposed:

- Amount and composition of the material;
- Material form, e.g., solid, liquid;
- Physical properties (especially solubility, specific gravity and density);
- Chemical and biochemical properties (e.g., oxygen demand, nutrients);
- Biological properties (viruses, bacteria, yeasts, parasites);
- Radioactivity;
- Toxicity;
- Persistence in the environment (physical, chemical and biological);
- Accumulation and biotransformation in biological materials or sediments;
- Chemical and physical changes of the substance or material after release, including formation of new compounds;
- Probability of production of taints or other changes reducing marketability of resources (e.g., fish, shellfish).

A report on the characteristics and composition of the substance or material for disposal should be submitted, addressing all criteria listed above, and any supporting information, as **Attachment C.2**.

Attachment C.2 included	Yes	No
	X	

SECTION D: IMPACT ON THE RECEIVING ENVIRONMENT

Advice on completing this section is provided in the accompanying Guidance Note.

D.1. Assessment of Impact on the Environment

- Provide an assessment of the predicted impacts of the proposed dumping at sea to which this application relates. This assessment should include the following, where applicable:
 - Initial dilution to be achieved by proposed method of release;
 - Methods of packaging and containment, if any;
 - Dispersal, horizontal transport and vertical mixing characteristics;
 - Existence and impact of current and/or previous dumping in the area (including accumulative effects);
 - Sea bottom characteristics, including topography, geochemical and geological characteristics and benthic micro-fauna and macro-fauna;
 - Water characteristics (e.g., temperature, pH, salinity, oxygen indices of pollution-dissolved oxygen (DO), nitrate, nitrite, ammonia, phosphate and suspended matter);
 - Interference with shipping, fishing, recreation, mineral extraction, desalination, fish spawning and nursery habitats, areas of special scientific importance, areas of natural or archaeological heritage importance, biological diversity (including diversity within species, between species, and of ecosystems) and other legitimate use of the sea.

- Details of any previous sampling at the loading and dumping sites, conducted either as part of this application or previous post-dumping monitoring programmes, should be supplied via Tables D.1(I) and (II). If sampling has been conducted as part of an EIS which has also been submitted with the application form, reference to the appropriate table(s) of results in the EIS will be sufficient in this case. Results of the National Seabed Survey should be included, where available.
- Describe the existing environment at the loading and dumping sites in terms of water quality and sediment quality, with particular reference to environmental quality standards or other legislative standards.
- Give details of any designations under any Council Directive or Regulations that apply in relation to the loading and dumping sites. Indicate whether or not the loading and disposal of the substance or material, the dumping methods employed, or other factors associated with such operations are likely to have a significant effect on a designated site.
- Any site which may have an impact on a Natura 2000 site (SPA or SAC) must be subject to screening for Appropriate Assessment in accordance with Article 6(3) of the Habitats Directive (92/43/EEC). The results of any such screening must be submitted as part of this application. Where screening has determined that an appropriate assessment is required, an appropriate assessment must be completed and a copy of said assessment submitted as part of this application. Please refer to the National Parks and Wildlife Service guidance document 'Appropriate Assessment of Plans and Projects in Ireland' with regard to this assessment.
- This section should also contain full details of any modelling of the proposed loading and dumping operations.

Full details of the assessment and any other relevant information on the receiving environment should be submitted as **Attachment D.1**.

Attachment D.1 included	Yes	No
	X	

SECTION E: DUMPING OPERATIONS

Advice on completing this section is provided in the accompanying Guidance Note.

E.1 Site Selection

Provide details of the site selection process, including site description, suitability and rationale for final site selection. Full details of the site selection process should be submitted as **Attachment E.1**

Attachment E.1 included	Yes	No
	X	

E.2 General Information

Provide information on the following points in the spaces provided.

E.2 (I) Has the proposed dump site(s) been used previously for disposal of material from the current proposed loading area(s) or any other loading area(s)? If so, provide details of tonnages/volumes, duration and any investigations into the impact of the dumping operations on

the environment at the dump site(s). Please provide details of any previous permits relating to dumping operations at the site(s), if applicable.

Attachment E.2(I) included	Yes	No
		X

E.2 (II) Dump site – four sets of coordinates must be given in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84). If dumping is to occur at more than one location, coordinates for additional areas should be appended.

DUMPSITE A1			
Latitude		Longitude	ITM
(a)	53 45.01N	06 11.06E	719749.47, 779370.66
(b)	53 45.01N	06 10.06E	720848.43, 779398.88
(c)	53 44.01N	06 10.06E	720896.27, 777544.73
(d)	53 44.01N	06 11.06E	719796.87, 777516.50

DUMPSITE A2			
Latitude		Longitude	ITM
(a)	53 46.12N	06 13.78E	716708.96, 781353.31
(b)	53 46.11N	06 13.13E	717423.45, 781352.62
(c)	53 45.54N	06 13.15E	717427.99, 780295.19
(d)	53 45.53N	06 13.82E	716692.29, 780258.24

DUMPSITE A3			
Latitude		Longitude	ITM
(a)	53 40.00N	006 13.12E	717672.03, 771878.12
(b)	53 41.08N	006 12.40E	718460.79, 772046.38
(c)	53 40.27N	006 12.17E	718751.93, 770550.92
(d)	53 40.21N	006 12.93E	717917.93, 770418.59

Attachment E.2(II) Any associated drawings / maps should also be provided as geo-referenced digital drawing files (e.g. ESRI Shapefile, MapInfo Tab or other upon agreement) in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84).

Attachment E.2(II) included	Yes	No
		X

E.2 (III) Name and address of disposal operator contracted to carry out the dumping (if known)

Name:	Londonderry Port and Harbour Company
Address:	Port Road
	BT47 6FL
	Londonderry, Northern Ireland
Tel:	04871860555
Fax:	+044 (0)28 7186 1168
e-mail:	info@londonderryport.com

E.2 (IV) Distance of dump site from the nearest shore.

A1: Nearest shore line, low water mark 2.5 nautical miles
A2: Nearest shore line, low water mark 0.6 nautical miles
A3: Nearest shore line, low water mark 0.5 nautical miles

E.2 (V) Provide details of the average, minimum and maximum depth of the dump site(s) (to chart datum).

A1: Depth at chart datum 14m
A2: Depth at chart datum 4m
A3: Depth at chart datum 4m

E.2 (VI) Provide details of the method and rate of disposal (i.e. tonnes and cubic meters per day/week/month) of substance or material from the vessel.

Bottom door disposal, current vessel daily disposal rate 1,600m³/2,560tonnes daily, one disposal per tide. This can be improved upon if contractually required.

Drogheda Port has in the past contracted with dredgers with a higher daily capacity and dredging permits have recognised this with a daily disposal rate of up to 9,000tonnes/5,625m³.

SECTION F: MONITORING

Advice on completing this section is provided in the accompanying Guidance Note.

F.1. Monitoring Programme

Proposed programmes for environmental monitoring at both the loading and dumping sites should be submitted as part of the application. These programmes should be provided as Attachment F.1.

Reference should be made to the proposed location of monitoring points, sampling methods, analytical and quality control procedures, including equipment calibration, equipment maintenance and data recording/reporting procedures to be carried out in order to ensure accurate and reliable monitoring.

In determining the monitoring programme to be carried out, the nature, frequency and duration of dumping operations and, where relevant, the effects of intermittent dumping on the receiving environment should be considered.

Details of any accreditation or certification of analysis should be included.

Attachment F.1 should also contain any supporting information.

Attachment F.1 included	Yes	No
		X

F.2. Tabular data on Monitoring Points

PT_CD	Latitude	Longitude	ITM
Monitoring points to be agreed following consultation with the Marine Institute and the Radiological Protection Institute of Ireland.			

Applicants should submit the following information for each proposed monitoring point:

An individual record (i.e., row) is required for each monitoring point. Acceptable file formats include Excel, Access or other upon agreement with the Agency.

SECTION G: DECLARATION

Declaration

I hereby apply for a Dumping at Sea permit, pursuant to the provisions of the Dumping at Sea Acts, 1996 to 2009.

I certify that the information given in this application is truthful, accurate and complete.

I give consent to the EPA to copy this application for its own use and to make it available for inspection and copying by the public, both in the form of paper files available for inspection at EPA and local authority offices, and via the EPA's website.

This consent relates to this application itself and to any further information or submission, whether provided by me as Applicant, any person acting on the Applicant's behalf, or any other person.

Signed by: 

(on behalf of the organisation)

Date: 30.03.12

Print signature name: Captain Martin Donnelly

Position in organisation: Harbour Master, Drogheda Port Company

ANNEX 1: TABLES

Table C.1(I) Material Sampling – Physical Properties

Sampling Date:		Sampling location: (e.g., L1-1, L1-2.....)
Substance		Result
Fine Fraction Conc. (<2mm) ^{Note 1} :		
<63µm:		
% Solids		
	Units of Measurement	
Density/Specific Gravity		
TOC		

Note 1: to be expressed as a percentage of total sample.

Table C.1(II) Material Sampling – Chemical Composition

Sampling Date:		Sampling location: (e.g., L1-1, L1-2.....)
Substance	Units of Measurement	Result
Arsenic		
Copper		
Cadmium		
Chromium		
Lead		
Mercury		
Nickel		
Zinc		
Aluminium		
Lithium		
Organochlorine Pesticides		
Tributyltin (TBT) ^{Note 1}		
Dibutyltin (DBT) ^{Note 1}		
PCBs ^{Note 1}		
PAHs ^{Note 1}		
Total Extractable Hydrocarbons		

Note 1: Only determined in certain circumstances – see Application Guidance Note for further information.

Table D.1(I) Receiving Environment Sampling – Physical Properties

Sampling Date:		Sampling location: (e.g., D1-1, D1-2.....)
Substance		Result
Fine Fraction Conc. (<2mm) ^{Note 1} :		
<63µm		
% Solids		

	Units of Measurement	
Density/Specific Gravity		
TOC		

Note 1: to be expressed as a percentage of total sample.

Table D.1(II) Receiving Environment Sampling – Chemical Composition

Sampling Date:		Sampling location: (e.g., D1-1, D1-2.....)	
Substance	Units of Measurement	Result	
Total Organic Nitrogen			
Arsenic			
Copper			
Cadmium			
Chromium			
Lead			
Mercury			
Nickel			
Zinc			
Aluminium			
Lithium			
Organochlorine Pesticides			
Tributyltin (TBT) Note 1			
Dibutyltin (DBT) Note 1			
PCBs Note 1			
PAHs Note 1			
Total Extractable Hydrocarbons			

Note 1: Only determined in certain circumstances – see Application Guidance Note for further information.

ANNEX 2: APPLICATION CHECKLIST

This checklist is to assist the applicant in ensuring a valid and complete application is submitted to the Agency.

Section of Application Form		Checked by Applicant	Checked by Agency
A.2	Planning Permission / EIS attached	X	
A.3(i)	SFADCo. correspondence attached	X	
A.3(iii)	Harbour Authority notice attached	X	
A.4	Original newspaper notice included	X	
A.5	Appropriate fee paid	✓	
A.6	Foreshore Licence attached	X	
A.7	Current / previous permit attached	✓	
B.1	Alternative measures investigation attached	✓	
B.2	Purpose of the operation attached	✓	
B.3	Loading location maps / drawings attached	✓	
B.4	Operational details attached	✓	
C.1	Material analysis report attached	✓	
D.1	Assessment of impact on the environment attached	✓	
E.1	Site selection report attached	X	
E.2(II)	Dump site maps / drawings attached	✓	
F.1	Correspondence from Marine Survey Office attached	X	
F.2	Details of marine position recording equipment attached	X	
G.1	Programme for environmental monitoring attached	X	
Additional Checks			
All drawings / maps provided as geo-referenced digital drawing files (e.g. ESRI Shapefile, MapInfo Tab or other upon agreement) in both 12-digit Irish Transverse Mercator (ITM) and in Longitude and Latitude (WGS 84)		✓	
1 signed original application form (with attachments).		✓	
1 additional application hardcopy.		✓	
2 copies of all files in electronic searchable PDF format on CD_ROM (OCR'd) or other agreed format.		✓	

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10	Attachment C2 (ii): Figures 3 and 4 – Sampling and Monitoring Points
11	Attachment D1: Sediment Plume Analysis (extract from <i>Drogheda Port Development Capital Dredging Scheme Environmental Impact Statement Main Report</i>, Kirk McClure Morton, 1997. Pages 5.19 – 5.21 and Figures 5.38 – 5.45)
12	Attachment D2: Survey Report on Drogue Releases at Drogheda Offshore Dump Site. 22nd November 2006, Hydrographic Surveys Ltd
13	Attachment D3: Aquatic Ecological Impact Study (June 2006), prepared by Aquatic Services Unit, on behalf of Malone O'Regan Environmental Services for inclusion in Environmental Impact Statement: Proposed Capital Dredging at River Boyne, Drogheda Port, Co. Louth (Malone O'Regan Environmental Services Ltd, 2006)
14	Attachment D4: Letter dated December 2003, regarding Maintenance Dredging and Maritime Archaeology (Dave Fadden, Principal Officer DoEHLG).

- 15 **Attachment D5: Natura Impact Statement: Provision of Information for an Appropriate Assessment for a Maintenance Dredging Plan for the Drogheda Port Company, Co. Louth**
- 16 **Attachment D6: Boyne Entrance Channel Dredging Impact on Sediment Cell (RPS, 2012).**
- 17 **Attachment E1.1: Figure 1 – Location of Maintenance Dredging Dumpsites**
- 18 **Attachment E1.2: Hydrographic survey of Dump Site A1, Drawing No. HS34/06.**

EPA DUMPING AT SEA PERMIT APPLICATION

SUPPORTING NOTES/DOCUMENTATION

SECTION A – GENERAL

A2 – Planning Authority

No planning permission is required. The relevant regulatory framework is covered by Dumping at Sea and Foreshore legislation and licensing.

Attachment A2: None included.

A3 – Other Authorities

A3 (iii) – Harbour Authority/Local Authority

Drogheda Port Company (DPC), under the Harbours Act 1996 and Harbours Amendment Act 2000, operates Drogheda Port. DPC, which is submitting this application, is the only harbor authority affected by the maintenance dredging operations.

Attachment A3: None included.

A4 – Newspaper Advertisement

To be submitted following submission of application, within 21 days.

Attachment A4: None included.

A5 – Fees

Relevant fee included with submission

Attachment A5: Fee included.

A6 – Foreshore Act Licences

There is no current Foreshore Licence for the existing Dump at Sea Permit No. 387.

An application for a Foreshore Licence to support this new Dump at Sea Permit application is currently being drafted.

Attachment A6: None included.

A7 – Current/Previous Permits

Previous Dumping at Sea permits held:

Permit No. 261, issued 30.12.1996
Permit No. 278, issued 05.01.1998
Permit No. 279, issued 05.01.1998
Permit No. 286, issued 21.05.1998
Permit No. 293, issued 06.01.1999
Permit No. 294, issued 06.01.1999
Permit No. 310, issued 06.01.1999
Permit No. 325, issued 07.02.2001
Permit No. 329, issued 29.03.2001

Permit No. 345, issued 29.07.2002
Permit No. 378, issued 19.10.2006
Permit No. 381, issued 28.03.2007
Permit No. 382, issued 05.07.2007

Current Dumping at Sea permit:

Dump at Sea Permit No. 387, issued 28.02.2008

Attachment A7 included: Copy of current Dumping at Sea permit No 387 included.

SECTION B – LOADING OPERATIONS

B1 – Alternative Measures

The OSPAR Convention recognises that dredging is essential to maintain navigation in ports and harbours as well as for the development of port facilities and that much of the material removed during these necessary activities requires disposal at sea. Within the OSPAR Convention framework dredged materials have been listed in Article 3.2 of Annex II as being permitted to be dumped at sea.

However the OSPAR Convention requires consideration of beneficial use of dredged materials, over dumping at sea, where possible. The OSPAR Commission's Guidelines for the Management of Dredged Material (2009) states "that where no beneficial or financially viable use for dredged material is available then disposal of material at sea is acceptable".

OSPAR lists 3 possible uses for marine dredged materials:

1. Engineering uses, land creation, fill material etc;
2. Agricultural and product use; and
3. Environmental enhancement.

Over previous dredging projects, both capital and maintenance, Drogheda Port has examined the following alternative disposal means in detail, but has rejected all, primarily on environmental and economic grounds.

Relevant findings from studies undertaken to examine alternative disposal options are:

- **Disposal on north beach as dune creation.** Not environmentally/ecologically acceptable as the area is designated as Special Protection Area (SPA), proposed Natural Habitats Area (pNHA) and candidate Special Area of Conservation (cSAC). Of particular concern is a Little Tern breeding colony at this location.
- **Disposal on south beach.** Contain gravels not suitable for an amenity Blue Flag beach.
- **Disposal behind the south training wall.** Not technically possible due to beach levels. Also area designated as SPA, pNHA & cSAC. There are high levels of sand bypass from behind the wall as the storage capacity of the wall has already been used up. In south easterly gales material would be immediately re-deposited into the approach channel.
- **Disposal in estuary polders.** Not environmentally/ecologically acceptable as these are designated as SPA, pNHA, & cSAC.
- **Other disposal methods.** Alternative means of land disposal or beach nourishment would be very expensive involving a considerable increase in project time and dredging contractor's time on site making it commercially unviable.

Material from the Channel, Berths & Swing Basins

The material within the commercial estuary from the Drogheda Port inner town quays to the river entrance at Mornington, including all berth, swing basins etc. comprises mostly silts and muds. These materials contain none of the physical or chemical properties suitable for any of the three OSPAR suitable uses. This leaves sea disposal as the only environmentally and commercially acceptable option for this material.

While the silts and mud's have no re-use or beneficial value, Drogheda Port have over the period of the previous 5 year permit being placing some sands from the bar and approach channel onto the north near shore Dumpsite A2 (see **Figure 1 in Attachment E1.1**), subject to suitable tides, weather conditions and dredger manoeuvring restrictions, to assist in beach nourishment. This was a recommendation of the Drogheda Port Company Five Year Maintenance Dredging Programme, September 2001 (see **Attachment B1 – Kirk McClure Morton Report, 2001**).

Entrance and Seaward Approaches

Material at the river entrance and seaward approach is primarily sand with some gravel. This material is suitable for beneficial re-use for the construction industry provided the quantities to be dredged are large, economics of scale can be applied and market conditions are suitable. Specialist dredging and shore side handling equipment is usually required for this. This type of beneficial re-use is generally more suited to capital dredging where fresh material is being dredged rather than deposition of suspended material for which maintenance dredging is required.

However following detailed investigation and in line with the requirements of condition 'R' of Permit No. 387 (**see Attachment A7**), over the past 24 months in conjunction with an aggregate company, Drogheda Port has been trialling beneficial re-use of the material from the river mouth and seaward approaches, with a proportion of this dredge material going into the construction industry. As a core principal this is not considered or promoted as aggregate dredging. Dredging at the river mouth and seaward approaches is primarily in response to sediment accretion caused by weather events, i.e. south east and north east gales when accelerated sediment accretion impacts immediately on safe navigational depths. Natural accretion occurs over a longer period. Since July 2010, 94,470m³ of material has been taken ashore as part of this beneficial re-use trial. This is only a portion of the total material dredged from the river mouth and seaward approaches, the balance going to the seaward dumpsite. The river mouth and seaward approaches dredging and beneficial re-use project trial are tied together, generally in response to weather events. If this beneficial trial was not being operated then all the material from the river mouth and seaward approaches would be destined for sea disposal. The Environmental Protection Agency has been appraised of this trial which is still on-going.

Attachment B1 included: ***Drogheda Port Company Five Year Maintenance Dredging Programme, September 2001 (Kirk McClure Morton Consulting Engineers, 2001)***

B2 – Purpose of the operation

The purpose of the operation is for on-going maintenance dredging. To understand the requirement for maintenance dredging it is important to understand the dynamic of the river in respect of siltation, sediment transport and material deposition at the river mouth and seaward approaches, as well as the port's operation which is the driver of the need to dredge.

The River Boyne rises in the north midlands and exists to the sea at Mornington Co. Meath. The river flows through the towns of Kells, Trim, Navan, Slane and finally Drogheda where commercial shipping traffic use the river to serve Drogheda Port.

From Drogheda town to the sea at Mornington the river has been trained by means of training walls constructed around the 1850s by the then Drogheda Harbour Commissioners. This captured the main river flow with estuarine polders being created north and south of the training walls. This important work had two effects in that it increased the tidal exit velocity and thereby produced a scouring effect and created a reserve of water from the estuarine polders to supplement the falling tide.

The fresh water flows and tidal exit velocities from the River Boyne were further enhanced in the late 1960s by the Boyne drainage scheme of the upper reaches between Kells, Trim and Navan.

The river maintains high ebb tide exit velocities during winter fresh flows supplemented with spring tides, however these exit velocities quickly fall off at the river mouth.

The high velocities experience allows the Boyne to carry a very substantial quantity of sediment and fluvial material out to the river mouth providing a natural scour to the estuary. However, within the river this does not totally eliminate the need for maintenance dredging particularly at the berths, ship turning basins and river bends.

In addition the high velocities have little effect at the river mouth and maintenance dredging is required at the approaches to the port.

The entrance to the Boyne estuary lies within the coastal cell between Clogherhead in the north and Bremore to the south, on a shallow shoaling sandy beach where there is net annual movement of material from south to north.

The entrance to the port is particularly vulnerable to gales from the northeast through to the southeast which deposits mobile sediments from the shallow gradient shoreline north and south into the deeper dredged port approach channel. This is compounded by the fact that the sediment storage reservoir behind the south training wall constructed in 1970s has now been exhausted allowing full sediment bypass, accelerated by south easterly storm events. This impacts the navigation channel reducing the warranted depth, effecting safe navigation.

From the late 1960s the Drogheda Harbour Commissioners and latterly the Drogheda Port Company has carried out several detailed physical and mathematical modelling studies of the coastal cell from Clogherhead in the north to Bremore in the south and has a detailed understanding of the coastal processes and sediment transport regime (see **Attachment B1 Kirk McClure Morton Report, 2001**). It has been established that circa 120,000m³ of sediment is moving annually from south to north, accelerated during south east gales and spring tides.

B3 – Loading Area

Within the waterway under the jurisdiction of the Drogheda Port Company, maintenance dredging takes place primarily and most frequently at the river mouth and seaward approaches. Thereafter, maintenance dredging can take place at any location within the commercial estuary as determined by the Port Company as the navigational authority for the purpose of ensuring safe navigation.

The extent of area which falls within the area to be dredged is indicated on **Figure 2 (see Attachment B3)** and the co-ordinates delimiting this area are:

Area	Latitude	Longitude	ITM
Seaward approaches	53 43.36N	06 14.22W	716230.47, 776214.52
	53 43.25N	06 14.26W	716311.10, 776018.36
	53 43.24N	06 13.60W	717038.15, 776015.56
	53 43.35N	06 13.60W	717033.06, 776219.54
Commercial channel berths & swing basins from Drogheda town quays to the sea at Mornington	53 42.81N	06 20.95W	708975.40, 775014.22
	53 42.82N	06 20.96W	708963.36, 775036.39
	53 43.36N	06 14.33W	716230.47, 776214.52
	53 43.25N	06 14.26W	716311.10, 776018.36

The river under the jurisdiction of the Drogheda Port Company is approximately 7km in length from St. Mary Bridge in the town of Drogheda to the river mouth at Mornington. In the town there are five working berths numbered 1 - 4, length 430mtrs, on the north side the Knaggs Head, length 60mtrs on the south side. There are three ship-swinging areas that can accommodate vessels of lengths 90mtrs, 95mtrs and 105mtrs. The berths are maintained to depths of approximately -1.6mtrs at Chart Datum. At low water vessels on these berths take the bottom in soft mud.

From the town at Drogheda the river narrows to the point of Donors Green. Immediately east of this point on the south side of the river is the Maxol Hydrocarbon terminal and Flogas LPG terminal that jointly share this single berth. The berth is maintained at -3.0mtrs Chart Datum within a dredged pocket of 100mtrs x 25mtrs. Vessels at this berth are required to remain afloat at low water.

From this location the river is maintained at -2.2mtrs at Chart Datum over the full length of the navigation to the sea at Mornington.

The berths of Premier Periclase Ltd are found on the north shore. Depths are maintained at - 1.0mtrs Chart Datum over the 180mtr quay immediately adjacent to the deeper navigation channel at -2.2mtrs at Chart Datum. At low water vessels on this berth take the bottom in soft sand/gravels.

The Tom Roe's Point berths to the north side of the channel lie within a deep-water dredged pocket of a length of 210mtrs, width 25mtrs excluding side slopes, maintained to a depth of -5.5mtrs at Chart Datum. This dredged pocket is essential, as vessels nominated to these berths are required to remain always afloat.

To the east of this facility, 2km from the sea is the Fish Meal Quay. This berth in state ownership is used primarily for local fishing vessels and the discharge of Class 1 cargoes, classified under the International Maritime Dangerous Goods Code. The berth has a depth of -2.5mtrs at Chart Datum.

From the Maxol Hydrocarbon terminal the channel has been dredged to a uniform width of 50mtrs with side slopes of a general 1:5 gradient. At the South Point beacon (53 43'.89N, 06 16'.14W) the channel width increases to 60mtrs to the Carrick beacon (53 43'.76N, 06 15'.42W). From this point the channel width is maintained at 50mtrs to the Bull beacon (53 43'.30N, 06 14'.62W) where the channel width is increased to 100mtrs with side slopes 1:10, and extends to a point 700mtrs east of Lyons Light (53 43'.24N, 06 14'.26W).

A summary of depths within areas to be dredged is provided below.

Town Berths, No 1- 4, Knaggs Head & Ship Swinging Areas	-1.6m CD
Oil / LPG Berth	-3.0m CD
Premier Periclase Berth	-1.0m CD
River Channel from Town Berths to Hydrocarbon/LPG Berth	-1.0m CD
Tom Roes Point Berth	-5.5m CD
Maxol Hydrocarbon/Flogas LPG Berth to sea	-2.2m CD
Seaward Approach Channel	-2.2m CD

Attachment B3 Included: Figure 2 - Loading Site Extent and Boundary

B4 – Details of the Operation

Drogheda Port Company engages its own internal hydrographical unit to maintain an ongoing monitoring programme on channel depths particularly at the sensitive river mouth and seaward approaches. Some pre-planning of maintenance dredging at the river mouth and seaward approaches is possible given the historical database of information over the previous decade and knowledge of the sediment transport taking into account weather and on-going monitoring. However, given the weather sensitive nature and effects of storm events unplanned maintenance dredging also takes places to maintain safe navigation. For that reason, Drogheda Port maintains an open 24 x 365 maintenance dredging policy for the river mouth and seaward approaches without any encumbrances. This is essential to maintain the port operations.

Maintenance dredging within the estuary i.e. river channel, river bends, berths and swing basins is pre-planned with timing determined by plant availability, opportunity dredging from passing plant, operational requirements, markets conditions etc.

Dredging requirements

Over the previous five year maintenance dredging licence periods the port has accumulated a good deal of data and experience on the performance of the river and bar and the effects of weather. This coupled with mathematical modelling (**see Attachment B1 – Kirk McClure Morton Report, 2001**) now allows realistic figures to be placed on our maintenance dredging prediction going forward over the next period. Monitoring of the bar/river mouth and the most sensitive area of the river in dredging requirement terms is now carried out by the port internal hydrographic unit, thereby maintaining a good check on depths particularly after easterly wind storm events.

Estimated annual quantities of maintenance dredging of the berths, swing basins, channel, river mouth and seaward approaches are shown below in Table B4. These estimates are averages, based on the last 12 years of data on actual quantities dredged (for full details see **Attachment B4 Annual Quantities Actually Dredged 2001 – 2011**). Annual requirements may increase or decrease on this average estimate depending on weather events.

Table B.4 Estimated Annual Quantities of Maintenance Dredging

LOCATION	ESTIMATED ANNUAL QUANTITIES
Channel from town to sea, including all berths and ship swing areas	30,000m ³ (48,000 tonnes)*
Seaward approaches	90,000m ³ (144, 000 tonnes)**

*For calculation and planning purposes dredge quantities are generally given in metre cubic m³. A conversion factor of 1.6 is used for tonnes.

** This quantity is based on an average over the previous 11 year history. An annual contingency is sought where due to unforeseen circumstances or due to weather events additional dredging is required either within the commercial estuary or the river mouth and seaward approaches.

A contingency of an additional 100,000m³ is to allow for the unexpected and unplanned events that may impede the navigation channel. This is to cover an unexpected weather event or where the river retaining walls that created the estuarine polders collapse (as occurred in 2000) and the material contained within a polder flows out into the main navigation channel. This can occur due to a differential in the water pressure between the retained waters in the polder and the river falling tide levels. The river walls were constructed in the 1850s and their construction and current condition leave them susceptible to the effects of ship wash and hydrodynamic action.

The contingency also allows for unexpected weather events at the river mouth and seaward approaches.

Appropriate Plant

A range of dredging plant is suitable for maintenance dredging in the river Boyne. A contractor's selection of preferred plant utilization will be dependant on plant availability, location of dredging (*i.e.* bar, channel, berths or ship swinging areas) and unit rate. For this Maintenance Dredging application, typical plant to include for utilisation on the river Boyne estuary, berths, swing basins and bar area/approach channel are:

Trailer suction dredger: This is where the dredging vessel drags a pipe on the river bed and material is sucked up into the hold of the vessel. The material settles in the hold and excess water from the suction operation is returned to the sea as the hold reaches capacity. Once the hold is full the vessel proceeds to the approved spoil dump site and discharges the material through bottom doors in her hull that open to release the hold contents. The vessel continuously passes over the area to the dredged gradually increasing the depths to the required levels.

Bachhoe dredger: This is a stationary dredger similar to a flat to barge with an excavator attached. The vessel is maintained in position by spud legs that anchor it to the ground and the excavator digs the area to be dredger. The material is loaded into a self-propelled barges that moors alongside the backhoe. As each area is dredged to the required depth, the spud legs are raised, the backhoe re-positions itself and the anchoring/digging process is repeated.

Split barge: this is a purpose built barge for receiving dredged material from a dredging vessel such as the backhoe. Once the hold of the vessel is filled, she sails to the approved dumpsite and through bottom doors in her hull that open, releases the material.

Grab dredger: This is a vessel with a grabbing crane on board and dredges using a clam shell bucket. The material is generally deposited into the vessels hold for later sea disposal via bottom

doors. This is a coarse dredger method, dredging holes to create the required depth. On occasions bed levelling may be required following the dredging where the material does not naturally slump.

Bed levelling: this is where a small tug or similar vessel tows a cage or plough and removes material to the required level. It is particularly useful after the work of the trailer suction dredger or backhoe to level out high spots remaining to obtain the required dredge level.

Plough: Similar to the bed levelling, this is where a cage or plough is towed behind a small tug or similar vessel. The water is agitated the material being placed in suspension and then carried away by strong currents to be recovered by the trailer suction dredger some distance downstream of the plough operations where the sediments settle out. Such plant would be used where larger vessels due to the size and manoeuvring characteristics cannot operate.

B4 (I) Date of commencement of loading operations:

The Dumping at Sea permit is sought for a period of 8 years to cover maintenance dredging requirements from 2013 to 2021. Other than the licence start and finish date, there is no date, time constraint or time limit sought for the maintenance dredging. Dredging at the river mouth and port approaches is generally driven by weather events that cannot be predicted or scheduled. If the river mouth silts up due to a weather event resulting in impaired depths that impact on safe then dredging is required. If dredging is not required then no dredging takes place.

B4 (III) Location and method of loading of the substance or material:

The primary locations for maintenance dredging are referred to above in **B3 – Loading Area** i.e. the commercial estuary including all berths and ship swing basins, channel and the river mouth and seaward approaches. However, dredging can take place at any location within the commercial estuary.

B4 (IV) Total quantities (in tonnes and cubic metres) to be loaded:

Estimates for the annual total quantities to be dredged for the Dumping at Sea permit period are outlined above under B4, with a 100,000m³ additional contingency.

Daily, weekly or monthly dredge quantities are difficult to define in the absence of a contract where the contractor can advise of a vessel or plants production/capacity.

Experience to date with the range of suitable vessels for maintenance dredging in a shallow water tidal estuary and noted in our current permit of 9,000tonnes/5,600m³ meets the current ports requirements. Again, based on historical experience a maintenance campaign at the river mouth and seaward approaches typically has duration of about three weeks. For dredging within the commercial estuary i.e. channel, berths and ship swing basins, the daily product and duration is dependant on the location, quantity, operational constraints and particular vessel contracted.

Attachment B4: Annual Quantities Actually Dredged 2001 – 2011)

SECTION C – MATERIAL ANALYSIS

C1 – Tabular data on Sampling Points

Sediment analysis has been undertaken at 17 sampling points; 14 within the channel from town centre to the sea, and one each at the three dump sites (**See Figures 3 and 4 in Attachment C2(ii)**). Full results of this analysis are included at **Attachment C2(i)**.

Please note that the Annex I Tables C1(i) and C1(ii) have not been completed as this would be replication of the information which is already contained in Attachment C2(i) in a format required by the Marine Institute guidance. This approach was agreed between Liam Curren of Enterprise Ireland who undertook the sediment analysis work and Tara Higgins of the EPA (**refer to email correspondence included with Attachment C2(i)**).

C2 – Characteristics and Composition of the Substance or Material for Disposal

Full results of the sediment sampling and analysis are included in **Attachment C2(i)**.

Attachments C2 (i) and (ii): Included as listed below.

Attachment C2 (i) *Report from Enterprise Ireland: Sampling and analysis of Drogheda Harbour Sediments, October, 2011 (including results from the National Laboratory Service: Analytical Report on Marine Sediment Analysis and from the Radiological Protection Institute of Ireland: Laboratory Test Report on Marine Sediments)*

Attachment C2 (ii) **Figure 3 – Sampling and Monitoring Points**
Figure 4 – Sampling and Monitoring Points in River Channel

SECTION D – IMPACT ON THE RECEIVING ENVIRONMENT

D1 – Assessment of impact on the environment

Assessment of the predicted impacts of the proposed dumping at sea

Maintenance dredging at Drogheda Port is primarily trailer suction dredging. As part of an EIS prepared in 1997 for a capital dredging scheme, a comprehensive study was conducted in respect of run off from the dredging vessel (**see Attachment D1 – Sediment Plume Analysis, extract from 1997 EIS**) which found that there is minimal release with low sediment in suspension. Often when the river is in full spate, background material levels in suspension exceeds the dredging vessels run off. Maintenance dredging is considerably less intensive than capital dredging (for which the 1997 study was conducted). Maintenance dredging is tidal, twice daily, usually commencing three hours before high water to one hour after high water, generally of three weeks duration. Campaigns are typically twice yearly depending on weather. Run-off from the dredger will only occur in the latter stages of the loading operation when the dredger's hold is almost at capacity and generally on the ebb tide. Given that the channel at the primary dredge site is 100mtrs in width (channel toe to toe, actual channel width breakwater to breakwater is considerably greater including the open sea outside of the breakwaters). A typical dredger's beam is only 12/14 metres, therefore extent of and spread of run-off is minimal considering the scale of the dredge, the dredge timing duration, site location and the duration of the run off.

Dredge material is contained within the enclosed hold of the vessel while dredging and in transport to the dumpsite with the usual method of disposal of material by bottom doors.

Given that dredging takes place in shallow water, within a defined channel, from a vessel with a draft of 3-5mtrs, where the flows are either flood or ebb, in a river that has a high fluvial material in suspension content, dispersal from dredging is difficult to quantify however as is indicated in the study undertaken as part of the 1997 EIS (**see Attachment D1 – Sediment Plume Analysis, extract from 1997 EIS**) there is minimal release with low sediment in suspension.

A similar argument can be made in respect of the inshore Dump Sites A2 and A3 where the depth of water at Chart Datum is only 4mtrs. At the off shore Dump Site A1 a Sediment Disbursement Analysis using tracking drogues was carried out in November 2006 (**See Attachment D2 – Survey Report on Drogue Releases at Drogheda Offshore Dump Site, 22nd November 2006, Hydrographic Surveys Ltd**). This study demonstrated there is little or no movement of dumped sediment shorewards when released at Dump Site A1.

Dump Site A1 has been the subject of two Impact Hypothesis, the most recent in June 2006 as part of a capital dredging scheme. (**See Section 3.4 of Attachment D3 - Aquatic Ecological Study, ASU, June 2006**). This study has demonstrated that this site has a reduced species diversity and abundance due to the history of use of this dump site.

Both the commercial estuary and dumpsite fall under the navigational jurisdiction of the Drogheda Port Company and there are no conflicts with navigation or leisure boating activities.

With regard to fishing and nursery habitats, as part of the 2006 Maxol Capital Dredging programme of 1.3km of the upper estuary, an extensive amount of environmental assessment work has been commissioned for previous dredging projects (**Attachment D1 – Sediment Plume Analysis, extract from 1997 EIS as well as Attachment D3 - Aquatic Ecological Study, ASU, June 2006**). These studies demonstrated that there is minimal release of dredge material and that dredging is not expected to have any significant negative impact on protected fisheries. This information while applicable to a capital scheme where new depths were being created, can also be applied to this maintenance scheme, however, it is important to appreciate that the impacts are considerably less by virtue of the fact that the dredging is only maintaining current depths, less concentrated in terms of activity levels and plant involved, carried out over a much shorter time scale (generally 2/3 weeks as opposed to 24/7 capital dredging methodology), mostly concentrated at the river mouth and seaward approaches.

The mussel fishery is closed. There is no Ministerial Bivalve Molluscs (Production Area) Designation. There are no vessels licenced to harvest the fishery. The fishery has no management plan.

There is a government ban on all licenced net salmon fishing on the river Boyne.

There is no commercial or recreational fishing at the offshore dumpsite given that it is a spoil ground, port anchorage and quarantine area etc. There is no commercial fishing at the inshore dumpsites given the shallow water and proximity to the low water mark.

The Drogheda Port Company has carried out extensive estuarial and seaward dumpsite archaeological investigation associated with its capital dredging schemes in 1999-2000 and 2006. Both of these dredging campaigns un-earthed a range of archaeological finds.

Archaeology investigation on the river has been on-going and in respect of particular areas of concern following the 1999-2000 capital dredging (*i.e.* “The Boyne Boat” in position close approximate to the Queensboro navigational beacon 53 43.49N 006 17.17W) and the capital dredging in 2006 (*i.e.* the “Viking Boat” in position close approximate to the Milestone navigational beacon 53 43.18N 006 19.12W), agreement has been reached between the Maritime Archaeological Unit of DoEHLG and the Port Company on the mechanisms for maintenance dredging in the two particular areas of archaeological concern should dredging be required.

As part of the 2002 – 2007 maintenance programme a once off monitoring programme was put in place without any archaeological artefacts being found. Maintenance dredging by its nature is not dredging to new depths but maintaining the current depths (eroded due to sediment accretion) and therefore is not invasive to archaeology. As policy, archaeological monitoring in respect of maintenance dredging is not now required (**see Attachment D4 – letter from D. Fadden 2003**).

None of the dump sites fall within cSAC, SPA or pNHA designations. The loading areas however fall under the following designations:

- The River Boyne and River Blackwater candidate Special Area of Conservation cSAC & pNHA 2299
- The Boyne Coast and Estuary cSAC 1957
- The Boyne Estuary Special Protection Area SPA 4080

Potential impacts on these designated sites are addressed in detail in the **Natura Impact Statement included in Attachment D5**. This report concludes that with the correct implementation of proposed mitigation measures negative impacts on these designated sites will be avoided.

A range of potential impacts have been examined in the **Natura Impact Statement included in Attachment D5**, including potential impacts of the loading and dumping operations on coastal processes and the sediment regime within the coastal sub-cell within which the operations are located. **The RPS 2012 report Boyne Entrance Channel Dredging Impact on Sediment Cell included as Attachment D6**, examines this in detail and concludes that the quantities of materials which it is proposed to dredge and either dump or remove for beneficial re-use are sustainable in terms of the coastal processes and sediment regime. This study concluded that, in order to ensure there are no impacts on the overall coastal cell from the dredging operations, not more than an annual average quantity of 60,000m³ of dredged sand should be brought ashore for beneficial reuse. The remaining 30,000m³ of material that is required on average to be dredged from the Boyne Estuary entrance is equivalent to about 0.6mm sand depth over the active beach area which is considered to be minor and insignificant. Nonetheless, the Drogheda Port Company has given a commitment that the 30,000m³ (average) of additional material to be dredged will be retained within the coastal cell, either within the active system (dumped at Dump Sites A2 and A3, depending on operational conditions) or placed in the offshore dump site.

Attachment D1-D6: Various included as follows:

- Attachment D1:** Sediment Plume Analysis (extract from *Drogheda Port Development Capital Dredging Scheme Environmental Impact Statement Main Report*, Kirk McClure Morton, 1997. Pages 5.20 – 5.21 and Figures 5.38 – 5.45)
- Attachment D2:** Survey Report on Drogue Releases at Drogheda Offshore Dump Site. 22nd November 2006, Hydrographic Surveys Ltd
- Attachment D3:** Impact Hypothesis, presented as Section 3.4 of the Aquatic Ecological Impact Study (June 2006), prepared by Aquatic Services Unit, on behalf of Malone O'Regan Environmental Services for inclusion in Environmental Impact Statement: Proposed Capital Dredging at River Boyne, Drogheda Port, Co. Louth (Malone O'Regan Environmental Services Ltd, 2006) (Attachment B1 (ii)).
- Attachment D4:** Letter dated December 2003, regarding Maintenance Dredging and Maritime Archaeology (Dave Fadden, Principal Officer DoEHLG).
- Attachment D5:** Natura Impact Statement: Provision of Information for an Appropriate Assessment for a Maintenance Dredging Plan for the Drogheda Port Company, Co. Louth
- Attachment D6:** Drogheda Port Company: Boyne Entrance Channel Dredging. Impact on Sediment Cell (RPS, 2012).

Please note that the Annex I Tables D1(i) and D1(ii) have not been completed as this would be replication of the information which is already contained in Attachment C2(i) in a format required by the Marine Institute guidance. This approach was agreed between Liam Curren of Enterprise Ireland who undertook the sediment analysis work and Tara Higgins of the EPA (**refer to email correspondence included with Attachment C2(i)**).

SECTION E – DUMPING OPERATIONS

E1 – Site Selection

The main dumpsite primarily used in the past for port maintenance and capital dredging is site Dumpsite A1 (**see Attachment E1.1: Figure 1 – Location of Maintenance Dredging Dumpsites**). This site is used for both sand, silt and mud materials. This is the site requested for the future maintenance dredging sea disposal from the berths, ship swinging basins and channel etc, i.e. from town to sea, and for the sand material from the river mouth and seaward approaches.

Dumpsite A1 is contained within the defined port limits of the Drogheda Port Company and is regulated as such from a navigational and control of shipping perspective. The site located within the designated anchorage of Drogheda Port in a depth of 13 - 15 metres of water at Chart Datum. The site is also within the designated ship quarantine area for implementation of the International Ship and Port Facility Security Codes (ISPS) and EU Security Directive 65/2005.

Dredge material has been disposed of at the site over the last decade and a half. There has been no significant impact or reduction on navigational depths or impact to the overall site hydrodynamics (**see Attachment E1.2: Hydrographic survey of site, Drawing No. HS 34/06**).

The north and south near shore sites ‘A2’ & ‘A3’ sites are contained within the defined port pilotage limits of the Drogheda Port Company and regulated as such from a navigational and control of shipping perspective. Both have been determined by hydraulic and hydrodynamic mathematic computer modelling to be the advantageous sites to aid the coastal process and beach re-nourishment (**see Attachment B1 – Kirk McClure Morton Report, 2001**).

Both sites are only suitable for sand material from the river mouth and seaward approaches.

The depth at both sites is shallow with only 4mtr of water at Chart Datum. Dredger access for safe material dumping is conditional on weather, state of the time i.e. late flood or early ebb tide and vessel manoeuvrability.

Attachments E1.1 and E1.2 included as follows:

Attachment E1.1	Figure 1 – Location of Maintenance Dredging Dumpsites
Attachment E1.2	Hydrographic survey of site, Drawing No. HS 34/06.

E2 – General Information

E2 (i) Dump Site

The seaward Dumpsite A1 has been used as the main dumpsite for over the past decade and a half for Drogheda Port maintenance and capital dredging. Drogheda Port Company is the only permit holder in respect of the dump site.

Detailed data about past disposal operations are included in an Excel spread sheet (**see Attachment B4: Annual Quantities Actually Dredged 2001- 2011**) and previous permits held are listed under **section A7** above.

Two Impact Hypotheses have been carried on Dumpsite A1, the most recent of which attached (**see Attachment D3: Aquatic Ecological Study, ASU, June 2006**). This study has demonstrated that this site has a reduced species diversity and abundance due to the history of use of this dump site.

Sediment Disbursement Analysis using tracking drogues was carried out in November 2006 at Dumpsite A1 (**See Attachment D2: Survey Report on Drogue Releases at Drogheda Offshore Dump Site, 22nd November 2006, Hydrographic Surveys Ltd**). This study demonstrated there is little or no movement of dumped sediment shorewards when released at Dump Site A1.

Attachment E2(i): None included.

E2 (ii) Dump Site Co-ordinates

All dumpsites with their co-ordinates are illustrated in **Attachment E1.1: Figure 1 – Location of Maintenance Dredging Dumpsites.**

Attachment E2(ii): None included.

SECTION F – MONITORING

Section F.1 Monitoring Programme

In line with the sediment analysis which Drogheda Port has undertaken for previous permit periods, sediment analysis will be carried out at the loading after a five year period in compliance with the guidelines from the Marine Institute.

Drogheda Port will maintain its Tier 1 pollution response.

Drogheda Port will maintain a daily register of all loading including details of the loading and dumping locations/times etc.

Attachments F1: None included.



AIB BANK, DROGHEDA, CO. LOUTH.

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DATE 27/3/12

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DROGHEDA PORT COMPANY

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JLC Payne
Michael Murphy

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DEPARTMENT OF AGRICULTURE FISHERIES AND FOOD

DUMPING AT SEA ACT, 1996 AND 2004

AMENDED LOADING AND DUMPING PERMIT NO. 387

1. The Minister for Agriculture, Fisheries and Food, in exercise of the power conferred on her by section 5 of the Dumping at Sea Act 1996 (as amended), and after consultation with the Minister for the Environment, Heritage and Local Government, and the Minister for Enterprise, Trade and Employment, hereby grants this permit to Drogheda Port Company, The Mall, Drogheda, Co. Louth

2. There is hereby authorised by this permit:-

- (a) the loading at Drogheda Harbour onto the vessels "Sospan", "Sospan Dau", "MV Hebble Sand" and "Lough Foyle" during the period from 25th January, 2010 to 12th February 2013 of 9,000 tonnes daily of dredge spoil up to a maximum total of 252,800 tonnes from dredging of the town quays of the port including all berths, shipping swinging areas and the estuarial channel to the sea, and a maximum of 1,332,800 tonnes from the bar mouth and approach channel of the port, subject to the exclusions at 3(a), 3(b), 3(c).
- (b) the dumping from the vessels "Sospan", "Sospan Dau", "MV Hebble Sand" and "Lough Foyle" in the following parts of the sea bounded by

SITE A:

- (i) latitude 53°45' North and longitude 06°11' West,
- (ii) latitude 53°45' North and longitude 06°10' West,
- (iii) latitude 53°44' North and longitude 06°11' West, and
- (iv) latitude 53°44' North and longitude 06°10' West.

SITE B:

- (i) latitude 53°46.11' North and longitude 06°13.72' West,
- (ii) latitude 53°46.10' North and longitude 06°13.07' West,
- (iii) latitude 53°45.52' North and longitude 06°13.76' West, and
- (iv) latitude 53°45.53' North and longitude 06°13.09' West.

SITE C:

- (i) latitude 53°40.99' North and longitude 06°13.06' West
- (ii) latitude 53°41.07' North and longitude 06°12.34' West,
- (iii) latitude 53°40.20' North and longitude 06°12.87' West, and
- (iv) latitude 53°40.26' North and longitude 06°12.11' West.

during the period from 25th January, 2010 to 12th ^{Feb} ~~January~~ 2013 of 9,000 tonnes daily of dredge spoil up to a maximum total of ~~252,800~~ tonnes from dredging of the town quays of the port including all berths, shipping swinging areas and the estuarial channel to the sea, and a maximum of 1,332,800 tonnes from the bar mouth and approach channel of the port, subject to the exclusions at 3(a), 3(b), 3(c).

- (c) All vessels used in connection with the dredging and dumping activity the subject of this permit must meet with the certification requirements of the Marine Survey Office for the purposes stated in this permit. The permit holder shall ensure that the vessels used in connection with this permit are fully certified for the entire period of validity of this permit.

3. This permit is granted upon and subject to the following conditions:-

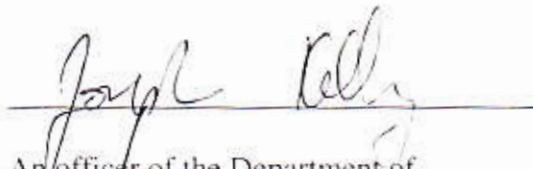
- (a) Dumping of dredge spoil in SITE A1 shall be restricted to within the area contained within the following co-ordinates; 53°45.00' North and longitude 06°11.00' West, 53°45.00' North and longitude 06°10.00' West, 53°44.00' North and longitude 06°11.00' West, 53°44.00' North and longitude 06°10.00' West.
- (b) Dumping of dredge spoil in site A2 and south near shore site A3 shall be restricted to when tides are suitable within the area contained within the following co-ordinates; 53°46.11' North and longitude 06°13.72' West, 53°46.10' North and longitude 06°13.07' West, 53°45.52' North and longitude 06°13.76' West, 53°45.53' North and longitude 06°13.09' West, and
- (c) 53°40.99' North and longitude 06°13.06' West, 53°41.07' North and longitude 06°12.34' West, 53°40.20' North and longitude 06°12.87' West, 53°40.26' North and longitude 06°12.11' West respectively.
- (d) The maximum amount of dredge spoil to be dumped at the three dumpsites in any one calendar year shall be 50,560 tonnes from dredging of the town quays of the port including all berths, shipping swinging areas and the estuarial channel to the sea, and 266,560 tonnes from the bar mouth and approach channel of the port.

- (e) Dredging and dumping shall be carried out in accordance with Drogheda Port Company's 5-Year Plan that was submitted to, and approved by, the Department of Agriculture, Fisheries and Food.
- (f) The substance or material to which this permit relates shall be material dredged to maintain the quays, berths, shipping swinging areas, the estuarial channel to the sea, the bar mouth and the approach channel of Drogheda Port.
- (g) Dumping shall be effected by release through the hull of the disposal vessel.
- (h) The following information in relation to each load of the substance or material intended to be dumped, and put on board the vessel, shall be entered in a register relating to the dumping which shall be maintained by the holder of the permit:
 - (i) the name of the vessel,
 - (ii) the source of the substance or material,
 - (iii) the date, time and position at which the voyage for the purposes of dumping began and the place at which it began,
 - (iv) the date, time and position at which dumping began,
 - (v) the date, time and position at which dumping ended,
 - (vi) the quantity, stated in metric tonnes, of the substance or material dumped,
 - (vii) the date, time and position at which the vessel completed the voyage for the purpose of dumping and the place at which it was completed.
- (i) Entries in a register or log required to be made pursuant to this permit shall be made as soon as may be after the events to which they relate. The register or log shall be retained for not less than three years after the making of the entries and copies of any such entries made in the preceding three months shall be sent to the Environmental Protection Agency, Johnstown Castle Estate, County Wexford as soon as may be after 1st May 2008 and every three months thereafter, with a final report as soon as may be after 1st January 2013.
- (j) The cost of any other tests, sampling, analysis and monitoring which the Minister for Agriculture, Fisheries and Food may require in relation to the dumping of the substance or material the subject of this permit shall be borne by the permit holder.

Furthermore, the cost of any tests, sampling, analysis and monitoring surveys carried out by an authorised officer or by or on behalf of the Minister for Agriculture, Fisheries and Food in relation to the dumping of a substance or material the subject of this permit shall also be borne by the holder of the permit.

- (k) The master and owner of the vessel shall, if so requested, permit an authorised officer to be on board the vessel during dumping operations. They shall permit and facilitate the carrying out by the officer of his functions under the Dumping at Sea Act, 1996, and shall comply with the provisions of that Act in relation to the officer and those functions.
- (l) A marine position recorder in accordance with Department of Agriculture, Fisheries and Food specifications shall be installed and maintained on the dumping vessels. Information regarding dumping voyages shall be automatically recorded to allow monitoring of the dumping operation by the Department of Agriculture, Fisheries and Food.
- (m) Drogheda Port Company shall indemnify and keep indemnified the State, the Minister for Agriculture, Fisheries and Food, his officers, servants or agents against all actions, loss, damage, costs, expenses and any demands or claims howsoever arising in connection with the dredging and disposal operations that are the subject of this permit, and the Port Company shall take such steps as the Minister may specify in order to ensure compliance with this condition.
- (n) Drogheda Port Company shall adhere to recommendations made by the Underwater Archaeology Unit of the Department of the Environment, Heritage and Local Government.
 - (1) The underwater archaeological assessment should be carried out by a suitably qualified underwater archaeologist and should be licensed to the Department of the Environment, Heritage and Local Government.
 - (2) As the areas of the Boyne boat and Drogheda boat sites have the potential for residual archaeological material within their immediate location, archaeological monitoring will be required during the course of the completion of the dredging works. The Department of the Environment, Heritage and Local Government will carry out the relevant archaeological monitoring at the sites.
 - (3) Sufficient notice will need to be given to the Dept of Environment, Heritage and Local Government to allow for monitoring archaeologists to be on board the dredger during the duration of the dredging works.

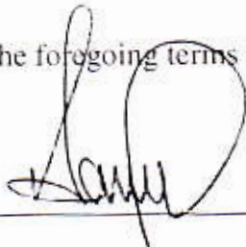
- (4) In the event that material that is potentially archaeological is recovered during the course of this monitoring, the dredging operation may have to cease until a dive survey is undertaken.
- (5) Archaeological monitoring is required for the known location of the 2 logboat sites and for the completion of capital dredging operations in the area of the Drogheda Boat location. Sufficient notice of (one week) should be given to allow for monitoring archaeologists to be on board of the dredger during the duration of the dredging works.
- (6) Drogheda Port Company will not carry out any dredging or dumping on the Boyne boat and do not plan any direct impact for the area of the wreck site. The dredging for the navigation channel shall avoid the wreck by at least 10 metres. The dredging operator should be made aware of the location of the wreck site and the dredger track plots and hydrographical data should be submitted to the Department of the Environment, Heritage and Local Government following completion of the dredging operations.
- (o) From a water quality point of view, an assessment of sediment quality to be undertaken in accordance with the Guidelines for the Assessment of Dredge Material issued by the Marine Institute in April 2006.
- (p) Drogheda Port Company shall adhere to the recommendation made by the Heritage and Planning Division of the Department of the Environment, Heritage and Local Government that no dredging shall be carried out during periods of low-tide.
- (q) All vessels used in this dumping/dredging operation must comply with statutory regulations.
- (r) Drogheda Port Company shall continue to actively investigate the possibility of alternative disposal and reuse options for the dredge material the subject of this Permit and shall liaise with the Department of Agriculture Fisheries and Food in this regard on an ongoing basis.
- (s) Drogheda Port shall adhere to the recommendations given by the Marine Survey Office. The applicant is required to arrange the publication of a local Marine Notice prior to commencement of operations. This notice should give a brief description of the work to be undertaken, the method of dredging and a time scale in order to give as much notice and information to port users. In order for charts and nautical publications to be undated the applicant is required to inform the British Admiralty Hydrographic Office at Taunton, UK, of the location and nature of the proposed works.



An officer of the Department of
Agriculture, Fisheries and Food duly
authorised by the Minister for
Agriculture, Fisheries and Food under
Section 15(4) of the Ministers and
Secretaries Act 1924, to authenticate
permits under section 5 of the Dumping
at Sea Act 1996 (as amended).

• • Dated this 3 day of February, 2010

The foregoing terms and conditions are accepted:



Signed on behalf of Drogheda Port Company

Harbour Master's Office

Drogheda Port Company

Date:

04.02.2010

This permit may be amended or revoked by the Minister for Agriculture, Fisheries and Food whenever he thinks it appropriate to do so. Breach of a condition of this permit will render the permit holder, the master and the owner of the vessel concerned, and any other person who causes or permits dumping or loading for dumping in pursuance of this permit, liable to prosecution for unlawful dumping or loading for dumping, as the case may be.

REGISTER OF LOADS DUMPED AT SEA

Permit No _____	Name of Vessel _____	Type of Spoil _____	Method of Positioning _____
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[illegible]

Total : _____ MT Cumulative Total : _____ MT

DROGHEDA PORT COMPANY
FIVE YEAR MAINTENANCE
DREDGING PROGRAMME
SEPTEMBER 2001



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1.0 INTRODUCTION

This report presents Drogheda Port Company's five year maintenance dredging programme required to maintain a navigable channel of -2.2 m C.D. at the bar. The maintenance dredging programme is essential to keep Drogheda Port open.

2.0 ANNUAL MAINTENANCE DREDGE SPOIL QUANTITIES

The annual maintenance dredge spoil quantities were calculated using sediment transport modelling techniques based on 3 hourly wave time series data over the 10 year period 1991-2000/01.

The computed annual maintenance dredge spoil quantities are presented in Table 1. The computed quantities were calibrated using measured sediment transport rates available over the period April 2000-March 2001, following completion of the Capital Dredging Scheme. The annual average maintenance dredging quantity is in the order of 130,000 m³/year. The annual maximum maintenance dredging quantity is in the order of 200,000 m³/year.

The long term sediment movements along the beaches, north and south of the training walls, are presented in Appendix 1. The sediment movements, illustrated for six locations along the beaches, show that sediment transport occurs both from the south to the north (blue line) and from the north to the south (red line). Overall the nett drift is from the south to the north. In the long term, approximately 60% of the material deposited in the navigation channel originates from south of the training walls and 40% from north of the training walls.

Table 1 Computed Annual Maintenance Dredging Quantities for Channel Maintenance to –2.2 m CD

Year	Quantity (m³)
1991	104,955
1992	65,045
1993	157,008
1994	113,551
1995	113,190
1996	169,807
1997	142,278
1998	116,675
1999	94,289
2000/01	192,910
Ten Year Average	126,971

3.0 SEDIMENT TYPE

The material to be dredged comprises fine to medium sands with a particle size of 130-160 μm which matches the general sandy nature of the sediments within the mobile zone off the beaches to the north and south of the training walls.

4.0 PROPOSED LOCATION OF DREDGE SPOIL DUMP SITES

It is proposed to dispose of the dredged spoil within the mobile zone, off the beaches to the north and south of the training walls at locations presented in Figure 1.

Approximately 60% of the material will be disposed of at the site south of the training walls. In an average year this would equate to around 80,000 m³. The maximum quantity to be disposed of in any one year is expected to be 120,000 m³.

Approximately 40% of the material will be disposed of at the site north of the training walls. In an average year this would equate to around 50,000 m³. The maximum quantity to be disposed of in any one year is expected to be 80,000 m³.

The co-ordinates of the extent of the proposed dredge spoil dump sites are as follows:

Site north of training walls

Latitude	53° 46.11'N	Longitude	6° 13.72'W
	53° 46.10'N		6° 13.07'W
	53° 45.52'N		6° 13.76'W
	53° 45.53'N		6° 13.09'W

Site south of training walls

Latitude	53° 40.99'N	Longitude	6° 13.06'W
	53° 41.07'N		6° 12.34'W
	53° 40.20'N		6° 12.87'W
	53° 40.26'N		6° 12.11'W

5.0 METHOD OF DISPOSAL

It is proposed to dispose of the dredge material using a bottom-opening barge. The material will be released whilst the barge is traversing the dump sites with the doors of the barge partially open to control the spread of the material across the site. The depth of material deposited on the site is expected to be on average 100 mm during the most extreme year of maintenance dredging. The average depth of material during a more typical year will therefore be less than 100 mm.

6.0 ENVIRONMENTAL IMPACT

The disposal of dredge spoil at the proposed dump site locations will have the following environmental impacts:

- the sediment will be retained in the littoral sediment transport cell.
- the disposal of the sediment in the mobile zone will allow natural sorting of the dredged material to take place with the sand migrating on to the beaches.

- the relocation of the dredged material to where it originated from will assist in maintaining the present status quo and be a contributing factor in preventing further erosion of the coastline at Bettystown and Laytown.
- the disposal of the dredged material within the mobile zone will limit the impact on benthic communities. The majority of species of the sand community are relatively mobile, and these will either re-colonize rapidly or be able to burrow up through the new sediment covering, as these processes occur naturally at the sites. There may nevertheless be a slight loss of biodiversity due to the frequent nature of the disposal operations.
- The proposed dump sites lie outside the areas classified for Razor Clam Fishing.
- The method of spreading the dredged material across the proposed dump sites from a bottom-opening barge will not impact on the marine archaeological potential of the sites.

Overall, the disposal of dredge spoil at the proposed dump sites is expected to have a beneficial environmental impact.

Explanation of Sediment Drift Charts

The longshore sediment transport direction depends upon the wave direction at the particular time in the annual wave time series. Thus some of the time the drift will be northwards and at other times it will be southwards. The charts show the rates of drift over the whole year in each direction plus the net drift direction.

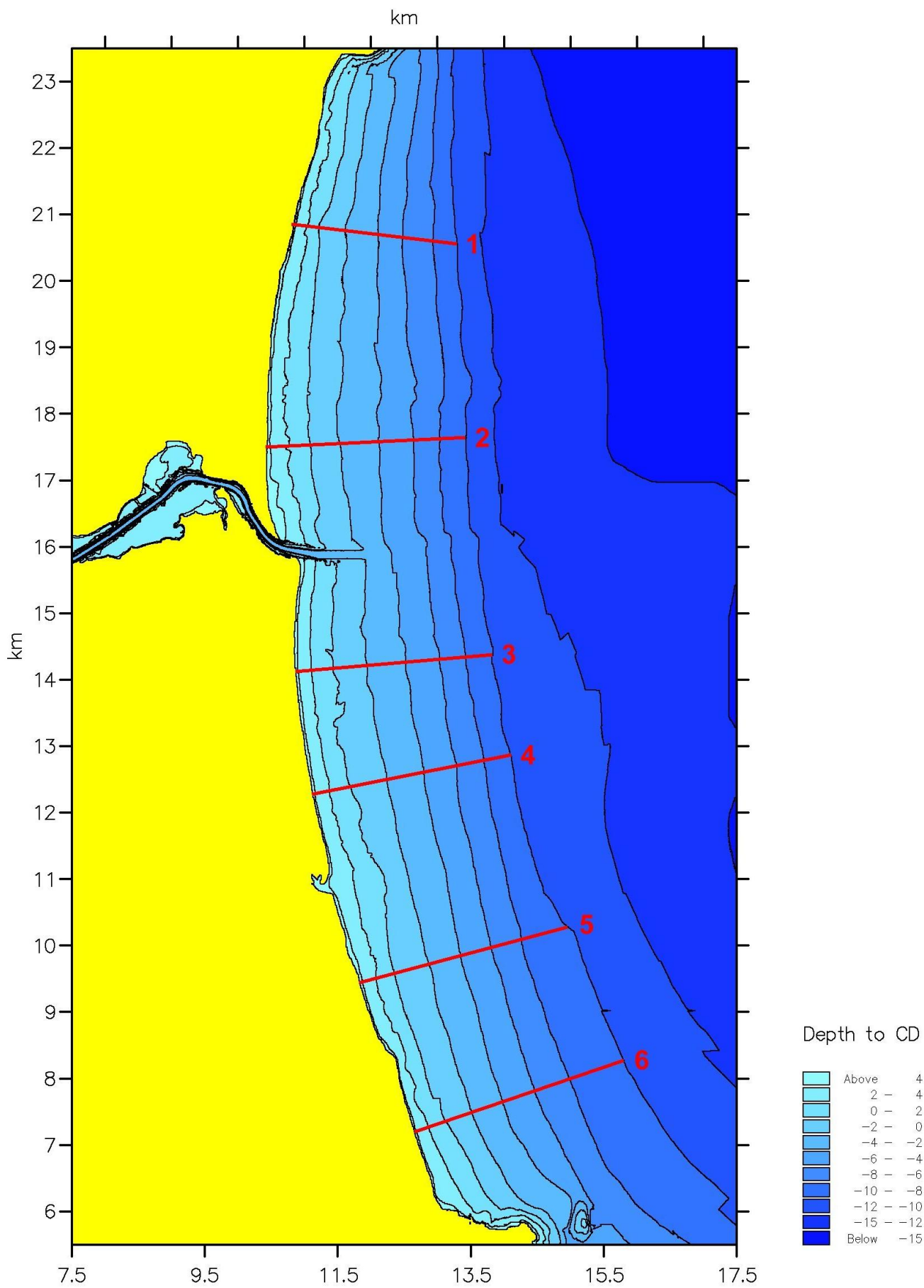
- Black line** - beach profile from deep water to the shoreline (moving from left to right on the chart). The level of the beach is given on the right hand y-axis in metres relative to Chart Datum. Distance along the beach is given on the x-axis in metres.
- Red line** - Rate of north going longshore sediment transport at each point along the beach profile. The units are in m^3/year per metre length along the beach profile and are given on the left hand y-axis.
- Blue line** - Rate of south going longshore sediment transport at each point along the beach profile. The units are in m^3/year per metre length along the beach profile and are given on the left hand y-axis.
- Purple line** - Net rate of longshore sediment transport at each point along the beach profile. The net drift is northwards where the purple line lies below the zero point on the left hand y-axis. The net drift is southwards where the purple line lies above the zero point on the left hand y-axis.

Notes

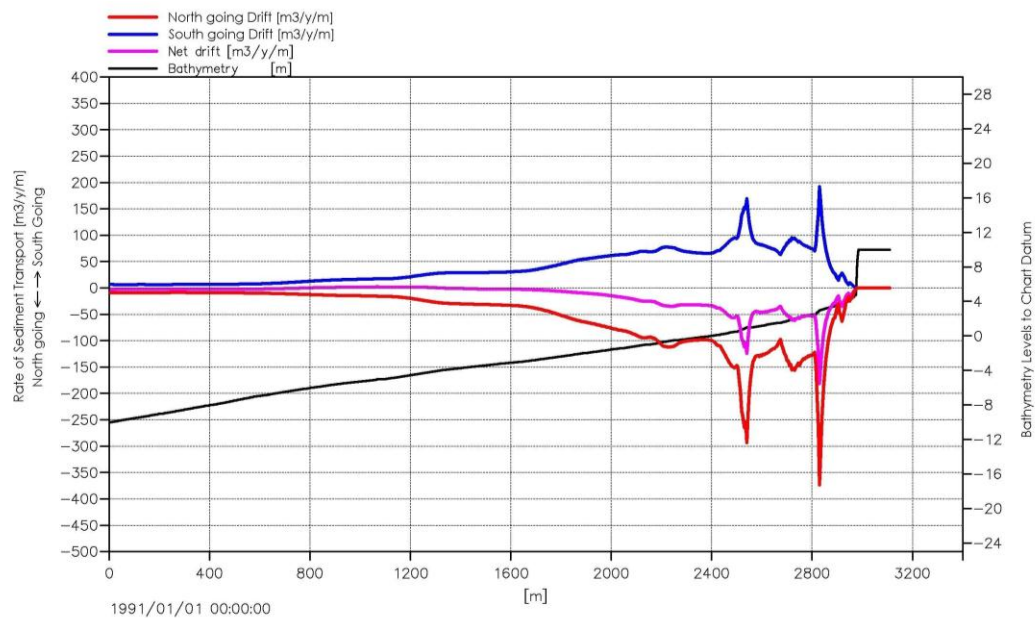
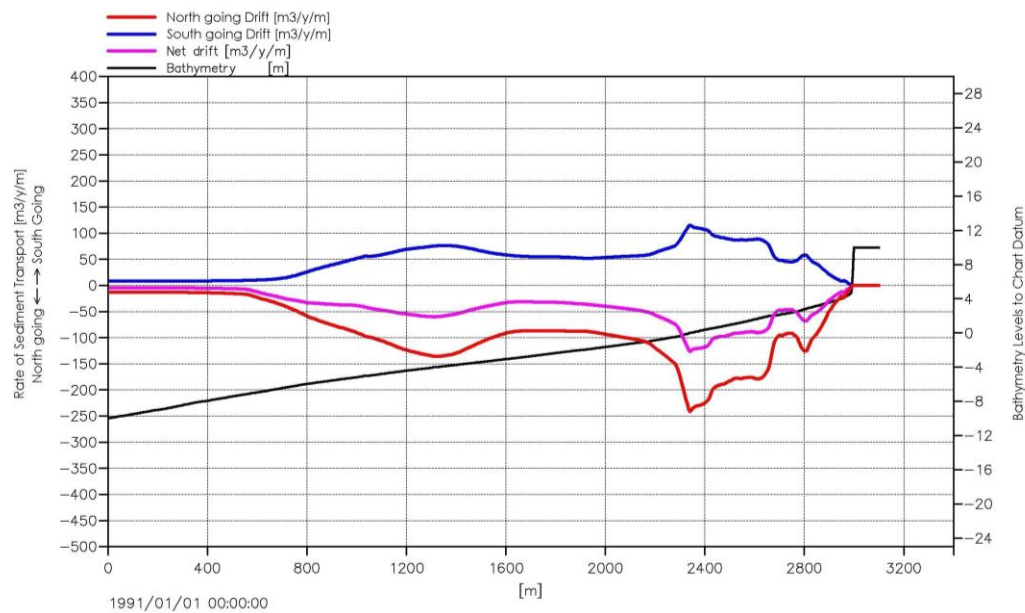
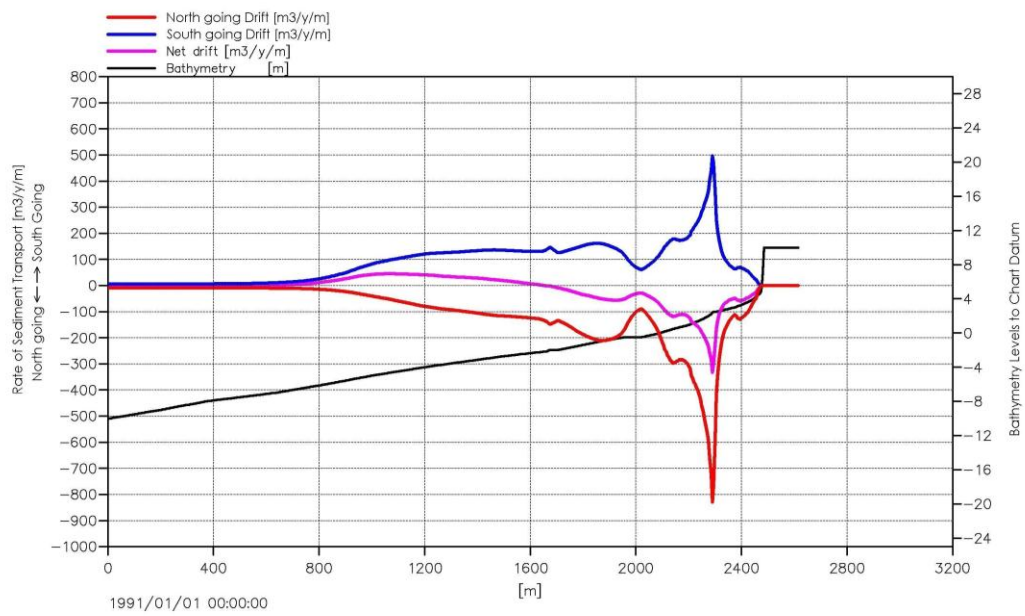
1. The charts represent the average annual sediment drift based on 10 years of simulations, 1991- 2000.
2. The seaward limit of the active zone for longshore sediment transport occurs where the red and blue lines diverge from the zero point on the left hand y-axis. The active zone is generally associated with water depths where waves break. The spikes in the curves occur where waves break over offshore sand bars.

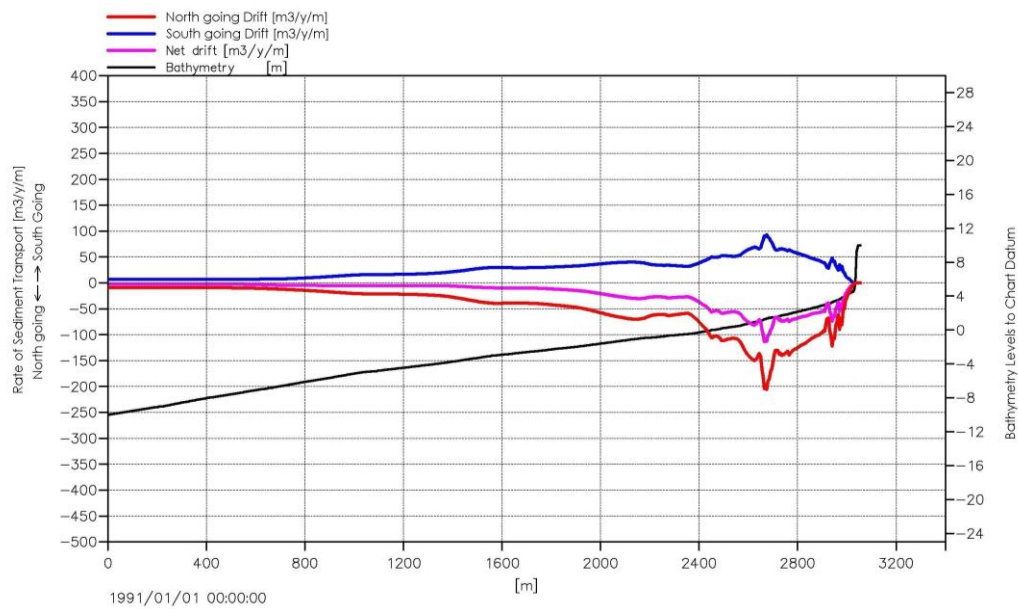
3. The proposed locations of dump sites for maintenance dredging generally lie between 2 m and 5 m below Chart Datum. The sediment drift curves show that these locations lie within the active zone. Sand dumped at these sites will therefore migrate both along and towards the shoreline.

APPENDIX 1
LONG TERM SEDIMENT TRANSPORT MOVEMENTS

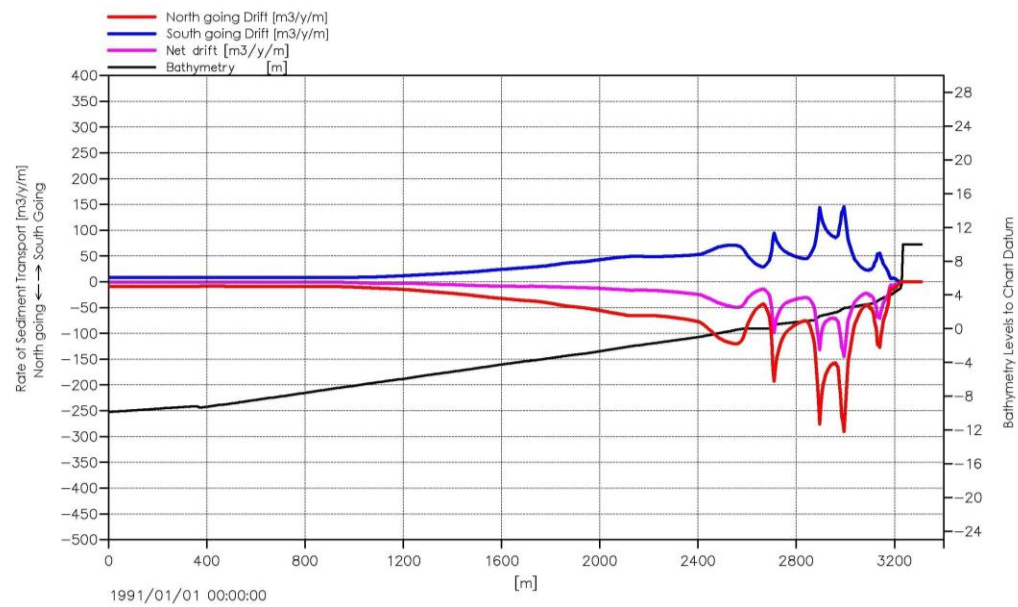


Location of Beach Profiles

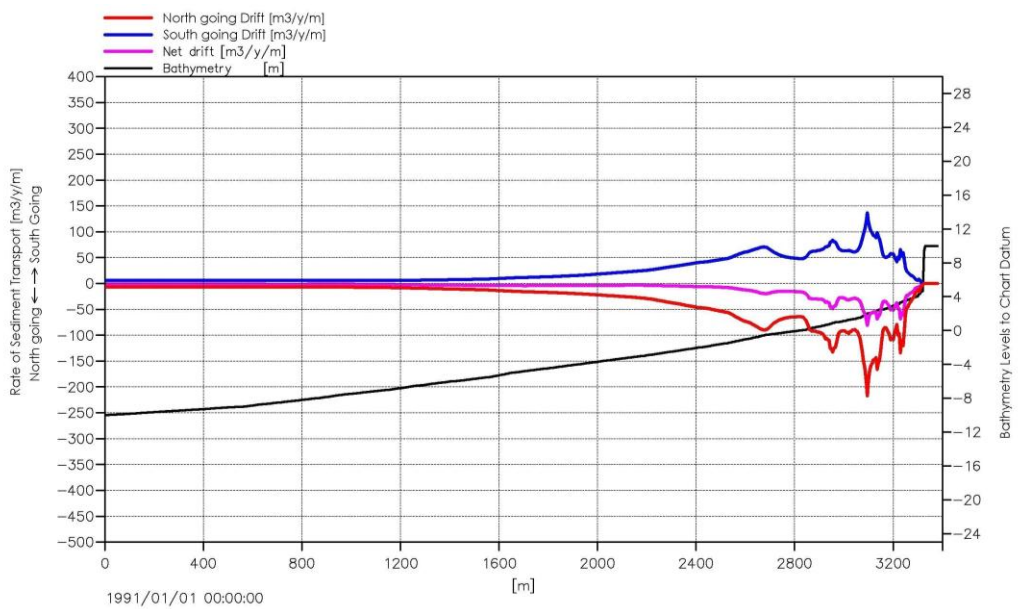




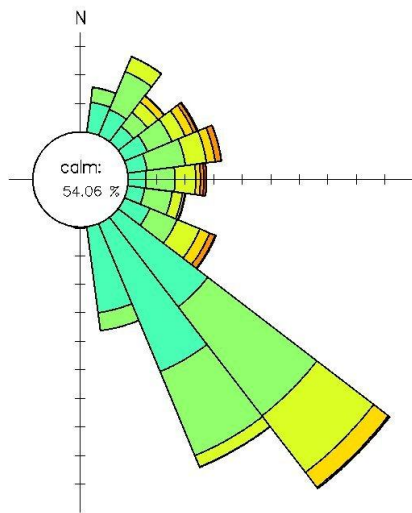
Profile 4 - Average Annual Sediment Drift 1991- 2000



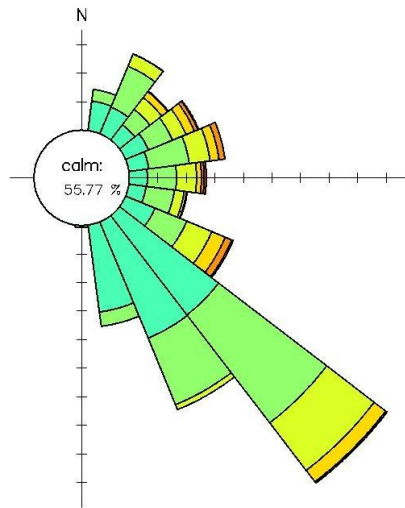
Profile 5 - Average Annual Sediment Drift 1991- 2000



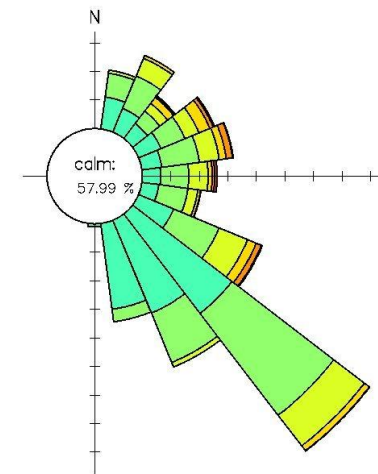
Profile 6 - Average Annual Sediment Drift 1991- 2000



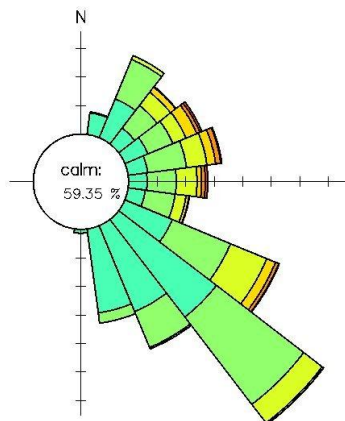
Profile 1



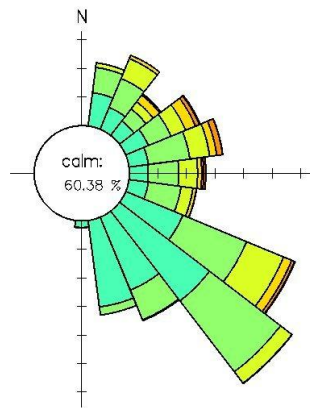
Profile 2



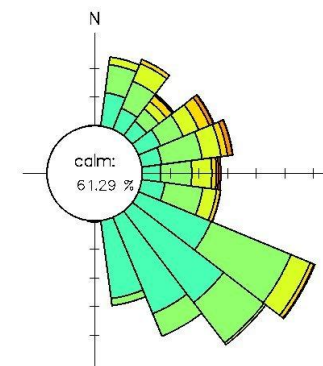
Profile 3



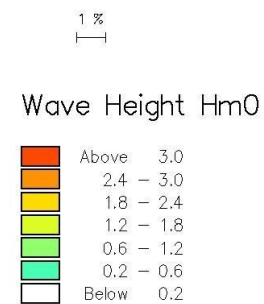
Profile 4



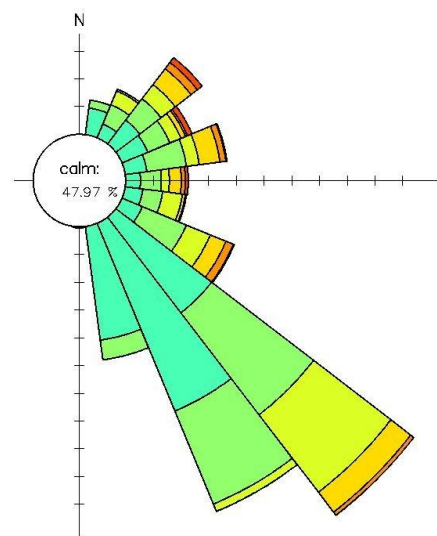
Profile 5



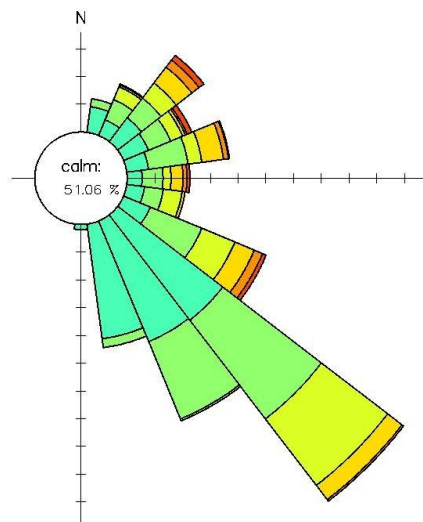
Profile 6



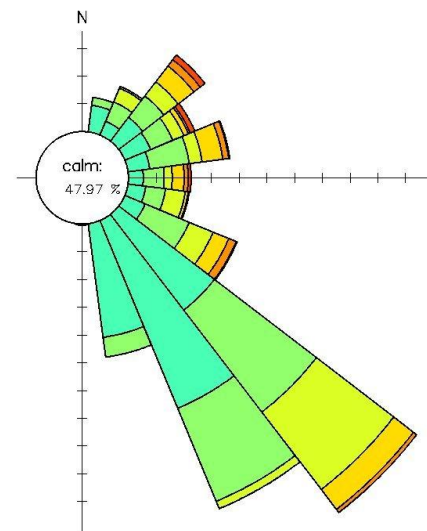
Inshore Wave Roses - Average Annual Climate 1991 - 2000



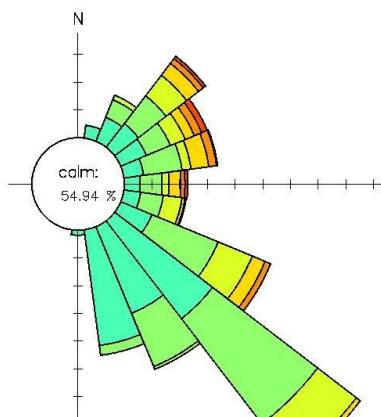
Profile 1



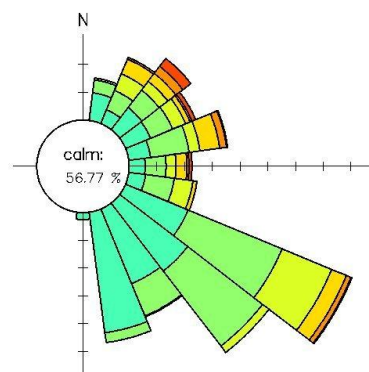
Profile 2



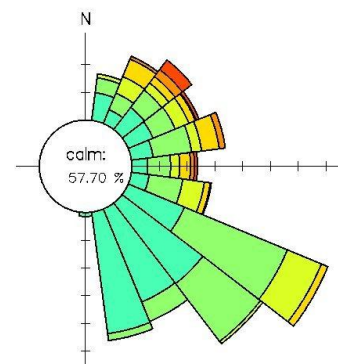
Profile 3



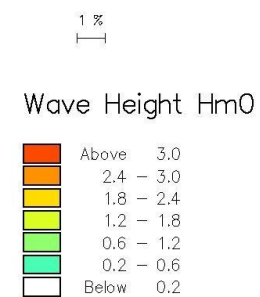
Profile 4



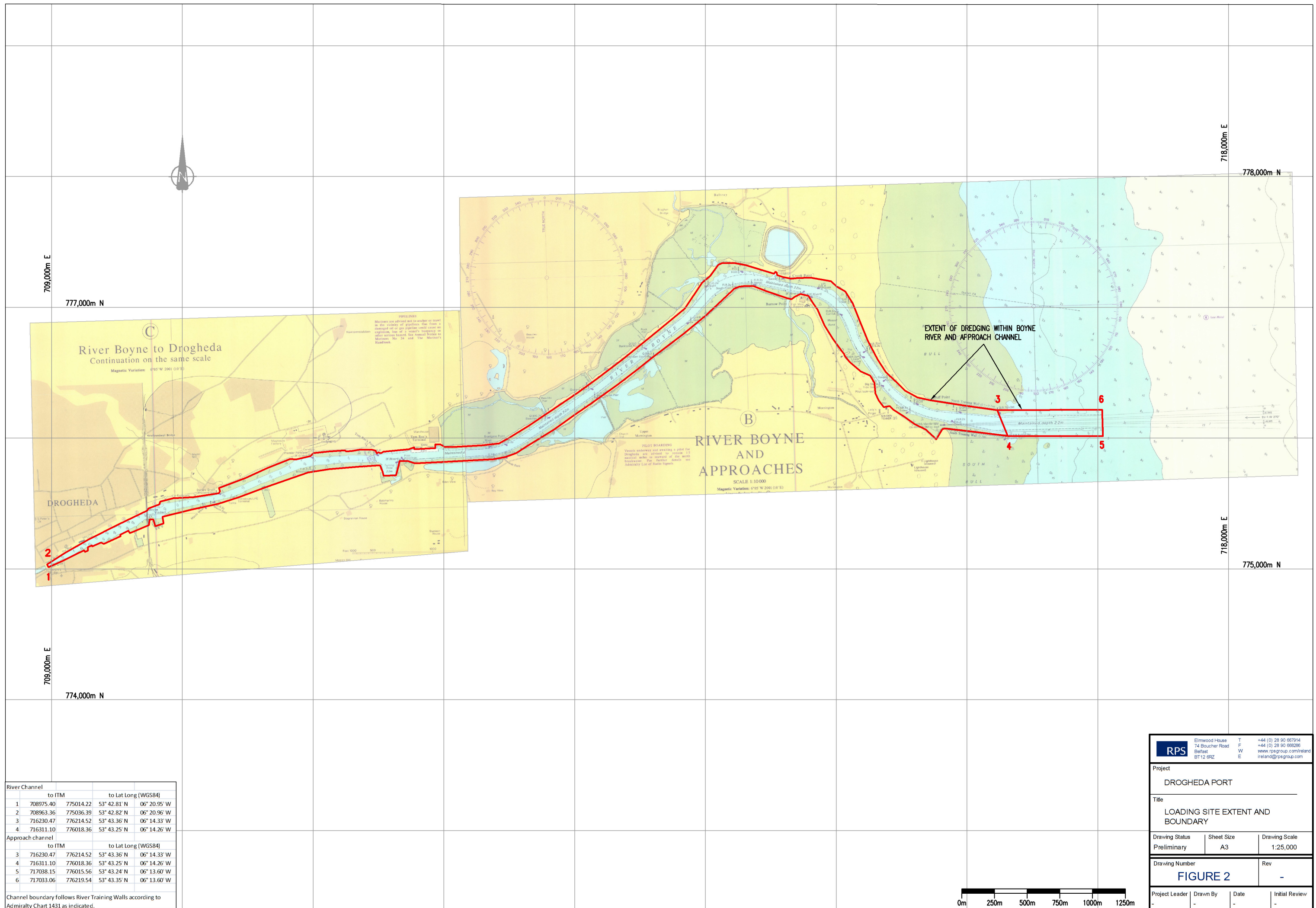
Profile 5



Profile 6



Inshore Wave Roses - April 2000 - March 2001



Dredging History 2000 - 2011

Date	Dredge Bar	Dredge Channel	Dredge TR Berth	Dredge S Basin	Dredge Other	Dredge Total	Sea Disposal	Shore Disposal	Permit No
Feb-01	53,963					59,963	59,963		329
May-01	40,493					40,493	40,493		329
Oct-01	29,726					29,726	29,726		329
Feb-02	36,022					36,022	36,022		329
Aug-02	10,395					10,395	10,395		345
Sep-02	26,339	3,570	8,495	6,819		45,223	45,223		345
Jan-03	70,701		3,586			74,267	74,267		345
Apr-03	23,266					23,266	23,266		345
May-03	4,121					4,121	4,121		345
Nov-03	59,623	6,332	9,245			75,200	75,200		345
Apr-04	60,784		11,740	7,275		79,799	79,799		345
Dec-04	30,000	8,532	14,444			52,976	52,976		345
May-05	49,095		15,011			64,106	64,106		345
Nov-05	34,434		11,341			45,775	45,775		345
Mar-06	53,057		14,487			67,544	67,544		345
Jun-06	42,911		8,591			51,502	51,502		345
Dec-06					126,844	126,844	126,844		378 capital work TRP to Maxol
Feb-07	70,000		2,521			71,632	71,632		345
Mar-08	63,017		11,053			74,070	74,070		387
Mar-09	58,074		3,992	2,552		64,618	64,618		387
Jan-10					318		318		387
Mar-10	44,962					44,962	44,962		387
Jul-10	31,131					31,131	7,076	24,055	387 1st beneficial recovery campaign
Nov-10	33,042					33,042	14,782	18,260	387 2nd beneficial recovery campaign
Feb-11	30,735		3,924			30,735.00	3,924.00	26,811.00	387 3rd beneficial recovery campaign
Jul-11	3,227					3,227.00	3,227.00		387
Dec-11	38,162				291	38,453.00	13,109.00	25,344.00	387 4th beneficial recovery campaign

Note: All quantities in m3

CONFIDENTIAL REPORT

ENVIRONMENT AND GREEN TECHNOLOGIES DIVISION

Dept. Shannon laboratory

Sheet no. 1 of 18 sheets

Client: Drogheda Port Company,
Harbourville,
Mornington Rd,
Drogheda,
Co. Meath.

Title: Sampling and analysis of Drogheda
Harbour sediments, October, 2011

Attn: Captain Martin Donnelly.

Report ref. DroghedaSeds2011

Order no.: 6261

File no.:

Report by: Liam Curran



Date recd.: 27/10/2011

Approved by: Tom Lowry



Copies to: R.6. Files

Date: 27/1/2012.

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1. Introduction.

The Environmental and Green Technologies Section of Enterprise Ireland was commissioned by Drogheda Port Company to carry out sampling and analysis of marine sediments from Drogheda Harbour and proposed dredge spoil dumpsites in close proximity to the river Boyne estuary. The Drogheda Port Company proposed to carry out maintenance dredging of the Boyne estuary and to dump the dredge spoil material at designated dumpsites. The sampling and analysis were required in order for the Environmental Protection Agency to issue a license for dumping the dredge spoil material at sea.

This report covers the sampling, analysis and results for sediment samples taken on October 27th, 2011 from the sampling sites designated by the Marine Institute.

2. Sampling.

2.1 Sampling Methodology

Sampling took place on October 27th 2011. Enterprise Ireland provided a Rigid Inflatable Boat (RIB) equipped with GPS. A list of required sampling points was provided by Drogheda Port Company in agreement with the Marine Institute. These sampling points were in the Boyne estuary and at three designated marine dumpsites in close proximity to the estuary. Surface sediment samples were taken using a stainless steel Van Veen grab and sealed in plastic containers. As each sample was taken, the exact position was noted from the boat's GPS system and recorded. The samples were then transported to the Enterprise Ireland laboratory at Shannon and stored at 4°C overnight. A small (30cm³) sub-sample was removed for density determination before the main sample was forwarded to the Environment Agency laboratory at Leeds for all other analysis.

While all the agreed sampling positions were sampled, a number of the samples were of coarse sand or gravel (i.e. Grain size >2mm). Only fine grained sediments accumulate contaminants and coarse grained sediments are therefore unsuitable for contaminant analysis. Of the seventeen designated sample positions, one sampling position at St. Mary's Bridge (Station 1) and three sampling positions in the vicinity of the Fish Meal Jetty (Stations 11,12 and 13) had sediments that were unsuitable for analysis. There were, therefore, 13 samples suitable for analysis – nine in the Boyne Estuary and a further three at dumpsites A1, A2 and A3.

A further two samples were taken for radionuclide analysis by the Radiological Protection Institute of Ireland (RPII). These were taken and stored as above and were forwarded to the RPII shortly after sampling:

RPII Station Number	RPII Sample Site Description	Latitude/Longitude
5	Ship Turning Circle	53° 43.17'N 006° 18.52'W
14	Bar at Boyne Estuary Mouth	53° 43.30'N 006° 14.15'W

2.2 Sampling locations/positions.

The sediment samples taken, their positions and suitability for analysis were as follows:

Samp. No.	Sampling Site	GPS Position	Suitable for Analysis?
1	St. Mary's Bridge	53° 42.81' N 006° 20.95' W	No. 100% >2mm
2	U/S Viaduct	53° 43.10' N 006° 20.28' W	Yes
3	100m D/S Maxol Terminal	53° 43.09' N 006° 19.59' W	Yes
4	Between Buoy 31 and Buoy 32	53° 43.18' N 006° 19.20' W	Yes
5	In Ship Turning Basin	53° 43.17' N 006° 18.52' W	Yes (also RPII sample station)
6	Centre Channel between Buoy 28 and Buoy 29	53° 43.22' N 006° 18.54' W	Yes
7	Centre of Berth, Tom Roe's Terminal	53° 43.25' N 006° 18.34' W	Yes
8	20m D/S of berth at Tom Roe's Terminal	53° 43.26' N 006° 18.24' W	Yes
9	Mornington Pier, between Buoy 21 and Buoy 22	53° 43.48' N 006° 17.13' W	Yes
10	Between Buoy 16 and Buoy 17	53° 43.90' N 006° 16.24' W	Yes
11	Between Buoy 11 and Buoy 12	53° 43.87' N 006° 15.57' W	No 100% >2mm
12	Between Buoy 7 and Buoy 8	53° 43.62' N 006° 15.25' W	No 100% >2mm
13	Between Buoy 1 and Buoy 2	53° 43.33' N 006° 14.65' W	No 100% >2mm
14	500m East of Station 13	53° 43.30' N 006° 14.15' W	Yes (also RPII sample station)
15	Mid Dumpsite A1	53° 44.51' N 006° 10.59' W	Yes
16	Mid Dumpsite A2	53° 45.80' N 006° 13.40' W	Yes
17	Mid Dumpsite A3	53° 40.70' N 006° 12.60' W	Yes

3 Sample Analysis

All analysis was carried out by the UK Environment Agency's laboratories in Leeds and Llanelli, Wales. These laboratories have extensive expertise and experience in the analysis of sediments and Enterprise Ireland routinely sends samples from a range of environmental matrices to these laboratories for analysis.

With the exception of the determination of solids at 105°C, the laboratories are accredited under the UK Accreditation Scheme (UKAS) for all the analytical parameters required on the sediment samples.

The actual results received, (including those of the Certified Reference Material (CRM) analysed with the sediment samples), a summary of the techniques used and the detection limits achieved are presented in the Appendix. A combination of five CRMs was used;

- (a) For Organics analysis (PAH, PCB and OCP) the CRM was SRM 1941b. OCP's were spiked in the lab as CRM levels were not applicable for the method.
- (b) For metals analysis the CRM MESS-3 was used.
- (c) For Organotins, the CRM used was BCR-646.
- (d) For grain sizing, the CRM used was BCR-130.
- (e) For Organic Carbon, CRM GBW07403 was used.

In order to make the data easier to access, the results are presented in tabulated form in Section 4.

An Excel spreadsheet containing the relevant data, suitable for use by both the Marine Institute and the Environmental Protection Agency, has been forwarded to Drogheda Port Company.

4. Results

4.1 Stations 2, 4, 9, 10 and 14.

Parameter	Units	Station 2	Station 4	Station 9	Station 10	Station 14
Sampling Site Description	N/A	Centre channel, Upstream Viaduct	Centre channel, Buoy 31/32	Mornington Pier, centre channel, Buoy 21/22	Centre channel, Buoy 16/17	Centre Channel, Boyne mouth.
Latitude/ Longitude	Lat/Long	53° 43.10' N 006°20.28'W	53° 43.18'N 006°19.20'W	53° 43.48'N 006°17.13'W	53° 43.90' N 006°16.24'W	53° 43.30' N 006°14.15'W
Visual Inspection of sample	N/A	Grey, low odour, gravel/fine mud. No biota	Black, H ₂ S odour, anoxic muddy sand. No biota	Grey, No odour, coarse sand. Tube worms.	Grey/brown. No Odour. Coarse sand. Tube worms.	Brown. No odour. Fine sand/silt. No biota
Water Content	%	44	40	24	18	56
Density	g/cm ³	1.8	1.6	1.9	2.2	2.1
Grain Size >2mm	%	19	0	4	17	0
2mm-63µm	%	72	64	95	83	43
<63µm	%	9	36	1	0	57
Total Organic Carbon	%*	2.6	2.0	2.1	2.4	3.4
Carbonate	%*	2.3	2.2	2.1	2.6	2.0
Mercury	mg/kg*	0.041	0.033	0.007	0.005	0.052
Aluminium	mg/kg*	15600	12400	5740	5020	12500
Arsenic	mg/kg*	9.50	7.30	8.94	8.53	11.3
Cadmium	mg/kg*	0.527	0.350	0.167	0.183	0.580
Copper	mg/kg*	20.8	14.4	5.53	5.07	20.6
Lead	mg/kg*	26.7	22.8	9.54	8.06	26.9
Zinc	mg/kg*	126	98.1	44.1	36.8	123
Chromium	mg/kg*	36.3	31.3	17.3	16.2	31.6
Nickel	mg/kg*	29.3	23.7	15.1	13.9	24.9
Lithium	mg/kg*	22.1	18.9	9.39	8.52	22.9
Dibutyltin	µg/kg*	<5	<4	<4	<4	<7
Tributyltin	µg/kg*	10	<3	<3	<3	6.00

* All values as dry weight.

4.2 Stations 3, 5, 6, 7 and 8. (Physio-chemical, metal, organotin and pesticide analysis)

Parameter	Units	Station 3	Station 5	Station 6	Station 7	Station 8
Sampling Site Description	N/A	100m downstream Maxol jetty	In Ship turning basin	Centre channel, Buoy 28/29	Centre of berth, Tom Roe's Terminal	20m D/S of berth, Tom Roe's Terminal
Latitude/ Longitude	Lat/Long	53° 43.09' N 006°19.59'W	53° 43.17' N 006°18.52'W	53° 43.22' N 006° 18.54'W	53° 43.25' N 006°18.34'W	53° 43.26' N 006°18.24'W
Visual Inspection of sample	N/A	Black, H ² S odour. Fine mud. No biota	Black, H ² S odour. Fine anoxic mud. Worms.	Grey, H ² S odour. Muddy sand. No biota.	Black/brown. H ² S Odour. Leaves/Fine mud. No bio.	Black. H ² S odour. Fine mud. No biota
Water Content	%	62	56	25	40	46
Density	g/cm ³	1.4	1.3	1.6	1.4	1.8
Grain Size >2mm	%	0	0	1	32	0
2mm-63µm	%	32	41	99	11	74
<63µm	%	68	59	0	57	26
Total Organic Car.	%*	5.0	3.5	3.2	3.6	3.1
Carbonate	%*	0.71	1.62	2.96	2.08	2.04
Mercury	mg/kg*	0.048	0.046	0.007	0.022	0.021
Aluminium	mg/kg*	20500	16400	5000	10400	11300
Arsenic	mg/kg*	15.0	12.4	3.96	6.19	8.19
Cadmium	mg/kg*	0.923	0.900	0.266	0.379	0.745
Copper	mg/kg*	28.9	26.8	6.01	12.3	24.2
Lead	mg/kg*	40.7	33.2	8.37	15.1	25.6
Zinc	mg/kg*	198	182	55.4	85.5	256
Chromium	mg/kg*	47.5	40.4	18.3	26.5	31.0
Nickel	mg/kg*	38.1	33.1	16.6	19.7	20.4
Lithium	mg/kg*	35.6	27.3	9.39	16.5	16.1
Dibutyltin	µg/kg*	13.1	43.3	4.1	<6	17.8
Tributyltin	µg/kg*	7.09	10.1	7.36	<4	19.2
Aldrin	µg/kg*	<1	<1	<1	<1	<1
DDE-pp	µg/kg*	<2	<2	<2	<2	<2
DDT-op	µg/kg*	<1	<1	<1	<1	<1
DDT-pp	µg/kg*	<2	<2	<2	<2	<2
Dieldrin	µg/kg*	<3	<3	<3	<3	<3
Endrin	µg/kg*	<2	<2	<2	<2	<2
HCH-alpha	µg/kg*	<1	<1	<1	<1	<1
HCH-beta	µg/kg*	<1	<1	<1	<1	<1
HCH-delta	µg/kg*	<1	<1	<1	<1	<1
HCH-gama (Lindane)	µg/kg*	<2	<2	<2	<2	<2
Hexachlorob- -enzene	µg/kg*	<1	<1	<1	<1	<1
Hexachlorob- -utadiene	µg/kg*	<1	<1	<1	<1	<1
Isodrin	µg/kg*	<2	<2	<2	<2	<2
TDE-pp	µg/kg*	<1	<1	<1	<1	<1

* All values as dry weight.

4.3 Stations 3, 5, 6, 7 and 8. Contd. (Total Hydrocarbon, PAH and PCB analysis)

Parameter	Units	Station 3	Station 5	Station 6	Station 7	Station 8
Sampling Site Description	N/A	100m downstream Maxol jetty	In Ship turning basin	Centre channel, Buoy 28/29	Centre of berth, Tom Roe's Terminal	20m D/S of berth, Tom Roe's Terminal
Latitude/ Longitude	Lat/ Long	53° 43.09' N 006°19.59'W	53° 43.17' N 006°18.52'W	53° 43.22' N 006° 18.54'W	53° 43.25' N 006°18.34'W	53° 43.26' N 006°18.24'W
Total Extractable Hydrocarb.	mg/kg*	107	134	27.5	123	242
Acenaphthene	µg/kg*	8.63	16.4	3.98	111	194
Acenaphthylene	µg/kg*	5.16	25.8	<2	4.61	41.7
Anthracene	µg/kg*	21.9	54.2	15.7	21.9	83.3
Benzo(a)anthracene	µg/kg*	86.2	240	18.8	45.3	83.9
Benzo(a)pyrene	µg/kg*	162	354	13.9	47.3	89.3
Benzo(b)fluoranthene	µg/kg*	178	336	19.8	52.2	94.3
Benzo(ghi)perylene	µg/kg*	143	249	<10	35.0	58.4
Benzo(k)fluoranthene	µg/kg*	75.8	130	<10	21.5	42.9
Chrysene	µg/kg*	93.7	285	18.5	53.5	104
Dibenzo(ah)anthracene	µg/kg*	14.9	30.7	<5	<5	7.57
Fluoranthene	µg/kg*	189	439	36.2	256	860
Fluorene	µg/kg*	33.6	38.6	15.4	114	303
Ideno(1,2,3-c,d)pyrene	µg/kg*	98.8	169	<10	23.3	36.8
Naphthalene	µg/kg*	102	167	<30	142	279
Phenanthrene	µg/kg*	104	107	36.2	308	973
Pyrene	µg/kg*	183	374	35.1	188	588
PCB-028	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-052	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-101	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-118	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-138	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-153	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-180	µg/kg*	<0.1	<0.1	<0.1	<0.1	<0.1

* All values as dry weight.

4.4 Dumpsites A1, A2, A3 and CRM (Physio-chemical, metal, organotin and pesticide analysis)

Parameter	Units	Dumpsite A1	Dumpsite A2	Dumpsite A3	CRM
Sampling Site Description	N/A	Centre Dumpsite A1	Centre Dumpsite A2	Centre Dumpsite A3	N/A
Latitude/ Longitude	Lat/Long	53° 44.51' N 006°10.59'W	53° 45.80' N 006°13.40'W	53° 40.70' N 006°12.60'W	N/A
Visual Inspection of sample	N/A	Brown. No odour. Fine sand. Bivalves.	Brown. No odour. Fine sand. Bivalves.	Brown. No odour. Fine sand. Tube worms.	N/A
Water Content	%	19	18	19	22
Density	g/cm ³	2.1	2.0	2.0	
Grain Size >2mm	%	0	10	0	0
2mm-63µm	%	93	90	100	93
<63µm	%	7	0	0	7
Total Organic Car.	%*	1.44	1.03	1.20	0.49
Carbonate	%*	1.49	1.48	0.96	0.028
Mercury	mg/kg*	0.007	0.003	0.0050	0.044
Aluminium	mg/kg*	3480	3100	2940	46400
Arsenic	mg/kg*	5.80	5.26	3.81	20.4
Cadmium	mg/kg*	0.048	0.050	0.080	0.223
Copper	mg/kg*	2.56	2.19	2.73	31.0
Lead	mg/kg*	6.31	6.06	7.58	19.3
Zinc	mg/kg*	29.1	26.6	28.3	155
Chromium	mg/kg*	11.4	12.0	14.0	57.8
Nickel	mg/kg*	7.39	6.74	7.08	40.1
Lithium	mg/kg*	7.44	6.38	6.79	50.6
Dibutyltin	µg/kg*	<4	<4	5.84	7.99
Tributyltin	µg/kg*	<3	<3	<3	7.46
Aldrin	µg/kg*	<1	<1	<1	20.8
DDE-pp	µg/kg*	<2	<2	<2	19.5
DDT-op	µg/kg*	<1	<1	<1	22.5
DDT-pp	µg/kg*	<2	<2	<2	19.5
Dieldrin	µg/kg*	<3	<3	<3	21.2
Endrin	µg/kg*	<2	<2	<2	21.0
HCH-alpha	µg/kg*	<1	<1	<1	20.0
HCH-beta	µg/kg*	<1	<1	<1	21.2
HCH-delta	µg/kg*	<1	<1	<1	20.9
HCH-gama (Lindane)	µg/kg*	<2	<2	<2	19.0
Hexachlorob- -enzyme	µg/kg*	<1	<1	<1	23.5
Hexachlorob- -utadiene	µg/kg*	<1	<1	<1	21.5
Isodrin	µg/kg*	<2	<2	<2	20.3
TDE-pp	µg/kg*	<1	<1	<1	19.1

* All values as dry weight.

4.5 Dumpsites A1, A2, A3 and CRM Contd. (Total Hydrocarbon, Total Nitrogen, PAH and PCB analysis)

Parameter	Units	Dumpsite A1	Dumpsite A2	Dumpsite A3	CRM
Sampling Site Description	N/A	Centre Dumpsite A1	Centre Dumpsite A2	Centre Dumpsite A3	N/A
Latitude/ Longitude	Lat/ Long	53° 44.51' N 006°10.59'W	53° 45.80' N 006°13.40'W	53° 40.70' N 006°12.60'W	N/A
Nitrogen	mg/kg*	<200	470	260	
Total Extractable Hydrocarb.	mg/kg*	4.4	1.86	4.16	1.39
Acenaphthene	µg/kg*	<2	<2	<2	30.8
Acenaphthylene	µg/kg*	<2	<2	<2	88.6
Anthracene	µg/kg*	<2	<2	<2	191
Benzo(a)anthracene	µg/kg*	3.87	<2	<2	302
Benzo(a)pyrene	µg/kg*	4.46	<2	<2	313
Benzo(b)fluoranthene	µg/kg*	10.9	<10	<10	496
Benzo(ghi)perylene	µg/kg*	<10	<10	<10	323
Benzo(k)fluoranthene	µg/kg*	<10	<10	<10	226
Chrysene	µg/kg*	4.98	<3	<3	360
Dibenzo(ah)anthracene	µg/kg*	<5	<5	<5	70.3
Fluoranthene	µg/kg*	8.64	4.36	3.46	628
Fluorene	µg/kg*	<10	<10	<10	66.3
Ideno(1,2,3-c,d)pyrene	µg/kg*	<10	<10	<10	23.3
Naphthalene	µg/kg*	53.0	<30	<30	232
Phenanthrene	µg/kg*	14.9	<10	<10	308
Pyrene	µg/kg*	7.20	3.92	3.57	1010
PCB-028	µg/kg*	<0.1	<0.1	<0.1	4.32
PCB-052	µg/kg*	<0.1	<0.1	<0.1	5.44
PCB-101	µg/kg*	<0.1	<0.1	<0.1	5.20
PCB-118	µg/kg*	<0.1	<0.1	<0.1	4.24
PCB-138	µg/kg*	<0.1	<0.1	<0.1	3.44
PCB-153	µg/kg*	<0.1	<0.1	<0.1	5.60
PCB-180	µg/kg*	<0.1	<0.1	<0.1	3.20

* All values as dry weight.

APPENDIX

(EA analytical method summaries and results)

Method Summary 1:

Determinand: Particle Size Distribution

Matrix: Solids including Sludge, Sediment and Biota

Method of Analysis: **Determination of Particle Size Distribution by Laser Diffraction**

Instrumentation: Laser diffraction particle sizer

Principle: A low power visible laser transmitter produces a parallel, monochromatic beam of light which illuminates the particles by use of an appropriate sample cell. The incident light is diffracted by the particles illuminated to give a stationary diffraction pattern regardless of particle movement. By integrating over a suitable period a representative bulk sample of the particles contributes to the final measured diffraction pattern.

Range of Application: 0.5 – 2000 μm by laser diffraction (larger sizes incorporated from sieve data by result emulation. Usually set up for standard size ranges as follows:-
>8000 μm
7999 – 4000 μm
3999 – 2000 μm
2000 – 1000 μm
999 – 500 μm
499 – 250 μm
249 – 125 μm
125 – 63 μm
< 63 μm
<20 μm
Kurtosis
Particle Diameter mean D(4,3) μm
Particle Diameter median D(v,0.5) μm
Graphic skewness
Sorting Coefficient

MRV: Minimum fraction - 0.5 μm s
Minimum % volume- 0.0%
Minimum % phi – 0.0%

Sample Container: Minimum of 100g is required, Plastic pots are provided for sediment and soil samples

Interference: If sample contains particles greater than 2000 microns (2mm), the sample must be pre-sieved

Method Summary 2:

Determinand: Carbon and Organic Carbon analysis

Principle:

Sediment samples are weighed into tin containers and dropped into a vertical quartz tube, heated to 900°C, through which a constant flow of helium is maintained. When the samples are introduced, the helium stream is temporarily enriched with pure oxygen. Flash combustion takes place, primed by the oxidation of the container. Quantitative combustion is then achieved by passing the gases over Cr₂O₃. The mixture of combustion gases is passed over a reduction reactor filled with copper at 650°C to eliminate the excess oxygen and reduce nitrogen oxides to nitrogen. The gas mixture is then introduced to a chromatographic column packed with 'Porapak QS' at about 100°C. The individual components are separated and eluted in the order N₂ - CO₂ - H₂O. They are measured by means of a thermal conductivity detector. The instrument is calibrated by combustion of known standard compounds. If organic carbon is required, samples are first treated with sulphurous acid to remove inorganic carbonates.

MRV: 0.4%

Method Summary 3:

Determinand: Analysis of Metals in Marine Sediments

Matrix: Soils, Sediments, Sludges & Biota

Method of Analysis: Nitric Acid soluble and Acid Soluble Metals; Microwave Digestion (for ICP or AAS)

Instrumentation: ICP- OPES and OES

Principle: This method is suitable for the digestion of soils, sediments, sludge, plants and animals prior to analysis for metals. Microwave heating of the digestion mixture in closed vessels allows the use of elevated temperatures and pressures, which bring about a more complete dissolution of metals than conventional digestion techniques. Contamination problems are kept to a minimum, using microwave digestion.

Sample Container: 1 Kg Plastic container

Sample Storage: Samples are stored in the data section in temperature controlled fridge's (between 2 – 8 °C) until ready for analysis.

Method Summary 4:

Determinand: OCP NMMP Sediment DW ug/kg

Matrix: Sediments, Soils & Biota

Method of Analysis: The Extraction of Pesticides in Sediments, Soils & Biota Determination by GCMS

Instrumentation: Gas Chromatography - Mass Spectrometry

Principle: Surrogate standards are added to a wet sample, which is extracted with an Accelerated Solvent Extraction (ASE), system with 1:1 Dichloromethane:Acetone as solvent. The solvent extract is reduced in volume and interfering organic compounds of high molecular weight are removed using Gel Permeation Chromatography (GPC). The post-GPC extract is concentrated prior to further clean-up by way of a Florisil Solid Phase Extraction Column and Diethyl Ether in Hexane eluent. The eluate is reduced in volume before injection onto a Gas Chromatograph equipped with a Mass Spectrometric Detector operating in selective ion mode (SIM).

The analytical system is automated and controlled by a computer chemstation, which also quantifies the results using a multilevel internal standard calibration

Range of Application: Up to 10ug/kg. The range may be extended by use of dilution or linearity check.

Sample Container: 1 Kg Plastic Containers and provided for soil and sediment

Storage/Preservation: On arrival at the laboratory samples are stored at 2 - 8°C in the laboratory cold-rooms except shellfish samples which are kept frozen until use. If samples are not to be extracted immediately they can be stored frozen (<-18C) for up to 6 months. Once thawed (in cold room or fridge etc @ 2-8C) they should be extracted within 48 hours to prevent degradation/decomposition. Analysis of the final extract (in hexane) should be carried out within 30 days.

Method Summary 5:

Determinand: PAH NMMP DW

Matrix: Soil, Sediment & Biota

Method of Analysis: **The Extraction of PAHs in Sediments, Soils & Biota**
Determination by GCMS

Instrumentation: Gas Chromatography – Mass Spectrometry

Principle: Labelled internal standards which are representative of the compounds determined are added to the sample. The sample is initially dried with Sodium Sulphate and extracted by means of an Accelerated Solvent Extraction (ASE) system employing Acetone/Dichloromethane as the extraction solvent. The solvent extract is transferred to a Turbovap tube where it is evaporated to low volume (approx. 2-3mls) with a stream of nitrogen or Argon gas in a Turbovap solvent evaporator system. The solvent extract is then transferred to a GPC clean up system followed by Silica adsorbent clean up. An aliquot of the extract is injected onto a Gas Chromatograph where the compounds of interest are separated on a capillary column. The eluate from the column is transferred into a Mass Spectrometer operating in Electron Ionisation Mode (EI) where the compounds are detected.

Range of Application: Up to 2500ug/kg. This may be extended by dilution of the final extract

Sample Container: 1Kg Plastic Container

Method Summary 6:**Determinand:** PCB NMMP Sediment DW ug/kg**Matrix:** Sediments, Soils & Biota**Method of Analysis:** The Extraction of PCBs in Sediments, Soils & Biota
Determination by GCMS**Instrumentation:** Gas Chromatography - Mass Spectrometry

Principle: Surrogate standards are added to a wet sample, which is extracted with an Accelerated Solvent Extraction (ASE), system with 1:1 Dichloromethane:Acetone as solvent. The solvent extract is reduced in volume and interfering organic compounds of high molecular weight are removed using Gel Permeation Chromatography (GPC). The post-GPC extract is concentrated prior to further clean-up by way of 3% deactivated silica (for biota), and basic alumina (for sediments), followed by a final acid-clean-up step, using concentrated sulphuric acid. The eluate is reduced in volume before injection onto a Gas Chromatograph equipped with a Mass Spectrometric Detector operating in selective ion mode (SIM).

Analytes: PCB congeners: 28, 52, 101, 118, 138, 153, 180**Range of Application:** Range: 0 to 100ug/Kg
The range may be extended by use of dilution or linearity check.**MRV:** Biota: 0.5ug/kg (based on 2 g of sample)
Soil / Sed: 2 & 10 ug/kg (based on 3g of sample)**Sample Container:** 1 Kg Plastic Containers and provided for soil and sediment

Storage/Preservation: On arrival at the laboratory samples are stored at 2 - 8°C in the laboratory cold-rooms except shellfish samples which are kept frozen until use. If samples are not to be extracted immediately they can be stored frozen (<-18C) for up to 6 months. Once thawed (in cold room or fridge etc @ 2-8C) they should be extracted within 48 hours to prevent degradation/decomposition. Analysis of the final extract (in hexane) should be carried out within 30 days.

Method Summary 7:

Determinand:	Organotins						
Matrix:	Soils, sediments and waste						
Method of Analysis:	Aqueous extraction with Derivatisation, GC-MS						
Instrumentation:	GC-MS						
Principle:	Samples extracted with methanolic acetic acid, derivatised and analysed by GC-MS						
Range of Application:	0 - 500 mg/kg						
Sample Container:	SOL 1kg Plastic tub						
Storage/Preservation:	Samples must be analysed immediately or stored in a refrigerator at 5±3°C for up to 7 days.						
MRV:	0.002 – 0.006 mg/kg						
QC within Laboratory:	<table><tr><td>Precision</td><td>-</td><td>Better than 15% RSD</td></tr><tr><td>Bias</td><td>-</td><td>Better than 30% Bias</td></tr></table>	Precision	-	Better than 15% RSD	Bias	-	Better than 30% Bias
Precision	-	Better than 15% RSD					
Bias	-	Better than 30% Bias					
External Quality Control:	Contest, SETOC						

Liam Curran
Enterprise Ireland
Shannon Laboratory
Town Centre
Shannon
Co Clare
Ireland

Dear Liam

Please find attached the results for the batch of 14 samples described below.

Samples Registered on:	08-Nov-2011
Analysis Started on:	08-Nov-2011
Analysis Completed on:	16-Dec-2011
Results for Batch Number	20034360
Your Purchase Order Number:	98113

You will be invoiced shortly by our accounts department.

If we can be of further assistance then please do not hesitate to contact us.

Yours sincerely



William Fardon
Customer Services Team Leader
Tel: (0113) 231 2177
nls@environment-agency.gov.uk

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation. Details of analytical procedures and performance data are available on request. The date of sample analysis is available on request.

The Environment Agency carries out analytical work to high standards and within the scope of its UKAS accreditation, but has no knowledge of whether the circumstances or the validity of the procedures used to obtain the samples provided to the laboratory were representative of the need for which the information was required.

The Environment Agency and/or its staff does not therefore accept any liability for the consequences of any acts or omissions made on the basis of the analysis or advice or interpretation provided.

Client: Enterprise Ireland
Folder No: 001772689
Comments: DROGHEDA STATION 3
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	0.710	%		None	NLS	864
Carbon : Dry Wt	5.71	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	5.00	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	39.7	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	68.2	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	9.22	%	0	None	LL	994
Grain Size Fraction : > 10 phi	1.59	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.250	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	4.33	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	11.6	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	17.5	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	11.6	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	4.32	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	15.9	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	10.2	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	16.8	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	17.2	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	16.8	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.250	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	14.4	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	15.7	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	10.2	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	14.4	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	5.46	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	2.19	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.536	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.0290	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	-0.0700	Unitless	-1	UKAS	LL	994
Kurtosis	6.60	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.0640	mm	0	UKAS	LL	994
Particle Diameter : Median	0.0300	mm	0	UKAS	LL	994
Sorting Coefficient	2.08	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	107	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	38.4	%	0	None	LL	97
Solids at 105 C	38.4	%	0	None	LL	97
Solids, Volatile at 500 C	9.37	%	0	None	LL	97
Volatile Matter : %	9.37	%	0	None	LL	97
Mercury : Dry Wt	0.0480	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	20500	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	15.0	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.923	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	47.5	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	28.9	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	40.7	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	35.6	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	38.1	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	198	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	8.63	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	5.16	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	21.9	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	86.2	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	162	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	178	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	143	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	75.8	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	93.7	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	14.9	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	189	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	33.6	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	98.8	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	102	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	104	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	183	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	13.1	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	7.09	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	39.1	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be black clay sediment.

44.48g of the sample was taken for drying at <30degC which gave 20.75g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772690
Comments: DROGHEDA STATION 5
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	1.62	%		None	NLS	864
Carbon : Dry Wt	5.12	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	3.50	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	33.0	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	59.0	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	7.50	%	0	None	LL	994
Grain Size Fraction : > 10 phi	1.37	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	1.80	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	7.71	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	14.8	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	15.2	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	14.8	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	7.71	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	16.9	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	8.35	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	15.7	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	16.1	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	14.7	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	1.80	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	12.2	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	16.7	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	8.36	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	12.2	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	4.33	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	1.81	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.540	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.0390	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	-0.110	Unitless	-1	UKAS	LL	994
Kurtosis	7.31	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.0920	mm	0	UKAS	LL	994
Particle Diameter : Median	0.0430	mm	0	UKAS	LL	994
Sorting Coefficient	2.18	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	134	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	43.5	%	0	None	LL	97
Solids at 105 C	43.5	%	0	None	LL	97
Solids, Volatile at 500 C	6.84	%	0	None	LL	97
Volatile Matter : %	6.84	%	0	None	LL	97
Mercury : Dry Wt	0.0460	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	16400	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	12.4	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.900	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	40.4	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	26.8	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	33.2	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	27.3	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	33.1	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	182	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	16.4	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	25.8	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	54.2	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	240	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	354	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	336	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	249	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	130	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	285	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	30.7	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	439	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	38.6	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	169	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	167	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	107	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	374	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	43.3	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	10.1	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	39.1	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be black clay sediment.

42.26g of the sample was taken for drying at <30degC which gave 21.06g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772691
Comments: DROGHEDA STATION 6
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.96	%		None	NLS	864
Carbon : Dry Wt	6.17	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	3.21	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	1.58	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	2.63	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	24.6	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	2.63	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	58.2	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	1.27	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	58.2	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	1.27	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	24.6	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	11.7	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	1.57	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	11.8	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.00	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.392	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.207	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.110	Unitless	-1	UKAS	LL	994
Kurtosis	25.3	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.278	mm	0	UKAS	LL	994
Particle Diameter : Median	0.203	mm	0	UKAS	LL	994
Sorting Coefficient	0.670	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	27.5	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	75.1	%	0	None	LL	97
Solids at 105 C	75.1	%	0	None	LL	97
Solids, Volatile at 500 C	0.670	%	0	None	LL	97
Volatile Matter : %	0.670	%	0	None	LL	97
Mercury : Dry Wt	0.00700	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	5000	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	3.96	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.266	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	18.3	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	6.01	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	8.37	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	9.39	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	16.6	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	55.4	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	3.98	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	15.7	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	18.8	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	13.9	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	19.8	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	18.5	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	36.2	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	15.4	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	<30	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	36.2	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	35.1	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	4.10	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	7.36	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	42.3	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be black/brown sandy sediment.

46.13g of the sample was taken for drying at <30degC which gave 35.74g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772692
Comments: DROGHEDA STATION 7
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.08	%		None	NLS	864
Carbon : Dry Wt	5.67	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	3.59	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	1.15	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	33.8	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	56.9	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	5.81	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.850	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	29.4	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	0.350	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	3.39	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	16.2	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	1.49	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	3.39	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	1.49	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	0.350	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	1.15	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	7.44	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	8.66	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	12.5	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	29.4	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	12.9	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	15.7	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	29.4	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	13.7	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	7.32	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	8.68	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	13.7	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	3.74	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	1.23	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.707	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.148	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.460	Unitless	-1	UKAS	LL	994
Kurtosis	-0.920	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	2.69	mm	0	UKAS	LL	994
Particle Diameter : Median	0.0410	mm	0	UKAS	LL	994
Sorting Coefficient	4.25	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	123	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	59.5	%	0	None	LL	97
Solids at 105 C	59.5	%	0	None	LL	97
Solids, Volatile at 500 C	3.51	%	0	None	LL	97
Volatile Matter : %	3.51	%	0	None	LL	97
Mercury : Dry Wt	0.0220	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	10400	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	6.19	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.379	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	26.5	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	12.3	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	15.1	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	16.5	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	19.7	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	85.5	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	111	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	4.61	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	21.9	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	45.3	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	47.3	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	52.5	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	35.0	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	21.5	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	53.5	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	256	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	114	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	23.3	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	142	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	308	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	188	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	<6	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	74.4	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be black clay sediment.

37.55g of the sample was taken for drying at <30degC which gave 22.42g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772693
Comments: DROGHEDA STATION 8
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.04	%		None	NLS	864
Carbon : Dry Wt	5.10	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	3.06	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	14.3	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	26.1	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	2.62	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.290	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	11.0	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	7.57	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	14.5	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	7.57	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	25.8	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	7.49	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	25.8	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	14.5	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	15.2	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	3.62	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	6.76	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	6.91	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	7.22	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	11.0	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	5.57	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	15.1	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	3.62	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	5.56	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	1.73	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.600	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.438	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.130	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	-0.210	Unitless	-1	UKAS	LL	994
Kurtosis	3.65	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.298	mm	0	UKAS	LL	994
Particle Diameter : Median	0.159	mm	0	UKAS	LL	994
Sorting Coefficient	2.31	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	242	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	54.4	%	0	None	LL	97
Solids at 105 C	54.4	%	0	None	LL	97
Solids, Volatile at 500 C	4.56	%	0	None	LL	97
Volatile Matter : %	4.56	%	0	None	LL	97
Mercury : Dry Wt	0.0210	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	11300	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	8.19	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.745	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	31.0	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	24.2	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	25.6	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	16.1	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	20.4	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	256	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	194	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	41.7	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	83.3	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	83.9	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	89.3	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	94.3	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	58.4	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	42.9	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	104	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	7.57	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	860	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	303	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	36.8	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	279	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	973	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	588	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	17.8	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	19.2	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	52.8	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be black clay sediment.

44.17g of the sample was taken for drying at <30degC which gave 24.89g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772696
Comments: DROGHEDA DUMPSITE A1
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Nitrogen : Dry Wt as N	<200	mg/kg	200	None	LE	606
Carbonate as C : Dry Wt	1.49	%		None	NLS	864
Carbon : Dry Wt	2.93	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	1.44	%	0.4	UKAS	LL	404
Nitrogen : Dry Wt as N	0.0740	%	0.02	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	5.53	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	6.74	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	1.55	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.0100	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	8.80	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	70.3	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.730	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	70.3	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	8.80	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	14.2	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	1.73	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	0.930	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	0.920	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.720	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.0100	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	1.80	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	14.2	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	1.73	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	1.80	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	1.32	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.240	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.129	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.160	mm	0	UKAS	LL	994

Inclusive Graphic Skewness :- {SKI}	-0.290	Unitless	-1	UKAS	LL	994
Kurtosis	2.22	Unitless	-12	UKAS	LL	994
Particle Diameter : Mean	0.167	mm	0	UKAS	LL	994
Particle Diameter : Median	0.161	mm	0	UKAS	LL	994
Sorting Coefficient	0.880	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	4.40	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	80.6	%	0	None	LL	97
Solids at 105 C	80.6	%	0	None	LL	97
Solids, Volatile at 500 C	0.660	%	0	None	LL	97
Volatile Matter : %	0.660	%	0	None	LL	97
Mercury : Dry Wt	0.00700	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	3480	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	5.80	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.0480	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	11.4	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	2.56	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	6.31	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	7.44	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	7.39	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	29.1	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	3.87	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	4.46	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	10.9	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	4.98	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	8.64	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	53.0	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	14.9	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	7.20	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	50.1	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be dark brown sandy sediment.

46.79g of the sample was taken for drying at <30degC which gave 38.63g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772697
Comments: DROGHEDA DUMPSITE A2
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	1.48	%		None	NLS	864
Carbon : Dry Wt	2.51	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	1.03	%	0.4	UKAS	LL	404
Nitrogen : Dry Wt as N	0.0470	%	0.02	UKAS	LL	404
Grain Size : 4000 to 7999 microns	7.71	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	2.46	%	0	None	LL	994
Grain Size Fraction : < 20 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	0.0200	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	2.46	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	0.420	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	64.8	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	64.8	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	7.71	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	25.2	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	0.0200	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	2.46	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	0.0100	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	25.2	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.00	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.0550	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.153	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.350	Unitless	-1	UKAS	LL	994

Kurtosis	25.8	Unitless	-12	UKAS	LL	994
Particle Diameter : Mean	0.496	mm	0	UKAS	LL	994
Particle Diameter : Median	0.155	mm	0	UKAS	LL	994
Sorting Coefficient	1.17	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	1.86	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	82.0	%	0	None	LL	97
Solids at 105 C	82.0	%	0	None	LL	97
Solids, Volatile at 500 C	0.490	%	0	None	LL	97
Volatile Matter : %	0.490	%	0	None	LL	97
Mercury : Dry Wt	0.00300	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	3100	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	5.26	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.0500	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	12.0	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	2.19	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	6.06	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	6.38	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	6.74	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	26.6	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	<3	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	4.36	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	<30	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	3.92	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	80.2	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be dark brown sandy sediment.

44.67g of the sample was taken for drying at <30degC which gave 36.62g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772698
Comments: DROGHEDA DUMPSITE A3
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	0.960	%		None	NLS	864
Carbon : Dry Wt	2.16	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	1.20	%	0.4	UKAS	LL	404
Nitrogen : Dry Wt as N	0.0260	%	0.02	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	0.0100	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	1.01	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	67.5	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	67.5	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	1.01	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	31.5	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	0.0100	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	0.0100	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	31.5	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.00	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.511	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.142	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.00	Unitless	-1	UKAS	LL	994

Kurtosis	0.370	Unitless	-12	UKAS	LL	994
Particle Diameter : Mean	0.147	mm	0	UKAS	LL	994
Particle Diameter : Median	0.142	mm	0	UKAS	LL	994
Sorting Coefficient	0.370	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	4.16	mg/kg	0.05	UKAS	LL	402
Dry Matter : %	81.4	%	0	None	LL	97
Solids at 105 C	81.4	%	0	None	LL	97
Solids, Volatile at 500 C	0.620	%	0	None	LL	97
Volatile Matter : %	0.620	%	0	None	LL	97
Mercury : Dry Wt	0.00500	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	2940	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	3.81	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.0800	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	14.0	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	2.73	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	7.58	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	6.79	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	7.08	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	28.3	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	<1	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	<2	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	<3	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	<1	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	<2	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	<2	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	<1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	<2	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	<3	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	3.46	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	<30	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	<10	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	3.57	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	5.84	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	79.5	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be dark brown sandy sediment.

46.51g of the sample was taken for drying at <30degC which gave 37.34g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772699
Comments: DROGHEDA STATION 4
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.20	%		None	NLS	864
Carbon : Dry Wt	4.18	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	1.98	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	20.6	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	35.8	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	4.98	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.860	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	5.70	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.550	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	24.9	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.550	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	23.7	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	8.68	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	23.7	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	24.9	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	9.48	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	5.62	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	9.28	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	9.50	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	8.34	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	5.70	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	7.22	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	9.38	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	5.63	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	7.21	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	2.97	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	1.15	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.547	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.0900	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	-0.490	Unitless	-1	UKAS	LL	994
Kurtosis	7.01	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.190	mm	0	UKAS	LL	994
Particle Diameter : Median	0.153	mm	0	UKAS	LL	994
Sorting Coefficient	2.26	Unitless	-3	UKAS	LL	994
Dry Matter : %	60.3	%	0	None	LL	97
Solids at 105 C	60.3	%	0	None	LL	97
Solids, Volatile at 500 C	4.01	%	0	None	LL	97
Volatile Matter : %	4.01	%	0	None	LL	97
Mercury : Dry Wt	0.0330	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	12400	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	7.30	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.350	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	31.3	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	14.4	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	22.8	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	18.9	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	23.7	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	98.1	mg/kg	3	UKAS	LL	1041
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	66.7	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be dark brown wet sandy sediment.

44.05g of the sample was taken for drying at <30degC which gave 30.10g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772736
Comments: DROGHEDA STATION 9
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.10	%		None	NLS	864
Carbon : Dry Wt	4.16	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	2.06	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.280	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	0.690	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	0.700	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	2.81	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	3.11	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	24.9	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	3.11	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	56.5	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	4.02	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	56.5	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	4.02	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	24.9	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.280	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	7.67	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	0.0100	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	0.0100	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	2.81	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	7.66	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	0.370	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.330	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.00	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.230	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.219	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.300	Unitless	-1	UKAS	LL	994
Kurtosis	17.3	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.376	mm	0	UKAS	LL	994
Particle Diameter : Median	0.214	mm	0	UKAS	LL	994
Sorting Coefficient	0.900	Unitless	-3	UKAS	LL	994
Dry Matter : %	75.9	%	0	None	LL	97
Solids at 105 C	75.9	%	0	None	LL	97
Solids, Volatile at 500 C	1.10	%	0	None	LL	97
Volatile Matter : %	1.10	%	0	None	LL	97
Mercury : Dry Wt	0.00700	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	5740	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	8.94	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.167	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	17.3	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	5.53	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	9.54	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	9.39	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	15.1	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	44.1	mg/kg	3	UKAS	LL	1041
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	78.2	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be brown wet sandy sediment.

22.36g of the sample was taken for drying at <30degC which gave 17.94g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772737
Comments: DROGHEDA STATION 10
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.63	%		None	NLS	864
Carbon : Dry Wt	4.98	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	2.35	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.0200	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.150	%	0	None	LL	994
Grain Size Fraction : < 20 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	18.0	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	10.2	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.0200	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	46.1	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.0200	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	25.1	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	16.5	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.300	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	25.1	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.300	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	46.1	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.0200	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	0.290	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.160	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	17.8	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	10.2	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	0.290	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.00	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.188	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.247	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.610	Unitless	-1	UKAS	LL	994
Kurtosis	4.13	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	1.36	mm	0	UKAS	LL	994
Particle Diameter : Median	0.171	mm	0	UKAS	LL	994
Sorting Coefficient	1.77	Unitless	-3	UKAS	LL	994
Dry Matter : %	81.8	%	0	None	LL	97
Solids at 105 C	81.8	%	0	None	LL	97
Solids, Volatile at 500 C	0.910	%	0	None	LL	97
Volatile Matter : %	0.910	%	0	None	LL	97
Mercury : Dry Wt	0.00500	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	5020	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	8.53	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.183	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	16.2	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	5.07	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	8.06	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	8.52	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	13.9	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	36.8	mg/kg	3	UKAS	LL	1041
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	80.4	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be dark brown wet sandy sediment.

28.79g of the sample was taken for drying at <30degC which gave 23.55g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772738
Comments: DROGHEDA STATION 14
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.04	%		None	NLS	864
Carbon : Dry Wt	5.47	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	3.43	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	34.1	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	56.7	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	7.61	%	0	None	LL	994
Grain Size Fraction : > 10 phi	1.41	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.810	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	7.83	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	18.8	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	15.1	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	18.8	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	7.84	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	16.0	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	8.70	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	12.8	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	13.1	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	14.5	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.810	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	12.6	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	15.8	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	8.71	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	12.6	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	4.44	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	1.78	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.566	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.0400	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	-0.130	Unitless	-1	UKAS	LL	994
Kurtosis	3.92	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.0900	mm	0	UKAS	LL	994
Particle Diameter : Median	0.0440	mm	0	UKAS	LL	994
Sorting Coefficient	2.18	Unitless	-3	UKAS	LL	994
Dry Matter : %	43.9	%	0	None	LL	97
Solids at 105 C	43.9	%	0	None	LL	97
Solids, Volatile at 500 C	6.50	%	0	None	LL	97
Volatile Matter : %	6.50	%	0	None	LL	97
Mercury : Dry Wt	0.0520	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	12500	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	11.3	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.580	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	31.6	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	20.6	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	26.9	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	22.9	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	24.9	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	123	mg/kg	3	UKAS	LL	1041
Dibutyl Tin : Dry Wt as Cation	<7	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	6.00	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	43.9	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be wet clay sediment.

44.83g of the sample was taken for drying at <30degC which gave 20.87g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772739
Comments: DROGHEDA STATION 2
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	2.33	%		None	NLS	864
Carbon : Dry Wt	4.94	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	2.61	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	2.09	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	14.6	%	0	None	LL	994
Grain Size Fraction : < 20 microns	4.58	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	9.29	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.600	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	14.6	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	13.0	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	3.64	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	25.4	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	3.64	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	23.0	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	2.21	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	1.81	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	23.0	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	1.81	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	25.4	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	2.09	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	6.78	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	1.26	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	3.27	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	14.6	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	3.30	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	2.12	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	13.0	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	1.96	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	6.73	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	1.26	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	1.95	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.580	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.0200	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.328	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.633	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	0.310	Unitless	-1	UKAS	LL	994
Kurtosis	1.49	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	1.83	mm	0	UKAS	LL	994
Particle Diameter : Median	0.328	mm	0	UKAS	LL	994
Sorting Coefficient	2.73	Unitless	-3	UKAS	LL	994
Dry Matter : %	56.1	%	0	None	LL	97
Solids at 105 C	56.1	%	0	None	LL	97
Solids, Volatile at 500 C	5.87	%	0	None	LL	97
Volatile Matter : %	5.87	%	0	None	LL	97
Mercury : Dry Wt	0.0410	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	15600	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	9.50	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.527	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	36.3	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	20.8	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	26.7	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	22.1	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	29.3	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	126	mg/kg	3	UKAS	LL	1041
Dibutyl Tin : Dry Wt as Cation	<5	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	10.0	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	55.4	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be wet gritty clay sediment.

28.93g of the sample was taken for drying at <30degC which gave 16.98g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Client: Enterprise Ireland
Folder No: 001772740
Comments: CRM
Quote No: 7928

Project: Marine Sediment Analysis
Sampled on: 27-Oct-11 @ (Time not supplied)

Matrix: Sediment

<u>Analyte</u>	<u>Result</u>	<u>Units</u>	<u>MRV</u>	<u>Accred</u>	<u>Lab ID</u>	<u>Testcode</u>
Carbonate as C : Dry Wt	0.0280	%		None	NLS	864
Carbon : Dry Wt	0.520	%	0.4	UKAS	LL	404
Carbon, Organic : Dry Wt as C	0.492	%	0.4	UKAS	LL	404
Grain Size : 4000 to 7999 microns	0.00	%	0	UKAS	LL	994
Grain Size : 8000 to 15999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : < 20 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : < -6 phi	0.00	%	0	None	LL	994
Grain Size Fraction : < 63 microns	7.30	%	0	UKAS	LL	994
Grain Size Fraction : <3.9 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 10 phi	0.00	%	0	None	LL	994
Grain Size Fraction : > 63000 microns	0.00	%	0	None	LL	994
Grain Size Fraction : > 8000 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 0 to 1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : -1 to 0 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 1 to 2 phi	13.6	%	0	None	LL	994
Grain Size Fraction : 1000 to 1999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 125 to 249 microns	45.3	%	0	UKAS	LL	994
Grain Size Fraction : 15.6 - 31.99 microns	0.0400	%	0	None	LL	994
Grain Size Fraction : 16000 - 31999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -2 to -1 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 2 to 3 phi	45.3	%	0	None	LL	994
Grain Size Fraction : 2000 to 3999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : 250 to 499 microns	13.6	%	0	UKAS	LL	994
Grain Size Fraction : -3 to -2 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 3 to 4 phi	34.0	%	0	None	LL	994
Grain Size Fraction : 3.9 - 7.79 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 32 - 62.9 microns	7.26	%	0	None	LL	994
Grain Size Fraction : 32000 - 62999 microns	0.00	%	0	None	LL	994
Grain Size Fraction : -4 to -3 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 4 to 5 phi	7.07	%	0	None	LL	994
Grain Size Fraction : -5 to -4 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 5 to 6 phi	0.0300	%	0	None	LL	994
Grain Size Fraction : 500 to 999 microns	0.00	%	0	UKAS	LL	994
Grain Size Fraction : -6 to -5 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 6 to 7 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 63 to 125 microns	33.8	%	0	UKAS	LL	994
Grain Size Fraction : 7 to 8 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 7.8 - 15.59 microns	0.00	%	0	None	LL	994
Grain Size Fraction : 8 to 9 phi	0.00	%	0	None	LL	994
Grain Size Fraction : 9 to 10 phi	0.00	%	0	None	LL	994
Grain Size Inclusive Kurtosis	0.521	mm	-12	UKAS	LL	994
Grain Size Inclusive Mean	0.140	mm	0	UKAS	LL	994
Inclusive Graphic Skewness :- {SKI}	-0.0500	Unitless	-1	UKAS	LL	994
Kurtosis	0.660	Unitless	-12	UKAS	LL	994

Particle Diameter : Mean	0.158	mm	0	UKAS	LL	994
Particle Diameter : Median	0.142	mm	0	UKAS	LL	994
Sorting Coefficient	0.760	Unitless	-3	UKAS	LL	994
Hydrocarbons : Total : Dry Wt as Ekofisk	1.39	mg/kg	0.05	UKAS	LL	402
Mercury : Dry Wt	0.0440	mg/kg	0.002	UKAS	LL	1042
Aluminium : Dry Wt	46400	mg/kg	0.02	UKAS	LL	1043
Arsenic : Dry Wt	20.4	mg/kg	0.5	UKAS	LL	1041
Cadmium : Dry Wt	0.223	mg/kg	0.02	UKAS	LL	1041
Chromium : Dry Wt	57.8	mg/kg	0.7	UKAS	LL	1041
Copper : Dry Wt	31.0	mg/kg	1	UKAS	LL	1041
Lead : Dry Wt	19.3	mg/kg	0.2	UKAS	LL	1041
Lithium : Dry Wt	50.6	mg/kg	0.3	UKAS	LL	1041
Nickel : Dry Wt	40.1	mg/kg	0.5	UKAS	LL	1041
Zinc : Dry Wt	155	mg/kg	3	UKAS	LL	1041
Aldrin : Dry Wt	20.8	ug/kg	1	UKAS	LL	672
DDE -pp : Dry Wt	19.5	ug/kg	2	UKAS	LL	672
DDT -op : Dry Wt	22.5	ug/kg	1	UKAS	LL	672
DDT -pp : Dry Wt	19.5	ug/kg	2	UKAS	LL	672
Dieldrin : Dry Wt	21.2	ug/kg	3	UKAS	LL	672
Endrin : Dry Wt	21.0	ug/kg	2	UKAS	LL	672
HCH -alpha : Dry Wt	20.0	ug/kg	1	UKAS	LL	672
HCH -beta : Dry Wt	21.2	ug/kg	1	UKAS	LL	672
HCH -delta : Dry Wt	20.9	ug/kg	1	UKAS	LL	672
HCH -gamma : Dry Wt :- {Lindane}	19.0	ug/kg	2	UKAS	LL	672
Hexachlorobenzene : Dry Wt	23.5	ug/kg	1	UKAS	LL	672
Hexachlorobutadiene : Dry Wt	21.5	ug/kg	1	UKAS	LL	672
Isodrin : Dry Wt	20.3	ug/kg	2	UKAS	LL	672
TDE - pp : Dry Wt	19.1	ug/kg	1	UKAS	LL	672
Acenaphthene : Dry Wt	30.8	ug/kg	2	UKAS	LL	1051
Acenaphthylene : Dry Wt	88.6	ug/kg	2	None	LL	1051
Anthracene : Dry Wt	191	ug/kg	2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	302	ug/kg	2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	313	ug/kg	2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	496	ug/kg	10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	323	ug/kg	10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	226	ug/kg	10	UKAS	LL	1051
Chrysene : Dry Wt	360	ug/kg	3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	70.3	ug/kg	5	UKAS	LL	1051
Fluoranthene : Dry Wt	628	ug/kg	2	UKAS	LL	1051
Fluorene : Dry Wt	66.3	ug/kg	10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	232	ug/kg	10	UKAS	LL	1051
Naphthalene : Dry Wt	1010	ug/kg	30	UKAS	LL	1051
Phenanthrene : Dry Wt	431	ug/kg	10	UKAS	LL	1051
Pyrene : Dry Wt	512	ug/kg	3	UKAS	LL	1051
PCB - 028 : Dry Wt	4.32	ug/kg	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	5.44	ug/kg	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	5.20	ug/kg	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	4.24	ug/kg	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	3.44	ug/kg	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	5.60	ug/kg	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	3.20	ug/kg	0.1	UKAS	LL	685

Dibutyl Tin : Dry Wt as Cation	825	ug/kg	3	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	435	ug/kg	3	UKAS	LE	897
Dry Solids @ 30°C	77.6	%	0.5	None	LE	1130
Accreditation Assessment	2	No.		None	LE	924
Sample Preparation	Report	Text		None	LE	924

The sample appeared to be black clay sediment.

38.41g of the sample was taken for drying at <30degC which gave 18.36g of dried sample (weights include tray weight).

The sample was crushed using a jaw crusher.

The sample was then sieved until it passed through a 2mm sieve.

The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Method Description Summary for all samples in batch Number 20034360

<u>Testcode</u>	<u>Method Reference</u>
97	LL ME 11.9 LOI - Moisture, Loss on Ignition - determined by gravimetry at specific temperature, from as received sample
402	NLS I UVF 10.2 - HCs - methanol digested, pentane xch, by UV fluorescence spectrometry
404	LL I CHN 11.2 and 11.3 - combusted, determined by TCD, Organic C - acid pretreated to remove inorganic carbonates
606	LE I TOC 01 - TC and TN - combusted with oxygen, thermal conductivity detection
672	LL O PESTICIDES - solvent extracted, determined by GCMS (SIM)
685	LL O PCBs - solvent extracted, determined by GCMS (SIM)
864	Parameter by calculation
897	LE O Organotins (GCMS) 01 - acetic acid/methanol extracted, derivatised, GCMS (SIM), from as received sample
924	Sample Preparation, Dry Solids (30°C), from as received sample
994	NLS I Particle Size Laser LL I 9.4 - bands - determined by laser light diffraction
1041	LL ME ICPMS 12.1 and 12.4- Metals - microwave aqua regia digested, determined by ICPMS
1042	LL ME Hg 10.8 - Mercury - microwave aqua regia digested, acidic SnCl ₂ reduced, determined by CV-AFS
1043	LL ME ICP-OES 22.1 and 22.2 - Metals - microwave aqua regia digested, determined by ICPOES
1051	LL O PAHs - solvent extracted, determined by GCMS (EI)
1130	LE P Soil Preparation 01: Air-dried at <30°C in a controlled environment to constant weight.



David Gazzard

Laboratory Site Manager

All reporting limits quoted are those achievable for clean samples of the relevant matrix. No allowance is made for instances when dilutions are necessary owing to the nature of the sample or insufficient volume of the sample being available. In these cases higher reporting limits may be quoted and will be above the MRV.

Solid sample results are determined on a "dried" sample fraction except for parameters where the method description identifies that "as received" sample was used.

Please note all samples will be retained for 10 working days for aqueous samples and 30 working days for solid samples after reporting unless otherwise agreed with Customer Services

Key to Accreditation: UKAS = Methodology accredited to ISO/IEC 17025:2005, MCertS = Methodology accredited to MCertS Performance Standard for testing of soils, None = Methodology not accredited

Key to Lab ID: LE = Leeds, LL = Llanelli, NM = Nottingham, SX = Starcross, SC = Sub-Contracted outside NLS, FI = Field Data, NLS = Calculated

Any subsequent version of this report denoted with a higher version number will supersede this and any previous versions

END OF TEST REPORT



Laboratory Test Report

Report Date: 6th January 2012

Samples Tested on Behalf of: Captain Martin Donnelly
Harbour Master
Drogheda Port Company
Habourville
Mornington Road
Drogheda
Co Meath

Laboratory Analysis: High Resolution Gamma Spectrometry with appropriate density correction

Sample Type: Marine Sediment

Date of Receipt: 27th October 2011

Date of Analysis 10th November – 19th December 2011

Results:

RPII Reference	Client Reference	Location	Nuclide	Activity Concentration (Bq/kg) ¹
CT1100844	Bar at Boyne Mouth	Site No. 14	K-40	165 ± 3
			I-131	< 1.5
			Cs-134	< 0.4
			Cs-137	10.5 ± 0.3
			Ra-226	32.9 ± 2.6
			U-235	1.3 ± 0.1
			U-238	28.2 ± 2.5

CT1100845	Ship turning circle	Site No. 5	K-40	146 ± 3
			I-131	< 1.1
			Cs-134	< 0.4
			Cs-137	6.8 ± 0.3
			Ra-226	24.3 ± 2.4
			U-235	2.5 ± 0.1
			U-238	55.1 ± 2.3

Note:

(1) combined standard uncertainty

The Radiological Protection Institute of Ireland received two samples from Enterprise Ireland on 27th of October 2011. The samples were prepared by placing an aliquot of sample in a well-defined counting geometry. These were then measured on a high-resolution gamma spectrometer. Appropriate density corrections were applied to the resultant spectra to take account of the differences in sample density.

The results indicate that dumping of these materials at sea will not result in a radiological hazard.

Lorraine Currivan
Laboratory Manager

Notes:

- This report relates only to the samples tested.
- This report shall not be reproduced except in full, without the approval of the Institute.
- The following scientific officers may sign test reports on behalf of the laboratory manager: Dr Ciara McMahon, Dr Kevin Kelleher, Dr Paul McGinnity
- Where applicable, the number following the symbol ± is the combined standard uncertainty and not a confidence interval.

DATA SUPPLIED IN FORMAT REQUIRED BY MARINE INSTITUTE

Robert Fennelly

From: Martin Donnelly <martindonnelly@droghedaport.ie>
Sent: 31 January 2012 14:33
To: Curran, Liam
Cc: Aebhin Cawley; Matt Hague
Subject: RE: Sedinment Sampling

Liam, tks again,

Can you also send the report text electronic as all the update for the epa is required electronically.

Many tks

Regards

Capt. Martin Donnelly
Harbour Master
Drogheda Port Company

Telephone: 00 353 (0)41 983 8378
Facsimile: 00 353 (0)41 983 2844
www.droghedaport.ie

----- Drogheda Port Global Gateway -----

This e-mail is confidential. If you receive it in error please advise by return e-mail and delete it.
Thank you for your co-operation.

From: Curran, Liam [mailto:Liam.Curran@enterprise-ireland.com]
Sent: 31 January 2012 12:58
To: Martin Donnelly
Subject: RE: Sedinment Sampling

Hi Martin,

I spoke to Tara Higgins of the EPA last week and she is happy to use the MI Excel spreadsheet that I attached last Friday with the main report. I would, however, recommend that you send a hard copy of the EI report with the application as it contains a good deal more data and detail than is contained in the Excel spreadsheet.

I've attached the Excel spreadsheet.

Regards,

Liam.

From: Martin Donnelly [mailto:martindonnelly@droghedaport.ie]
Sent: 31 January 2012 12:36
To: Curran, Liam
Cc: Aebhin Cawley; mhague@scottcawley.com
Subject: RE: Sedinment Sampling

Hi Liam,

Report arrived today. Many tks.

Could you also forward a electronic copy or disc, particularly looking for the excel spreadsheet for upload to the EPA application.

Regards

Capt. Martin Donnelly
Harbour Master
Drogheda Port Company

Telephone: 00 353 (0)41 983 8378
Facsimile: 00 353 (0)41 983 2844
www.droghedaport.ie

----- Drogheda Port Global Gateway -----

This e-mail is confidential. If you receive it in error please advise by return e-mail and delete it.
Thank you for your co-operation.

From: Curran, Liam [mailto:Liam.Curran@enterprise-ireland.com]
Sent: 25 January 2012 11:00
To: Martin Donnelly
Subject: RE: Sedinment Sampling

Hello Martin,

Just to keep you up to date on progress; I've got the written report ready to go to you, but I had a few queries for the MI and EPA on the Excel spreadsheets to be sent with the report. I've managed to get agreement from the EPA that the Excel spreadsheet to be sent to them can be a duplicate of the one for Margot in the MI. This saves me from having to do up two separate Excel spreadsheets for both agencies.

Sorry for the delay, but I wanted to be sure that the EPA were going to accept the data format in Margot's spreadsheet.

I hope to get all the data into Excel today.

Regards,

Liam.

From: Martin Donnelly [mailto:martindonnelly@droghedaport.ie]
Sent: 16 January 2012 15:55
To: Curran, Liam
Cc: acawley@scottcawley.com
Subject: RE: Sedinment Sampling

Liam,

Thanks for that.

Rgds

Capt. Martin Donnelly
Harbour Master
Drogheda Port Company

Telephone: 00 353 (0)41 983 8378
Facsimile: 00 353 (0)41 983 2844
www.droghedaport.ie

-----Drogheda Port Leading the Way in Port Logistics -----

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From: Curran, Liam [mailto:Liam.Curran@enterprise-ireland.com]
Sent: 16 January 2012 14:11

Project ID	Dredge Quantity m ³	Location	Survey Company	Sampling Date	Analysing Laboratory	Sub Contract Lab	Analysis Date
Drogheda Maintenance Dredging	2012	Boyne Estuary and Marine Dumpsites	Enterprise Ireland Water Laboratory	27/10/2011	Environment Agency, UK	Not Applicable	Oct/Nov/Dec 2011

Project id	Fraction analysed	Granulometry method	OC method	Metals extraction type	Methods of detection (metals & mercury/arsenic)	Organics extraction types	Methods of detection (PCBs / PAHs / TBT / DBT)
Drogheda '12	<2mm	Laser diffraction	TOC Meter	Microwave digestion	ICP-OPES/OES	ASE/GPC/SPEC/Silica Ab	GCMS

Site/Sample Number	Site/Sample Location	Depth M	Position Latitude degree / mins/ decimal mins	Position Longitude degree / mins/ decimal mins
2	U/S Viaduct	Surface	53°43.10'N	006°20.28'W
3	100m D/S Maxol Terminal	Surface	53°43.09'N	006°19.59'W
4	Between Buoy 31 and Buoy 32	Surface	53°43.18'N	006°19.20'W
5	In Ship Turning Basin	Surface	53°43.17'N	006°18.52'W
6	Centre Channel between Buoy 28 and Buoy 29	Surface	53°43.22'N	006°18.54'W
7	Centre of Berth, Tom Roe's Terminal	Surface	53°43.25'N	006°18.34'W
8	20m D/S of berth at Tom Roe's Terminal	Surface	53°43.26'N	006°18.24'W
9	Mornington Pier, between Buoy 21 and Buoy 22	Surface	53°43.48'N	006°17.13'W
10	Between Buoy 16 and Buoy 17	Surface	53°43.90'N	006°16.24'W
14	500m East of Station 13	Surface	53°43.30'N	006°14.15'W
15	Mid Dumpsite A1	Surface	53°44.51'N	006°10.59'W
16	Mid Dumpsite A2	Surface	53°45.80'N	006°13.40'W
17	Mid Dumpsite A3	Surface	53°40.70'N	006°12.60'W

Visual appearance life signs eg worms?	% Moisture	% >2mm	% <2mm >63um	% <63um	% OC	TEH g kg ⁻¹	METAL Cu mg kg ⁻¹	METAL Zn mg kg ⁻¹
No Biota obvious	44	19	72	9	2.6		20.8	126
No Biota obvious	62	0	32	68	5.0	0.107	28.9	198
No Biota obvious	40	0	64	36	2.0		14.4	98.1
Worms	56	0	41	59	3.5	0.134	26.8	182
No Biota obvious	25	1	99	0	3.2	0.0275	6.01	55.4
No Biota obvious	40	32	11	57	3.6	0.123	12.3	85.5
No Biota obvious	46	0	74	26	3.1	0.242	24.2	256
Tube worms	24	4	95	1	2.1		5.53	44.1
Tube worms	18	17	83	0	2.4		5.07	36.8
No Biota obvious	56	0	43	57	3.4		20.6	123
Bivalves	19	0	93	7	1.44	0.0044	2.56	29.1
Bivalves	18	10	90	0	1.03	0.00186	2.19	26.6
Tube worms	19	0	100	0	1.2	0.00416	2.73	28.3

METAL Cd mg kg ⁻¹	METAL Hg mg kg ⁻¹	METAL Pb mg kg ⁻¹	METAL As mg kg ⁻¹	METAL Cr mg kg ⁻¹	METAL Mn mg kg ⁻¹	METAL Ni mg kg ⁻¹	METAL Li mg kg ⁻¹
0.527	0.041	26.7	9.5	36.3		29.3	22.1
0.923	0.048	40.7	15	47.5		38.1	35.6
0.35	0.033	22.8	7.3	31.3		23.7	18.9
0.9	0.046	33.2	12.4	40.4		33.1	27.3
0.266	0.007	8.37	3.96	18.3		16.6	9.39
0.379	0.022	15.1	6.19	26.5		19.7	16.5
0.745	0.021	25.6	8.19	31		20.4	16.1
0.167	0.007	9.54	8.94	17.3		15.1	9.39
0.183	0.005	8.06	8.53	16.2		13.9	8.52
0.58	0.052	26.9	11.3	31.6		24.9	22.9
0.048	0.007	6.31	5.8	11.4		7.39	7.44
0.05	0.003	6.06	5.26	12		6.74	6.38
2.73	0.005	7.58	3.81	14		7.08	6.79

OT Σ TBT + DBT mg								
METAL Al mg kg ⁻¹	OT DBT mg kg ⁻¹	OT TBT mg kg ⁻¹	kg ⁻¹	PCB 028 ug kg ⁻¹	PCB 052 ug kg ⁻¹	PCB 101 ug kg ⁻¹	PCB 138 ug kg ⁻¹	PCB 153 ug kg ⁻¹
15600	<0.005	0.01	0.01					
20500	0.0131	0.00709	0.02019	<0.1	<0.1	<0.1	<0.1	<0.1
12400	<0.004	<0.003	<0.007					
16400	0.0433	0.0101	0.0534	<0.1	<0.1	<0.1	<0.1	<0.1
5000	0.0041	0.00736	0.01146	<0.1	<0.1	<0.1	<0.1	<0.1
10400	<0.006	<0.004	<0.010	<0.1	<0.1	<0.1	<0.1	<0.1
11300	0.0178	0.0192	0.037	<0.1	<0.1	<0.1	<0.1	<0.1
5740	<0.004	<0.003	<0.007					
5020	<0.004	<0.003	<0.007					
12500	<0.007	0.006	0.006					
3480	<0.004	<0.003	<0.007	<0.1	<0.1	<0.1	<0.1	<0.1
3100	<0.004	<0.003	<0.007	<0.1	<0.1	<0.1	<0.1	<0.1
2940	0.0584	<0.003	0.0584	<0.1	<0.1	<0.1	<0.1	<0.1

PAH Benzo k fluoranthene ug kg ⁻¹	PAH Chrysene ug kg ⁻¹	PAH Dibenz a,h anthracene ug kg ⁻¹	PAH Flourene ug kg ⁻¹	PAH Fluoranthene ug kg ⁻¹	PAH Indeno 1,2,3 – cd pyrene ug kg ⁻¹	PAH Naphthalene ug kg ⁻¹	PAH Phenanthrene ug kg ⁻¹	PAH Pyrene ug kg ⁻¹	PAH Σ 13 ug kg ⁻¹
75.8	93.7	14.9	33.6	189	98.8	102	104	183	1499.69
130	285	30.7	38.6	439	169	167	107	374	3015.7
<10	18.5	<5	15.4	36.2	<10	<30	36.2	35.1	213.58
21.5	53.5	<5	114	256	23.3	142	308	188	1423.61
42.9	104	7.57	303	860	36.8	279	973	588	3839.17
<10	4.98	<5	<10	8.64	<10	53	14.9	7.2	107.95
<10	<3	<5	<10	4.36	<10	<30	<10	3.92	8.28
<10	<3	<5	<10	3.46	<10	<30	<10	3.57	7.03

OCP HCH Gamma ug kg ⁻¹	OCP HCB ug kg ⁻¹	Notes / comments:
<2	<1	
<2	<1	
<2	<1	PAH sum on determinands above detection limits.
<2	<1	
<2	<1	
<2	<1	PAH sum on determinands above detection limits.
<2	<1	PAH sum on determinands above detection limits.
<2	<1	PAH sum on determinands above detection limits.

[illegible]

METAL Hg mg kg ⁻¹	METAL Pb mg kg ⁻¹	METAL As mg kg ⁻¹	METAL Cr mg kg ⁻¹	METAL Mn mg kg ⁻¹	METAL Ni mg kg ⁻¹	METAL Li mg kg ⁻¹	METAL Al mg kg ⁻¹
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0.044	19.3	20.4	57.8	40.1	50.6	46400
0.091 +/- 0.009	21.1 +/- 0.7	21.2 +/- 1.1	105 +/- 4	46.9 +/- 2.2	73.6 +/- 5.2	

												PAH
OT DBT mg kg ⁻¹	OT TBT mg kg ⁻¹	OT Σ TBT + DBT mg kg ⁻¹	PCB 028 ug kg ⁻¹	PCB 052 ug kg ⁻¹	PCB 101 ug kg ⁻¹	PCB 138 ug kg ⁻¹	PCB 153 ug kg ⁻¹	PCB 180 ug kg ⁻¹	PCB 118 ug kg ⁻¹	Σ 7 PCB ug kg ⁻¹	Acenaphthene ug kg ⁻¹	
			4.32	5.44	5.2	3.44	5.6	3.2	4.24	31.44		30.8
			4.52 +/-	5.24 +/-	5.11 +/-	3.60 +/-	5.47 +/-	3.24 +/-	4.23 +/-		38.4 +/-	5.2
			0.57	0.28	0.34	0.28	0.32	0.51	0.19			

0.825

0.435

1.26

0.770 +/-0.090

0.480 +/-0.080

1.25+/-0.17

PAH Acenaphthylene ug kg ⁻¹	PAH Anthracene ug kg ⁻¹	PAH Benzo (a) anthracene ug kg ⁻¹	PAH Benzo (a) pyrene ug kg ⁻¹	PAH Benzo (b) fluoranthene ug kg ⁻¹	PAH Benzo (ghi) perylene ug kg ⁻¹	PAH Benzo (k) fluoranthene ug kg ⁻¹	PAH Chrysene ug kg ⁻¹
88.6	191	302	313	496	323	226	360
53.3 +/- 6.4	184 +/- 18	335 +/- 25	358 +/- 17	453 +/- 21	307 +/- 45	255 +/- 18	291 +/- 31

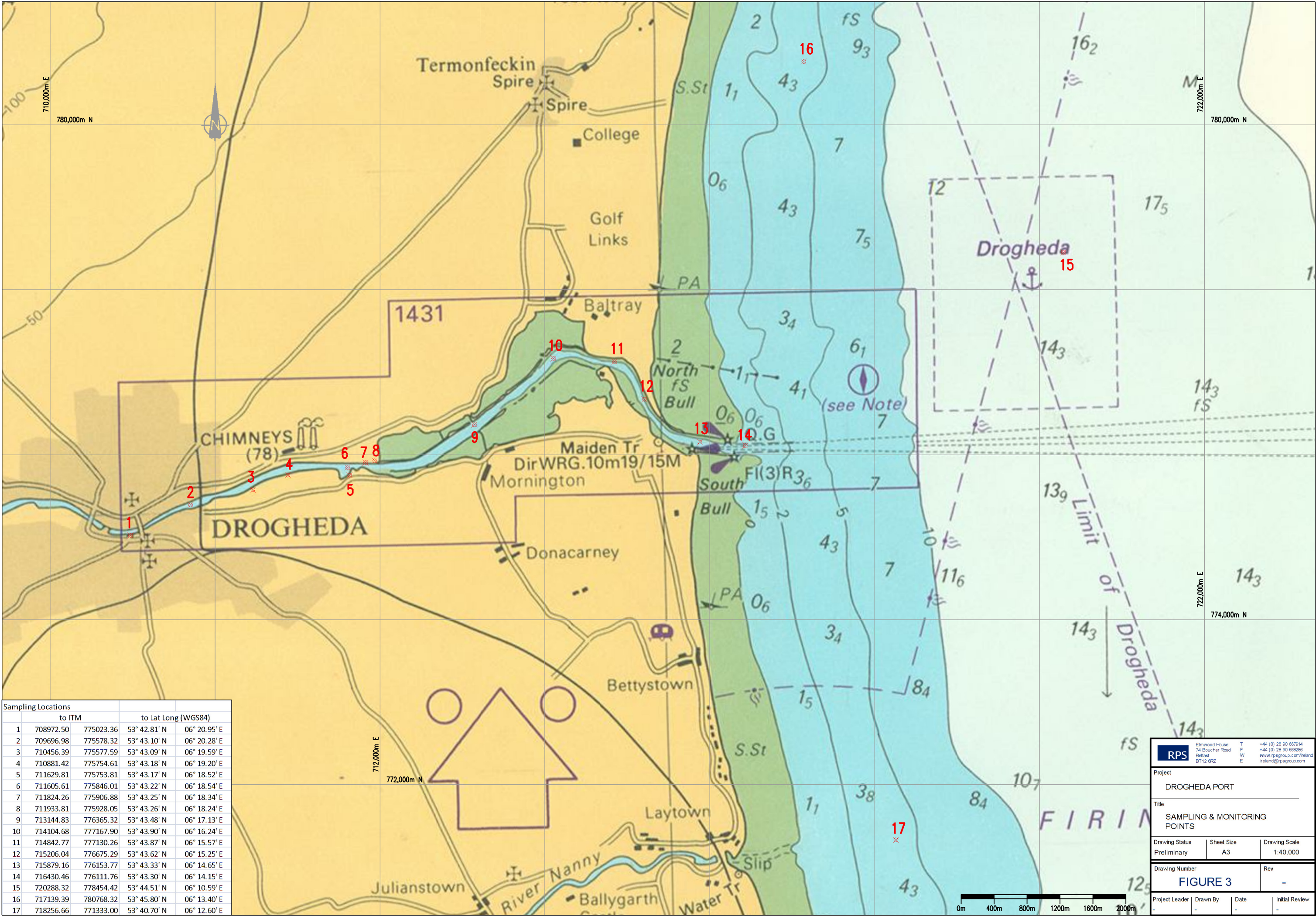
PAH Dibenzo (a,h) anthracene ug kg ⁻¹	PAH Fluorene ug kg ⁻¹	PAH Fluoranthene ug kg ⁻¹	PAH Indeno (1,2,3 – cd) pyrene ug kg ⁻¹	PAH Naphthalene ug kg ⁻¹	PAH Phenanthrene ug kg ⁻¹	PAH Pyrene ug kg ⁻¹	PAH Σ 13 PAH ug kg ⁻¹	OCP HCH Gamma ug kg ⁻¹	OCP HCB ug kg ⁻¹
70.3	66.3	628	232	1010	431	512	4668.3	19	23.5
53 +/- 10	85 +/- 15	651 +/- 50	341 +/- 57	848 +/- 95	406 +/- 44	581 +/- 39			

Key	Value
Location:	Area eg Cork Harbour / Dublin Bay
Date of sampling:	
CRMs used:	Certified reference materials used in analyses for metals, organics & TBT
Fraction analysed:	Which fraction of sediment was analysed? < 2mm is requested, but some labs use < 63mm.
Are results reported as wet weight or dry wt?	Were analyses carried out on wet or dry sediment?
Laboratory	Main laboratory where samples are sent to for analysis
Sub-contract	Sub-contracted laboratory where samples are sent by Main Laboratory
Sample no.	Sample number assigned by sampler
Sample id	Sample number assigned by analysing laboratory
Position (dd/mm.ss)	Position where sample was taken. To be reported in either degree / minute / decimal minute or in metres. Please also list datum and projection.
Units	Units of concentration
H ₂ O	Water content of sample, reported as %
<2mm	Grain size % < 2mm
<63um	Grain size % < 63mm
OC	Organic carbon (NOT organic matter)
TEH	Total extractable hydrocarbons
Cu	Copper
Zn	Zinc
Cd	Cadmium
Hg	Mercury
Pb	Lead
As	Arsenic
Cr	Chromium
Mn	Manganese
Ni	Nickel
Li	Lithium
Al	Aluminium
DBT	Dibutyl tin
TBT	Tributyl tin
Σ TBT + DBT	Sum of di-butyl tin & tri-butyl tin
PCB 028	
PCB 052	
PCB 101	
PCB 138	
PCB 153	

PCB 180	
PCB 118	
Σ 7 PCB	Sum of the seven ICES polychlorinated biphenyls previously listed
Acenaphthene	
Acenaphthylene	
Anthracene	
Benzo (a) anthracene	
Benzo (a) pyrene	
Benzo (b) fluoranthene	
Benzo (ghi) perylene	
Benzo (k) fluoranthene	
Chrysene	
Dibenz (a,h) anthracene	
Flourene	
Fluoranthene	
Indeno (1,2,3 – cd) pyrene	
Naphthalene	
Phenanthrene	
Pyrene	
Σ 13 PAH	Sum of 13 polycyclic aromatic hydrocarbons
HCH Gamma	1α,2α,3β,4α,5α,6β-hexachlorocyclohexane (Lindane)
HCB	Hexachlorobenzene

Notes

- 1 Please complete all worksheets.
- 2 Position where sample was taken to be reported in either degree / minute / decimal minute or in metres. Please also list datum and projection.
- 3 Insert column to the right on results sheet for any additional determinands as required
- 4 Brief description of methodology eg sample treatment, extraction method, method of detection
- 5 Ensure that quality assurance data is completed, and name of certified reference materials is inserted.
- 6 Ensure that methodology data is completed for each determinand group.



Sampling Locations				
	to ITM		to Lat Long (WGS84)	
1	708972.50	775023.36	53° 42.81' N	06° 20.95' E
2	709696.98	775578.32	53° 43.10' N	06° 20.28' E
3	710456.39	775577.59	53° 43.09' N	06° 19.59' E
4	710881.42	775754.61	53° 43.18' N	06° 19.20' E
5	711629.81	775753.81	53° 43.17' N	06° 18.52' E
6	711605.61	775846.01	53° 43.22' N	06° 18.54' E
7	711824.26	775906.88	53° 43.25' N	06° 18.34' E
8	711933.81	775928.05	53° 43.26' N	06° 18.24' E
9	713144.83	776365.32	53° 43.48' N	06° 17.13' E
10	714104.68	777167.90	53° 43.90' N	06° 16.24' E
11	714842.77	777130.26	53° 43.87' N	06° 15.57' E
12	715206.04	776675.29	53° 43.62' N	06° 15.25' E
13	715879.16	776153.77	53° 43.33' N	06° 14.65' E
14	716430.46	776111.76	53° 43.30' N	06° 14.15' E
15	720288.32	778454.42	53° 44.51' N	06° 10.59' E
16	717139.39	780768.32	53° 45.80' N	06° 13.40' E
17	718256.66	771333.00	53° 40.70' N	06° 12.60' E

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Project

DROGHEDA PORT

Title

SAMPLING & MONITORING
POINTS

Drawing Status

Sheet Size

Drawing Scale

Preliminary

A3

1:40,000

Drawing Number

Rev

FIGURE 3

-

Project Leader

Drawn By

Date

Initial Review

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- 5.58 The implications of the dispersal of the sediment plumes expected as a result of the dredging works were assessed using the computational models SEDPLUME-RW which comprise a suite of post processing packages to the hydrodynamic models. The programs were developed at HR Wallingford and are designed to compute the dispersion of suspended silts/fine sands released by dredging related activities.
- 5.59 The sediment dispersal models are capable of accurately simulating the advection, dispersion, settling, deposition and re-erosion of sediments typically encountered during capital and maintenance dredging operations. A detailed description of the models and their implementation are presented in Appendix B.
- 5.60 A series of SEDPLUME-RW simulation runs were completed in order to determine the distribution of sediments in suspension during various stages of the dredging operations. The resulting sediment plumes when the dredger is working in the middle of the navigable channel are presented in Figures 5.38 to 5.41. Contours of 25 mg/l (Guideline value for salmonid fish, see Chapter 8.0) and 50 mg/l have been plotted to illustrate the concentrations of suspended solids making up the sediment plumes. These values do not include background levels which are discussed in paragraph 5.49. The results show that elevated levels of suspended solids will become quickly dispersed due to the dilution and settlement. A curtain of elevated suspended solids across the navigable channel will therefore not occur allowing the free passage of migrating salmon. High suspended solids loadings in the order of 400 mg/l are only expected immediately downstream of the dredger itself (circa 50 m).

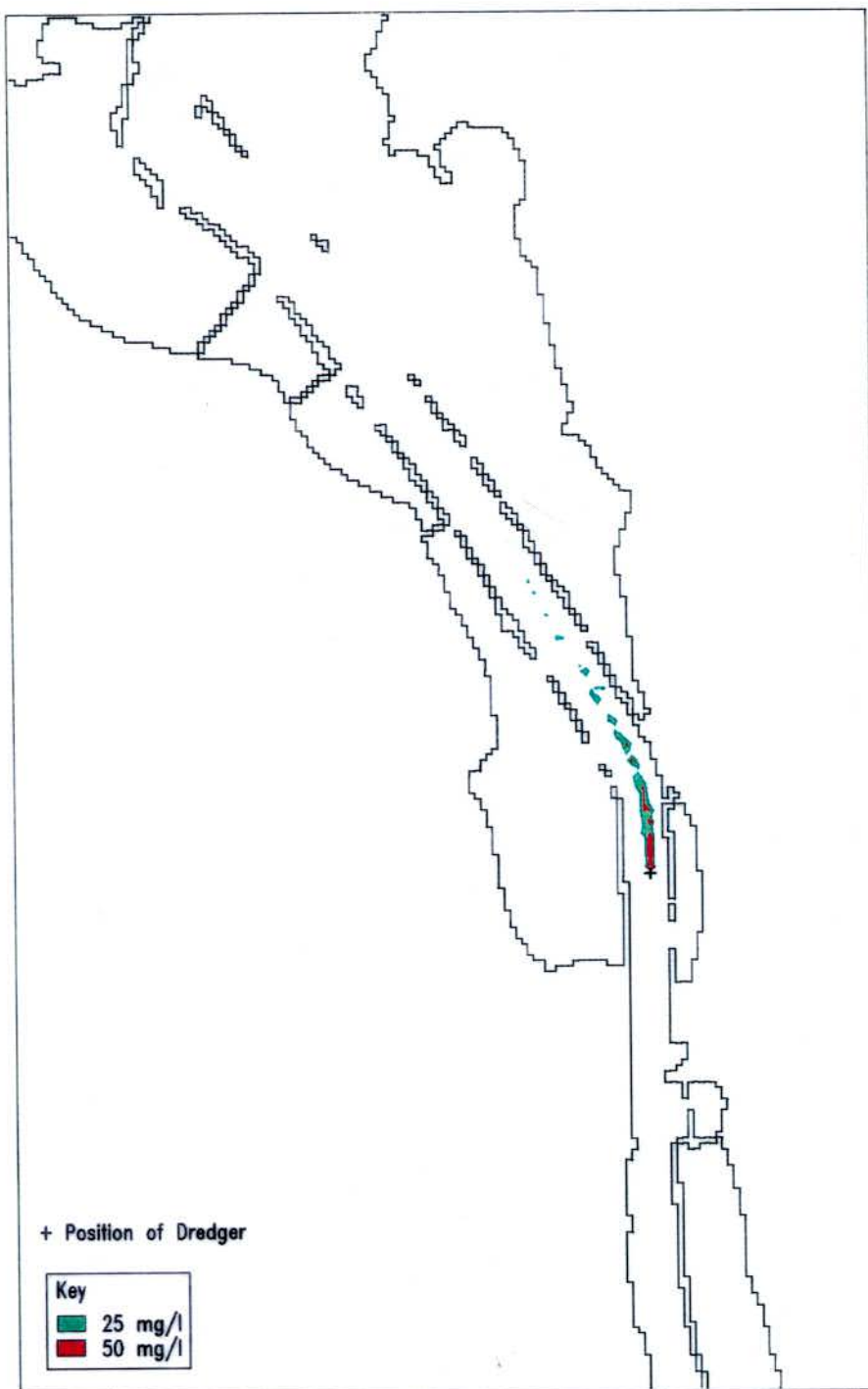
- 5.61 Further plume simulation results are presented in Figures 5.42 to 5.45 which show the resulting sediment plumes when the dredger is working at the edge of the navigable channel in close proximity to a tidal opening to the polders. In this case, a limited volume of sediment is expected to enter the polders during the last 3 hours of the flood Spring tide at concentrations less than 50 mg/l. Less material will enter the polders during Neap tides. Again high suspended solids loadings are only expected immediately downstream of the dredger itself (circa 50 m).
- 5.62 The background suspended solids loading within the Boyne Estuary is regularly monitored by the Environmental Protection Agency. The results of the routine monitoring programme for the period 1994 to 1995 are presented in Table 5.4. The location of the sampling points are also presented in Figure 5.46. The results show that suspended solids are often recorded above 25 mg/l and can reach levels in excess of 150 mg/l in the vicinity of Mornington during storm conditions. It is also worth noting that regular maintenance dredging of the navigable channel takes place at present which uses a grab to remove sediments. This type of dredge is expected to result in a much greater percentage loss of material, albeit at a lesser scale. Present maintenance dredging removes around 20,000 - 30,000 m³/year of sediment from the navigable channel to a licensed offshore disposal site.

References

- Kirk McClure Morton (1994)** Hydraulic Studies on the River Boyne Navigation Channel, Estuary, Bar and Environs. A report for the Drogheda Harbour Commissioners.
- Kirk McClure Morton (1994)** Ship Manoeuvring Studies. A report for the Drogheda Harbour Commissioners.

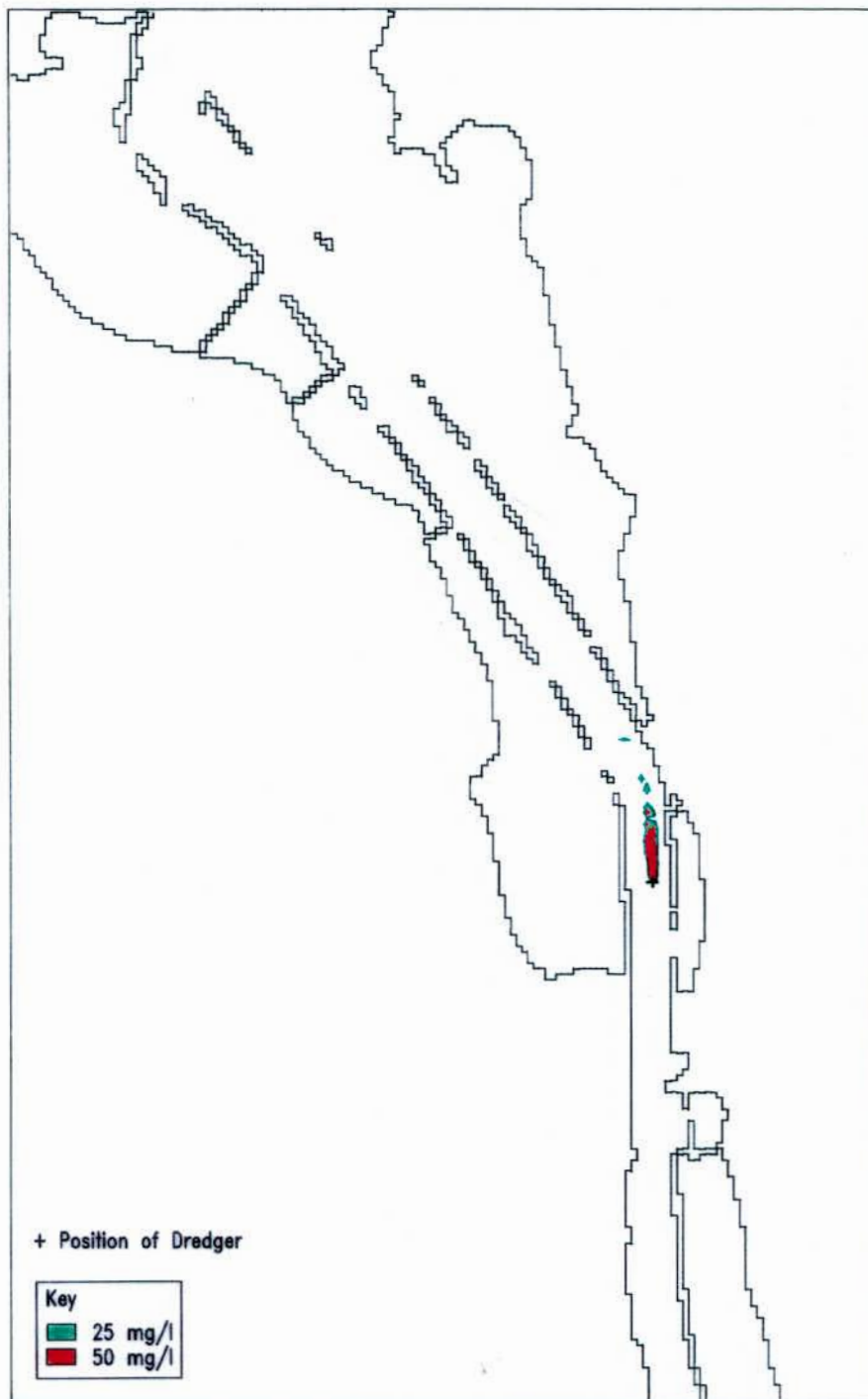
Table 5.4 Background Suspended Solids Loading (mg/l)
(recorded by EPA Regional Inspectorate, Monaghan)

Date	Sample Location													
	30	31	32	33	34	35	36	37	38	39	40	41	42	43
11.05.94														
Run 1	6	7	8	8	14	12	19	-	37	75	25	27	6	10
Run 2	6	6	2	18	4	1	2	14	17	23	184	-	-	-
15.11.94														
Run 1	19	17	20	17	19	20	16	18	20	90	32	34	25	16
Run 2	-	-	62	-	70	33	26	27	25	32	46	-	-	24
22.06.95														
Run 1	-	17	47	18	19	27	25	30	24	15	28	8	20	-
Run 2	-	29	20	18	20	49	24	28	29	20	16	15	13	6
26.07.95														
Run 1	-	84	52	52	41	65	63	168	66	71	-	-	-	-
Run 2	-	69	82	54	121	74	100	176	92	145	-	-	-	-



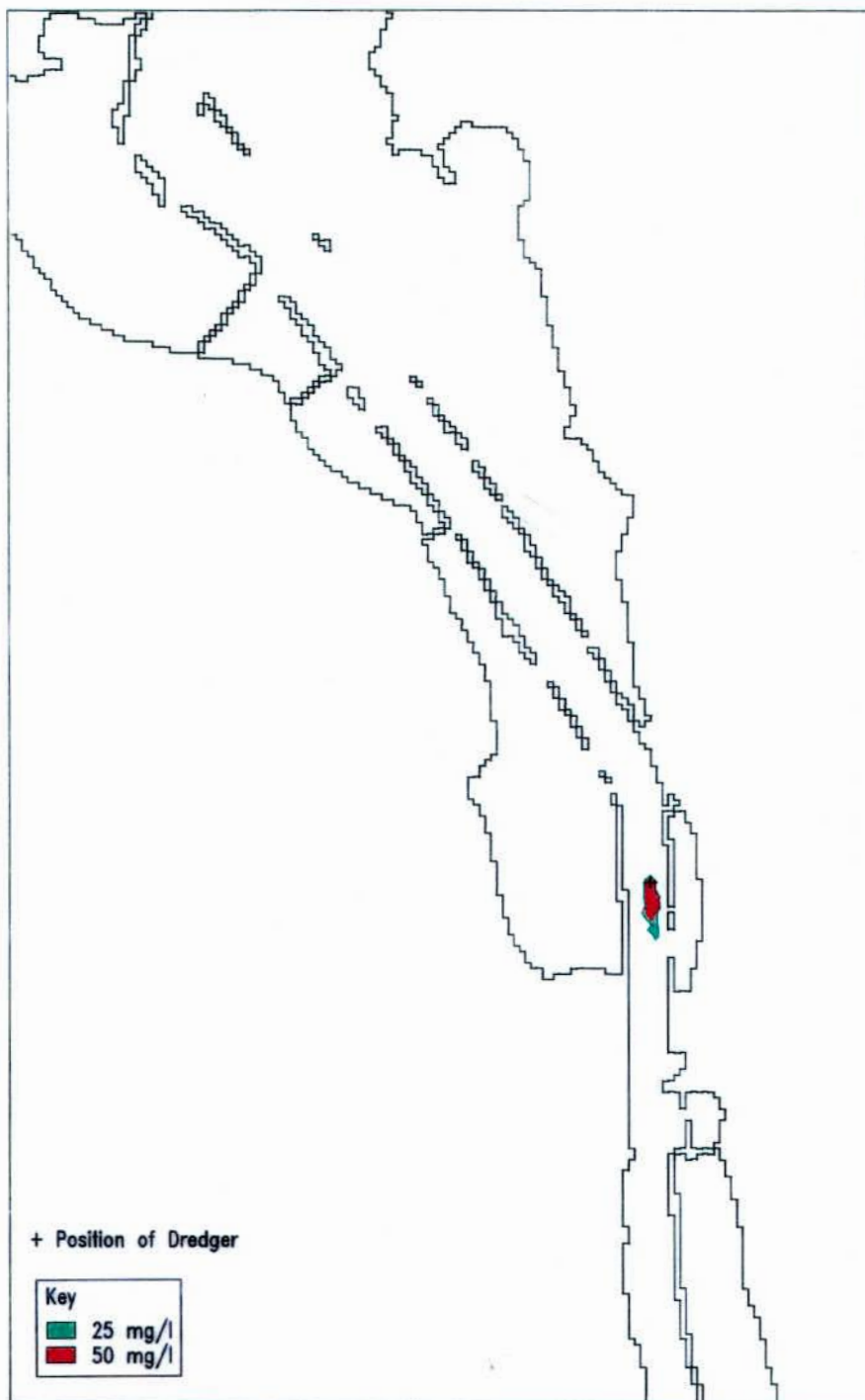
Drogheda Harbour Study
Predicted Sediment Plume at Mid-Ebb
Due to Dredging in Centre of Channel
Tidal times relate to HW at the Bar

Figure 5.38



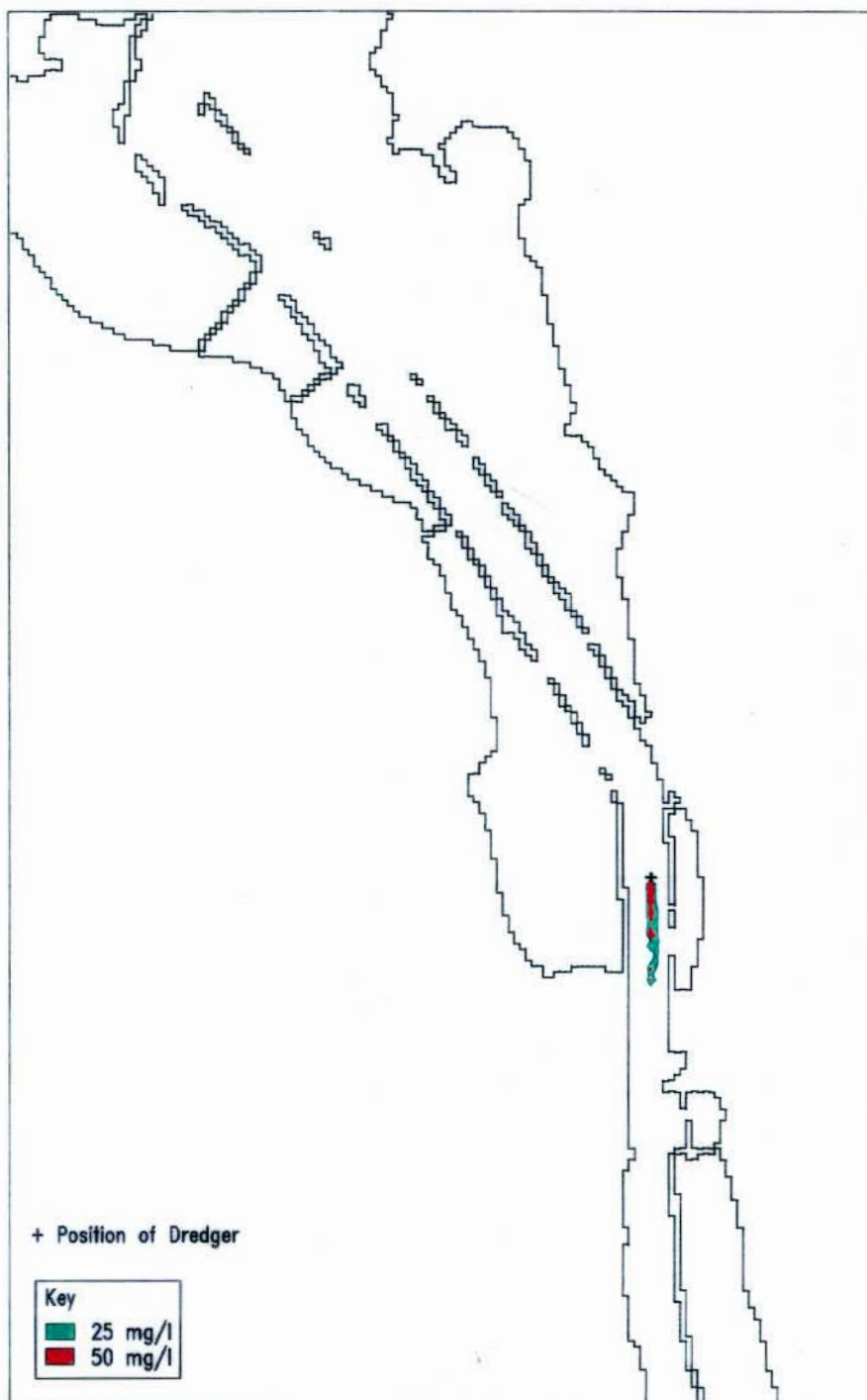
Drogheda Harbour Study
Predicted Sediment Plume at Low-Water
Due to Dredging in Centre of Channel
Tidal times relate to HW at the Bar

Figure 5.39



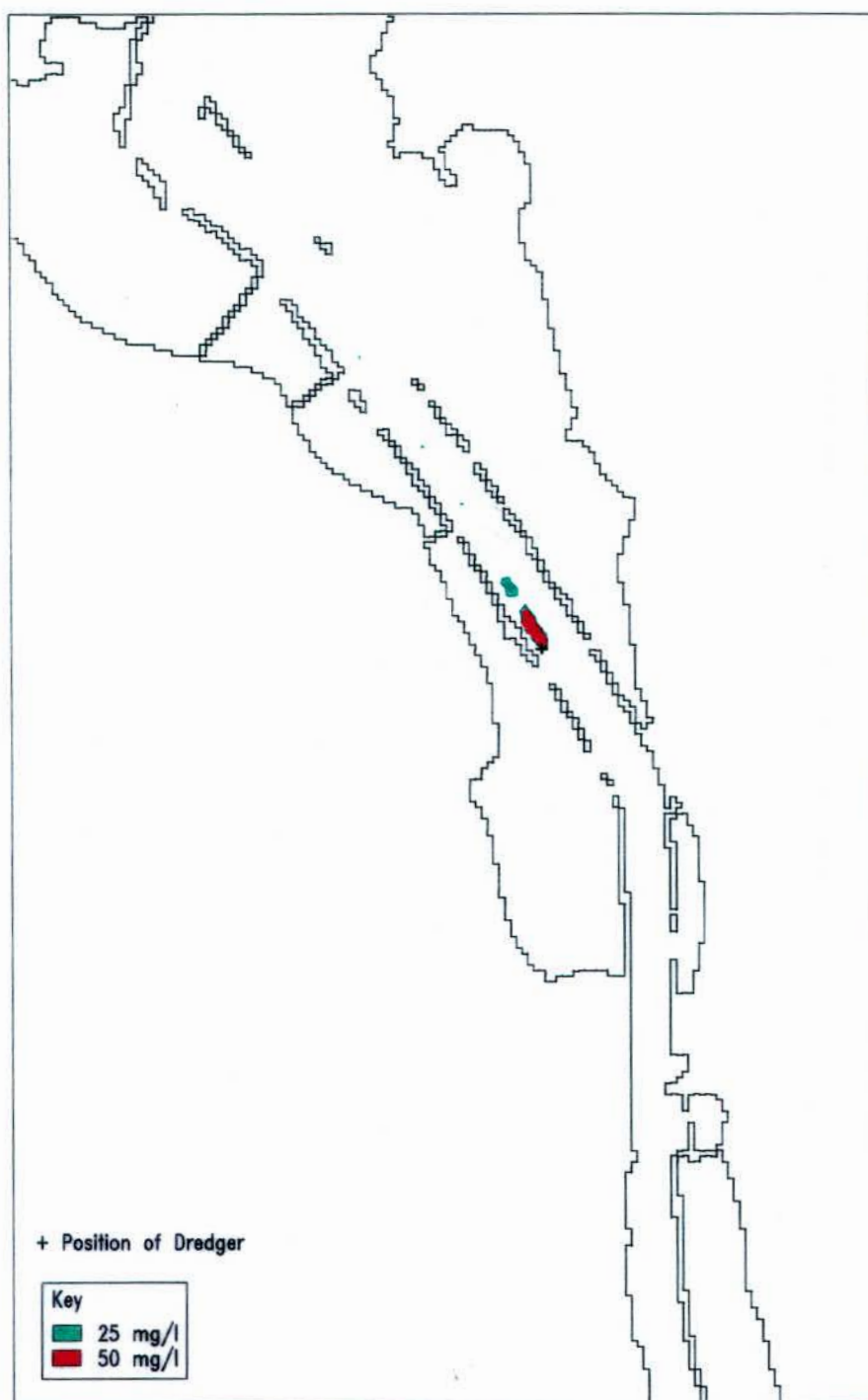
Drogheda Harbour Study
Predicted Sediment Plume at Mid-Flood
Due to Dredging in Centre of Channel
Tidal times relate to HW at the Bar

Figure 5.40



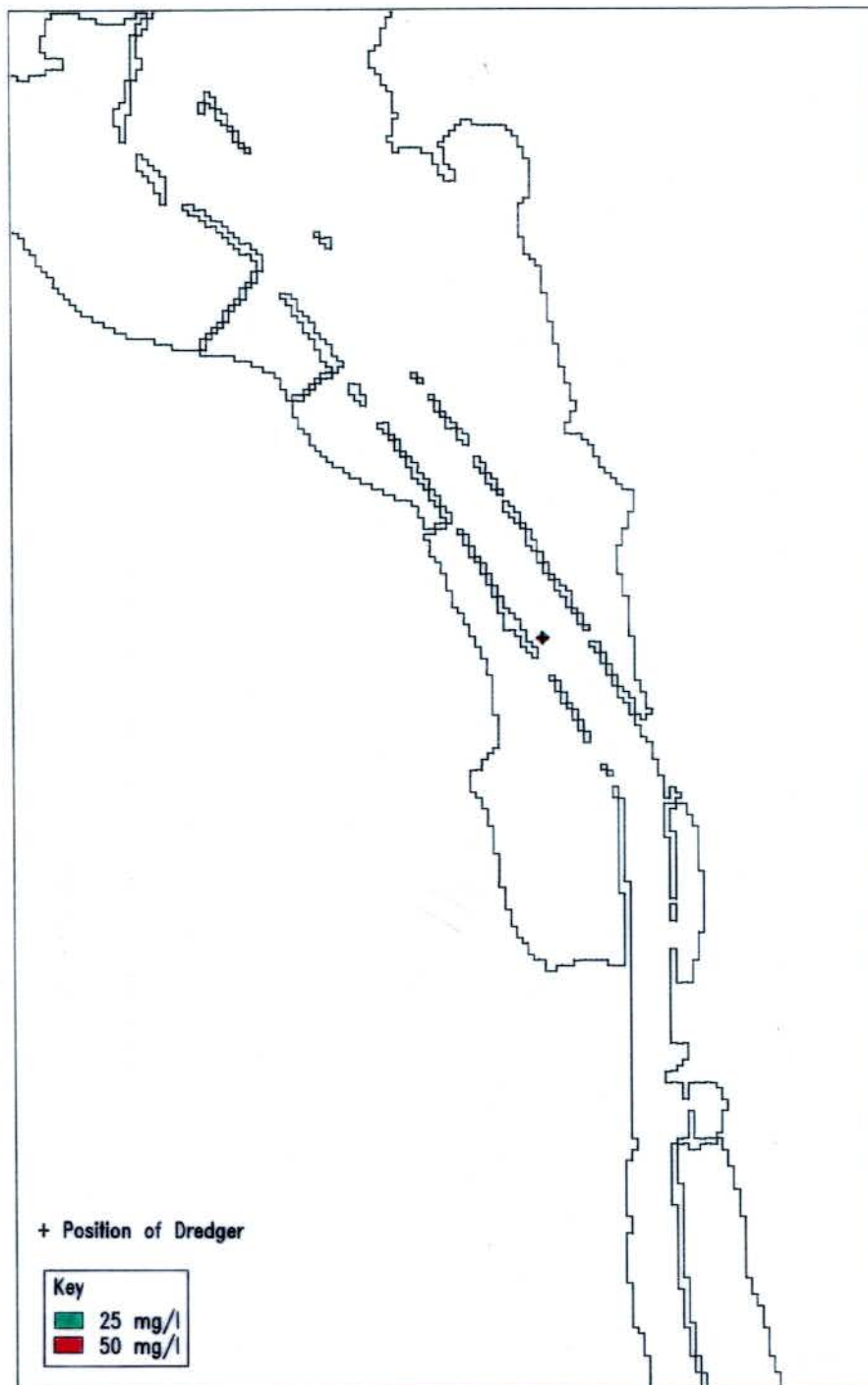
Drogheda Harbour Study
Predicted Sediment Plume at High-Water
Due to Dredging in Centre of Channel
Tidal times relate to HW at the Bar

Figure 5.41



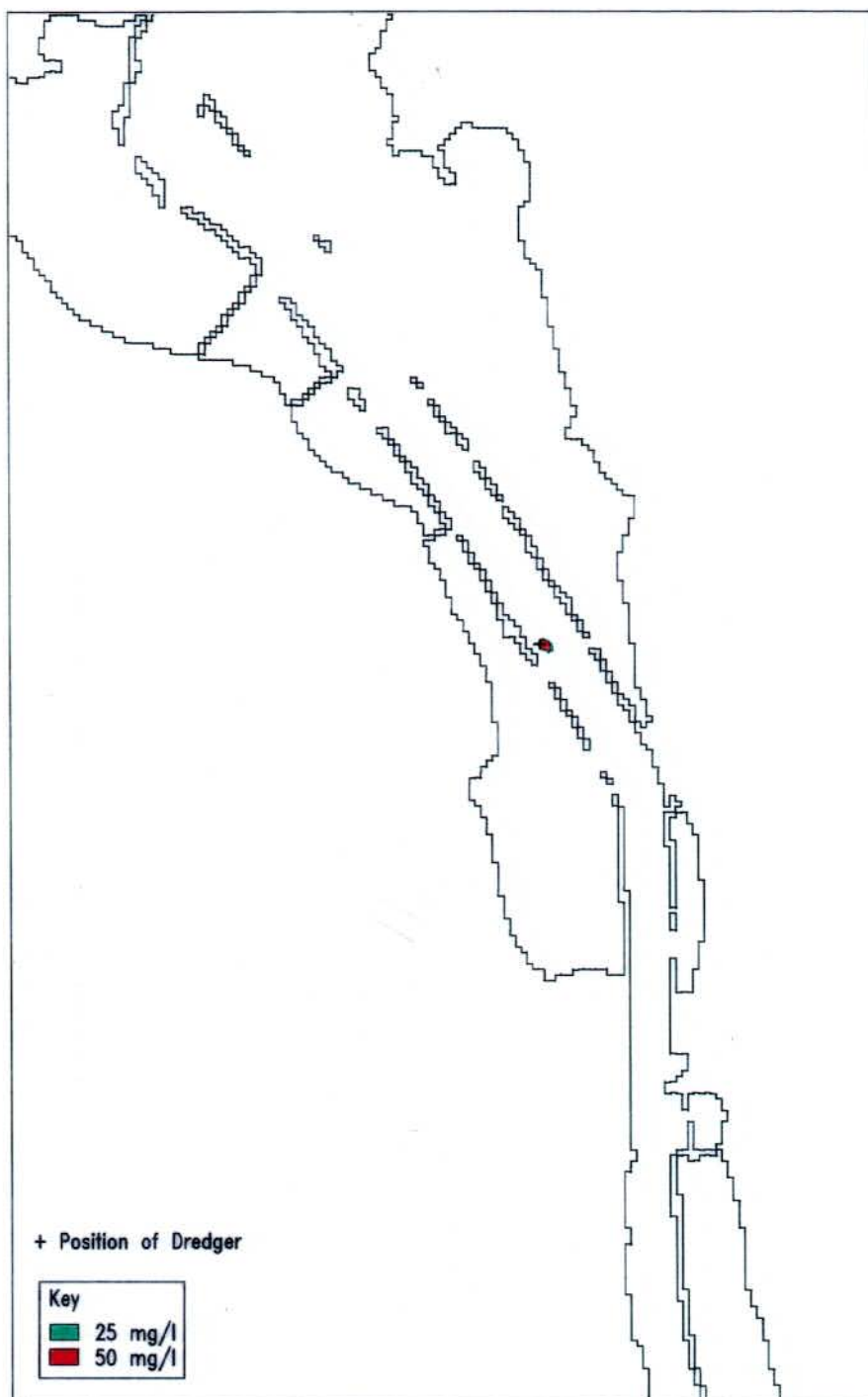
Drogheda Harbour Study
Predicted Sediment Plume at Mid-Ebb
Due to Dredging at Edge of Channel
Tidal times relate to HW at the Bar

Figure 5.42



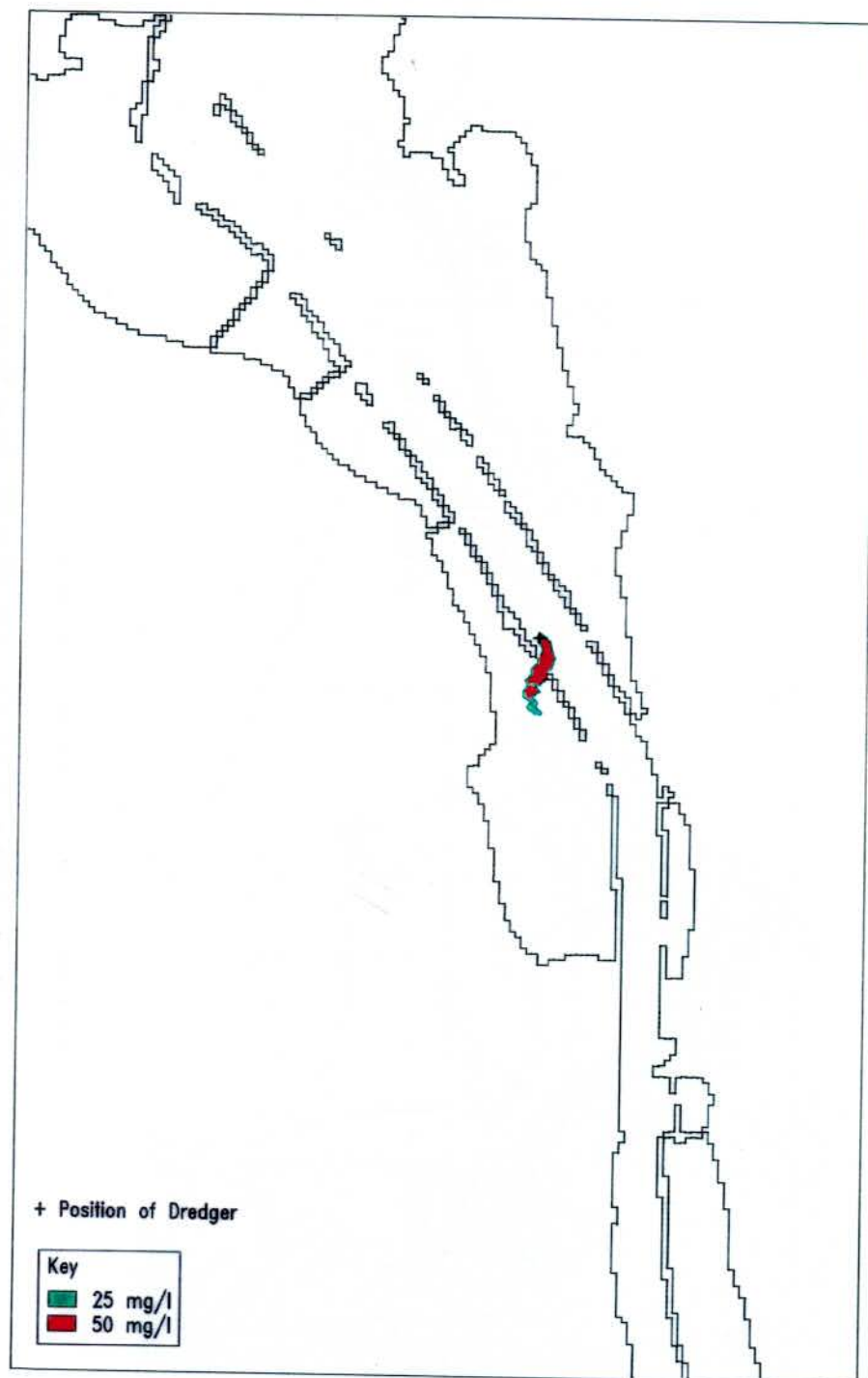
Drogheda Harbour Study
Predicted Sediment Plume at Low-Water
Due to Dredging at Edge of Channel
Tidal times relate to HW at the Bar

Figure 5.43



Drogheda Harbour Study
Predicted Sediment Plume at Mid-Flood
Due to Dredging at Edge of Channel
Tidal times relate to HW at the Bar

Figure 5.44



Drogheda Harbour Study
Predicted Sediment Plume at High-Water
Due to Dredging at Edge of Channel
Tidal times relate to HW at the Bar

Figure 5.45

Survey Report

On

Drogue Releases

At

Drogheda Offshore Dump Site

22nd November 2006

Prepared For:

Drogheda Port Company

Maritime House

The Mall

Drogheda

Co. Louth

Prepared By:

Hydrographic Surveys Ltd

The Cobbles

Crosshaven

Co. Cork

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1. Requirements

The requirements for the survey were defined in the Monitoring Strategy Document prepared by Malone O'Regan, Consulting Engineers, which supported the Foreshore Licence and Dumping at Sea Permit Application dated September 2006.

More specifically paragraph 4.0 headed **Monitoring at Dump Site**. This states the following:

“The primary objective of monitoring at the dump site is to establish if any material released at the dump site is brought back ashore. Therefore it is proposed to carry out the following:

- *The current regime will be established using tracking drogues. This can take place just prior to or during an actual dumping event.*
- *Tracking drogues will be released at spring tide at surface, mid and bottom depths.*
- *The drogue will be tracked until the tide turns.*
- *A report will be prepared detailing findings of the tracking programme and in particular will determine if currents are likely to bring sediment ashore.*
- *The monitoring programme and report will be carried out and prepared by suitably qualified person(s).*

It has been suggested that tracking should be done during easterly winds however easterly winds represent an operational constraint and dumping will be suspended due to strong winds and sea conditions.”

2. Drogues

The drogues used in this study are designed so as to enable them to be deployed at whatever depth they are specified to be set to, in this case, surface, mid and bottom depths, surface is taken as 1m below surface to minimise any surface wind effect and bottom taken as 1-2m above the seabed.

The drogue is constructed as in figure 1 with a light line connecting it to a surface float, it is this float that is tracked for position, each float has a short thin narrow pole with flag attached for identification purposes.

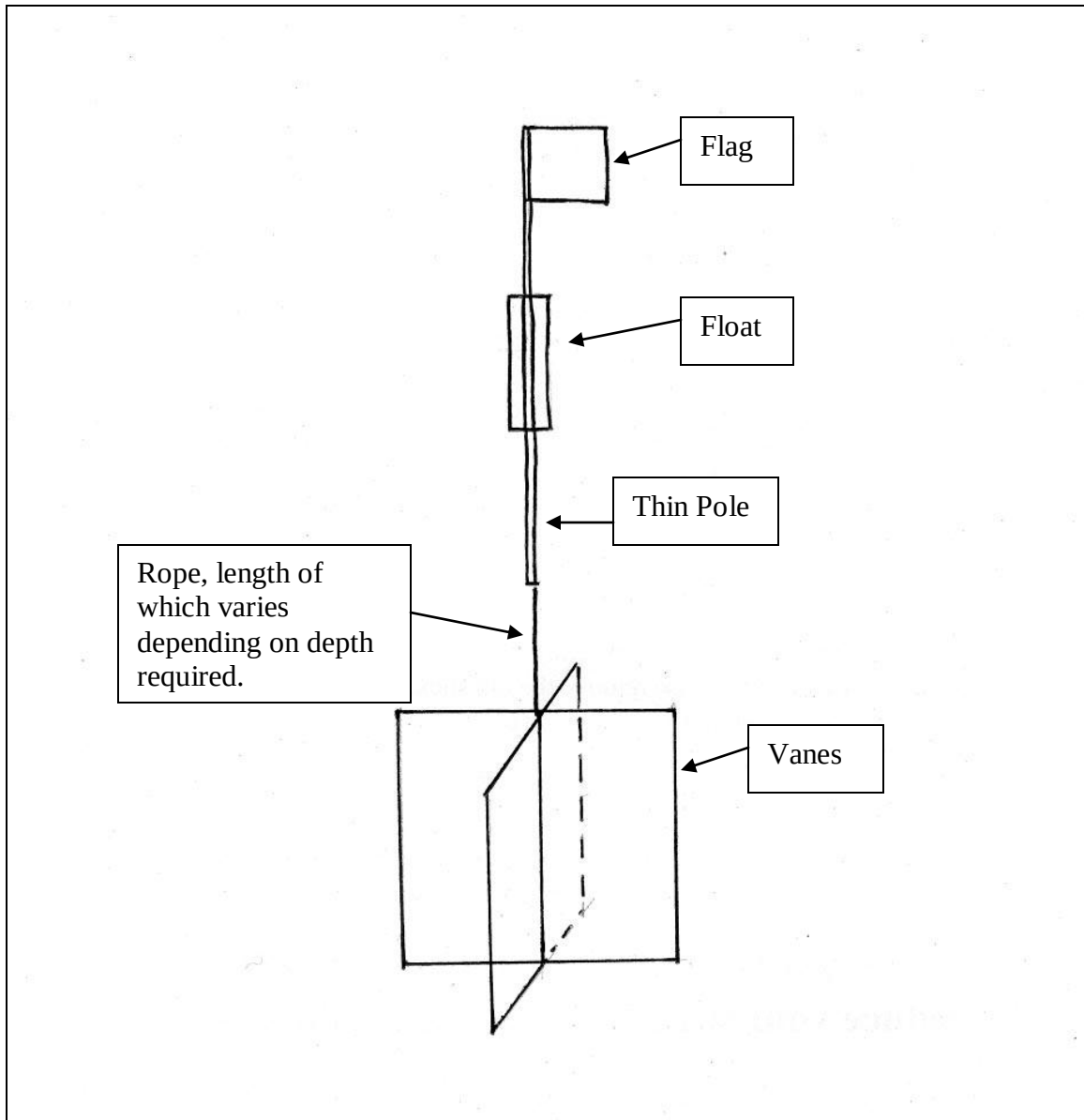


Figure 1: Typical Cruciform drogue arrangement.

3. Positioning

The navigation receiver used during all survey work was the Trimble AgDGPS 132. The unit was interfaced and logged to Hypack Max survey software to provide real-time line guidance and a continuous record of position for the entire survey. Position data was output in WGS '84 Latitude and Longitude. On-line transformation of the WGS '84 latitude and longitude positions to Irish National Grid took place within the survey programme.

This navigation unit provides sub-meter differential position accuracy. The accuracy is better than 1m horizontal.

4. Tides

In order to see the maximum excursion of the drogue it is necessary to carry out the study over a Spring Tides, in this case, the tides on the day were just below Mean Spring Range.

Predictions from Admiralty Tide Tables give the following:

Dublin 22nd November 2006.

LW 05:25 1.0m

HW 12:02 4.0m

LW 17:45 1.0m.

It was agreed to proceed at this time as any further delay in waiting for a greater range could mean bad weather or the dredging campaign was over.

The times of High and Low water were ideal as it gave Mid-flood and ebb tide times at suitable times to enable the drogues to be released and recovered whilst visibility was still reasonable.

5. Weather

Weather conditions were good throughout the day, wind was very light, southwest force 1-2.

The sea was flat with no swell enabling the drogues to be visible and easily identifiable at all times.

6. Vessel

A small half decker (approximately 30ft) was mobilised and worked out of Skerries for the survey. The M.F.V. Lios Darragh was under the control of Mr. Frank Rogan who was familiar with the area of work.

The layout of the vessel was good in that it had a sheltered wheelhouse to install the navigation equipment and a release point for the drogues alongside the wheelhouse.

The vessel mobilised from Skerries at 06:30hrs on the day and demobilised at 20:00hrs.

7. Operations

After mobilising from Skerries the vessel proceeded to the designated dump site.

Following a release by the dump vessel 3 drogues were released from the survey boat, a suitable time delay was allowed so as not to allow the drogues to interface with each other.

Following release each of the drogues were tracked and their position taken at random intervals. The survey vessel approached the drogue from the rear of its direction of travel so as not to impede its track and speed. Once alongside the position was recorded against time. This procedure was followed until the drogues had reached the limit of their general track line and turned. In each case drogues turned seawards or offshore. None of the drogues headed in a landwards direction. After it became clear the drogue was heading offshore it was recovered and stored aboard.

8. Charting and Results

On return to the office the position of each release, fix and recovery was plotted against time after release. It was then possible to calculate the velocity of excursion for each of the drogues between each fix. The velocities between each fix were then added to the chart. On inspecting the chart it can be seen that the velocities decrease as the tide slackens and as it approaches low or high water the drogues turned offshore.

In general the drogues travelled parallel to the coast in either a North-South or South-North direction, at no time did they travel in a direction that would indicate any shoreward direction of travel. From this, it would be reasonable to assume that no sediment would come ashore when released from the designated dump site. If this exercise was to be carried out at Neap Tides the velocities would be lower and therefore even less possibility of a shoreward movement.

The results are presented in the following charts: **HS: 131_01/06**

HS: 131_02/06

9. Personnel

The survey was carried out by Mr. Colin Johnston, Dip Geosurveying and assisted by Mr. Matthew Bevan.

Mr Johnston has over 20 years experience of Hydrographic Surveying including drogue tracking, current metering and general hydrography.

Report Prepared By:

Mr Colin Johnston	Senior Surveyor	Dip GeoSurveying.
-------------------	-----------------	-------------------

Report Approved for Issue By:

Mr J.B. Jenkins	Project Manager	F.I.S.
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Flood Drogue Release

Site

Drogheda Dump Site

Location

Drogheda

Survey

Flood Drogue Release

Client

Drogheda Port Company

Surveyed by

Hydrographic Surveys Ltd.
The Cobbles, Crosshaven, Co. Cork. Ireland.

Consulting Engineers

Malone O'Regan

Memoir

1. Constructed on Irish Grid.
2. Horizontal control by D.G.P.S.
3. Release point shown by 0:00 and recovered by Rec.
4. Elapsed time shown thus 10:30 = 10 min. 30 seconds.
5. Velocities are in msec. = $\frac{m}{s}$
6. Wind, light South westerly.

Key

Drogues shown thus

●

 Surface drogue 1 meter below surface

◆

 Mid drogue 7 meters below surface

▲

 Bottom drogue 14 meters below surface

Drwg. No. HS 131-1/06

Project No. 58/06

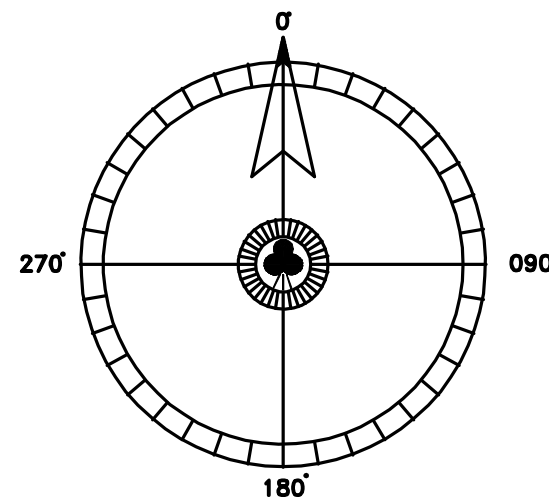
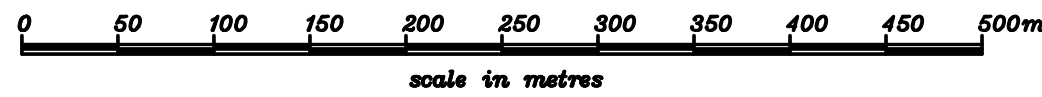
Date 22/11/06

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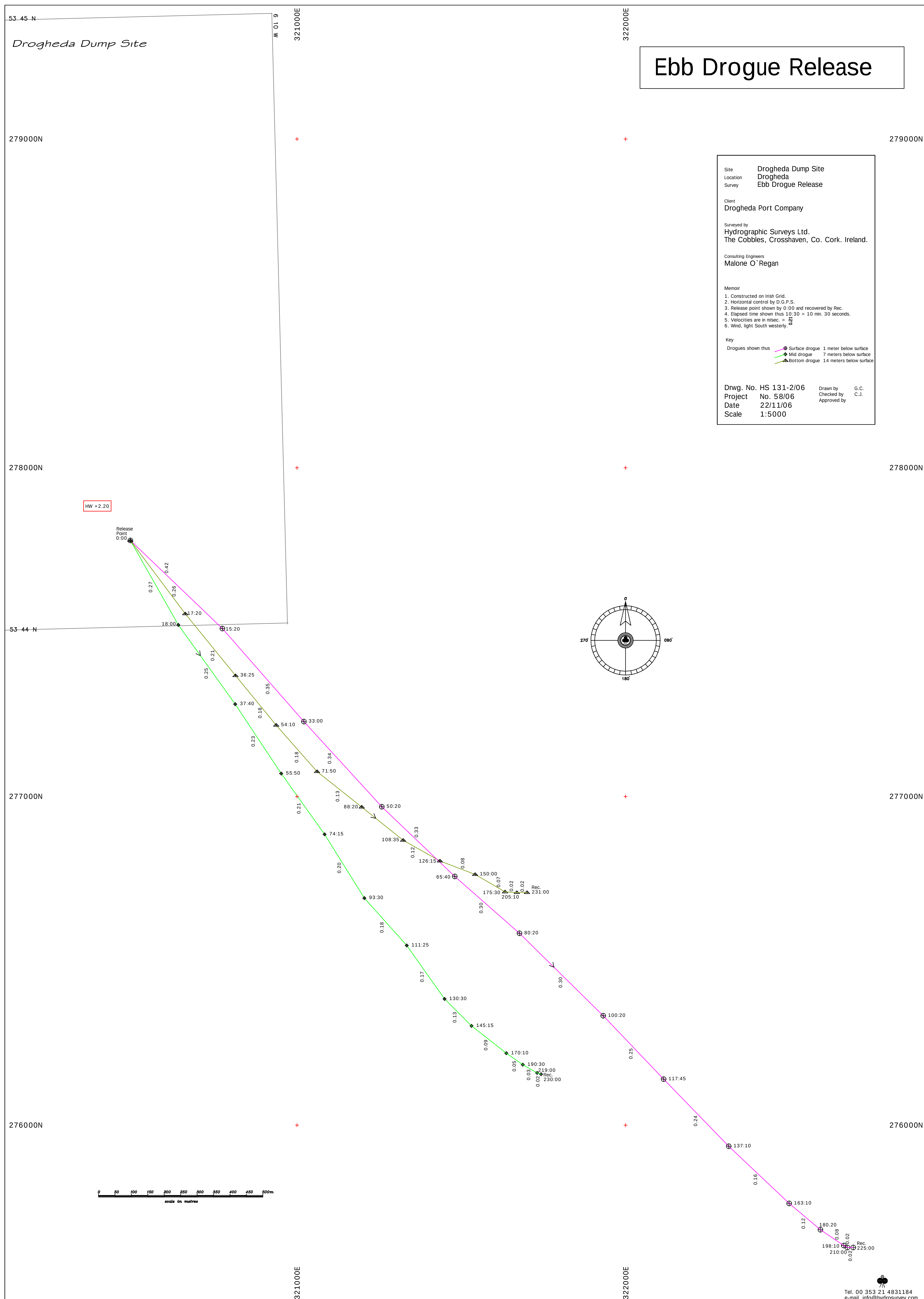
Drawn by G.C.

Checked by C.J.

Approved by



Drogheda Dump Site



DROGHEDA PORT DEVELOPMENT

PROPOSED CAPITAL DREDGING SCHEME

AQUATIC ECOLOGICAL IMPACT STUDY
(June 2006)

Commissioned by: Malone O'Regan Environmental Services Ltd.
Carried out by: Aquatic Service Unit

June 2006

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1 INTRODUCTION

The Aquatic Services Unit (ASU) was commissioned by Malone O'Regan Environmental Services Ltd. to undertake an Ecological Impact Survey of aquatic habitats and fisheries for the proposed capital dredging works for Drogheda Port to include an Environmental Impact Statement (EIS) for the proposed capital dredging incorporating an Environmental Impact Hypothesis (EIH) for the proposed dredge spoil disposal site offshore.

The report is presented under the followings headings:

Dredge Site Survey (River Survey), which examines the receiving environment and impact assessment of the channel earmarked for dredging.

Dredge Spoil Disposal Site Survey, which entails a survey of the marine dredge spoil disposal site out from the Boyne Estuary coast as well as an impact hypothesis outlining the effects of the disposal.

Fisheries, which examines the potential impact of the proposal on protected and rare fish species and lamprey, as well as potential impacts on commercial netting in the estuary.

Boyne Mussel Fishery, which deals with the potential impact of the proposal on the commercial mussel fishery in the outer estuary of the Boyne.

2 DREDGE SITE SURVEY (River Survey)

2.1 Introduction

As part of the assessment of the impact of the proposed capital dredging works along a 1.3 km section of the Boyne Estuary, the Aquatic Services Unit (ASU), were commissioned by Malone O' Regan to undertake a baseline biological survey at the dredge location and to assess the likely impact of the operation. Specifically, ASU were asked to carry out faunal surveys of the subtidal to include a benthic infauna survey in areas within and adjacent to the site of the proposed dredging works.

The area of the proposed dredging works is within the very lower portion of the River Boyne & Blackwater Special Area of Conservation (SAC – Site Code: 002299). The river channel beyond this point from Tom Roe's Point to the outer estuary is subjected to maintenance dredging on an annual basis, while some maintenance dredging occasionally also takes place within the study area.

2.2 Methodology

Fieldwork was carried out on the 25th April 2006. Sub-tidal benthic faunal samples and sediment samples were taken by means of a 0.1m², stainless steel Van-Veen grab. All sampling stations were positioned using a Trimble Pro XRS differential GPS. A complete list of stations sampled and the stations are displayed on a map (Figure 2.1) and are presented in Table 2.1.

Station	Co-ordinates (Irish National Grid)	
	Easting (m)	Northing (m)
T1-1	312264.342	275902.034
T1-2	312411.733	275868.964
T1-3	312262.725	275828.971
T2-1	311275.184	275827.840
T2-2	311286.615	275804.333
T2-3	311284.292	275777.992
T3-1	310899.038	275781.591
T3-2	310898.312	275732.570
T3-3	310868.076	275693.093
T4-1	310393.614	275569.953
T4-2	310420.838	275552.598
T4-3	310544.995	275640.679
T5-1	309927.492	275489.623
T5-2	310037.212	275465.379
T5-3	310034.225	275437.411

Table 2.1 Positions of sampling stations. All locations given in Irish National Grid.

A total of five transects were sampled during the course of the survey. At each transect, three samples were taken across the river where possible. Three transects were taken

within the area to be dredged (T2, T3 & T4), one transect was taken upstream (T5) and one transect was taken downstream (T1) of the impacted area (Figure 2.1).

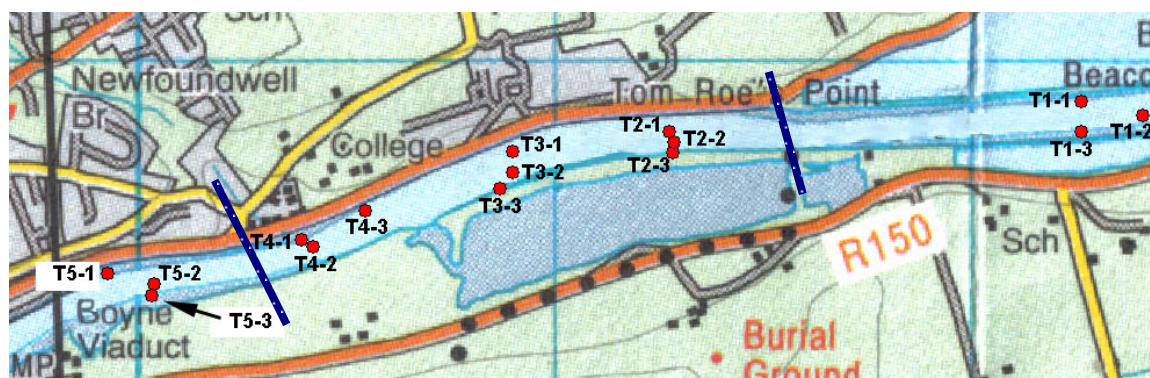


Figure 2.1 Map showing locations of sampling positions. The two blue lines crossing the river indicate the upstream and downstream extent of the proposed dredging works.

2.2.1 Sub-tidal benthic samples

Fifteen sub-tidal stations were sampled for benthic faunal analysis, with 14 of these sampled for granulometric and organic carbon analysis. Samples were only taken where there was sufficient penetration of the Van-Veen grab.

At each station:

- 1 x 0.1m² Van-Veen grabs were deployed for samples for benthic faunal analysis, and the samples were transferred to separate, labelled, 10 litre buckets (15 Samples).
- 1 x 0.1m² Van-Veen grab from which 100g of well-mixed sediment was transferred to a sealed plastic container for granulometric and organic carbon analysis (14 Samples). No sample was taken from T3-2 as the substrate consisted primarily of gravel with small amounts of interstitial fine sediment. The area would be classified as a muddy gravel site.

2.2.2 Sample Processing

Granulometric analysis was carried out on oven dried sediment samples from each station. The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The sediments were then divided into three fractions: % Gravel (>2mm), % Sand (<2.0mm >63µm) and % Silt-Clay (<63µm).

Organic matter was estimated using the Loss on Ignition (LOI) method. One gram of dried sediment was ashed at 450°C for 6 hours and organic carbon was calculated as % sediment weight loss.

On returning to the laboratory all faunal samples were sieved on a 0.5mm sieve within 24 hours of collection. Samples were preserved in 4% buffered formalin to which an organic dye (Rose-Bengal) had been added. All fauna were identified to the lowest taxonomic level possible using standard keys to north-west European fauna.

2.3 Existing Environment

2.3.1 Sediment Infauna

A total of 10 taxa were recorded in the area (Table 2.2), although Oligochaetae were not identified beyond group level. All sites were characterised by low species diversity typical of upper estuarine environments (Table 2.3). All species identified are of widespread occurrence in Irish waters.

2.3.1.1 JNCC Biotopes

None of the sites fall neatly into the latest JNCC Biotope classification scheme (Conor *et al* 2004) but some broad similarities are evident. Overall, it appears that the site could be characterised as belonging to a single community type, although some station groupings were observed (see Section 1.2.1.2). The biotope present is broadly classified as a mixture of IMU.EstMu (Estuarine sublittoral muds) and IMX.Est.Mx (Estuarine sublittoral mixed sediments) dominated by oligochaetes and *Streblospio benedicti*. These biotopes are very common in Irish coastal waters.

2.3.1.2 Data Analysis

Non-metric Multidimensional Scaling (Fig. 2.3) on fourth root transformed abundance data of the Bray_Curtis classification scores (Fig. 2.2) reveals the presence of three relatively distinct station groupings, with Station T1-2 occupying a further isolated position. The isolated position of the latter Station is caused by the high abundance of the polychaete, *Nephtys hombergii*. The stations grouping comprising stations T1-1, T2-1, T2-2, T3-1 and T5-3 separates out from the remaining stations due to low diversity and extremely low numerical abundances (Tables 2.2, 2.3). The remaining two station groupings appear to separate on the basis of the presence or absence of the polychaete *Streblospio benedicti*. The underlying causes for this are unclear and do not appear to be related to any substantial differences in grainsize or organic matter (Table 2.4), and thus may relate to small scale population patchiness, a common characteristic of estuarine populations.

	T1-1	T1-2	T1-3	T2-1	T2-2	T2-3	T3-1	T3-2	T3-3	T4-1	T4-2	T4-3	T5-1	T5-2	T5-3
<i>Nereis diversicolor</i>	-	1	7	-	-	2	-	-	3	4	3	24	4	3	-
<i>Nephtys hombergii</i>	-	10	2	-	-	-	-	-	-	3	-	-	-	-	-
<i>Streblospio benedicti</i>	7	1	-	5	7	19	16	340	2	-	84	-	2	180	2
<i>Oligochaeta</i>	2	-	24	2	-	3	-	158	42	9	16	210	2	164	1
<i>Abra alba</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
<i>Macoma balthica</i>	-	-	1	1	-	-	-	-	1	-	-	-	-	-	-
<i>Crangon crangon</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
<i>Corophium volutator</i>	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-
<i>Gammarus locusta</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Carcinus maenas</i>	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-
Biomass (grams)	0.05	0.05	3.18	0.12	0.02	0.2	0.04	0.99	1.85	0.35	0.55	3.65	1.4	0.32	0.01

Table 2.2 Abundance data from each of the 15 sampling stations. Results are expressed as abundances per 0.1m². Blotted wet weight data is expressed per gram for total wet weight. Results within the shaded area are from sampling locations within the area of the proposed dredging works.

	T1-1	T1-2	T1-3	T2-1	T2-2	T2-3	T3-1	T3-2	T3-3	T4-1	T4-2	T4-3	T5-1	T5-2	T5-3
Number of Species	2	3	5	3	1	4	1	2	5	3	3	4	5	3	2
Number of Individuals	9	12	35	8	7	26	16	498	49	16	103	237	10	347	3
H'	0.53	0.566	0.947	0.9	0	0.873	0	0.625	0.593	0.984	0.559	0.402	1.47	0.736	0.637
E	0.764	0.515	0.589	0.819	****	0.63	****	0.901	0.368	0.896	0.508	0.29	0.914	0.67	0.918
C	0.654	0.708	0.515	0.469	1	0.559	1	0.567	0.741	0.414	0.69	0.795	0.26	0.493	0.556

Table 2.3 Primary and derived diversity indices (H' - Shannon-Wiener index; E - Pielou's evenness, C - Simpson's Dominance Index). Results within the shaded area are from sampling locations within the area of the proposed dredging works. [**** indicate no calculation was possible]

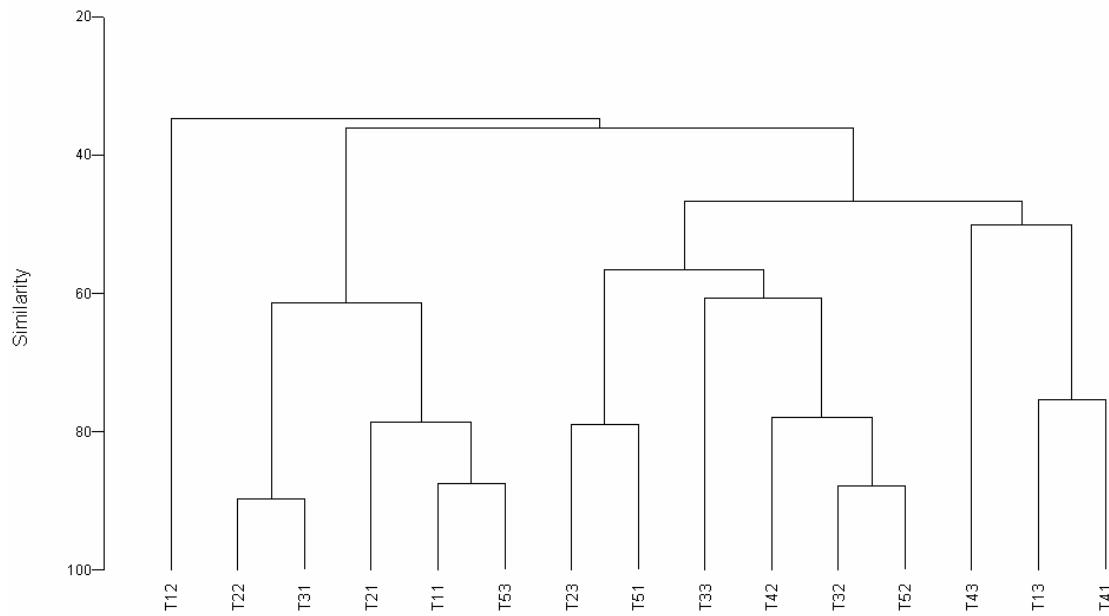


Figure 2.2 Dendrogram of Bray-Curtis similarity analysis on fourth root transformed data.



Figure 2.3 Non-metric Multi Dimensional Scaling (nMDS) on Bray-Curtis scores from fourth root transformed data (Stress = 0.09)

2.3.2 Sediment Grainsize

Site	% Gravel	% Sand	% Mud	Textural Classification	Depth (m)	Loss On Ignition
T1-1	0.0%	39.2%	60.8%	Sandy Mud	-0.1	8.49%
T1-2	0.0%	62.2%	37.8%	Muddy Sand	-2.4	4.52%
T1-3	4.7%	48.1%	47.2%	Slightly Gravelly Muddy Sand	1.0	6.30%
T2-1	35.2%	27.5%	37.4%	Muddy Gravel	-1.2	8.97%
T2-2	1.5%	38.2%	60.3%	Slightly Gravelly Sandy Mud	-1.5	8.79%
T2-3	0.7%	64.1%	35.2%	Slightly Gravelly Muddy Sand	0.9	7.21%
T3-1	0.0%	33.2%	66.8%	Sandy Mud	0.0	7.40%
T3-2	N/R	N/R	N/R	Muddy Gravel *	-1.0	N/R
T3-3	1.7%	49.9%	48.4%	Slightly Gravelly Muddy Sand	1.2	5.17%
T4-1	0.0%	31.4%	68.6%	Sandy Mud	0.5	10.06%
T4-2	63.8%	32.3%	3.9%	Muddy Sandy Gravel	-1.2	2.00%
T4-3	57.0%	33.6%	9.4%	Muddy Sandy Gravel	1.6	3.05%
T5-1	0.5%	37.3%	62.2%	Slightly Gravelly Sandy Mud	0.7	8.84%
T5-2	22.8%	60.1%	17.1%	Gravelly Muddy Sand	-1.7	4.23%
T5-3	0.0%	36.3%	63.7%	Sandy Mud	0.5	6.97%

Table 2.4 Textural classification, depth to Chart Datum and Loss on Ignition of each sampling location. Results within the shaded area are from sampling locations within the area of the proposed dredging works. [N/R – No Record]. * Indicates classification based on visual examination of the substrate.

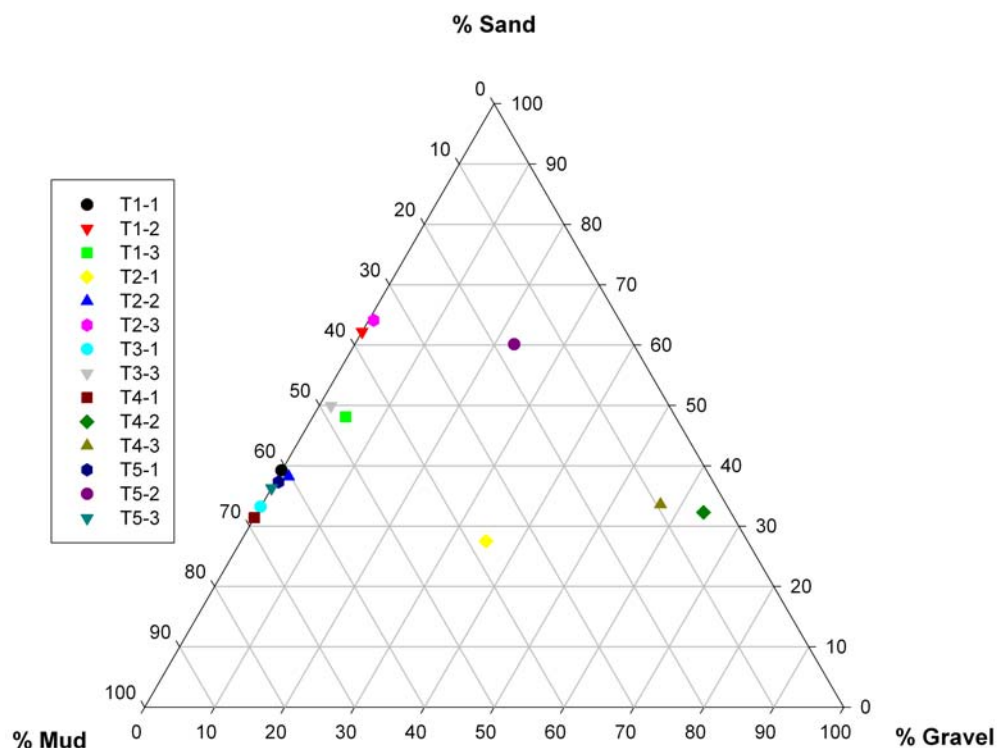


Figure 2.4 Ternary plot of sediment grainsize from each of the sampling stations.

2.4 Potential Impacts

Approximately 6.5 ha of sub-littoral estuarine sediment will be removed as part of the capital dredging works. The sediment to be removed consists of mixed sediments with varying levels of gravels, sands and silts (Table 2.4). The method of sediment removal will be either back-hoe excavator or trailer suction dredger. Changes that will occur in community structure after dredging is likely to be medium-term and locally significant, as it will cause the complete removal of all communities present within the area of the proposed dredging works. It has been noted that the species found in the area are common species with a wide distribution in similar environments throughout Irish coastal waters.

The benthic community removed or damaged during the operation should begin to re-establish itself almost immediately after the cessation of the dredging, by emigration from adjoining areas (both upstream and downstream) and by larvae from the plankton. In addition, the dominant species present in the proposed dredge area are opportunistic species and can rapidly colonise from resident populations present in unaffected areas upstream and downstream of the site. In any case, the community should have largely restored itself within a few years (1-3 years). An example of this is present in the community found at transect 5 (T5-1, T5-2 and T5-3). This location is subjected to annual maintenance dredging and the community present is similar to that located in un-dredged areas.

2.5 Mitigation

There is little in the way of mitigation measures which may be recommended in this case as the removal of the communities present is unavoidable. As it is proposed to undertake the dredging late in the season (September-October), the site will be ripe for larval re-colonisation at the start of the following years growing season.

2.6 Residual Impact

The infaunal species present within the dredged area are common in Irish coastal waters and are typical of upper estuarine environments. In addition, the community present in the area to be dredged is also present upstream and downstream of the dredge area (T1 and T5). The area downstream of the proposed dredge area was subjected to a large scale capital dredging operation in 1999/2000 and is also subjected to annual maintenance dredging as per the programme of maintenance dredging commenced in 2002. Communities have recovered in this area (T1) to levels comparable to un-dredged areas within a period of 1-2 years. As such, it is expected that the communities within the area of the proposed dredge works will re-establish themselves quickly.

2.7 Conclusion

On balance it is considered that the significance of any impacts on the benthos associated with the proposed development will be locally significant and short term (habitat loss / change). Communities are expected to re-establish themselves quickly post dredging to pre-dredge levels after 1-3 years.

2.8 References

Connor, D.W, Allen, J.H., Golding, N, Howell, KL, Lieberknecht LM, Northen, K.O.and J.B. Reker (2004). *The Marine Habitat Classification for Britain and Ireland version 04.05* JNCC Peterborough ISBN 1 861 07561 8 (internet version).

Anon (1992) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

3 DREDGE SPOIL DISPOSAL SITE SURVEY

3.1 Introduction

As part of a proposed Capital Dredging Scheme to be undertaken by Drogheda Port Company, ASU were asked to undertake a benthic survey of an offshore dredge disposal site and to propose an Environmental Impact Hypothesis (EIH) associated with the disposal of dredge spoil from Drogheda Port. The site is located approximately 3km off shore to the north-east of the mouth of the Boyne Estuary. The area of the disposal site measures approximately 400 hectares with water depths ranging from 13 to 15m below C.D.

The proposed dredging will entail the removal of approximately 130,000m³ of dredge material from a 1.3km stretch of the River Boyne near Drogheda Port. It is proposed that the spoil be transported to the existing dumpsite, 'Site B', which has been in use since port maintenance dredging began in 1994. Since 1994, approximately 1.35 million tonnes of sediment has been deposited on the dumpsite arising from these dredging activities in the Boyne Estuary.

The dumpsite was previously subjected to an Environmental Impact Hypothesis in 1998 as part of a capital dredging campaign undertaken in 1999/2000.

3.2 Methodology

Fieldwork for the dumpsite survey was carried out on the 4th May 2006. The ten sampling locations chosen were the same as those sampled in 1998, which pre-dated the 1999/2000 capital dredging. At each station benthic fauna and sediment samples were taken by means of a 0.1m² Day Grab. All sampling stations were positioned using a Trimble Pro XRS differential GPS. At each station, three replicate Day Grab samples were taken for faunal analysis. A further sample was taken for particle size and organic carbon by means of Loss on Ignition analysis. A list of stations sampled are presented in Table 3.1 and displayed on a map (Figure 3.1).

Data and positions from the 1998 dataset were obtained from a previous survey undertaken at Dumpsite B (KMM MarEnCo, 1998).

Station	Replicate	Co-ordinates	
		Latitude	Longitude
DA	1	53°45'37.35"N	6°10'48.85"W
	2	53°45'38.01"N	6°10'52.78"W
	3	53°45'39.17"N	6°10'48.76"W
	PS	53°45'36.94"N	6°10'45.90"W
DB	1	53°45'24.67"N	6°10'35.64"W
	2	53°45'27.10"N	6°10'39.09"W
	3	53°45'25.29"N	6°10'35.15"W
	PS	53°45'24.68"N	6°10'34.26"W
DC	1	53°44'46.90"N	6°10'45.88"W
	2	53°44'46.22"N	6°10'48.07"W
	3	53°44'46.22"N	6°10'45.06"W
	PS	53°44'45.04"N	6°10'46.44"W
DD	1	53°44'47.59"N	6°10'11.45"W
	2	53°44'47.29"N	6°10'10.91"W
	3	53°44'47.58"N	6°10'10.86"W
	PS	53°44'47.23"N	6°10'10.96"W
DE	1	53°44'32.95"N	6°10'35.58"W
	2	53°44'32.42"N	6°10'31.79"W
	3	53°44'30.28"N	6°10'36.59"W
	PS	53°44'30.56"N	6°10'32.73"W
DF	1	53°44'11.33"N	6°10'45.30"W
	2	53°44'12.53"N	6°10'46.19"W
	3	53°44'11.29"N	6°10'47.24"W
	PS	53°44'09.43"N	6°10'48.18"W
DG	1	53°44'11.44"N	6°10'12.00"W
	2	53°44'10.72"N	6°10'13.86"W
	3	53°44'10.88"N	6°10'11.49"W
	PS	53°44'11.07"N	6°10'10.70"W
DH	1	53°43'24.50"N	6°09'59.06"W
	2	53°43'24.87"N	6°09'56.62"W
	3	53°43'24.65"N	6°09'57.60"W
	PS	53°43'23.60"N	6°09'58.53"W
DI	1	53°42'47.34"N	6°09'38.10"W
	2	53°42'47.12"N	6°09'35.92"W
	3	53°42'46.68"N	6°09'37.47"W
	PS	53°42'48.23"N	6°09'38.04"W
DJ	1	53°44'30.98"N	6°07'40.92"W
	2	53°44'30.57"N	6°07'41.57"W
	3	53°44'30.61"N	6°07'39.69"W
	PS	53°44'31.17"N	6°07'39.50"W

Table 3.1 Positions of sampling stations. All locations given in Irish National Grid. PS = Particle Size.

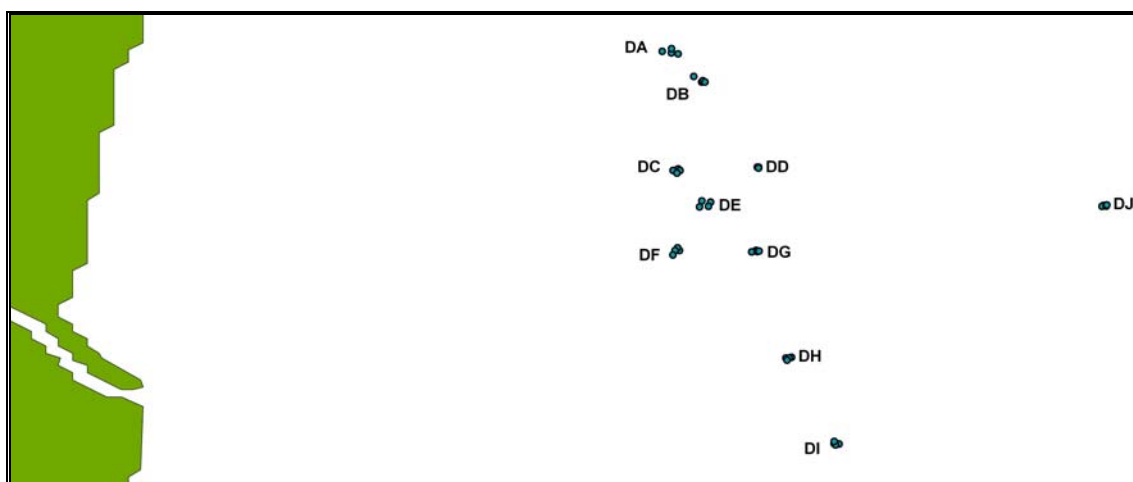


Figure 3.1 Map showing locations of all sampling positions. Positions are based on sampling points from a previous survey conducted in 1998.

3.2.1 Sub-tidal benthic sampling

Ten stations were sampled for benthic faunal analysis, with three replicates taken at each station. Samples were taken exclusively where there was sufficient penetration of the Day Grab.

At each station:

- 3 x 0.1m² Day Grabs were deployed for samples for benthic faunal analysis. Samples were transferred to separate, labelled, 10 litre buckets (30 Samples).
- 1 x 0.1m² Day Grab from which 100g of well-mixed sediment was transferred to a sealed plastic container for particle size and organic carbon analysis (10 samples).

3.2.2 Sample Processing

Granulometric analysis was carried out on oven dried sediment samples from each station. The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The sieve sizes used are: 2mm, 1mm, 500µm, 250µm, 125µm, 63µm and <63µm.

Organic matter content was estimated using the Loss on Ignition (LOI) method. One gram of oven dried sediment was ashed at 450°C for 6 hours and organic carbon was calculated as % sediment weight loss.

Faunal samples were sieved on a 0.5mm sieve within 24 hours of collection. Samples were preserved in 4% buffered formalin to which an organic dye (Rose-Bengal) had been added. All fauna were identified to family level using standard keys to north-west European fauna. Blotted wet weight biomass to four decimal places was measured for each family group.

3.2.3 Data Analysis

Data analysis was carried out using PRIMER (Plymouth Routines in Multivariate Ecological Research), a specifically designed statistical package for benthic faunal analysis developed by Plymouth Marine laboratory. This package was also employed during the 1998 survey.

3.3 Existing Environment

3.3.1 Sediment Infauna

A full list of the taxa recorded in the present survey is presented in Appendix 1. Macrofauna was identified to the same taxonomic level as reported in the previous survey. In total, 53 taxa were identified in the present survey, with 1,137 individuals recorded for all stations. In addition, total biomass for all stations was recorded at 351.4 grams blotted wet weight. A list of the biomass of each taxon for each sample is presented in Appendix 2. A table containing the taxonomical affinities of the encountered taxa is presented in Appendix 3.

The highest number of individuals was recorded at station DI with a mean value of 57 individuals per 0.1m². This station is located in southern zone of dispersion. The dominant taxa present were Amphiuiridae, Nephtyidae and Thraciidae. In addition, this site had the highest diversity score and lowest dominance score of all sampled stations.

The control site DJ had the lowest mean number of taxa recorded during the present survey. The dominant taxon present was the mollusc family Turritellidae. This mollusc is known to colonise mud and sandy mud substrata forming very dense colonies.

3.3.2 Data Analysis

3.3.2.1 Univariate Analysis

Univariate analyses similar to those undertaken in 1998 was performed on the present dataset. Results from these analyses are presented in Tables 3.2 and 3.3. When comparing diversity and evenness values from both surveys, it is obvious that major changes have occurred since 1998. Diversity values have decreased, whilst evenness values have significantly increased (Figure 3.2). This is indicative of reduced biodiversity across all stations and is typical of a stressed community.

Station	Mean number of taxa	Mean number of individuals	Mean biomass Grams/0.1m ²
DA	9	29	6.64
DB	9	33	8.34
DC	10	28	4.10
DD	13	41	3.49
DE	11	36	10.39
DF	8	21	11.69
DG	15	40	11.04
DH	17	52	26.01
DI	17	57	14.39
DJ	5	43	21.04

Table 3.2 Mean abundance and biomass data per 0.1m² for each station. Results are expressed as abundances per 0.1m².

	Number of Species	Number of Individuals	H'	J'	SI
DA1	10	37	1.83	0.79	0.22
DA2	10	33	1.58	0.69	0.29
DA3	6	18	1.16	0.65	0.47
DB1	4	17	0.96	0.69	0.48
DB2	12	43	1.85	0.74	0.23
DB3	11	38	1.93	0.80	0.19
DC1	9	28	1.76	0.80	0.24
DC2	12	28	2.10	0.85	0.17
DC3	10	27	1.66	0.72	0.29
DD1	9	20	1.80	0.82	0.25
DD2	18	65	2.12	0.73	0.24
DD3	12	37	1.87	0.75	0.25
DE1	11	26	2.25	0.94	0.12
DE2	10	40	1.49	0.65	0.38
DE3	13	42	2.04	0.80	0.19
DF1	5	15	1.42	0.88	0.27
DF2	10	30	1.81	0.79	0.23
DF3	8	19	1.91	0.92	0.17
DG1	11	17	2.17	0.90	0.15
DG2	19	54	2.25	0.76	0.22
DG3	15	48	1.94	0.72	0.26
DH1	10	32	2.10	0.91	0.14
DH2	20	59	2.30	0.77	0.19
DH3	20	64	2.56	0.85	0.11
DI1	16	54	2.42	0.87	0.12
DI2	17	60	2.35	0.83	0.13
DI3	17	56	2.26	0.80	0.16
DJ1	5	38	0.96	0.60	0.49
DJ2	6	42	1.05	0.59	0.49
DJ3	3	50	0.67	0.61	0.59

Table 3.3 Primary and derived diversity indices (H' - Shannon-Wiener index; J' - Evenness, SI - Simpson's Dominance Index).

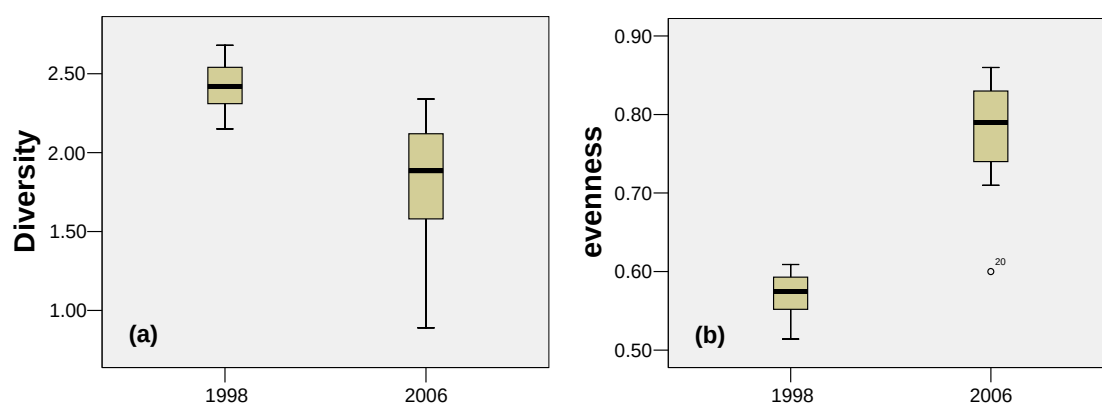


Figure 3.2: Values of Shannon Diversity (a) and Evenness (b) values plotted for the 1998 and 2006 surveys.

3.3.2.2 Multivariate Analysis

Non-metric Multidimensional Scaling analysis was performed on double root square transformed data of the Bray-Curtis classification scores. Analysis on the replicate data indicates that there is a large degree of variability between the stations at replicate level (Figures 3.3 & 3.4).

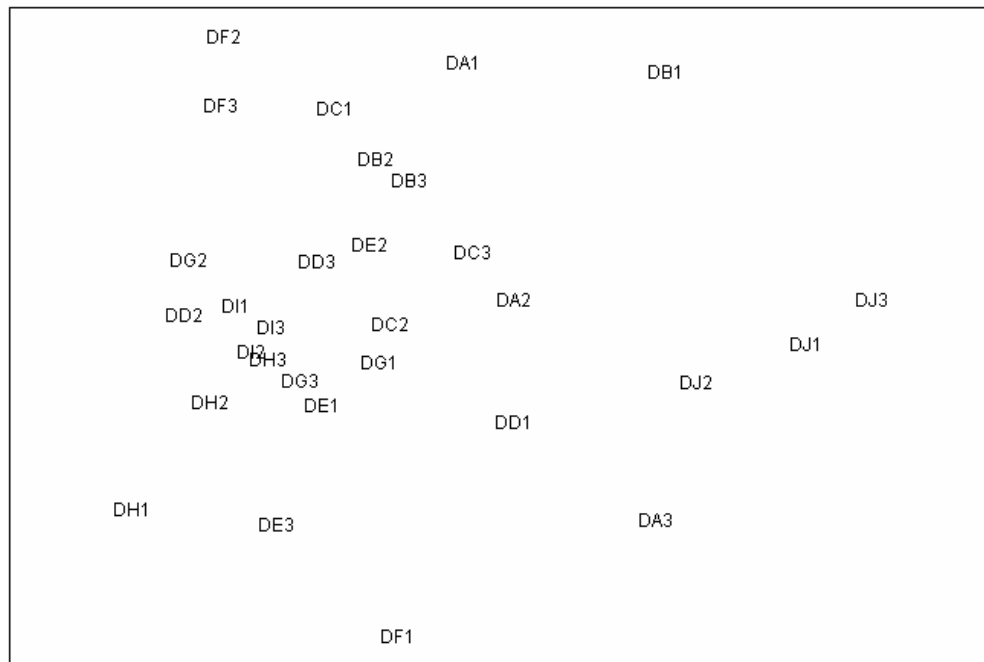


Figure 3.3 Non-metric Multi Dimensional Scaling (nMDS) plot on Bray-Curtis scores for all replicates for all sites.

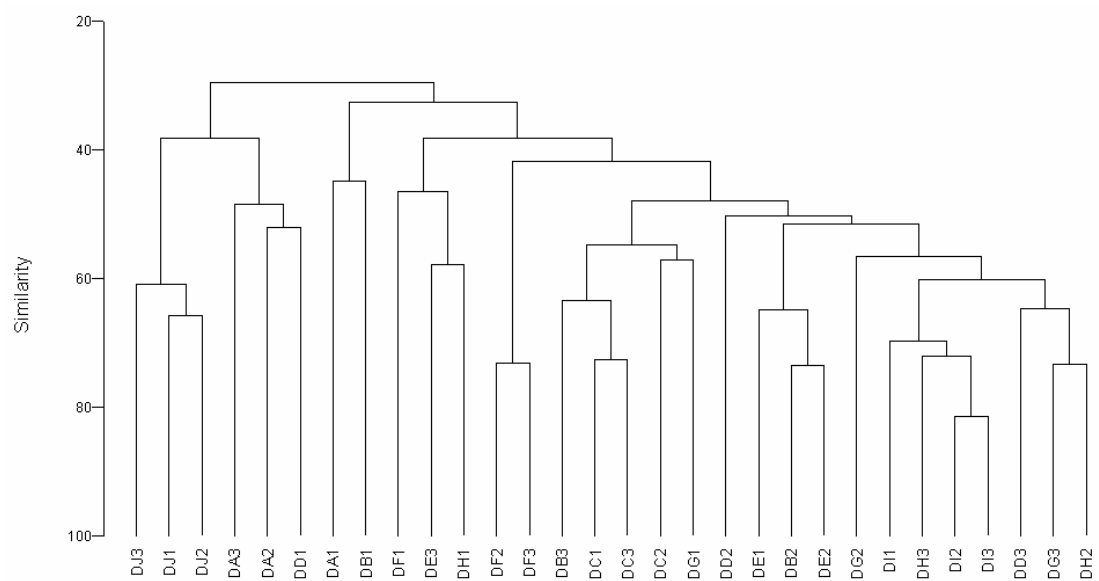


Figure 3.4 Dendrogram of Bray-Curtis similarity analysis on double root square transformed data for all replicates for all sites.

To reduce this variability, replicates for each station were pooled and averaged to determine relationships between sites (Figure 3.5). The results obtained from this reveals the presence of two distinct station groupings, with Station DJ being distinctly different from all other stations. The isolated position of this station is caused by the high abundance of the gastropod mollusc family, Turritellidae. These molluscs are present in very large numbers at this site. However, certain taxa, such as Nephtyidae, are common to station DJ and all other sites.

The other grouping consists of all stations impacted directly by the ongoing dredge spoil disposal. These stations are grouped based on the relatively high abundances of the brittlestar Amphiuridae and Nephtyidae polychaetes at each of these stations. These characteristic species are common throughout the impacted zone.

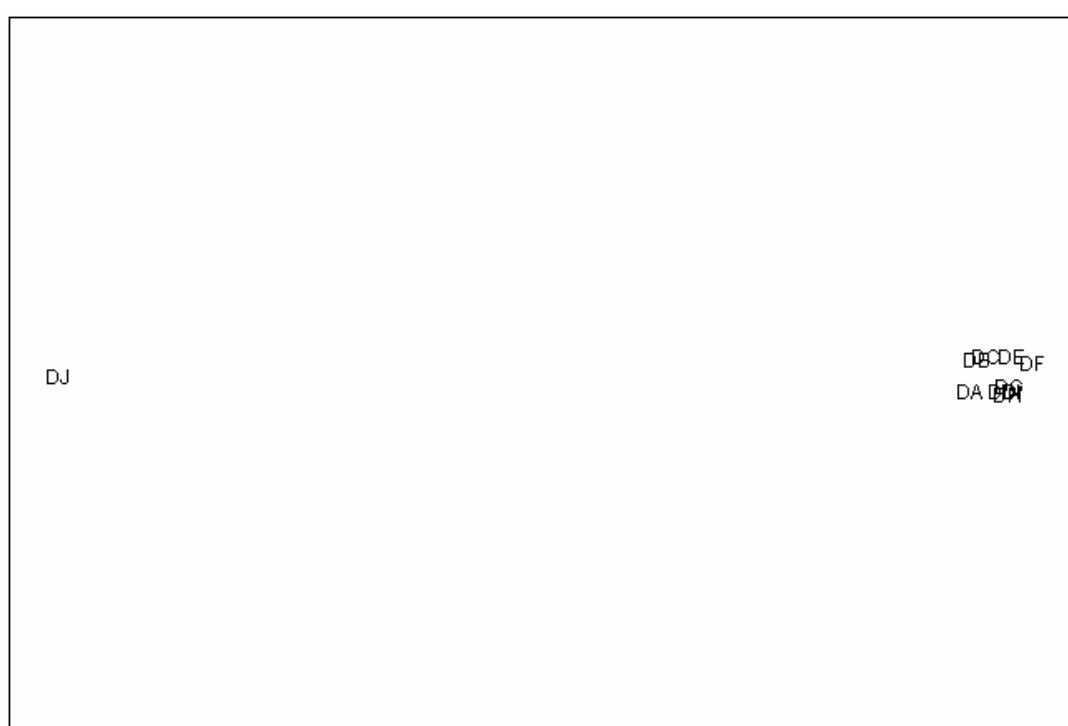


Figure 3.5 Non-metric Multi Dimensional Scaling (nMDS) plot on Bray-Curtis scores for all sites.

In addition, a similarity dendrogram was produced (Figure 3.6) which indicated that site DJ is markedly different from all other stations (~30% Similarity). All other sites within the impacted zone show degrees of similarity of ranging from 50% to 75%. This is markedly different from results obtained in 1998, where all sites showed similarity levels of >75%.

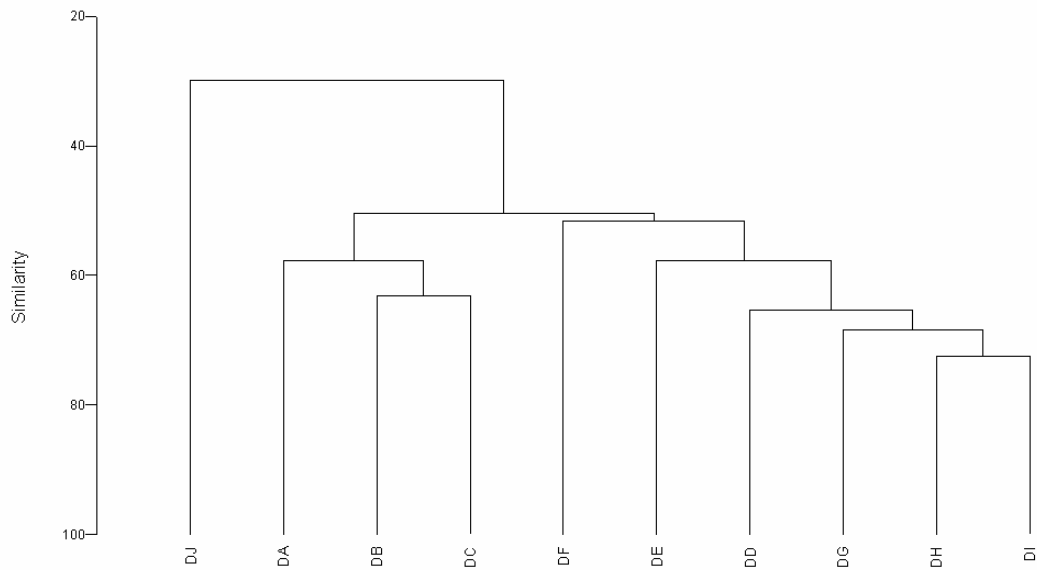


Figure 3.6 Dendrogram of Bray-Curtis similarity analysis on double root square transformed data for all sites.

To investigate further the changes over the course of the dredge spoil disposal works, both datasets were analysed together. It is clear from the results that all stations in the 1998 dataset were characterised as a relatively homogeneous environment, with similarity values of >75% for all stations. Results from the 2006 dataset clearly show a change to a more heterogeneous environment, with lower similarity values (Figure 3.7).

In addition, MDS analysis of both datasets shows clear differences in community structure across all sites between 1998 and 2006 (Figure 3.8).

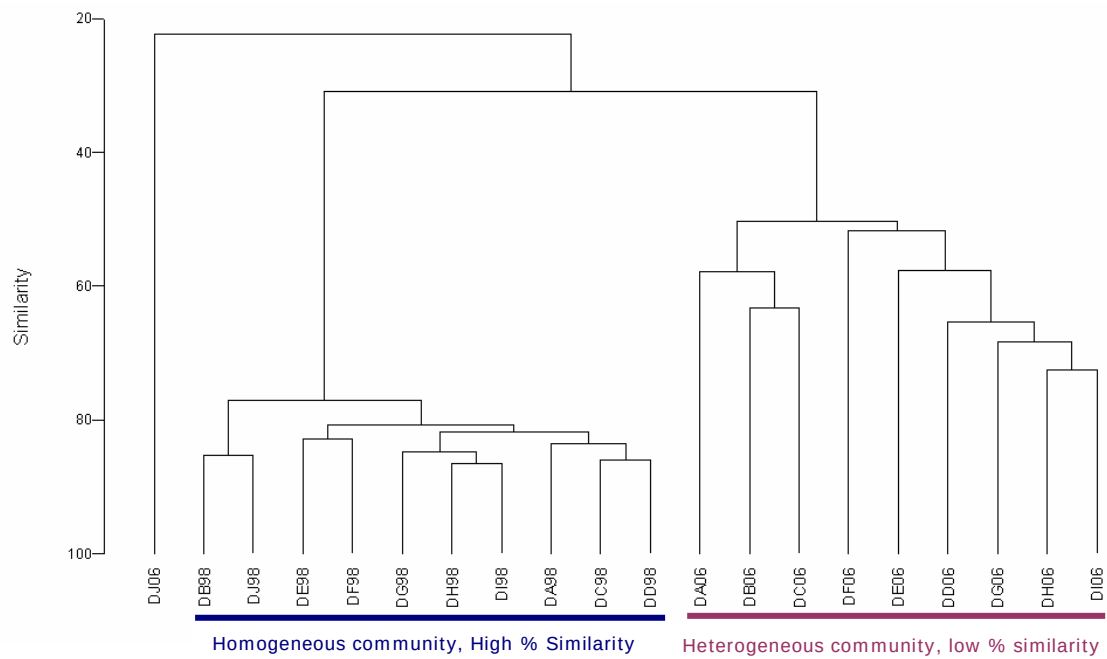


Figure 3.7 Dendrogram of Bray-Curtis similarity analysis on double root square transformed data of pooled replicates. Blue line indicates areas of high similarity (1998 dataset); purple line indicates area of low similarity (2006 dataset).

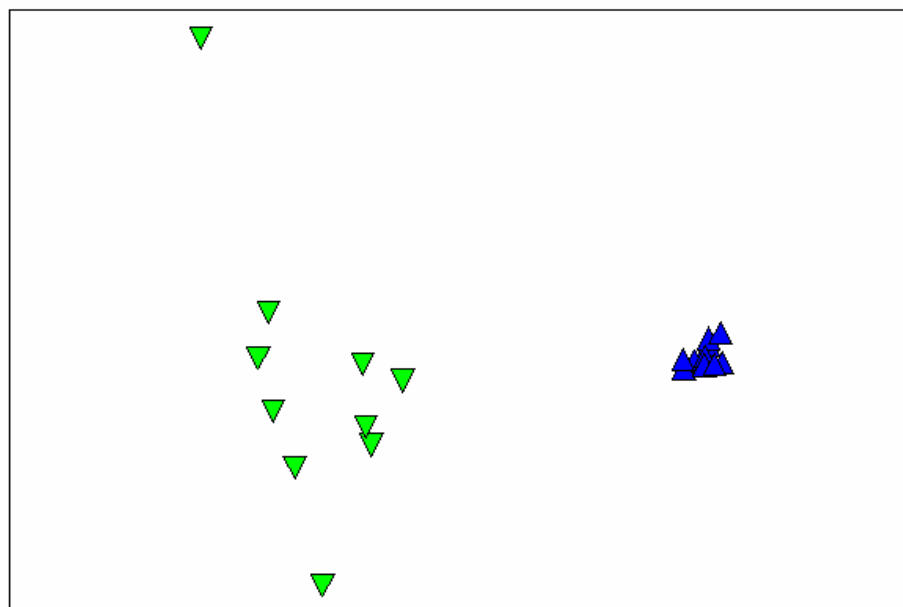


Figure 3.8 Non-metric Multi Dimensional Scaling (nMDS) plot on Bray-Curtis scores for all sites. Green triangles (inverted) represent 2006 dataset; Blue triangles represent 1998 dataset.

3.3.3 Environmental Parameters

3.3.3.1 Particle Size Analysis

The results from all particle size analysis and % loss on ignition are presented in Table 3.4 and are represented graphically in Figure 3.9. The sediments from all stations, with the exception of DA are classified as very fine sand. DA is classified as very coarse silt based on a mean particle size of $>4\phi^1$. In addition, samples range from poorly sorted at five stations to moderately sorted at five stations. Sediment grain size is relatively similar across all stations.

Site	% Silt/Clay (<63 μm)	Median Diameter (M_{50}) ϕ	Mean particle Diameter (M_z) ϕ	Sorting Coefficient (σ_1)	Skewness (Sk_1)	Kurtosis (K_G)	% LOI *
DA 1998	20.76	3.35	3.42 Very Fine Sand	0.65 Mod. well sorted	0.43 Strongly fine skewed	1.26 Leptokurtotic	1.3
DA 2006	22.7	3.76	4.14 Very Coarse Silt	1.11 Poorly sorted	0.58 Very fine skewed	4.40 Ex. Leptokurtotic	2.6
DB 1998	27.94	3.50	3.70 Very Fine Sand	0.60 Mod. well sorted	0.58 Strongly fine skewed	0.91 Mesokurtotic	<0.1
DB 2006	22.8	3.72	3.90 Very Fine Sand	1.29 Poorly sorted	0.36 Very fine skewed	3.84 Ex. Leptokurtotic	2.3
DC 1998	15.98	3.25	3.37 Very Fine Sand	0.62 Mod. well sorted	0.33 Strongly fine skewed	1.80 Very Leptokurtotic	0.9
DC 2006	15.4	2.95	3.16 Very Fine Sand	1.13 Poorly sorted	0.45 Very fine skewed	1.79 Very Leptokurtotic	2.5
DD 1998	20.09	3.35	3.50 Very Fine Sand	0.68 Mod. well sorted	0.23 Strongly fine skewed	1.42 Leptokurtotic	0.9
DD 2006	20.8	3.66	3.74 Very Fine Sand	1.37 Poorly sorted	0.20 Fine skewed	1.95 Very Leptokurtotic	2.1
DE 1998	10.42	3.00	3.08 Very Fine Sand	0.55 Mod. well sorted	0.35 Strongly fine skewed	1.43 Leptokurtotic	0.6
DE 2006	7.9	2.82	3.04 Very Fine Sand	0.75 Mod. sorted	0.67 Very fine skewed	1.43 Leptokurtotic	2.1
DF 1998	16.28	3.20	3.23 Very Fine Sand	0.93 Mod. sorted	0.03 Near symmetrical	1.87 Very Leptokurtotic	0.5
DF 2006	5.5	3.86	3.01 Very Fine Sand	0.67 Mod. well sorted	0.40 Very fine skewed	2.85 Very Leptokurtotic	1.4
DG 1998	20.67	3.20	3.40 Very Fine Sand	0.74 Mod. sorted	0.40 Strongly fine skewed	1.38 Leptokurtotic	1.2
DG 2006	9.5	2.95	3.14 Very Fine Sand	0.92 Mod. sorted	0.48 Very fine skewed	1.48 Very Leptokurtotic	2.0
DH 1998	16.26	3.10	3.27 Very Fine Sand	0.73 Mod. sorted	0.43 Strongly fine skewed	1.70 Very Leptokurtotic	1.5
DH 2006	14.9	2.91	3.16 Very Fine Sand	0.98 Mod. sorted	0.67 Very fine skewed	1.54 Very Leptokurtotic	3.2
DI 1998	16.92	3.00	3.25 Very Fine Sand	0.89 Mod. sorted	0.56 Strongly fine skewed	2.08 Very Leptokurtotic	1.1
DI 2006	16.1	2.97	3.20 Very Fine Sand	1.00 Mod. sorted	0.65 Very fine skewed	1.55 Very Leptokurtotic	3.1
DJ 1998	33.59	3.45	3.82 Very Fine Sand	1.11 Poorly sorted	0.56 Strongly fine skewed	1.26 Leptokurtotic	2.1
DJ 2006	18.8	3.54	3.60 Very Fine Sand	1.15 Poorly sorted	0.31 Very fine skewed	1.59 Very Leptokurtotic	4.4

Table 3.4 Particle size analysis results from disposal site sediments. * Comparisons for LOI/TOC between 1998 and 2006 are not possible as no method given for analysis of TOC from 1998 survey.

¹ $\phi = -\log_2$ of the particle diameter in millimetres. $>4\phi$ = mean particle size of $<63\mu\text{m}$ (Buchanan & Kain, 1971)

Comparisons with the 1998 survey reveal that there are no obvious changes in sediment classification across nine stations (DB – DJ). There appears to be a slight reduction in the mean particle diameter at site DA since 1998 (Table 3.4). Overall, the structure of the sediment appears to be similar to that reported in 1998.

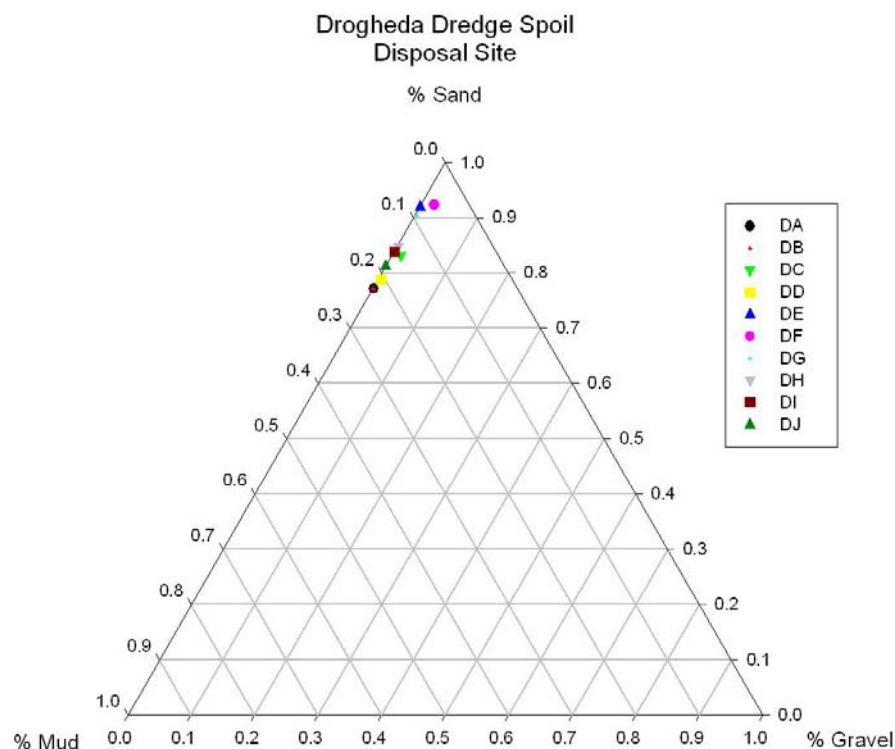


Figure 3.9 Ternary plot of sediment grainsize from each of the sampling stations.

Detailed results from the current survey are presented adjacent to results obtained from the previous survey in Appendix 4.

3.3.3.2 Organic Matter

The organic matter contents from each station are presented in Table 3.4. The maximum value recorded was at the control site DJ (4.4%) and the lowest value recorded was at DF (1.4%). Overall LOI values recorded in the present survey are consistent with clean sandy environments.

3.3.4 Biotope Classification

Nine of the ten sites (DA – DI) can be classified as one biotope/community type SS.SMu.CSaMu.AfilMysAnit (*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud) (Connor *et al.*, 2004). It is characteristic of cohesive sandy mud off wave exposed coasts with weak tidal streams. However, several species, which were numerically abundant during the 1998 survey, such as *Mysella bidentata* and Pseudocumatidae, were not recorded during the present survey.

The remaining station (DJ) is classified as a different community, dominated by Turritellidae, and appears to be a transitional community from SS.SMu.CSaMu.AfilMysAnit (*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud) (Connor *et al.*, 2004). These gastropod molluscs are known to colonise mud and muddy sand forming dense populations. The low species diversity and limited abundances found at this site prevents further classification.

3.4 Impact Hypothesis

The current proposal is to dredge 130,000m³ of sediment from the upper stretches of the River Boyne Estuary. It is proposed to dump this dredge spoil at Dumpsite B over the course of the dredging campaign.

Results from the present survey indicate that there have been significant changes in the benthos within the immediate vicinity of the Dumpsite B (DC – DG) and within the dispersion zone to the north (DA & DB) and to the south (DH & DI) of the dumpsite. Although community structure remains relatively consistent, several species that were present in large numbers in 1998 are absent from the present survey. In 1998, 117 separate taxa were identified across all stations sampled. In 2006, this number had reduced to 53 taxa. In addition, abundances were also significantly down on 1998 levels. In 1998, 31,817 individuals were recorded, whereas, in 2006, this number had fallen to 1,137 individuals over the same number of stations. In contrast, overall biomass values across all stations has increased somewhat from 306.5g to 351.4g.

The community reported in the 1998 survey can be classified as SS.SSa.CMsSa.Abra.Airr (*Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand) (Connor *et al.*, 2004). This is the same community identified in the present survey, although with significant changes in abundances and diversity. This was reported as a relatively homogenous community in 1998 (Similarity of levels of >77%). In addition, diversity across all stations was considered good, with reported diversity indices of >2.1 across all stations.

The present survey indicates that although community type remains similar, it has become more heterogeneous in nature, as similarity levels are much lower than previously recorded. Diversity levels have also reduced across all stations in 2006 compared to 1998. These trends are indicative of increased stress on benthic communities (Warwick & Clarke, 1993). The observed change in the control station DJ is in all likelihood related to natural change within the community, and is independent of any impact caused by dredge spoil disposal at Dumpsite B.

Since 1998, almost 1.25 million tonnes of dredge spoil has been deposited within the dumpsite (Table 3.5). This compares to less than one tenth of the sediment deposited at the dumpsite pre-1998 (total amount disposed of since 1994 is approx. 1.35 million tonnes). It would appear therefore that the amount and regularity of dredge spoil disposed of at the dumpsite since the 1998 survey is the main reason for the observed changes to the benthic community in the survey area.

Permit No.	Date Issued	Volume of Material	Dredge Type
210	30/12/1994	38,000 tonnes	Maintenance
225	22/12/1995	24,261 tonnes	Maintenance
261	30/12/1996	35,285 tonnes	Maintenance
278	05/01/1998	15,350 tonnes	Maintenance
293	06/01/1999	9,500 tonnes	Maintenance
310	06/01/1999	400,000 tonnes	Capital
325	07/02/2001	78,322 tonnes	Maintenance
329/345	3/03/2001 (to present)	750,000 (approx.)	Maintenance

Table 3.5 Frequency and volume of dredge spoil disposal at Dumpsite B.
It is expected that the disposal of 130,000m³ of dredge spoil from the proposed capital works will result in a continuation of same stressed community reported in the current survey.

3.5 Mitigation

There is little in the way of mitigation that can be recommended to ameliorate the potential impact of the proposed dumping at this location.

3.6 Residual Impact

The community present within, and adjacent to, Dumpsite B will remain in a state of stress as a result of the proposed spoil disposal. Results from the present survey indicate that as long as continuous dumping takes place at this location, the benthic community will not recover to its pre-disposal condition.

3.7 Recommendations

It is recommended that at least three additional control sites be chosen for monitoring this disposal site and that these be surveyed before the proposed disposal takes place, so that they can provide an adequate baseline for follow-up surveys.

3.8 References

- Anon (1992) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
- Buchanan, J.B. & Kain, J.M. (1971) 'Measurent of the Physical and Chemical Environment' in Methods for the Study of Marine Benthos, eds NA Holme and AD McIntyre, Blackwell Scientific Publications, Oxford and Edinburgh, pp30 – 58.
- Connor, D.W, Allen, J.H., Golding, N, Howell, KL, Lieberknecht LM, Northen, K.O.and J.B. Reker (2004). *The Marine Habitat Classification for Britain and Ireland version 04.05* JNCC Peterborough ISBN 1 861 07561 8 (internet version).
- KMM MarEnCo (1998) 'Baseline biological monitoring survey of dredged material disposal site and impact hypothesis.' Report to Drogheda Port Company in relation to a Capital Dredging Scheme.
- Warwick, R.M. & Clarke, K.R. (1993) 'Increased variability as a symptom of stress in marine communities.' *Journal of Experimental Marine Biology and Ecology*. **172**, 215-226.

4 FISHERIES

The following section deals with the potential impacts of the proposal on protected fish species and commercial fishing in the Boyne Estuary.

4.1 Receiving Environment

The site of the proposed Drogheda capital dredging is a migratory route for at least two Annex II species under the EU Habitats Directive, namely Atlantic salmon (*Salmo salar*) and River Lamprey (*Lampetra fluviatilis*). There is also a published reference to a third Annex II species, twait shad (*Alosa fallax fallax*) occurring in the Boyne (Doherty *et. al.*, 2004) but its current status is unknown. Other rare or protected species, which may occur in the Boyne, include smelt (*Osmerus eperlanus*), Sea Lamprey, (*Petromyzon marinus*) and Allis shad (*Alosa alosa*) although there are no records of these species occurring there. All of the above species are anadromous entering freshwater from the sea in order to spawn.

4.1.1 Protected Species other than Salmon

The river lamprey is the only Annex II species other than salmon, which is definitely known to be present within the Boyne system at present. This species has been taken in phyke nets near Oldbridge in the lower freshwater reaches during October – November in 2002 (pers comm. Dr. Jimmy King, Central Fisheries Board) and were probably on their autumn spawning migration from the sea at the time. River lampreys are also known to have an autumn migration on other rivers such as the Slaney. They spawn in the March-April period and may have a spring spawning migration also. The fact that river lamprey migrate in autumn, means that they may be migrating during the proposed dredging operation, which is proposed for the September-October period.

A recent survey of the freshwater reaches of the Boyne catchment has revealed a widespread stock of juvenile river lamprey (Dr. Ferdia Marnell, NPWS, pers. comm.). The results of this survey (undertaken by William O'Connor of Ecofact) are due to be published on-line in the NPWS Wildlife Manual Series shortly.

Were smelt and shad to occur on the Boyne they would have their spawning migrations in spring and early summer respectively.

4.1.2 Salmon

The Boyne is the most important river on the east coast for salmon caught both commercially and on rod and line. In the 1970's the Boyne was subject to severe arterial drainage and its salmon stocks declined as a result. In recent years however, the stocks have recovered significantly. According to the District Fisheries Inspector (Eastern Regional Fisheries Board) the spawning potential within the Boyne is good with consistently good redd counts recorded in recent years.

Within the Boyne estuary there are 51 draft net commercial licences allocated and there are 11 traditional draft net fishing areas within the estuary all of which are between the Drogheda viaduct and the mouth of the estuary. A licence allows the

holder to fish anywhere within the estuary for salmon and seatrout. However, only certain licence holders normally fish certain draft netting sites. Only one draft-netting site occurs within the proposed capital dredging stretch, on the south shore opposite Tom Roe's Point and upstream from the Turning Basin. This site is traditionally fished at most by six licence holders.

Draft-netting in the Drogheda District is undertaken with nets no more than 85 yards in length for two hours at either side of low water. The season is generally from mid-May to mid-August each year.

4.1.3 Other fishing.

No other fishing, commercial or recreational, is undertaken within the proposed dredging stretch.

4.2 Potential Impact

4.2.1 Direct and Indirect Impacts on Migratory Fish and Lamprey

Dredging can give rise to sediment blooms with high levels of suspended solids, especially close in to the dredger head and a depth in the water column. High levels of solids can damage fish gills and thereby contribute to bacterial gill disease or more rarely to direct fish mortalities. The latter situation is not common in nature and would only be expected where fish were exposed for extended periods to high solids levels (i.e. thousands or tens of thousands of mg/l) in areas where they are unable to take avoidance actions. Other things being equal, juveniles are more susceptible than adults to suspended solids impacts.

As part of the 1999/2000 capital dredging EIS, which included the current proposed dredging stretch, a sediment dispersion model was developed in order to predict the likely levels of suspended solids in the dredge plume. This was undertaken for a backhoe dredger and predicted that solids were always lower than 75mg/l, except very close in to the dredger. However, for most of the tidal cycle, the levels of solids predicted in the plume were 25mg/l or less. Monitoring undertaken during the dredging generally found that the actual suspended levels were lower than those predicted by the model.

The proposed timing of the dredging (September and October) will be outside the main migration period for salmon both adults and smolts and it will also be outside the commercial netting season for salmon and seatrout. Furthermore, any juvenile shad that might be present in the estuary should by that time be in the lower part of the estuary and therefore outside the immediate influence of the works (see Claridge and Gardner, 1978).

Migrating river lamprey could be potentially influenced by the proposed dredging as they are known to enter the Boyne in the autumn. No literature could be found on the response of migrating lamprey to suspended solids plumes. However, it is known that lamprey present in rivers such as the Suir must migrate through the high turbidity

zones of these rivers, where suspended solids levels, especially at low water can be more than 100mg/l in concentration (pers. obs). Only very close in to the dredging operation are lamprey likely to experience levels comparable to these levels on the Boyne during the proposed dredging. Furthermore, the likelihood is that the concentrations across the plume will allow animals to travel through less turbid areas of the channel.

4.2.2 Commercial Fishing

As the proposed dredging will take place upstream of Tom Roes Point, only one draft netting station can be directly impacted by the proposal, although the proposed timing of the dredging in the autumn will avoid any disruption of netting season by the dredger.

The depth of the site will be increased to -2.2m below chart datum, i.e. about 1.5m or less below the current bed level at centre channel and 1 to 2m at the edge of the channel depending on the location. This will be the main physical change at the site, as the dredging of the channel side-slopes will result in a very similar bed-slope post-dredging to that already existing i.e. 1in 5. It isn't possible to state with certainty, however, whether or not these changes will have a significant adverse impact on the draft netting at this point.

During the first season after the main capital dredging operation of 1999/2000, several draft-nets fishermen complained to the local District Fisheries Inspector about the fact that the dredging had left a lot of irregularities in the bed of the river, which, they claimed reduced the efficiency of the netting. An uneven bed is also a possibility on this occasion. It isn't clear whether local irregularities in the bed have persisted since the original dredging at the affected sites but one might expect that storms and floods would have tended to even them out over time. However, this is likely to vary from site to site.

The total numbers of salmon caught by draft netting since the 1999/2000 dredging on the Boyne is presented in Figure 4.1. These figures are relatively stable at 1000 to 2000 fish caught since a low point in 1999 when fewer than 800 fish were recorded. It isn't possible to say from these data whether catching efficiency has been reduced or not in the Boyne as a result of the previous capital dredging.

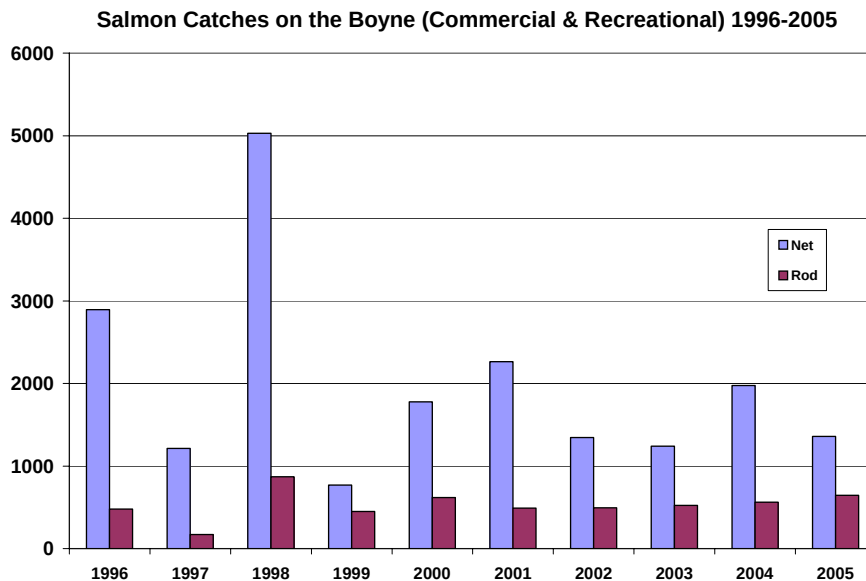


Figure 4.1 Commercial and recreational salmon landings in the Drogheda District from 1996 to 2005 inclusive. (Data courtesy of the Eastern Regional Fisheries Board)

4.2.3 Mitigation

A number of mitigation measures can be utilised to reduce the potential impacts of dredging operations as follows:

- (i) Timing the dredging to avoid impacting on important conservation or commercial species.
- (ii) Reduction in the amounts of solids lost from the dredging operation.
- (iii) Reinstatement of the River Bed

4.2.4 Timing of Dredging

The case of the Drogheda dredging, the autumn timing of the operation will avoid the main period of migration of salmon (adults and smolts), and likewise the spawning migrations of smelt and twait shad if they occur, as well as the spring migrations of river lamprey (if the take place) or the spring summer migrations of sea lamprey if the latter species is present in the system. This timing would also avoid the commercial salmon and sea trout netting season.

The timing is likely to overlap, at least in part, with the late autumn upstream migration of river lamprey. However, as mentioned in the section on potential impacts, lamprey are unlikely to be prevented from migrating upstream by the dredging.

4.2.5 *Reduction of Suspended Sediment Escape*

There are many ways in which suspended solids can be reduced from dredging operations including in particular the choice of dredger and the equipment employed by that dredger, the rate of movement of the dredger and the method of handling the dredge spoil, among others.

A means of reducing suspended solids would be to minimise the amount of overflow from the barge when it is being filled by the backhoe dredger. Given that the previous dredging produced relatively low suspended solids levels in line with modelling predictions, adoption of a similar strategy for the proposed work should have the same outcome.

4.2.6 *Reinstatement of the River Bed*

It is recommended that every effort be made to ensure that the channel side slopes in the area of the one draft net fishing haul within the dredging stretch be left in a state as close as possible to that existing at present. This may require some form of localised bed levelling to be employed at this spot or back-filling with gravel, depending on the state of the bottom post dredging. All debris and snags, if any, uncovered by the dredging in this area should be removed.

4.3 *Residual Impacts*

Provided all the mitigation measures outlined are implemented in full, the proposed dredging is not expected to have any significant negative impact on protected fish within the study area. While, a significant adverse impact on the one draft-net fishing site is not anticipated, i.e. it is expected that the site will still be fishable after the dredging, this cannot be said with certainty.

4.4 *Recommendations*

It is recommended that the District Fisheries Inspector for the Drogheda District of the Eastern Regional Fisheries Board and the fishermen who traditionally fish the Tom Roes' draft-netting haul be consulted before and after the dredging in order to optimise the dredging and reinstatement of that section of the shoreline.

4.5 *References*

- Doherty, D., O'Maoileidigh and T.K. McCarthy (2004). The biology, ecology and future conservation of twait shad (*Alosa fallax*), allis shad (*Alosa alosa*) and Killarney shad (*Alosa fallax killarnensis*) in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, 104B. 93-102
- Claridge P. N. and Gardner D. C. (1978) growth and movements of the twaite shad , *Alosa fallax*, in the Severn Estuary. *J. Fish Biol.* 12, 203-211

5 BOYNE ESTUARY MUSSEL FISHERY

5.1 Receiving Environment

Traditionally there has been a blue mussel (*Mytilus edulis*) fishery in the outer Boyne Estuary at Mornington. This fishery was substantially removed during the 1999-2000 portion of the capital dredging by Drogheda Port and since then re-instatement of the beds has been ongoing through systematic annual re-seeding with imported seed from the Irish Sea.

Prior to capital dredging the mussel beds were surveyed in 1996 to establish the extent of the beds and the density of the mussels present. This work was carried out by CMAR from Queen's University in Belfast (KMM, 1997). This survey indicated that the full extent of the beds stretched from Bight Beacon to the west and S Bull Beacon to the east, i.e. the outer 2km approximately of the estuary. The survey estimated that the beds held approximately 1,800 tons give or take 200 tons of mussels (i.e. somewhere between 1,600 and 2,000 tons). Prior to that time the beds were occasionally re-seeded but not heavily so and it is thought that the beds were naturally re-seeding, although it wasn't known whether the seed was emanating from within the estuary's stock or whether it was supplied from stocks outside the estuary.

Re-instatement of the beds with external seed has been carried out systematically on an annual basis since the capital dredging was completed. Table 5.1 gives the dates and the tonnages involved; this work was undertaken by the South East Shellfish Cooperative.

Table 5.1 Dates and Tonnages of Mussel Reseeding in the Boyne Estuary

Date of Re-seeding	Tonnage of Seed Laid
summer 2000	1,765
autumn 2001	830
winter 2002	355
autumn 2003	415

Data from: Seabed Surveys International Ltd. 'Seventh Acoustic Survey of the Boyne Estuary April 24-27, 2005'.

This re-instatement programme has resulted in an estimated 70% - 87% recovery of the original stock (~1,600-2,000 tons) in 2005 when a Seabed Survey's International survey estimated that the beds contained 1,410 tonnes. That survey report also indicated that 75% of the mussels were harvestable (i.e. >60mm in size) and that there was evidence of local mussel recruitment (individuals <20mm in size) at all the survey sites.

5.2 Potential Impacts

The two obvious sources of impact from the proposed round of capital dredging on the mussel industry in the Boyne Estuary would be (i) direct removal of stocks by the

dredger and (ii) damage to the mussels or the beds by excessive suspended solids or toxic substances in the sediments.

5.2.1 Direct Damage to Mussel Beds

The current round of capital dredging is just over 2.5km upstream of the Mornington Mussel Fishery and will therefore have no direct impact on the beds.

5.2.2 Damage to Mussel Beds due to Suspended Solids and Sedimentation

Indirect impacts on mussels could in theory derive from increased suspended solids in the water column. However, the sediment dispersion model produced for the EIS for the 1999-2000 capital dredging predicted very low levels of additional suspended solids (always below 25mg/litre) at the mussel beds from dredging activity around Tom Roe's Point. These solids would only contain the finest particles (silt / clay) as all heavier particles would have dropped out of suspension in the areas of natural accretion in the intervening 2.5km stretch. These levels, which would be likely to contain only the finest particles (silt/clay), are much lower than levels found to have adverse impacts on mussels (Wilber and Clarke, 2001). Furthermore, ambient currents and normal pumping by mussels, within the mussel beds themselves would likely prevent this low level of suspended solids from smothering any mussel beds in-situ.

5.3 Mitigation

It is not considered necessary to undertake any specific mitigation measures to protect the mussel beds in the Boyne Estuary as the risk to them is considered very low from the proposal. In any case, care will be taken to undertake the dredging in an environmentally responsible manner and in particular to fill barges from the backhoe dredger in a manner which will minimise the loss of sediment.

5.4 Residual Impact.

No adverse impact on the mussel beds is predicted to occur as a result of the proposed dredging operation.

5.5 References

- Wilber, D.H. and D.G. Clarke (2001) Biological effects of suspended sediments: a review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. *North American Journal of Fisheries Management* **21**, pp.855-875.
- Kirk McClure Morton, (1997) Drogheda Port Company, Environmental Statement. Capital Dredging Scheme. Appendix Scheme Appendix C: A survey of the Mussels Stocks of the Boyne Estuary. (undertaken by Drs. Philip Heath and John Wilson at the Centre for Marine Resources and Mariculture. Queens University Belfast).

6 APPENDICES

APPENDIX 1: Faunal abundance data matrix. Values expressed as abundances per 0.1m².

	DA1	DA2	DA3	DB1	DB2	DB3	DC1	DC2	DC3	DD1	DD2	DD3	DE1	DE2	DE3
Abra	2	0	0	0	1	0	0	0	0	0	0	0	0	2	0
Actiniaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampeliscidae	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0
Ampharetidae	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
Amphiuridae	10	12	0	0	15	12	12	9	13	0	30	17	2	3	4
Asterias	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Astropecten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cardiidae	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Chaetodermatidae	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	0	0	0	0	1	1	5	0	0	0	0	0	0	0	0
Corbiculidae	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Cucumariidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultellidae	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Diastylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinocardium	0	0	1	0	2	0	0	1	0	0	0	0	3	1	4
Flabelligeridae	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Glyceridae	2	0	0	4	2	6	2	0	0	0	3	1	4	2	1
Golfingiidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goneplacidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucosiidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Lumbrineridae	0	0	0	0	1	1	0	1	0	0	0	1	3	1	0
Mactridae	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Magelonidae	4	0	0	1	4	2	0	3	0	2	3	4	2	1	0
Maldanidae	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Montacutidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Naticidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Nemertea	0	1	2	0	0	1	1	3	1	2	2	2	0	0	0
Nepthyidae	13	13	12	11	13	9	3	5	6	9	6	5	3	4	15
Nuculiidae	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
Opheliidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ophiura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orbiniidae	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Oweniidae	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Pectinariidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Phascolionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoxocephalidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllodocidae	2	0	0	0	0	1	1	0	1	0	1	0	0	0	0
Polynoidae	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Processa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammobiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scalibregmatidae	0	0	0	0	1	1	0	1	1	2	4	1	1	1	0
Scaphandridae	0	0	0	0	1	0	0	0	0	0	2	0	0	1	0
Sigalionidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Spionidae	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Syllidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Synaptidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellimya ferruginosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Terebellidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1

APPENDIX 1 (contd): Faunal abundance data matrix. Values expressed as abundances per 0.1m².

	DA1	DA2	DA3	DB1	DB2	DB3	DC1	DC2	DC3	DD1	DD2	DD3	DE1	DE2	DE3
Thraciidae	0	1	0	0	0	0	2	1	1	1	2	0	5	24	8
Thyasiridae	0	1	0	0	0	0	0	0	0	1	3	0	0	0	2
Turritellidae	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0
Veneridae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2

APPENDIX 1 (contd): Faunal abundance data matrix. Values expressed as abundances per 0.1m².

	DF1	DF2	DF3	DG1	DG2	DG3	DH1	DH2	DH3	DI1	DI2	DI3	DJ1	DJ2	DJ3
Abra	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Actiniaria	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0
Ampeliscidae	0	0	0	1	1	1	2	1	1	0	0	0	0	0	0
Ampharetidae	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0
Amphiuridae	0	1	5	3	24	23	8	24	14	12	14	12	0	0	0
Asterias	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astropecten	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Cardiidae	0	1	1	0	3	0	0	0	0	3	1	0	0	0	0
Chaetodermatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0
Corbiculidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Cucumariidae	0	0	0	0	0	0	0	1	1	4	1	1	0	0	0
Cultellidae	0	0	0	0	0	1	0	1	3	2	1	1	0	0	0
Diastylidae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinocardium	5	0	0	0	0	2	1	2	3	0	4	1	0	0	0
Flabelligeridae	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Glyceridae	0	1	0	1	0	2	0	0	1	0	0	4	0	0	0
Golfingiidae	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Goneplacidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Leucosiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbrineridae	0	2	2	0	2	2	0	1	3	1	3	2	0	0	0
Mactridae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Magelonidae	0	0	0	1	3	0	4	5	1	2	2	2	0	2	0
Maldanidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montacutidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Naticidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemertea	0	0	2	1	2	1	0	3	4	3	4	2	0	0	0
Nepthyidae	3	2	1	1	2	6	0	4	6	11	8	5	9	8	13
Nuculiidae	1	0	0	0	2	1	0	1	0	0	0	1	0	0	0
Opheliidae	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0
Ophiura	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Orbiniidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Oweniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectinariidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phascolionidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Phoxocephalidae	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Phyllodocidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Polynoidae	0	0	0	0	2	0	3	0	0	0	0	1	0	0	0
Processa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Psammobiidae	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Scalibregmatidae	0	0	0	1	1	1	0	4	3	2	3	2	2	2	0
Scaphandridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigalionidae	0	2	0	0	2	0	0	0	0	1	0	0	0	0	0
Spionidae	0	7	4	0	1	0	0	0	0	0	0	0	0	0	0
Syllidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synaptidae	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Tellimya ferruginosa	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0
Terebellidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 1 (contd): Faunal abundance data matrix. Values expressed as abundances per 0.1m².

	DF1	DF2	DF3	DG1	DG2	DG3	DH1	DH2	DH3	DI1	DI2	DI3	DJ1	DJ2	DJ3
Thraciidae	5	12	3	5	1	1	5	1	12	4	12	17	0	0	0
Thyasiridae	0	0	0	0	1	0	4	0	2	2	2	2	0	0	0
Turritellidae	0	0	0	0	0	0	0	0	0	0	0	0	25	28	36
Veneridae	1	0	0	1	2	4	3	3	3	4	1	0	0	1	0

APPENDIX 2: Faunal biomass data matrix. Values expressed as grams per 0.1m².

	DA1	DA2	DA3	DB1	DB2	DB3	DC1	DC2	DC3	DD1	DD2	DD3	DE1	DE2	DE3	DF1	DF2	DF3
Abra	0.015	0	0	0	0.005	0	0	0	0	0	0	0	0	0.085	0	0	0	0
Actiniaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampeliscidae	0	0.005	0.065	0	0	0.005	0.005	0	0.005	0	0	0	0	0	0	0	0	0
Ampharetidae	0	0	0	0	0	0	0	0	0	0	0.06	0	0.075	0	0.07	0	0	0
Amphiuridae	1.485	2.305	0	0	1.495	0.935	0.925	2.005	1.235	0	2.09	4.815	0.105	0.115	1.455	0	0.035	0.045
Asterias	0	0	0	0	0	0	0	0	0	0	0	0	4.025	0	0	0	0	0
Astropecten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cardiidae	0.17	0.615	0	0	0	0	0	0	0	0	0	0.185	0	0	0	0	0.015	0.005
Chaetodermatidae	0	0.085	0	0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	0	0	0	0	0.005	0.005	0.015	0	0	0	0	0	0	0	0	0	0.005	0.005
Corbiculidae	0	0	0	0	0	0	0	0	0	0	0.005	0	0	0	0	0	0	0
Cucumariidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultellidae	0.025	0	0	0	0.195	0	0	0	0	0	0	0.205	0	0	0	0	0	0
Diastylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0
Echinocardium	0	0	10.565	0	18.645	0	0	4.955	0	0	0	0	3.905	1.415	14.745	32.795	0	0
Flabelligeridae	0	0	0	0	0	0	0	0.025	0.005	0	0	0	0	0	0	0	0	0
Glyceridae	0.025	0	0	0.025	0.01	0.055	0.01	0	0	0	0.085	0.015	0.275	0.025	0.095	0	0.015	0
Golfingiidae	0.015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goneplacidae	1.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucosiidae	0	0	0	0	0	0	0	0	0	0	0.005	0	0	0	0	0	0	0
Lumbrineridae	0	0	0	0	0.01	0.015	0	0.015	0	0	0	0.015	0.005	0.01	0	0	0.02	0.035
Mactridae	0	0	0	0	0	0	0	0	0	0	0	0.165	0	0	0	0	0	0
Magelonidae	0.015	0	0	0.005	0.01	0.015	0	0.045	0	0.005	0.01	0.015	0.1	0.015	0	0	0	0
Maldanidae	0	0	0	0	0	0	0	0.125	0.055	0	0	0	0	0	0	0	0	0
Montacutidae	0	0	0	0	0	0	0	0	0	0	0.005	0	0	0	0	0	0	0
Naticidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.025	0	0	0
Nemertea	0	0.015	0.995	0	0	0.015	0.02	0.765	0.045	0.345	0.125	0.1	0	0	0	0	0	0.05
Nepthyidae	0.345	0.925	0.585	0.875	2.315	0.255	0.075	0.545	0.455	0.065	0.065	0.015	0.285	0.08	0.895	0.205	0.005	0.005
Nuculiidae	0	0	0	0	0	0	0	0	0	0.04	0.015	0.015	0.1	0	0.015	0.215	0	0
Opheliidae	0	0	0	0	0	0	0	0	0	0	0.075	0	0	0	0	0	0	0
Ophiura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orbiniidae	0	0	0	0	0	0.015	0	0	0	0	0	0	0	0	0	0	0	0
Oweniidae	0	0	0	0	0	0	0	0.045	0	0	0.005	0	0	0	0	0	0	0

APPENDIX 2 (contd): Faunal biomass data matrix. Values expressed as grams per 0.1m².

	DA1	DA2	DA3	DB1	DB2	DB3	DC1	DC2	DC3	DD1	DD2	DD3	DE1	DE2	DE3	DF1	DF2	DF3
Pectinariidae	0	0	0.125	0	0	0	0	0	0	0	0	0	0	0	0.315	0	0	0
Phascolionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoxocephalidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllodocidae	0.015	0	0	0	0	0.005	0.005	0	0.015	0	0.065	0	0	0	0	0	0	0
Polynoidae	0	0.005	0	0	0	0	0	0	0	0	0.005	0	0	0	0	0	0	0
Processa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psammobiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scalibregmatidae	0	0	0	0	0.005	0.005	0	0.035	0.025	0.005	0.065	0.005	0.005	0.025	0	0	0	0
Scaphandridae	0	0	0	0	0.015	0	0	0	0	0	0.005	0	0	0.005	0	0	0	0
Sigalionidae	0	0	0	0	0	0	0	0	0	0.015	0	0	0	0	0	0	0.005	0
Spionidae	0	0	0	0	0	0	0.005	0	0.005	0	0	0	0	0	0	0	0.025	0.015
Syllidae	0	0	0	0	0.005	0	0	0	0	0	0	0	0	0	0	0	0	0
Synaptidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellimya ferruginosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0	0	0
Terebellidae	0	0	0	0	0	0	0	0.81	0	0	0	0	0	0	0.7	0	0	0
Thraciidae	0	0.005	0	0	0	0	0.015	0.005	0.005	0.005	0.005	0	0.315	0.365	0.025	0.105	0.015	0.005
Thyasiridae	0	0.005	0	0	0	0	0	0	0	0.005	0.005	0	0	0	0.005	0	0	0
Turritellidae	0	0.245	0.235	0	0	0	0	0	0	0.775	0	0	0	0	0	0	0	0
Veneridae	0	0	0	0	0	0	0	0	0	0	0	0.975	0	0	1.475	1.425	0	0

APPENDIX 2 (contd): Faunal biomass data matrix. Values expressed as grams per 0.1m².

	DG1	DG2	DG3	DH1	DH2	DH3	DI1	DI2	DI3	DJ1	DJ2	DJ3
Abra	0	0	0	0	0	0.085	0	0	0	0	0	0.005
Actiniaria	0	0	0	0	0.725	0.055	0	0	0	0	0	0
Ampeliscidae	0.005	0.005	0.005	0.005	0.005	0.005	0	0	0	0	0	0
Ampharetidae	0	0.105	0.04	0.005	0.095	0	0	0	0	0	0	0
Amphiuridae	0.055	1.175	1.885	2.765	4.055	2.715	1.895	2.115	3.525	0	0	0
Asterias	0	0	0	0	0	0	0	0	0	0	0	0
Astropecten	0	4.435	0	0	0	2.945	0	0	0	0	0	0
Cardiidae	0	0.015	0	0	0	0	0.37	0.285	0	0	0	0
Chaetodermatidae	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	0	0.005	0	0	0	0	0	0	0	0	0	0
Corbiculidae	0	0	0	0	0.005	0	0	0	0	0	0	0
Cucumariidae	0	0	0	0	0.245	0.275	2.415	0.635	0.415	0	0	0
Cultellidae	0	0	0.34	0	0.075	0.325	0.545	0.115	0.105	0	0	0
Diastylidae	0	0	0	0	0	0	0	0	0	0	0	0
Echinocardium	0	0	21.855	4.795	24.145	24.115	0	4.565	14.245	0	0	0
Flabelligeridae	0	0	0	0	0	0.035	0	0	0	0	0.045	0
Glyceridae	0.015	0	0.055	0	0	0.005	0	0	0.105	0	0	0
Golfingiidae	0	0	0	0	0	1.385	0	0	0	0	0	0
Goneplacidae	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae	0	0	0	0	0.155	0	0	0	0	0	0	0
Leucosiidae	0	0	0	0	0	0	0	0	0	0	0	0
Lumbrineridae	0	0.005	0.01	0	0.045	0.065	0.035	0.015	0.065	0	0	0
Mactridae	0	0	0	0	1.475	0	0	0	0	0	0	0
Magelonidae	0.005	0.105	0	0.11	0.015	0.025	0.025	0.025	0.01	0	0.045	0
Maldanidae	0	0	0	0	0	0	0	0	0	0	0	0
Montacutidae	0	0	0	0	0	0	0	0	0	0	0	0
Naticidae	0	0	0	0	0	0	0	0	0	0	0	0
Nemertea	0.045	0.075	0.03	0	0.111	0.555	1.905	0.675	0.585	0	0	0
Nepthyidae	0.015	0.065	0.205	0	0.745	0.515	0.23	0.355	0.405	0.695	1.005	0.675
Nuculiidae	0	0.075	0.01	0	0.01	0	0	0	0.175	0	0	0
Opheliidae	0	0	0.035	0	0.085	0	0.07	0	0	0	0	0
Ophiura	0	0	0	0	0.67	0	0	1.595	0	0	0	0
Orbiniidae	0	0.005	0	0	0	0	0	0	0	0	0	0
Oweniidae	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 2 (contd): Faunal biomass data matrix. Values expressed as grams per 0.1m².

	DG1	DG2	DG3	DH1	DH2	DH3	DI1	DI2	DI3	DJ1	DJ2	DJ3
Pectinariidae	0	0	0	0	0	0	0	0	0	0	0	0
Phascolionidae	0	0	0	0	0	0	0	0	0	0.075	0	0
Phoxocephalidae	0	0	0	0	0	0	0	0.005	0.005	0	0	0
Phyllodocidae	0	0	0	0	0	0	0	0	0	0.035	0	0
Polynoidae	0	0.05	0	0.105	0	0	0	0	0.005	0	0	0
Processa	0	0	0	0	0	0	0.125	0	0	0	0	0
Psammobiidae	0.005	0	0.125	0	0	0	0	0	0	0	0	0
Scalibregmatidae	0.005	0.005	0.005	0	0.065	0.055	0.01	0.015	0.005	0.005	0.015	0
Scaphandridae	0	0	0	0	0	0	0	0	0	0	0	0
Sigalionidae	0	0.005	0	0	0	0	0.015	0	0	0	0	0
Spionidae	0	0.005	0	0	0	0	0	0	0	0	0	0
Syllidae	0	0	0	0	0	0	0	0	0	0	0	0
Synaptidae	0	0	0	0	0	0	1	1	0	0	0	0
Tellimya ferruginosa	0	0	0	0.005	0	0.005	0.005	0.005	0.005	0	0	0
Terebellidae	0.565	0	0	0	0	0	0	0	0	0	0	0
Thraciidae	0.015	0.05	0.005	0.005	0.005	0.075	0.005	0.12	0.185	0	0	0
Thyasiridae	0	0.005	0	0.005	0	0.005	0.005	0.005	0.005	0	0	0
Turritellidae	0	0	0	0	0	0	0	0	0	14.675	17.985	24.055
Veneridae	0.005	0.395	1.18	1.075	3.075	0.115	1.715	1.435	0	0	3.815	0

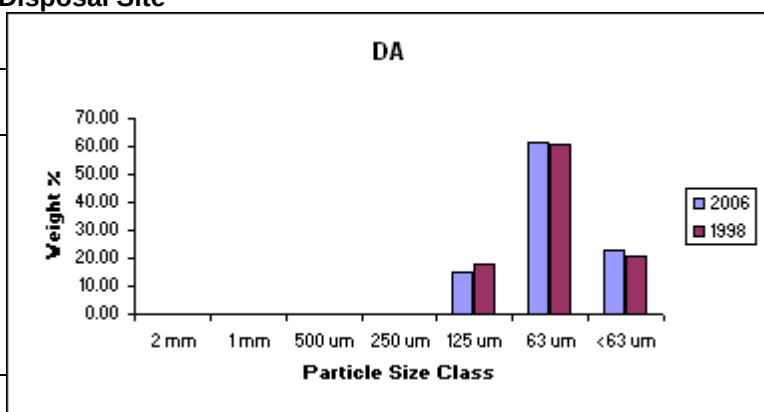
APPENDIX 3: Taxonomical affinities of encountered taxa.

Mollusca	Polychaeta	Echinodermata
Cardiidae	Ampharetidae	Amphiuridae
Chaetodermatidae	Cirratulidae	Asterias
Corbiculidae	Flabelligeridae	Astropecten
Cultellidae	Glyceridae	Cucumariidae
Mactridae	Goniadidae	Echinocardium
Montacutidae	Lumbrineridae	Ophiura
Naticidae	Magelonidae	Synaptidae
Nuculiidae	Maldanidae	
Psammobiidae	Nepthyidae	Crustacea
Scaphandridae	Opheliidae	Ampeliscidae
Tellimya ferruginosa	Orbiniidae	Diastylidae
Thraciidae	Oweniidae	Goneplacidae
Thyasiridae	Pectinariidae	Leucosiidae
Turritellidae	Phyllodocidae	Phoxocephalidae
Veneridae	Polynoidae	Processa
	Scalibregmatidae	
Nemertea	Sigalionidae	Sipuncula
Nemertea	Spionidae	Golfingiidae
	Syllidae	Phascolionidae
	Terebellidae	

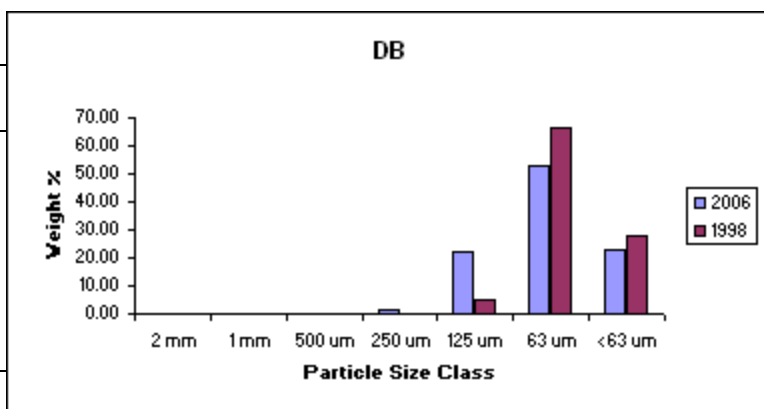
APPENDIX 4 Granulometric Analysis – Disposal Site

Sample

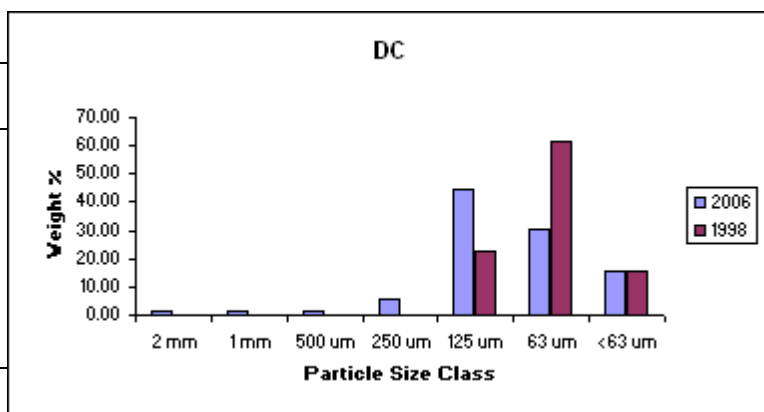
DA	Sieve Size	2006	1998
	2 mm	0.14	0
	1 mm	0.10	0.05
	500 um	0.07	0.06
	250 um	0.27	0.09
	125 um	15.22	18.01
	63 um	61.43	61.03
	<63 um	22.76	20.76



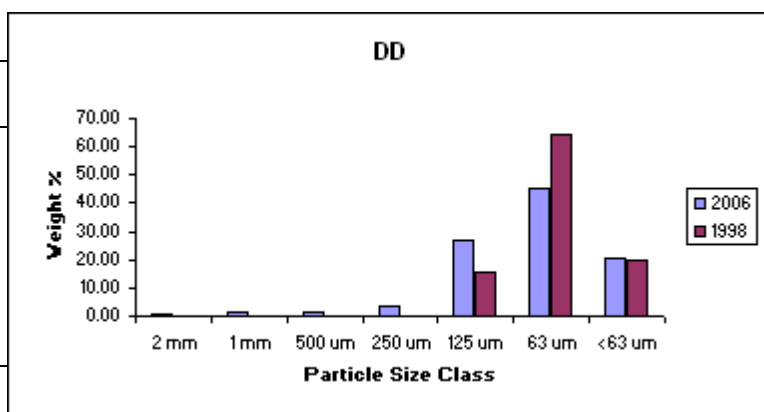
DB	Sieve Size	2006	1998
	2 mm	0.12	0
	1 mm	0.09	0.11
	500 um	0.11	0.09
	250 um	1.78	0.08
	125 um	22.46	5.15
	63 um	52.61	66.63
	<63 um	22.84	27.94



DC	Sieve Size	2006	1998
	2 mm	1.40	0
	1 mm	1.13	0.3
	500 um	1.45	0.11
	250 um	5.97	0.07
	125 um	44.27	22.49
	63 um	30.36	61.65
	<63 um	15.42	15.38



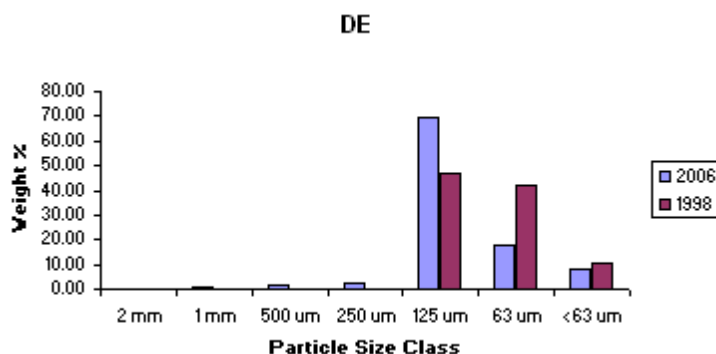
DD	Sieve Size	2006	1998
	2 mm	0.55	0
	1 mm	1.26	0.05
	500 um	1.48	0.08
	250 um	3.59	0.14
	125 um	27.18	15.26
	63 um	45.15	64.38
	<63 um	20.79	20.09



APPENDIX 4 (contd) Granulometric Analysis – Disposal Site

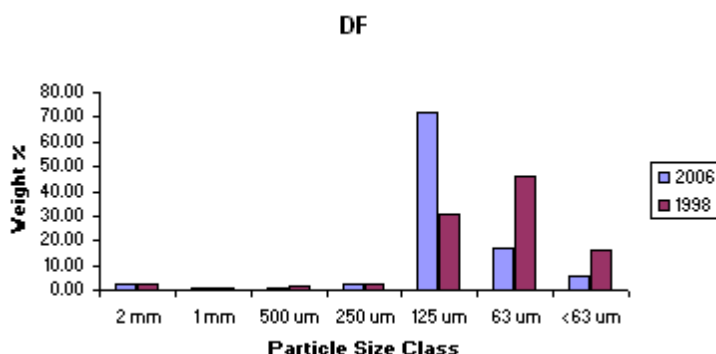
DE

Sieve Size	2006	1998
2 mm	0.09	0
1 mm	0.82	0.14
500 um	1.24	0.12
250 um	2.48	0.07
125 um	69.81	46.89
63 um	17.60	42.36
<63 um	7.96	10.42



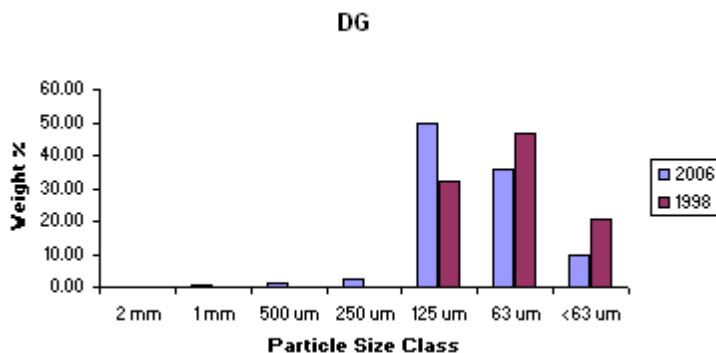
DF

Sieve Size	2006	1998
2 mm	2.12	2.53
1 mm	0.58	0.54
500 um	0.90	1.35
250 um	2.08	2.28
125 um	71.55	30.93
63 um	17.22	46.09
<63 um	5.56	16.28



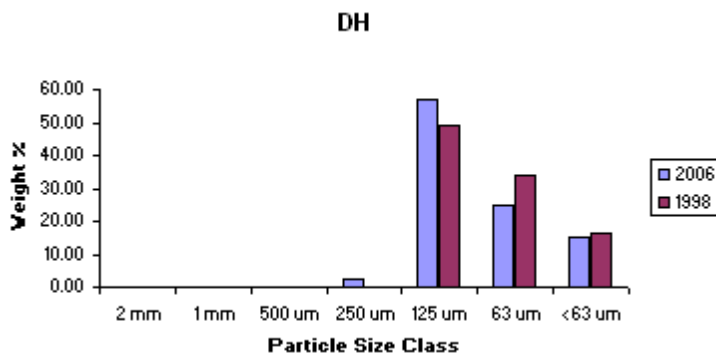
DG

Sieve Size	2006	1998
2 mm	0.29	0.25
1 mm	0.87	0.06
500 um	1.38	0.05
250 um	2.57	0.08
125 um	49.90	32.13
63 um	35.52	46.76
<63 um	9.47	20.67



DH

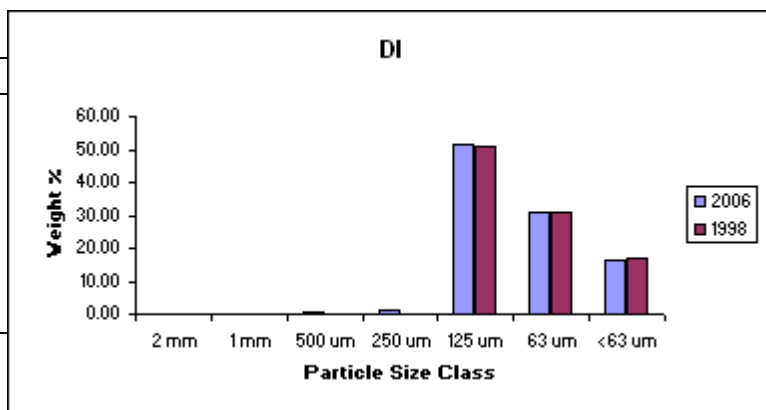
Sieve Size	2006	1998
2 mm	0.13	0.09
1 mm	0.12	0.16
500 um	0.21	0.13
250 um	2.68	0.08
125 um	56.81	49.17
63 um	25.11	34.11
<63 um	14.95	16.26



APPENDIX 4 (contd) Granulometric Analysis – Disposal Site

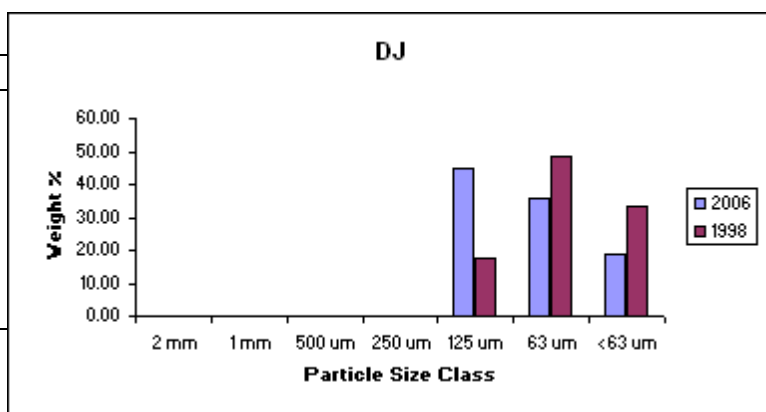
DI

Sieve Size	2006	1998
2 mm	0.00	0
1 mm	0.18	0.22
500 um	0.39	0.15
250 um	1.05	0.12
125 um	51.56	51.11
63 um	30.68	31.18
<63 um	16.15	16.92



DJ

Sieve Size	2006	1998
2 mm	0.01	0.15
1 mm	0.07	0.05
500 um	0.00	0.1
250 um	0.25	0.08
125 um	44.90	17.43
63 um	35.93	48.6
<63 um	18.83	33.59



December, 2003

Capt. Martin Donnelly
Drogheda Port Company
Maritime House
The Mall
Drogheda
Co. Louth

Maintenance Dredging – Maritime Archaeology

Dear Captain Donnelly,

I wish to refer to previous correspondence and our meeting on 3 December, 2003 regarding maintenance dredging at Drogheda Port and at Irish Ports generally.

After a review of the situation, it has been decided that there will not be a requirement for archaeological monitoring for future maintenance dredging at Irish ports. This position will be reflected in the code of practice to be agreed. We hope to be in a position to progress the code of practice bilaterally with the Irish Ports Authority as soon as there is clarification of roles within the State sector in relation to archaeology.

In relation to Drogheda, diver truthing may be required to be undertaken to give provenance to timbers pinpointing potential wreck sites should future works to widen or deepen the channel be undertaken. It was also agreed that the "Boyne Boat" should be avoided in future dredging operations unless mitigation is first agreed with the Department.

We also discussed other potential areas of co-operation in relation to the publication of the results of the archaeological mitigation at Drogheda and the licensing of UK underwater archaeologists which we will explore with you again.

I look forward to addressing the next meeting of Harbour Masters in the New Year.

With best wishes,

Yours sincerely



Dave Fadden
Principal officer

AN ROINN COMHSHAOIL

DÍDHREACHTA AGUS

RIALTAIS AITIÚIL

DEPARTMENT OF THE

ENVIRONMENT, HERITAGE

AND LOCAL GOVERNMENT

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Mr Daniel Shine
CZAD
Dept of Communications Marine & Natural Resources
Lesson Lane
Dublin 2

18.12.03

Re: Maintenance Dredging – Archaeological Requirements

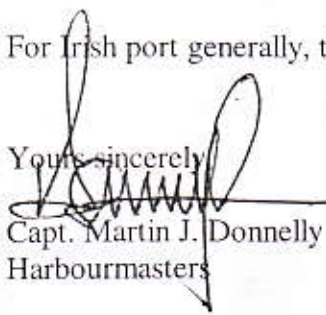
Dear Mr. Shine,

I refer to the above and now enclose herewith copy correspondence from Mr. D Fadden PO, Dept of the Environment with responsibility for archaeology.

The recognition of non archaeological requirements in respect of maintenance dredging follows serious discussions between the Irish Port Authorities (Harbourmasters technical sub-committee) supported by correspondence from the dredging industry.

For Irish port generally, this is an important step forward.

Yours sincerely,


Capt. Martin J. Donnelly
Harbourmasters

Encl;



NATURA IMPACT STATEYMENT

PROVISION OF INFORMATION FOR AN APPROPRIATE ASSESSMENT FOR A MAINTENANCE DREDGING PLAN FOR THE DROGHEDA PORT COMPANY, CO. LOUTH

Rev.	Status	Author	Reviewed By	Approved By	Issue Date
D01	Draft	AC	AC	AC	6 th Dec 2011
D02	Final	AC	AC	AC	30 th March 2012

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1 Introduction

The information in this report, required for a competent authority to undertake an “Appropriate Assessment” (or AA), has been prepared by Scott Cawley Ltd, on behalf of Drogheda Port Company (‘the applicant’). It provides information on and assesses the potential for the proposal to impact on Natura 2000 sites.

It is necessary that the proposal has regard to Article 6 of the *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora* (as amended) (hereafter referred to as the Habitats Directive). This is transposed in Ireland primarily by *S.I. No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011* (hereafter referred to as the Birds and Habitats Regulations) and by the *Planning and Development (Amendment) Act 2010*, as amended (hereafter referred to as the Planning Acts).

It is the responsibility of the competent authority, in this case the Environmental Protection Agency, to make a decision as to whether or not the proposed development is likely to have significant effects, either individually or in combination with other plans or projects, on Natura 2000 sites.

The information in this report which will assist the competent authority in undertaking an Appropriate Assessment, forms part of and should be read in conjunction with all documentation associated with the application for the proposal.

2 Methodology

2.1 Guidance on Appropriate Assessment

This Natura Impact Statement (NIS) has been prepared with regard to the following guidance documents where relevant:

- *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities*. (Department of Environment, Heritage and Local Government, 2010 revision).
- *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities*. Circular NPW 1/10 & PSSP 2/10.
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission Environment Directorate-General, 2001); hereinafter referred to as the “EC Article 6 Guidance Document”. The guidance within this document provides a non-mandatory methodology for carrying out assessments required under Article 6(3) and (4) of the Habitats Directive.
- *Managing Natura 2000 sites: The Provisions of Article 6 of the Habitat’s Directive 92/43/EEC* (EC Environment Directorate-General, 2000); hereinafter referred to as “MN2000”.
- *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC. Clarification of the Concepts of Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures, Overall Coherence*. Opinion of the European Commission, January 2007.

2.2 Stage 1: Screening

The relevant guidance documents for Appropriate Assessment set out a staged process for carrying out Appropriate Assessment, the first of which is referred to as screening. The screening stage identifies the likely impacts on Natura 2000 sites, if any, which would arise from a proposed plan or project, either alone or in combination with other plans and projects, and further considers whether these impacts are likely to be significant.

If it can be concluded during the screening exercise that there is no likelihood of significant impacts occurring on any Natura 2000 sites, as a result of the proposed development either alone or in combination with other plans and projects, then there is no requirement to proceed to subsequent stages of Appropriate Assessment.

If it is not possible to conclusively rule out significant impacts upon Natura 2000 sites, the assessment should proceed to Stage Two: Appropriate Assessment for which a NIS must be prepared.

The proposed development was screened for Appropriate Assessment and applying the precautionary principle, it was found that a likelihood of significant negative effects on Natura 2000 sites in the absence of mitigation could not be objectively ruled out.

This was on the basis that the proposed dredging activities fall within three Natura 2000 sites and therefore the likelihood of significant negative impacts arising from works occurring within these Natura 2000 sites cannot be ruled out. Furthermore, the likelihood of significant negative impacts on one additional Natura 2000 site as a result of indirect impacts, could not be ruled out.

On this basis the need for an Appropriate Assessment of the proposal has been screened in.

2.3 Stage 2: Provision of Information for an Appropriate Assessment

Once the screening stage has demonstrated that an Appropriate Assessment is required, then the current normal practice is that the proponent of the plan or project prepares and submits information necessary to undertake the Appropriate Assessment to the competent authority in the form of a NIS. The competent authority then uses this information to undertake the Appropriate Assessment and to inform its decision as to whether the plan or project may be permitted.

The Appropriate Assessment is focused on the potential impact of the proposed plan or project to impact on the conservation objectives of Natura 2000 sites, and furthermore, on whether the proposed plan or project would impact on the integrity of Natura 2000 sites. Therefore this stage involves the collection of information which is specifically relevant to determining this, including:-

- A description of the proposed plan or project (outlined in Section 3).
- The conservation objectives of the Natura 2000 sites and an understanding of current factors which either maintain or threaten those conservation objectives (included in Table 2).
- An assessment of aspects of the proposed plan or project which could negatively impact the conservation objectives of the Natura 2000 sites, both in the absence of and with mitigation measures (outlined in Tables 3).

Desktop sources of information relied upon in this NIS include the following:

- Online data available on Natura 2000 sites as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie.
- Information on water quality in the area available from www.epa.ie
- Information on the Eastern River Basin District from www.wfdireland.ie
- Information on soils, geology and hydrogeology in the area available from www.gsi.ie
- Information on the location, nature and design of the proposed development supplied by the applicant's design team.

Other key information sources¹:

- *The Status of EU Protected Habitats in Ireland – Backing Documents Volumes 1 to 3.* (National Parks & Wildlife Service, 2007)
- *The Status of Birds in Ireland: An Analysis of Conservation Concern 2008-2013* (Lynas *et al.*, 2007);
- *Eastern River Basin District Management Plan 2010*
- *Louth County Development Plan 2009 – 2015*

¹ There are no conservation management plans available for any of the Natura 2000 sites relevant to this NIS.

Guidance which has been followed in determining magnitude and significance of impacts as well as in proposing mitigation measures include:

- *Guidelines for Ecological Impact Assessment in the Britain and Ireland – Marine and Coastal* (Institute of Ecology and Environmental Assessment, 2010)
- *Guidelines for Ecological Impact Assessment in the United Kingdom* (Institute of Ecology and Environmental Assessment, 2006)
- *Environmental Construction Guidelines Series* (National Roads Authority 2005-2009)

2.4 Approach to Assessing Impacts in this Natura Impact Statement

Impact assessment requires the identification of the type and magnitude of potential impacts. In this NIS impacts are characterised according to the criteria in Table 1 as per IEEM guidance (IEEM, 2006).

Table 1 Characterisation of impacts

Parameter	Categories
Type of impact	Positive/ Negative
Magnitude of impact	'Size' or 'amount' of impact <i>e.g.</i> number of Otters likely to be displaced or total area of particular habitat to be removed.
Extent	Area over which impact occurs (may be the same as magnitude if whole habitat impacted)
Duration & Reversibility	Time over which impact is expected to last, and the capacity of the receptor to recover to its baseline state. Duration is quantified as follows (EPA, 2002): • Temporary: up to 1 year, • Short-term: from 1-7 years, • Medium-term: 7-15 years, • Long-term: 15-60 years, • Permanent: over 60 years
Timing and frequency	Timing of impacts in relation to relevant life-stages or seasons (e.g. Salmon spawning or migration periods), The frequency of an activity and hence the resulting impact should also be considered. E.g. a single person walking a dog may have limited effect on nearby waders using wetland habitat, however, many walkers on repeated occasions are likely to subject the waders to a higher level of impact.

Based on EC (2000) and IEEM *Guidelines for Ecological Impact Assessment* (IEEM, 2006), impacts are listed as significant if impacts have the potential to have a significant impact on the ecological integrity on the conservation objectives (i.e. the habitats and species for which the site is designated), or on the overall integrity of the Natura 2000 site itself.

The approach to assessing the significance of impacts in the IEEM guidelines (2006) states that the significance of an impact *"is defined as an impact (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area."* Definitions of 'integrity' and 'conservation status' are provided in the IEEM guidelines.

If an ecological feature is likely to experience a significant negative impact, the consequences of that impact will depend on the level at which the ecological feature is valued. Typically in Appropriate Assessment only features of international importance are considered as it is these features (Annex I habitats and Annex II species under the Habitats Directive and Annex I bird species under the Birds Directive) that Natura 2000 sites are designed for.

Once an impact is deemed to be significant on the basis of effects on integrity and/or conservation status, then the value of the ecological feature that will be significantly affected is used to identify the geographical scale at which the impact is significant. Impacts are not always significant at the level at which the ecological feature

has been valued and may be significant at a lower geographical frame of reference. For example, a particular impact may not be considered likely to have a negative effect on the overall integrity or conservation status of a species which is considered to be internationally important. However it may be considered that there would be an impact at the local population scale on this internationally important species. In this case the impact on an internationally important species is considered to be significant at only a local scale, rather than an international scale.

With respect to determining the geographical frame of reference for impacts on species, wherever possible, the assessment is based on quantitative assessments of population size. For example the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009) suggest that, in general, where a population of certain species of conservation concern/interest represents 1% of the national population of that species, this would qualify as an internationally important population. However, smaller populations may also still qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle. A similar approach is used for habitats by considering their geographic range and distribution.

Finally, when discussing significant impacts the likelihood of the significant impact occurring has been considered. Some impacts will be certain to occur (*e.g.* hedgerow removal), while some will be unlikely to occur (*e.g.* oil tanker overturning during operation of a road scheme leading to large oil spill). The IEEM guidelines (2006) have been followed for determining likelihood of impacts occurring. This provides the following four categories, based on the fact that the 5% confidence level is conventionally chosen as the lowest limit for acceptable statistical significance:

- Certain/near-Certain: probability estimated at 95% chance or higher.
- Probable: probability estimated 50% to 95%.
- Unlikely: probability estimated 5% to 50%.
- Extremely Unlikely: probability estimated at less than 5%.

3 Overview of Receiving Environment and the Proposed Activity

3.1 Site Description and Context

The River Boyne rises in the north midlands and exits to the sea at Mornington Co. Meath. The river flows through the towns of Kells, Trim, Navan, Slane and finally Drogheda where commercial shipping traffic use the river to serve Drogheda Port (see Figure 2 enclosed at Attachment B3 to this Dumping at Sea Permit application).

From Drogheda town to the sea at Mornington the river has been trained by means of training walls constructed around the 1850s by the then Drogheda Harbour Commissioners. This captured the main river flow with estuarine polders being created north and south of the training walls. This work had two effects in that it increased the tidal exit velocity and thereby produced a scouring effect and created a reserve of water from the estuarine polders to supplement the falling tide. The fresh water flows and tidal exit velocities from the River Boyne were further enhanced in the late 1960s by the Boyne drainage scheme of the upper reaches between Kells, Trim and Navan.

The river maintains high ebb tide exit velocities during winter fresh flows supplemented with spring tides, however these exit velocities quickly fall off at the river mouth. The high velocities experience allows the Boyne to carry a substantial quantity of sediment out to the river mouth providing a natural scour to the estuary. However, within the river this does not totally eliminate the need for maintenance dredging particularly on the berths, ship turning basins and river bends.

Furthermore the high velocities have little effect at the river mouth and maintenance dredging is required at the approaches to the port. The entrance to the port is particularly vulnerable to gales from the northeast through to the southeast which deposit mobile sediments from the shallow gradient shoreline north and south into the deeper dredged port approach navigation channel.

From the late 1960's the Drogheda Harbour Commissioners and latterly the Drogheda Port Company has carried out several detailed physical and mathematical modelling studies of the coastal cell from Clogherhead in the north to Bremore in the south and has a detailed understanding of the coastal processes and sediment transport regime (see report by Kirk McClure Morton enclosed at Attachment B1 to this Dumping at Sea Permit application). It has been established that circa 120,000m³ of sediment is moving annually from south to north, accelerated in the south east gales and spring tides.

3.2 River, Channel & Berth Description

The river under the jurisdiction of the Drogheda Port Company is approximately 7km in length from St. Mary Bridge in the town of Drogheda to the river mouth at Mornington. There are five working berths in the town which are maintained at depths of approximately -1.6mtrs Chart Datum. At low water vessels on these berths take the bottom in soft mud.

From the town at Drogheda the river narrows to the point of Donors Green. Immediately east of this point on the south side of the river is the Maxol Hydrocarbon terminal and Flogas LPG terminal who jointly share the single berth. Here the berth is maintained at -3.0mtrs Chart Datum within a dredged pocket of 100mtrs x 25mtrs. Vessels at this berth are required to remain afloat at low water.

From this location the river is wider and deeper the channel being maintained at -2.2mtrs Chart Datum over the full length of the navigation to the sea at Mornington.

The berths of Premier Periclase Ltd. are found on the north shore. Depths are maintained at - 1.0mtrs Chart Datum over the 180m quay immediately adjacent to the deeper navigation channel at -2.2mtrs Chart Datum. At low water vessels on this berth take the bottom in soft sand/gravels.

The Tom Roe's Point berths to the north side of the channel lie within a deep-water dredged pocket of a length of 210mtrs, width 25mtrs excluding side slopes, maintained to a depth of -6.0mtrs Chart Datum. This dredged pocket is essential as vessels nominated to these berths are required to remain always afloat.

To the east of this facility, 2km from the sea is the Fish Meal Quay. This berth is used primarily for local fishing vessels and the discharge of Class 1 cargoes, classified under the International Maritime Dangerous Goods Code. The berth has a depth of -2.5mtrs Chart Datum.

From the Maxol Hydrocarbon terminal the channel has been dredged to a uniform width of 50mtrs with side slopes of 1:5. At the South Point beacon the channel width increases to 60mtrs to the Carrick beacon. From this point the channel width is maintained at 50mtrs to the Bull beacon where the channel width is increased to 100mtrs with side slopes 1:10, and extends to a point 700mtrs east of Lyons Light.

There are three ship turning areas at the town quays that can accommodate vessels of lengths 90mtrs, 95mtrs and 105mtrs; and at Tom Roe's Point ships of up to 130mtrs. For locations of all berths and ship turning areas (see Figure 2 enclosed at Attachment B3 to this Dumping at Sea Permit application).

3.3 History of Maintenance Dredging in Drogheda Port

The port of Drogheda has had a long history of dredging. In the last century small timber dredgers carried out work and gradually channel depths were increased. With the passage of time the Drogheda Harbour Commissioners built steel mechanized dredgers and on occasions contracted these vessels to other adjacent ports. Dredging methods varied from suction to grab, grab being the more successful for the hard ground conditions.

The Drogheda Port Company withdrew from in-house dredging in August 1999, with the sale of its grab dredger as it was deemed more economic and efficient for the maintenance of the new port and channel to contract the maintenance dredging requirements to specialists in the field.

Full details of all maintenance dredging undertaken to date are provided in the main application for this proposal. All previous maintenance-dredged material has been disposed of at licensed sea disposal sites.

3.4 Sedimentation and Accretion of Material

Sediments within the Drogheda Port jurisdiction originate from three sources; (a) the fluvial material in suspension from the upriver flood plain, (b) sediments carried in from sea, and (c) coastal process by-pass material (*i.e.* material brought in at the mouth of the estuary as it is moving south to north).

Mud and silts are carried down in the fresh water flows and while the river is in general self cleaning, deposition of sediments takes place along the berths, ship swinging areas, river bends and in areas where the river widens and the flow exit velocities are reduced. Localized effects are attributed to propeller and bow thrusters wash and municipal discharges.

The incoming tide accounts for sediments brought in from the shallow sloping adjacent beaches to the north and south of the east Irish Sea. This material is of fine and coarse grain sands.

The approach channel is particularly susceptible to gales from the northeast through to the southeast. The sediments are agitated and the localized currents coupled with the sea and swell generated by the gales make for a very dynamic and unstable sediment transport regime. These storms also disturb the dredged channel side slopes causing slumping of the slopes and coupled with the general storm transport regime, narrow the channel and reduce the warranted depths.

Within the coastal cell from Bremore Point to Clogherhead there is a net movement of sediment from south to north. Over the years, the constructed breakwaters at Drogheda Port (1970) created a groin effect trapping much of this material. The reservoir of the breakwaters or storage capacity has now been exhausted resulting in full bypassing of material from south to north thereby affecting the port approach channel warranted depths and navigational safety. This is particularly prevalent in gales from the northeast to the southeast.

3.5 Future Maintenance Dredging Requirements

Dredging at the river mouth and approaches generally takes place twice yearly, although in some years over the previous decade there have been three annual campaigns. The dredging at this location is generally in response to weather events. The time of year for dredging is dictated by the weather and weather events. A typical campaign takes about three weeks, working each tide, twice daily, generally from three hours before the high water to about 1 hour after the highwater.

Over the previous maintenance licence periods the port has accumulated a good deal of data and experience on the performance of the river and bar and the effects of weather. This coupled with mathematical modelling see reports by Kirk McClure Morton and RPS enclosed at Attachments B1 and D6 to this Dumping at Sea Permit application). allow realistic figures of annual maintenance dredging predictions. Monitoring of the bar/river mouth and the most sensitive area of the river in dredging requirement terms is now carried out by the port internal hydrographic unit, thereby maintaining a good check on depths particularly after easterly wind storm events.

The estimated annual quantity of maintenance dredging for the commercial channel, berths & swing basins from Drogheda town quays to the sea at Mornington is 30,000m³ or 48,000tonnes, for the seaward approaches 90,000m³ or 144, 000 tonnes, with an additional annual contingency of 100,000m³ to allow for the unexpected and unplanned events that may impede the navigation channel. This contingency is to allow for the unexpected and unplanned events that may impede the navigation channel. This is to cover an unexpected weather event or where the river retaining walls that created the estuarine polders collapse (as occurred in 2000) and the material contained within a polder flows out into the main navigation channel. This can occur due to a differential in the water pressure between the retained waters in the polder and the river falling tide levels. The river walls were constructed in the 1850s and their construction and current condition leave them susceptible to the effects of ship wash and hydrodynamic action. The contingency also allows for unexpected weather events at the river mouth and seaward approaches.

A detailed breakdown of historic figures upon which this annual estimate is based on is provided in the main application. The majority of the material will come from the bar mouth and approach channel with much smaller quantities arising from the channel from the town to sea including all berths and ship turning areas.

3.6 Disposal of Dredged Materials

The OSPAR Convention has published guidelines for the management of dredged material (*Revised OSPAR Guidelines for the Management of Dredged Material, 2004*). The guidelines are designed to assist Contracting Parties in the management of dredged material in ways that will prevent and eliminate pollution in accordance with Annex II of the 1992 OSPAR Convention, and protect marine species and habitats in the OSPAR maritime area in accordance with Annex V. The OSPAR 2004 guidelines state that where physical/chemical/biological characterisation of the dredged material indicates that it is suitable, in principle, for disposal at sea, it is nonetheless important to consider the availability of beneficial uses for the material over dumping at sea.

Various alternative disposal means have been examined by the Drogheda Port Company and rejected primarily on environmental and economic grounds, as is detailed in the main application for this proposal. However following detailed investigation and in line with the requirements of condition 'R' of the existing Dumping at Sea Permit No. 387 (see Attachment A7 to this Dumping at Sea Permit application), over the past 24 months in conjunction with an aggregate company, Drogheda Port has been trialling beneficial re-use of the material from the river mouth and seaward approaches, with a proportion of this dredge material going into the construction industry. Since July 2010, 94,470m³ of material has been taken ashore as part of this beneficial re-use trial. This is only a portion of the total material dredged from the river mouth and seaward approaches, the balance going to the seaward dumpsite. The river mouth and seaward approaches dredging and beneficial re-use project trial are tied together, generally in response to weather events. If this beneficial trial was not being operated then all the material from the river mouth and seaward approaches would be destined for sea disposal. The Environmental Protection Agency has been appraised of this trial which is still on-going.

For all materials which are not destined for beneficial re-use the disposal site sought for material disposal from the town to the sea, including all berths and ship turning areas, bar mouth and port approach is Dump Site A1 as indicated on Figure 1 enclosed at Attachment E1.1 to this application. The disposal sites sought for the material from the bar mouth and approach channel, when tides and weather conditions are suitable, are the north near shore Dump Site A2 and the south near shore Dump Site A3, also indicated on Figure 1 enclosed at Attachment E1.1 to this application.

3.7 Proposed Dredging Plant

A range of dredging plant is suitable for maintenance dredging in the river Boyne. A contractor's selection of preferred plant utilization will be dependant on plant availability, location of dredging (i.e. bar, channel, berths or ship swinging areas) and unit rate. For this Maintenance Dredging application, typical plant to include for utilisation on the river Boyne estuary, berths, swing basins and bar area/approach channel are:

- **Trailer suction dredger:** This is where the dredging vessel drags a pipe on the river bed and material is sucked up into the hold of the vessel. The material settles in the hold and excess water from the suction operation is returned to the sea as the hold reaches capacity. Once the hold is full the vessel proceeds to the approved spoil dump site and discharges the material through bottom doors in her hull that open to release the hold contents. The vessel continuously passes over the area to the dredged gradually increasing the depths to the required levels.
- **Backhoe dredger:** This is a stationary dredger similar to a flat to barge with an excavator attached. The vessel is maintained in position by spud legs that anchor it to the ground and the excavator digs the area to be dredged. The material is loaded into a self-propelled barges that moors alongside the backhoe. As each area is dredged to the required depth, the spud legs are raised, the backhoe re-positions itself and the anchoring/digging process is repeated.
- **Split barge:** this is a purpose built barge for receiving dredged material from a dredging vessel such as the backhoe. Once the hold of the vessel is filled, she sails to the approved dumpsite and through bottom doors in her hull that open, releases the material.

- **Grab dredger:** This is a vessel with a grabbing crane on board and dredges using a clam shell bucket. The material is generally deposited into the vessels hold for later sea disposal via bottom doors. This is a coarse dredger method, dredging holes to create the required depth. On occasions bed levelling may be required following the dredging where the material does not naturally slump.
- **Bed levelling:** this is where a small tug or similar vessel tows a cage or plough and removes material to the required level. It is particularly useful after the work of the trailer suction dredger or backhoe to level out high spots remaining to obtain the required dredge level.
- **Plough:** Similar to the bed levelling, this is where a cage or plough is towed behind a small tug or similar vessel. The water is agitated the material being placed in suspension and then carried away by strong currents to be recovered by the trailer suction dredger some distance downstream of the plough operations where the sediments settle out. Such plant would be used where larger vessels due to the size and manoeuvring characteristics cannot operate.

3.8 Brief Description of the Other Plans/Projects Which Could Give Rise to In-combination Effects

In the *Eastern River Basin District Management Plan*, the River Boyne catchment is located within the *Baltray Water Management Unit Action (WMU)*. The objective within the programme of measures is to achieve good water status by 2027. The major threats/pressures to water quality are agriculture (80%) and wastewater (20%), while physical modifications and abstractions are separately listed as significant threats. The Drogheda Wastewater Treatment Works (WwTW) is the only WwTW in Co. Louth. The current discharge quality is moderate (secondary treatment facilities are present following upgrades in 2000-2007), and there are no proposed upgrades detailed in the ERBD. The WMU is relatively understudied and there is currently little data available on macroinvertebrate status, fish status or morphology. There are a number of industrial developments in the vicinity of Drogheda including the EPA licensed Premier Periclase facility.

3.9 Description of Designated sites in the Area

Designated sites within 1km, 5km and 15km of the proposed development site are shown in Figure 1 below and include.

- The River Boyne and River Blackwater candidate Special Area of Conservation (cSAC) 2299
- The Boyne Coast and Estuary cSAC 1957
- The Boyne Estuary Special Protection Area (SPA) 4080
- The River Boyne and River Blackwater SPA 4232
- The River Nanny and Estuary SPA 4158

A brief description of each of these sites is provided below and full details of the reasons for their designation (*i.e.* their qualifying interests), conservation status, objectives and threats are provided in Table 2. This information has been compiled from data available from www.npws.ie.

The proposed dredging activities fall within the first three of these Natura 2000 sites. The remaining Natura 2000, the River Nanny and Estuary SPA 4158, is a separate estuary and freshwater system to the Boyne river and estuary and there are no hydrological connections between them. However as the bird species for which this SPA is designated move between these two estuaries, there would be potential for indirect impacts on this SPA, if its bird populations were impacted by dredging activities while making use of the Boyne estuary. Therefore this site has additionally been screened in as requiring Appropriate Assessment.

The River Boyne and River Blackwater cSAC 2299

This site comprises the freshwater element of the River Boyne as far as the Boyne **Viaduct**. This cSAC site therefore falls mainly to the west, upstream and outside of the sections of the River Boyne in which the dredging works are proposed at the town quays. As the river is tidal in this area upstream sections of the cSAC could additionally be affected indirectly by proposed dredging works.

The cSAC has been selected for Alkaline fens [7230] and *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0], both habitats listed on Annex I of the Habitats Directive, with the latter being a priority habitat as indicated by a *.

The main areas of alkaline fen are concentrated in the vicinity of Lough Shesk, Freehan Lough and Newtown Lough which are not located in the vicinity of the sections of the River Boyne in which the proposed dredging works are proposed. Wet woodland, made up of willows and alder, fringes many stretches of the River Boyne, some of which conforms to the Annex I priority habitat type Alluvial forests [91E0]. The Boyne River Islands, a small chain of three islands which were formed by the build up of alluvial sediment in this part of the river where water movement is sluggish, are covered by dense thickets of wet willow woodland with smaller areas of wet alder woodland. There is no wet woodland along the stretch of the River Boyne within which the dredging works are proposed, which is largely estuarine and brackish/marine in nature and where the river has been highly modified over time by quay walls, estuary training walls and infill for urban development. The closest area of wet woodland habitat is at the Boyne River Islands approximately 3km west and upstream of the proposed dredging works.

A number of other semi-natural habitats of ecological interest occur within this cSAC (e.g. mature woodland strips, marsh and wet grasslands along the river banks) however these habitats are not directly relevant to Appropriate Assessment as they are not listed as qualifying interests for this cSAC.

This cSAC is also selected for three species listed on Annex II of the Habitats Directive; Atlantic Salmon *Salmo salar* (only in fresh water) [1106], River Lamprey *Lampetra fluviatilis* [1099] and Otter *Lutra lutra* [1355]. The cSAC is important for its populations of River Lamprey which is present in the lower reaches of the Boyne River and Otter can be found throughout the cSAC.

A survey of juvenile lamprey populations in the Boyne catchment was undertaken on behalf of the National Parks and Wildlife Service in the summer of 2005 (O'Connor 2006). The surveys confirmed "*that significant populations of river/brook lampreys occur throughout the River Boyne catchment*".

Otter are likely to feed and travel throughout the Boyne catchment and estuary. There is no published information available on locations of Otter holts within the estuary. However work undertaken by Scott Cawley associated with the ecological restoration of Stagrennan Polder, directly opposite Tom Roe's Point, frequently noted Otter activity on Stagrennan polder.

The River Boyne is a designated Salmonid Water under the EU Freshwater Fish Directive. It is one of Ireland's premier game fisheries and it offers a wide range of angling from fishing for spring salmon and grilse to sea trout fishing and extensive brown trout fishing. The Boyne catchment is the most important river for Atlantic Salmon on the east coast of Ireland, and the current population is said to be large and healthy (Malone O'Regan, 2006). Atlantic Salmon use the tributaries and headwaters as spawning grounds. Salmon is considered to be endangered or locally threatened elsewhere in Europe. Atlantic Salmon run the Boyne almost every month of the year. The Boyne is most important as it represents an eastern river which holds large three-sea-winter fish from 20 –30 lb. These fish generally arrive in February with smaller spring fish (10 lb) arriving in April/May. The grilse come in July, water permitting. The river gets a further run of fish in late August and this run would appear to last well after the fishing season. The salmon fishing season lasts from 1st March to 30th September.

The cSAC additionally supports many other fauna species occurring in Ireland including species listed in the Irish Red Data Book (e.g. Pine Marten, Badger, Irish Hare and Common Frog) and others offered protection under the Wildlife Acts (1976, as amended in 2000) e.g. Stoat and Red Squirrel. However these species are not directly relevant to Appropriate Assessment as they are not listed as qualifying interests for this cSAC.

The Boyne Coast and Estuary cSAC 1957

This cSAC is a coastal site which includes most of the tidal sections of the River Boyne, intertidal sand and mud flats, salt marshes, marginal grassland, and the stretch of coast from Bettystown to Termonfeckin that includes the Mornington and Baltray sand dune systems.

The Boyne River channel, which is navigable and dredged, is defined by training walls, these being breached in places. Intertidal flats occur behind the training walls on the sides of the channelled river. The sediments vary from fine muds in the sheltered areas to sandy muds or sands towards the river mouth. The linear stretches of intertidal flats to the north and south of the river mouth are mainly composed of sand. Parts of the intertidal areas are fringed by Atlantic salt marsh.

The cSAC has been selected for the following Annex I Habitats Directive habitats:

- Estuaries [1130],
- Mudflats and sandflats not covered by seawater at low tide [1140],
- *Salicornia* and other annuals colonizing mud and sand [1310],
- *Spartina* swards (*Spartinion maritimae*) [1320],
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330],
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410],
- Embryonic shifting dunes [2110],
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] and
- *Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130].

Dredging will only occur within the main navigation channel as defined by the training walls with no dredging occurring within polders in the Boyne Estuary. Therefore only one of these habitat types (Estuaries [1130]) occurs directly within the area where the dredging is proposed.

There are two sand dune systems within this cSAC, at Baltray and Mornington. These are of conservation value, despite the restricted distribution of the intact areas and the high recreational pressure to which they are subjected. A gradient from embryonic dunes to Marram dunes and then fixed dunes is shown at both systems. The embryonic dunes are particularly well-developed at Baltray where there is active accretion. The embryonic dunes grade into a narrow band of shifting Marram dunes. Some dune slacks may still occur at this cSAC. A number of scarce plants such as Viper's-bugloss (*Echium vulgare*), Adder's tongue (*Ophioglossum vulgatum*), Variegated Horsetail (*Equisetum variegatum*) and Wild Sage (*Salvia verbenaca*) have been recorded from this cSAC in the past. The last named species is of particular note as it is a Red Data Book species at its most northerly known Irish station. The cSCA supports a population of the rare snail, *Helix pisana*, in Ireland known only from the coast between counties Louth and Dublin.

The Boyne Estuary Special Protection Area SPA 4080

This SPA comprises most of the estuary of the Boyne River and part of the estuary is a Wildfowl Sanctuary. Apart from one section which is over 1 km wide, its width is mostly less than 500 m. The river channel, which is navigable and dredged, is defined by training walls, these being breached in places. Intertidal flats occur along the sides of the channelled river. The sediments vary from fine muds in the sheltered areas to sandy muds or sands towards the river mouth. The linear stretches of intertidal flats to the north and south of the river mouth are mainly composed of sand. One or more species of Eelgrass (*Zostera* spp.) occur in the estuary. Parts of the intertidal areas are fringed by salt marshes, most of which are of the Atlantic type. Common Cord-grass (*Spartina anglica*) occurs frequently on the flats and salt marshes.

The Boyne Estuary is the second most important estuary for wintering birds on the Louth-Meath coastline. It has a total of ten species with populations of national importance; Shelduck, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Knot, Sanderling, Black-tailed Godwit, Redshank and Turnstone. Of particular note is that the site supports 7% of the national population of Knot and 4% of the total for Golden Plover.

Other species which occur, some of regional or local importance, include Bar-tailed Godwit, Cormorant, Brent Goose, Wigeon, Teal, Dunlin, Curlew, Mallard, Red-breasted Merganser, Greenshank, Ringed Plover and Mute Swan. The site provides both feeding and high-tide roost areas for the birds. The estuary also attracts large numbers of gulls in winter, including Black-headed Gull, Common Gull, Herring Gull and Great Black-backed Gull.

An area of shingle at Baltray Dunes is also an important breeding site for Little Tern, with 14 pairs recorded in 1995. After 1996 successful breeding had not occurred since 1996 until recent years.² Little Tern is the rarest Irish tern species.

Of particular significance is that two of the wintering species, Golden Plover and Bar-tailed Godwit are listed on Annex I of the Birds Directive. Little Tern is also listed on Annex I of this directive.

The SPA has been designated specifically for the following species:

² This information available from www.npws.ie on Little Terns dates from 2005. Since then Little Terns have successfully bred due to the efforts of local conservation volunteers.

- [wintering] Shelduck *Tadorna tadorna*
- [wintering] Oystercatcher *Haematopus ostralegus*
- [wintering] Grey Plover *Pluvialis squatarola*
- [wintering] Lapwing *Vanellus vanellus*
- [wintering] Knot *Calidris canutus*
- [wintering] Sanderling *Calidris alba*
- [wintering] Black-tailed Godwit *Limosa limosa*
- [wintering] Redshank *Tringa totanus*
- [wintering] Turnstone *Arenaria interpres*
- [breeding] Little Tern *Sterna albifrons*
- Wetlands & Waterbirds

The River Boyne and River Blackwater SPA 4232

The River Boyne and River Blackwater SPA is a long, linear site that comprises stretches of the River Boyne and several of its tributaries; most of the site is in Co. Meath, but it extends also into Cos Cavan, Louth and Westmeath. The site includes the river channel and marginal vegetation. The site is a SPA under the E.U. Birds Directive of special conservation interest for Kingfisher.

A survey in 2010 recorded 19 pairs of Kingfisher (based on 15 probable and 4 possible territories) in the River Boyne and River Blackwater SPA. A survey conducted in 2008 recorded 20-22 Kingfisher territories within the SPA. Other species which occur within the site include Mute Swan (90), Teal (166), Mallard (219), Cormorant (36), Grey Heron (44), Moorhen (84), Snipe (32) and Sand Martin (553).

The River Nanny and Estuary SPA 4158

The site comprises the estuary of the River Nanny and sections of the shoreline to the north and south of the estuary (c. 3 km in length). The estuarine channel, which extends inland for almost 2 km, is narrow and well sheltered. Sediments are muddy in character and edged by saltmarsh and freshwater marsh/wet grassland. The saltmarsh is best developed in the eastern portion of the estuarine channel. The shoreline, which is approximately 500 m in width to the low tide mark, comprises beach and intertidal habitats. It is a well-exposed shore, with coarse sand sediments. The well-developed beaches, which are backed in places by clay cliffs, provide high tide roosts for the birds. The village of Laytown occurs at the northern side of the River Nanny estuary.

This is an important site for wintering waders, with nationally important populations of Golden Plover, Oystercatcher, Ringed Plover, Knot and Sanderling present. The populations of Knot and Sanderling are of particular note as they represent approximately 4% of their respective national totals. Black-headed Gull and Herring Gull also occur here in significant numbers. A range of other waterbirds also occurs, including Cormorant, Brent Goose, Mallard, Grey Plover, Lapwing, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Turnstone, Common Gull and Great Black-backed Gull.

The site is of most importance as a roost area for the birds but the intertidal flats also provide feeding habitat. Many of the birds also utilise the intertidal areas and beaches further to the north and south, and also the fields above the shore. Two species using the site, Golden Plover and Bar-tailed Godwit, are listed on Annex I of the Birds Directive.

This SPA is designated specifically for:

- [wintering] Oystercatcher *Haematopus ostralegus*
- [wintering] Ringed Plover *Charadrius hiaticula*
- [wintering] Knot *Calidris canutus*
- [wintering] Sanderling *Calidris alba*
- Wetlands & Waterbirds

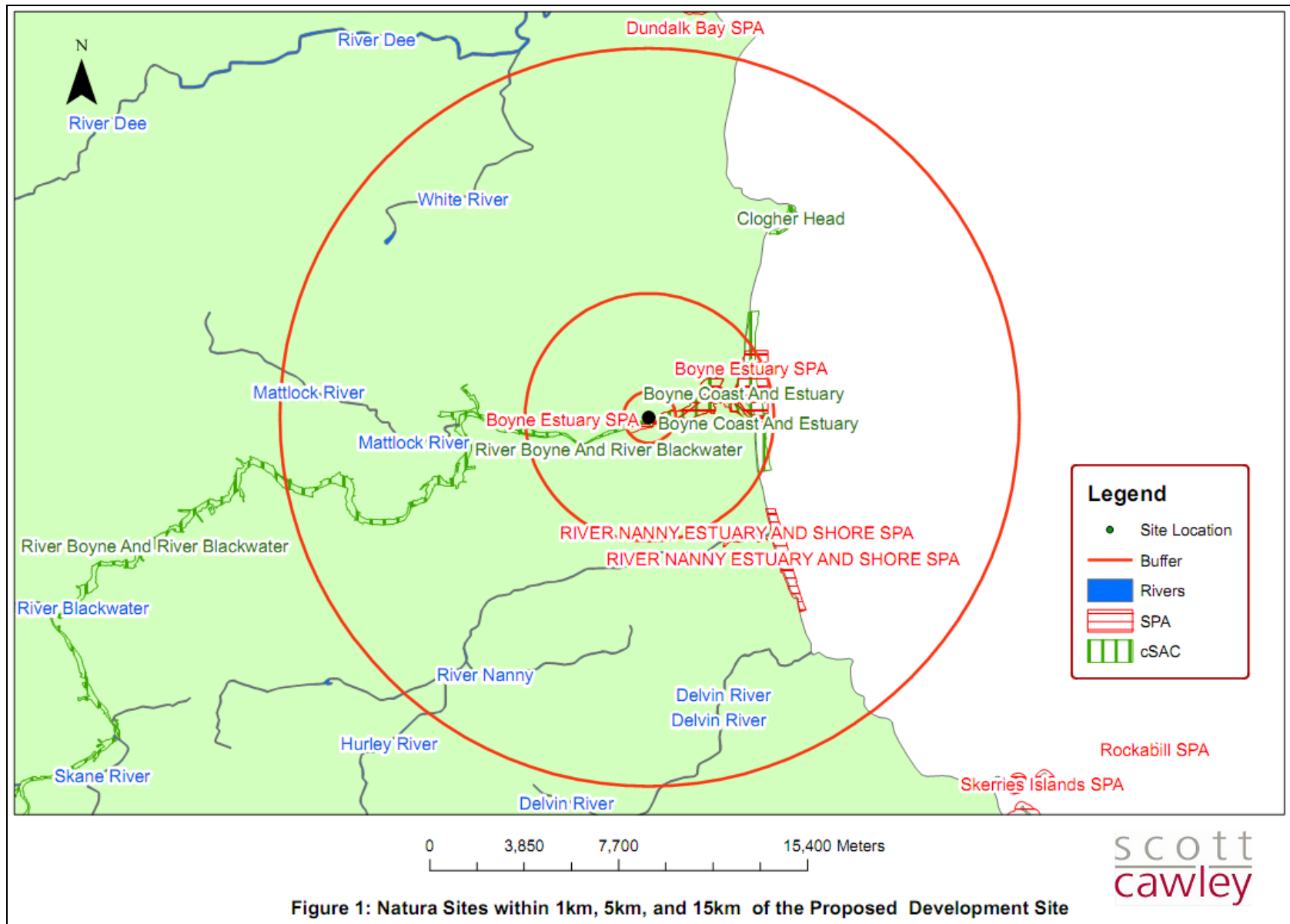


Table 2 Natura 2000 Site Qualifying Interests, Conservation Status, Conservation Management Objectives, and Threats				
candidate Special Areas of Conservation				
Site Name and Code	Qualifying Interests ³	Conservation Status ⁴	Conservation Management Objectives	Threats ⁵
River Boyne and River Blackwater cSAC 2299	<u>Habitats Directive Annex I habitats for which the site is designated:</u> - Alkaline fens [7230] *Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i>, <i>Alnion incanae</i>, <i>Salicion albae</i>) [91E0] <u>Habitats Directive Annex II species for which the sites is designated:</u> - Atlantic Salmon <i>Salmo salar</i> (only in fresh water) [1106] - River Lamprey <i>Lampetra fluviatilis</i> [1099] - Otter <i>Lutra lutra</i> [1355]	Of the two Annex I habitats, both are considered to be of 'bad' conservation status. Of the Annex II species, one is of 'bad' status, one of 'poor' status, and one of 'good' status. Habitats - Alkaline fens - Bad *Alluvial forests - Bad Species - Atlantic Salmon - Bad - River Lamprey - Good - Otter – Poor	<u>Generic Conservation Objective for the cSAC dated 18th July 2011:</u> To maintain or restore the favourable conservation condition of the Annex I habitat(s) and /or the Annex II species for which the SAC has been selected (<i>i.e.</i> the qualifying interests)	<u>Known Threats</u> - Drainage - Water pollution – including eutrophication from agriculture - Dredging
Boyne Coast and Estuary cSAC 1957	<u>Habitats Directive Annex I habitats for which the sites is designated:</u> - Estuaries [1130] - Mudflats and sandflats not covered by seawater at low tide [1140]	Of the eight Annex I habitats, two are considered to be of 'bad' conservation status, six of 'poor' status, and none of 'good' status. Habitats - Estuaries - Poor - Tidal mudflats and sandflats - Poor	<u>Generic Conservation Objective for the cSAC dated 18th July 2011:</u> To maintain or restore the favourable conservation condition of the Annex I habitat(s) and /or the Annex II species for which the SAC has been selected	<u>Known Threats</u> - Water pollution – including industrial and sewage - Dredging - Recreational pressure - Infilling

³ Specific reasons for the designation of the Natura 2000 site – information from www.npws.ie dated 18th July 2011.

⁴ The status of the relevant Annex I habitats and Annex II species has been taken from a report on *The Status of EU Protected Habitats and Species in Ireland* (NPWS 2008). Each habitat or species is given a conservation status of Good (Favourable Status) or Poor / Bad (Unfavourable status)..

⁵ Information on threats taken from NPWS Site Synopses and Natura 2000 Standard Data Forms accessed at www.npws.ie November 2011.

Table 2 Natura 2000 Site Qualifying Interests, Conservation Status, Conservation Management Objectives, and Threats				
	• <i>Salicornia</i> and other annuals colonizing mud and sand [1310] • <i>Spartina</i> swards (<i>Spartinion maritimae</i>) [1320] • Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>) [1330] • Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [1410] • Embryonic shifting dunes [2110] • Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120] • *Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	• Salicornia muds - Poor • Atlantic salt meadows - Poor • Mediterranean salt meadows - Poor • Embryonic shifting dunes - Poor • Marram dunes (white dunes) - Bad • Fixed dunes (grey dunes) - Bad	d (i.e. the qualifying interests)	
Special Protection Areas				
Site Name and Code	Special Conservation Interests ⁶	Conservation Status ⁷	Conservation Management Objectives	Threats ⁸
Boyne Estuary SPA	This SPA is designated specifically for:	Of the ten bird species, three are red listed, five are amber listed, and two are green	<u>Generic Conservation Objective for the SPA dated 18th July 2011:</u>	<u>Known Threats</u> • Water pollution – including

⁶ Specific reasons for the designation of the Natura 2000 site – information from www.npws.ie dated 18th July 2011.

⁷ The conservation status of bird populations in Ireland is taken from the following two sources:

BirdLife International (2012) Species factsheet: *Alcedo atthis*. Downloaded from <http://www.birdlife.org> on 02/04/2012.

The Status of Birds in Ireland: An Analysis of Conservation Concern 2008-2013 (Lynas *et al* 2007). Species are assigned to the red list (high conservation concern), amber list (moderate conservation concern) or green list (no conservation concern), based on a range of categories relating to breeding populations, non-breeding/wintering populations and international importance. It is important to note that some species may have entirely discrete breeding and non-breeding/wintering populations, and therefore conservation concern may apply primarily to only one of their populations.

⁸ Information on threats taken from NPWS Site Synopses and Natura 2000 Standard Data Forms accessed at www.npws.ie November 2011 as well as from <http://www.birdlife.org/datazone> accessed 11/2/2011.

Table 2 Natura 2000 Site Qualifying Interests, Conservation Status, Conservation Management Objectives, and Threats				
4080	• [wintering] Shelduck <i>Tadorna tadorna</i> • [wintering] Oystercatcher <i>Haematopus ostralegus</i> • [wintering] Grey Plover <i>Pluvialis squatarola</i> • [wintering] Lapwing <i>Vanellus vanellus</i> • [wintering] Knot <i>Calidris canutus</i> • [wintering] Sanderling <i>Calidris alba</i> • [wintering] Black-tailed Godwit <i>Limosa limosa</i> • [wintering] Redshank <i>Tringa totanus</i> • [wintering] Turnstone <i>Arenaria interpres</i> • [breeding] Little Tern <i>Sterna albifrons</i> • Wetlands & Waterbirds	listed. The Boyne Estuary SPA has been designated primarily for wintering populations. The red-list status of most species is related to their breeding populations; the only species suffering declines in its wintering populations is Knot. Little Tern is the only species with a breeding population in the SPA. • Shelduck – Amber, localised non-breeding population • Oystercatcher - Amber, localised non-breeding population • Grey Plover – Amber, localised non-breeding population • Lapwing - Red, decline in breeding population • Knot - Red, decline in population during winter season • Sanderling – Green list, no conservation concern • Black-tailed Godwit - Amber, localised non-breeding population • Redshank - Red, decline in breeding population • Turnstone – Green list, no conservation concern • Little Tern – Amber, decline in breeding population and localised breeding population	To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.	industrial and sewage • Dredging • Human disturbance • Infilling • Future port expansion <u>Known Threats (Birdlife International)</u> • Human disturbance • Nest predation (only relevant to Little Tern) • Pesticide pollution • Artificial changes in saltmarsh water levels • Habitat loss
River Boyne and River Blackwater SPA 4232	This SPA is designated specifically for: • Kingfisher <i>Alcedo atthis</i>	<u>Least Concern (current IUCN Red List category)Amber listed in Ireland.</u>	<u>To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (Kingfisher).</u>	<u>Known Threats</u> • Disturbance from riverside recreation • Loss of nest sites due to bankside interference

Table 2 Natura 2000 Site Qualifying Interests, Conservation Status, Conservation Management Objectives, and Threats				
				Loss of riparian scrub and woodland
River Nanny and Estuary SPA 4158	This SPA is designated specifically for: [wintering] Oystercatcher <i>Haematopus ostralegus</i> [wintering] Ringed Plover <i>Charadrius hiaticula</i> [wintering] Knot <i>Calidris canutus</i> [wintering] Sanderling <i>Calidris alba</i> - Wetlands & Waterbirds	Of the four bird species, one is red listed, two are amber listed, and one is green listed. The River Nanny and Estuary SPA has been designated for wintering populations. The only species suffering declines in its wintering populations is Knot. - Oystercatcher - Amber, localised non-breeding population - Ringed Plover - Amber, localised non-breeding population - Knot - Red, decline in population during winter season Sanderling – Green list, no conservation concern	<u>Generic Conservation Objective for the SPA dated 18th July 2011:</u> To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.	<u>Known Threats</u> - Recreational pressure – disturbance due to beach users (walkers & dogs) <u>Known Threats (Birdlife International)</u> - Human disturbance - Pesticide pollution - Artificial changes in saltmarsh water levels Habitat loss

4 Assessment of Potential Impacts on Natura 2000 Sites

4.1 River Boyne and River Blackwater cSAC 2299

Water Quality

The proposed dredging works have the potential to impact on surface water quality through increasing the concentration of suspended sediment in the water column within the length of the channel to be dredged. Dredging works will result in increased localised concentrations of suspended solids in the water column, however the works will take place over a short time period and will have no lasting impact on water quality. The mobilisation of contaminants is not expected at concentrations likely to cause significant impacts given that most are at typical or expected background levels within the sediment (Malone O'Regan, 2006).

There is also potential for oil or fuel spills during the operation of the dredging machinery. Although a spill event is extremely unlikely (*i.e.* probability estimated at less than 5%), should an accidental spill occur it could have significant negative impacts on water quality and therefore indirectly on fauna species for which this SAC is designated. This could have an indirect impact on the fauna species listed below.

Impact Prediction: **No significant impact from sediment disturbance.**

Extremely unlikely, medium term locally to internationally significant impact from oil or fuel spills depending on the level of impact.

Atlantic Salmon and River Lamprey

The proposed dredge site is part of a migratory route for Atlantic Salmon and River Lamprey. Both spawn in the headwaters of river catchments, and therefore are unlikely to spawn in the vicinity of the proposed dredging activities. However, as they are anadromous species, they migrate between the sea and the river to spawn and therefore at certain times of year pass through the area in which the dredging will take place.

Impacts on Salmon and lamprey are not assessed as being significant for the following reasons. Maintenance dredging at Drogheda Port is primarily trailer suction dredging. As part of an EIS prepared in 1997 for a capital dredging scheme, a comprehensive study was conducted in respect of run off from the dredging vessel (see Attachment D1 – Sediment Plume Analysis, extract from 1997 EIS, enclosed with this Dumping at Sea Permit application) which found that there is minimal release with low sediment in suspension. Often when the river is in full spate, background material levels in suspension exceeds the dredging vessels run off. Maintenance dredging is considerably less intensive than capital dredging (for which the 1997 study was conducted). Maintenance dredging is tidal, twice daily, usually commencing three hours before high water to one hour after high water, generally of three weeks duration. Campaigns are typically twice yearly depending on weather. Run-off from the dredger will only occur in the latter stages of the loading operation when the dredger's hold is almost at capacity and generally on the ebb tide. Given that the channel at the primary dredge site is 100mtrs in width (channel toe to toe, actual channel width breakwater to breakwater is considerably greater including the open sea outside of the breakwaters). A typical dredger's beam is only 12/14 metres, therefore extent of and spread of run-off is minimal considering the scale of the dredge, the dredge timing duration, site location and the duration of the run off. Given that dredging takes place in shallow water, within a defined channel, from a vessel with a draft of 3-5mtrs, where the flows are either flood or ebb, in a river that has a high fluvial material in suspension content there is minimal release with low sediment in suspension (see Sediment Plume Analysis study, extract from 1997 EIS, enclosed at Attachment D1 of this Dumping at Sea Permit application).

With regard to fishing and nursery habitats, an extensive amount of environmental assessment work has been commissioned for previous dredging projects (see also Aquatic Ecological Study, ASU, June 2006 enclosed at Attachment D3 of this Dumping at Sea Permit application). These studies demonstrated that there is minimal release of dredge material and that dredging is not expected to have any significant negative impact on protected fisheries. This information while applicable to a capital scheme where new depths were being created, can also be applied to this maintenance scheme, however, it is important to

appreciate that the impacts are considerably less by virtue of the fact that the dredging is only maintaining current depths, less concentrated in terms of activity levels and plant involved, carried out over a much shorter time scale (generally 2/3 weeks as opposed to 24/7 capital dredging methodology), mostly concentrated at the river mouth and seaward approaches.

Additionally it is known that lamprey present in rivers such as the Suir migrate through the high turbidity zones of these rivers, where suspended solids levels, especially at low water can be more than 100mg/l in concentration (Malone O'Regan, 2006). For the proposed dredging activity, turbidity is only likely to be comparable to this level in the immediate proximity of the dredging operation. During monitoring of a capital dredging scheme in 1997, levels of suspended solids in the dredging plume for most of the tidal cycle were 25mg/l or less. The likelihood is that the concentrations across the dredged plume will allow lamprey to travel through less turbid areas of the channel. Impacts on lamprey are therefore not considered to be significant.

Impact Prediction: No significant impact.

Otter

Otters are known to occur within the Boyne estuary and are likely to have breeding sites within it. However holts would not be located either within or immediately adjacent to the proposed dredging activity due to the lack of suitable habitat for holts along the river channel which is enclosed by training walls. Therefore there will be no direct significant impacts to Otter.

Given that the existing Otter population currently tolerates a high volume of shipping through the area, it is considered highly unlikely that the additional barges, which will be in operation for 2 – 3 weeks at a time on a number of occasions during the year, associated with the disposal of the dredged sediments will have any significant impact on Otter.

As it is not anticipated that there would be any significant negative impact on Salmon, it is not expected that there would be any significant indirect impact on Otter as a result of a reduction in one of their food sources.

Impact Prediction: No significant impact.

4.2 Boyne Coast and Estuary cSAC 1957

Disturbance to Habitat

The only qualifying interest habitat which will be directly impacted on is Estuaries [1130]. The proposed activity will take place entirely within this habitat type in the Boyne Estuary. The impact will not result in the loss of this habitat but will result in disturbance to it, as well as its benthic fauna communities. This habitat is already highly modified, having been subject to regular maintenance and capital dredging for many years.

Benthic fauna was surveyed within the dredging area in 2006, and all sites surveyed were characterised by low species diversity typical of upper estuarine environments. All species identified are of widespread occurrence in Irish waters.

Two biotope/community types were recorded by Aquatic Services Unit (Malone O'Regan, 2006). The more common which was recorded from most sampling stations was SS.SMu.CSaMu.AfilMysAnit (*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud), is characteristic of cohesive sandy mud off wave exposed coasts with weak tidal streams. At one sampling station the community was dominated by *Turritellidae*, and appeared to be a transitional community from SS.SMu.CSaMu.AfilMysAnit (*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud) but the low species diversity and limited abundances found at this station prevented further classification.

Changes that will occur in the benthic fauna community structure after dredging is likely to be medium-term and locally significant, as it will cause the temporary but complete removal of all communities present within the area of the proposed dredging works. The benthic community removed or damaged during the operation should begin to re-establish itself almost immediately after the cessation of the

dredging, by inward migration from adjoining areas (both upstream and downstream) and by larvae from the plankton. In addition, the dominant species present in the proposed dredge area are opportunistic species and can rapidly colonise from resident populations present in unaffected areas upstream and downstream of the site. There is evidence to verify this assessment as the survey work in 2006 determined that the benthic fauna communities present in area subject to annual maintenance dredging were similar to that located in un-dredged areas (Malone O'Regan, 2006).

Potential impacts of the loading and dumping operations on coastal processes and the sediment regime within the coastal sub-cell within which the operations are located have been examined (refer to the RPS report *Boyne Entrance Channel Dredging Impact on Sediment Cell* included as Attachment D6 to this Dumping at Sea Permit application). This study examines the issue and concludes that the quantities of materials which it is proposed to dredge and either dump or remove for beneficial re-use are sustainable in terms of the coastal processes and sediment regime. This study concluded that, in order to ensure there are no impacts on the overall coastal cell from the dredging operations, not more than an annual average quantity of 60,000m³ of dredged sand should be brought ashore for beneficial reuse. The remaining 30,000m³ of material that is required on average to be dredged from the Boyne Estuary entrance is equivalent to about 0.6mm sand depth over the active beach area which is considered to be minor and insignificant. Nonetheless, the Drogheda Port Company has given a commitment that the 30,000m³ (average) of additional material to be dredged will be retained within the coastal cell, either within the active system (dumped at Dump Sites A2 and A3, depending on operational conditions) or placed in the offshore dump site.

Impact Prediction: Medium term locally significant impact.

4.3 Boyne Estuary SPA 4080

Disturbance to birds

Little Terns are breeding on the beach at Baltray. The dredging activities will be remote from this location and will have no impact on this species.

The wintering bird populations in this SPA use the polders which are behind the training walls that define the river channel. These polders become exposed at low tide and are used for feeding and roosting by wintering bird species which the SPA is designated for. There will be no dredging activity within the polders and so there will be no direct impact on wintering birds.

Given that the waterfowl populations in the Boyne estuary currently tolerate a high volume of shipping through the SPA, it is considered highly unlikely that the additional barges, which will be in operation for 2 – 3 weeks at a time on a number of occasions during the year, associated with the disposal of the dredged sediments will have any significant impact on waterfowl populations for which the SPA is designated.

Impact Prediction: No significant impact.

4.4 River Boyne and River Blackwater SPA 4232

This SPA lies approximately 3km west of the proposed dredging area. There will be no direct impact therefore to this SPA. No ex-situ or indirect impacts are predicted in Kingfisher as the dredging activities are all located within the existing training walls and will not directly affect any habitat suitable for breeding use by Kingfisher. It is likely that Kingfisher move up and down the Boyne river and estuary but any potential disturbance to birds caused by the dredging activities will be temporary and minor with birds able to readily re-located to other undisturbed parts of the estuary.

Impact Prediction: No significant impact.

4.5 River Nanny and Estuary SPA 4158

Disturbance to birds

The wintering bird populations in this SPA move between this site and the Boyne Estuary SPA which is located approximately 6km to the north west. The River Nanny and Estuary SPA, is a separate estuary and freshwater system to the Boyne river and estuary and there are no hydrological connections between them. However as the bird species for which this SPA is designated move between these two estuaries,

there would be potential for indirect impacts on this SPA, if its bird populations were impacted by dredging activities while making use of the Boyne estuary. Therefore this site has additionally been assessed. However as it discussed above there will be no significant impacts to bird populations in the Boyne estuary and therefore there will be no indirect significant impacts to bird populations in the Nanny estuary.

Impact Prediction: No significant impact.

5 Proposed Mitigation

In order to avoid and reduce impacts on water quality the following mitigation is proposed:

- A good dredging regime prepared with due regard to recognised guidance notes for same will be employed in order to minimise the release of suspended particulate matter within the water column.
- With regard to potential oil spills during dredging operations, an emergency spill kit and oil spill containment equipment will be held on board by the dredging operator.
- Drogheda Port Company will maintain its Tier 1 pollution response unit and equipment for immediate deployment. Drogheda Port Company as part of its pollution plan has a contract call up facility for additional resources and expertise.
- Drogheda Port will carry out a five yearly sediment analysis programme, consistent with the timing of previous sediment programmes and to the guidance of the Marine Institute.
- A daily log will be maintained of the dredging and dumping locations and times.

Table 3 Summary of Impacts and Mitigation Measures					
Site Name and Code	Qualifying Interest	Potential Impact	Potential Cumulative Impacts	Proposed Mitigation	Residual Impacts
candidate Special Areas of Conservation					
River Boyne and River Blackwater cSAC 2299	• Alkaline fens [7230]	None	None	None required	No significant impacts
	• *Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>) [91E0]	None	None	None required	No significant impacts
	• Atlantic Salmon <i>Salmo salar</i> (only in fresh water) [1106]	No significant impacts but potential for extremely unlikely, medium term locally to internationally significant impact from oil or fuel spills depending on the level of impact.	There are current pressures on water quality arising from drainage and water pollution but as the impacts arising from the proposal are not significant (other than in the extremely unlikely case of a spill accident) the proposed development is not expected to have any significant cumulative impact in addition to current impacts.	The dredging regime will employ measures to minimise the release of suspended particulate matter within the water column.	No significant impacts
	• River Lamprey <i>Lampetra fluviatilis</i> [1099]			Emergency spill kit and oil spill containment equipment will be held on board by the dredging operator.	
	• Otter <i>Lutra lutra</i> [1355]			The Drogheda Port Company will ensure there is pollution response capability and will implement an emergency response plan in the event of an incident.	
Boyne Coast and Estuary cSAC 1957	Estuaries [1130]	Medium term locally significant impact and potential for	There are current pressures on water quality arising from water pollution,	None possible.	No significant impacts

Table 3 Summary of Impacts and Mitigation Measures					
Site Name and Code	Qualifying Interest	Potential Impact	Potential Cumulative Impacts	Proposed Mitigation	Residual Impacts
		extremely unlikely, medium term locally to internationally significant impact from oil or fuel spills depending on the level of impact.	recreational pressure and infilling. The cumulative impacts arising from the proposed dredging activity in addition to other existing impacts is not expected to be any more severe than the predicted medium term locally significant impact.		
	• Mudflats and sandflats not covered by seawater at low tide [1140] • <i>Salicornia</i> and other annuals colonizing mud and sand [1310] • <i>Spartina</i> swards (<i>Spartinion maritima</i>) [1320] • Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>) [1330] • Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [1410]	None	None	None required	No significant impacts
	• Embryonic shifting dunes [2110] • Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120] • *Fixed coastal dunes with	None	None	N/A	N/A

Table 3 Summary of Impacts and Mitigation Measures					
Site Name and Code	Qualifying Interest	Potential Impact	Potential Cumulative Impacts	Proposed Mitigation	Residual Impacts
	herbaceous vegetation (grey dunes) [2130]				
Special Protection Areas					
Boyne Estuary SPA 4080	• [wintering] Shelduck • [wintering] Oystercatcher • [wintering] Grey Plover • [wintering] Lapwing • [wintering] Knot • [wintering] Sanderling • [wintering] Black-tailed Godwit • [wintering] Redshank • [wintering] Turnstone	None	None	None required	No significant impacts
	• [breeding] Little Tern	None	None	None required	No significant impacts
	• Wetlands & Waterbirds	None	None	None required	No significant impacts
River Boyne and River Blackwater SPA 4232	• Kingfisher	None	None	None required	No significant impacts
River Nanny and Estuary SPA 4158	• [wintering] Oystercatcher • [wintering] Ringed Plover • [wintering] Knot • [wintering] Sanderling	None	None	None required	No significant impacts
	• Wetlands & Waterbirds	None	None	N/A	N/A

6 Conclusions of Assessment Process

As confirmed in the checklist in Table 4 below, all of the potential impacts identified will be avoided with the correct implementation of the proposed mitigation measures. As there are no significant residual negative impacts on any of the conservation objectives of any Natura 2000 sites, it is concluded that the proposals will not have a significant negative impact on any Natura 2000 site.

Table 4 Integrity of Site in Relation to Residual Impacts

Does the project have the potential to:	Yes or No	Details
cause delays in progress towards achieving the conservation objectives of the site?	No	No significant residual negative impacts
interrupt progress towards achieving the conservation objectives of the site?	No	No significant residual negative impacts
disrupt those factors that help to maintain the favourable conditions of the site?	No	No significant residual negative impacts
interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No	No significant residual negative impacts
cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No	No significant residual negative impacts
change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	No significant residual negative impacts
interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	No significant residual negative impacts
reduce the area of key habitats?	No	No significant residual negative impacts
reduce the population of key species?	No	No significant residual negative impacts
change the balance between key species?	No	No significant residual negative impacts
reduce diversity of the site?	No	No significant residual negative impacts
result in disturbance that could affect population size or density or the balance between key species?	No	No significant residual negative impacts
result in fragmentation?	No	No significant residual negative impacts
result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No	No significant residual negative impacts

Due to the location of the proposed dredging activities within Natura 2000 sites in the Boyne estuary, and close to other Natura 2000 sites, it is necessary that the proposal be subject to an Appropriate Assessment of the potential for impacts upon these sites.

This report has been prepared for the purpose of providing the competent authority with adequate information to undertake the Appropriate Assessment.

As a result of the appropriate design of the proposed activities and the proposed mitigation measures, this report concludes that the proposed development will have no significant residual impacts on the integrity of the Natura 2000 sites.

7 References

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Drogheda Port Company

**Boyne Entrance Channel Dredging
Impact on Sediment Cell**

February 2012



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Drogheda Port Company

Boyne Entrance Channel Dredging Impact on Sediment Cell

February 2012

DOCUMENT ISSUE

Client	Drogheda Port Company					
Project Title	Boyne Entrance Channel Dredging – Impact on Sediment Cell					
Document Title	Study Report					
Document No.	IBE0676/AKB/Drogheda/Feb12					
This Document Comprises	DCS	TOC	Text	Figures		
	x	x	x	x		

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
0	Draft	AKB	s	AKB	Belfast	16/02/2012
1	Draft Final	AKB	CR	AKB	Belfast	23/02/2012
2	Final	AKB	CR	AKB	Belfast	07/03/2012

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1.0 Introduction

The entrance to Drogheda Port is located on a shallow shoaling coastline and is subject to rapid siltation from easterly and south easterly gales. Drogheda Port Company, the port authority and regulator of safe navigation to and from Drogheda Port, dredges the entrance channel to the Boyne Estuary to maintain safe access for shipping to and from Drogheda Port particularly following an easterly gale event. Although the quantities of dredging vary from year to year, the average over an eleven year period was about 90,000 m³ per annum of sand from the entrance channel. Historically the port has disposed of the material to an offshore dump site located about 2.5 nautical miles north east of the entrance to the Boyne where the water depth is greater than about 14m.

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

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

2.0 Data Sources

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

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

- Hydraulic Studies of the Dredging of the Boyne Entrance and Bar by Kirk McClure Morton 2001⁽¹⁾ and 2002⁽²⁾.
- Beach Restoration at Laytown/Bettystown studies by RPS Kirk McClure Morton 2005⁽³⁾.
- Hydraulic and Coastal Engineering study by DHI, 2008⁽⁴⁾ (unpublished).
- Morphodynamic modelling of the Irish Sea, Project report by MarCon Computations International Ltd, 2008⁽⁵⁾.

3.0 Analysis

3.1 Transport from the offshore dump site

The assessment of the movement of dredged material from the offshore dump site area which is centred at 6° 10.5'W, 53° 44.5'N, was simulated by computing the sediment transport rates for every 3 hours through a typical year. The wave climate at the site was established by modelling the transformation of the 3 hourly offshore data set to the site using RPS Mike21 SW wave model and the tidal currents were extracted from the RPS Irish Coastal tidal and surge model. The extent of the wave and tidal models is shown in Figure1.

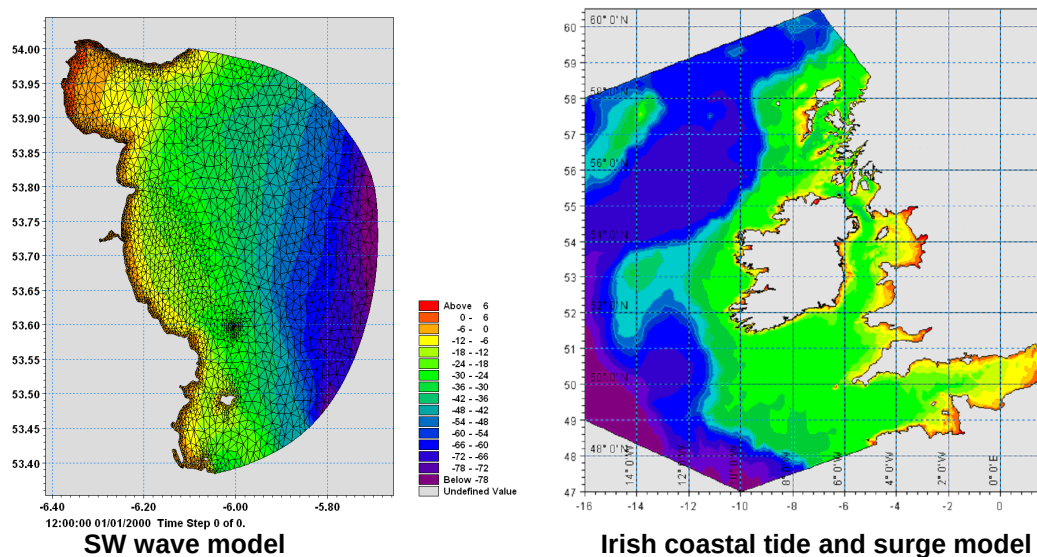


Figure 1 Extent of wave and tidal models used for dump site analysis

The results of the sediment transport simulations for the offshore dump site showed that sediment would only move at the site during significant storm events when the larger waves with the longer wave periods could disturb the seabed sediment at this location. However the amount of dredged material which would be moved towards the beaches by these events was very small and generally less than about 500 m³/annum. The analysis was also checked against the bed load transport results shown in the MarCon 3D morphodynamic modelling of the Irish Sea⁽⁵⁾. Although the size of the grid spacing in this model is rather large (2km x 1.6km) compared to the Mike21 models, the results of the bed load transportation are of the same order of magnitude with transport rates of about 1,500m³ per annum in the area around the offshore dump site. Thus it is concluded that only about 1% of the dredged material dumped on the offshore dumpsite is likely to find its way back onto beaches of Counties Louth or Meath.

3.2 Net sediment transport into the sediment sub cell at the Boyne

3.2.1 Sediment distribution

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

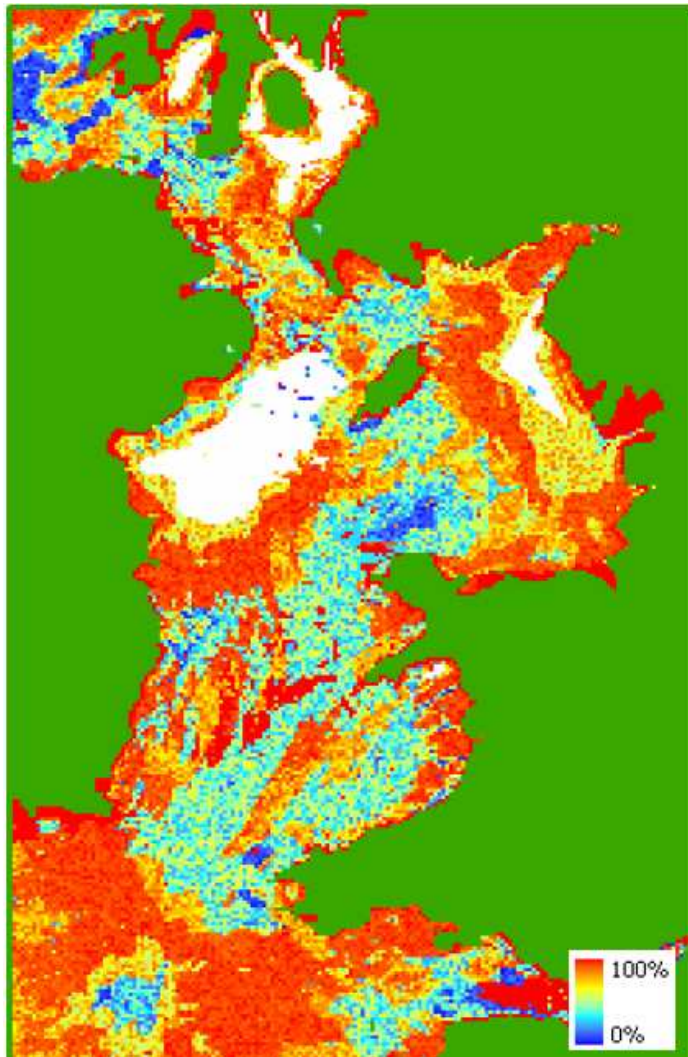


Figure 2 **Distribution of non cohesive sediments in the Irish Sea**
(taken from Figure 9 of Morphodynamic Modelling of Irish Sea⁽⁵⁾)

3.2.2 Net sediment movement

The net sediment drift around the coastal sub cell which includes the entrance to the Boyne runs north west to north along the coast from Skerries to Clogher Head. Thus the main source of sediment supply to the coastal cell comes from the south past Skerries and to seaward of Bremore Point. A Hydraulic and Coastal Engineering report by DHI, estimated the annual net drift quantities along the coast as shown in Figure 3 below (taken from Figure 5-27 of the report). It will be seen that these net rates are in the region of 30,000 m³ at Bremore Point to 90,000 m³ at the entrance to the Boyne.



Figure 3 Estimated annual net sediment drift rates.⁴⁾

The net annual drift rates calculated were based on the synthesizing of seven years of wave data applied to a single coastal profile with tidal data based on Howth. The KMM reports give the same general movement of sediment but with somewhat higher rates as they had a more extensive time series of events and used a variation in profiles along the coast. The rates derived during the KMM studies^{(1) (2)} have been calibrated against the dredging records for the Boyne entrance. The 2002 KMM report showed that there was a total of about 350,000 m³ of sediment moving both north and south across the entrance to the Boyne with more going north than coming south. Comparison of the drift rates between the various reports suggests that the rates in the DHI Coastal Engineering report are low. The DHI report also notes that there is some uncertainty about their estimated drift rates past Bremore Point due to the two dimensional nature of the drift in this area.

The 3 dimensional morphological modelling of the Irish Sea undertaken as part of the Interreg IMAGIN study ⁽⁵⁾ shows a similar north westerly movement of bed sediment into the Co Meath and Louth coastal areas around the Boyne. The morphodynamic modelling considered two formulations for the bed sediment transport, one based on the Bagnold formula and the other based on the formula of Meyer-Peter and Mueller. The predicted transport vectors for an average month are shown for the two formulations in Figures 4 and 5.

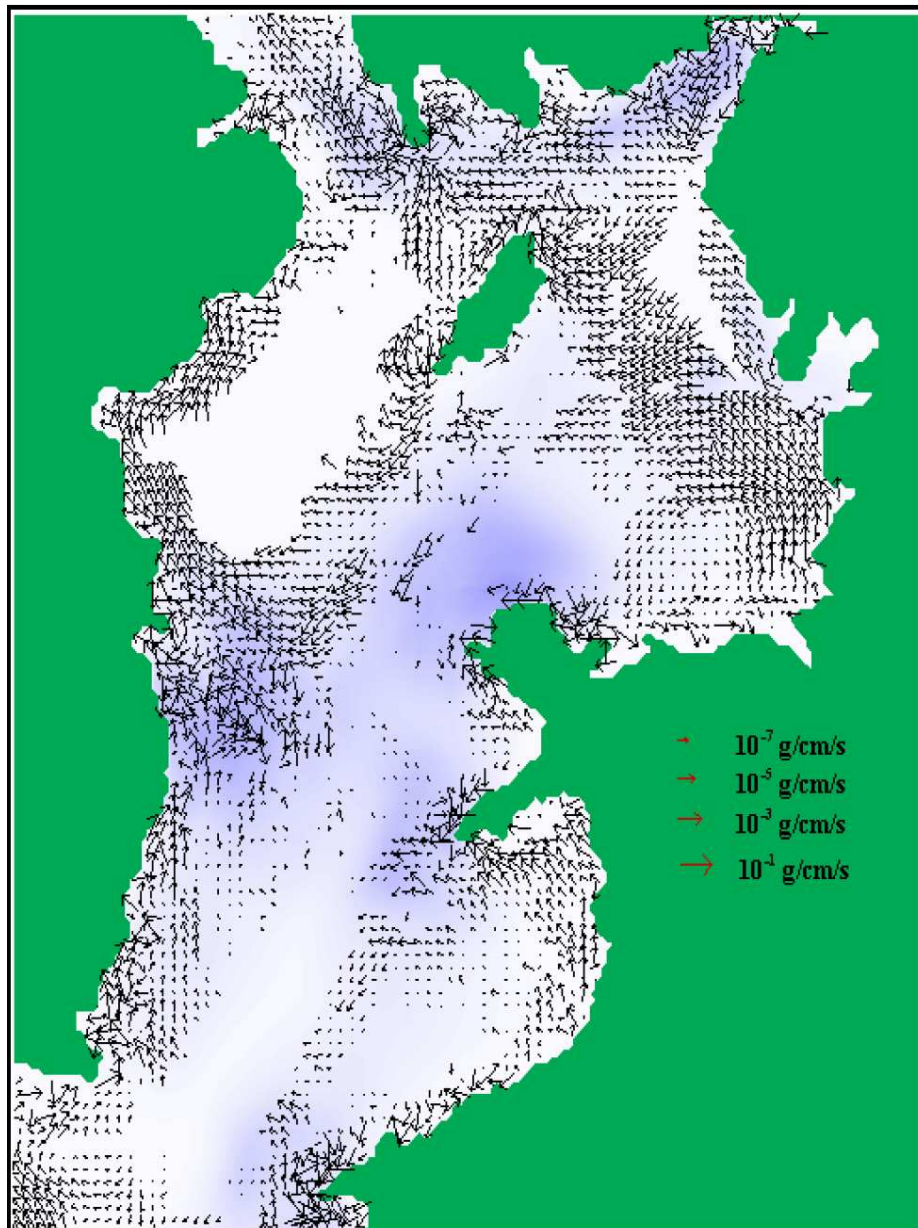


Figure 4 Predicted average monthly bed-load transport vectors (after Bagnold) from MarCon study⁽⁵⁾

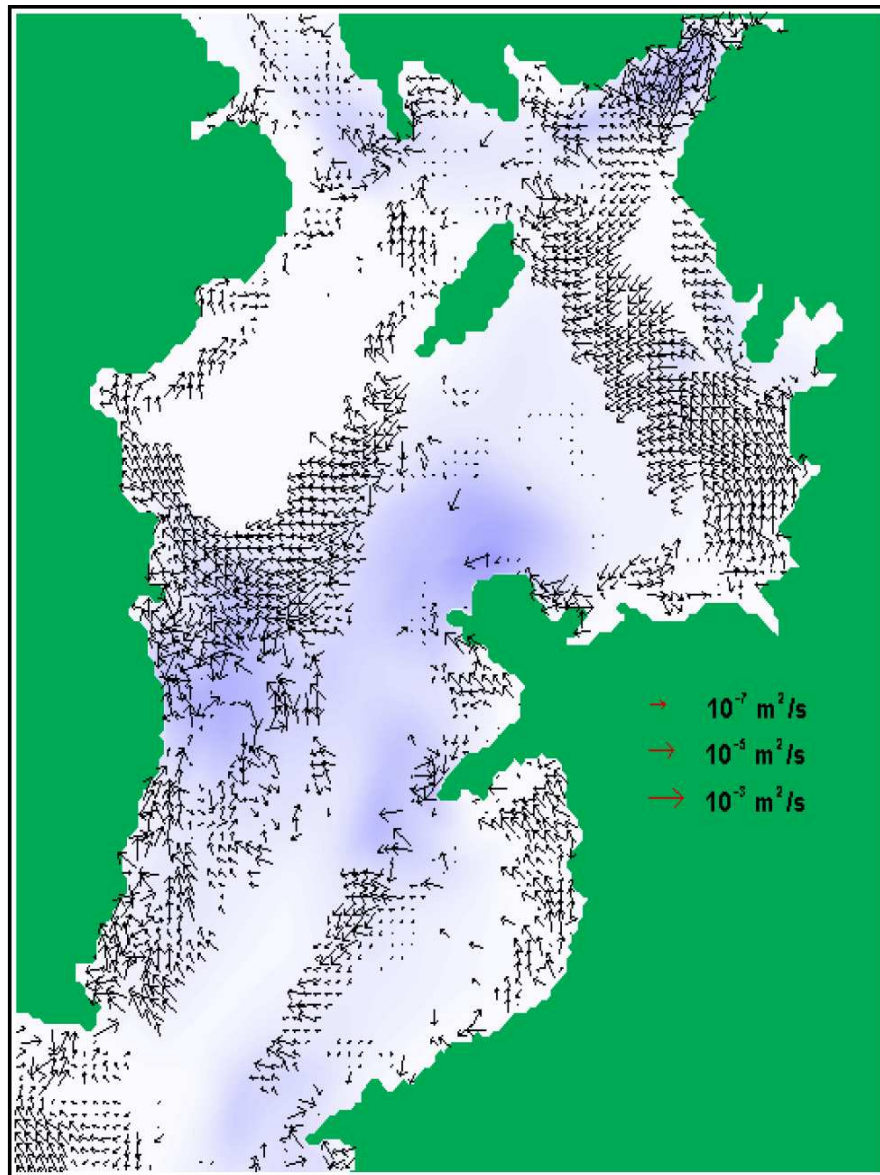


**Figure 5 Predicted average monthly bed-load transport vectors
(after Mayer-Peter & Mueller) from MarCon study⁽⁵⁾**

Output from the two methodologies cannot be directly compared as the bed load transport is expressed in different units in the two formulas. However it will be seen from the diagrams that there is a similar direction of transport into the Boyne Estuary area with both formulations.

The vector results for an average month have been used to calculate the net sediment transport into the Boyne coastal sub cell. As expected the two different formulations yield somewhat different average annual transport rates but the average of the two values at 60,000 m³ per annum is in line with the drift rates from other studies and is in accord with the overall sediment transport mass balance for the area.

4.0 Conclusions

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

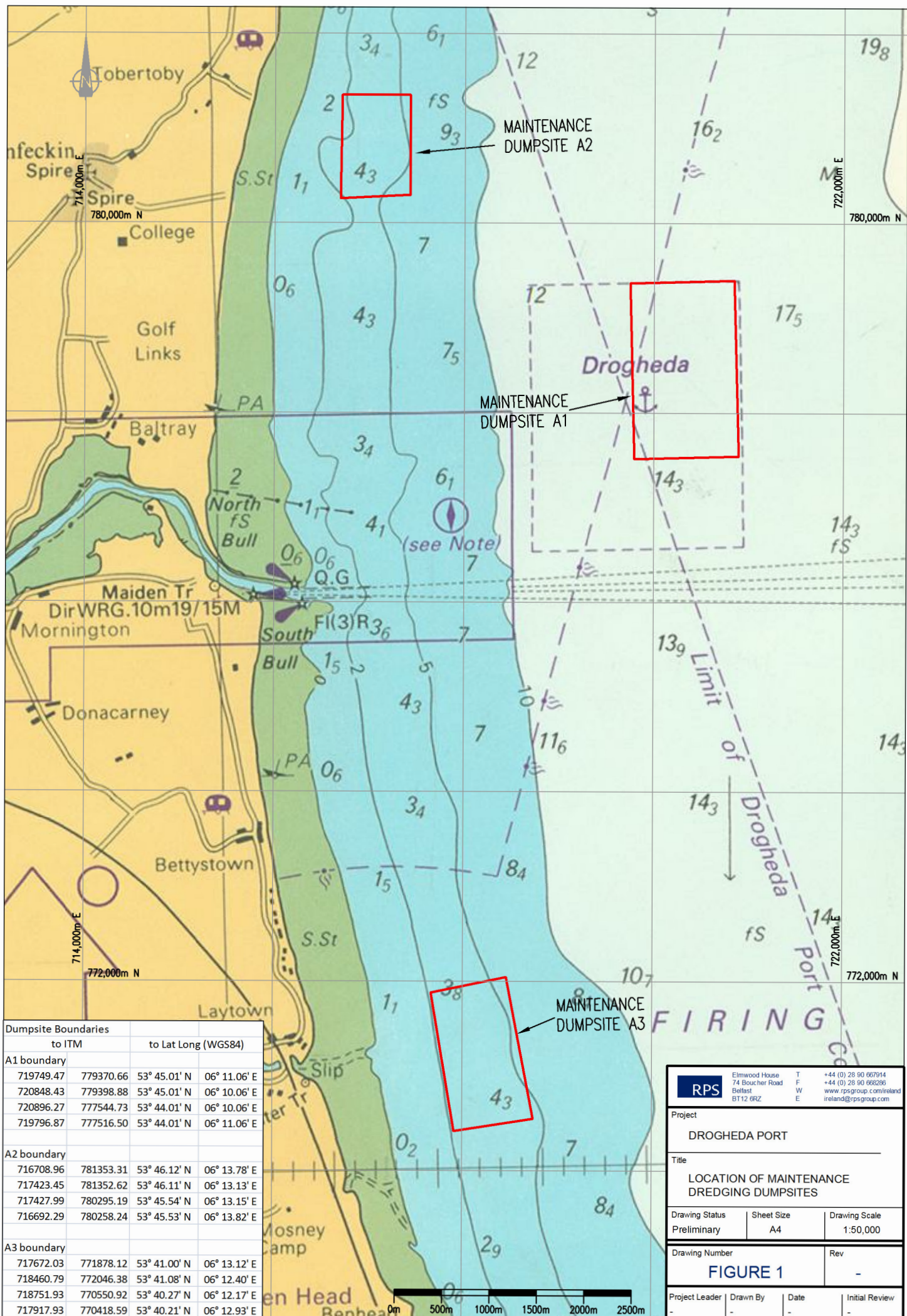
The sediment movement into and around the coastal sub cell at the Boyne entrance has been studied in various reports. The most recent report on the hydraulic and coastal engineering by DHI indicated a net north going sediment bypass of 30,000m³ at Bremore Point. However the drift rates in this report had been calibrated against a drift rate across the Boyne entrance given in a study by KMM in 1994 which was subsequently found to be too low by a factor of about 2.

The analysis of the results of the modelling undertaken for the IMAGIN project indicates a net annual bed sediment transport into the Co Meath and Co Louth beach system from the south east of 60,000m³ per year. This figure is consistent with the historical dredging practices and the changes observed on the beaches around the entrance to the Boyne Estuary.

On the basis of the information available at the time of this study it is concluded that, in order to ensure there are no impacts on the overall coastal cell from the dredging operations, not more than an annual average quantity of 60,000m³ of dredged sand should be brought ashore for beneficial reuse. The remaining 30,000 m³ of material that is required on average to be dredged from the Boyne Estuary entrance is only equivalent to about 0.6mm sand depth over the active beach area. Nevertheless, the 30,000m³ (average) of additional material to be dredged should be retained within the coastal cell, either within the active system (dumped at the northern or southern dump sites) subject to weather and tidal restrictions or placed in the offshore dump site.

5.0 References

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- 5) MarCon Computations International Ltd, *Morphodynamic Modelling in the Irish Sea – Project Report*, March 2008



Dumpsite Boundaries			
to ITM		to Lat Long (WGS84)	
A1 boundary			
719749.47	779370.66	53° 45.01' N	06° 11.06' E
720848.43	779398.88	53° 45.01' N	06° 10.06' E
720896.27	777544.73	53° 44.01' N	06° 10.06' E
719796.87	777516.50	53° 44.01' N	06° 11.06' E
A2 boundary			
716708.96	781353.31	53° 46.12' N	06° 13.78' E
717423.45	781352.62	53° 46.11' N	06° 13.13' E
717427.99	780295.19	53° 45.54' N	06° 13.15' E
716692.29	780258.24	53° 45.53' N	06° 13.82' E
A3 boundary			
717672.03	771878.12	53° 41.00' N	06° 13.12' E
718460.79	772046.38	53° 41.08' N	06° 12.40' E
718751.93	770550.92	53° 40.27' N	06° 12.17' E
717917.93	770418.59	53° 40.21' N	06° 12.93' E

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Project

DROGHEDA PORT

Title

LOCATION OF MAINTENANCE DREDGING DUMPSITES

Drawing Status

Preliminary

Sheet Size

A4

Drawing Scale

1:50,000

Drawing Number

FIGURE 1

Rev

-

Project Leader

-

Drawn By

-

Date

-

Initial Review

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