



Rampion Offshore Wind Farm



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SCOPING OPINION

Proposed Rampion Offshore Wind Farm

October 2010



independent impartial inclusive

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Executive Summary

This is the Infrastructure Planning Commission's (the Commission's) Scoping Opinion (the Opinion) in respect of the content of the environmental statement for the proposed Rampion Offshore Wind Farm in the English Channel off the Sussex coast south of the city of Brighton and Hove.

This report sets out the Commission's Opinion on the basis of the information provided in E.ON Climate and Renewables UK Rampion Offshore Wind Ltd's (EC&R) report entitled 'Rampion Offshore Wind Farm – Scoping Report (September 2010) (the Scoping Report)'. The Opinion can only reflect the proposals as currently described by the applicant.

The Commission has consulted on the Scoping Report and the responses received have been taken into account in adopting this Opinion. The Commission is satisfied that the topics identified in the Scoping Report encompass those aspects of the environment identified in Schedule 4, Parts 1 and 2 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009.

The Commission draws attention both to the general points and those made in respect of each of the specialist topics in this opinion.

The main potential issues identified offshore are:

- sediment impacts – including changes to the sediment regime and resultant impacts on ecology and fish;
- ecological impacts – including disturbance, displacement and collision risk for birdlife; disturbance and displacement of marine mammals; effects of electro-magnetic fields on sensitive fish and loss or change to seabed habitats;
- construction noise impacts - leading to disturbance to fish and marine mammals;
- visual impact of the wind farm and its effect on the area's seascape; and
- socio-economic impacts – including severance and displacement of fishing and recreational areas.

The main potential issues identified onshore are:

- landscape impacts – including the visual impact of the proposed substation and temporary loss of vegetation from cable landing and laying;
- ecological impacts – including habitat loss or fragmentation due to the cable route corridor or the substation, species loss and possible pollution impact from the construction phase;
- noise impacts – including construction, traffic and possible substation noise;
- air quality impacts chiefly associated with the emission of dust from construction activities; and

- socio-economic impacts – opportunities for employment during the construction period; effects on tourism.

Matters are not scoped out unless specifically addressed and justified by the applicant and confirmed as being scoped out by the Commission.

INTRODUCTION

Background

- 1.1 On 13 September 2010, the Commission received a Scoping Report submitted by E.ON Climate and Renewables UK Rampion Offshore Wind Ltd (the applicant) under Regulation 8 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (SI 2263) (the EIA Regs) in order to request a scoping opinion for the proposed Rampion Offshore Wind Farm in the English Channel off the Sussex coast south of Brighton and Hove. This Opinion is made in response to this request and should be read in conjunction with the Scoping Report.
- 1.2 The EIA Regs enable an applicant, before making an application for an order granting development consent, to ask the Commission to state in writing its formal opinion (a 'scoping opinion') on the information to be provided in an environmental statement (ES).
- 1.3 The proposals fall within Schedule 2 development under the EIA Regulations as being a wind farm (Schedule 2, paragraph 3(i)). An EIA is not mandatory for Schedule 2 development but depends, amongst other matters, upon the sensitivity of the receiving environment, the likelihood of significant environmental effects and the scale of the proposals.
- 1.4 In submitting the information included in their request for a scoping opinion, the applicant is deemed to have notified the Commission under Regulation 6(1)(b) of the EIA Regs that it proposes to provide an ES in respect of the proposed Rampion Offshore Wind Farm. Therefore the proposed development is determined to be EIA development in accordance with Regulation 4 of the EIA Regs.
- 1.5 Before adopting a scoping opinion the Commission (or the relevant authority) must take into account:
 - 'the specific characteristics of the particular development;
 - the specific characteristics of the development of the type concerned;
 - the environmental features likely to be affected by the development'.

(EIA Regs 8 (9))
- 1.6 This Opinion sets out what information the Commission considers should be included in the ES for the proposed offshore wind farm. The Opinion has taken account of:
 - i the EIA Regs;

- ii the nature and scale of the proposed development;
 - iii the nature of the receiving environment; and
 - iv current best practice in the preparation of environmental statements.
- 1.7 The Commission has also taken account of the responses received from the statutory consultees. It has carefully considered the matters addressed by the applicant and has used professional judgement and experience in order to come to this Opinion. It should be noted that when it comes to consider the ES the Commission will take account of relevant legislation and guidelines. The Commission will not be precluded from requiring additional information if it is considered necessary in connection with the ES submitted with that application when considering the application for a development consent order (DCO).
- 1.8 This opinion should not be construed as implying that the Commission agrees with the information or comments provided by the applicant in their request for an opinion from the Commission. In particular, comments from the Commission in this Opinion are without prejudice to any decision taken by the Commission on submission of the application that any development identified by the applicant is necessarily to be treated as part of a nationally significant infrastructure project or associated development, or development that does not require development consent.
- 1.9 Regulation 8(3) of the EIA Regs states that a request for a scoping opinion must include:
 - i. a plan sufficient to identify the land;
 - ii. a brief description of the nature and purpose of the development and of its possible effects on the environment;
 - iii. such other information or representations as the person making the request may wish to provide or make.
- 1.10 The Commission considers that this has been provided in the applicant's Scoping Report.

Commission's Consultation

- 1.11 The Commission has a duty under Regulation 8(6) of the EIA Regs to consult widely before adopting a scoping opinion. A full list of the consultation bodies is given at Appendix 1. The list of respondents, with copies of those comments is given at Appendix 2, to which reference should be made.
- 1.12 The ES submitted by the applicant must also demonstrate consideration of points raised by the statutory consultees. It is recommended that a table is provided in the ES summarising the

scoping responses from the statutory consultees and how they are considered in the ES.

- 1.13 Any subsequent consultation responses, received after the statutory deadline for receipt of comments, will be forwarded to the applicant and should be given due consideration by the applicant in carrying out the EIA.

Structure of the Document

- 1.14 This document is structured as follows:

Section 2 The Proposed Development;

Section 3 EIA Approach and Topic Areas;

Section 4 Other Information;

Appendix 1 Consultation Bodies;

Appendix 2 Respondents to Consultation and Copies of Replies;

Appendix 3 Presentation of the Environmental Statement.

2.0 THE PROPOSED DEVELOPMENT

Applicant's Information

- 2.1 The following is a summary of the information on the site and surroundings prepared by the applicant in the Scoping Report. The Commission has not verified this information.

Background

- 2.2 The Scoping Report provides an overview of the proposed Rampion Offshore Wind Farm (ROWF) project which comprises an offshore development of wind turbines and substations, inter-array and export cables and associated onshore developments.
- 2.3 The proposed development forms Zone 6 (out of nine zones identified) in the Crown Estate's third round of offshore wind farm leasing.
- 2.4 The zone is located in the English Channel off the south coast and extends from approximately 13km to 25km offshore. The proposed area is approximately 28km in an east-west direction; 10km in a north-south direction. The nearest coastal settlements are Brighton, Newhaven, Shoreham-by-Sea, Littlehampton and Worthing.
- 2.5 The proposed project has a generating capacity of 665 MW and comprises:
- offshore wind turbines;
 - offshore substations;
 - turbine and substation support structures and foundations;
 - inter-array cables;
 - offshore export cables;
 - landfall locations (west of Brighton and Hove);
 - cable vaults;
 - transmission cables defined in a cable corridor; and
 - onshore substation.

The Proposed Offshore Development

- 2.6 The proposed ROWF will cover an area of approximately 271km² and, depending upon the size of the turbines, consist of between 95 (with 7MW turbines) and 185 (with 3.6MW turbines) wind turbines. The precise location and spacing of these turbines has yet to be decided.
- 2.7 Monopile, multi-pile/jacket, gravity base and suction caisson system foundations are being considered. More than one of these foundation types may be deployed across the proposed wind farm site.

- 2.8 There are likely to be two offshore substations which are needed to transform the electricity to a higher voltage before it is transmitted to the shore via the export cables. These substations are likely to have either monopile or multi-pile jacket foundations.
- 2.9 Scour protection around the bases of the turbine and substation foundations may be required to ensure the structural integrity of the installations. No detail of this protection has been provided in the Scoping Report.
- 2.10 Inter-array and export cables will be required to transmit the electricity. Installation of these cables is likely to be carried out by cable ploughing, jetting or trenching techniques. 'Directly laid' techniques may also be considered for the inter-array cables in deeper, more difficult terrain areas.
- 2.11 An offshore export cable route corridor has been identified. However, the exact route will be determined through consideration of environmental sensitivities and seabed conditions.

The Proposed Onshore Development

- 2.12 The onshore infrastructure for the proposed ROWF development comprises cables, cable vaults and a substation as listed above.
- 2.13 The applicant has identified a range of locations west of Brighton and Hove for the offshore cable landfall. Construction will be carried out using either trenching or directional drilling techniques. Jointing between the export cables and the onshore cables will be in cable vaults on the landward side of the sea defences. The Scoping Report states that typically each cable vault will be a large underground concrete structure housing the cables, fibre optics and earthing equipment. There are likely to be four cable vaults, each having two surface manholes.
- 2.14 The present preference is to route the onshore cables underground. An indicative cable route area for the underground onshore cables from the cable vaults to the proposed substation site has been identified by the applicant. The cable construction corridor is likely to be no wider than 40m, and may be narrower at sensitive points, although a wider corridor may be needed at some locations to facilitate construction.
- 2.15 In addition, temporary construction laydown areas will be required along the route.
- 2.16 The proposed substation will be located on land near to the existing National Grid 400kV substation at Bolney. The area required for this substation is likely to be up to two hectares which will be taken up with transmission equipment, buildings containing switchgear and controls and amenities for visiting service engineers.

The Surrounding Area – Offshore

- 2.17 The proposed development is located in the eastern English Channel in an area of relatively shallow water (depths between 11m and 50m) and gentle seabed slopes. The tidal range is approximately 5.0m for spring tides and 2.5m for neap tides. Mean significant wave heights range from 0.9m to 1.26m with the prevailing wave direction coming from the south-west.
- 2.18 The seabed in the proposed development area is mainly composed of sands and gravels which overlay consolidated sands and clays. Layers of peat and basal gravels are also present in some areas. Sediments in the area comprise relatively mobile fine grains and static, coarse-grained lag deposits.
- 2.19 Within the proposed development area, the subtidal zone is characterised by the presence of chalk reefs and cliffs. In the UK, subtidal (and intertidal) chalk is a priority habitat under the Biodiversity Action Plan (BAP). Additionally the offshore chalk cliffs off Sussex are regarded as regionally important for their geomorphological interest and have been proposed in the past as potential marine sites of nature conservation importance.
- 2.20 There are no statutory designated wildlife sites within the offshore area proposed for the wind farm.
- 2.21 The proposed wind farm area supports a wide variety of fish and shellfish species. Spawning grounds for whiting, plaice, lemon sole, Dover sole, sandeel and sprat and nursery grounds for whiting, plaice, lemon sole, Dover sole and sandeel are located within or near to the proposed ROWF development. The inshore area may be important for bass which is significant for commercial and recreational fishing. Migratory fish, such as sea trout, eel and shad, may also pass through the area but it is not thought to be a critical habitat for these species.
- 2.22 The area of the proposed development is also important for shellfish and crustacean being a spawning and nursery area for lobster, edible crab, whelk and other species.
- 2.23 Bottlenose dolphins are the most frequently recorded cetacean within the potential development area with some recording of harbour porpoise, short beaked dolphin, long-finned pilot whales, Risso's dolphin and very occasional sightings of other cetaceans. Grey seal and common seal have also been recorded infrequently in the area, although neither species breed or haul-out in the region.
- 2.24 The English Channel coastline supports a range of breeding, wintering and passage seabirds including species on the International Union for Conservation of Nature (IUCN) Red List of threatened species and the

UK BAP species list. The following species are considered to be of principal potential concern in relation to the proposed development:

- terns (common, little, Sandwich and roseate);
- fulmar;
- gannet;
- auk;
- divers (red-throated and black-throated);
- swan (Bewick's swan);
- geese (dark-bellied brent goose);
- ducks (red-breasted merganser);
- gulls (Mediterranean, common, black-headed, lesser black-backed, herring, greater black-backed and kittiwake); and
- waders (bar-tailed godwit, golden plover and grey plover, and lapwing).

- 2.25 There are 60 charted wrecks within the proposed development area although none of the sites have been investigated in sufficient detail to establish their importance.
- 2.26 The proposed wind farm site has relatively little merchant shipping traffic due to the fact that the main shipping routes do not cross the site. However, fishing vessel activity is relatively high and recreational cruising routes pass through the area. There are numerous marinas and clubs along the south coast.
- 2.27 There are no military practice and exercise areas within the proposed wind farm area. There is some potential for the turbines to interfere with radar, communications systems and navigational aids for aircraft, however, as the site is close to zones identified by NATS (En Route) plc (NERL) as vulnerable to such interference.
- 2.28 There is one marine aggregate 'pre-application' area (application by Hanson Aggregates) located within the area of the proposed wind farm. There are also other aggregate extraction licensed areas close to the western edge of the area.
- 2.29 There are a number of sub-sea cables in the vicinity of the proposed development area. In particular, a cable known as 'UK-France 3' runs along the eastern boundary of the area and two redundant British Telecom cables pass directly through the site.

The Surrounding Area - Onshore

- 2.30 The indicative onshore cable corridor crosses two former landfill sites – Brooklands Park, which is now a recreational area incorporating a golf course and boating lake, and Meadow Road, which is now fenced off. Both sites were formerly used to deposit domestic refuse.

- 2.31 Part of the proposed cable corridor in the vicinity of the coast is designated by the Environment Agency as being Flood Zone 3 (high risk of tidal flooding). The rest of the corridor is within Flood Zone 1, a zone of low flood probability (less than 1 in 1000 in any year). The proposed route includes a number of river crossings, the largest being the River Adur.
- 2.32 There are two Sites of Special Scientific Interest (SSSIs) within the planned cable corridor (Adur Estuary and Beeding Hill to Newtimber Hill). There are also five Local Nature Reserves within this area which are: Lancing Ring, Mill Hill, Widewater Lagoon, Shoreham Beach and Tottington Wood. Additionally, there is a Royal Society for the Protection of Birds (RSPB) reserve (Adur Estuary); a Sussex Wildlife Trust (SWT) nature reserve (Woods Mill); a number of Sites of Nature Conservation Importance (SNCIs) and several notable trees and ancient woodland sites within the proposed corridor.
- 2.33 The potential onshore cable corridor is in an area known to be within the distribution range of the Bechstein's bat and the Barbastelle bat. These two species are amongst the rarest in the UK, appearing in Annex II of the Habitats Directive.
- 2.34 There are nine scheduled monuments, seven Grade II* listed buildings and 189 Grade II listed buildings within the proposed cable corridor. There are also numerous heritage assets within the corridor ranging in period from Palaeolithic to modern and in importance from 'high' to 'negligible'.
- 2.35 The proposed cable corridor area crosses the South Downs National Park for approximately 7.5km and the South Downs Way National Trail. There are two National Trust sites within the proposed cable corridor.

Construction

- 2.36 The construction of ROWF will be phased and is likely to take three to four years. Construction of the onshore works is likely to commence before the offshore construction programme begins.
- 2.37 The design life of the turbines and other components of the wind farm is likely to be in the order of 20 to 25 years although the Crown Estate lease for the Rampion site is for 50 years. Therefore, it is possible that some refurbishment or replanting of the turbines may occur. If this proves to be the case additional relevant licences and consents will be applied for at the time.

Operation

- 2.38 Once commissioned, the wind farm will operate automatically. It is expected that maintenance for the offshore wind farm will be via personnel transfer vehicles. The maintenance strategy will address

scheduled and unscheduled maintenance. The onshore substation will be unmanned although there will be regular service visits.

Decommissioning

- 2.39 The lease for the project with the Crown Estates will run for 50 years. It is a condition of the lease that the wind farm will be decommissioned. It is likely this would comprise the reverse of the construction process with some exceptions relating to the foundations and cables. Onshore the substation may continue to be used. If it was decommissioned all equipment and buildings above ground level would be removed.

Commission's Comment

Description of the Development

- 2.40 The applicant should ensure that the description of the proposed development that is being applied for is as accurate and firm as possible as this will form the basis for the environmental assessment.
- 2.41 In line with best practice and case law, the proposed development will need to be defined in sufficient detail in the ES to enable a robust assessment of the adverse and positive impacts to be undertaken.
- 2.42 The Commission recommends that the ES should include a clear description of all aspects of the proposed development, at the construction, operation and decommissioning stages, and include:
- Land use requirements;
 - Site preparation;
 - Construction processes and methods;
 - Transport routes;
 - Operational requirements including the main characteristics of the production process and the nature and quantity of materials used, as well as waste arisings and their disposal;
 - Maintenance activities including any potential environmental or navigation impacts; and
 - Emissions (water, air and soil pollution, noise, vibration, light, heat, radiation etc).
- 2.43 Any proposed works and/or infrastructure required as associated development, or off-site as an ancillary matter, should be considered as part of an integrated approach to environmental assessment.
- 2.44 The ES must contain and set out an outline of the main alternatives studied by the applicant and provide an indication of the main reason for the applicant's choice, taking account of the environmental effects (Schedule 4, Part 1, paragraph 18). The reasons for the preferred

choice should be made clear and the comparative environmental effects identified in the ES.

- 2.45 The applicant should make every effort in the ES to assess the potential impacts of the proposed development including any known parameters (during construction, operation and decommissioning). If a plan is included in the ES showing the location of the proposed development then this should show: the wind farm array, including the number and location of the turbines; the position of inter-array cables and off-shore sub-stations; the site of landfall; the route of underground cabling and the location of on-shore substation(s).

Flexibility

- 2.46 The Commission accepts that wind farm operators are unlikely to know precisely which turbines will be procured for the site at the time of the scoping opinion request. It is acknowledged that at the time of application, whilst it may be necessary for design parameters to be sufficient to allow for minor variations in the scheme design, such parameters should not be so great that any variations would effectively constitute a material departure from the scheme design assessed in the EIA or result in a different assessment outcome.
- 2.47 The Rochdale envelope principle (see *R v Rochdale MBC ex parte Tew* (1999) and *R v Rochdale MBC ex parte Milne* (2000)) is an accepted way of dealing with such uncertainty. The applicant should consider narrowing the proposed range of between 95 and 185 possible turbine numbers suggested in their Scoping Report to enable the EIA to be carried out on as precisely a defined scheme as possible. The EIA should assess a maximum adverse scenario (the 'worst case') in environmental terms. The applicant should in any event explain clearly in the ES which elements of the scheme have yet to be finalised and provide the reasons.
- 2.48 The Commission does not consider it appropriate as part of this Opinion to address the wording and content of a proposed draft DCO, since these are matters for applicants, but does draw the attention of the applicant to CLG and the Commission's published guidance and advice on the preparation of a draft DCO and accompanying application documents. The environmental statement should support the application as described.
- 2.49 The Scoping Report provides little detail on the dimensions of the turbines which may be used at ROWF. The Landscape, Seascape and Visual section explains that it has been assumed initially that the hub height is 80m and the overall tip height is 133m, but without reference to which turbine (3.6MW or 7MW) this refers. Thus it is not possible to determine the maximum hub height, the maximum rotor diameter or the upper blade tip height of the turbines which could be used.

- 2.50 Whilst the Commission acknowledges that there may be some level of uncertainty in the description of the proposed development in the ES, the applicant must provide reasoned justification for this and fully describe all possible scenarios and parameters, any resulting potential impacts and any proposed mitigation measures. The maximum and other dimensions of the proposed development should be clearly described in the ES, with appropriate justification.

- 2.51 The ES should be able to confirm that any changes to the development within the proposed parameters would not result in significant impacts not previously identified. It will also be important to consider choice of materials, colour and the form of the structure and buildings. Lighting proposals should also be described.

- 2.52 The Commission notes that the process of EIA is iterative and therefore the proposals may change and evolve. For example, there may be changes to the scheme design in response to consultation. Such changes should be addressed in the ES. Once submitted, the application should not change in any substantive manner as the Commission is not able to entertain material changes to the project once the application is submitted.

- 2.53 It should be noted that if the proposed development changes substantially during the EIA process, prior to application submission, then the applicant may wish to consider the need to request a new scoping opinion.

Micro-siting

- 2.54 It is acknowledged that the application, if accepted, should be sufficiently flexible to allow for any necessary micro-siting of elements of the proposed wind farm during its construction. This allows for unforeseen events such as the discovery of previously unknown marine archaeology that it would be preferable to leave in situ.

- 2.55 The need to accommodate eventualities by micro-siting is understood. The assessment should reflect the implications of any micro-siting as far as reasonably possible. The Commission would suggest, though, that any such limited tolerances should not be taken as an opportunity to build unnecessary uncertainties into the proposal. Therefore, in order to fully assess the environmental impact of the proposed development the ES should provide a detailed description of its design and form, including the type and design of the turbine foundations.

Marine issues

- 2.56 Water depth, bathymetry and geological conditions are all important considerations for the selection of sites and will affect the design of the foundations of the turbines, the layout of turbines within the site and the siting of the cables that will export the electricity.

- 2.57 The Commission notes that it will be important to be clear about refurbishment or replanting and whether there is likely to be any relocation of sub-sea infrastructure or alteration of the wind farm layout.
- 2.58 Whilst the technical suitability of the foundation design is not in itself a matter for the Commission, it will need to be satisfied that the foundations will not have an unacceptable adverse impact on marine biodiversity, physical environment and marine cultural heritage. The applicant should provide the necessary details to allow the assessment of such impacts. Further, the details of the scour protection to be used on each of the foundation types should be detailed.
- 2.59 The ES should consider the network of protected Marine Conservation Zones (MCZ), under the Marine and Coastal Access Act 2009, in English and Welsh waters that are being identified through both the English and Welsh MCZ Projects. The ES should recognise that MCZ's will be in place before the proposed construction of this proposed development and provide more detail with regard to new designations such as the MCZ taking into account the significance of these designations.

Decommissioning

- 2.60 In terms of decommissioning, the Commission acknowledges that the further into the future any assessment is made, the less reliance may be placed on the outcome. However, the purpose of such a long term assessment is to enable the decommissioning of the works to be taken into account in the design and use of materials such that structures can be taken down with the minimum of disruption. The process and methods of decommissioning should be considered and options presented in the ES. The Commission encourages consideration of such matters in the ES.
- 2.61 The Commission draws the attention of the applicant to the comments from Trinity House (see Appendix 2) regarding the marine navigational marking, not only during the construction and operational phases, but also as part of decommissioning.

Grid connection

- 2.62 The connection of a proposed offshore wind farm into the relevant electricity network is an important consideration. Therefore, the Commission welcomes the inclusion within the proposed DCO application of the export cable to shore, the onshore cabling and the related substation as part of the overall project so that all the effects can be assessed.
- 2.63 The Scoping Report does not describe any overhead transmission cables as part of the proposed application, in the event that the

applicant's preference to underground the cables changes, the applicant's attention is drawn to the comments of the Commission in paragraph 2.53 above.

3.0 EIA APPROACH AND TOPIC AREAS

General Comments on the Scoping Study

Content of the Environmental Statement

- 3.1 The Scoping Report gives an overview of the EIA process that will be used in the ES (section 4). This is welcomed. Information is provided as to how the evaluation of significance will be addressed and the way in which mitigation measures will be applied. It is made clear that definitions of significance will be provided for each environmental topic and that the ES will consider the construction, operational and decommissioning phases of the proposals (section 4.5).
- 3.2 The Commission agrees that the assessment should consider all phases of the proposals – construction, operation and decommissioning. Therefore it is considered important to consider the provision of a decommissioning programme and to consider its potential impacts.
- 3.3 Within the specialist topic sections there is not always specific mention of the separate phases, although this may be considered explicit in the general introductory comments. For the avoidance of doubt, the Commission recommends that construction, operation and decommissioning should be addressed in all the EIA topic areas.
- 3.4 Mitigation is clearly considered in terms of avoidance, reduction, compensation and remediation (section 4.6). Again this approach is welcomed.
- 3.5 Cumulative, secondary and indirect impacts are also addressed (section 4.7) although the Commission draws attention to the commentary at Appendix 3 of this scoping opinion and in particular the terminology regarding cumulative and combined impacts, which suggests a preferred approach to be adopted. The Commission suggests that a clear terminology should be applied such that impacts resulting from a number of impacts on one receptor can be addressed in the ES and that these are clearly differentiated from any impacts associated with other proposals in the area.
- 3.6 Combined impacts should refer to multiple impacts on the same receptor. These occur where a number of separate impacts, such as noise and air quality, affect a single receptor, for example people. The inter-relationship between specialist topics is a requirement of the Regulations. The ES should not be a series of separate reports collated into one document, but rather a comprehensive assessment drawing

together the environmental impacts of the proposed development as a whole.

- 3.7 The Commission considers that details should be provided as to how interactions will be assessed in order to address the environmental impacts of the proposal as a whole. This is particularly important in considering the combined impacts arising from any permutations to the scheme proposals.
- 3.8 Cumulative and combined impacts should be considered for the both the onshore and offshore elements of the proposed development. Cumulative impacts should consider the proposed development within the baseline context of the site and surroundings and with any other major development in the vicinity.
- 3.9 It is indicated that cumulative impacts onshore will take account of planning applications in the area (section 4.7). The Commission recommends that other major development in the area should be taken into account on the basis of major developments that are:
 - built and operational;
 - under construction;
 - permitted application(s), but not yet implemented;
 - submitted application(s) not yet determined, and if permitted would affect the proposed development in the scoping study; and
 - identified in the Development Plan (and emerging Development Plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.
- 3.10 The consultation with the relevant local authorities is welcomed.
- 3.11 The Commission advises that whilst detailed information may not always be available for every aspect of such proposals, that nevertheless these proposals should be addressed in the assessment with an explanation provided as to the limitations in terms of the assessment.
- 3.12 The applicant should note the recommendation made by the EA to use the guidance on the assessment of cumulative impacts on the historic environment from onshore renewable energy (2008) by Collaborative Offshore Wind Research into the Environment (COWRIE).
- 3.13 An outline of the structure of the ES is provided at section 7 of the Scoping Report. The Commission notes that the ES should be a stand alone document and should include all appendices as well as any plans, photographs or photomontages.

- 3.14 The Commission recommends that the 'Project Description' should include an explanation of the proposed construction programme and methods, including any impacts on the beach and foreshore. The methodology should use up-to-date regulations and guidance to undertake the assessment and the methods used should be agreed with the relevant consultees. Where this is not possible, a reasoned justification should be given in the ES.
- 3.15 The Commission recommends that the physical scope of the study areas should be identified under all the environmental topics and should be sufficiently robust in order to undertake the assessment. The extent of the study areas should be on the basis of recognised professional guidance, whenever such guidance is available. The study areas should also be agreed with the relevant consultees and, where this is not possible, this should be stated clearly in the ES and a reasoned justification given. With regard to the proposed substation at Bolney, the Commission draws the applicant's attention to the need to provide a robust physical scoping area. Very little information is provided in the Scoping Report regarding the onshore substation other than its location is stated to be 'near to' the existing National grid 400kV substation and that the 'overall site footprint is expected to be within two hectares'. There is no information as to how the substation will be connected to the national grid, nor on the type of equipment to be used. This should be addressed in the ES in order to ensure that the impacts can be fully assessed. In addition, care will be needed to identify the physical scope of the area to be considered in order to ensure all the potential significant impacts are addressed.
- 3.16 The Commission recommends that the baseline data should be comprehensive, relevant and up-to-date. In a number of instances reference is made in the Scoping Report to designations or policy that has been revoked or replaced. In other examples, more recent baseline information is available and should be used. The timing and scope of all proposed surveys should be agreed with the relevant statutory bodies.
- 3.17 Any proposed mitigation should be discussed and agreed with the appropriate consultees. Only mitigation measures which are a firm commitment or are likely should be identified in the ES and taken into account as part of the assessment.
- 3.18 Care should be taken in the preparation of the ES to ensure that all publications referred to within the technical reports are cited in the summary reference section of the ES. Additional publication sources have been suggested by a number of those consulted by the Commission and the applicant should use this advice.

Matters to be Scoped Out

- 3.19 Matters are not scoped out unless specifically addressed and justified by the applicant and confirmed as being scoped out by the Commission.
- 3.20 The applicant has proposed that the following matters are to be 'scoped out'. The text below is the justification provided by the applicant at this stage:

Offshore matters proposed by applicant to be scoped out

- marine disposal areas – as the nearest site for marine disposal is some 12 km from the proposed wind farm area;
- marine archaeology during operation – as no activities having the potential to significantly disturb or damage archaeological resources are anticipated to take place during operation of the project; and
- hydrodynamic cumulative impact assessment from other offshore wind farms – as the closest known offshore renewable energy project is 'West Isle of Wight' (located 74km west of the zone).

Onshore matters proposed by the applicant to be scoped out

- agriculture and soils during operation – as no activities with potential to significantly effect agriculture and soils are anticipated to take place during operation of the project;
- archaeology during operation – as no activities with potential to significantly disturb or damage archaeological resources are anticipated to take place during operation of the project;
- traffic during operation – as no activities with potential to significantly effect local traffic movements are anticipated to take place during operation of the project;
- recreation during operation – as no activities with potential to significantly effect recreation are anticipated to take place during the operation of the project;
- air quality during operation – as no activities with the potential to significantly effect air quality are anticipated to take place during the operation of the project;
- socio-economic impacts – although there may be some small benefit for the local economy, particularly the utilising of local service industries and the requirement for accommodation for the workforce, the small workforce involved and the temporary nature of the work is not expected to result in significant effects on the socio-economics of the area during the construction or operation of the project; and
- emf from the proposed substation – as the layout of the proposed substation, and distances between equipment and the site boundary, will be such that it fully complies with national

guidelines designed to limit EMF levels both for occupational exposure for workers within the site and at the external boundary fence.

- 3.21 The Commission does not agree with these issues to be ‘scoped out’. With regard to most of the issues described, the Commission is not satisfied that sufficient evidence has been advanced at this stage to justify their being scoped out.
- 3.22 The Commission agrees that the following issues only may be scoped out:
- Onshore – soils during operation;
 - Onshore – archaeology during operation;
 - Onshore – air quality during operation.

Alternatives

- 3.23 Although reference is made to alternatives in the Scoping Request (paragraph 4.8) little information is provided. The Commission advises that an outline of the main alternatives considered for the proposed development should be provided both in terms of the onshore and offshore elements.

Presentation

- 3.24 The applicant’s attention is drawn to Appendix 3 regarding the presentation of the environmental statement.

Topic Areas

General Comments

- 3.25 The EIA Regulations Schedule 4, Parts 1 and 2, set out the information for inclusion in an ES.
- 3.26 Schedule 4 Part 1 of the EIA Regulations sets out the aspects of the environment likely to be significantly affected by the development which should include *‘in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors’* (paragraph 19).
- 3.27 Traffic and transport is not specified as a topic for assessment under Schedule 4; although in line with good practice the Commission considers it is an important consideration *per se*, as well as being the source of further impacts in terms of air quality and noise and vibration. The Commission acknowledges the applicants consider transport at 5.10: Navigation and Shipping and 6.10: Transport of the Scoping Report. The Commission makes further comments on these under the

topic headings below but notes that the impacts should be assessed during construction, operation and decommissioning.

- 3.28 Part 2 sets out the minimum requirements and is included below for reference:

Schedule 4 Part 2

- a description of the development comprising information on the site, design and size of the development;
- a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects;
- the data required to identify and assess the main effects which the development is likely to have on the environment;
- an outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects;
- a non-technical summary of the information provided [*under the four paragraphs above*].

- 3.29 The scoping study has considered the environment under the following topics:

Offshore

- bathymetry, geology and hydrodynamics;
- benthos and sediment quality;
- fish and shellfish ecology;
- nature conservation;
- marine mammals;
- marine ornithology;
- landscape, seascape and visual;
- marine archaeology;
- navigation and shipping;
- civil and military aviation;
- socio-economics;
- commercial fisheries; and
- other marine uses.

Onshore

- agriculture and soils;
- air quality;
- ground conditions and water resources;
- ecology and nature conservation;
- archaeology and cultural heritage;
- landscape and visual impact;
- noise and vibration;
- recreation;

- transport; and
 - electric and magnetic fields.
- 3.30 The Commission is satisfied that the topics as identified above in Sections 4 and 5 of the Scoping Report encompass those matters identified in Schedule 4, Part 1, paragraph 19 of the EIA Regulations. However, attention is drawn to the importance of also considering the inter-relationship between these factors i.e. the combined impacts (see Appendix 3 for further information).
- 3.31 The Commission recommends that an assessment of the environmental effects associated with the generation and elimination of waste be added as a topic to the ES in accordance with Schedule 4, Part 1, paragraph 20 of the EIA Regs. This assessment should clarify the environmental effects of all wastes to be processed and removed from the site and identify impacts associated with relevant traffic movements and routes.
- 3.32 Each of the specialist topics listed in paragraph 3.29 above is considered in turn below. It should be noted that the general points made above and elsewhere in this opinion are not repeated under each of the specialist topics. However the applicant should ensure that such issues are addressed fully before the ES is submitted to the Commission. Consideration should be given to the scoping responses, copies of which are provided in Appendix 2.
- 3.33 The Commission also notes that certain topics identified in paragraph 3.29 above do not fall discretely into on and offshore elements, for example noise, socio-economics and landscape and visual. The Commission considers that the applicant will need to consider how best to assess these topics areas such that the impacts can be clearly understood.
- 3.34 It is also evident to the Commission that work on certain topic areas is at a much more advanced stage than on others. Within the ES, the Commission suggests that it would be appropriate to consider the amount of detail within the topic areas and this should relate to the significance and number of potential impacts.

Offshore

Bathymetry, geology and hydrodynamics (Section 5.2 of the Scoping Report)

- 3.35 The Commission would wish to be assured in the ES that the surveys are up to date. Evidence should be provided to demonstrate whether previous data can be relied upon, and if so on what basis. The Commission considers that great care should be taken to ensure the assessment is undertaken against a consistent baseline. Where baseline surveys are not consistent this should be explained.

- 3.36 The Commission refers the applicant to the comments from the MMO regarding the need to include a detailed assessment of any impacts to sediment transport and in particular to any impacts on the coastline as well as very careful assessment of scour and sediment transport pathway effects.
- 3.37 The Commission refers the applicant to the comments from Southern Water (see Appendix 2) and both to the need to protect marine infrastructure and to ensure no adverse effects on the dispersal of effluent.
- 3.38 The Commission notes the reference to scoping out hydrodynamic cumulative impact assessment from other offshore wind farms, the applicant relies on research undertaken by CEFAS. No evidence has been provided, without which the Commission cannot agree to this matter being scoped out. The Commission suggests that consultation should take place with the relevant bodies to ascertain the details and the assessment proceed on the basis of that advice.
- 3.39 The Commission advises that reference should be made to the comments and advice from English Heritage regarding the offshore element of the investigations used to inform the ES (see Appendix 2).

Benthos and sediment quality (Section 5.3 of the Scoping Report)

- 3.40 The Commission refers the applicant to the comments from MMO relating to methodology and data sources and survey techniques.
- 3.41 The Commission refers the applicant to the detailed comments from Natural England and the need to consider, in particular, the chalk reefs. This is acknowledged in the Scoping Report, together with the need to consider an appropriate assessment.
- 3.42 The Commission draws attention to the potential impacts on the coast and foreshore which should be assessed.

Fish and shellfish ecology (Section 5.4 of the Scoping Report)

- 3.43 The Commission notes the reference to potential noise and vibration impacts on fish and shellfish (paragraph 5.4.2 of the Scoping Report) although noise and vibration is not listed as a specialist topic to be addressed as part of the offshore element of the assessment. The Commission agrees with the need to consider noise and vibration impacts but it is unclear in the Scoping Report how this will be addressed. This should be clarified. The Commission notes generally that it is important for the ES not to be a series of separate reports.
- 3.44 The Commission recommends that the ES should address fully the needs of protecting and enhancing biodiversity. The assessment should cover habitats, species and processes within the site and the

surrounding area. The Commission recommends that the impacts on protected fish species is fully assessed and appropriate mitigation provided.

- 3.45 The applicant's attention is drawn to the comments from EA regarding the proposed methodology.

Nature conservation (Section 5.5 of the Scoping Report)

- 3.46 The Commission refers the applicant to the detailed comments from NE regarding habitat identification (see Appendix 2) and advises that these comments should be addressed in the ES. There are a number of designated sites in the proposed development area and the assessment should ensure that these are clearly identified together with their qualifying interests.
- 3.47 The assessment should include an appraisal of all matters which may be altered by the proposed development and thereby affect designated sites including effects on, *inter alia*, coastal and sedimentary processes, marine benthos, fish resources, marine mammals and birds.
- 3.48 The proposed development should consider the intertidal and subtidal habitat and the impacts of dredging and sediment type and quality.
- 3.49 The section of the ES on nature conservation should be fully cross-referenced with those on the biological environment and commercial fisheries.

Marine mammals (Section 5.6 of the Scoping Report)

- 3.50 The Commission refers the applicant to the detailed comments from NE regarding marine mammals and advises that these comments should be addressed in the ES or a full explanation provided as to why the recommendations were not considered appropriate.
- 3.51 The Commission notes the reference in the Scoping Report to noise, but that there is no noise assessment included in the offshore section of the ES and that this should be addressed.

Marine ornithology (Section 5.7 of the Scoping Report)

- 3.52 The Commission refers the applicant to the detailed comments from NE regarding ornithology and advises that these comments should be addressed in the ES or a full explanation provided as to why the recommendations were not considered appropriate. The MMO's advice to review of a publication to inform seabird sensitivity should be noted.

- 3.53 The Scoping Report indicated that there are unlikely to be impacts associated with the wind farm to the west of the Isle of Wight (paragraph 5.7.3.3 of the Scoping Report). Whilst the Report does not specifically propose to 'scope out' this matter, the Commission would draw the applicant's attention to the importance of assessing the potential impact of this issue.

Landscape, seascape and visual (Section 5.8 of the Scoping Report)

- 3.54 The Commission is unclear as to the approach to consider the offshore and onshore elements of the scheme separately. If two separate sections are proposed within the ES, there will be a need to consider the impacts of the on and offshore elements of the proposal collectively. This should be made clear and assessed in the ES.
- 3.55 The Commission suggests that the comments from English Heritage (see Appendix 2) regarding the proposed methodology should assist the applicant.
- 3.56 The Commission welcomes the consultation with relevant statutory bodies and considers that these consultations should be used to help identify cumulative impact assessments with other existing or proposed developments in the area. The use of photomontages would assist in the understanding of the proposals.
- 3.57 The applicant should consider night time impacts of any lighting.

Marine archaeology (Section 5.9 of the Scoping Report)

- 3.58 The Commission draws the attention of the applicant to the comments from EH and East Sussex County Council (see Appendix 2). The specialist report should not be 'stand alone' and it is expected that it will refer to other specialist reports in the ES.

Navigation and shipping (Section 5.10 of the Scoping Report)

- 3.59 The Commission welcomes the consultation with Trinity House and other marine bodies and recommends that the results of these consultations are used effectively to inform the potential impacts and identify appropriate mitigation as necessary. The MMO advise the consultation of the Marine Aggregate Producers Association.
- 3.60 With regard to shipping and navigation, the cumulative impacts of this proposal and others in the area should be addressed.

Civil and military aviation (Section 5.11 of the Scoping Report)

- 3.61 Reference should be made to the comments from the CAA (see Appendix 2) regarding offshore development and aviation issues including the need for consultation with operators and service providers

as well as the MOD and NATS En-Route Ltd (NERL). There is no reference to Shoreham Airport in the Scoping Report and this should be considered in terms of the possible impacts associated with the construction of the cable route corridor onshore.

- 3.62 The applicant should consider the potential effects of the proposed wind farm on the communications, navigation and surveillance infrastructure and the need to liaise with NERL on the adoption of potential mitigation measures.

Socio-economics (Section 5.12 of the Scoping Report)

- 3.63 The Commission considers that the potential impacts on socio-economics should consider both the off-shore and on-shore elements. Reference is made (paragraph 5.12.3 of the Scoping Report) to 'employment generation and external benefits'. The Commission considers that the socio-economic impacts of the proposals should be fully assessed. The construction programme is scheduled to take place over 3-4 years (see paragraph 2.4 of the Scoping Report) and the economic impacts, both positive and negative on the local community should be assessed.
- 3.64 The economic impacts should be set within the context of local initiatives and the Commission notes the comments from Adur District Council and Brighton and Hove City Council as well as SEEDA (see Appendix 2).

Commercial fisheries (Section 5.13 of the Scoping Report)

- 3.65 The Commission would wish to be assured that consultation had been undertaken with appropriate commercial fisheries and, in the light of the number of foreign vessels in the area, notes the intent to obtain data from other Member States. It is noted that there is small scale commercial fishing in the area and the comments from East Sussex County Council should assist in helping to identify data on these bodies. The MMO also strongly advise early consultation with the fishing industry, MMO local officers and local sea fisheries committee to help to inform the assessment of the likely impacts of the proposals on fisheries.
- 3.66 The Commission refers the applicant to the detailed and helpful advice from the MMO regarding additional data sources and species found in the vicinity of the proposals.
- 3.67 All stages of the proposal should be assessed – construction, operation and decommissioning. Appropriate mitigation measures should be identified.
- 3.68 Appropriate cross reference should be made to other specialist reports, notably noise and vibration and the potential impacts.

Other marine uses (Section 5.14 of the Scoping Report)

- 3.69 Due to the lack of information, the Commission does not agree that the assessment of the impact of the potential development on marine aggregate extraction can be scoped out of the ES (see paragraph 5.14.1.2 of the Scoping Report).
- 3.70 The Commission accepts that provided no evidence can be shown for the presence of munitions; and as there are no licensed oil and gas exploration areas within or adjacent to the wind farm zone, that these matters will not need a detailed assessment.

Noise and Vibration (omitted from the offshore section of the Scoping Report)

- 3.71 As noted in the above comments, an assessment of noise and vibration is proposed to be included for the onshore elements of the scheme, but no reference is made to the potential offshore impacts. The Commission considers that this should be included.

Onshore

Agriculture and soils (Section 6.2 of the Scoping Report)

- 3.72 The section's title refers to 'Agriculture and Soils' although the text focuses upon soils. The Scoping Report identifies a wide indicative route for the on-shore cable route corridor. The Commission suggests that careful consideration should be given as to how the applicant meaningfully consults on, and properly assesses, likely impacts arising from the proposed on-shore cable route. It is hoped that the iterative nature of the assessment work will allow a more defined route for the proposed on-shore cable route corridor to enable the EIA to be carried out on as precisely defined scheme as possible.
- 3.73 The Commission considers that impacts on agriculture and farm businesses during the construction phase should be assessed and also considers that there is potential for sterilisation of land for the easement along the route during the operational phase. This should be assessed. Appropriate cross reference should be made to the socio-economics section.

Air quality (Section 6.3 of the Scoping Report)

- 3.74 The Commission advises that the baseline data should be up to date and refers the applicant to the comments from Adur District Council and Mid Sussex District Council (see Appendix 2) regarding AQMAs.
- 3.75 The Commission welcomes the consultation with key stakeholders, including the local authorities and recommends that the methodology should be agreed with the relevant bodies.

Ground conditions and water resources (Section 6.4 of the Scoping Report)

- 3.76 The applicant's attention is drawn to the comments from the EA (see Appendix 2) particularly regarding the proposed assessment methodology.
- 3.77 The Commission welcomes the provision of a Flood Risk Assessment (FRA). The FRA should form an appendix to the ES. The Commission recommends that the FRA considers potential impacts arising from the inclusion of the National Grid apparatus at the substation location.
- 3.78 Appropriate cross-reference should be made to the agriculture and soils section in the ES in relation to any potential contaminated land and run-off.
- 3.79 The baseline description should be up to date, the Commission draws the attention of the applicant to the comments from Adur District Council.

Ecology and nature conservation (Section 6.5 of the Scoping Report)

- 3.80 The Commission welcomes the consultation and recommends that consideration be given to including all the local authorities through which the route passes.
- 3.81 The plan produced at Figure 6.4 in the Scoping Report is too small and therefore should be produced to a larger scale in the ES to make it readable.
- 3.82 There are a number of designated sites in the area and the assessment should address these. Comments on the baseline information from both West Sussex and East Sussex County Councils and NE should be noted.
- 3.83 The Commission recommends that the ES should address fully the needs of protecting and enhancing biodiversity.
- 3.84 The Commission recommends that appropriate cross reference is made to other specialist reports in the ES, for example landscape and visual, and that mitigation and enhancement measures are considered overall and not just in relation to a single specialist topic. Mitigation should include consideration of the impact on trees and appropriate survey work. This could include for example use of BS 5837:2005 Trees in Relation to Construction.

Archaeology and cultural heritage (Section 6.6 of the Scoping Report)

- 3.85 The assessment of archaeology and cultural heritage should also include the consideration of the impact of the onshore development

and the cumulative impact of other development in the area including the proposed National Grid infrastructure on the setting of the historic environment and heritage assets. Photomontages should be provided in the ES where an initial assessment identifies potentially harmful effects on the setting of the historic environment and heritage assets.

- 3.86 Consideration should be given to how in-situ archaeology will be recorded and attention is drawn to the comments by English Heritage on unrecorded archaeological remains. Consultation to agree a programme of investigative works with West Sussex County Council is welcomed.
- 3.87 The applicant's attention is drawn to the comments by West Sussex County Council, in particular regarding the use of aerial photography (see Appendix 2).

Landscape and visual impact (Section 6.7 of the Scoping Report)

- 3.88 The Commission welcomes the use of recognised guidelines. Reference should be made to the comments on landscape from West Sussex County Council.
- 3.89 It is noted that the preferred option to underground the cables and the route will be designed to avoid key features. The Commission considers that these should also include veteran trees as identified in the ecology and nature conservation section. Cross reference should be made to this section and it is suggested that any mitigation could be developed in association with ecological mitigation.
- 3.90 In the event that overhead power lines should be used then the Commission recommends that the applicant agrees key viewpoints with statutory consultees and that photomontages are prepared.
- 3.91 The Commission would reiterate the comments made above in respect of the offshore landscape, seascape and visual assessment and how the off and onshore assessment will be drawn together.
- 3.92 The Commission also draws the attention of the applicant to the helpful list of guidance set out by both EH and NE.
- 3.93 The landscape and visual assessment should include the assessment of any access roads required for permanent access and temporary access during construction.
- 3.94 The assessment should include the consideration of any lighting required for the substation, access road to the substation and any lighting required on the National Grid apparatus.
- 3.95 It is stated (in 6.6.1.2) that non-statutory heritage assets are a material consideration according to PPS5. PPS5 also refers to designated

heritage assets and sets out a presumption in favour of their conservation. It is important that the ES includes impacts on all designated and non designated heritage assets. It is noted that Figure 6.4 “Designated Conservation Areas” does not include those Conservation Areas designated under the Planning (Listed Buildings and Conservation Areas) Act 1990 and the Commission recommends these are mapped in the Environmental Statement.

Noise and vibration (Section 6.8 of the Scoping Report)

- 3.96 The Commission welcomes the statement that the relevant Council Environmental Health Department(s) will be consulted by the applicant regarding the identification of noise receptors to agree the extent of the baseline noise monitoring. Noise levels off-site along roads and public rights of way (PROW) should be addressed.
- 3.97 The Commission considers that vibration caused by abnormal loads and HGVs should be assessed. Appropriate cross-reference should be made in the ES to the specialist transport assessment. The noise and vibration assessment should also inform the ecological assessment and historic environment topics where appropriate.
- 3.98 The Commission welcomes the assessment to determine noise emissions from the permanent apparatus at the substation (paragraph 6.8.2 of the Scoping Report).
- 3.99 Noise impacts on people should be specifically addressed and particularly any potential noise disturbance at night and other unsocial times such as weekends and public holidays.
- 3.100 Consideration should be given to monitoring noise complaints, including those associated with potential offshore works undertaken during the night.
- 3.101 Noise and Vibration should also be assessed in terms of the offshore environment to include the potential impacts on fish and shellfish, marine mammals and marine ornithology.

Recreation (Section 6.9 of the Scoping Report)

- 3.102 It is unclear where recreational impacts associated with the beach would fall to be considered in the ES. The Commission draws the attention of the applicant to the comments from the EA and possible effects on beach areas and bathing water quality.
- 3.103 Details of the construction methods, working hours and duration of works should be provided in the ES. Cross-reference should be made to the transport assessment and any impacts the onshore works may have on public transport, including consideration of potential works to existing and new access roads to the substation.

- 3.104 The Commission notes the identification of potential impacts on existing PROW, cycle ways and bridlepaths and recommends that consultation is undertaken with the Public Rights of Way officers at the relevant local authorities to agree appropriate mitigation. Cross-reference should be made to any visual impacts on PROW identified in the landscape and visual assessment.

Transport (Section 6.10 of the Scoping Report)

- 3.105 The Commission welcomes the applicant's intention to provide information on the traffic and transport impacts in the ES and notes the reference to the A259 and A27 as well as the main railway line.
- 3.106 The Commission recommends that the relevant local highways authorities are consulted formally on the need for a Transport Assessment (TA) to accompany the DCO. The Commission has noted the comments from the local authorities that suggest that the local road network suffers from congestion. Therefore there may be a need for a formal TA.
- 3.107 The transport assessment should include consideration of the potential impact on the rail network. The Commission notes the comment that one operational railway line would be crossed. The assessment should also consider the potential impacts of any construction or diversion activities on public transport.
- 3.108 The Commission does not agree that the traffic and transport assessment should only consider the construction transport associated with the onshore development. The assessment of the vehicles associated with the construction of the offshore development including both delivery vehicles and personnel vehicles, abnormal loads, if applicable, and traffic associated with maintenance will need to be considered in the ES. Assumptions made to derive the traffic forecasts will need to be clearly explained.
- 3.109 No information is provided regarding marine vehicular movements. These should be included.
- 3.110 Appropriate cross-reference should be made to the Landscape and Visual section including the potential locations of construction compounds and lay down areas identified during the construction phase. Cross-reference should also be made to the specialist air quality topic including consideration of airborne pollution and dust especially during the construction phase for the entirety of any transportation and access routes. Cross reference should also be made to the noise and vibration section.

Electric and magnetic fields (Section 6.11 of the Scoping Report)

3.111 The Commission refers the applicant to the HSE comments on electrical safety and the HPA comments on EMF set out in Appendix 2.

4.0 OTHER INFORMATION

Appropriate Assessment

- 4.1 The applicant's attention is drawn to the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (APFP Regs) and the need to include information identifying European sites to which the Habitats Regulations applies or any Ramsar site which may be affected by a proposal. The information to be submitted should also be sufficient to enable the competent authority to make an appropriate assessment of the implications for the site if required by regulation 48(1). The decision maker is the competent authority for this purpose.
- 4.2 The report to be submitted under Reg 5(2)(g) of the APFP Regs with the application must deal with two issues. The first is to enable a formal assessment by the competent authority of whether there is likely significant effect and the second, should it be required, is to enable the carrying out of an appropriate assessment by the competent authority.
- 4.3 When considering aspects of the environment likely to be affected by the proposed development for example flora, fauna, soil, water, air and the inter-relationship between these, consideration should be given to the designated (and possible future designated) areas/sites in the vicinity of the proposed development.

Health Impact Assessment

- 4.4 The Commission draws the applicant's attention to the comments of the HPA on the effects of exposure to electromagnetic fields and how the assessment of this issue should be included within the ES.
- 4.5 The Commission considers that it would be a matter for the applicant to decide whether or not it would be appropriate to submit a stand-alone Health Impact Assessment (HIA). The methodology for the HIA, if prepared, should be agreed with the relevant statutory consultees and take into account any mitigation measures for acute risks.

Other Regulatory Regimes

- 4.6 The Commission recommends that the applicant should state clearly what regulatory areas are addressed in the ES and that the applicant should ensure that all relevant authorisations, licences, permits and consents that are necessary to enable operations to proceed are described in the ES. Also it should be clear that any likely significant effects of the proposed development which may be regulated by other statutory regimes have been properly taken into account in the environmental impact assessment (EIA).

- 4.7 It will not necessarily follow that the granting of consent under one regime will ensure consent under another regime. For those consents not included or capable of being included in an application for development consent under the Planning Act 2008, it would be helpful for the Commission to receive a level of assurance from the relevant regulatory authorities that the proposed project is acceptable and likely to be approved by them. If relevant, this would be required by the Commission before a recommendation or decision on any development consent application is made. Applicants are encouraged to make early contact with other regulators. Information from applicants about progress in obtaining other permits, licences or other consents and confirmation that there is no obvious reason why they will not subsequently be granted will also be helpful in supporting an application for development consent to the Commission.

Transboundary Effects

- 4.8 Consideration should be given to providing an indication whether the proposal is likely to have any significant effects on another European State. It is noted that this has been considered in the Scoping Report in terms of the potential impacts on commercial fisheries. The Commission suggests that the ES will need to address this matter in each topic area and summarise the position on transboundary effects of the proposed project, taking into account inter-relationships between any impacts in each topic area.
- 4.9 In this regard, the applicant is referred to Regulation 24 of the EIA Regs., which *inter alia* requires the Commission to publicise a DCO application if the proposed development is likely to have significant effects on the environment of another EEA state and where relevant to consult with the EEA state affected. Where Reg. 24 applies, this is likely to have implications for the Commission's examination of a DCO application. Given these likely implications, the IPC would encourage the applicant to draw such matters to the Commission's attention at the earliest possible opportunity.

Applicant's Consultation

- 4.10 It is recommended that the applicant provides preliminary environmental information¹ to the local authority when presenting it with the draft Statement of Community Consultation (SoCC) for comment under s47 of the Planning Act 2008.
- 4.11 Consultation with the local community should be carried out in accordance with the SoCC which will state how the applicant intends to consult on the preliminary environmental information. Where

¹ For an explanation see under 'Interpretation' in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 SI2263

consultation responses have resulted in important changes affecting the EIA, such comments could usefully be reported and considered in the ES. This reporting could also assist the applicant in the preparation of its consultation report required to be submitted with the application for development consent.

APPENDIX 1

CONSULTATION BODIES

APPENDIX 1

LIST OF CONSULTATION BODIES FORMALLY CONSULTED DURING THE SCOPING EXERCISE

CONSULTEE	ORGANISATION
SCHEDULE 1 LIST OF CONSULTEES	
The Relevant Regional Planning Body ²	South East Leaders Board
The Health and Safety Executive	Health and Safety Executive
The Relevant Strategic Health Authority	NHS South East Coast
Natural England	Natural England Natural England South East Senior Specialist - Marine Operations
The Historic Buildings and Monuments Commission for England	English Heritage English Heritage – South East Maritime Archaeology Team

² The Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations was amended by The Local Democracy, Economic Development and Construction Act 2009 (Consequential Amendments) (England) Order 2010. Regional planning bodies were replaced by responsible regional authorities as consultees in schedule 1. Responsible regional authorities are defined as follows:

(1) References in this Part to “responsible regional authorities”, in relation to a region, are to the following (acting jointly)—

- (a) the regional development agency for the region, and
- (b) the Leaders’ Board for the region.

(2) But if during any period after the coming into force of this section there is no Leaders’ Board for a region, the references in this Part to “responsible regional authorities” are in relation to that period and region to be read as references to the regional development agency for the region. (s.72 of The Local Democracy, Economic Development and Construction Act 2009).

Please see table for Regional Development Agencies consulted.

The Relevant Fire and Rescue Authority	East Sussex Fire and Rescue Service West Sussex Fire and Rescue Service
The Relevant Police Authority	Sussex Police Authority
The Relevant Parish Council(s) or Relevant Community Council	Lancing Parish Council Poyning Parish Council Albourne Parish Council Sompting Parish Council Coombes Parish Meeting Bramber Parish Council Upper Beeding Parish Council Woodmancote Parish Council Henfield Parish Council Shermanbury Parish Council Twineham Parish Council Cowfold Parish Council Bolney Parish Council Steyning Parish Council Ashurst Parish Council West Grinstead Parish Council Findon Parish Council Newtimber Parish Meeting Fulking Parish Council Pyecombe Parish Council Ansty and Staplefield Parish Council Slaugham Parish Council Burgess Hill Town Council Hassocks Parish Council Hurstpierpoint and Sayers Common Parish Council Nuthurst Parish Council Lower Beeding Parish Council

The Environment Agency	The Environment Agency The Environment Agency South Downs Office
The Commission for Architecture and The Built Environment	CABE Design Review
The Relevant Regional Development Agency	South East England Development Agency
The Equality and Human Rights Commission	Equality and Human Rights Commission
The Commission for Sustainable Development	Sustainable Development Commission
The Homes and Communities Agency	HCA
The Joint Nature Conservation Committee	Joint Nature Conservation Committee The Joint Nature Conservation Committee (Offshore Wind Farms)
The Commission for Rural Communities	The Commission for Rural Communities
The Maritime and Coastguard Agency	Maritime & Coastguard Agency- Navigation Specialist Support
The Marine Management Organisation (English Waters) ³	Marine Management Organisation (MMO)
The Civil Aviation Authority	Directorate or Airspace Policy
The Highways Agency	The Highways Agency
The Relevant Highways Authority	West Sussex County Council
The Rail Passengers Council	Rail Passenger Council
The Disabled Persons Transport Advisory Committee	DPTAC
The Coal Authority	The Coal Authority

³ The Marine and Coastal Access Act 2009 s.23(2) amends the Planning Act 2008 s.42.

The Office Of Rail Regulation	Office of Rail Regulation
Approved Operator	Network Rail Infrastructure Ltd
Approved Operator	Network Rail (CTRL) Ltd
The Gas and Electricity Markets Authority	OFGEM
The Water Services Regulation Authority	OFWAT
The Relevant Waste Regulation Authority	West Sussex County Council Lewes District Council
The British Waterways Board	The British Waterways Board
The Health Protection Agency	Health Protection Agency
The Relevant Local Resilience forum	Sussex Local Resilience Forum
The Crown Estate Commissioners	The Crown Estate
The Forestry Commission	South East England Forest District Office
RELEVANT STATUTORY UNDERTAKERS	
Health Bodies under s.16 of the Acquisition of Land Act 1981	NHS South East Coast Brighton and Sussex University Hospitals NHS Trust Western Sussex Hospitals Trust Sussex Partnership NHS Foundation Trust South East Coast Ambulance Service NHS Trust NHS West Sussex Primary Care Trust
Railways	BRB Residuary Limited
Harbour	Shoreham Port Authority
Licence Holder (Chapter 1 Of Part 1 of Transport Act 2000)	NATS En Route plc

Universal Service Provider	Royal Mail Group
Water and Sewage Undertakers	Southern Water
Public Gas Transporter	British Gas Pipelines Limited Energetics Electricity Limited Energetics Gas Limited ES Pipelines Ltd ESP Connections Ltd ESP Networks Ltd ESP Pipelines Ltd Fulcrum Pipelines Limited GTC Pipelines Limited Energy House Independent Pipelines Limited Intoto Utilities Limited National Grid Gas Plc (NTS) National Grid Gas Plc (RDN) Northern Gas Networks Limited Quadrant Pipelines Limited Scotland Gas Networks Plc Southern Gas Networks Plc SP Gas Limited SSE Pipelines Ltd The Gas Transportation Company Limited Wales and West Utilities Limited Utility Grid Installations Limited Wales and West Utilities Ltd
Electricity Distributors With CPO Powers	ECG (Distribution) Limited EDF Energy (IDNO) Limited EDF Energy Networks (EPN) Plc EDF Energy Networks (LPN) Plc EDF Energy Networks (SPN) Plc Energetics Electricity Limited

	ESP Electricity Limited Independent Power Networks Limited Southern Electric Power Distribution Plc The Electricity Network Company Limited National Grid
LOCAL AUTHORITY (S.43)	
	Adur District Council Worthing Borough Council Horsham District Council Mid Sussex District Council West Sussex County Council Chichester District Council Waverely Borough Council Mole Valley District Council Crawley Borough Council Tandridge District Council Wealden District Council Havant Borough Council Reigate and Banstead Borough Council East Hampshire District Council Lewes District Council Brighton and Hove City Council Arun District Council Hampshire County Council Surrey County Council East Sussex County Council
NON-PRESCRIBED CONSULTEES	
Local Authority	Eastbourne Borough Council
National Park	South Downs National Park

CONSULTATION WITH THE APPLICANT	
The Applicant	E.ON Climate and Renewables UK Ltd

APPENDIX 2

RESPONDENTS TO CONSULTATION AND COPIES OF REPLIES

APPENDIX 2

LIST OF BODIES WHO REPLIED BY 12 OCTOBER 2010

Adur District Council
Ansty and Staplefield Parish Council
Arun District Council
Bolney Parish Council
Brighton and Hove City Council
Burgess Hill Town Council
Commission for Architecture and the Built Environment
Chichester District Council
Civil Aviation Authority
Coal Authority
Crawley Borough Council
Disabled persons Transport Advisory Committee
East Sussex County Council
English Heritage
Environment Agency
ES Pipelines Ltd
Fulcrum Pipelines Limited
Fulking Parish Council
Hassock Parish Council
Havant Borough Council
Health and Safety Executive
Health Protection Agency
Homes and Communities Agency
Hurstpierpoint and Sayers Common Parish Council
Lancing Parish Council
Marine Management organisation
Maritime and Coastguard Agency
Mid Sussex DC
Mole Valley District Council
Natural England
Reigate and Banstead Borough Council

South East England Development Agency (SEEDA)
Shoreham Port
Sompting Parish Council
South Downs National Park Authority
Southern Water
Surrey County Council
Sussex Police
Trinity House
West Sussex County Council



Planning, Regeneration and Wellbeing

Owain George
Infrastructure Planning Commission
Temple Quay House, Temple Quay
BRISTOL
BS1 6PN

Your Ref: 140910_EN010032_243108
Our Ref: 13.41

Date: 11 October 2010

Dear Mr George,

Proposed Rampion Offshore Wind Farm: E-On Climate & Renewables

Thank you for your letter of 14 September 2010, consulting this Council on the Scoping Report for the EIA for the project.

It is noted that the proposed windfarm is described as including as many as 280 wind turbines and that it would be located 8-15 miles off the coast but stretching about 17 miles from Worthing to Newhaven. It is noted that the indicative area of search for cable routes passes predominantly through Adur District where it makes landfall (and then mainly through Mid Sussex District).

As regards noise from the off-shore wind turbines themselves, although the chances of this causing a problem on land may seem unlikely, there is concern that low frequency noise may be created which can travel long distances over water affecting a potentially long stretch of coastline. Therefore, it is considered that the EIA needs to include a detailed assessment of noise from the wind turbines.

Noise from the off-shore construction works, which could last for a period of as long as 4 years, is also a serious concern that needs full assessment. It appears that overnight construction of off-shore wind turbines has caused complaints from land-based residents in other parts of the Country, and also from cabling procedures both off and on-shore which can be very noisy.

As regards effects on air quality from activities on land, including traffic associated with the construction works, DMRB is a fairly crude tool for determining problems with air quality. If the EIA indicates there may be a problem near relevant receptors, it is considered that this should be assessed using a more robust modelling system. It should be noted that, in addition to the 2 AQMAs in Adur District there is a recently-declared AQMA at Warren Road (A27T) in nearby Worthing Borough.

As regards highways, West Sussex County Council (WSSC) are the relevant local highway authority and I understand they are sending you their comments separately.

As for archaeology, again advice is normally sought from WSSC. There are a large number of areas with archaeological interest within the cable search area which need to be taken into account in the assessment.

As regards ecology, this Council normally relies on advice from both WSSC and the Environment Agency, both of whom are responding separately. In addition to the 4 marine SNCIs, there are a large number of ecologically sensitive areas within the wide area denoted for cable search.

I would endorse the recommendations of WSSC that the applicant's consultants:-

1. Contact Sussex Biodiversity Record Centre to obtain accurate and up to date sites' data particularly for ancient woodland and SNCIs.
2. Append all survey data current and historical to Environmental Statement.
3. Provide a clear graphic indication of the cable route options being considered.
4. Detail all methodologies, mitigation and avoidance measures that will minimise ecological damage onshore and offshore.
5. Give a clear indication that all opportunities to provide ecological enhancement have been taken.
6. Append all communication with the Environment Agency, Natural England, etc.
7. Give a clear description of how the easement for the cable will look and be expected to be maintained.

I trust that you will take these comments into account.

Yours sincerely,

Keith Morgan
Planning Services Manager

Tel: 01273 263239 (direct line)
e-mail: keith.morgan@adur.gov.uk



Planning, Regeneration and Wellbeing

Owain George
Infrastructure Planning Commission
Temple Quay House, Temple Quay
BRISTOL
BS1 6PN

Your Ref: 140910_EN010032_243108
Our Ref:

Date: 12 October 2010

Dear Mr George,

Proposed Rampion Offshore Wind Farm: E-On Climate & Renewables

Further to the letter dated 11th October from Keith Morgan at Adur District Council, the Planning Policy Team would like to add to these comments on the EIA Scoping Report. I trust that these comments will be taken into account alongside those already received.

Please find below comments relating to various sections of the report:

Page 13

Please note that the South East Plan is now revoked.

Page 24

Paragraph 3.1.1: The South East Plan is referred to here with regards to renewable energy generation. It should be noted that there are other policies within the South East plan relevant to the area, in particular, Shoreham Harbour is allocated as a Strategic Development Area. If policies from the South East Plan are to be referred to, it is considered that policies relating to the regeneration of the Shoreham Harbour Area should also be referenced. Related to this, the area has been awarded Growth Point status as well as Eco-town funding to investigate the potential for an Eco-town development. The aim is to deliver regeneration to the coastal communities in the vicinity of Shoreham Harbour.

Page 25

Paragraph 3.1.2.2: Whilst the Core Strategy was withdrawn in 2007, there are a large number of new studies that have been developed to help inform a new version of the Core Strategy. These studies can be made available, but are not all currently available on the Council's website. The Council is carrying out a new Transport Study which will supersede the previous study mentioned in the report. It would therefore be wrong to use outdated studies for the purpose of the EIA scoping report, subsequent EIA, and planning application.

In addition, the inclusion of Shoreham Harbour as a major regeneration scheme, should be considered in the scoping report but is not mentioned in Paragraph 3.1.2.2. The vision for the regeneration is as follows:

‘The overall objective is to regenerate the Harbour area so that it provides the homes, jobs, facilities and services that are needed by the local community, and reduces deprivation and inequalities. This will be achieved by improving existing areas and creating attractive new developments which link closely with, and are part of, the existing communities of Shoreham, Southwick, Fishersgate and Portslade. The changes will promote and enable sustainable living that will set an example to other areas nationally and internationally.’

Shoreham Harbour is being delivered in partnership with Adur District Council, Brighton and Hove City Council, West Sussex County Council, Shoreham Port Authority, South East England Development Agency (SEEDA) and the Homes and Communities Agency (HCA). This regeneration project is being considered through Adur and Brighton and Hove’s Local Development Frameworks, and as mentioned above has received funding from central government. As such it is requested that this major regeneration scheme is considered through the assessment process.

Page 75

Section 5.12: It is considered that further information related to employment should be considered through the EIA process. In terms of the baseline data, this relates to an acknowledgement that wards within Adur suffer high levels of multiple deprivation, specifically suffering from skills and education related deprivation. In addition, it is disappointing that the socio-economic impacts are only considered for the offshore element of the scheme, and not the onshore aspects.

Page 93

Paragraph 6.4.1: Adur District Council’s flood risk information is held within the Council’s Strategic Flood Risk Assessment. This has the most up-to-date flood maps and should be used for the EIA instead of the EA flood maps for the Adur District element of this scheme.

Page 93

Please note that Adur Recreation Ground has had historic waste activity.

Yours sincerely,

Sam Sykes
Planning Policy Officer

Tel: 01273 263243 (direct line)
e-mail: sam.sykes@adur.gov.uk

From: Joanne Golding
To: ["Liz Bennett";](#)
Subject: Proposed Rampion Offshore Wind Farm
Date: 20 September 2010 10:12:00
Attachments: [Advice-note-3-scoping-opinion.pdf](#)

Dear Ms Bennett

Further to your query, please find below an explanation as to why Ansty and Staplefield Parish Council has been consulted on the proposed Rampion offshore wind farm scoping report.

Parish Councils are considered by the Commission to have valuable information about the environment and locale for which they have responsibility. Therefore the Commission will seek the views of the parish council where the project is located (termed parish council "B") and the view of any parish councils which share a boundary with a "B" parish council (termed parish council "A"). For further information please refer to the IPC's Advice Note 3, attached for your reference.

In this case, because Ansty and Staplefield Parish Council shares a boundary with Bolney Parish Council and Hurstpierpoint and Sayers Common Parish Council where elements of onshore infrastructure of the project may be located as indicated by the applicant, it has been consulted as an "A" parish council (please see p9 of the Rampion Offshore Wind Farm Scoping Report available on the Commission's website).

If you have any further queries please feel free to contact me.

Kind regards

Joanne

Joanne Golding
Assistant EIA and Land Rights Advisor
Infrastructure Planning Commission (IPC)
Temple Quay House
Temple Quay
Bristol
BS1 6PN

Direct Line: 0303 444 5039
Helpline: 0303 444 5000

Email: Joanne.Golding@infrastructure.gsi.gov.uk

Website: www.independent.gov.uk/infrastructure

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We are required by law to publish on our website a record of the advice we provide and to record on our website the name of the person or organisation who asked for the advice. We will however protect the privacy of any other personal information which you choose to share with us and we will not hold the information any longer than is necessary.

You should note that we have a Policy Commitment to Openness and Transparency and you should not provide us with confidential or commercial information which you do not wish to be put in the public domain.

I have received information regarding the scoping document because Ansty and Staplefield Parish Council has been identified as a consultation body. I am not sure why we would be a consultation body for this project since we are located in Mid Sussex, not adjacent to the coast, and I cannot see how this would impact our parish.

Regards,

Liz Bennett

Clerk, Ansty and Staplefield Parish Council

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From: [Claire Rodway](#)
To: [IPC Scoping Opinion;](#)
Subject: For the attention of Owain George
Date: 05 October 2010 13:53:47

Dear Mr George,

**PROPOSED RAMPION OFFSHORE WINDFARM ("THE PROJECT")
E.ON CLIMATE AND RENEWABLES ("THE APPLICANT")
INFRASTRUCTURE PLANNING (ENVIRONMENTAL IMPACT ASSESSMENT)
REGULATIONS 2009 SI 2263
(THE EIA REGULATIONS")**

Thank you for your letter, which was received in this office on 15th September 2010, consulting this Council on the scoping opinion that has been submitted in relation to the project detailed above.

I can confirm that the submitted scoping opinion appears extremely comprehensive and this Council has no further comments to make.

I trust this information is of some assistance.

Kind regards,

Claire Rodway Senior Planner, Strategic Development Team, Planning Arun District Council Location: Ground Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF Internal: 37776 External: +44 (0) 1903 737776 E-mail: claire.rodway@arun.gov.uk
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From: [Debbie Thomas](#)
To: [IPC Scoping Opinion;](#)
Subject: Proposed Rampion Offshore Wind Farm
Date: 29 September 2010 10:20:47

Your ref: 140910_EN010032_243108

Following receipt of your letter concerning the Proposed Rampion Offshore Wind Farm, the Bolney Parish Councillors have now had a chance to review the Rampion Scoping Report provided on-line.

With regard to the work to be done in Bolney, the only question that has been raised is concerning what precisely will be done in Bolney, will it affect any area(s) outside of the curtilage of the existing sub-station, will it cause any disruption, roads etc. and how long will it take.

Kind Regards
Debbie Thomas
Clerk to Bolney Parish Council
Tel: 01444 230711

The relevant section from the report is as follows;

2.3.2 Onshore Substation

The National Grid connection offer is to connect at Bolney. In order to connect the cables from the offshore wind farm to the electricity network, a substation will be required. The proposed substation will be located on land near to the existing National

Grid 400 kV substation at Bolney (see Figure 2.5). The overall site footprint is expected to be within two hectares. Elements of the substation are likely to include: transmission equipment and buildings containing switchgear and controls and amenities for visiting service engineers. Transmission equipment within the substation

usually consists of transformers, air-core reactors, capacitor banks and open busbars.



Figure 2.5: Photograph showing the existing Bolney substation site

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**Planning Strategy & Projects
Group**

Planning Strategy, Development
Planning and Public Protection
Brighton & Hove City Council
Hove Town Hall, Norton Road
Hove BN3 3BQ

Owain George
Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

Date: 12 October 2010
Our Ref:
Your Ref: 140910_EN010032
Phone: 01273 292263
Fax: 01273 292379
e-mail: catherine.laurence@brighton-
hove.gov.uk

Dear Mr George

**PROPOSED RAMPION OFFSHORE WIND FARM
E.ON CLIMATE AND RENEWABLES
INFRASTRUCTURE PLANNING (EIA) REGULATIONS 2009
SCOPING CONSULTATION**

I refer to the letter dated 14 September 2010 from Mr David Price in respect of the above consultation. Brighton & Hove City Council's response is divided into three sections below, and includes one attachment:

1. Comments on matters to be scoped in to the assessment
2. Further items relevant to the planning policy context
3. Amendments to minor errors in the Scoping Report

1. Comments on matters to be scoped in to the assessment

Brighton & Hove City Council (BHCC) are largely satisfied that the applicant's Scoping Report scopes in relevant EIA topic areas. However the City Council have several comments in relation to matters which should be taken into account when carrying out the assessment.

1.1 Local socio-economic impacts

The City Council welcomes the inclusion of socio-economic impacts as a topic area for assessment in relation to the offshore elements of the project in section 5 of the Scoping Report. However, we query why local socio-economic impacts are scoped out as a topic for assessment in relation to onshore elements in section 6.

The Scoping Report indicates that the construction phase may continue for up to four years, which represents a significant opportunity for local employment generation. In addition, early discussions with the applicant have highlighted a number of supply chain, employment and skills development opportunities within Brighton & Hove.

BHCC would therefore wish to have assurance that the environmental impact assessment will take full account of all socio-economic impacts, in respect of both onshore and offshore elements of the project. We suggest that these should be considered together as a conjoined topic area.

1.2 Regeneration aspirations for Shoreham Harbour

The long-term regeneration of Shoreham Harbour has been an objective of BHCC, Adur District Council and West Sussex County Council, and also the Shoreham Port Authority, for a number of years. This desire has been driven by:

- The challenge of finding strategic land for housing and economic growth given the physical and environmental constraints of the subregion;
- An underperforming coastal economy;
- Worsening deprivation;
- The need for port modernisation; and
- Under-utilised land in and around the port.

The Shoreham Harbour area has been awarded Growth Point status and Eco Development status by Government with significant associated funding awards, and remains a priority for the three councils.

The majority of Shoreham Harbour and the potential regeneration area is located within Adur District. However, a significant part of the port and its surrounding area lies within Brighton & Hove City. BHCC therefore request that the regeneration of Shoreham Harbour and its surrounding area should be taken into account by the applicant when carrying out the environmental assessment for the proposed windfarm.

This should include consideration of the aims of the Shoreham Harbour regeneration including addressing socio-economic deprivation and the intention of providing new exemplar, zero-carbon, mixed-use development of several thousand new homes, jobs, leisure and retailing alongside the working Port.

1.3 Noise and vibration

Although noise and vibration from onshore activities are scoped in, the Scoping Report does not consider noise from offshore sources. BHCC would request that prior to scoping out any offshore noise sources and their cumulative impact, the offshore noises need considering at the very minimum. Please refer to the detailed response in this regard from the Council's Senior Environmental Health Officer, attached.

In addition, as stated in the attached EHO response, BHCC would expect a Construction Environmental Management Plan and section 61 prior consent agreement if the evolving scheme results in the requirement for any construction work to occur within the City.

1.4 Transport and air quality

While BHCC understand that E.ON state that minimal local traffic movements will be generated during operation, these have not been fully explained/quantified at this stage. In addition, the Scoping Report does indicate that all onshore construction movement, at least, is expected to be by road. Through the considerable amount of work that has been done on Shoreham Harbour, both Highway Authorities are aware that the local road network, especially the A259, suffers from congestion and that little/no spare capacity exists at certain times. Government guidance on Transport Assessments refers to indicative thresholds for TAs which includes reference to freight, HGV and abnormal load movements, inadequate local transport infrastructure and proximity to an AQMA, all of which apply in relation to the indicative onshore cable corridor. Taking these issues into account, BHCC would therefore request that the assessment should include further data on transport impacts, in order to provide evidence for the conclusion on expected levels and impacts of traffic.

In addition, BHCC request inclusion of the impacts from marine vehicular activity resulting from the use of barges / boats / maintenance vehicles / machines at all phases of the development. These types of emissions are not currently referred to in the Scoping Report.

1.5 Marine aggregates

As marine aggregates are an important local source of construction materials in the City, BHCC request that this is taken into account under the assessment of potential impacts on marine aggregate extraction operations (scoped in under section 5.14 of the Scoping Report).

2. Further items relevant to the planning policy context

BHCC note several omissions in the section on Policy Context, and request that the following policy documents should be taken into account:

- Brighton & Hove City Council Local Plan (saved policies)
- Brighton & Hove City Council Local Development Framework (LDF), including adopted SPDs and emerging Core Strategy
- East Sussex and Brighton & Hove Waste Local Plan
- Brighton & Hove City Council emerging Waste and Minerals Development Framework (WMDF), undertaken jointly with East Sussex County Council.
- Brighton & Hove Local Transport Plan 2 and emerging Local Transport Plan 3.

BHCC also suggest that the EIA should take account of the incoming marine planning regime. The Marine & Coastal Access Act 2009 divides UK waters into inshore regions (0-12 nautical miles) and offshore regions (12-c.200 nautical miles). Therefore the offshore windfarm itself will be in the offshore marine plan region, while the under-sea cables will travel through the onshore plan region.

3. Amendments to minor errors in the Scoping Report

- Policy context:
 - The Scoping Report p.22 refers to the National Policy Statements EN-1 and EN-3 (Overarching Energy and Renewables NPSs). We note that the Coalition Government is now proposing to review and issue new drafts of these NPSs as stated in the DECC [Annual Energy Statement 2010](#).
 - p.23 refers to PPG20 Coastal Planning. We note that this PPG has been cancelled with the exception of paragraphs 2.9, 2.10 and 3.9, and has been replaced by Planning Policy Statement 25 Supplement: Development and Coastal Change.
 - As PPS11 has been cancelled since the abolition of Regional Strategies, we would also suggest that this should be removed from the policy context.
- The revocation of RSSs should be recognised on p.13.
- The reference to the Conservation (Natural Habitats, &c.) Regulations 1994 on p.27 is out of date as these regulations have now been replaced by the Conservation of Habitats and Species Regulations 2010.

Yours faithfully

Catherine Laurence
Sustainability Appraisal Officer
Brighton & Hove City Council

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Brighton & Hove

Memorandum

From:	Scott Castle Senior Environmental Health Officer	Date:	8 th October 2010
Service:	Public Safety	Our ref:	2010/11129/enq/eh
Location:	2 nd Floor, Barts	Phone:	(01273) 292248
To:	Catherine Laurence Sustainability Appraisal Officer	Fax:	(01273) 292196
		e-mail:	Scott.Castle@brighton-hove.gov.uk
		Copies to:	Bruce Reynolds. Adur District Council

ADDRESS: Rampion Off Shore Windfarm

PLAN NO: Pre Application - Scoping

I write having read the EON Scoping Report by RSK Group dated September 2010, reference : P41318. The scoping report invites comments on what should be considered and what sort of information should be scoped out for the potential project. The phases are usefully broken down into onshore activities and off shore activities.

In brief, a large wind-farm is proposed off of the Sussex coastline which is crown waters. This is approximately 13km off shore with a development square of 28km by 10km with a proposal to use two thirds of this space with potential extension at a later stage. Initially whilst the project is in its infancy, the range and exact models of turbines are unknown, however to allow some modelling, 280 wind turbines are proposed (185x 3.6MW and 95x 7MW). Along with the off shore turbines will be two electricity substations and cabling to link the electricity energy from the turbines to these and also to bring the electricity to shore.

The proposal is that the cabling route would meet up with Bolney electrical substation which is located in Mid Sussex area and this would need to be significantly upgraded. Importantly, under 6.3 of the Scoping Report, it indicates on page 95 that Brighton and Hove City Council should not be impacted by the onshore construction issues as it is understood that the work will be in another local authority area. If any onshore construction is proposed within the Brighton and Hove City Council boundary, we would expect a Construction, Environmental Management Plan and section 61 prior consent agreement to manage this process and minimise noise impact.

Having examined the documentation it is apparent that noise and vibration has only been considered for the onshore activities such as the cabling corridor and infrastructure works necessary to link this to the substation. These are discussed under 6.8 (Page 115). However, there is no apparent proposal to consider the noise from the off shore sources, especially given that there could be 280 independently operating turbines of various sizes. I would suggest that prior to scoping out any off shore noise

sources and their cumulative impact, the off shore noises need considering at the very minimum. There is also evidence to suggest that wind farms may and can create low frequency noise which is able to travel long distances very easily. I would suggest that a variety of approaches should be considered including but not limited to the following:

Contd/...

Contd/...

- BS EN 61400-11:2003 - Wind turbine generator systems. Acoustic noise measurement techniques
- BS 4142:1997 : Method for rating industrial noise affecting mixed residential and industrial areas
- ETSU –R-97 – The assessment and rating of noise from windfarms

I note also that no consideration has been given to the construction noise off shore. I note from the information provided that construction could be up to four years in length. Discussion with my counterparts in other local authorities have identified that the overnight construction of off shore wind turbines did attract complaints from land based residents and additionally that the cabling procedures were also very noisy, again attracting complaints.

I note also that if provided consent, that this would be limited to 50 years at which time, the turbines would have to be decommissioned and the infrastructure removed. If the substation was also required to be decommissioned, this would also require the trenched on land cable routes to the electrical substation to the off shore plant.

I am happy to discuss my comments as above or provide clarification where necessary.

Scott Castle
Senior Environmental Health Officer
01273 292248

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From: [Jennifer O'Grady](#)
To: [IPC Scoping Opinion](#)
Subject: Burgess Hill Town Council Response to 140910-EN010032-243108
Date: 06 October 2010 12:41:31

Infrastructure Planning Commission Temple Quay House Temple Quay BRISTOL BS1 6PN	Moira Hoare 01444 238206	
	moira@burgesshill.gov.uk	
MH.JOG	Date: Wednesday 6 October 2010	

Dear Sir

PROPOSED RAMPION OFFSHORE WIND FARM
YOUR REFERENCE: 140910-EN010032-243108

Thank you for your letter dated received 15 September 2010 regarding a request for comments on the above Wind Farm. This consultation was considered by our Planning Committee at their meeting on Monday 4 October 2010 when the following comments were made:

"Councillors felt that this would have little discernable impact on Burgess Hill."

Please give me a call if you would like to discuss this further.

Yours sincerely

MOIRA HOARE
Assistant to the Town Clerk

Jennifer O'Grady
Administrative Co-ordinator
Burgess Hill Town Council, 96 Church Walk, Burgess Hill, West Sussex, RH15 9AS
tel: 01444 247726 fax: 01444 233707 web: www.burgesshill.gov.uk youth website: www.you-bh.com

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IPC

28 SEP 2010

27 September 2010

REF:

Owain George
Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN



Our ref: CSE-20971

Dear Owain George

**INFRASTRUCTURE PLANNING COMMISSION: RAMPION WIND FARM
PLANNING APPLICATION REFERENCE: 140910_EN010032_423108**

Thank you for consulting the Commission for Architecture and the Built Environment (CABE) about this proposal.

We regret to say that we are unable to review this scheme, as we are consulted on more projects than we have the resources to deal with.

Yours sincerely

Clare Rutherwood
Design Review assistant
DRsubmissions@cabe.org.uk

From: [Peter Filtress](#)
To: [IPC Scoping Opinion;](#)
Subject: Rampion Offshore - Scoping Opinion
Date: 01 October 2010 09:04:20

Yr Ref 140910-EN10032-243108

Dear Mr Price

Further to your letter of 14 September, I would thank you for consulting us and I confirm this Council has no comment to make

Peter Filtress

Area Planning Manager (South)
Development Control (South)
Chichester District Council

Tel: 01243 53 4734 | | Fax: 01243 776766 | pfiltress@chichester.gov.uk | <http://www.chichester.gov.uk>

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Directorate of Airspace Policy

Mr David Price
Infrastructure Planning Commission (via e-mail)

8 October 2010

Reference: ERM/DAP/Wind/Rampion
Your Ref: 140910_EN010032_243108

Dear Mr Price

Proposed Rampion Wind Turbine Development – Scoping Opinion Comment

Thank you for your recent correspondence relating to the proposed Rampion wind turbine development. You sought related Civil Aviation Authority (CAA) scoping opinion comment. I trust the following is useful.

I should initially state that, like any wind turbine development, the proposed subject development has the potential to impact upon aviation-related operations; the Department for Trade and Industry (DTI – now the Department for Energy and Climate Change)-sponsored document 'Wind Energy and Aviation Interests' and Civil Air Publication 764 refer¹. The related need to establish the scale of the potential impact of the Triton Knoll development is evident.

As highlighted in the Scoping Opinion Request there is the potential to impact upon aviation and we would expect the outcomes of discussions with the associated operators and service providers to be in the Environmental Impact Assessment.

We would also expect consultation with both the MoD and NATS En-Route Ltd, with a view to identifying and addressing any aviation concerns that they may have.

Furthermore given the proximity of Shoreham Airport to the development, in particular as it is potentially in the onshore cable corridor, there may be interactions that need to be identified. As it is indicated that the cables will be underground the impact may be negligible but this will need to be confirmed with Airport Licensee.

Moreover, from a generic perspective, in respect of the offshore development the following aviation issues are also relevant:

- **Aviation Warning Lighting.** Some or all of the wind turbines will need to be equipped with aviation warning lighting. The legal requirement for aviation obstruction lighting on offshore wind turbines is formally documented within the UK Air Navigation Order 2009 (Article 220 refers). Furthermore, the Directorate of Airspace Policy has published a policy on offshore

¹ These documents are available at <http://www.bwea.com/pdf/Wind-Energy-and-aviation-interim-guidelines.pdf> and <http://www.caa.co.uk/docs/33/Cap764.pdf> respectively. Please note that after a full review CAP 764 was re-issued on 12 February 2009.

lighting², which highlights the latest developments in this area, including lighting to support helicopter operations within the wind farm if applicable.

- Markings / Colour Scheme. International aviation regulatory documentation requires that the rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines that are deemed to be an aviation obstruction should be painted white, unless otherwise indicated by an aeronautical study.
- Aviation Promulgation. The developer should be aware that there would be a requirement for the Rampion turbines (and all other similar offshore developments) to be charted for aviation purposes. In addition to the requirements of DfT / ODPM Circular 1/2003, Annex 2, it is recommended that the Defence Geographic Centre be kept fully apprised of the windfarm's development. Appropriate contact details are:

Defence Geographic Centre
AIS Information Centre
Jervis Building
Elmwood Avenue
Feltham
Middlesex
TW13 7AH

Telephone: 0208 818 2708

We also recommend that as and when construction time frames are established specific consultation with the CAA is conducted such that charts can be updated in a timely fashion and the turbines can be collectively promulgated to the aviation community as aviation obstacles.

The associated ES will need to present the findings of all aviation-related consultation and will accordingly be expected to include the consideration of various potential issues highlighted above.

I hope this information and comment is of assistance. Please do not hesitate to get in touch with me if clarification of any point is required.

Yours Sincerely,

{via email}

Paul Askew
Renewable Energy Project Officer

² The policy can be found at <http://www.caa.co.uk/docs/7/20100728LightingOfOffshoreWindTurbinesWinchLightingIssueDate20100802.pdf>

Tel: 01623 637 119 (Planning Enquiries)

Email: planningconsultation@coal.gov.uk

Web: www.coal.gov.uk/services/planning

David Price – EIA and Land Rights Advisor
Infrastructure Planning Commission

[By Email: ipcscopingopinion@infrastructure.gsi.gov.uk]

27 September 2010

For the Attention of: Owain George

Dear Owain

PLANNING APPLICATION: 140910 EN010032 243108

Proposed Rampion Offshore Wind Farm – Scoping Opinion

Thank you for your consultation letter of the 14 September 2010 seeking the views of The Coal Authority on the above planning application.

I have reviewed the proposals and confirm that The Coal Authority has no observations or specific comments.

Yours sincerely



Miss Rachael A. Bust *B.Sc.(Hons), MA, M.Sc., LL.M., AMIEnvSci., MIPSM, MRTPI*
Deputy Head of Planning and Local Authority Liaison

From: [Fairham, Paul](#)
To: [IPC Scoping Opinion;](#)
Subject: Rampion Offshore Wind Farm ref 104910_EN010032_243108
Date: 28 September 2010 12:30:54

Thank You for your letter of the 14th September regarding the above project. Crawley BC has no comment to make on this project given the geographical relationship of the site to Crawley.

Regards
Paul Fairham
DC Manager

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Mr D Price
Infrastructure Planning
Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

IPC

20 SEP 2010

REF:

Ann Morley
Secretary, Disabled Persons Transport
Advisory Committee
2/23 Great Minster House
76 Marsham Street
London
SW1P 4DR
Telephone: 020 7944 8012
Fax: 020 7944 6998
E-mail: dptac@dft.gsi.gov.uk
16 September 2010

Dear Mr Price

Proposed Rampion Offshore Wind Farm

Thank you for your letter dated 14 September requesting views from the Disabled Persons Transport Advisory Committee (DPTAC) regarding the above document. DPTAC would advise that you consult with local disability groups or access groups in the area who are more likely to be affected by your proposals and who could offer more relevant comments on issues such as this.

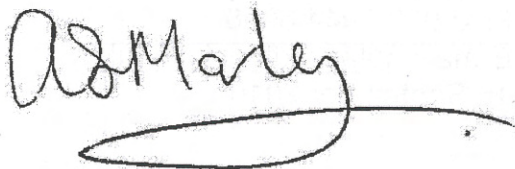
DPTAC is a statutory advisory body to Ministers on transport matters as they relate to the interests of disabled people. It was established under the Transport Act 1985 to advise the Government on the transport needs of disabled people. DPTAC has identified four overarching principles on which to base its advice to Government, other organisations and disabled people, which are that:

- accessibility for disabled people is a condition of any investment;
- accessibility for disabled people must be a mainstream activity;
- users should be involved in determining accessibility;
- achieving accessibility for disabled people is the responsibility of the provider.

These principles are the basis of DPTAC's response to most consultations. For further information please visit our website at www.independent.gov.uk/dptac

I would be very grateful if you could remove DPTAC from your Database

Yours Sincerely

A handwritten signature in black ink, appearing to read 'Ann Morley'. The signature is fluid and cursive, with a long horizontal stroke extending from the end of the name.

Ann Morley
Secretary

**INFRASTRUCTURE PLANNING COMMISSION – PROPOSED RAMPION
OFFSHORE WIND FARM (SCOPING OPINION)**

EAST SUSSEX COUNTY COUCL (ESCC) RESPONSE

Thank you for the opportunity to comment on the Scoping Opinion for the proposed Rampion offshore wind farm. This response provides officer's comments on behalf of East Sussex County Council.

General Comments:

The proposed comprehensive programme of investigation into the possible impacts of the development is welcomed.

On-shore:

The onshore elements will only affect West Sussex. West Sussex County Council and the South Downs National Park Planning Authority should be advised to seek compensation payments as a contribution to the conservation and enhancement of the South Downs landscape which would be affected by the works. Even though these are temporary in nature, planning policy requires that this type of disturbance in protected landscape should be compensated for. A recent example of this was when ESCC successfully secured compensation from the Water Authority for rights of way enhancements for a pipeline which was put across the High Weald.

Off-shore:

The site development area and the offshore cable corridor lie within or partially within areas covered by the archaeological advice service at ESCC for East Sussex districts and boroughs and Brighton & Hove City Council.

The background work undertaken by Wessex Archaeology (2007), and other similar consultation, has started the project in the right direction. There is an understanding of the potential for early prehistoric archaeology when sea levels would have been lower exposing what is now sea bed as a terrestrial environment. This is in addition to the post Upper Paleolithic/Mesolithic inundated environment where all potential will be limited to wreck sites. There is considerable potential with regard to both marine heritage aspects but there is little detail in this report about how evaluation of that potential will be undertaken. Evaluation of potential will need an integrated approach, with marine archaeologists having an early input into designing sea floor geophysical and geotechnical studies to ensure that adequate data is available for assessing potential.

The offshore development will impact on views from the East Sussex coast and the South Downs National Park, therefore the assessment needs to fully address this issue. There may be other key issues to be considered within the Zone of Visual Influence (ZVI); when more detail is provided and the 35km zone is established these should be refined. Photomontage views of the wind farm from some of the key viewpoints in East Sussex should be produced in the future, however at this stage; it would be useful to see which views are at least significant.

The visual impact on recreational users should be recorded as part of the visual assessment, notably from open access areas on the South Downs, pleasure craft and beach/seafront users.

The inclusion of marine and coastal ecology, site designations and their potential impacts and uses, is welcomed. However the ongoing process to designate national Marine Conservation Zones (MCZs), a process investigating use and impacts on the marine environment in the same area, and with a number of potential related issues, is only mentioned briefly and requires further consideration. Further specific information is provided below.

Specific Comments:

The Scoping Opinion needs to be updated in terms of recent changes to regional policy i.e. the revocation of the South East Plan (the Regional Spatial Strategy). The document should also be consistent with recent changes to national planning policy, i.e. reference should be made to the new PPS5 instead of PPGs 15 and 16.

EIA Process:

Ref: 4.7 In terms of cumulative effects, there is little mention of the effect of displacement of activity. The Rampion proposed area is noted for its high concentration of industry use (commercial fisheries, marine aggregate extraction) and recreation, as well as shipping. Any development which restricts any of these activities may cause them to be displaced elsewhere; however this is not mentioned in the Scoping Report.

Ref: 4.7 Further cumulative effects are also possible with the introduction of MCZs. It is imperative that Eon, and their subsequent contractors, fully consider the effects this impact may have on the wider environment. Such a large scale development will likely have an impact on species within the project area, and conceivably this may cause some to migrate to neighbouring areas. Such migration will undoubtedly have an impact on biodiversity levels within the immediate vicinity of the project area, and may also put undue pressure on neighbouring areas. Considering the cumulative effects of the project across a wider area would be advisable.

Offshore EIA Topic Areas to be assessed:

Ref: 5.1 This section must include information on terrestrial archaeology/cultural heritage (within West Sussex) and it should be stressed that the EIA needs to cover all three areas (array, cable corridor and onshore).

Ref: 5.1 The document states that marine archaeology can be scoped out at the operational stage. It is unclear as to how this can be demonstrated at this stage. It would also be safer not to scope out the consideration of the potential for operational impacts on marine archaeology.

Ref: 5.3 The inclusion of the importance of subtidal and intertidal chalk habitats, and their prominence off the Sussex Coast area, is welcomed. There are several such intertidal wave-cut chalk platform areas along the coast in the intertidal zone, as well as shallow underwater chalk reefs, which are thought to be among the only sites in the UK. A number of these are currently designated as Marine Sites of Nature Importance (mSCNIs), (please note that these are not potential mSNCIs as stated in the scoping report). In addition, the Seven Sisters voluntary marine conservation area (vMCA) should be mentioned here. MCZ sites should also be mentioned within this section, some of which may be designated for particular habitats and species which are specific to particular sediment types or benthic environment characteristics.

Ref: 5.3.1.2 The report mentions data gathered through the Seasearch program as a source of information to advise decision makers. Shoresearch is a programme of

intertidal surveys which have been carried on a regular (monthly) basis since 2008. This data may also assist in the decision making process, enabling analysts to obtain a broader picture of the marine environment within that area. There is a possibility that this information could be made available. It is currently being held at the Booth Museum of natural history.

Ref: 5.3.2 The last bullet point states that a potential impact of the development will be 'colonisation of turbines leading to increased biodiversity (operational phase)'. Whilst there are studies demonstrating colonisation of structures in the marine environment, this will not necessarily lead to an overall increase in biodiversity across a whole site and is very much dependent upon several factors not mentioned here, and therefore this statement should be clarified.

Ref: 5.4.3 This section covers gaps in knowledge of local fish and shellfish ecology. It is stated that this will be discussed with the regulatory authorities Natural England and Cefas, however Sussex Sea Fisheries District Committee (and partners) have carried out extensive research in the area and should therefore also be consulted.

Ref: 5.5 This section does not consider the proposed Ramsar, SPA, SAC and other sites within the vicinity of the proposed Rampion site (e.g. the proposed SAC at Pevensey Levels). Natural England should be consulted and these potential sites also considered. Potential MCZs should also be considered within this section.

Ref: 5.5.1.1 There are currently 25 mSNCIIs situated around the coastal waters of East and West Sussex, as mentioned briefly above. Although mSNCI is not a statutory designation, these sites are extremely important at a local and national level for their varying wildlife interest. It is hoped that Eon will recognise this fact throughout their evaluation of the project area, and work towards safeguarding these areas from damage.

Ref: 5.5.1.2 The VMR is known as the 'Seven Sisters Voluntary Marine Conservation Area' or VMCA.

Ref: 5.5.1.3 contains a brief description of the process to identify National MCZs. However the potential impact of MCZ designations is omitted throughout the remainder of the scoping report. Such potential MCZs could have a large direct and / or indirect impact on many of the topics and issues mentioned within the Scoping Report, therefore more information is required on such potential zones. The MCZ process, (through the regional 'Balanced Seas' project, has collated a large amount of data relating to a number of the topics identified in the Report; including large data sets relating to usage/activity (recreational, commercial and otherwise) and baseline ecology. Many of the consultees listed in various sections have already submitted large amounts of information through the MCZ process. To repeat this exercise would seem unnecessary.

Ref 5.8.1: This section states that views from the ferry are to be assessed. It is highly recommended that views from recreation boats in the area are also considered, as these are sensitive receptors.

Ref: 5.9 Historic Environment Records (HERs) should be referred to as a key source and it should be made clear (within 5.9.3) that there are two principle HERs, one for East Sussex (and Brighton and Hove) and one for West Sussex. There is also a reference to 'Sussex County Council' which needs altering.

Ref: 5.9.1 It is recommended that if the IPC wish to seek additional information on wrecks, it is advised that the applicant consult Dr Peter Marsden at the Shipwreck & Coastal Heritage Centre in Hastings.

Ref: 5.12 This section talks of impacts on diving and recreational sea angling (amongst other activities). These recreational activities, along with many others in the area, have been investigated and categorised through the MCZ designation process which would help provide some of the baseline information. This would prevent duplication of work and/or consultation.

Ref: 5.13 Much of the commercial fishing activity within the vicinity of the proposed Rampion wind farm is of a small scale and therefore is not covered by VMS data. Data from the Sussex Sea Fisheries District Committee, and data collected directly from such small scale fisheries through the Balanced Seas MCZ project would add valuable information on fishing activity and allow more accurate identification of potential impacts.

Onshore EIA topic areas to be assessed

Ref: 6.2 Agricultural land is a vital resource which spans all areas of the natural environment. As well as its importance in providing a range of products, agricultural areas can be a valuable resource for a variety of wildlife. Many agricultural areas have entered into stewardship schemes, reflecting their intention to give consideration to wildlife interest during the course of their management. Care should be taken to protect agricultural areas from damage during the course of the project. Where damage to these areas is unavoidable, appropriate mitigation should be implemented to reduce / negate any such damage.

Ref: 6.5 Sites which display a national or statutory designation are an important part of the wildlife network; however it is equally important to recognise locally designated sites. Such sites are valuable for their individual wildlife interest, and provide a level of connectivity across the wider environment. West Sussex supports a variety of locally designated sites on both the coastal fringe and further inland. The range of locally designated sites across the area include SNCIs, Regionally Important Geological Sites, and Notable Road Verge sites. It is vitally important for Eon to avoid damage to such areas during the onshore phase of the project. Where such damage is unavoidable, Eon should formulate appropriate mitigation strategies to reduce / negate the impact of such activities.

Rebecca Sheridan - Strategic Planner

(On behalf of officers at East Sussex County Council)

11 October 2010



ENGLISH HERITAGE

SOUTH EAST REGION

Owain George
Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

Direct dial: 01483 252032

Fax: 01483 252001

Our reference: NSIP/0016/00

Your reference:
140910_EN010032_243108

Date: 11th October 2010

Dear Mr George

**Proposed Rampion Offshore Windfarm
E.ON Climate and Renewables
Infrastructure Planning (EIA) Regulations 2009 SI 2263**

Thank you for your letter of the 14th September, in which you referred us to the Rampion Offshore Wind Farm Scoping Report (Sept 2010) and asked us to inform the Commission of the information that we consider should be provided in the environmental statement. We offer our comments on the Scoping Report below.

English Heritage is the Government's advisor on all aspects of the historic environment in England: we are an Executive Non-departmental Public Body sponsored by the Department for Culture, Media and Sport (DCMS) and we report to Parliament through the Secretary of State for Culture, Media and Sport. The National Heritage Act (2002) made English Heritage responsible for maritime archaeology in the English area of the UK Territorial Sea, however we note that part of the proposed development might be located within the UK Marine Area (as described by the Marine and Coastal Access Act 2009) and so any advice for development within the UK Marine Area is offered without prejudice to our responsibilities as provided by the National Heritage Act 2002. We have therefore copied this response to DCMS, who may wish to comment.



EASTGATE COURT 195-205 HIGH STREET GUILDFORD SURREY GU1 3EH

Telephone 01483 252000 Facsimile 01483 252001
www.english-heritage.org.uk

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Section 3 – Planning Policy Context

3.1 Planning context

Please note that *Planning Policy Guidance Notes 15 and 16* have been cancelled and replaced by *Planning Policy Statement 5: Planning for the Historic Environment (PPS5)*, which says that heritage assets are a material consideration to the planning and impact assessment processes. Although *PPS5* is not mentioned in this section, we note that the scoping report does refer to it in the onshore archaeology and cultural heritage section (6.6.1.2).

Section 4 – EIA process

4.7 Cumulative, secondary and indirect impacts

We recommend that the assessment of cumulative impacts also takes into account the guidance for the assessment of cumulative impacts on the historic environment from offshore renewable energy (2008) by Collaborative Offshore Wind Research into the Environment (COWRIE).

Section 5 – Offshore EIA topic areas to be assessed

5.1 Overview

We do not agree that marine archaeology during operation should be scoped out of the EIA for the following reasons:

- o The foundation design of turbines has not yet been agreed and so it is not possible, at this stage, to know if any heritage assets on the seabed may be affected by scouring, or other disturbances, caused by proximity to turbine foundations.
- o During operation, it may be necessary to place rock armour or other material on the seabed to protect foundations or cables, and the impact of such work on heritage assets should be considered as part of the EIA.
- o Reference to an archaeological protocol is too imprecise; it does not properly explain how impacts on heritage assets will be mitigated.



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5.2.1.2 Seabed geology

We note that geophysical surveys are intended to determine the exact location of palaeo-channels within the zone, but also that they should chart obstructions, man-made objects, debris and wrecks (section 5.2.31). All of these features have potential to be of heritage interest (as noted in 5.9.1.1) and we recommend that the applicant contacts English Heritage's maritime team as soon as possible to discuss how to incorporate archaeological objectives into the surveying campaign.

5.2.3.3 Impact assessment

We recommend that the proposed scope of the assessment should also include consideration of *Historic Environment Guidance for the Offshore Renewable Energy Sector* (2007) by COWRIE.

5.8 Landscape, seascape and visual

5.8.3 Proposed assessment methodology

We recommend that the applicant makes use of English Heritage's work on Historic Seascape Characterisation (HSC), which analyses the cultural processes shaping the present land- and seascapes in coastal and marine areas and maps their character in a manner similar to Historic Landscape Characterisation (HLC). Past human activity has had a significant effect on all aspects of the present coastal and marine environment, just as on land, and historic characterisation tools allow the historic landscape from land through coast to sea to be encompassed in a common framework and to stand alongside natural environment datasets.

A nationally-applicable HSC method was finalised in March 2008 from the England's Historic Seascapes Programme, funded by the Aggregates Levy Sustainability Fund (ALSF). That HSC method has now been implemented across England's north east coast and adjacent seas. Along with four ongoing HSC projects, also ALSF-funded, coverage will extend to about 60% of England's seas and adjacent UK Controlled Waters by March 2011, including all areas of current



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or prospective marine aggregates extraction and contributing to a national HSC database.

The applicant should find this methodology helpful when addressing the capacity of the seascape to accommodate change during the process of Environmental Impact Assessment. Resources from the England's Historic Seascapes Programme, including the Method Statement detailing the national HSC methodology, are available at: <http://ads.ahds.ac.uk/project/alsf/seascapes.cfm>

5.9 Marine archaeology

5.9.3 Proposed assessment methodology

We note that the report says that geophysical survey data will be "reviewed by appropriately qualified archaeologists", however we think that this statement is potentially ambiguous. To clarify, we think that appropriately qualified archaeologists should be part of the earliest stage of survey planning to ensure that the data obtained is of sufficient quality and quantity to support later archaeological interpretation. Furthermore, archaeologists should have input to the engineering assessment of geotechnical and geophysical survey material. Integrating archaeological objectives and assessment in these ways is the appropriate way to achieve an adequate archaeological mitigation package for the Environmental Statement. We would like to discuss with the applicant their offshore survey programmes as soon as possible to this end and we recommend that an archaeological Written Scheme of Investigation (WSI) is devised in consultation with English Heritage. Published guidance on how to achieve this can be found in *Historic Environment Guidance for the Offshore Renewable Energy Sector*.

We also recommend that the applicant should take account of ongoing work by COWRIE to produce guidance on optimising geotechnical survey results to support archaeological interpretation (further information about this project can be supplied on request) and the recently the completed South Coast Regional Environmental Characterisation project supported by the Aggregates Levy Sustainability Fund (see: <http://www.alsf-mepf.org.uk/projects/rec-projects.aspx>).



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Section 6 - Onshore EIA topic areas to be assessed

6.6 Archaeology and cultural heritage

6.6.2 Key potential environmental impacts

It seems to be implied that the only onshore impacts will arise from the excavation for, and installation of the cable, however, the construction and operation of the substation near Bolney may also have direct physical impacts on heritage assets, as well as impacts on the setting of nearby or associated heritage assets.

With regard to the issue of the setting of heritage assets generally, we would draw the applicants' attention to the provisions of *Planning Policy Statement 5* (Policy HE10), which says that the effect of development on the setting of a heritage asset should be taken into account when considering applications, and English Heritage's guidance, *The Setting of Heritage Assets: English Heritage guidance, consultation draft* (2010, English Heritage).

Whilst we concur that the effects of the works for the cable on the visual aspects of setting are likely to be temporary (although the cable corridor may take some years to recover after completion of works), it is possible that works may also have an effect on non-visual aspects of the setting of heritage assets by severing associations and relationships.

We also concur that no activities likely to significantly affect heritage assets or their setting are likely to occur during operation, however we think that decommissioning could have an effect. We therefore recommend that assessment of impacts on heritage assets of decommissioning should not be scoped out of the EIA.

6.6.3 Proposed assessment methodology

The assessment methodology for heritage assets will require careful planning and therefore we recommend that the outline methodology in this section is developed into an archaeological WSI in discussion with the County Archaeologist. We also recommend that the methodology includes provision for some archaeological field evaluation to be undertaken to inform the



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impact assessment, as this work may be necessary to characterise areas of known archaeological potential, or gaps in the historic environment record, before the potential impact of the work can be appreciated. Archaeological field evaluation might involve techniques such as geophysical survey, palaeoenvironmental and geoarchaeological survey and archaeological trial trenching,

The County Archaeologist should be consulted as soon as possible as he will be able to provide historic environment record information and be able to advise about heritage assets, character and potential, and about the production of a VSI. English Heritage will be happy to advise again at the pre-examination and examination stages of the application process.

6.7 Landscape and visual impact

6.7.1 Preliminary environmental baseline

The imprint of the of past human activity on landscape is known as time- depth and is one of landscape's most important characteristics. It recognises that the long sequence of events and actions that have produced the present environment, and which is visible within landscape, is the result of human activity as well as natural processes. Time-depth can be seen in field boundaries, the patterns of settlement and route ways, and buried archaeological remains and earthworks. It is also apparent in human influence on vegetation patterns. An important aspect of understanding time-depth is recognising that human influence has occurred, and can be traced, even where the landscape appears natural. Historic Landscape Characterisation is a methodology that is complementary to National and County Character Area assessment and should be used in the assessment of landscape and visual impact to take account of the inherited character of landscape. The Integrated Landscape Character Assessment for the South Downs is a useful document but was written prior to completion of the HLC for Sussex.

6.7.2 Key potential environmental impacts

The second paragraph on page 112 seems to place emphasis on the effect of works on individual landscape features, such as designated heritage assets. However, the effect on landscape character may arise from cumulative effects on areas as well as from specific effects



EASTGATE COURT 195-205 HIGH STREET GUILDFORD SURREY GU1 3EH

Telephone 01483 252000 Facsimile 01483 252001
www.english-heritage.org.uk

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English Heritage will use the information provided by you to evaluate your application for Scheduled Monument Consent. Information contained in this application and any information obtained from other sources will be retained in all cases in hard copy form and/or on computer for administration purposes and future consideration, where applicable.



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on individual assets. This is partly recognised in the acknowledgment of the cumulative effects on hedgerows on page 12.

Landscape character also comprises non-visual aspects that give it meaning and these aspects, or the spatial relationships between them, can be impacted by works, though the works themselves eventually leave no visible trace.

We wish to emphasise that an areal, character-based approach that also takes into account non-visible aspects of landscape should be adopted in addition to a consideration of views.

6.7.3 Proposed assessment methodology

In addition to the guidance on landscape and visual impact assessment, we recommend that the following guidance on the assessment of historic landscape character and the setting of heritage assets is also consulted: *The Setting of Heritage Assets: English Heritage guidance, consultation draft* (2010, English Heritage) and *Using Historic Landscape Characterisation* (2004, Clark, Darlington and Fairclough, English Heritage).

We hope that you will find our comments useful. Please let us know if we can be of any further assistance.

Yours sincerely

PAUL ROBERTS

Inspector of Ancient Monuments

cc Annabel Houghton, Architecture & Historic Environment Division, DCMS
Alan Gibson, the Marine Management Organisation
Mark Taylor, County Archaeologist for West Sussex
Casper Johnson, County Archaeologist for East Sussex



EASTGATE COURT 195-205 HIGH STREET GUILDFORD SURREY GU1 3EH

Telephone 01483 252000 Facsimile 01483 252001
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English Heritage will use the information provided by you to evaluate your application for Scheduled Monument Consent. Information contained in this application and any information obtained from other sources will be retained in all cases in hard copy form and/or on computer for administration purposes and future consideration, where applicable.

Ms Joanne Golding
Infrastructure Planning Commission
Temple Quay House (2 The Square)
Temple Quay
Bristol
Avon
BS1 6PN

Our ref: HA/2010/110706/01-L01
Your ref: 140910_EN010032_238723
Date: 08 October 2010

Dear Ms Golding

**PROPOSED RAMPION OFFSHORE WIND FARM (“the Project”)
E.ON CLIMATE AND RENEWABLES (“the Applicant”)
INFRASTRUCTURE PLANNING (ENVIRONMENTAL IMPACT ASSESSMENT)
REGULATIONS 2009 SI 2263 (“the EIA Regulations”)**

Thank you for your Environmental Impact Assessment (EIA) Scoping consultation letter dated 14 September 2010

Environment Agency Position

We have reviewed the Scoping Report dated September 2010 prepared by RSK. This report appears to be well considered following the good practice guidance for undertaking EIA. However we have a few technical comments to make in respect of biodiversity, flood risk and water quality to ensure that the Environmental Statement (ES) will appropriately address the environmental issues we consider are of most importance for this proposal.

Technical Comments and advice

I hope that you find the following technical comments and advice helpful.

SECTION 5: OFFSHORE TOPICS TO BE DISCUSSED

5.4: Fish and Shell Fish Ecology

5.4.3: Proposed Assessment Methodology

We would expect the following to be included in the assessment methodology:

Environment Agency
Guildbourne House Chatsworth Road, Worthing, West Sussex, BN11 1LD.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Cont/d..

- Potential impacts on migratory fish such as sea trout, salmon and eels from electro magnetic fields
- Potential impacts from the construction operations such as piling and loss of habitat and disturbance to prey.
- Suitable mitigation to be demonstrated.

SECTION 6: ONSHORE TOPICS TO BE DISCUSSED

6.4: Ground Conditions and Water Resources

6.4.3: Proposed Assessment Methodology

We would expect the following to be included in the assessment methodology:

- The Shoreham to Lancing Sea Defences fall under the jurisdiction of the Environment Agency. Under the Water Resources Act 1991 the integrity of these defences must be ensured.
- **All** watercourses along the proposed route must be identified, including ditches and drains.
- Several of these watercourses have status under the Water Framework Directive (WFD). It will be necessary to demonstrate how this development will contribute to the delivery of WFD actions on impacted waterbodies.
- A number of main rivers will be crossed, including the tidal Adur. The method of crossing these must be appropriate to the type and size of watercourse. All crossings must be below bed level.
- The impacts on flood storage and flow routes from excavation and storage of material in the floodplain in accordance with the principles of Planning Policy Statement 25 - "Development and Flood Risk (PPS25).

6.5 Ecology and Nature Conservation

6.5.3 Proposed Assessment Methodology

We would expect the following to be included in the assessment methodology:

- Likely impacts (construction and operational) on water and wetland habitats on site and within the surrounding area, including potential impacts on the existing hydrology
- Detailed, up-to-date ecological surveys (habitats and species) of the development site, undertaken at an appropriate time of year by a suitably qualified ecologist. We would expect to see justification and at least like for like compensation for any wetland habitat/feature loss (and terrestrial habitat for wetland species e.g. Great Crested Newt)

- The extent to which it is possible to avoid or mitigate against adverse effects, and any limitations of mitigation, including methods statements demonstrating how impacts will be minimised
- If mitigation is required it is important to assess how effective any measures are likely to be to establish whether the potential harm and risk posed to the environment by development will be addressed. There could be potential for off site enhancements as mitigation for any impacts arising from the development

We would want to be included in early consultations to define the scope of detailed surveys for habitats and species especially those of a wet nature. We would be more than happy to discuss enhancements with the applicant.

6.9: Recreation

6.9.3: Proposed Assessment Methodology

This section concludes that no activities with the potential to significantly impact on recreation are expected. As a consequence recreation impacts are scoped out of the EIA. However, the construction impacts across the beach areas may have an impact on water quality through pollution, specifically affecting bathing water quality for which there are statutory water quality standards. This risk should be considered within the EIA.

Further details to be addressed

- 1) Under the Environmental Permitting Regulations 2010, depending on the volume of waste generated during this project will require an Environmental Permit or an exemption from one.
- 2) Due to the size of this proposal a Site Management Plan will need to be in place.
- 3) Where any works are proposed near or crossing a watercourse, this may require the prior Flood Defence Consent of the Environment Agency.

This includes:

- any works whatsoever on, over, or under any sea defence or between low water mark and a distance of 15 metres from the landward toe of the embankment, under our Byelaws
- any works whatsoever in, over, or under the channel of tidal main rivers, on its banks or within 15 metres from the landward toe of the tidal embankment under Section 109 of the Water Resources Act 1991 and/or Byelaws
- any works whatsoever in, over, or under the channel of non-tidal main rivers, or on its banks within 8 metres from the top of the channel, under Section 109 of the Water Resources Act 1991 and/or Byelaws
- where the watercourse is unclassified, any proposed culvert, diversion, weir, dam, or like obstruction to the flow of the watercourse (including temporary works) requires consent, under the Land Drainage Act 1991.

The comments we set out above are without prejudice to future decisions we make regarding any applications subsequently made to us for our permits or consents for operations at the site.

I trust that the above comments are satisfactory but if you require any further information please contact me.

Yours sincerely

HELEN TIER
Planning Liaison Officer (South Downs Area)

Direct dial 01903 703862

Direct e-mail planning.southdowns@environment-agency.gov.uk

From: [Alan Slee](#)
To: [IPC Enquiries;](#)
cc: [IPC Scoping Opinion;](#)
Date: 16 September 2010 14:46:20

Dear David,

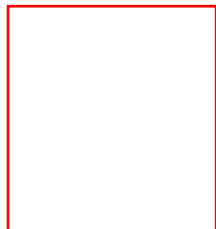
**Environmental Impact Assessment, Proposed Rampion
Offshore Wind Farm (off Brighton Coastline)
(140910_EN010032_243108)**

Further to your communication to E S Pipelines Ltd, ESP Networks Ltd, ESP Pipelines Ltd, ESP Electricity Ltd and ESP Connections Ltd dated 15 September 2010 I can confirm that our businesses have no comments at this stage.

Regards,

Alan Slee
Operations Manager

DD 01372 227567
Mobile 07766 802070
Fax 01372 386203



Hazeldean,
Station Road,
Leatherhead
KT22 7AA
(01372 227560 2 01372 377996

[MAP](#)

<http://www.espipelines.com>

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From: [&box_FPLplantprotection_conx,](#)
To: [IPC Scoping Opinion;](#)
Subject: RE: Rampion offshore wind farm
Date: 16 September 2010 12:45:19

David Price
EIA and Land Rights Advisor
Infrastructure Planning Commission (IPC)
David,

I have examined the affected area for the Rampion offshore wind farm. I can confirm that we do not have any plant within the offshore section. However we do have a number of sites within the Onshore Cable Corridor. We will be happy to supply information about these sites prior to any onshore excavations taking place.

Kind regards

Graham Penlington
Admin Assistant
Fulcrum Pipelines Limited
Rotherham

T: 01709 845375
F: 0845 6411808
E: graham.penlington@fulcrum.co.uk
I: www.fulcrum.co.uk

From: IPC Scoping Opinion [<mailto:IPCScopingOpinion@infrastructure.gsi.gov.uk>]
Sent: 15 September 2010 10:47
To: [&box_FPLplantprotection_conx,](#)
Subject: Rampion offshore wind farm

Dear Sir/Madam,

Please find attached an electronic version of the scoping consultation request for Rampion offshore wind farm.

We look forward to receiving your response.

Kind regards <<100914_EN010032_243108_Letter_to_stat_consultees[1].doc>>

David

David Price
EIA and Land Rights Advisor
Infrastructure Planning Commission (IPC)
Temple Quay House
Temple Quay
Bristol
BS1 6PN

Direct Line: 0303 444 5055
Helpline: 0303 444 5000
Email: David.Price@infrastructure.gsi.gov.uk
Website: www.independent.gov.uk/infrastructure

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FULKING PARISH COUNCIL

Chairman: Mr A R Brooks
Clerk to the Council: Mrs P Hazard
Laurel House, The Street,
Fulking, Henfield BN5 9LU
Phone: 01273 857957

29 September 2010

Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

IPC
- 5 OCT 2010
REF:

Attn of Owain George

Dear Sirs

Proposed Rampion Offshore Wind Farm
Your Ref 140910_EN010032_243108

Thank you for your letter of 14 September regarding the "scoping opinion" for the above project. Fulking Parish Council would like to make the following comments in relation to the environmental statement.

- There should be no overhead cables over the South Downs
- The path of the underground cables needs to be assessed in terms of likely long-term damage to the land. There should be no digging up of the Downs as this will scar the landscape. For example, the scars of the old railway track up to the Devils Dyke at Poynings which were removed in 1909 can still be seen today. For this reason underground cables next to the River Adur from Shoreham might be a possible route.
- If underground cables pass through the Downs this should be via the horizontal drilling method (referred to in the Scoping Report) which would not involve digging up the Downs. One area that could be explored is removing the overhead cables that pass over the Downs at Fulking and combining all the cables to be put underground.

Yours sincerely



Mrs Paula Hazard
Parish Clerk

cc South Downs National Park Authority - Andrew Shaxson (Chair Planning Committee)
E.On Climate and Renewables UK Ltd - Eleri Owen
Poynings Parish Council

From: [Hassock Parish Council](#)
To: [IPC Scoping Opinion;](#)
Subject: Proposed Rampion Offshore Wind Farm
Date: 05 October 2010 15:48:06

Your Ref: 140910_EN010032_243108

On behalf of Hassocks Parish Council I am responding to your letter dated 14 September 2010 regarding the proposed Rampion Offshore Wind Farm:

The Parish Council is grateful for being consulted and at this stage has no comment to make, but looks forward to receiving further information of a more specific nature, when it may wish to comment.

Pat Elliott
Assistant to the Clerk to the Council

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Bee Crawford

From: Bee Crawford
Sent: 12 October 2010 09:14
To: 'ipcscopingopinion@infrastructure.gsi.gov.uk'
Cc: Stephen Cantwell
Subject: Proposed Rampion Offshore Wind Farm

IPC
17 OCT 2010
REF:

Dear Mr Price

EIA Scoping : Proposed Rampion Offshore Wind Farm (Your reference 140910_EN010032_243108) - Scoping comments from Havant Borough Council

Thank you for your scoping consultation letter of 14th September to the former Head of Development and Technical Services. I am writing in reply on behalf of the new Executive Had for Planning and Built Environment and Havant Borough Council, Mrs J Potter. I will send the following comments by letter following this email.

Although it has not been possible to study the scoping report in detail, it is helpful that it is divided into offshore and off-shore impacts. As the development project lies some 35km and more from Havant Borough, impacts may therefore include indirect effects; these comments are offered in order to ensure that such impacts are included.

Navigation: I note that the development is intended not to obstruct navigation channels but in any planning application I would suggest that these lanes are also shown in the EIA, including diversions if any and the classes of vessel which might be affected. Effect on leisure-craft should be included.

Marine and shoreline conservation: Chichester and Langstone Harbours are designated as international sites of nature conservation (RAMSAR, SPA & SAC as well as SSSI), protected species including Brent Geese are present. EIA should include consideration of the impact on flight and migration patterns and feeding grounds of marine and coastal wildlife, (including the impacts of silt and benthic disturbance).

Coastal management: Impacts on marine currents and implications for coastal processes/mechanisms and existing and planned defences should be included, including consideration of the coastal management plans for the Hampshire/IOW/West Sussex coast.

Visual impact: Impact during differing weather and visibility conditions should be included, with view point assessment to include both coastal and inland vantages. The east coast at Hayling Island and the harbour areas at Langstone and Emsworth should be considered. Night-time illumination, particularly of tall structures should be also be included.

Risk of accidents: Impacts on maritime safety and conservation should be included. Management response should be included in accident management plans.

Social and economic: the source of raw materials, manufactured components and manpower should be included. In particular whether there are opportunities for the use of the local workforce. Any impact on leisure craft should be considered, with consideration of the harbour facilities at Emsworth, Langstone and Hayling Island

Transport: The delivery of large components to the site may affect coastal roads. There are opportunities for water-based transport which should be included

The Council would wish to be consulted when the formal application is submitted and would wish to comment again if there is any further scoping stage for this project.

Thank you for your consideration. I would be obliged for your confirmation that this correspondence has been received.

Yours sincerely

12/10/2010

Stephen Cantwell
Development Control Team Leader
Havant Borough Council
Civic Centre
Havant
PO9 2AX

☎: 023 9244 6509

✉: stephen.cantwell@havant.gov.uk

Chief Scientific Adviser's Group
Building 3.3
Redgrave Court
Merton Road
Bootle
Merseyside
L20 7HS

Your ref:
140910-EN010032-243108

HSE: email:
NSIP.applications@hse.gsi.gov.uk

David Price
Infrastructure Planning Commission (IPC)
Temple Quay House
Temple Quay
Bristol
BS1 6PN

12th October 2010

Dear Mr Price

**PROPOSED RAMPION OFFSHORE WIND FARM ("the project")
E.ON CLIMATE AND RENEWABLES ("the applicant")
INFRASTRUCTURE PLANNING (ENVIRONMENTAL IMPACT
ASSESSMENT)
REGULATIONS 2009 SI 2263 ("the EIA Regulations")**

Thank you for your letter of 14th September 2010 regarding the information to be provided in an environmental statement relating to the above project.

There is little for HSE to comment on at this stage however, there are some observations that it would seem sensible to pass on to E.ON Climate and Renewables.

Major hazards sites and explosives sites within the vicinity of the proposed development

The Rampion Offshore Wind Farm being approximately 13km to 25km offshore does not impinge on the separation distances of any explosive site licenced by the HSE.

There are no fixed explosives sites within the cable corridor outlined in the proposal. However, you should be advised that the Port of Shoreham is a notified COMAH establishment for the storage and handling of Ammonium Nitrate.

The proposal does not provide detail on where landfall for the transfer cable will take place and we are therefore unable to comment definitively on the potential impact until the final route has been decided.

As well as satisfying general UK health and safety legislation (i.e. Health and Safety at Work etc Act 1974 and supporting regulations) the promoter should consider providing a summary of the design standards that will be specified at the wind turbine procurement stage. For example the relevant standards include EN 61400-1:2005 (*Wind Turbines – Design Requirements*), EN 50308:2004 (*Wind Turbines – requirements for design, operation and maintenance*), EN 62271-200:2004 (*High-voltage switchgear and control gear*).

In particular, HSE would prefer any high voltage switch gear to be at a separate level to the entry point for each turbine. Likewise details of the various EU product safety Directives that the turbines will be certified (“CE-marked”) in accordance with, for example the Machinery Directive (2006/42/EC). We would expect each turbine to be equipped with an access lift complying with the same Directive in view of the access height to the nacelle. The guidance in *Planning for Renewable Energy, A Companion Guide to PPS22* also set out other relevant issues.

Electrical Safety

The projects involve connections to the electrical power distribution systems and have an impact on existing generation, transmission and distribution assets on the UK mainland. In the light of that HSE offers the following comments.

As well as satisfying general UK health and safety legislation (i.e. Health and Safety at Work etc Act 1974 and supporting regulations), the proposed design and future operations must comply with the Electrical Safety, Quality and Continuity Regulations 2002, as amended. Generators, distributors, their contractors and others have defined duties in order to protect members of the public from the dangers posed by the electrical equipment used. HSE enforces the safety aspects of these regulations. If you have any doubts about the particular application of these regulations in terms of either the operation or construction of substations, overhead lines or underground cables, please contact Mr J C Steed, Principal Specialist Inspector (Electrical Networks), either at john.steed@hse.gsi.gov.uk or Rose Court GSW, 2 Southwark Bridge Road, London SE1 9HS.

I hope this is useful. HSE looks forward to receiving the formal s42 consultation from the promoter in due course when the plans are sufficiently developed.

Please note any further communication on this project can be sent direct to the HSE designated e-mail account for NSIP applications the details of which

can be found at the top of this letter. All future correspondence should be directed to Miss Vilja Gatrell ; Vee.gatrell@hse.gsi.gov.uk
4S3 Redgrave Court,
Merton Road,
Bootle
Merseyside
L20 7HS
Tel; 0151 951 4607

Yours sincerely

Penny Taylor
Risk Communications Policy Unit

**Centre for Radiation, Chemical and
Environmental Hazards**



FAO Owain George
Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

— I P C —
20 SEP 2010
_ REF: _

Health Protection Agency

Centre for Radiation,
Chemical and
Environmental Hazards

Radiation Protection
Division

Physical Dosimetry
Department

Chilton, Didcot
Oxfordshire OX11 0RQ

Tel +44 (0) 1235 831600
Fax +44 (0) 1235 833891
www.hpa.org.uk/radiation

20 September 2010

Your Ref: 140910_EN010032_243108

Our Ref: EN_RN_WF_100915_0058

Dear Owain George

Thank you for your letter dated 14 September 2010 advising of the proposal by E.ON Climate and Renewables for the proposed Rampion Offshore Wind Farm.

The attached document sets out the Health Protection Agency's (HPA's) position in relation to Nationally Significant Infrastructure Project (NSIP) applications for new onshore and offshore wind farms under the Planning Act 2008. Please do not hesitate to contact me if you require any clarification. In doing so, please send all correspondence to crce.ipcconsultations@hpa.org.uk to ensure we are able to deal with your queries efficiently.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Jill Meara', written over a circular stamp.

Dr Jill Meara

Consultant in Health Protection/Deputy Director, Centre for Radiation, Chemical and Environmental Hazards (CRCE), Health Protection Agency

Encl. Planning Act 2008: HPA position in relation to applications for onshore and offshore wind farms

Planning Act 2008: HPA position in relation to applications for onshore and offshore wind farms

This document sets out the Health Protection Agency's (HPA's) position in relation to Nationally Significant Infrastructure Project (NSIP) applications for new onshore and offshore wind farms under the Planning Act 2008. It is intended for the use of NSIP promoters and should be read in conjunction with the HPA's external guidance. Promoters should refer to the HPA IPC web-pages (www.hpa.org.uk/IPC), which detail the protocol for interacting with the HPA. Electronic-format correspondence concerning NSIP applications should be directed to crce.ipcconsultations@hpa.org.uk

Background

The HPA is a statutory consultee at the pre-application **and** application stages for NSIPs "which are likely to involve chemicals, poisons or radiation which could potentially cause harm to people"¹. The HPA is also required to consider other related planning documents such as Environmental Impact Assessments (EIA), where these accompany a NSIP application.

The HPA response to NSIP consultations covers chemicals, non-ionising and ionising radiation. The HPA will not comment upon wider health determinants as these are outside the HPA's remit as a statutory consultee. Promoters should ensure that they consult other health bodies: Strategic Health Authorities (SHAs), Primary Care Trusts (PCTs), and Health Boards (HBs) (in Wales) are statutory consultees to NSIP. Whilst SHAs are directly named as a consultee for NSIPs in the Regulations², PCTs and HBs come under the wider definition of "statutory undertakers."

Wind farms: non-ionising radiation (power frequency electric and magnetic fields)

The HPA provides advice on standards of protection for exposure to non-ionising radiation, including the power frequency electric and magnetic fields associated with electricity power lines and associated equipment. A summary of this advice is provided as a separate annex to this document.

Wind farms: chemicals

At this point in time, there is no body of evidence conclusively linking wind farms with adverse health effects arising from emissions of chemicals.

When operational, wind generation should not produce emissions, pollutants, or waste products. Installations are therefore highly unlikely to lead to public health impacts associated with emissions of chemicals.

There is potential for impacts to arise during the construction and decommissioning phases from the transport of material and equipment (e.g. accidental leaks, spills, and releases). The movement of material off-site has the potential to lead to impacts, if not properly managed (e.g. associated with contaminated land or dredged sediment). The HPA would expect the applicant to adhere to best practice guidance during these phases and for them to ensure that potential impacts are assessed and minimised. Further HPA recommendations are outlined in the HPA's EIA scoping response template (www.hpa.org.uk/IPC).

Offshore wind farms are located out to sea, away from members of the public, hence the potential for the public to be affected by any emissions from them is very small. Where onshore wind farms are located near to people, there is evidence that they may be more likely to give rise to other environmental impacts. A brief outline is given in the section below. Note that this is intended to provide an overview and does not constitute a literature review or HPA opinion on these aspects.

¹Cited in the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
http://www.opsi.gov.uk/si/si2009/uksi_20092264_en_1

²The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
http://www.opsi.gov.uk/si/si2009/uksi_20092264_en_1

Wind farms: environmental aspects outside of the HPA's remit as a consultee

The most common concerns expressed, with regard to siting of wind turbines close to housing, are related to noise and shadow flicker (which occurs when the sun is at low-levels and the sunlight is intermittently blocked by the blades of the turbine, causing a flashing effect).

Government departments have published some information of relevance with respect to noise and other impacts^{3,4}. It is important that promoters consult Local Authorities regarding potential nuisance impacts.

Wind farms: summary of HPA requirements

The HPA considers that the onus is on the applicant to conduct the assessment of compliance with the referenced advice and policy, and to gather and present the information clearly, leaving no additional analysis necessary on the part of the HPA. The assessment should be clearly laid out, either as an identified section of a report which can be read in isolation or as a separate report.

In respect of electromagnetic fields, compliance with the ICNIRP guidelines should be highlighted. If it is considered not practicable for compliance to be achieved at all locations accessible to the public, the report should provide a clear justification for this. The report should include an appropriate risk assessment showing that consideration has been given to mitigation measures for acute risks. In relation to possible long-term health effects and precaution, the report should include a summary of compliance with HPA advice and Government policy.

³ Wind Power: 10 Myths Explained

<http://webarchive.nationalarchives.gov.uk/+http://www.berr.gov.uk/energy/sources/renewables/explained/wind/myths/page16060.html#MythTurbinesareahealthhazard>

⁴ Moorhouse, A. et al. (2007) Research into Aerodynamic Modulation of Wind Turbine Noise: Final Report. July 2007. Contract no NANR233. Department for Business, Enterprise and Regulatory Reform, University of Salford. URN 07/1235.

Annex

HPA advice regarding power frequency electric and magnetic fields

In March 2004, the National Radiological Protection Board, NRPB (now part of the HPA), published advice on limiting public exposure to electromagnetic fields. The advice was based on an extensive review of the science and a public consultation on its website, and recommended the adoption in the UK of the EMF exposure guidelines published by the International Commission on Non-ionizing Radiation Protection (ICNIRP):-

<http://www.hpa.org.uk/Publications/Radiation/NRPBArchive/DocumentsOfTheNRPB/Absd1502/>

The ICNIRP guidelines are based on the avoidance of known adverse effects of exposure to electromagnetic fields (EMF) at frequencies up to 300 GHz (gigahertz), which includes static magnetic fields and 50 Hz electric and magnetic fields associated with electricity transmission.

For static magnetic fields, ICNIRP recommend that acute exposure of the general public should not exceed to 400 mT (millitesla), for any part of the body. However, because of potential indirect adverse effects, ICNIRP recognises that practical policies need to be implemented to prevent inadvertent harmful exposure of people with implanted electronic medical devices and implants containing ferromagnetic materials, and injuries due to flying ferromagnetic objects, and these considerations can lead to much lower restrictions, such as 0.5 mT as advised by the International Electrotechnical Commission.

At 50 Hz, the known direct effects include those of induced currents in the body on the central nervous system (CNS) and indirect effects include the risk of painful spark discharge on contact with metal objects exposed to the field. The ICNIRP guidelines give reference levels for public exposure to 50 Hz electric and magnetic fields, and these are respectively 5 kV m⁻¹ (kilovolts per metre) and 100 µT (microtesla). If people are not exposed to field strengths above these levels, direct effects on the CNS should be avoided and indirect effects such as the risk of painful spark discharge will be small. The reference levels are not in themselves limits but provide guidance for assessing compliance with the basic restrictions and reducing the risk of indirect effects. Further clarification on advice on exposure guidelines for 50 Hz electric and magnetic fields is provided in the following note on the HPA website:

http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1195733805036

HPA notes the current Government policy is that the ICNIRP guidelines are implemented in line with the terms of the European Recommendation:

http://www.dh.gov.uk/en/Publichealth/Healthprotection/DH_4089500

There is concern about the possible effects of long-term exposure to electromagnetic fields, including possible carcinogenic effects at levels much lower than those given in the ICNIRP guidelines. In the NRPB advice issued in 2004, it was concluded that the studies that suggest health effects, including those concerning childhood leukaemia, could not be used to derive quantitative guidance on restricting exposure. However, the results of these studies represented uncertainty in the underlying evidence base, and taken together with people's concerns, provided a basis for providing an additional recommendation for Government to consider the need for further precautionary measures, particularly with respect to the exposure of children to power frequency magnetic fields.

The Stakeholder Advisory Group on ELF EMFs (SAGE) was then set up to take this recommendation forward, explore the implications for a precautionary approach to extremely low frequency electric and magnetic fields (ELF EMFs), and to make practical recommendations to Government. In the First Interim Assessment of the Group, consideration was given to mitigation options such as the 'corridor option' near power lines, and optimal phasing to reduce electric and magnetic fields.

<http://sagedialogue.org.uk/> (go to "Document Index" and Scroll to SAGE/Formal reports with recommendations)

The Agency has given advice to Health Ministers on the First Interim Assessment of SAGE regarding precautionary approaches to ELF EMFs and specifically regarding power lines and property, wiring and electrical equipment in homes:

http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1204276682532?p=1207897920036

The evidence to date suggests that in general there are no adverse effects on the health of the population of the UK caused by exposure to ELF EMFs below the guideline levels. The scientific evidence, as reviewed by HPA, supports the view that precautionary measures should address solely the possible association with childhood leukaemia and not other more speculative health effects. The measures should be proportionate in that overall benefits outweigh the fiscal and social costs, have a convincing evidence base to show that they will be successful in reducing exposure, and be effective in providing reassurance to the public.

The Government response to the SAGE report is given in the written Ministerial Statement by Gillian Merron, the Minister of State, Department of Health, published on 16th October 2009:

<http://www.publications.parliament.uk/pa/cm200809/cmhansrd/cm091016/wmstext/91016m0001.htm>

The above information provides a framework for considering the health impact associated with the proposed development, including the direct and indirect effects of the electric and magnetic fields as indicated above.

Our Ref: DC/30_09_2010

Your Ref: 140910_EN010032_243108

Mr. Owain George
Infrastructure Planning
Commission
Temple Quay House
Bristol
BS1 6PN

Date: 30 September 2010

Dear Sir,

**Proposed Rampion Offshore Windfarm ("the Project")
E.ON Climate and Renewables ("the Applicant")
Infrastructure Planning (Environmental Impact Assessment)
Regulations 2009 SI 2263 ("the EIA Regulations")**

Thank you for your letter dated 14 September 2010, addressed to Sir Bob Kerslake, our Chief Executive, which has been passed to myself for attention.

After reviewing your consultation in respect of the screening opinion associated with the EIA for this development, this response is to confirm that the Homes and Communities Agency has no comment to make.

Yours sincerely,



Derek Clarke
Planning Manager South East
Homes and Communities Agency

HURSTPIERPOINT SAYERS COMMON
PARISH COUNCIL

PARISH OFFICE • TRINITY ROAD • HURSTPIERPOINT • WEST SUSSEX BN6 9UY
TEL: 01273 833264 • FAX: 01273 834976 • WEB SITE: WWW.HURSTPIERPOINT.GOV.UK
E-MAIL: HURSTPIERPOINT.PC@BTINTERNET.COM

Infrastructure Planning Commission
Temple quay house
Temple quay
BRISTOL BS1 6PN

IPC

01 OCT 2010

REF:

28 September 2010

Dear Sirs

Re: Proposed Rampion Offshore Wind Farm
Ref: 140910 EN010032 243108

We refer to your letter of 14 September 2010 consulting on this proposal, and the Scoping report - September 2010.

The matter was considered by our Planning and Environment Committee at its meeting on 23 September 2010 from which our Council concluded that it has no objection in principle to the Wind Farm but that it would oppose any increase in the number or the scale of overhead power lines running from the coast to the regional sub-station at Bolney.

Yours faithfully



Stephen Hoyles
CLERK TO THE COUNCIL

CLERK TO THE COUNCIL: STEPHEN HOYLES
Office Hours: Monday 9:30am - 12:30pm, and
Tuesday, Thursday, Friday 9.30am - 3.30pm

Lancing Parish Hall
South Street
Lancing
West Sussex
BN15 8AJ

Tel: 01903 753355
Fax: 01903 765096

Email: clerk@lancingparishcouncil.gov.uk
www.lancingparishcouncil.gov.uk



IPC

20 SEP 2010

REF: _____

Your reference 140910 EN010032 243108

Mr David Price,
Infrastructure Planning Commission,
Temple Quay House,
Temple Quay,
BRISTOL
BS1 6PN

16th September 2010

Dear Sir,

Proposed Rampion Offshore Wind Farm.

I refer to your letter dated 14th September 2010 regarding the above.

I would inform you that your letter was reported to the Council's Planning Advisory Committee on 15th September 2010 and that the Council would wish to make you aware that within the Parish at Widewater, there is a site of nature conservation importance (SNCI)

This is a protected area of importance for wild life at a County scale, adopted by the Adur District Council for planning purposes and identified in the local development plan.

I shall be grateful if you would consider this matter in the environmental statement in relation to the project.

I trust the above has been of assistance to you.

Yours Sincerely

A handwritten signature in black ink, appearing to read 'Colin Hunt', is written over a horizontal line.

Colin Hunt

Clerk to the Council

Quality
Parish
Council

From: [Helen Croxson](#)
To: [IPC Scoping Opinion](#);
Subject: Re: Rampion offshore wind farm
Date: 15 September 2010 12:16:46

David,

Many thanks - all received.

Regards

Helen

Helen Croxson
Navigation Specialist Support
Maritime & Coastguard Agency
Navigation Safety Branch
Bay 2/04 Spring Place
105 Commercial Road
Southampton, SO15 1EG
tel: +44 (0) 23 80329 437
fax: +44 (0) 23 80329204
Helen.Croxson@mcga.gov.uk

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>>> "IPC Scoping Opinion" <IPCScopingOpinion@infrastructure.gsi.gov.uk> 15/09/2010 10:45 >>>

> Dear Helen,

>

> Please find attached an electronic version of the scoping consultation request letter for Rampion offshore wind farm.

>

> We look forward to receiving your response.

>

> Kind regards> > <<100914_EN010032_243108_Letter_to_stat_consultees[1].doc>>

>

> David

>

> David Price

> EIA and Land Rights Advisor

> Infrastructure Planning Commission (IPC)

> Temple Quay House

> Temple Quay

> Bristol

> BS1 6PN

>

> Direct Line: 0303 444 5055

> Helpline: 0303 444 5000

> Email: David.Price@infrastructure.gsi.gov.uk

> Website: www.independent.gov.uk/infrastructure

>

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> We are required by law to publish on our website a record of the advice we provide and to record on our website the name of the person or organisation who asked for the advice. We will however protect the privacy of any other personal information which you choose to share with us and we will not hold the information any longer than is necessary.

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Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN
FAO David Price

12th October 2010

Our Reference: REN307
Your Ref: 140910_EN010032_243108

Dear David,

FORMAL SCOPING REQUEST UNDER THE INFRASTRUCTURE PLANNING (ENVIRONMENTAL IMPACT ASSESSMENT) REGULATIONS 2009 FOR THE PROPOSED RAMPION OFFSHORE WINDFARM (OWF) IN THE ENGLISH CHANNEL BY E.ON CLIMATE AND RENEWABLES.

The following comments are provided after consultation with the Marine Management Organisation (MMO) District Office at Hastings and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS).

General Comments

1. The information presented on the project description does not clearly define the proposed project. Without such supporting information and wide envelope presented it is not at this stage possible to define the project and it is difficult to scope the impacts that may be significant. A refined project description is required in the ES.
2. Most methodologies for the acquisition and analysis of data are identified including the undertaking of a number of ecological baseline surveys, such as offshore ornithological and marine mammal (both aerial and boat-based) surveys. Geophysical surveys for the entire zone have been completed.
3. The proposed EIA structure appears to include all the relevant potential receptors, pathways and impacts associated with the ROWF. The scoping report also provides an appropriate summary of the existing baseline information on the physical, biological and human environments. Cumulative impacts are also to be considered, and the proposed EIA methodology appears to be fit for purpose.
4. A number of publications cited in the report do not appear to have been included in the references listed in Appendix 1.

Planning Policy Context

5. We recommend that reference is also made to the draft Marine Policy Statement

Coastal Processes

6. Section 5.2.2 (page 39) states that both near and far-field effects will be considered on the wave, tidal and sedimentological regimes. The sedimentological work should include a detailed assessment of any impacts to sediment transport and particularly to any effect on the coastline.
7. We agree with Section 5.2.3.4 (page 40) that there are no other offshore wind farms within one tidal ellipse/excursion of the proposed site and that hydrodynamic cumulative impact assessment can be scoped out.
8. Section 5.3.2 (page 43) lists the key potential environmental impacts with regards to benthos and sediment quality. Two potential impacts that should be given very careful consideration are scour and sediment transport pathways effects. Scour assessment is likely to require some modelling data. Sediment transport pathways effects need to be assessed because of their potential impacts on the coastline.

Benthic Ecology

9. Although the major issues appear to be addressed we are unable to give full advice due to the omission of survey methodology
10. It may be advantageous to include the South Coast Regional Environmental Characterisation within data sources for the desk-based review would as it covers the majority of the proposed wind farm area. The report is available at: <http://www.alsf-mepf.org.uk/projects/2008/rec-0802/final-report.aspx>. James, J W C, Pearce, B, Coggan, R A, Arnott, S H L, Clark, R, Plim, J F, Pinnion, J, Barrio Frójan, C, Gardiner, J P, Morando, A, Baggaley, P A, Scott, G, Bigourdan, N. 2010. The South Coast Regional Environmental Characterisation. British Geological Survey Open Report OR/09/51. 249 pp.
11. Section 5.3.3.2 states that grab sampling will not be undertaken at sites which have potential to support biogenic reefs. Underwater video would be the preferred tool for sampling these areas.

Marine Ornithology

12. We recommend that the following publication is also reviewed to inform seabird sensitivity in relation to offshore wind farms. Langston, R.H.W. (2010) *Offshore wind farms and birds: Round 3 zones, extensions to Round 1 and Round 2 sites and Scottish Territorial Waters*. RSPB Research Report No. 39. RSPB, Sandy.

Navigation and Shipping

13. Given the density of marine minerals dredging in the wider area, The British Marine Aggregate Producers Association (BMAPA; <http://www.bmapa.org>) should be included in the consultation.

Fisheries

14. Cefas should be included in the list of sources for baseline data included in Section 5.13.3.1.
15. Although the report mentions that there is significant amount of information available on fish and shellfish ecology in the area, no specific data has been referenced. Therefore it is difficult to comment upon the adequacy of the information provided and the completeness of the characterisation. A 2006 report by Parker-Humphreys on ICES area VIId may be a valuable source of information.

16. The report identified potential gaps in existing data and the possible requirements to carry out further surveys work. We are able to comment further once these gaps and proposed surveys are identified.
17. We recommend further investigation of the black bream spawning area as there will be sensitive times of year for this species and this will need to be described.
18. In general the proposals seem comprehensive and appear to take into account all shellfishery implications that we are aware of. It is noted that whelks (*Buccinum undatum*) contribute the major landings for both fish and shellfish in weight and value, from official data (2009), in ICES rectangle 30E9. Edible crab (*Cancer pagurus*) and lobster (*Homarus gammarus*) are also caught in significant quantities from this rectangle. The exact location of some of these fisheries is not known to us, but it is likely that potting fisheries for crab, lobster and whelks occur within the OWF site and/or cable corridor. Other shellfish fisheries from 30E9 include cuttlefish (*Sepia officinalis*) and king scallop (*Pecten maximus*) and these may also occur in the OWF site and cable corridor.
19. Some of the shellfish species referenced above may not be adequately sampled using the otter trawl, scientific beam trawl or scallop dredges mentioned in the assessment methodology (5.4.3). After the fishing industry has been consulted and the local fish and shellfisheries have been adequately described e.g. spatial and temporal distribution, gear type etc, it may become apparent that the use of more specialist gears is warranted e.g. whelk pots or cuttle traps. We recommend the use of fishing vessels that already target specific fisheries in these areas if additional survey work on specific fisheries is warranted.
20. The effects of the project on commercial fish and shellfish especially spawning aggregations were mentioned in the scoping report. This should include edible crab as ovigerous females may over winter in the vicinity of the OWF, and from spring through to autumn female crabs may pass through it on their westerly migration routes.
21. We strongly advise early consultation with the fishing industry, MMO local offices and local sea fisheries committee to adequately describe these fisheries and assess the potential impacts of the development upon them.

Conclusions

The scoping report provides a summary of the existing baseline information on the physical, biological and human environments. Cumulative impacts are also to be considered, and provided that the points made above are addressed, the proposed EIA methodology appears to be fit for purpose. However we do not see this letter as a definitive list of all Environmental Statement / Environmental Impact Assessment requirements and other subsequent work may prove necessary.

Please contact me if you wish to discuss further.

Regards

Ross Hodson
Marine Environment Team
Marine Management Organisation

From: [Andrew Marsh](#)
To: [IPC Scoping Opinion;](#)
Subject: Proposed Rampion Offshore Wind Farm - EIA
Date: 12 October 2010 10:09:29

FAO Owain George,

Thank you for consulting with Mid Sussex District Council Re: Proposed Rampion Offshore Wind Farm (Ref: 140910_EN010032_243108).

It is noted that the area of search for onshore cable corridors falls within the Mid Sussex boundary, and therefore policies within our development plan will apply. As highlighted in the Scoping Report, at this moment in time the development plan is made up of the saved policies in the Mid Sussex Local Plan (2004) and the Small Scale Housing Allocations Development Plan Document.

There is only one area I would like to draw your attention to:

Air Quality- It should be noted that a possible Air Quality Management Area (AQMA) has been identified in the District Council's "Air Quality 2010 Progress Report" which has been submitted to Defra (August 2010). If Defra accept these findings, an AQMA will need to be declared by the District Council within 4 months. The area in question is Stonepound Crossroads, Hassocks. This is within proximity of the area of search.

We have no further comment on the scoping report, however wish to be kept informed of future stages of work prior to an application being received.

Many thanks again for consulting with Mid Sussex District Council.

Kind regards,
Andrew

Andrew Marsh
Planning Officer
Planning Policy
(01444) 477488
AndrewJM@midsussex.gov.uk
www.midsussex.gov.uk

Working together for a better Mid Sussex

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From: [Rhoades-Brown, Gary](#)
To: [IPC Scoping Opinion;](#)
Subject: You ref - 140910 EN010032 243108 - Rampion Offshore Wind Farm
Date: 24 September 2010 15:11:03

Dear Joanne,

Thank you for your letter dated 14 September 2010. I understand that the proposal is offshore in the vicinity of Brighton.

As discussed, Mole Valley District Council does not have any comments.

Regards.

Gary Rhoades-Brown
Development Control Manager

Please don't print this e-mail unless you really need to. Save paper.

Visit <http://www.molevalley.gov.uk> for information about Council services, online payments and planning information.

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12 October 2010

Your ref: 140910_EN010032_238723



Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

Natural England
7th Floor
Hercules House
Hercules Road
London
SE1 7DU
T 0300 060 4911

BY EMAIL ONLY

Dear David Price

**PROPOSED RAMPION OFFSHORE WIND FARM ("the Project")
E.ON CLIMATE AND RENEWABLES ("the Applicant")
INFRASTRUCTURE PLANNING (ENVIRONMENTAL IMPACT ASSESSMENT) REGULATIONS
2009 SI 2263 ("the EIA Regulations")**

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development. We are working towards the delivery of four strategic outcomes:

- A healthy natural environment;
- People are inspired to value and conserve the natural environment;
- Sustainable use of the natural environment;
- A secure environmental future.

We have considered the proposal against the full range of Natural England's interests in the natural environment.

The advice given by Natural England in this letter is made for the purpose of the present consultation only. In accordance with section 4 of the Natural Environment and Rural Communities Act 2006, Natural England expects to be included as a consultee in relation to any additional matters to be determined by the consulting body that may arise as a result of, or are related to, the present proposal. Natural England retains its statutory discretion to modify its present advice or opinion in view of any and all such additional matters or any additional information related to this consultation that may come to our attention.

Should you wish to discuss this response please do not hesitate to contact me at the above address.

Yours sincerely

Joanna Watson

A handwritten signature in blue ink, appearing to read "Joanna Watson", written over a light blue rectangular background.

Marine Renewables Advisor
Tel: 0300 060 2436
Mobile: 07824 868997

NATURAL ENGLAND SCOPING OPINION FOR THE RAMPION OFFSHORE WIND FARM SCOPING REPORT

Natural England would like to make the following comments on what should be provided in the environmental statement, in addition to what is presented in the scoping report. This should not be considered a definitive list of what NE deem necessary, as we hope the EIA process will evolve as the acquisition and analysis portion of the project progresses.

1. General Comments

- 1.1 We feel it is important that this assessment builds upon the lessons learnt during the development of other offshore windfarms, ensuring that the assessment is sufficiently detailed and targeted to both fulfil the requirements of the EIA Directive *EC Directive 85/337/EEC* and any Appropriate Assessment required under the Habitats Regulations (Natural Habitats & C) (Amendment)(No. 2) Regulations 2009.
- 1.2 We support the developer's proposal of utilising the Rochdale envelope approach to impact assessment but we would urge developers not to assume all possible impacts have been identified and can be potentially mitigated against through this approach. Where a favoured technical solution is likely to be adopted it is preferred that a full environmental assessment be made of that solution in preference to any worst case scenario. To ensure the maximum efficiency of this approach we would urge the applicant to maintain discussion with Natural England throughout the development process.
- 1.3 This is a large document (131 pages) that is of use, but please note that we feel it is generic and high level. Natural England would wish to have further discussions about the details of specific surveys to ensure that all of the information that is/isn't required is provided e.g. drop down video surveys as there are potential reefs in the area.
- 1.4 There is limited information and description about the landfall location. How is landfall going to be achieved? We note that there are cliffs in this area therefore the developers may have to consider Horizontal Directional drilling and other methods?
- 1.5 Precautionary principle - All forms of environmental risk should be tested against the precautionary principle which means that where there are real risks to the site, lack of full scientific certainty should not be used as a reason for postponing measures that are likely to be cost effective in preventing such damage. It does not however imply that the suggested cause of such damage must be eradicated unless proved to be harmless and it cannot be used as a licence to invent hypothetical consequences.
- 1.6 The proposed development site is an area of high anthropogenic activity both past and present. Natural England would urge the applicant in the scoping phase of the EIA to conduct a full audit of available information from both public and private sources. This data should be analysed comprehensively before any new information is collected to increase the efficiency and relevance of any assessment or survey programme.
- 1.7 In the Environmental Impact Assessment for this proposal (to be reported in the ES), the developer should address the following phases of wind farm development:

Construction. The ES should include details on proposed construction methods including information on project management – contractor arrangements, „chain of command“, roles and responsibilities of key staff – and timetabling – the phasing/sequencing of proposed works – especially if this has been identified as a mitigation measure for environmental, visual or other effects. Information should also be included on the proposed construction equipment, and intended delivery routes and port facilities.

Operation & Maintenance. The ES should include details of operation and maintenance activities and an assessment of any impacts that could arise – considering any potential environmental, navigational and/or other effects.

Repowering. It is important to be clear on what repowering entails and whether there is likely to be any relocation of subsea infrastructure or alteration of the wind farm layout. This includes whether further scour protection is required for foundations in the same, or in new, locations across the wind farm site. Any alterations to the locations of offshore elements for repowering may require an update to the benthic survey work and assessments that have previously been carried out.

Decommissioning. The process and methods of decommissioning should also be considered, and reviewed, at this (pre-application) stage, with an options appraisal present in the ES.

Specific Comments

2 Benthic Ecology

- 2.1 Please consider the references / data holders below:

Sources to add: DASHH, UKHO (eastern English Channel – EECMM - <http://www.marinealsf.org.uk/data/>), and Channel REC data

- 2.2 p. 45 We would expect to see reference to Annex 1 habitats (e.g. reefs and sandbanks) http://www.jncc.gov.uk/Publications/JNCC312/UK_habitat_list.asp
- 2.3 We note there is the potential for Chalk reefs along the export cable route, we should advise E.ON that all potential Annex I habitats are afforded the same protection as those within designated sites until such time as Europe deems that these habitats are proficiently designated. Therefore, we would wish this to be taken into account when considering the Environmental impacts of cable installation and potential cable protection that maybe required.
- 2.4 5.2.12 Seabed Geology Page 37 – Natural England notes that there is a layer of chalk starting at about 20/30m depth in some locations. Therefore, dependent upon the water depth at these locations, if monopiles are used then the developer may need to use the drill drive drill method for foundation installation. If this is the case our preferred options would be for the arising s to be disposed of at one of the licensed sites identified oat 5.14.1.2 page 82

3 Habitat Identification

- 3.1 P.36 We feel it would be appropriate to divide Species / Habitats / Conservation into different sub-sections (other users – oil & gas, aggregates, recreation)
- 3.2 p. 38 No mention of chalk reefs (mSNCIs see below). These are possible Marine Conservation Zones. Balanced Seas should be mentioned here as well, put in section 5.2.3.1.
- Sources to add: DASHH, UKHO (eastern English Channel – EECMM - <http://www.marinealsf.org.uk/data/>), and Channel REC data
- p. 45 No mention of Annex 1 habitats (reefs and sandbanksamong others http://www.jncc.gov.uk/Publications/JNCC312/UK_habitat_list.asp)
- 3.3 5.5.1. Need to consider Marine Conservation Zones (MCZs) and role of mSNCIs / (see below)
- 3.4 p.26 Habitats Regulations: Marine Natura 2000 sites, Lyme Bay, Dorset and Margate & Longs

Sands, Kent are the closest new N2K sites, both are cSACs.

- 3.5 Page 43, 5.3.2 - in addition, potential habitat loss through cable and scour protection should be considered
- 3.6 Page 43, 5.3.3.2 - Please note that there is a revised protocol for undertaking grab samples where there is potential biogenic reefs. The latest guidance is attached. It would be appropriate to conduct one grab sample and DDV/ROV to ground truth acoustic data.

NATURA 2000

New Marine Protected Areas around the UK have been created following submission of Special Areas of Conservation and Special Protection Areas to the European Commission (EC) for inclusion in the Natura 2000 network in August 2010.

Natural England, the Joint Nature Conservation Committee and the Countryside Council for Wales conducted a formal consultation on 10 possible marine Special Areas of Conservation (pSACs) and 2 potential Special Protection Areas (pSPAs) in English, Welsh and offshore waters around the UK, between November 2009 and February 2010.

Natural England and JNCC submitted final recommendations for 10 SACs and 2 SPAs to Defra for approval in June 2010. CCW also submitted Liverpool Bay SPA, which lies partly in Welsh waters, to the Welsh Assembly Government for their approval. [The sites](#) were then submitted to the EC and are now legally protected

The EIA for the Rampion project needs to be site specific as cables etc may run through the chalk reef areas – it should also assess indirect effects.

p. 49 – there is no mention of Bassurelle Sandbank cSAC which lies outside territorial waters and for which JNCC is the lead statutory adviser–

<http://www.jncc.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H11110>

Bassurelle Sandbank

The Bassurelle Bank is a linear sandbank in the Dover Strait which straddles the boundary between UK and French waters. It is an example of an open shelf ridge sandbank, which is formed by tidal currents (Graham et al., 2001). The part of the sandbank within UK waters is approximately 2.5km at its widest point, and has a maximum height of around 15m. It extends for about 15km in a NE-SW direction to the UK-France median line, and then continues for some distance into French waters.

<http://www.jncc.gov.uk/pdf/web432.pdf>

Habitats Regulations

On receipt of the Environmental Statement Natural England must be consulted in order to advise your Council whether an appropriate assessment is required. Regulation 61 requires your authority, before deciding to give any consent to a project which is (a) likely to have a significant effect on a European site (either alone or in combination with other plans or projects), and (b) not directly connected with or necessary to the management of the site, to make an appropriate assessment of the implications for the site in view of its conservation objectives. Any approval of planning permission pending the result of this assessment would be contrary to the Habitats Regulations.

6.5.2 Emphasis should be placed on ensuring where possible and practicable that all significant effects are avoided by avoiding designated sites in the first place or building appropriate mitigation into the scheme

4 Marine Conservation Zones

- 4.1 The UK has signed up to international agreements that aim to establish an 'ecologically coherent network of Marine Protected Areas (MPAs)' by 2012. Marine Conservation Zones (MCZs) are a new marine protected area designation introduced through the UK Marine and Coastal Access Act and will contribute to this network of MPAs. They will protect nationally important marine wildlife, habitats, geology and geomorphology and sites will be selected to protect not just the rare and threatened, but the range of marine wildlife.
- 4.2 The scoping report references the future designation of marine conservation zones and their implication on the project. It should be recognised that MCZs are likely to be in place before the proposed construction of this project and whilst no information has been finalised on where these sites will be located, considerable information is available on what habitats and physical features need to be brought under protection. Natural England would therefore recommend that the benthic survey information be analysed with reference to guidance notes written by Natural England and JNCC on the identification of features of conservation interest (FOCI) at marine conservation zones.

<http://naturalengland.etraderstores.com/NaturalEnglandShop/NECR018>

4.3 MCZs and role of mSNCIs

The EIA for the Rampion project needs to be site specific as cables etc may run through the chalk reef areas – it should also assess indirect effects

Currently there is a Marine Site of Nature Conservation Importance (mSNCI) located within 4 miles of the Shore (Chalk reef – SW Rocks, Looe gate, Ship Rock)



5 Marine Mammals - Impacts of Underwater noise and EPS licensing (for future reference)

5.1 The scoping report does not address the issues surrounding European protected species (EPS) at sea e.g. Harbour Porpoise, Bottlenose Dolphin and common dolphin, and the potential requirement for an injury/disturbance license. The Conservation (Natural Habitats &c) Regulations 1994 for England and Wales (i.e. the Habitats Regulations) were amended in 2007 and 2009. The offshore Marine Conservation (Natural Habitats &c) Regulations 2007 (i.e. the offshore Marine Regulations) were also amended in 2009. Both sets of amended regulations contain a revised definition of the disturbance offence and introduced the offence of injury. Also, the introduction of the Offshore Marine Regulations in 2007 applied both offences to areas of UK jurisdiction beyond 12nm. Regulation 39 (1) of both the Habitats Regulations and the Offshore Marine Regulations (as amended in 2009) state the following:

1. Subject to regulations 40 and 49 a person is guilty of an offence if he –
 - a) Deliberately captures, injures, kills any wild animal of a European protected species;
 - b) Deliberately disturbs wild animals of any such species

For the purposes of paragraph 1b – disturbance of animals includes any disturbance which is likely to:

- Impair their ability to survive, to reproduce, or nurture/rear their young
- To affect significantly the local distribution or abundance of the species to which they belong.

5.2 During the construction of an offshore windfarm, piling often takes place from spring to autumn over at least a two year period (i.e. two construction seasons). This could lead to chronic exposure to sound in animals that show fidelity to the area affected, or it may result in the displacement of several animals from a large area for considerable periods of time (which would be longer than they would normally be absent). Both these effects could be regarded as disturbance in terms of the Regulations. If these risks cannot be avoided or reduced then the developers would need to apply for a license under regulations 44/49 (Habitats Regulations/Offshore Marine Regulations respectively) in order to exempt them from the offence. Even though the effectiveness of standard mitigation measures has not been fully tested, it is considered that having these in place should reduce the risk of injury or significant long term disturbance. The JNCC, with input from Natural England and CCW have developed guidance on the interpretation of these regulations for the waters of England, Wales and the UK offshore marine area – ‘JNCC guidance on the protection of marine EPS from injury and disturbance’. This document is likely to be published later in 2010 and includes guidance on how to conduct impact assessments for noise producing activities to avoid or reduce the risk of committing any of the above offences. Developers should consult this document during the EIA process. The advice on disturbance contained in this document is to be taken into consideration by courts in proceedings for an offence.

5.3 To qualify for a license it is essential that the applicant presents information which outlines any usage of the site by a protected species, (likely to be Bottlenose Dolphin, Harbour porpoise or common dolphin) and in this region of the English Channel. This information should ideally be presented in the form a desk study supported by observations taken during ornithological surveys. The applicant will also be required to show how they may mitigate the impact of construction noise on a protected species i.e. through ‘soft start’ piling, visual and acoustic observations and potentially acoustic deterrents. It is possible that the significance of any noise impacts may be reduced greatly if piling of monopoles is not the chosen method for installation eg if jacket, pin and pile, drill or gravity foundations are used instead, thereby negating the need for an EPS licence. These alternatives may have other environmental effects and the worst case scenario for each should be assessed in the EIA.

5.6.3.1 Page 55 – We would welcome discussion with the applicant about undertaking a relevant/dedicated marine mammal survey prior to construction in order to have a relevant baseline in which impacts can be measured against

6 Ornithology

SPA's <http://www.jncc.gov.uk/page-162>

p. 57 Thames array = **London Array**

p. 60 Turbine strike & other direct effects, issue of potential oil spill / habituation

5.7.2 Page 60 Birds – Collision risk is not discussed in sufficient detail. First minimal mention is at 5.7.3.2

5.7.3.1 More information on the nature and scope of the aerial surveys is required to ensure that comparative post construction surveys can be carried out.

We would welcome the opportunity for more detailed discussion with the developer regarding ornithology.

7 Fish

p. 28 EIA approach – Fish species should be considered as should Biodiversity Action Plan (BAP) species <http://www.ukbap.org.uk/> , such as *Raja clavata* (thornback ray) a definition of 'metocean' would also be useful.

p. 72 Breakdown of marine limits: division as follows (fisheries) 0-6nM (UK Inshore) and 6-12nM includes traditional use (Bel, NL, Ger, Fr)



<http://www.ieep.eu/publications/pdfs/inshorefisheries/N2Kinshorebriefing1.pdf>

p. 75 – Shoreham airport (aviation issues) is not mentioned

p. 80 SFCs are becoming IFCA's in October and get their regulatory and enforcement powers in April 2011, this should be mentioned.

See <http://www.defra.gov.uk/foodfarm/fisheries/wwo/ifca/index.htm>

p. 46 – Other species that may be worth mentioning as of regional significance / importance e.g. Native oyster and Mackerel / bass – of recreational angling importance.

p.46 – Range of black bream extends further (suggest Eastbourne – Selsey – See Sussex Sea Fisheries Committee report – contact Rob Clark 01273454407)

8 Cumulative Impact

8.1 Due to the high level of anthropogenic activity in this region of the English Channel it is important that the impacts of the proposed windfarm are cumulatively assessed with those of other projects and activities on land and at sea. This should include:

- Existing completed projects
- Approved but uncompleted projects
- Ongoing activities
- Plans or projects for which an application has been made and which are under consideration by the consenting authorities
- Plans and projects which are reasonably foreseeable, i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects.

8.2 Natural England welcome the applicants plan for a full study into the potential impacts on coastal processes and oceanographic forces. This study should be conducted in combination with surrounding projects and should explore potential changes to both subtidal and intertidal geomorphology and sediment transport.

9 Onshore

P86, 6.1 We note that operational impacts have been scoped out. More information should be detailed as to why this is the case.

9.1. Sites of Special Scientific Interest (SSSIs) and sites of European or international importance (Special Areas of Conservation, Special Protection Areas and Ramsar sites).

The development site is within/adjacent to the following designated nature conservation site[s]:

- **Adur Estuary SSSI**
- **Beeding Hill – Newtimber Hill SSSI**
- **Wolstonbury Hill SSSI**
- **South Downs National Park**
- **Marine and Terrestrial SNCIs**

Further information on the SSSI can be found at www.natureonthemap.org.uk or by request from this office. The Environmental Statement should include a full assessment of the direct and indirect effects of the development on the features of special interest within this/these site[s] and should identify such mitigation measures as may be required in order to avoid, minimise or reduce any adverse significant effects.

European sites (e.g. designated SPAs) fall within the scope of the Conservation of Habitats and Species Regulations 2010. Government policy, stated in PPS9 and Ramsar Sites in England: A Policy Statement (DETR 2000)¹, stipulates that Ramsar Sites be treated as if they are fully designated European sites for the purpose of considering development proposals that may affect them.

Under Regulation 61 of the Conservation of Habitats and Species Regulations 2010 an appropriate assessment needs to be undertaken in respect of any plan or project which is (a) likely to have a significant effect on a European site (either alone or in combination with other plans or projects) and (b) not directly connected with or necessary to the management of the site. In this case the proposal is not directly connected with, or necessary to, the management of a European site and in our view it is likely that it will have a significant effect on internationally designated sites and therefore will require an appropriate assessment. We recommend that there should be a separate section of the Environmental Statement to address impacts upon European and Ramsar sites entitled 'Information for Appropriate Assessment'.

P 96, 6.4. Information on how water courses will be crossed should be supplied in the EIA.

9.2. Landscape, seascape and visual impacts

Landscape, Seascape and Visual (5.8) – Impacts/effects on landscape character, seascape character and on the visual resource need to be ascertained and addressed. Comments at 5.8.2, 2nd bullet, do not indicate a full understanding that views from land to sea, sea to sea, and sea to land, and land to land need to be considered (ref. DTI 2005 doc.) Unless potential impacts are identified appropriately then they cannot be adequately avoided/mitigated.

In order to foster high quality development that respects, maintains, or enhances, local landscape,

¹ http://www.ramsar.org/wurc/wurc_policy_uk_england.htm

seascape character and distinctiveness, Natural England would encourage all new development to consider the character and distinctiveness of the area, with the location, design and layout of all elements of a proposed development reflecting local design characteristics and wherever possible using local materials. The Environment Impact Assessment process should detail the measures to be taken to ensure the design will be of a high standard, as well as detail of layout alternatives together with justification of the selected option in terms of landscape impact and benefit.

Natural England have the following comments to make on Landscape:

- Accurate maps of protected sites and designated sites should be included in the ES showing the spatial extent of the visual influence of the proposal. Protected landscapes must be assigned the highest level of sensitivity in the SVIA and LVIA.
- All seascapes and landscapes have distinctive characteristics that give them a strong sense of place. These qualities will be outlined in their character assessments. Natural England would wish to see these special characteristics conserved and sustained.
- Any other associated infrastructure development should be incorporated into the impact assessments.

Good LVIAs and SVIAs will demonstrate how the impact assessment process was carried out iteratively and how these have informed the proposed development. Bearing this in mind we would welcome discussions on seascapes throughout this iterative process to ensure any negative impacts are minimised.

Page 63, 5.8.1– NE would like the opportunity to agree the view points to be used in the EIA

Page 63, 5.8.3- Guidance the applicant should consider (but not exclusively) includes the following

- Scottish Natural Heritage Guidance “Cumulative effect of Windfarms” (Version 2 revised 13.04.05).
- Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact Report, by the Department of Trade and Industry (DTI) in association with Scottish Natural Heritage, the former Countryside Agency (now Natural England) and the Countryside Council for Wales (2005)
- Guide to Best Practice in Seascape Assessment, Maritime Ireland / Wales INTERREG (March 2001)
- Guidelines for Landscape and Visual Impact Assessment (GLVIA); Second Edition, Spon Press, copyright by The Landscape Institute and the Institute of Environmental Management and Assessment, 2002.
- Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact Report, by the Department of Trade and Industry (DTI) in association with Scottish Natural Heritage, the former Countryside Agency (now Natural England) and the Countryside Council for Wales (2005)
- “Visual Representation of Windfarms Good Practice Guidance” prepared for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning by Horner + Maclellan & Envision (March 2006)

9.3. AONB

If the proposal site is within an Area of Outstanding Natural Beauty (AONB) or potential National Park boundary, we recommend that you contact the relevant AONB unit to ensure that planning issues regarding this proposal take into account the various issues that arise as a result of this designation.

9.4. South Downs National Park

As the application is within the National Park boundary the provisions of government policy relating to National Parks (currently including PPS7, circulars 12/96 and 125/77) apply. The South Downs National Park Authority will become the Local Planning Authority for the South Downs National Park on the 1 April 2011. In the meantime, Natural England recommends that the opinions of the South Downs National Park Authority are sought.

9.5. Local Wildlife Sites

Local Wildlife Sites are identified by the County ecologist/local wildlife trust and are of county importance for wildlife. The Environmental Statement should therefore include an assessment of the likely impacts on the wildlife interests of these site[s]. The assessment should include proposals for mitigation of any impacts and if appropriate, compensation measures. Contact the County ecologist/local wildlife trust for further information.

9.6. Species protected by the Wildlife and Countryside Act 1981 (as amended) and by the Conservation of Habitats and Species Regulations 2010

We strongly recommend that surveys for protected species (including, for example, great crested newts, reptiles, water voles, badgers and bats) should be carried out within the area affected by the development.

If any protected species are found the Environmental Statement should include details of:

- The species concerned;
- The population level at the site affected by the proposal;
- The direct and indirect effects of the development upon that species;
- Full details of any mitigation or compensation that might be required;
- Whether the impact is acceptable and/or licensable.

In order to provide this information there may be a requirement for a survey at a particular time of year. Surveys should always be carried out by suitably qualified and where necessary, licensed, consultants and should be planned well in advance to ensure that they are conducted during the appropriate season(s).

The great crested newt, dormouse and all species of bats are European protected species such that it is illegal to intentionally kill, injure or otherwise disturb them. If any of these species are found to be present you should also consult Natural England's Wildlife Management and Licensing Unit in Bristol (Tel. 0845 6014523) about licensing implications before any work can proceed.

9.7. Other features of nature conservation interest, e.g. habitats and species identified within the UK and County Biodiversity Action Plans.

Natural England advises that a habitat survey (analogous to Phase 2) is carried out on the sites which may be affected by landfall, substations and other infrastructure, including cable routeing on land, in order to identify any important habitats present. In addition, ornithological, botanical and invertebrate surveys should be carried out at appropriate times in the year, to establish whether any scarce or priority species are present. The Environmental Statement should include details of:

- Any historical data for the site affected by the proposal (e.g. from previous surveys);
- Additional surveys carried out as part of this proposal;
- The habitats and species present;
- The status of these habitats and species (e.g. whether BAP priority habitat);
- The direct and indirect effects of the development upon those habitats and species;

- Full details of any mitigation or compensation that might be required.

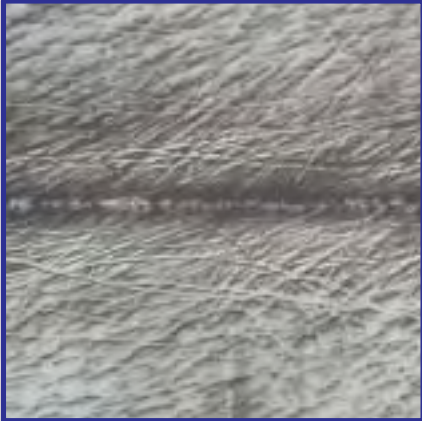
The development should avoid adversely impacting the most important wildlife areas and should, if possible, provide opportunities for overall wildlife gain.

9.8. Cumulative and in-combination effects.

The EIA should include an impact assessment to identify, describe and evaluate the effects that are likely to result from the project in combination with other projects and activities that are being, have been or will be carried out. To carry out the assessment of cumulative and in-combination effects, the following types of projects should be included. (Subject to the availability of information):

- f. Existing completed projects
- g. Approved but uncompleted projects
- h. Ongoing activities
- i. Plans or projects for which an application has been made and which are under consideration by the consenting authorities
- j. Plans and projects which are reasonably foreseeable, i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects.

Guidelines for the conduct of benthic studies at aggregate dredging sites



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This report has been produced by the
Centre for Environment, Fisheries and Aquaculture Science
on behalf of the
Department for Transport, Local Government and the Regions



May 2002

Department for Transport, Local Government and the Regions

This report has been compiled by Dr S. E. Boyd of The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Burnham Laboratory, Burnham-on-Crouch, Essex CM0 8HA. Email: S.E.Boyd@CEFAS.co.uk

Authors responsible for writing chapters of the report are as follows:

Chapter 2 - H. L. Rees and S. E. Boyd
Chapter 3 - C. Brown, D. S. Limpenny, and W. Meadows
Chapter 4 - K. M. Cooper and S. E. Boyd
Chapter 5 - D. S. Limpenny and W. Meadows
Chapter 6 - J. Rees and S. E. Boyd
Chapter 7 - C. Mason and D. S. Limpenny
Chapter 8 - M. Schratzberger and S. E. Boyd
Chapter 9 - H. L. Rees and K. M. Cooper
Chapter 10 - S. E. Boyd and D. S. Limpenny
Chapter 11 - S. E. Boyd, C. Brown and M. Schratzberger

Steering Group Members are listed at Annex I.

Department for Transport, Local Government and the Regions
Eland House
Bressenden Place
London SW1E 5DU
Telephone 020 7944 3000
Internet service: <http://www.dtlr.gov.uk>

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or on the department's web site at www.planning.dtlr.gov.uk

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Preface

These guidelines for the conduct of benthic surveys at commercial aggregate extraction sites have been produced in response to the rapid increase in survey work for Environmental Statements to accompany dredging applications, and to impending legislation which will bring extraction activity under statutory control (see Introduction). The guidelines are designed to promote a comprehensive and consistent approach to the assessment of the seabed environment (i.e. sediments and the associated benthic fauna) as part of the planning process and, on granting of a permission to dredge, in response to any monitoring requirements. They have been written by scientists at the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) on behalf of the UK Department for Transport, Local Government and the Regions, who will shortly assume the role of the regulator. Since the inception of the requirement for such benthic surveys, CEFAS, as an Executive Agency of the Department for Environment, Food and Rural Affairs (DEFRA), has led on the provision of scientific advice regarding their conduct, as well as carrying out related R&D programmes of a strategic nature in UK waters. The production of these guidelines was overseen by a Steering Group, membership of which is given at Annex I.

The increased demand for evaluations of environmental status at and around aggregate extraction sites, whether for Environmental Statements prepared by the industry or in connection with R&D and monitoring programmes, spans a period of less than ten years. Historically, the scientific study of coarser substrata has presented a significant challenge, largely on account of the difficulties in obtaining reliable quantitative samples. As a consequence, information on the nature and distribution of benthic assemblages, and on their wider role in the marine ecosystem, is considerably more limited than in areas of soft sediments.

Developments in sampling practices, such as the use of acoustic techniques for accurate discrimination of substratum type, thereby allowing inferences to be made concerning biological status, are proceeding rapidly. At the same time, there is increasing emphasis in national and international fora on the development of more holistic (ecosystem-level) approaches to marine environmental management, including evaluations of the scope for 'cumulative' or 'in-combination' effects. Given this, a question may reasonably be asked as to the correct timing for the production of study guidelines. In terms of the operational need for greater consistency in sampling and analytical approaches the answer is, unquestionably, now. However, a document of this nature cannot anticipate with certainty the consequences of all ongoing R&D effort, or of future developments in environmental policy, in specifying present requirements for the conduct of routine benthic surveys. The account therefore serves a dual purpose, namely the provision of guidance on established approaches accompanied, where appropriate, by evaluations of the 'state of the art' of parallel developments in UK methodologies which may influence the direction of future studies. It is recommended that the guidance is updated at appropriate intervals to incorporate significant improvements to current practices arising from such developments.

Finally, this document is targeted at experienced marine scientists (especially benthic ecologists, sedimentologists and geophysicists) working on behalf of the industry or the regulator in the conduct of R&D or, more usually, on the implementation of environmental assessment and monitoring programmes. **However, it is not intended as a substitute for appropriate consultation at critical stages in the environmental assessment process.** This is especially true at the initial design stage, when the guidelines contained herein are adapted to meet the circumstances prevailing at individual sites.

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CHAPTER 1

Introduction

1.1. Background and scope of guidelines

The control of marine aggregate dredging in the U.K. under the Government View (GV) Procedure dates back to 1968. Under this non-statutory system, the Crown Estate, as owners of most of the seabed, would only issue a dredging licence if the Government was satisfied that predicted impacts on the environment were viewed to be acceptable. The level of information required to assess these impacts has progressively increased as more has become known about the marine environment. The GV procedure was revised in 1989 and requires that an Environmental Impact Assessment (EIA) is undertaken by the dredging applicant as part of the application process for a dredging licence/permit. In view of the move towards statutory control of aggregate dredging activity through the impending introduction of the Environmental Impact Assessment and Habitats (Extraction of Minerals by Marine Dredging) Regulations, there is an increasing need to harmonise approaches to benthic surveys associated with the activity of marine aggregate extraction. Under these regulations, monitoring and other requirements will be specified in conditions attached to Dredging Permissions.

Aggregate extraction can have a number of environmental effects on the seabed including the removal of sediment and the resident fauna, changes to the nature and stability of sediments accompanying the exposure of underlying strata, increased turbidity and redistribution of fine particulates particularly from screening. The activity is of concern not only from the standpoint of effects on the benthic fauna during and after the event of aggregate extraction, but also in terms of its effects on the wider resource including dependent fish/shellfish populations and associated fisheries and other legitimate interests such as conservation and recreation. These concerns are addressed in Environmental Statements (ESs). Methodology for appraisals of the distribution of commercial fish stocks and fishing activity is beyond the scope of these guidelines. Rather, the focus of this report is on the conduct of surveys of the seabed and the associated benthic fauna, the results of which are submitted in ESs in support of dredging applications. The dredging industry or their consultants have carried out many of these surveys and, to date, a notable feature has been the wide variation in their scope and the analytical methodology employed. This is, in part, an inevitable consequence of differences in prevailing environmental conditions present across the areas where extraction permissions are concentrated. Despite this, there is clearly scope for greater harmonisation of approaches, leading to improvements in the quality of samples collected during seabed surveys, and in the resulting data.

The purpose of this report is to provide detailed guidance on the conduct and reporting of benthic surveys to facilitate consistency of approaches among consultants employed by the

industry to conduct ESs and when carrying out monitoring surveys. In addition, this report has been produced to foster compatibility between ongoing regulatory monitoring activity and related R&D.

The report begins with an account of the rationale for benthic surveys at aggregate extraction sites (Chapter 1.2), presents a strategy for their planning and design (Chapter 2) and then documents current and developing methodologies for their conduct and should be of use to both the regulatory authorities and the industry. This is followed by a general review of the range of equipment available for sampling the marine benthic fauna from coarse substrata (Chapter 3), and then a discussion of the approaches for processing faunal samples both in the field and the laboratory (Chapter 4). Recognising the role of remote acoustic techniques in complementing conventional approaches, Chapter 5 describes a number of devices for use in characterising attributes of the physical habitat. Coverage of this topic was considered to be important, as the production of high-resolution biotope maps of the seabed, using data derived from a combination of conventional sampling devices, acoustic and visual techniques, has potential in assisting with future site-specific environmental assessments of aggregate extraction sites (Brown *et al.*, 2001).

It has long been recognised that abiotic factors such as the sediment grain size and tidal current strength are responsible for determining broadscale benthic community patterns (Cabioch, 1968; Warwick and Uncles, 1980; Rees *et al.*, 1999). Therefore, interpreting trends in the status of benthic assemblages in areas which have been subjected to dredging should include consideration of variations in sediment particle size and the hydrodynamic regime. Thus, Chapters 6 and 7 briefly describe a range of techniques for characterising the wave and current climate and for the collection and particle size analysis of sediments. The report then details a framework for analysing benthic community data and for linking the output to environmental variables (Chapter 8). Throughout the report, good practice in terms of Quality Assurance (QA) procedures is presented within each of the sections describing methodological approaches. This is supplemented by generic guidance on QA matters in Chapter 9. Recommendations are also made on the format for presenting findings from environmental surveys (Chapter 10).

Finally, in addition to providing detail on established methodological approaches with the aim of fostering continuity and harmonisation among the various establishments carrying out such work, the report also identifies “state-of-the-art” approaches (Chapter 11). These are likely to evolve further in line with the outcome of ongoing R&D, e.g. strategies for the evaluation of cumulative effects.

1.2. Rationale for benthic surveys at aggregate extraction sites

As the extraction of marine aggregate has its primary impact at the seabed, assessment of the effects of this activity has conventionally targeted bottom substrata and the associated benthic fauna. Benthic communities are a logical target for investigations of the effects of aggregate extraction since:

1. They may be valued in terms of their links with other resources, as well as containing representatives which are themselves commercially harvested (e.g. crabs, shrimps,

flatfish). They may also have intrinsic value in terms of their rarity and hence conservation status (which may also apply to individual species). Because of the open nature of the marine environment, evaluations of benthic biodiversity, productivity and trophic interactions may all bear upon wider ecosystem integrity.

2. They are constant features of the seabed, and vary predictably in association with the physical habitat and in response to man-made changes. Furthermore, unlike shifting populations of planktonic organisms or many pelagic fish species, adults of most benthic invertebrate species are either sessile or mobile within narrow spatial ranges. Thus they are good indicators of locally induced environmental changes.

Attendant sampling of sediments is also essential for assessing the physical properties of the seabed environment and for interpreting any biological changes (Kenny and Rees, 1994, 1996; Kenny *et al.*, 1998; Newell *et al.*, 1998; Desprez, 2000; Brown *et al.*, 2000). Remote methods for surveying such as sidescan sonar and photography can also be employed in order to provide an indication of the spatial distribution of sediments in the wider area encompassing the dredged site and to estimate the likely spatial extent of dredging disturbance (Kenny and Rees, 1994, 1996; Kenny *et al.*, 1998).

In recent years, greater consideration has been given to identifying mitigation measures to reduce the impact of aggregate extraction which are translated into appropriate permit conditions. To ensure that such permit conditions are effective in minimising environmental disturbance and that predictions regarding the extent and significance of effects are sound, a monitoring programme is usually initiated. Monitoring is required to document both pre- and post- extraction conditions at dredging sites and to determine whether unacceptable impacts are occurring, or if conditions that could lead to an unacceptable impact are developing, within and in the vicinity of new and existing extraction sites. The outcome of monitoring programmes can therefore usefully contribute to judgements on the acceptability or otherwise of continued dredging within an extraction site. Monitoring will also be appropriate to determine whether permit conditions are being properly implemented, and to improve the basis on which future dredging applications are assessed by improving knowledge of field effects.

CHAPTER 2

Planning and design of benthic surveys at aggregate extraction sites

2.1. Introduction

This section provides a strategy for assessing the environmental status of an area of seabed, which may be targeted for its commercially exploitable reserves of sand and gravel, and then setting up a monitoring programme to evaluate the effects of dredging, in the event that extraction is permitted.

The strategy consists of a series of logical steps which are comparable to those employed in national and international guidelines for the evaluation of the effects of marine waste disposal activities (e.g. Rees *et al.*, 1990, 1991; Anon., 1996, 1997). Similar principles apply to studies of the effects of aggregate extraction in that all are manifestations of man-made perturbations (see also Davies *et al.*, 2001 for draft guidelines in relation to the monitoring of marine nature conservation sites). However, there are some important differences in practical approaches, which are accounted for here. In keeping with these earlier guidelines, it is not possible to provide a definitive design blueprint applicable to all areas. Thus the design of surveys, along with sampling effort, must be tailored to local circumstances. These may vary according to the nature and perceived sensitivity of the environment, the amount and area to be dredged, and the need to address other activities nearby, including the possibility that cumulative consequences may arise.

Examples of approaches to the design of sampling programmes at aggregate extraction sites are given at 2.3 below. Useful general sources of information concerning the evolution of sampling designs in benthic studies include Elliott (1971), Cohen (1977), Green (1979), Holme and McIntyre (1984), Andrew and Mapstone (1987), Skalski and Robson (1992) and Underwood (1997).

2.2. Objectives of benthic surveys at aggregate extraction sites

The outcomes of benthic surveys provide essential information on environmental status at the pre-application stage, and on the consequences of dredging activity in cases where permits are issued. The objectives of surveys are:

- To provide a spatially extensive description of the seabed environment within and around the proposed extraction area including the identification of important/sensitive habitats or species.
- To assess the progress of any changes over time (in nature, intensity and spatial extent) which may be attributable to the effects of aggregate extraction.
- To determine whether the permit conditions are appropriate and that they are having their desired effect of minimising the effects of aggregate extraction.
- To determine whether permit conditions have been properly implemented and adhered to.
- To determine whether unacceptable impacts are occurring, or if conditions that could lead to unacceptable impacts are developing, within and in the vicinity of new and existing extraction sites.
- To establish the nature and rate of recolonization by benthic invertebrates following cessation of dredging.

2.3. Stages in the planning, design and conduct of benthic surveys

2.3.1. Desk study

This is an essential pre-cursor to all field sampling effort. The outcome should allow a preliminary evaluation of the likely environmental consequences of extraction activity and hence provide a rationale for appropriate sampling design and sampling frequency, as well as an indication of the suitability of various sampling devices to meet survey needs.

Information on the study area may be obtained from the published literature, geological maps and Admiralty charts. Industry surveys at the prospecting stage (especially the output from acoustic surveys and the sampling of sediments using vibrocores or hydraulic grabs) may provide valuable information on local conditions, although wider access may be limited by commercial considerations. An evaluation of the possible physical consequences for the shoreline environment arising from aggregate dredging, especially the risks of coastal erosion, is now required for all dredging applications. The mathematical models employed in this evaluation may also aid in the design of sampling programmes, in the event that a permit is issued, for example in respect of predicted water movements or particulate transport.

Contacts with governmental and research agencies may reveal ongoing research and monitoring initiatives in the area of interest, including the existence of GIS and archived oceanographic data, as well as providing information on nearby discharges, disposal sites, species or habitats of conservation value, and so on. Access to unpublished literature, including earlier Environmental Statements in the vicinity, and consultations with individuals with local sampling experience may provide useful background information, which will reduce uncertainties at the planning stage, and hence increase the cost-effectiveness of sampling programmes.

A component of the desk study will be an evaluation of the scope for cumulative impacts at the seabed arising from aggregate extraction, which may influence survey effort. Cumulative impacts have been defined as effects on the environment, either from the summation of individually minor but collectively significant impacts, or as a result of the interaction of impacts from one or more source (DETR, 2001). The scope for such effects may be enhanced by a wide range of man-made activities, which may raise issues for resolution such as the extent to which a company responsible for a new application should, in planning an environmental survey, consider the influence of all other existing activities in the vicinity. This evaluation will generally be carried out as part of a more holistic appraisal of the scope for cumulative effects on the marine environment (Baskerville, 1986) for which detailed guidelines on aggregate extraction activity are awaited (see Chapter 11.1). In the meantime, an assessment should be made on the basis of locally available information on the nature, extent and disposition of documented impacts at the sea bed arising from man-made activities, as a result of which survey design and effort should be adjusted accordingly. The outcome of research by CEFAS into the cumulative impacts of aggregate extraction (see Chapter 11) will, in due course, help in the planning of sampling programmes.

A summary of the key information requirements at this stage of the process is given in Table 1. **The outcome, namely a plan of survey intentions, should be accompanied by a concise rationale, for appropriate consultation.** In certain cases, it may be necessary to conduct a pilot survey (see Chapter 2.3.3 below) before evolving and then submitting a plan.

2.3.2. Survey planning

Information gained during the desk study will inform decisions regarding the range of sampling equipment needed which will, in turn, determine the size and capability of the survey vessel required for field sampling. Critical issues regarding the suitability and seaworthiness of chartered vessels, along with safe working practices for scientists at sea, must be considered at this stage by competent and experienced individuals. Where possible, the Maritime and Coastguard Agency workboat code of practice should be followed (DETR, 1998). As a general rule, the larger the size of vessel needed, the more notice will be required of the intended period of charter. Larger vessels are also more expensive, but there are circumstances where the extra cost can be offset against the facility to work in a wider weather window, thereby achieving survey aims in a shorter time, or increasing the likelihood of success where only a narrow time-frame is available to guarantee year-on-year comparability in an ongoing monitoring programme.

Approximately four weeks before any survey work is to be carried out, it is strongly recommended that the Clerks of the appropriate Sea Fisheries Committees (SFCs) and the relevant DEFRA District Inspectors are provided with a survey plan. The plan should include details of the timing of the survey, the name and contact number of the survey vessel, station positions and the type of gear to be used. These measures will help to avoid conflict with local fishing activities (e.g. fixed fishing gear) during the period of the survey. Relevant port authorities should also be notified if all or part of the survey falls within their jurisdiction. Contact must also be made with aggregate extraction companies who may be actively dredging at extraction sites within the survey area.

If epibenthic trawling is a survey requirement, the District Inspectors will also be able to provide advice on local regulations regarding trawl mesh sizes, since the finer meshes employed in sampling may break minimum legal requirements (see Chapter 3.3.3). The use of such gear will require a dispensation which should be applied for 4 weeks prior to the

Table 1 Summary of strategy for the planning, design and conduct of sampling programmes at marine aggregate extraction sites

Desk study	Survey planning	'Pilot' survey	'Baseline' survey	'Ongoing' survey
- Seek information on: - wave climate - tidal/residual currents - substratum type - benthic communities - valued resources (e.g. fish/shellfish) - man-made activities/impacts - Determine: - survey needs/sampling gear - QA strategy - hypotheses for dredging-induced changes - Submit plan, with accompanying rationale, for approval	- Determine: - survey timing - suitability/availability of charter vessel - availability of sampling gear - Attend to issues of safety at sea and other relevant matters	- Determine: - local hydrography - suitable sampling gear - substratum type (qualitative) - benthic fauna (qualitative) - boundaries of survey area - Evaluate findings	- Carry out: - quantitative spatial survey - initial sampling at representative stations - analysis/AQC of samples - Analyse data/report and act on findings - Refine hypotheses for dredging-induced changes - Repeat at intervals	- Carry out: - sampling at representative stations over time - analysis/AQC of samples - hypothesis-testing for dredging-induced changes - Report and act on findings - Review sampling design/frequency

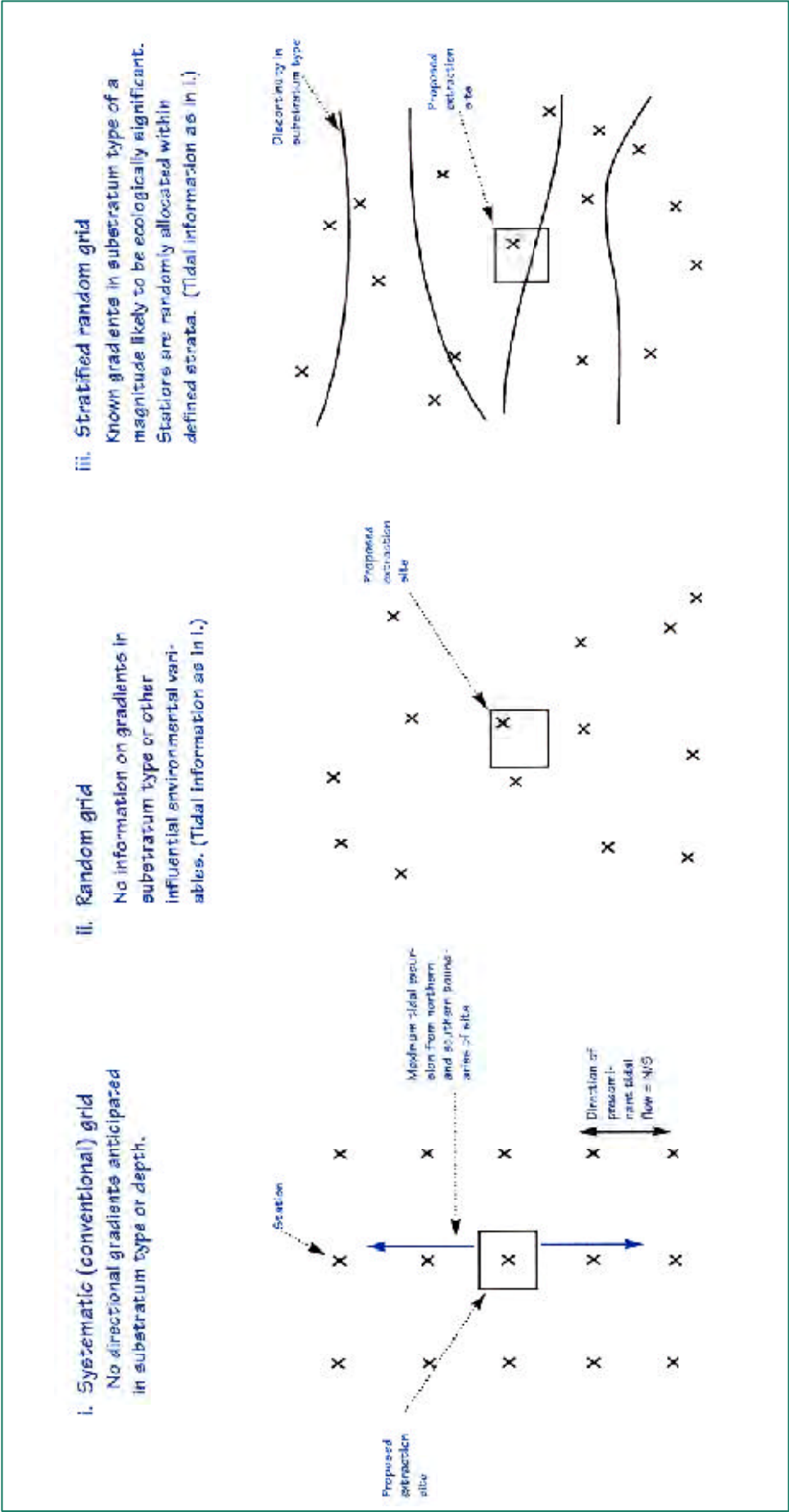


Figure 1 Hypothetical examples of approaches to sampling design in a Pilot Survey. (The numbers and locations of stations are purely indicative)

survey from the DEFRA Sea Fisheries Conservation Division (Branch B, Room 425, Nobel House, 17 Smith Square, London, SW1P 3JR). The Sea Fisheries Conservation Division will require information such as the nature and timing of the work being carried out, the name of the vessel to be used for the survey and the rationale behind the work, before a dispensation will be granted.

A summary of the key stages involved in survey planning is given in Table 1.

2.3.3. 'Pilot' survey

The necessity for such a survey will depend upon the availability of existing information for the area of interest. A well-studied location may provide all the information necessary for selecting suitable sampling tools, and designing a 'baseline' survey (see Chapter 2.3.4). In its absence, preliminary sampling over a wide area encompassing the proposed extraction site may be required, using a range of mechanical sampling devices, along with acoustic and visual methods for ground discrimination. Any deficiencies in local knowledge of water movements and their influence on particulate transport may be made good by the deployment of current and turbidity meters.

The adopted sampling design may be random, systematic, stratified or even selective (e.g. for confirmation of the presence of features), depending upon the extent of prior knowledge of the area. Hypothetical examples of alternative designs are given in Figure 1. The options are similar to those available for subsequent 'baseline' surveys, further details of which are given in 2.3.4 below. Thus, in terms of *design*, the two may differ only in respect of the number of stations visited, if the 'pilot' survey is successful in confirming prior inferences concerning variability.

For bottom sediments and the accompanying fauna, on-board qualitative or semi-quantitative assessments of collected samples will usually suffice at this stage. The purpose will be to determine the most effective sampling tools to meet the aims of future monitoring, to establish the distribution of habitat types which may influence subsequent sampling design, and to provide a preliminary characterisation of the benthic fauna, which may influence decisions on the size and number of samples to be taken. For example, larger numbers of samples are likely to be required in order to reduce the variance of counts of organisms that are present in uniformly low densities, or are patchily distributed. In many areas around the UK coastline, sufficient information may already exist on a larger scale, and pilot sampling may only be necessary to confirm that local conditions conform with the wider pattern. Such an investigation may be conducted immediately prior to a 'baseline' survey, in order to 'fine tune' the sampling design or sampling practices, but need not involve a separate sampling trip. A summary of targets for determination during a 'pilot' survey, and its relationship to the overall strategy is given in Table 1.

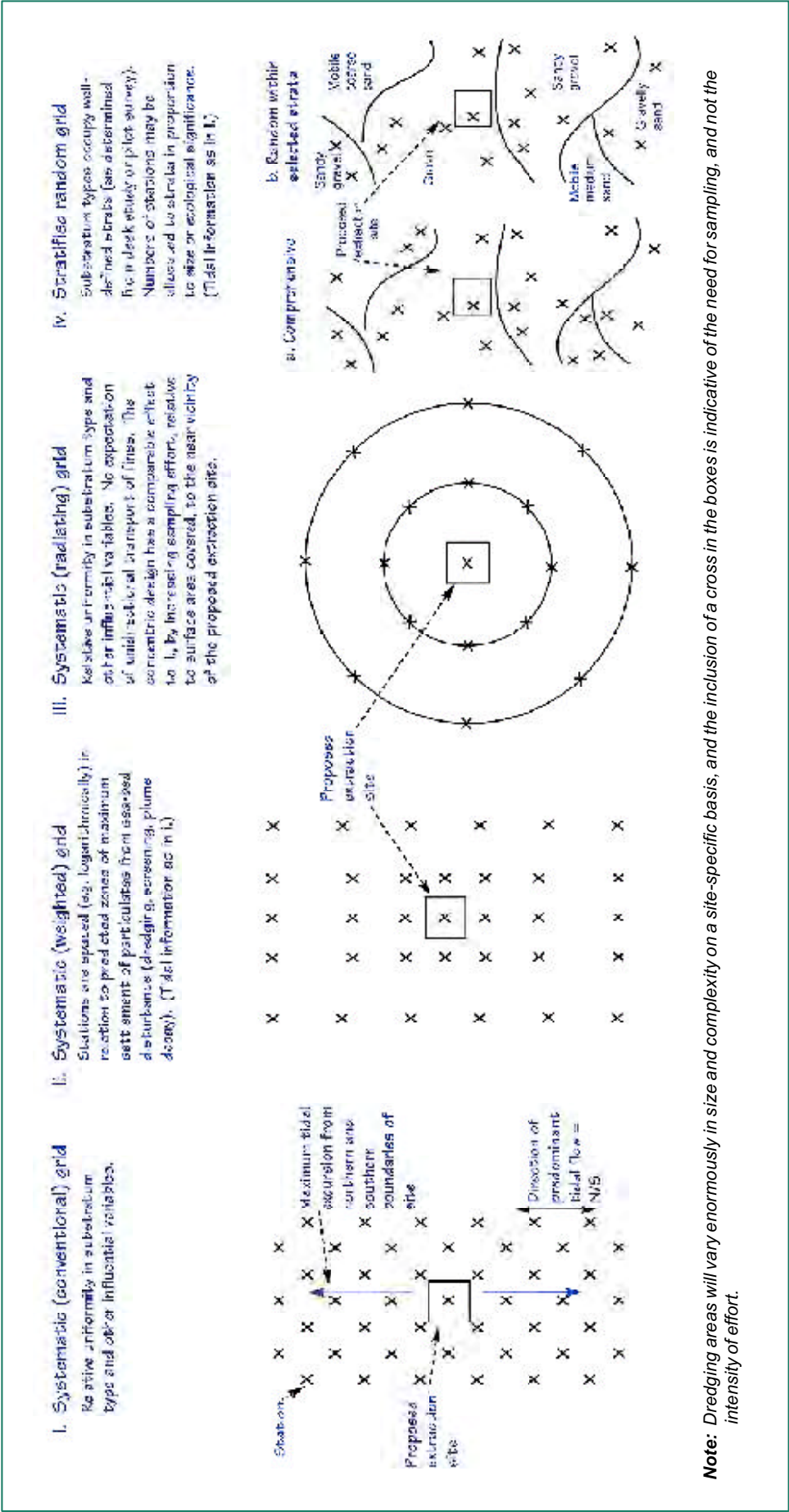


Figure 2 Hypothetical examples of approaches to sampling design in a Baseline Survey. (The numbers and locations of stations are purely indicative)

2.3.4. 'Baseline' survey

The purpose of this survey is to provide a quantitative description of the benthic fauna and associated sediments over an area encompassing predicted effects of dredging activity, before the event of permit issue. In an area of relative uniformity, this will typically take the form of a systematic grid of stations extending at least one tidal excursion beyond the limit of proposed dredging. In practice, this is the most commonly employed sampling design and provides a convenient basis for determining the distribution of benthic assemblages, and for exploring relationships with environmental variables. The design may be modified to enhance coverage near to anticipated future dredging activity and along predicted dispersal pathways for finer material released during dredging. More complex and spatially extensive sampling designs may be necessary to account for other man-made activities or features of conservation interest in the vicinity. A stratified random sampling design may be more appropriate where prior information (e.g. from desk study or 'pilot' survey) reveals well-defined spatial partitioning of habitat types. Hypothetical examples of approaches to 'baseline' survey design are given in Figure 2. **It must be strongly emphasised that sampling intensity within prospective dredging areas will be in proportion to their size and complexity, and therefore will commonly involve multiple stations.** Ideally, the same sampling device will be employed at all stations but alternative methods may be necessary in some circumstances, e.g. in the presence of significant rock outcropping supporting a valued epifauna.

As the emphasis in such a survey is on the elucidation of spatial pattern, a strategy involving the collection of single samples from several stations is favoured over repetitive sampling at fewer stations. The latter approach is more appropriate for 'ongoing' monitoring surveys at representative stations (see Chapter 2.3.5), but selective sampling at this stage in anticipation of the future need is likely to be cost-effective. A summary of the procedures involved in the conduct and reporting of a 'baseline' survey is given in Table 1.

2.3.5. 'Ongoing' survey

The main emphasis in this activity is on the monitoring of temporal trends before, during and after dredging activity. However, a spatial component is also essential to establish whether any trend at a location within the sphere of dredging influence is distinct from that occurring at a comparable but distant 'reference' location, i.e. whether any trend is attributable to natural or man-made influences. Ideally, a limited number of sampling stations occupying identical habitats within and beyond the predicted influence of dredging activity should be identified for this purpose. The approach is comparable to the 'Control/Treatment Pairing' principle of Skalski and McKenzie (1982) and developments (by Underwood, 1992) of the 'Before/After and Control/Impact' (BACI) design of Stewart-Oaten *et al.* (1986). (However, the term 'reference' is preferred to 'control' since, *sensu stricto*, examples of the latter do not exist in natural communities). Examples of the application of this approach to the monitoring of waste disposal activities are given in Rees and Pearson (1992) and MAFF (1993).

Properly designed, an 'ongoing' survey will allow a statistical evaluation of outcomes in relation to earlier predictions for dredging-induced changes. Stations may be located along a transect where effects are predicted to occur principally along a well-defined gradient away from a dredging area, or at representative locations within physically comparable zones. The number of stations will vary with the complexity of the physical habitat, the dispersive properties of the environment

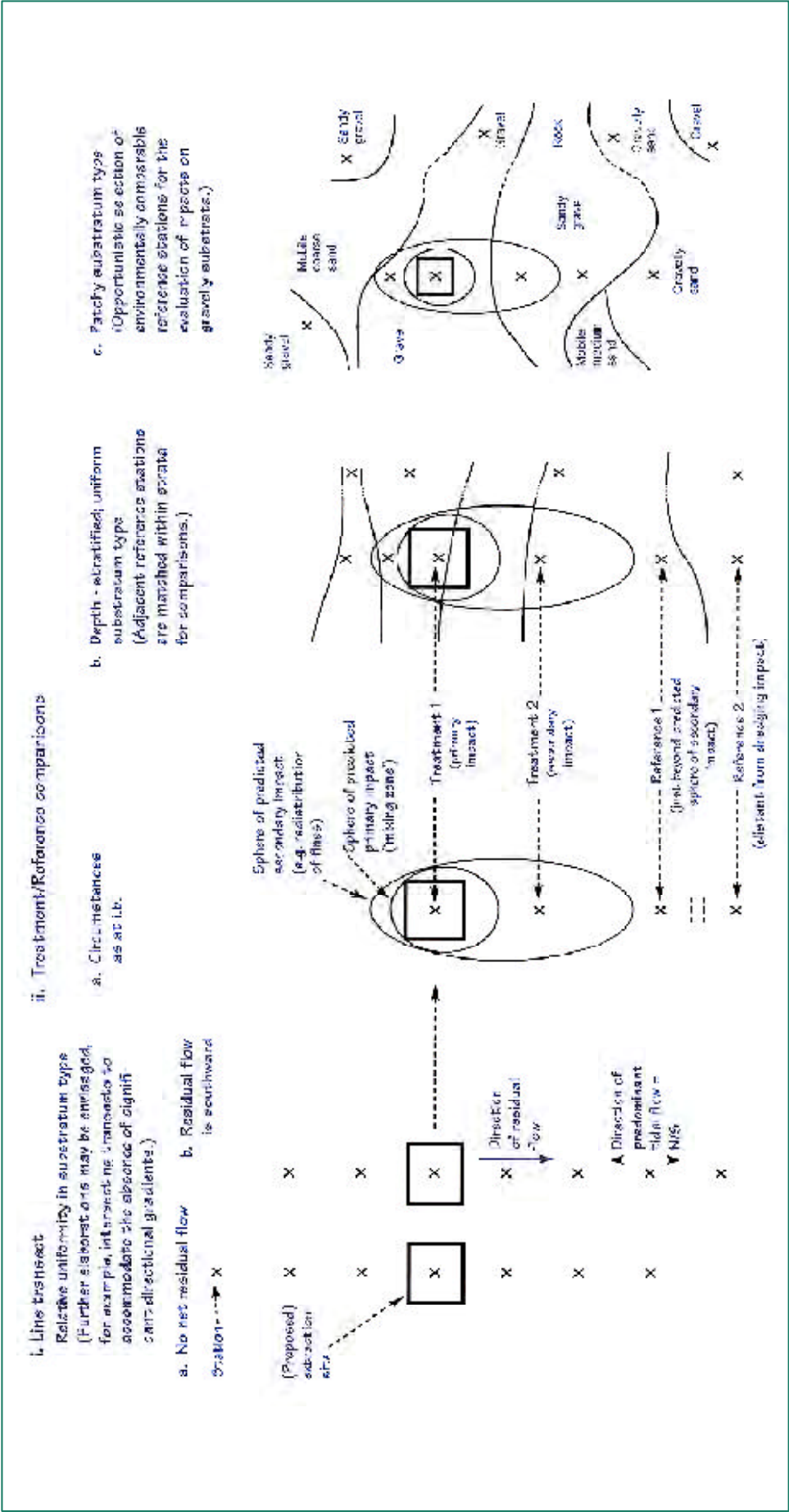


Figure 3 Hypothetical examples of approaches to sampling design in an Ongoing Survey. Note: these examples assume that dredging effort is uniform throughout the licensed site. In practice, many sites are more complex and subject to variable rates of dredging, so that zones of primary impact may be confined to locations within the licensed boundaries

within which dredging is to occur, the pattern and intensity of dredging, and the proximity of other man-made influences. As a minimum, an ongoing sampling design will consist of one 'treatment' station located within the predicted sphere of dredging influence, but peripheral to the centre of intensive dredging activity (see below), accompanied by two 'reference' stations, one just beyond the predicted sphere of influence, and one at some distance away.

The rationale for locating a 'treatment' station peripheral to the centre of dredging activity is that (by analogy with the 'mixing zone' concept applied to waste discharges: Water Authorities Association, 1988) any standards governing permissible biological changes in the surrounding environment would not be expected to be met at the point of immediate impact. Nevertheless, sampling at one or more stations within this area may often be necessary, since 1) in cases where dredging proceeds in sequence across zones within a licensed area, or following cessation of dredging, there will be a management interest in the recovery process, and 2) experience suggests that, depending on the spatial distribution and intensity of dredging, licensed zones are rarely lifeless, and there is a wider scientific and management interest in the responses of animal populations to ongoing physical perturbations, especially if there are specific sensitive features within the permit area which are being protected by dredging exclusions (e.g. *Sabellaria* reef). Hypothetical examples illustrative of this approach to the monitoring of aggregate extraction sites are given in Figure 3.

The number of samples to be collected at each station will reflect a balance between the statistical requirements of data analysis, the nature of the fauna and any resource constraints. Commonly, a minimum of 5 replicates will be collected either from a fixed point or randomly within a well-defined habitat type, and a minimum of three subsequently analysed.

The frequency of sampling will depend (*inter alia*) upon the perceived sensitivity of the environment within which dredging is taking place, and the amounts of material to be removed. In general, the frequency is likely to be higher in the period just prior to, and soon after, the onset of dredging, and then lower following demonstration that the environmental consequences conform with expectation (i.e. are acceptable), and are stable over time.

Sampling will be carried out at the same time of the year, preferably in the period February – May (i.e. before the main recruitment period for pelagic larvae), but only rarely will there be a need for seasonal sampling.

The choice of sampling locations should be informed by the outcome of the 'baseline' survey, and indeed sampling to generate the first (pre-dredging) data points in an 'ongoing' monitoring series may be feasible during this survey. As part of an overall quality assurance strategy, it will be important to check on the continued validity of stations selected as representative of impacted and reference conditions. This may be achieved by periodically repeating the 'baseline' survey, at intervals appropriate to local circumstances, but typically once every 3 – 5 years.

In 'ongoing' monitoring programmes, allowance must therefore be made for the possibility of modifications to sampling design or survey frequency in response to unanticipated man-made or natural influences. In some circumstances, design modifications may be justified in response to changes in dredging patterns within extraction sites. With the advent of Electronic Monitoring Systems which accurately record vessel movements during dredging, sampling may be precisely targeted at locations of varying dredging intensity (Boyd and Rees, in press and Chapter 2.4 below). Such an approach may also be useful in evaluations of the recovery of dredged areas after cessation of the activity.

A summary of the requirements of an 'ongoing' survey is given in Table 1.

2.4. The use of EMS information for designing surveys

Since 1993, every vessel dredging on a Crown Estate licence in the UK has been fitted with an Electronic Monitoring System (EMS). It consists of a PC electronically linked to a navigation system and one or more dredging status indicators. This automatically records the date, time and position of all dredging activity every 30 seconds to disk. Many of the dredgers operating in UK waters are fitted with Differential GPS navigation systems, which allow the EMS to operate with an accuracy of ± 10 m. This information can be collated and displayed as intensity plots showing the location of active dredging for any period of time. The information can also be interrogated to locate areas of the seabed within extraction sites, which have been subjected to different levels of dredging intensity. This information can be used in the design of seabed surveys and for interpreting the results (see, for example, Boyd and Rees, in press).

CHAPTER 3

The conduct of benthic surveys at aggregate extraction sites

3.1. Introduction

The type of gear selected for sampling seabed substrata and the benthic macrofauna at aggregate dredging sites is primarily determined by the hardness/compactness of the substrata. Whilst a wide variety of sampling methods are available (see Holme and McIntyre, 1984), only a small proportion of these have the ability to effectively collect samples from areas of relatively coarse sediments which are characteristic of dredging sites. Recommendations for equipment, which are capable of collecting samples of the benthic macrofauna and/or sediments from such areas, are provided below. Future innovations may improve sampling efficiency in such deposits and it should therefore be noted that certain techniques which are presently favoured may be superseded as new equipment is developed, tested and applied.

The majority of grab sampling devices are unsuitable for the collection of coarse sediments in environmental monitoring programmes. Typically, the downwardly-directed jaws are vulnerable to incomplete closure due to the presence of stones. For this reason, only a small number of grabs are presently appropriate for use at aggregate extraction sites (see Table 2). Whilst grabs allow quantitative evaluation of the macrobenthic infauna and a proportion of the epifauna, their size and mode of action means that they do not effectively sample the larger, rarer epifaunal species, or those capable of rapid avoidance reactions. Towed gear, such as trawls and dredges, are more appropriate for sampling these species, although usually at the expense of accurate quantification due to their inherent inefficiency (see below). For this reason, the overall aims of the survey should be taken into consideration when selecting the most appropriate sampling equipment and, in certain situations, it may be necessary to use more than one technique in order to sample the full range of benthic organisms present in an area. Finally, the important issues of position-fixing and vessel heading associated with the field sampling process are covered in Chapter 3.4.

3.2. Quantitative methods for sampling the benthic macrofauna and sediments

3.2.1. The Hamon Grab

The Hamon grab is the recommended tool for sampling the benthic macro-infauna from coarse substrata (Oele, 1978). This grab, originally designed by the Netherlands Institute for Applied Geosciences, consists of a rectangular frame forming a stable support for a sampling bucket attached to a pivoted arm (see Figure 4). On reaching the seabed, tension in the wire is released which activates the grab. Tension in the wire during inhauling then moves the pivoted arm through a rotation of 90° , driving the sample bucket through the sediment. At the end of its movement, the bucket locates onto an inclined rubber-covered steel plate, sealing it completely (Figure 4). This results in the sediment rolling towards the bottom of the sample bucket, thereby reducing the risk of gravel becoming trapped between the leading edge of the bucket and the sample retaining plate, and thus preventing part of the sample being washed out. Weights are attached to the grab to minimise the lateral movement of the supporting frame during sample collection. Weighting of the grab should be adjusted to obtain optimum sampling efficiency. A grab stand should support the grab before and after sampling (Figure 5). The stand should allow enough space for a container to be placed under the grab to receive the sampled material following its release from the bucket.

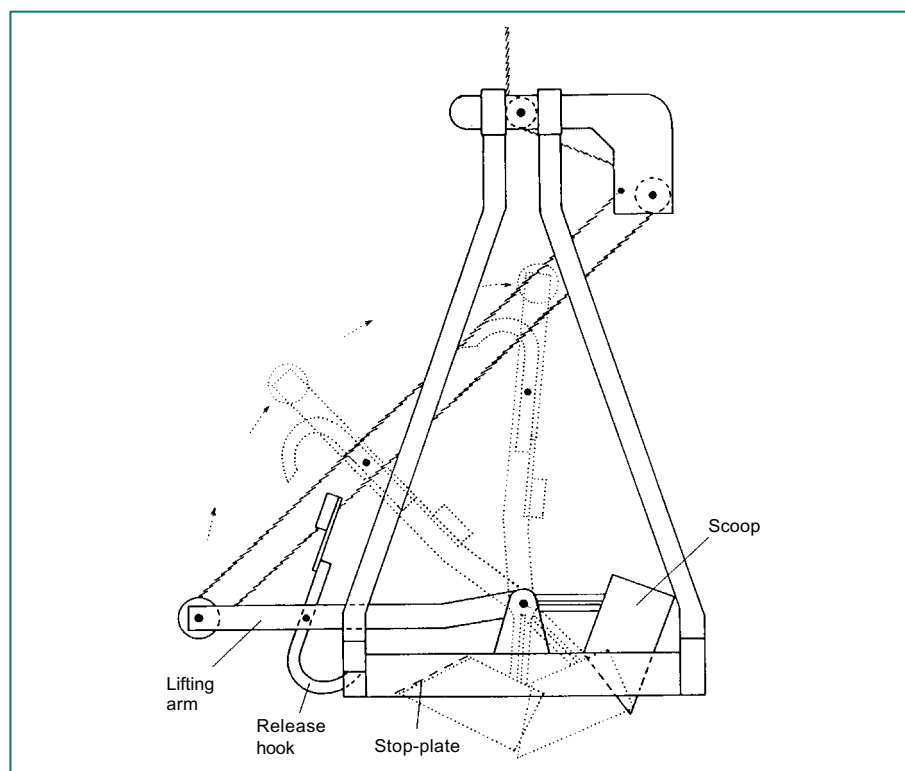


Figure 4 Hamon grab, showing mode of action. The lifting arm rotates through 90° to drive the sampling bucket (scoop) through sediment, closing against the stop plate. Plate taken from Eleftheriou and Holme (1984)



Figure 5 A 0.1 m² Hamon grab supported on an open frame to facilitate retrieval of the sample into a moveable container following controlled release from the bucket. Note the nearside rack supporting lead weights to increase sampler efficiency (a comparable rack on the other side of the sampler is hidden from view in this photograph)

The Hamon grab is robust, simple to operate and has been shown to be particularly effective on coarse sediments. It has been employed as a quantitative benthic sampler in several studies designed to assess the impacts of marine aggregate extraction on the macrofauna (van Moorsel and Waardenburg, 1991; Kenny and Rees, 1994, 1996; Kenny *et al.*, 1998; Seiderer and Newell, 1999). The original design was for a grab which samples an area of about 0.25 m². Since then, CEFAS has introduced a smaller device, sampling an area of 0.1 m². The height clearance (approximately 3 m) required for the larger device has caused operational difficulties when deployed from small research vessels (<25 m). However, when used from larger ships, it can be safely deployed and retrieved in most sea states (up to Beaufort Scale Force 5 to 6). Nevertheless, the smaller version (Figures 5-6) has a greater utility due to its ease of handling, which potentially widens the weather window for sampling and allows it to be used on smaller vessels. Furthermore, 0.1 m² is the conventional surface sample unit employed in most benthic surveys of continental shelf sediments, and conformity with this size therefore allows direct comparison of results with those from a wide array of other sources using a range of other sampling devices. This grab also takes quantitative samples of a more manageable volume than the large Hamon grab: up to a volume of 15 litres compared with up to 35 litres from the larger grab. Thus, the smaller grab is the preferred sampler for collecting samples of the macrobenthic infauna in a cost-effective manner. There may be locations with a very sparse fauna where the collection of a larger surface area is justified, but this can be achieved by increasing the numbers of replicates using the smaller-sized sampler. Enhanced replication also has the potential advantage of increasing the statistical power of the resulting data.

A drawback of the Hamon grab is that the sediment sample is 'mixed' during the process of collection and retrieval, thereby precluding the examination or sub-sampling of an undisturbed sediment surface.



Figure 6 A 0.1 m² Hamon Grab being retrieved. Note the use of a winch-controlled lateral supporting rope for increased stability (and therefore safety) during deployment and recovery. It is unhooked before descent of the sampler

3.2.2. The modified Day grab

The Day grab evolved from the spring-loaded Smith-McIntyre grab (see Holme and McIntyre, 1984), and represents an attempt to simplify this earlier type of sampling device, without loss of operational efficiency. It incorporates a frame to keep the grab level on the seabed and two trigger plates to activate the release, but there are no springs to force the hinged buckets into the bottom. The modifications over the original Day grab design (see Eagle *et al.*, 1978) consist of 'stub axles', with closing flaps that hinge from the exterior of the buckets, rather than centrally (Figure 7). This device samples an area of 0.1 m², to a maximum depth of 14 cm. The jaws are supported within an open framework, which will cause minimal down-wash as it lands on the seabed (Figure 8). Lead weights are usually added to obtain optimum penetration of the sediment. The grab should not be allowed to bite too deeply into the sediment, as this results in the sediment surface making contact with the closing flaps of the sample bucket, which can ultimately lead to loss of material on retrieval and disturbance of the surficial layers. The jaws of the grab and the flaps on top should seal well to ensure no loss of material when the grab is retrieved.

This grab was designed for sampling soft sediments i.e. ranging from sands to muds. It does not function well on coarse sediments due to the tendency of larger particles to prevent closure of the buckets, causing loss of sample and is therefore not well suited for use at aggregate dredging sites. However, where there is a high percentage of soft sediment (sands or muddy sands) associated with a gravelly component, this grab could be used, albeit with the likelihood of a relatively high failure rate.

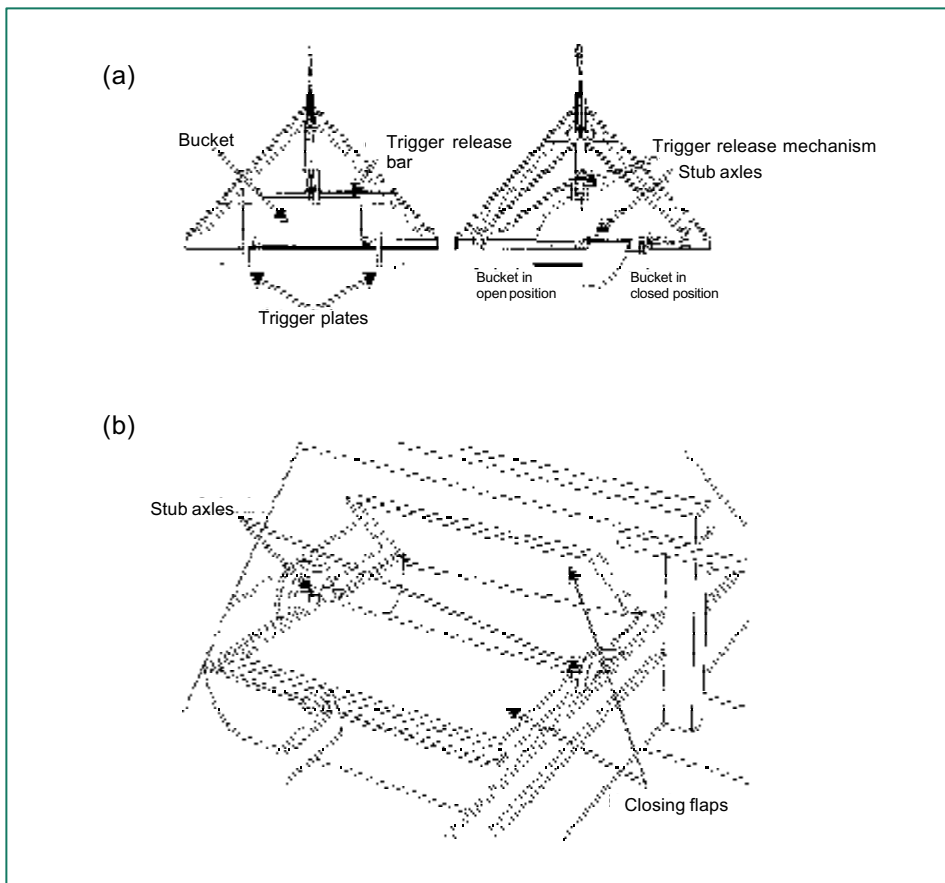


Figure 7 **Modified Day grab (source Eagle *et al.*, 1978). a) Side views of the grab showing the opened and closed bucket positions; b) Top view of the sampling buckets. In the original Day grab design a solid axle ran across the top opening between the two bucket pivots to which the closing flaps were hinged. In the modified design the solid axle has been replaced by stub axles and the closing flaps are hinged from the outer edges of the buckets to allow better access to the sample**



Figure 8 **A 0.1 m² Day grab during deployment. Note that the sample buckets are in the open position prior to sampling. Also note the addition of triangular lead weights to improve sampling efficiency**

3.2.3. The Shipek grab

The Shipek grab employs a semicircular bucket activated by powerful springs (see Holme and McIntyre, 1984). It has proved very effective in sampling coarse substrata and is widely used in marine geophysical and geochemical surveys (Figure 9). The spring loaded bucket rotates through 180° on closure, ensuring that no wash-out of sediment occurs during recovery through the water column. The strong spring mechanism also allows samples to be collected from relatively hard and consolidated sediments, albeit with an increased failure rate due to larger particles preventing proper closure. Unfortunately, due to its small size (sampling an area of approximately 0.04 m²), this device is unsuitable in routine macrofauna investigations, but may be useful in 'pilot' surveys aimed at preliminary characterisation of variability in habitat type and the associated fauna.

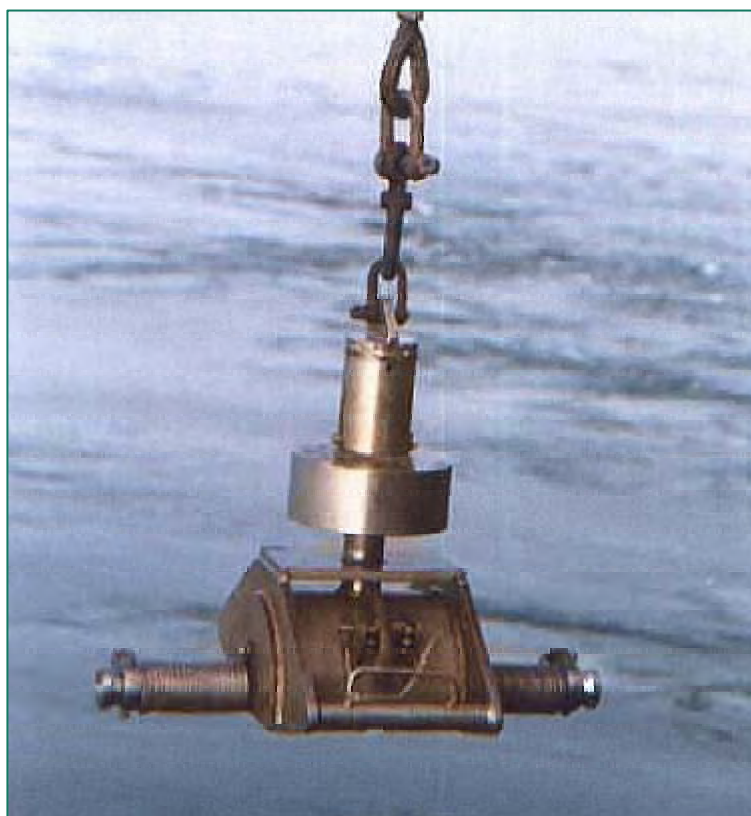


Figure 9 **A Shipek grab prior to deployment. Note the powerful spring on the side-arms, and the top-mounted weight under warp tension which, on release following contact with the seabed, induces firing of the closing mechanism and, at the same time, increases collection efficiency by downward pressure**

3.2.4. The van Veen grab

The van Veen grab (van Veen, 1933), in common with many other grabs, relies on the closure of two opposing jaws for the collection of a sediment sample. The difference between this and the Petersen grab (see Holme and McIntyre, 1984), is that the van Veen grab has long arms attached to each bucket, thus giving better leverage during closure. This mode of action is not ideally suited for the collection of coarse sediments as large particles of

gravel tend to become caught between the jaws, resulting in loss of the sample upon retrieval of the grab. Thus, whilst this type of grab has been used widely in benthic macrofauna studies, it is not recommended for use on coarser substrata. On softer substrata, (i.e. with a reduced gravel component) its performance characteristics are likely to match those of the Day grab and, in some instances, may be preferable on account of the greater leverage provided by the side arms. In such localities, the success rate, and therefore the cost-effectiveness of the device relative to, e.g. a Hamon grab, will be a matter for judgement by experienced survey scientists.

3.2.5. Other grabs

Canadian scientists have devised a hydraulically operated benthic grab, which incorporates a top-mounted camera for precision sampling (Gordon *et al.*, 1997; Rowell *et al.*, 1997). This has been found to work efficiently on gravel deposits in the Grand Banks area, but presently is employed as a research tool, and is an expensive option. Future developments may widen the scope for its application in routine monitoring. Similar considerations apply to industrial-scale samplers such as the hydraulic clam shell grab, and the scope for their adaptation to scientific-scale sampling merits further exploration.

3.2.6. Deployment and recovery of grabs

Despite substantial differences in the design and operation of grab samplers, there are a number of important general issues relating to their deployment and recovery (see for example, Rumohr, 1999). During retrieval of the gear from the seabed, the first 5 metres of warp should be hauled slowly so as to maximise sampling efficiency. The grab can then be hauled to the surface at a faster rate. When the grab reaches the sea surface, it should be swung onboard as soon as possible, as the device presents a danger on a rolling vessel. Once the grab is recovered, it should be lowered on to a supporting frame, designed to allow efficient placement and removal of a sample container underneath the sample bucket. In rough seas, the bow of the vessel should, where possible, face into the direction of oncoming swell, thus minimising the roll of the vessel, and hence reducing the potential for loss of control of the grab during deployment and recovery.

3.2.7. Corers

A large number of corers have been designed for the collection of sediments and the associated macrobenthic fauna (see Holme and McIntyre, 1984). On coarse or well-consolidated sediments many of these devices will have a low sampling efficiency, as coarse sediment particles will prevent penetration of the sampling device and will hinder the proper sealing of the core barrel. Therefore such devices are not appropriate for routine surveys of the macroinfauna from marine aggregate extraction sites. However, devices such as vibrocorers (James and Limpenny, *unpublished*) will be appropriate for collecting samples from coarse substrata in order to evaluate vertical structure and integrity. Vibrocorers are widely used by the industry in prospecting surveys and therefore may provide information relevant to 'pilot' surveys. Again, adaptation of industrial scale vibrocorers for use in environmental sampling programmes merits further attention.

Table 2 A comparison of the merits and drawbacks of various devices used for the collection of faunal samples at aggregate extraction sites

Sampling device	Surface area sampled	Approximate weight without sample	Suitable for sampling coarse substrata	Quantitative/semi-quantitative	Easily and safely deployed from small (<25 m) vessels	Advantages	Disadvantages
Small Hamon grab	0.1 m ²	300 kg + weights up to 300 kg.	Yes	Quantitative	Yes	Easy to handle. Surface area sampled conforms with the conventional sampling unit for continental shelf sediments.	More replicates may be required in patchy environments, compared with its larger counterpart.
Large Hamon grab	0.25 m ²	350 kg + weights up to 150 kg.	Yes	Quantitative	No	Large sample may be more representative of coarser or more sparsely populated sediments.	Large size makes it more difficult to handle than the smaller version. Large sample volumes (35 litres max) can be relatively time consuming to process. Surface area sampled not directly comparable to other sampling devices.
Day grab	0.1 m ²	80 kg + weights up to 80 kg.	No	Quantitative	Yes	Easily deployed. Standard sampler for most U.K. infaunal soft sediment surveys.	Not effective in coarse substrata.
Small van Veen grab	0.1 m ²	80 kg	No	Quantitative	Yes	Easily deployed. Widely used for infaunal surveys, especially in continental Europe.	Not effective in coarse substrata.
Large van Veen grab	0.2 m ²	100 kg	Will meet with variable success depending on coarseness of substrata	Quantitative	Yes	Easily deployed. Widely used for infaunal surveys, especially in continental Europe.	Unreliable in very coarse substrata, but may be more effective in some coarse sediments than 0.1 m ² version.
Shipek grab	0.04 m ²	80 kg	Yes	Unsuitable for infaunal assessments	Yes	Can be used effectively for physical characterisation of substrata.	Sample too small and variable for quantitative faunal assessment.
Newhaven Scallop dredge	Variable	Single dredge 90 kg. Three dredges on beam 400 kg	Yes	Semi-quantitative	Single dredge configuration easily deployed. Two or three dredge option more cumbersome.	Extremely robust design is suitable for use over coarse unconsolidated substrata. Under favourable conditions can sample effectively for the duration of a fixed distance tow.	Sampling efficiency variable under poor weather conditions. Heavy. Selective towards epifauna.
Rallier du Baty dredge	Variable	80 kg	Yes	Semi-quantitative	Yes	Robust design will work in most unconsolidated substrata. Circular mouth increases sampling efficiency. Easy to deploy. Can be fitted with mesh liner for retaining smaller organisms.	Uncertain mode of sampling, especially over coarse or rocky terrain.
Modified Anchor dredge	Variable	65 kg	Yes	Semi-quantitative	Yes	Inexpensive and easy to handle. Will operate either side up. Easy to deploy.	Uncertain mode of sampling, especially from large vessels. Can be damaged on rocky ground.
Rock dredge	Variable	140 kg	Yes	Semi-quantitative	Yes	Can be used over very coarse ground, including bedrock. Useful for 'blind' sampling during pilot surveys. Can be fitted with mesh liner for retaining smaller organisms.	Heavy when full. Uncertain mode of sampling.
Heavy duty 2m Beam trawl	Variable	60 kg	Yes	Semi-quantitative	Yes	Can yield relatively consistent samples over coarse unconsolidated substrata, under calm sea conditions.	May be damaged if towed over very coarse or rocky terrain. May lose bottom contact during unfavourable sea or tidal states, or as a result of vessel speed and size.

3.3 Qualitative and semi-quantitative methods for sampling the benthic macrofauna

Much of the following account is taken from Rees and Service (1993) and Rees *et al.* (1990) and is mainly concerned with epifauna sampling. However, certain devices referred to (notably the Anchor dredge) will also be appropriate for the sampling of infaunal populations.

3.3.1. Background

The epibenthos comprises animals and plants living on - as distinct from within - the seabed. They may be sedentary, e.g. hydroids and bryozoans, or motile e.g. decapods, starfish and flatfish. Animals in the former category are typically filter-feeders, whilst the latter are typically carnivores or omnivorous scavengers. Some groups spend their entire adult life intimately associated with the seabed, e.g. hydroids, most crabs and flatfish, while others may only be transiently associated, e.g. shrimps and many ground fish species. Subtidally, the most well-developed epibenthic assemblages normally occur on mixed substrata with a significant coarse component, where the range of micro-habitats can allow colonisation by a wide array of species.

There are several attributes of the epibenthos of coarse substrata which can make this group an important target in environmental assessment. For example:

- i. on predominantly rocky areas or tide-swept grounds, they may be the only significant component of the benthos. Such areas may support an exceptionally high diversity and biomass of species, e.g. associated with subtidal mussel beds;
- ii. sedentary epibenthic species provide a direct route for carbon from the water-column to the seabed via filter-feeding;
- iii. many species are preyed upon by fish;
- iv. complementary surveys of the epifauna provide additional information, beyond that obtained from infaunal investigations, about the status of an area, e.g. in terms of the range and relative abundance of species present, or their mode of feeding.

3.3.2. Sampling approaches

Because of the much wider size range of organisms encountered compared with the infauna, as well as factors such as the motility and comparative rarity of some of the component species, small (0.1 m²) grab samplers are generally unsuitable for quantitative assessment of the epifauna. Moreover, on mixed substrata or hard ground, grab sampling devices may operate at low sampling efficiency or not at all. A wide range of dredges and trawls have been devised for remote epibenthic sampling, with varying efficiency of organism retention (see e.g. Eleftheriou and Holme, 1984 and below). In addition, a number of devices, more usually associated with epifaunal sampling, can collect large volumes of sediment. In this

mode of operation, such devices can be useful tools for semi-quantitative or qualitative sampling of the infaunal fraction of the benthos during 'pilot' surveys.

Given suitable tidal and weather conditions and adequate water clarity, diving probably provides the best means for quantitative assessment of the epifauna through a combination of direct observation and sampling, but these conditions are not typical for much of the U.K coastline. For these and other logistical reasons diving can be an expensive - and potentially hazardous - option for the conduct of regular offshore monitoring programmes, although guidelines for survey and sampling of inshore (mainly rocky) habitats by this means are well-defined in the UK, largely through the efforts of conservation interests (e.g. Hiscock, 1990; Davies *et al.*, 2001).

Alternative methods for *in situ* assessment include remotely deployed underwater video and still photography. These, along with a range of other imaging methods, have been reviewed by Rumohr (1999); further detail is provided below. Again, water clarity is an important limiting factor but, in general, this option is likely to be cheaper and less weather-dependant than diving surveys. Moreover, they may be operated in areas deeper than those normally accessible to divers.

A combination of *in situ* observation by photography and efficient remote sampling of sediments offers the most promising tool for routine assessment of epifaunal communities at aggregate extraction sites. This may be achieved by attaching a video camera and light in order to collect an image of the seabed adjacent to or in front of the sampling device.

3.3.3. Trawls

Small-sized Beam and Agassiz trawls are commonly used for remotely sampling the epifauna in a 'semi-quantitative' or qualitative manner (see Holme and McIntyre, 1984). These trawls are designed to sample at and just above the surface of the seabed and, because of the relatively large area that can be covered in one deployment, they are appropriate for collecting the larger, rarer or more motile species. A 2-m beam trawl is generally to be recommended for sampling the epifauna at marine aggregate extraction sites. The small size of this type of gear makes it easy to deploy and usually results in the collection of a manageable sample size. On coarser substrata, such as those likely to be encountered during surveys of aggregate extraction sites, the use of a heavy duty 2-m beam trawl is advised (Figure 10). This consists of a metal beam, a chain mat designed to prevent the collection of larger boulders, and chafers to limit net damage (see Jennings *et al.*, 1999 for design information). Standard 2-m Lowestoft beam trawls with wooden beams and tickler ground chains (Riley *et al.*, 1986) have also proved useful for epifaunal sampling on finer substrata (Rees *et al.*, 1999) (see Figure 11). The net consists of a belly (98 rows m⁻²) and codend (157 rows m⁻²), with a 3mm mesh codend liner to capture smaller organisms.

On each deployment, 2 m beam trawls should be towed over a distance which will produce a sufficiently large sample to adequately characterise the epibenthic community, but not so large that the sample is unmanageable. The appropriate towing distance will vary according to ground type and the density of the epibenthic fauna. For this reason, it is prudent to assess the towing distance to be used for the survey by carrying out a trial tow or tows before commencing the survey proper. As a general guide, towing distances of between 200 m and 800 m produce manageable sample sizes, i.e. when the objective is a full census of all animals retained, whilst covering sufficient ground to adequately characterise the communities. Start and end positions should be recorded for each tow, even in cases where towing over a fixed time interval is the primary goal. This allows calculation of the appropriate distance



Figure 10 **A heavy-duty 2-m beam trawl with chain mat being recovered over the stern of the research vessel. Note the metal beam between the two trawl shoes and the chain mat attached to the underside of the beam**

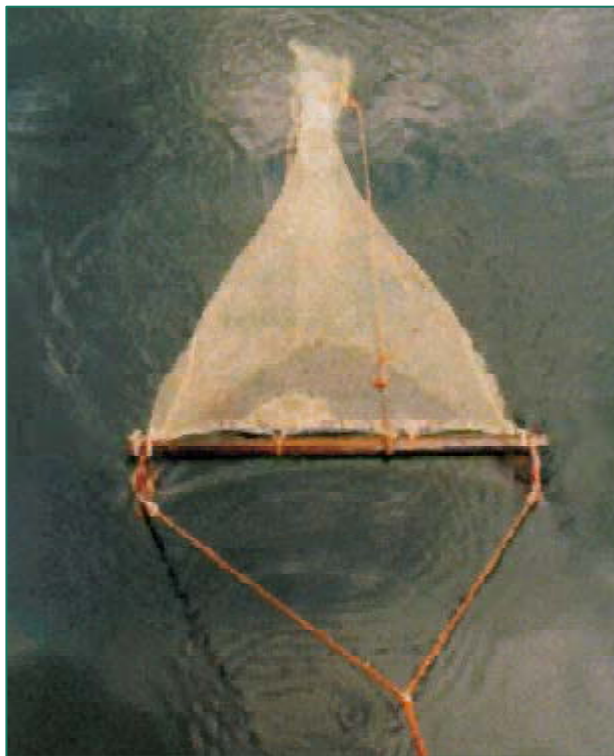


Figure 11 **A standard Lowestoft 2-m wooden beam trawl (Riley *et al.*, 1986) at the water surface prior to deployment. Note the wooden 2 m beam and the pair of towing bridles attached to the trawl shoes**

covered (see also below). The start position should be recorded at the point at which the trawl winch is stopped, and the end position should be recorded at the point of commencement of hauling.

Beam trawls can be towed on a pair of bridles attached to a single tow-rope or line. As a guide, the length of the warp should be approximately three times the maximum expected water depth. Clearly, the speed at which the beam trawl is towed will depend on local circumstances and the type of vessel employed; however, a maximum speed of 1.5 knots over the ground is recommended. The beam trawl is likely to be damaged if it meets an obstruction on the seabed whilst being towed, which can limit the use of the gear to relatively uniform areas. Trawls should be inspected before and after tows and any repairs should be carried out immediately, with any damage being noted in the field log. A second tow may be necessary, and its contents assessed, before a station is finally abandoned. Clearly, serious damage to the net or frame will be taken to indicate that the station is unsuitable for beam trawl deployment. If this is the case, careful consideration should then be given to nearby locations where trawling may be possible.

Evidence that the device has maintained good bottom contact during towing should be sought from an examination of the warp under tension, and of the beam trawl shoes on retrieval. Inspection of the underside of trawl shoes will give an indication of seabed contact and whether the gear has been sampling in the correct orientation. Clearly this cannot provide confirmation on the extent of bottom contact. An odometer wheel attached to one of the shoes can also provide useful information on seabed contact, although its function may be impaired on mixed substrata or in the presence of significant quantities of hydroid colonies, which can become entangled in the mechanism. (Research is in progress at CEFAS to produce a more reliable electronic device for determining the duration of bottom contact). A weight placed in the cod-end of the trawl can also be used to prevent the net fouling the beam during deployment.

The efficiency of the sampling gear will often be dependent on the different tidal and wind conditions that prevail at the time of sampling and, for offshore surveys, it is rarely practicable to co-ordinate effort in such a way as to ensure close comparability on all sampling occasions. Thus sample size and quality may vary, irrespective of whether tows are conducted over fixed times or fixed distances. Therefore it is essential that information on tidal state and weather conditions are recorded, as they may contribute to observed differences between stations and/or sampling times. It is to be expected that the efficiency of capture of epibenthic organisms by the trawl will vary with substratum type and weather conditions, and will always fall well short of 100%.

A degree of expert judgement regarding sampling efficiency will be a routine requirement during trawl survey, and samples will accordingly be accepted or rejected on this basis. This also emphasises the need to recognise that the data generated are, at best, 'semi-quantitative' in nature. Further work is required in order to improve the quality and comparability of epifaunal data generated from trawl surveys.

3.3.4. Dredges

In general, the use of towed dredges for evaluation of epifaunal community structure should be avoided when other sampling tools (e.g. beam trawls) can be effectively employed. However, where the hard or uneven nature of the substrata precludes the use of a trawl it is often possible to obtain adequate samples using dredges, a variety of which are available (Holme and McIntyre, 1984).

NEWHAVEN SCALLOP DREDGE

The Newhaven Scallop dredge (Franklin *et al.*, 1980) (Figure 12) is a commercially-used towed device that may be operated over very coarse terrain but would be likely to suffer damage if towed over bedrock or through large boulders. The dredge itself consists of a triangular steel frame supporting, on its underside, a spring-loaded plate to which a tooth bar, designed to dig into the sediment, is bolted. When the dredge encounters rock or large stones, the springs allow the tooth-bar to swing back thus avoiding snagging and reducing the quantity of stones caught. The tooth bar is normally 0.8 m wide and bears about 10 teeth up to 7 cm long. The mouth of the dredge is approximately 800 mm wide and 110 mm high during deployment. Also attached to each frame is a bag whose lower surface is made up of heavy-duty metal links (outside diameter ~55 mm, inside diameter ~42 mm) with an upper surface of heavy gauge nylon mesh. The maximum diameter of particle likely to be retained within the dredge is approximately 20 mm. A number of these dredges may be attached to a robust metal beam which is fitted with large rubber rollers at each end.

The dredges are deployed over the stern or side of a vessel and towed for a pre-determined time. Care must be taken to ensure that the dredge is deployed the right way up. The sampling efficiency of the dredge for each tow can be assessed on deck, normally by the quantity of material collected. Variables such as the duration of the tow or the length of warp paid out can be adjusted each time in an attempt to increase the quantity of material collected. In general, the same considerations employed during the beam trawl survey (Chapter 3.3.3) regarding towing duration should be applied. Samples collected using the Scallop dredge should only be treated as at best semi-quantitative in nature. The use of this device is recommended for the collection of qualitative samples as a last resort in areas of coarse, unconsolidated sediments which are too rough or uneven to permit the deployment



Figure 12 **A Newhaven Scallop dredge. Note the robust metal beam with rubber rollers on each end. Three dredges are attached to the beam, and the upper nylon mesh side of the collection bags are visible**

of less robust gear (e.g. small trawls). They may also be used to sample for 'keystone' species, such as horse mussels, from an area of interest. The Scallop dredge may be used to test the suitability of the ground prior to the deployment of less robust gear (e.g. beam trawl). This may be particularly useful if the ground is thought to be very coarse or uneven. There are other types of commercial Scallop dredges (e.g. French Scallop dredge) which may also be used in environmental sampling, but which differ in that they are heavier in design and lack the spring-mounted teeth (see Franklin *et al.*, 1980).

RALLIER-DU-BATY DREDGE

The Raillier-du-Baty dredge (Figure 13, see also p.498 in Cabioch, 1968) is designed to work in a range of substrata from sands to cobbles, and has a long and successful history of use in the English Channel and Celtic Sea (e.g. Cabioch, 1968). It consists of a robust metal ring (inside diameter 550 mm large version, 390 mm small version) attached to a central towing arm. An open ended bag of the desired mesh size (e.g. 500 μm or 1 mm) is attached to the ring, and the trailing end of the bag is tied to prevent loss of material during collection of the sample. This inner bag is protected by an outer, coarser bag which is, in turn, enclosed by a heavy duty apron of fishing net, in order to reduce chafing. The warp is attached to a fixing point on the metal ring, and a weak link is placed between this point and the central arm. This optimises the digging capability of the edge of the ring and reduces the chances of the edge being lifted away from the seabed.



Figure 13 A Raillier-du-Baty dredge. The dredge consists of a robust circular metal mouth to which a collection bag is attached. The dredge is towed from the bridle attached to the outer rim of the dredge. A weak link between the towing bridle and the central towing arm of the dredge is designed to break if the dredge meets an obstruction on the seabed

The dredge is deployed over the stern or side of a vessel, and the warp is paid out to a length of approximately three to five times the water depth. Contact with the seabed can be judged by the vibration of the warp as the device is towed. The dredge should be towed at not more than 1.5 knots for a pre-determined time which should not normally exceed 5 minutes. On completion of the tow, the dredge is recovered and the mesh bag untied. For convenience, the dredge can be suspended and the sample released onto the deck. Samples collected by this method should be treated as semi-quantitative or qualitative.

The circular nature of the mouth of the dredge allows it to roll as it is towed across the seabed, which has the advantage that the device can continue to sample over uneven terrain. The device is suitable for collecting both infaunal and epifaunal organisms. The disadvantage of this gear is that it can collect very large volumes of sediment (e.g. occasionally > 100 litres) which may be very time consuming to process. It can also be difficult to judge whether the dredge fills up immediately upon reaching the seabed, or whether it fills gradually as it is towed along the seabed. This uncertainty can complicate interpretations of the resulting macrofaunal data. This device is not for routine use other than in cases where recommended by CEFAS, and where other sampling tools prove ineffective.

ANCHOR DREDGE

The Anchor dredge (Forster, 1953) is designed to be operated from a small vessel in sandy sediments, although it can produce acceptable samples when used on coarser substrata (see Eleftheriou and Holme, 1984). It consists of a rectangular metal frame, forming the mouth



Figure 14 **A CEFAS modified Anchor dredge. Note the solid rectangular metal collection box (as opposed to a net bag as in the original design), the open side of which forms the mouth of the dredge. The warp is attached to a hinged wishbone arm which enables the dredge to collect a sample irrespective of which side it lands on the seabed**

of the dredge, which is towed by hinged wishbone arms. In the original version a net collection bag is attached to the rear of the device to retain the sample (Holme and McIntyre, 1984). This design has been modified by CEFAS to make the device more robust (Figure 14). In the modified version, the net collection bag is replaced by a sealed metal plate: the dredge therefore consists of a metal box, the open anterior end of which is 450 mm wide by 225 mm deep.

The Anchor dredge is deployed over the side or stern of a vessel and after sufficient warp is paid out (three to five times water depth) the warp is secured. As the name suggests, the dredge is intended to collect a discrete sample from a single point as it digs into the sediment under the weight of the drifting vessel. On larger vessels, it may be employed deliberately or by default as a towed device but, as with the Rallier-du-Baty dredge, uncertainty in its mode of action at the seabed may complicate interpretations of the resulting data. Again, the data generated are, at best, semi-quantitative in nature. Advantages of this dredge are that it can fall either side up and will still collect a sample, its small size makes it relatively easy to handle and deploy, and it is relatively inexpensive.

ROCK DREDGE

The Rock dredge (Nalwalk *et al.*, 1962) (Figure 15) is an extremely robust device that was originally designed for the collection of rock samples from deep-water locations. It is comprised of a heavy gauge rectangular metal rim to which a heavy-duty mesh made of interlaced metal rings is attached. The dimensions of the mouth of the dredge are 595 mm wide by 400 mm high and the diameter of the rings is 55 mm outside diameter and 42 mm inside diameter. The largest particle which can pass through the mesh is approximately 20 mm. It can be used successfully over most substrata including gravels and cobbles, and will even collect surface scrapings of bedrock. It is possible to fit a fine mesh bag inside the outer metal mesh enabling the dredge to collect finer material. The mesh size used will depend on the requirement of the survey. The dredge is deployed in a similar fashion to that described above for other dredges. On return to the deck the dredge is lifted by its trailing end and the sample is tipped onto the deck. As with other dredges, the data generated should be treated as, at best, semi-quantitative.



Figure 15 **A Rock dredge. Note the heavy-duty rectangular metal rim and the collection bag consisting of interlaced metal rings**

The robust nature of this type of gear permits deployment in areas where little is known about the nature of the substratum, and it may therefore be useful during 'pilot' surveys, at locations where difficult sampling conditions are a possibility. Advantages of this dredge are that it can fall either side up and will still collect a sample, its small size makes it relatively easy to handle and deploy and it is relatively inexpensive.

3.3.5. Underwater video and stills techniques for surveying hard ground

The following account is an extended version of that provided by Rees and Service (1993). Underwater video and stills photography are valuable, non-destructive methods for the assessment of all types of seabed habitat. They can be particularly useful over hard and consolidated ground where the sampling efficiency of other physical sampling methods is low. Remote-control underwater photography has been in use for a number of years to obtain static images of the seabed, and high quality images can be obtained which enable the identification of much of the macro-invertebrate fauna present. These images cover a small area of seabed and, while useful in pilot surveys, do not give information on the overall distribution of faunal communities.

To allow wider coverage of the seabed, photographic and video cameras have been mounted on a variety of platforms (Figures 16-17). Cameras have also been attached to a variety of grabs to provide real time images of the nature of the substratum sampled. However, in most instances platforms will fall into one of the following categories:

- devices which are capable of moving or being directed under their own power such as Remotely Operated Vehicles (ROVs).
- samplers which are lowered to a point above the seabed (e.g. remotely operated hoisted platforms), or are towed along the seabed, such as photographic sledges.

The most commonly used method for photographing coarse aggregate environments is the camera sledge (Figure 16), which is robust and simple to operate. It is usually towed over the seabed at slack water and typically includes a vertically mounted stills camera and a forward-, or sideways-pointed television camera linked by way of an electrical 'umbilical' cable to a recording unit on the survey vessel. This allows still photographs to be taken at selected locations of interest, or at regular fixed distances. By using a fixed frame, the area in view at any one time can be calculated and this, coupled with knowledge of the distance covered in any one haul, allows transect-type studies to be conducted.

Cameras can also be mounted on ROVs, which are self-propelled vehicles controlled by commands from the surface which are relayed down an umbilical cable which also carries the video and other telemetry signals. The apparent advantage held by ROVs over towed vehicles is their manoeuvrability, which offers the freedom to move in three dimensions. This should allow objects to be viewed from a variety of angles and the vehicle can be stopped or moved back onto an object for further study. However, small ROVs are restricted by their limited capability to operate in currents in excess of 1.5 knots. The area covered by ROVs is generally restricted by the length of umbilical and the water depth.

A third alternative to the systems listed above is the Remotely Operated Towed Vehicle (ROTV), whose depth and altitude are controlled by rotors. Such devices allow relatively fast towing speeds and the possibility of midwater observations. However, the cost of the elaborate control systems required for these devices will tend to limit their use by smaller organisations.

Camera systems, both video and stills, may also be attached to other sampling platforms such as grabs, corers and trawls. This enables the collection of images which not only relate directly to the substratum being sampled, but in many cases also allows some assessment of the sampling efficiency of the device to be made.

The following guidelines for the deployment of underwater camera systems are recommended:

- i. underwater photographic systems should normally comprise at least one video camera and a stills camera;
- ii. where towed sledges are used, the field of view of each camera should be known from previous calibration;
- iii. the distance travelled by the sledge should be known, either using the ship's electronic navigator or a meter wheel attached to the sledge;
- iv. towing should be at constant speed;
- v. still photographs should be taken at fixed intervals either on a distance or on a time basis. These can be backed up by opportunistic shots taken of 'interesting subject matter', e.g. dredge tracks as identified on the video monitor.
- vi. where ROVs are used, the distance travelled, heading, height above seabed and field of view should be calculated.

The quality of photographs largely depends on water clarity and this can vary considerably, even at the same location, depending on the state of the tide and season of sampling. The chances of encountering good visibility can be increased by deploying the equipment at slack water periods. Use of towed devices is also dependent on the tidal/current speeds, requiring towing speeds of less than 1 knot to obtain clear images. Therefore, the slow towing speeds necessary to obtain high quality images when using towed sledges means that, at most UK extraction sites, transects will be run in the form of controlled drifts along the direction of the prevailing tidal current. The data from such surveys can be treated at a number of levels, which will be partially determined by the quality of the images obtained (see Figure 18). Still photographs taken at regular intervals along the transect can be treated as point quadrats, the fauna identified to the appropriate taxonomic level and quantified. Data obtained by 'freezing' the video image at regular intervals can be treated in a similar manner. It should also be noted that advances in digital video and stills technology are improving image quality, and such systems may become the preferred choice as the price of these continues to fall. Digital video has the advantage that near-photographic quality images can be obtained by 'freezing' the video image. It may therefore become unnecessary to have both video and stills equipment mounted on underwater survey platforms.

Two of the most common platforms used for the collection of photographic data in the UK are shown in Figures 16 - 17. It should be recognised, however, that other systems exist, which are currently not in use in the UK and that may be useful for the collection of video and stills images. In particular, a number of pieces of equipment recently developed in Canada are worthy of further investigation for application in the UK. The BRUTIV (Bottom Referenced Underwater Towed Instrument Vehicle) is a video sledge that is towed a few metres above the seabed and collects good images of conspicuous epifauna and their

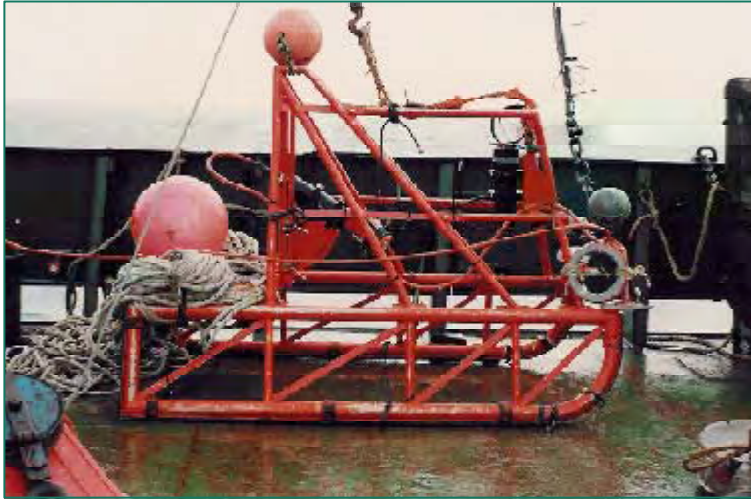


Figure 16 **A CEFAS camera sledge. Note the downward pointing 35 mm stills camera at the front of the sledge and the forward looking video camera towards the rear of the sledge. The large buoy on the back of the sledge floats at the surface during deployment, and provides a visual indication of the position of the sledge. It also acts as a means of recovery for the main towing cable parts**



Figure 17 **A drop-camera frame. The video and stills cameras, lights and flash unit are housed within the protective metal frame, orientated to collect images of the seabed directly below the frame**

associated substrata (Gordon *et al.*, 1997; Rowell *et al.*, 1997; Gordon *et al.*, 2000). This device may be less effective in UK waters where water turbidity would preclude the collection of images at distances of several metres from the seabed. An elaborate videograb has also been developed which allows scientists to evaluate, and if necessary reject, a sample whilst the grab remains at the seabed. The grab has a video camera directed at the seabed through the jaws of the device. When a suitable substratum is located, the grab is dropped and the jaws are closed hydraulically. This system has worked well on many substratum types and has the advantage that poor samples can be rejected, and further sampling attempts can be made whilst the grab is still at the seabed. This may be particularly advantageous where the collection of good quality samples from coarse substrata is problematic. Another device which utilises photographic techniques is the Aquareve III Epibenthic sledge (Gordon *et al.*, 1997; Rowell *et al.*, 1997). This is primarily a device for the collection of surface substrata, and macrofaunal species living at and just below the sediment surface. It has a backward pointing video camera which monitors the performance during sample collection and provides information on the undisturbed nature of the substrata collected.

These devices are expensive in comparison to the video and stills equipment currently in use in the UK for environmental surveys, and furthermore are not easily available. Nevertheless, they merit further consideration as an alternative to conventional devices.



Figure 18 **An example of a digital still image of a 'gravelly' substratum taken using a Benthos™ DSC4000 digital stills camera mounted on a drop camera frame (Figure 17)**

3.4. Positioning

It is essential that a geographical reference position can be assigned to any sample or datapoint that is generated from a survey. The most frequently used positioning system both in UK waters and worldwide is the Global Positioning System (GPS) which can provide the latitude and longitude of a point to within a few metres. Differential GPS (DGPS) improves on the accuracy of GPS by using precisely-surveyed reference ground stations to generate a position which is accurate to within a metre (Ashjaee, 1986). The absolute accuracy of GPS depends on numerous factors, but by using DGPS the antenna of a vessel may be confidently and precisely located anywhere in the world.

On larger vessels, the position from which gear is deployed may be tens of metres away from the antenna location, thus generating an inaccurate sampling position, and this potential source of error should be corrected for (e.g. with the use of survey software to allow manual input of an offset) in surveys requiring a high degree of accuracy.

If very precise sample or equipment positioning is required this can be achieved using acoustic positioning systems. Acoustic positioning is used for the location of underwater objects and is available in two different forms. Long baseline systems (LBL) involve a network of accurately positioned seabed beacons, which are used to calculate a triangulated position from a transponder fitted to the sampling equipment. In contrast, short baseline systems (SBL) rely on vessel-mounted sensors, which can detect the incoming direction of an acoustic signal from a remote beacon or transponder fixed to the item being tracked. Short baseline systems are especially aimed at tracking towed sensors such as a sidescan sonar fish, where cable length measurements are not sufficiently accurate for the aims of the survey.

Concerns about positional errors must be weighed against the aims of the survey. In most cases, horizontal accuracies to within a few metres are sufficient for routine assessments at aggregate extraction sites.

Information relating to the horizontal datum, projection and grid used for the survey must be documented and the same versions of these variables should be applied when post-processing the positional data.

3.4.1. Heading

Vessel heading is measured by magnetic or gyro compass systems. Magnetic systems are lower cost but less accurate. In contrast, gyro compass systems are expensive and mechanically complex, but solid-state sensors are now available using laser interferometry to give accurate heading and attitude information. GPS based systems are also available which can provide more accurate measurements than gyro-compasses. However this level of accuracy is rarely required in the execution of routine surveys.

CHAPTER 4

Approaches to processing benthic samples

4.1. Introduction

For convenience, the process of extracting macrobenthic organisms from sediments or (in the case of trawls and dredges) other residual material is usually separated into two stages. Initially, samples are processed over sieves of appropriate mesh sizes on board the survey vessel in order to reduce the bulk of the material transported back to the laboratory. Having reduced samples to a manageable size in this way, the retained material is preserved and the final sorting of the fauna from the residue can then proceed in the laboratory at a later stage. In cases where, for logistical reasons (e.g. due to restricted deck space or limited numbers of personnel), it is impractical to carry out sample processing onboard the survey vessel, entire samples may be preserved in the field (see Chapter 4.4.3), and then dealt with on return to the laboratory.

This chapter describes the treatment of benthos samples obtained using grabs, trawls and dredges.

4.2. Approaches to processing quantitative samples collected by grabs

4.2.1. Estimation of sample volume

On retrieval of the grab, an estimate of the sample volume should be made, along with a description of the sediment type. This information is required, since it provides an indication of the performance of the grab and should be noted in the survey log (see Chapter 4.4.6). With, for example, a Day grab, where a relatively undisturbed sample can be accessed *in situ* via opening flaps, an estimate of the volume can be made by measuring the depth of sediment at its deepest point (usually at the point of closure of the grab buckets) and then applying a standard conversion factor. Alternatively, with a Hamon grab sample, an estimate may be made by measuring the depth of the sediment following release of the material into an underlying sample container.

In some cases, it may be necessary to reject grab samples and the following criteria should be used:

1) Sample inspection

If the jaws of the grab are not fully closed (e.g. due to the presence of stones) and there is associated evidence of the winnowing of surface material, then the sample should be rejected.

2) Acceptable sample volume

For the Hamon grab, the aim should be to collect a minimum sample volume of 5 litres, and samples smaller than this would normally be rejected. However, in very coarse substrata, the failure rate may be very high, and expert judgement should be exercised regarding the collection of the occasional sample of less than 5 litres. The reasoning behind this judgement should be documented in the survey log and in any subsequent reports, and the sample(s) flagged on account of their failure to meet the above quality criterion.

Pooling of collected material, i.e., the practice of amalgamating two or more samples individually rejected due to insufficient volume to provide a composite sample of acceptable size, **should not** be carried out. This procedure is invalid, as faunal occurrences are expressed in terms of unit area, not volume. Volume is used as a practical measure of sampling efficiency (see above). The relationship between volume and faunal content is more complex and more unpredictable than that of surface area: **the two measures should not be confused.**

4.3. Separation of benthic infauna from the sediment

Sediment samples should be slowly released into appropriately sized sample containers, ensuring there is no spillage of material. Once an acceptable sample has been obtained a sub-sample for sediment particle size analysis is taken (see Chapter 7.2.1).

The contents of the sample container should then be transferred to a purpose-built sieving table where it should be washed with seawater (under gentle hose pressure) over a removable 5mm square mesh screen. A range of equipment for washing and sieving sediment samples is available and these have been reviewed by Eleftheriou and Holme (1984) and Proudfoot *et al.* (*in prep.*). They vary from purpose-built sieving tables (e.g. Figure 19) to automated methods such as the 'Wilson autosiever' (Proudfoot *et al.*, *in prep.*). However, the utility of automated methods for extracting fauna from mixed sediments has not been fully assessed and consideration should be given to any recommendations arising from an ongoing 'best practice' review (Proudfoot *et al.*, *in prep.*).

For convenience, the description below relates to the treatment of samples using a sieving table, as this is the device most frequently employed for processing benthic samples in the U.K. This device consists of an open wooden box, the base of which slopes downwards towards an outlet pipe. The interior of the box is coated with epoxy resin to present a smooth surface for ease of washing, and to act as a wood preservative, thereby prolonging the life of the device. Small blocks mounted on the interior of the box provide support for a removable square stainless steel frame with 10 mm or 5 mm square mesh aperture. The



Figure 19 Processing of a macrofaunal sample using a purpose built sieving table on a survey vessel. The sample is being washed over a 5 mm square mesh aperture sieve supported by a removable square stainless steel frame. Note also the 1mm mesh sieve held within a sieve holder beneath the outlet pipe of the table

entire device is supported on legs that can be adjusted to allow the table to be positioned at a suitable height (normally waist height) for ease of use.

Collected sediment in the sample container should be slowly transferred to the 5 mm mesh sieve supported within the sieving table, using gentle hose pressure. In this way, much of the lighter fraction (including the more delicate organisms) is separated from the residual coarser material at an early stage. Once the sample has been emptied onto the sieving table, the larger animals and all encrusting fauna present on shell and gravel which are retained on the 5 mm mesh can be removed and transferred to sealable plastic bottles or buckets (of appropriate size). It is recommended that this material is preserved separately in order to prevent damage through abrasion to the smaller and more delicate organisms collected on a finer mesh sieve at the outlet pipe. Any remaining material on the 5 mm mesh sieve screen may then be discarded. The finer sediment fraction is washed over a 1 mm or (exceptionally) a 0.5 mm mesh sieve, the choice depending on the objectives of the investigation (see below).

This sieve is supported beneath the outlet pipe of the sieving table. Inevitably, some sediment will also be retained and animals must be separated at a later stage in the laboratory. Periodically, the fine-mesh sieve may become blocked with sediment, thus reducing the effective mesh size and the efficiency of the extraction process. In such cases, care should be taken to ensure that the sieve does not overflow. Accumulations of sediment on the mesh can usually be removed by gentle ‘puddling’ (see Figure 20), involving vertical motions of the sieve in a seawater-filled container. Horizontal movements of the sieve should be avoided as this can result in damage to the fauna through abrasive action. The remaining material should then be carefully transferred to an appropriate sample container (see Chapter 4.4.2). If spillage/loss of material occurs at any stage during processing, a repeat sample should be taken.



Figure 20 **‘Puddling’ - the removal of accumulations of fine sediment through gentle vertical motion of the sieve. Note that the seawater-filled container is placed at waist height for ease of processing**

For most routine surveys at gravel extraction areas, it is recommended that a stainless steel 1mm mesh sieve is used, conforming to British Standard 410. The effects of different sieve apertures on the results of macrofaunal surveys, based largely on experiences of working in soft sediments, have been examined by a number of authors including Eleftheriou and Holme (1984), Rees (1984) and Kingston and Riddle (1989). Sieves should be discarded at the first sign of damage to the mesh.

4.4. Approaches to processing epifaunal samples from trawls and dredges

On retrieval of the trawl, the catch should be concentrated in the cod-end of the net. The contents of the cod-end should then be released into a suitable sample container, and an estimate made of the total volume of the catch. This should be recorded in a logbook, along with a summary of the contents, noting especially the presence of stones, rock etc. The presence of any infaunal organisms arising from the fouling of soft sediment should also be noted, together with the occurrences of pelagic species. However, these additional faunal records should be excluded from the final compilation of the data for most monitoring and baseline surveys. It is essential that all the fauna is retrieved from the full length of the net and included in the analysis of material.

The structure and dimensions of a 2-m beam trawl (the most commonly used device for epifaunal sampling at extraction areas) is given in Chapter 3.3.3. It is recommended that all samples be processed over a frame-supported 5mm mesh. Any material passing through the sieve should be discarded.

Ideally, the contents of the trawl should be processed on board the ship. This entails counting and, where possible, identifying all solitary species. Counts of very abundant solitary species may be derived from sub-sampling, as appropriate. This may be achieved through sub-dividing the catch after it has been evenly distributed over the 5 mm mesh sieve, or by transferring the sample contents to a container and then removing an appropriate volume of material for subsequent processing.

Colonial species (notably hydroids and bryozoans) are generally recorded on a presence/absence basis or on a scale of relative abundance such as the SACFOR scale (**S**uper abundant, **A**bundant, **C**ommon, **F**requent, **O**ccasional, **R**are) employed by the UK Marine Nature Conservation Review (<http://www.jncc.gov.uk/mit/sacfor.htm>). This scale has been in use since 1990 as a system for recording the cover/density of marine benthic flora and fauna.

At least one individual of each species should be retained for inclusion in a reference collection. Specimens which cannot be reliably identified whilst on the ship should be preserved for later laboratory attention (see Chapter 4.5.2).

Epifaunal samples obtained with other gears, e.g. dredges, should be processed following the same procedures as above.

Because of the relatively high sampling error associated with epifaunal sampling, the data are generally considered unsuitable for the detection of subtle numerical trends.

4.4.1. Washing equipment

Both the grab and sieving table (see Chapter 4.3) should be washed between sampling occasions to avoid any risk of cross contamination. Finer-mesh sieves should also be cleaned (e.g. with a scrubbing brush) to prevent excessive clogging with sand particles.

Furthermore, to avoid potential cross-contamination of epifaunal samples, trawls should be washed out, after every deployment, by towing the trawl at the sea surface for approximately 5 minutes with the cod-end of the net open.

4.4.2. Transfer of processed material to sample containers

During this stage in the process there is the potential for loss of sample material and therefore appropriate means to avoid this should be instituted. The material should be backwashed into the container using a funnel or other 'foolproof' device. The entire process should be carried out within a large receptacle, in such a way that any accidental spillage can be retrieved. Any enmeshed fauna should be carefully removed with forceps and transferred to the sample container.

4.4.3. Sample preservation

Biological material will require fixing with a solution of formaldehyde. Fixation hardens the tissues and limits the scope for fragmentation of the specimens, as well as preventing decomposition. Improperly fixed specimens may cause problems during laboratory identification. There should be a final concentration of 4-5% formaldehyde in the sample for effective fixation. If necessary, prior to fixation, any excess supernatant in the sample container can be poured off through a sieve mesh of the same size as that used in initial processing, and any animals retained by the sieve should be returned to the sample. Samples should be stored in the fixative for a minimum of three days before any further processing (Gray *et al.*, 1992; Eleftheriou and Holme, 1984). For very large samples, containing large quantities of gravel, care should be taken to ensure that there is sufficient fixative and that it is adequately mixed through the sample.

Since formaldehyde tends to become acidic during storage, a buffering agent, such as sodium acetate trihydrate (25 g l^{-1} for 30% formaldehyde), should be added as this will help to prevent the dissolution of any calcareous material, including mollusc shells, which may make subsequent identification of specimens difficult. **Formaldehyde is a toxin, a carcinogen and an irritant and therefore extreme caution should be exercised whilst preparing dilutions of this substance**, particularly when transferring neat chemical from one container to another. Eye protection, disposable gloves and waterproof clothing must be worn and the procedure must be carried out in a well-ventilated area. Alcohol (70% ethanol/IMS) is often used for later preservation of samples, but it should not be used during initial field preservation, as it is an inadequate fixative and can cause the production of a precipitate when mixed with seawater. However, specimens can be transferred to alcohol (70% ethanol/IMS), after fixation, if long-term preservation of samples is anticipated. Further information on the use of fixatives, preservatives and buffering agents is provided by Lincoln and Sheals (1979).



Figure 21 **An example of a visual record of the contents of a 0.1 m² Hamon grab. Such photographs can be reviewed at a later stage during data interpretation.**

4.4.4. Sample staining

Rose Bengal, a vital stain, may be added to the fixation fluid, to enhance the colour contrast between inconspicuous specimens and the sediment, thereby potentially increasing subsequent sorting efficiency. **Rose Bengal is an extremely hazardous carcinogen** and, in its powder form, should only be handled under fume extraction. It should therefore be added to the concentrated formaldehyde solution in the laboratory under carefully controlled conditions or made up as an aqueous solution for use in the field. The final concentration of Rose Bengal should be around 0.01% in 10% formaldehyde.

4.4.5. Sample labelling

Each sample must be suitably labelled as follows: date, research cruise number or code, the type of sample, station code and sample location. Labels should be applied to both the outside and inside of any sample container. The internal label should be waterproof and chemically resistant and annotated with a soft-carbon pencil which will not fade in formaldehyde. This label should accompany the sample through each stage of processing.

4.4.6. Sample logging

All surveys should be logged in a pre-designed field log or electronic datasheet. Each log sheet should contain prompts for all the information required. It may also be useful to offer a list of options within the survey log for recording certain variables (e.g. sediment type), to improve objectivity. A book format has the advantage that it keeps all the information together and is perhaps less likely to be damaged in the field situation.

Information that should be recorded during the survey will include the state and direction of tide, wind direction and strength and any swell. Photographs of collected samples should also be routinely taken, as they provide a visual record (see Figure 21). The names of all personnel involved in sample collection/processing should also be logged. In addition, for each sample collected a record of the following information should be made:

- date of sampling
- sampling position (this is usually recorded at the instant that the sampling device makes contact with the seabed)
- survey datum
- type and size of sampler employed
- any modifications to the sampling device (including the addition of weights)
- type of sample retrieved (e.g. macrobenthos sample)
- sieve mesh size employed (e.g. 1 mm)
- depth or volume of sediment sample obtained
- water depth at each sampling position
- time in GMT that the device landed on the seabed
- whether the sample was retained or rejected (and the criteria used to reject the sample)
- volume of any material removed for additional analyses (e.g. particle size analysis)
- a brief description of the sediment
- presence of any artefacts
- size of sample container(s) used to store preserved samples
- any deviation from standard operating procedures

4.5. Laboratory processing of grab samples

4.5.1. Elutriation and sorting

The formaldehyde fixative must first be removed from a sample prior to processing. Formaldehyde is toxic and carcinogenic and this initial phase must be carried out under fume extraction whilst wearing disposable gloves and a laboratory coat. The 5 mm sample fraction (see Chapter 4.3) is first washed with freshwater over a 1 mm sieve, to remove excess formaldehyde solution. The sample material is then backwashed into a sample container for examination. Attaching a flexible tube to the freshwater supply is highly recommended, as it greatly increases the control over the direction and strength of the water flow.

The finer sample fraction (usually > 1 to < 5 mm: see Chapter 4.3) is initially washed over a 1 mm sieve and then backwashed into a 10 litre sample container. This container is then filled with fresh water and the sample is gently agitated in order to separate the smaller and lighter animals from the sediment. Once the animals are in suspension, the supernatant is decanted over a sieve. This procedure should be repeated until no further specimens are recovered. This stage in the process allows the smaller and more delicate animals to be elutriated from the bulk of the sediment and, by doing so, improves the speed and efficiency of the sorting process. The decanted fine fraction is placed in labelled petri-dishes for identification and enumeration under a binocular microscope with a light source.

A few remaining animals, such as heavy-shelled bivalves (e.g. *Nucula* spp.), will not be recovered in the decanting process. These are dealt with by washing aliquots of sediment into the sieve using a very low water pressure. The contents of the sieve are then backwashed onto a shallow sorting dish, preferably divided into grid sections. Sufficient water should be added to the dish so that the entire sample is immersed. This dish is then examined under an illuminated magnifier of at least x 1.5 magnification. The amount of material on the sorting dish should not obscure grid markings. Animals can be removed from the sediment using watchmaker's forceps or, if exceptionally small and delicate, using a pipette, and transferred to a suitable container, one for each species or faunal group. Ideally, an independent analyst should check each aliquot of sediment to ensure that all animals have been enumerated and extracted.

After the entire sample has been processed the sieve residue is returned to the original container, formaldehyde or alcohol applied, and the material stored until satisfactory completion of AQC procedures.

4.5.2. Identification and enumeration

All specimens of solitary taxa should be enumerated and identified down to the lowest possible taxonomic level, usually species, using standard taxonomic keys. It is essential that competent personnel are employed, in order to ensure accurate and consistent identification of specimens. The skills of personnel involved in species identification should be regularly assessed and updated through attendance at training workshops and participation in exercises designed to test proficiency.

Distinction should be made between adult and juvenile macrobenthic specimens. Only individual specimens with an anterior end are counted. Common species that are readily identifiable can be counted using digital counters. Colonial species (e.g. hydroids and bryozoans) are usually recorded on a presence/absence basis or using the MNCR SACFOR scale (see Chapter 4.4).

Nomenclature should conform with that of Howson and Picton (1997). All taxonomic references employed for identification should be documented. In cases where specimens cannot be assigned to the level of species due to damage, the lowest definitive taxonomic level should be recorded. An indication of the level of uncertainty associated with identifications should be denoted by a question mark before the second epithet for a species binomen (e.g. *Sabellaria ?spinulosa*), and before the generic name at the genus level (e.g. *?Sabellaria*). Following standard convention, if there is only a single species within a particular sample, then this is acknowledged by 'sp.' following the genus (e.g. *Sabellaria* sp.). However, if it is established that there are more than one species present within a sample (or dataset), then this is indicated by 'spp.' (e.g. *Sabellaria* spp.). Occasionally, due to taxonomic disputes, collective groups may have to be assigned (e.g. *Eteone flava/longa*). Identified specimens of each species should be transferred to numbered vials (one per species) containing preservative.

4.5.3. Biomass determination

If biomass estimates are required, they may be determined as wet weight and then converted to Ash Free Dry Weight (AFDW) using standard conversion factors (e.g. Rumohr *et al.*, 1987; Ricciardi and Bourget, 1998). Ideally, samples should be left in the fixative solution for a minimum of three months prior to weighing to allow for weight loss stabilisation (Brey, 1986). The wet weight is measured after the specimen has been blotted dry by moving it around on dry absorbent paper until no wet mark is left. Once blotted dry, the specimen should be transferred to a weighing balance as soon as possible, and the blotted wet weight recorded once equilibrium has been attained, or after a fixed time interval. Fauna should be weighed to the nearest 0.1mg.

Taxa containing fluid (e.g. heart urchins) should be punctured and drained before blotting. Tube-dwelling taxa should be weighed after removal from their tubes. Where possible, faunal fragments (lacking an anterior end) should be assigned to the appropriate species and included as part of the biomass estimate for the species; otherwise they should be weighed separately and then allocated across appropriate taxonomic groups. Ideally, estimates of biomass should be provided for each identified species and these, together with the estimated total biomass for each sample, should be reported.

4.5.4. Sample re-analysis

To ensure that laboratory processing is carried out to an acceptable standard, a random selection of 10% of the samples processed should be re-analysed. AQC criteria, typically those employed by the UK NMBAQC (see Chapter 9 for more details) are used to assess whether any error is acceptable for the purposes of the investigation. If the error is unacceptable then a repeat analysis of the entire batch of samples may be necessary. The outcome of AQC activity should be included in any reporting of the data.

4.5.5. Preservation and storage

After completion of identification, enumeration and estimation of biomass, specimens from each sample should be transferred to a single container, and a preservative solution of 70% ethanol/IMS applied. Sample containers should be labelled and kept in storage until all quality assurance issues have been resolved to the satisfaction of the responsible authority.

4.5.6. Reference collections

A separate reference collection should be catalogued and maintained in a curatorial manner for all benthic surveys. This involves the preservation of at least one individual of each species found in the survey in a separate container. Specimens should be preserved using an alcohol-based preservative (70% ethanol/IMS) and labelled with at least the following information: species name, station number, station replicate number, date of sampling and name of identifier. This collection can be used to validate identifications between samples and surveys.

4.5.7. Sample tracking

Collected samples constitute a valuable resource, both financially and in terms of the data they provide. Sample tracking i.e., information concerning the location and status of samples at all stages following collection, is an essential part of any Quality Assurance programme.

CHAPTER 5

Remote acoustic methods for examining the seabed

5.1. General Introduction

Remote acoustic techniques have been employed for many years to complement the physical sampling methods traditionally used to carry out benthic surveys. The most useful and, consequently, the most commonly applied technique is sidescan sonar. However, more recently, other techniques such as acoustic ground discrimination systems (AGDS), sub-bottom profiling, swathe bathymetry, and more conventional line bathymetry (some of which are commonly used by the industry in resource-driven surveys) have become more readily available to the environmental surveyor, especially in an R&D context. The application of these tools may significantly enhance the capability to accurately interpret biological data, as well as having ‘stand-alone’ value in impact assessments, although many have not yet reached the stage at which routine deployment can be recommended (e.g. on grounds of cost or ease of interpretation).

The following Chapter describes a variety of acoustic methods for use in support of environmental surveys of the seabed. Further details on operating procedures are provided in General Instructions for Hydrographic Surveyors (GIHS) and other standards issued by the International Hydrographic Organisation (www.iho.shom.fr IHO Publication S-44: Standards for Hydrographic Surveys) and various national organisations (listed at www.marinenav.net/hydro_nav_ofc/). Hydrographic survey standards exist for single, multibeam and sidescan sonar operations, but there is no current unified international reference. However a new International Hydrographic Survey Manual is being co-ordinated by the IHO with contributions from its various member states expected in 2002.

5.2. Bathymetric surveys

5.2.1. Introduction

The generation of bathymetric data may serve a number of purposes when it is integrated into an environmental survey. Bathymetry is an easily viewed backdrop over which other data might be draped, particularly when a range of datasets are presented in a GIS format. Information from a line bathymetry survey is able to quickly and cheaply provide an interpolated map of the general topography of the seabed. Gross features such as channels and banks can be accurately mapped, and associated changes in the horizontal distribution of habitats might be more easily interpreted and explained when provided with a bathymetric map. Swathe bathymetry is able to generate a 100% coverage map of the seabed enabling far

better feature definition and object resolution than line bathymetry is able to provide. Swathe bathymetry is able to discern comparatively small seabed features such as rippled sand and suction trailer dredge tracks, and therefore provides the surveyor with a more detailed view of those features which might affect the distribution of habitats. Swathe systems also offer backscatter information, albeit of a relatively reduced quality, at little extra cost, and some systems also claim to provide concurrent swathe acoustic ground discrimination. A disadvantage of swathe bathymetry is that it is still a relatively expensive tool, although costs are gradually reducing.

Bathymetric survey data may be used to map both the large- and fine- scale topography of the seabed and also to monitor changes in depth over time. Bathymetric data are usually gathered under contracted procedures aimed at specific survey needs (e.g. pipeline, aggregate extraction sites, cable route or hydrographic surveys).

Bathymetric data are most frequently collected using a single beam echo-sounder with a transducer attached either to the hull of a vessel, or to a pole mounted over the side or bow of the vessel. The sounder is operated in tandem with a motion reference unit which monitors change in the attitude and height of the transducer due to heave, pitch and roll of the vessel. Standard single beam echo-sounders collect data from a narrow zone directly beneath the vessel track and generally the data are presented either in line form, with gaps between each data point, or as an interpolated plot of these data.

Multibeam (or swathe) sonar is a relatively new remote survey method. The hire and purchase costs of these systems are decreasing and their reliability and performance is improving. There are two main types of multibeam system: true multibeam (or focussed multibeam) and interferometric (or bathymetric sidescan sonar) systems. True multibeam consists of a transmitter and receiver capable of projecting and detecting multiple beams of sound energy which ensonify the seabed in a fan-shaped swathe. Multiple soundings are thus taken at right angles to the vessel track, as opposed to a single sounding underneath the vessel with a conventional single beam echosounder. This gives a far greater density of soundings enabling quicker coverage of the survey site. An interferometric sonar is a variant of sidescan sonar technology where electronic techniques are applied to a multiple set of sidescan sonar-like transducers arranged to give phase information in the vertical plane. This phase information is used to determine the angle of reception of reflected sound from the seabed and, given the time of flight of the return pulse, a range/angle measurement can be made of the seabed. The main difference is that soundings for a multibeam system are denser directly under the vessel, and sparser at full swathe range. The inverse is true for interferometric systems. Both systems are prone to greater errors on the outer limits of the swathe. Both are also dependent on a very high quality motion reference unit (MRU) to determine the position and attitude. This apparatus significantly increases the cost of the system but is essential for accurate and precise depth measurement. The application of swathe bathymetry techniques demands a lengthy calibration procedure to define any systematic errors in the installation (e.g. heading, latency and roll).

5.2.2. Survey design

Bathymetric surveys should be planned with the following considerations in mind:

- The navigational limitations of the survey vessel in relation to the objective of the survey. For example, shallow water or sandbanks may prevent access to some areas.

- The limits of the survey should be pre-defined and should always encompass, and ideally overlap, the area of interest. The degree of overlap will depend on the aims of the survey.
- The spatial separation of the survey lines and the density of the soundings need to be defined. This will again depend on the specific aims of the survey, and should take into consideration the size and shape of the features likely to be encountered, the complexity of the bathymetric variability of the seabed and the intended scale of the final survey chart.
- The horizontal datum, projection and grid to be used.

5.2.3. Survey execution

Bathymetric surveys using either single or multibeam systems should only be undertaken by an experienced hydrographic surveyor. The method for installing the survey equipment will depend, amongst other things, on the objectives of the survey, vessel size and configuration and specification of the equipment to be used. A recognised set of guidelines for the conduct of bathymetric surveys such as the International Hydrographic Organisation Standards S-44 for Hydrographic Surveys, should be followed.

5.2.4. Post-processing and reporting of data

Modern swathe bathymetry systems collect data with a width up to about seven times the water depth. The data are collected digitally and the high-resolution multibeam swathe bathymetry information can be used to produce ‘synoptic’ maps of the seabed. Until recently swathe bathymetry systems have been a prohibitively expensive option for the collection of routine data. However, these systems are becoming steadily cheaper, encouraging greater future utilisation by the dredging industry, and others involved in the assessment and monitoring of impacts from aggregate extraction. Both can provide backscatter information similar to sidescan sonar but, unlike sidescan sonar, the hull-mounted sensors are not optimised to the best grazing angles for the provision of textural information.

The processing and reporting of the acquired data is a task that should only be undertaken by an experienced hydrographic surveyor who is fully familiar with the technical specifications of the survey. As with all stages of the bathymetric survey process an accepted Standard Operating Procedure should be followed when carrying out the data post-processing.

The reporting of bathymetric data can take a number of forms. Single beam data is usually presented as a large format paper record with a sub-set of the total dataset plotted along the ships' track. The full XYZ dataset can be processed using bespoke software to produce an interpolated map of the bathymetric setting. The software may also be used to overlay other relevant datasets such as sampling positions (Figure 22). Of particular benefit is the use of bathymetric data as a backdrop for other datasets (e.g. sidescan sonar backscatter or Acoustic Ground Discrimination Systems (AGDS): Figure 23 and Figure 25). This can often be achieved using GIS packages.

Swathe data are most frequently presented as sun-illuminated plots or colour-shaded relief maps.

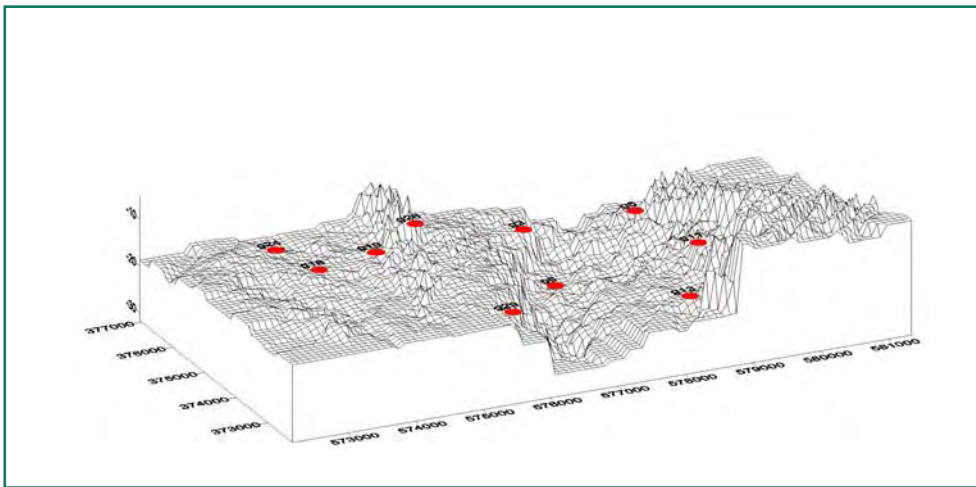


Figure 22 **Interpolated wireframe plot of bathymetric data gathered using single beam echo-sounder. Sampling positions are overlaid as red circles**

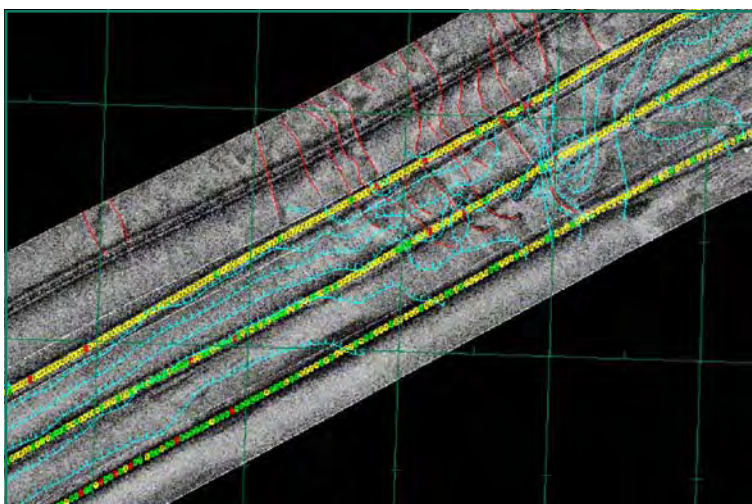


Figure 23 **Single beam bathymetric data and AGDS data overlain on backscatter data from a sidescan sonar survey. The green and yellow central tracks represent different substratum types distinguished by AGDS. The blue lines are interpolated bathymetric contours. The red lines track the crests of large sand waves**

5.3. Sub-bottom profiling

5.3.1. Introduction

Seismic or sub-bottom profiling techniques obtain data in the vertical plane defining the layers of sediment or bedrock strata below the seabed. The equipment applies high-energy acoustic pulses to the seabed, and sensitive arrays detect the reflected energy. The scale and resolution of this technique varies enormously, from deep seismic (where powerful air or water guns project high-energy, low-frequency sound through kilometres of substratum, to be picked up by thousands of metres of hydrophone arrays, towed or streamed behind the vessel), to centimetric resolution of sub-bottom echosounders operating in the decimetre layers of fine silts and muds. An example of the output from a high resolution chirps sub-bottom system is shown in Figure 24. (Chirps systems generate an acoustic pulse containing a narrow band of wavelengths, rather than a single wavelength pulse).

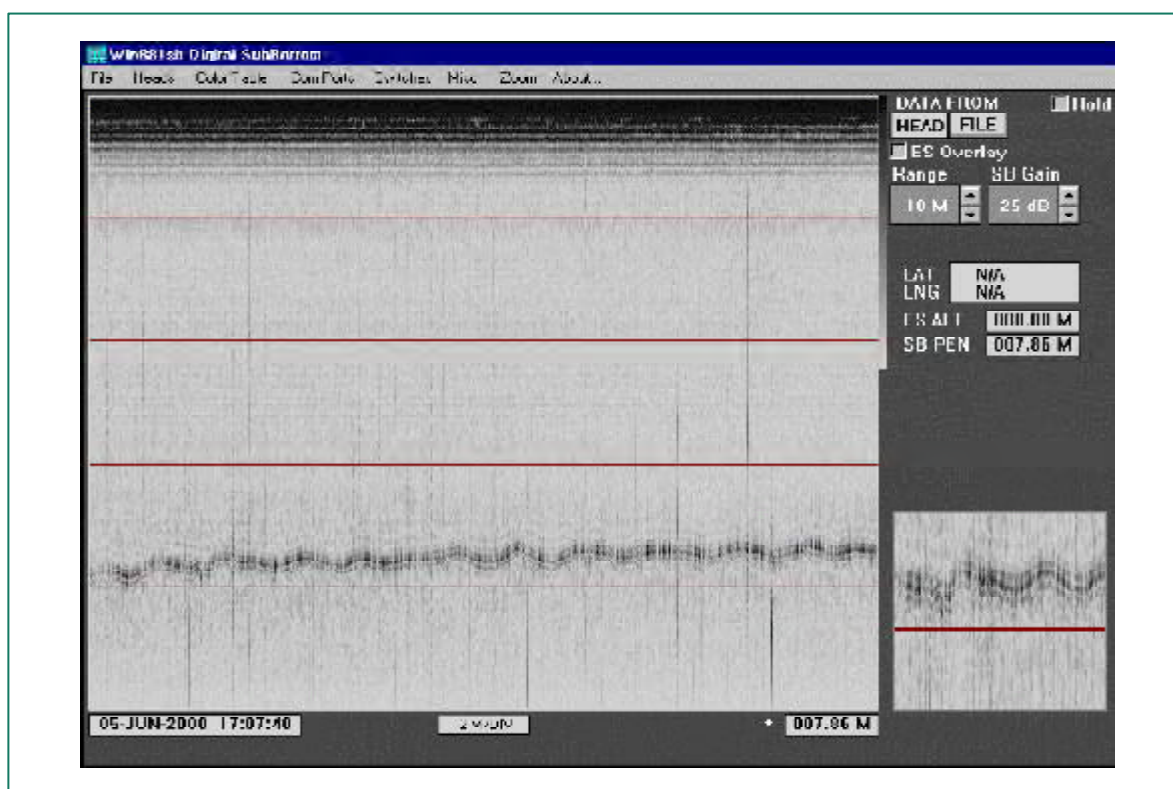


Figure 24 **Example of the output from a digital chirps sub-bottom profiling system when used in coarse substrata. The seabed is the dark line towards the bottom of the image. The indented box to the right of the main image is a 'zoomed in' section of the seabed. The vertical scale is 10 m overall, and the horizontal scale is approximately 90 m. There is no apparent structure below the highly reflective seabed surface**

Sub-bottom profiling techniques are used principally by the aggregate industry to assess the nature, quantity and distribution of a buried aggregate resource. None of the currently available sub-bottom profiling systems are able to effectively resolve distinct layers within the top 0.5 m – 1.0 m below the surface of coarse, and consequently highly reflective, seabeds characteristic of aggregate extraction sites. As this is the part of the sediment that is of most interest to the benthic ecologist, acoustic sub-bottom techniques rarely provide data

that are of significant value in assisting the interpretation of benthic data collected as part of environmental surveys at aggregate extraction sites. However, access to industry generated resource data may provide useful background information on the bulk disposition of sediments, buried geological deposits, and the nature and scale of seabed features such as sandwaves. This information may serve to assist decisions relating to survey design.

A review of sub-bottom profiling techniques, and their effectiveness in environmental assessments at aggregate extraction sites, is given by James and Limpenny (*unpublished*). It is beyond the scope of these guidelines to produce detailed procedures for the execution of sub-bottom profiling surveys.

5.4. Acoustic Ground Discrimination Systems (AGDS)

Acoustic ground discrimination systems are designed to detect the acoustic reflectance properties of seabed substrata. The acoustic differences reflected by the seabed are linked to differences in the physical, or occasionally biological nature (e.g. mussel beds) of these substrata. AGDS are one of a range of tools currently being utilised in the field of habitat mapping. For the most frequently applied systems, a vessel mounted single beam echosounder is used to generate a single frequency acoustic pulse which travels through the water column, is reflected off the seabed either once or twice, and is received back on board the vessel by the transducer. The signal may then be displayed in a conventional depth format by the echosounder, and is also received and processed by the AGDS.

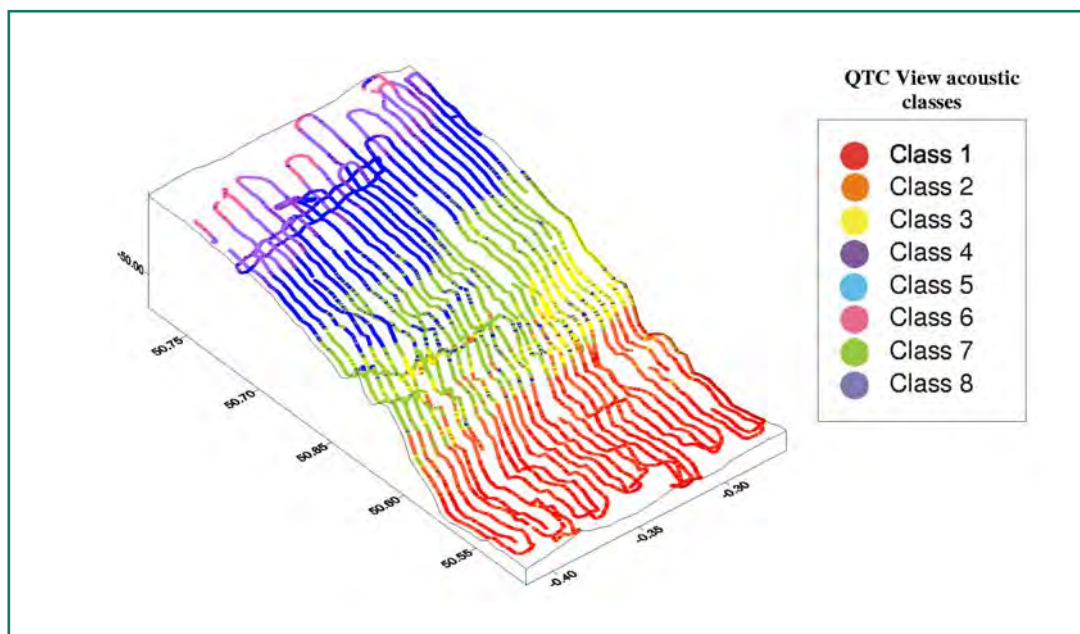


Figure 25 **Plot of QTC™ View data from Shoreham following post-processing using the Quester Tangent IMPACT™ software. 8 acoustically distinct classes are illustrated and have been overlaid on the bathymetry interpolated from the QTC™ data (Brown *et al.*, 2000). Although these classes represent acoustic differences, ground truthing enables some physical distinctions to be made, e.g. Classes 1 and 2 represent clean offshore gravels with sand veneers, and Class 3 represents clean mobile sand**

Presently there are very few systems in commercial supply. The first extensively used system was RoxAnn[™], and this system remains in common usage world-wide. RoxAnn[™] uses analogue features associated with the first and second echo returns to allocate values for reflective properties of the seabed. The first return is the direct bounce off the seabed to the transducer. The second return is caused by the transmitted echo bouncing off the seabed a first time, off the sea surface back to the seabed, from where it is reflected again to be finally received by the transducer. The first return is sensitive to bed roughness (E1), whilst the second return is sensitive to bed hardness (E2). Because of the multipath nature of the second return, this parameter is also affected by its interaction with the sea surface. By plotting the relationship between E1 and E2 on an XY scale, and associating that relationship with a substratum type (defined using ground truthing methods), a spatial distribution map of substrata can be produced.

More recent advances in AGDS technology have resulted in the development of a system known as QTC[™]-View. This product converts the analogue echo return into a digital format which is then analysed by a large number of algorithms to provide a detailed interrogation of the features associated with the first return only, to produce its interpretation of ground type. Bespoke software may be used to identify natural clusters within the dataset, which can then be groundtruthed and assigned a substratum type. This system has advantages in that it provides a more reliable pathway for the acoustic pulse, with no sea surface interference. The wider utility of AGDS, and guidelines for the application of these systems in environmental assessment programmes, is the subject of much ongoing research (Hamilton *et al.*, 1999; Brown *et al.*, 2000; Foster-Smith *et al.*, 2001; Brown *et al.*, 2001; Brown *et al.*, 2002). However, at present, it is recommended that AGDS are not used in isolation, but rather that they be used in combination with other more conventional methods such as sidescan sonar, underwater TV and physical sampling methods when producing high-resolution biotope maps of an area (Brown *et al.*, 2001).

5.5. Sidescan sonar

5.5.1. Introduction

A sidescan sonar survey provides information on the texture of the substrata within the survey area, and from this it is possible to predict the particulate nature of the sediments and assign sediment descriptions to regions of the seabed (e.g. gravel, mud). Sidescan sonar also enables sediment transport features such as sand waves and ripples, lineated gravel features and scour marks to be identified. The nature of the substrata and their associated features are key elements in determining the distribution of faunal communities. Sediment transport features identified using this method suggest bed sediment transport pathways and allied hydrodynamic effects that will also affect the structure of benthic communities. This information may be used to direct subsequent monitoring surveys.

Geological features such as outcrops of bedrock, and aggregate deposits associated with submerged river valleys may also be mapped using this technique, especially when used in conjunction with other acoustic techniques such as bathymetry and AGDS. Examples of sidescan sonar output are shown in Figures 26-27.

Sidescan sonar surveys can be used to map changes in the physical composition and morphology of the seabed. The technique can also be used to assess the rate at which

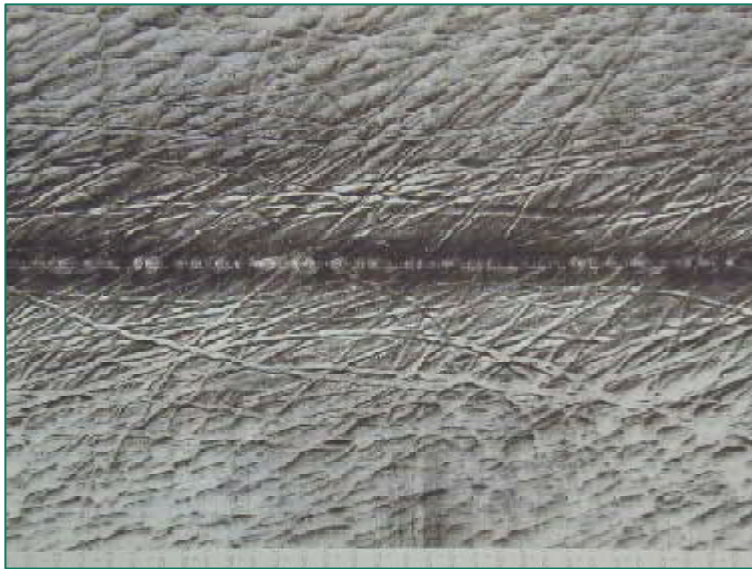


Figure 26 Sidescan sonar image showing the scars on the seabed left as a result of trailer suction dredging activities. The image shows a sidescan sonar swathe approximately 300 m across, with an along-track distance of approximately 400 m

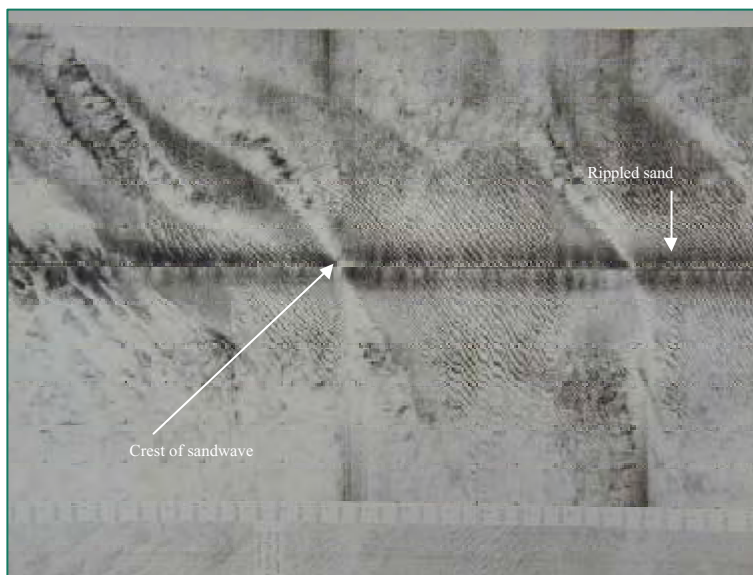


Figure 27 Sidescan sonar image showing the crests of two large sandwaves, with rippled sand covering their flanks. The image shows an area of seabed approximately 300 m by 400 m

dredge tracks become infilled with sediment. Sidescan sonar data are produced using towed or hull mounted transducers which ensonify a swathe of the seabed to either side of the transducers. The reflected portion of the acoustic signal is received by the transducers, amplified and converted into a paper or on-screen image showing levels of strength of return across the ensonified swathe of seabed indicating hardness of the substrata and orientation of seabed features. The use of sidescan sonar technology as part of a suite of sampling techniques is commonplace when carrying out benthic surveys, as its application fulfils a number of objectives.

5.5.2. Equipment

Several sidescan sonar systems are available to achieve a number of different aims. Coastal sidescan sonar systems are generally designed to work in water depths of up to approximately 300 m. They are designed to be routinely operated at frequencies of between 100 – 500 kHz. Systems operating at the lower frequencies will give a wider swathe with lower feature resolution. In contrast, systems operating at the higher frequencies will produce a narrower swathe but with far greater feature resolution. Systems are available that can operate at more than one frequency with the advantage that relatively broadscale surveys can be carried out using the lower frequency, followed by more detailed investigations using the higher frequency setting. Other systems are able to survey using a high and a low frequency signal simultaneously and combine the received signals into a single output. These systems produce the wide swathe of the low frequency systems, and utilise the improved image quality of the higher frequency signal at the shorter ranges. Some newer systems utilise chirp technology to produce a pulse of sound within a frequency bandwidth. These systems send a more powerful signal out to a greater range than single or dual frequency products and hence generate an improved image at greater distances from the transducer. Most modern sonar systems generate a digital signal at the towfish which is sent to an acquisition system onboard the vessel. Some systems generate an analogue signal at the towfish which is sent up the tow cable and either digitised and stored electronically for later processing on board the vessel, or plotted as an analogue signal on a paper record. Whilst the analogue systems produce a satisfactory image, the digital image is of superior quality. Factors such as the nature and aim of a survey, cost limitations, and equipment currently held by and familiar to the surveyor, will determine the most appropriate sonar system employed to complete any particular sidescan sonar survey. Useful reviews of sidescan sonar techniques are given in Fish and Carr (1990) and Blondel and Murton (1997).



Figure 28 Datasonics™ SIS 1500 Chirp sidescan sonar fish. This device acts as a stable platform for the transducers, and is towed behind the vessel during the survey

5.5.3. Survey design and execution

The factors mentioned above, which define the choice of survey equipment, are similarly important when designing a sidescan sonar survey. The model survey design might consist of 125% coverage of the survey area using a variety of survey line orientations, utilising both high and low frequency systems and towing the transducer at a range of depths above the seabed. Ideally, the survey should be carried out in favourable weather conditions with no cross-fish tidal effect and the vessel used should produce little or no turbulent wake.

Similarly, the survey vessel should not be subjected to forced changes of course due to other shipping, or due to fixed fishing gear, which may present a risk to the safety of the towed transducer. The positional co-ordinates of the towfish should be logged alongside the data to within 1m accuracy. However, it is generally accepted that a combination of cost, and the range of variables encountered, rarely allow the execution of the model survey and, in practice, the final survey will be limited to some degree.

The high cost of survey vessels, particularly all-weather vessels, is the main factor that limits the amount of data that can be collected. Therefore, it is frequently the case that a survey design must be limited to some degree at the outset, and it is the task of the scientist to judge how best to minimise the effects of this limitation.

5.5.4. Coverage

Increased coverage is achieved either by increasing the swathe width, increasing the vessel speed or by increasing the number of survey lines. Increased swathe width will generally result in reduced resolution as the ground distance displayed per pixel increases with increased swathe range. This need not be a problem if the finer detail of the substratum is of lesser importance than the broader scale information that is generated.

Vessel speed over the ground may be increased up to a point, but will eventually have a detrimental effect on the quality of the sidescan sonar record. It is the speed of the vessel over the ground (SOG), not the speed of the vessel through the water (TTW) which should be used to select the appropriate survey speed for the vessel. A vessel travelling at 3 knots TTW directly into a 3 knot tide will have an SOG of 0 knot and consequently would be surveying the same seabed location. In this situation the TTW would need to be around 8 knots to achieve an SOG of 5 knots.

The optimum speed for a survey is the one that will give the best along-track time/distance ratio without reducing the quality of the output. This optimum speed will vary from survey to survey and will depend on factors such as the depth of the transducers below the ships wake, the prevailing sea state, the in-water stability and the frequency of the transducers, the width of the ensonified swathe and the ability of the on-board PC to acquire the data at a sufficiently fast rate. It is largely a subjective decision for the surveyor to evaluate when the acoustic signal is beginning to be adversely affected due to vessel speed. A frequent sign that excessive speeds are being reached is a blurring of the signal at the extreme margins of the record. A safety margin of around 0.5 knot below the optimum speed should be maintained to allow for short-term fluctuations in vessel speed during the survey. As a rough guide vessel SOG should not exceed 7 knots, and sidescan sonar surveys should normally be undertaken at an SOG of around 5 knots. However these recommended speeds might be increased or decreased subject to survey conditions and the sidescan sonar system used.

The maximum coverage a survey might expect to achieve would be 100% with some degree of overlap of each adjacent line. This approach would ensure that all parts of the seabed within the survey area were ensonified. This will of course increase the distance covered by the survey vessel and hence the time required to complete the survey. For this reason, it is often the case that less than 100% coverage is achieved, particularly when carrying out surveys over a large area. In these circumstances it is necessary to design the survey in such a way that maximum information is gained from the survey time available. In this instance, the most effective method of increasing survey coverage is to increase the density of the survey lines.

5.5.5. Survey structure

As mentioned above, whilst it may be desirable to achieve 100% or even 125% coverage of the survey area, operational limitations, or limitations of cost often preclude this objective. In these circumstances it is necessary to pre-select the density of coverage. This may involve a systematic reduction over the entire area or a tiered approach with some areas receiving more attention than others. It is the specific requirements of the survey that will dictate the most effective approach. For example, a survey of a large area of seabed, the nature of which is largely unknown, might take the form of a regular grid which will cover the whole area at a reduced density. This will allow the scientist to identify broadscale differences in substratum type and provide information that might guide subsequent investigations. In some cases the scientific objectives may require a detailed look at a relatively small area of seabed, such as an aggregate extraction site, but there may also be a requirement to describe the nature of the substrata surrounding it. These aims might suggest a two-tiered approach, with at least 100% coverage over the extraction site and less dense coverage over the surrounding area. Each situation will require an approach that best suits the objectives.

The orientation of the lines is important when designing a survey. Features on the seabed that show some relief such as rocky outcrops, and sediment transport features such as sand waves and ripples will manifest themselves differently on the sidescan sonar record depending on their orientation on the sea-bed in relation to the sonar transducers and the acoustic signal produced. A sand ripple whose long axis runs parallel to the vessel track will present a relatively steep face to the acoustic signal which will readily be reproduced on the sidescan sonar record. However, if the same ripple runs at right angles to the vessel track the acoustic signal will run along the ripple, not meeting any steep faces, and consequently the feature may not appear at all on the sonar record (see Figure 29). It is possible to miss, or mis-interpret substratum types or bed features because of this. Therefore, it is extremely important to include lines of differing orientation within the survey grid. The orientation of bed-sediment transport features can often be predicted after consideration of local tidal axes or the direction of the dominant wave climate. The surveyor might choose to orientate the primary grid lines in such a way that these features are best represented on the sidescan sonar record. A reduced number of survey lines placed at right angles (or some other orientation) to the primary grid would serve to identify other features that might not be effectively represented whilst surveying using the primary grid.

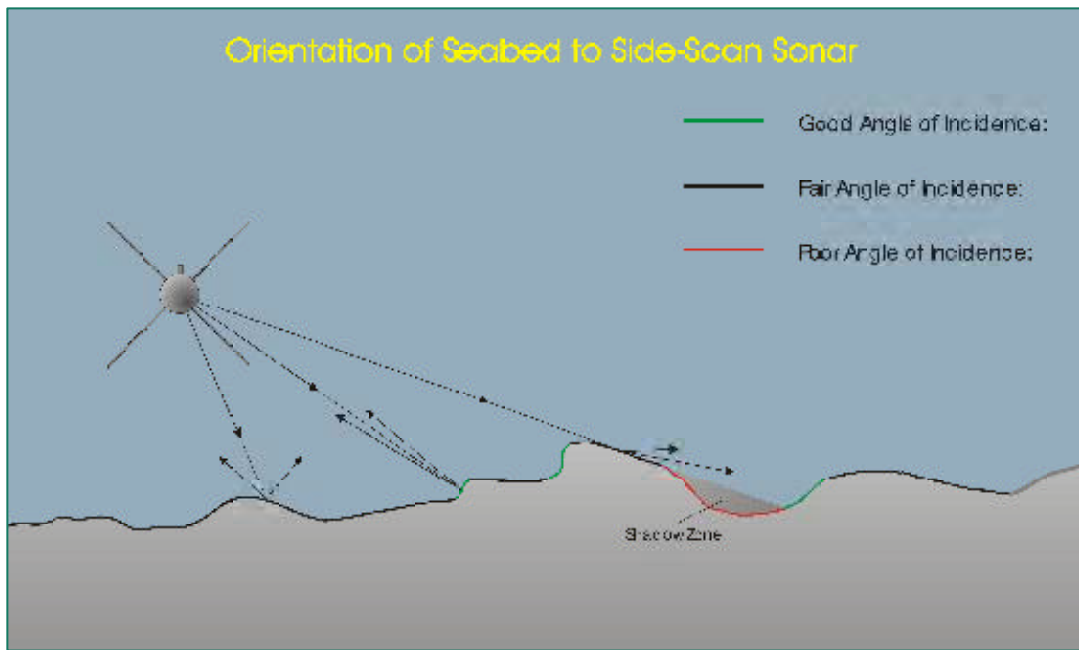


Figure 29 **Diagram illustrating the angles of orientation of sidescan sonar beams in relation to the seabed**

5.5.6. Operational considerations

The most appropriate choice of sidescan sonar system for a specific survey has already been discussed in Chapter 5.5.2. It should be emphasised that the most efficient balance between quality, coverage and cost should be struck when selecting the data gathering equipment.

Weather conditions and sea state at the time of the survey are important factors that will affect the quality of the sidescan sonar image. A rough sea surface will interfere with the sonar signal, as will the consequent aeration of the surface water layer. This will manifest itself as a non-systematic greying of the water column on the sidescan sonar image, and a reduction in contrast of the seabed image. Ideally, the transducer should be lowered below the influence of this “surface noise”, but this may not be possible when surveying in shallow water depths. The sea state will also affect the movement of the vessel, and therefore the stability of the transducer. If the vessel is subject to rapid motion due to a rough sea state, the sonar image can have a smeared or blurred appearance. If the transducer cannot be lowered below the influence of detrimental surface noise then the survey should either be postponed or terminated, and ideally recommenced when weather conditions have improved. If the ship's motion due to the poor sea state is having an adverse effect on the sonar image, an attempt to run each survey line with a following sea should be made.

Whilst this approach will significantly increase the survey time, it will often allow the collection of acceptable data during poor weather conditions. The size of the vessel will of course affect the motion of the vessel under poor sea conditions, and a larger vessel will generally provide a more stable platform than a smaller one. Therefore it may be more cost effective in some circumstances to pay a higher cost for a larger vessel on the basis that the weather window for good quality data will be wider than if a smaller, cheaper vessel were used.

The accurate geographic position of the transducer throughout the survey is an important factor for the collection of good quality data. Under normal circumstances the data gathering system will receive a GPS or DGPS input string providing positional information for each data point. The location of the transducer would be interpolated by the data gathering software using a calculation based on the length of tow cable and the depth of the transducer below the surface. This system frequently relies on the operator manually entering the cable-out information to the on-line survey PC as the transducer is raised and lowered through the water column during the survey. This method does not take into account horizontal deviations of the towed transducer from the central line of the vessel track which are most likely to occur during changes in the vessel course. This may lead to inaccuracies of up to several tens of metres depending on the length of tow cable out and the speed, degree and sharpness of the course change. However, this is the most frequently applied method of producing positional information for routine environmental surveys at aggregate extraction sites.

The utilisation of an Ultra Short Baseline (USB) positional system is an effective but expensive method of ensuring very accurate positional information relating to the towed transducer. Again, it is the specific requirements of the survey which will dictate the level of positional accuracy that must be achieved.

Sidescan sonar surveys should be carried out by a personnel who have an understanding of both the technical nature of the surveying equipment and the onboard data gathering system, and also appreciate the scientific requirements of the exercise. An individual who has knowledge of the technical side of the operation will ensure that the data being gathered is of optimal quality, and will also be able to identify and repair or replace faulty equipment. A thorough understanding of the scientific objectives of the survey will allow online interpretation of the image, and will consequently allow informed modifications of the survey design when appropriate. Davies *et al.* (2001) provide a useful guide to the execution of sidescan sonar surveys.

5.5.7. Presentation of sidescan sonar data

Data generated during a sidescan sonar survey may be presented in a number of ways depending on the nature of the data and the requirements of the end user. Data collected in analogue form is recorded directly on to a paper or higher quality plasticised film roll, using a custom-built printer. This paper record should be annotated automatically with time and position to aid subsequent interpretation. It can also be annotated by hand to highlight points of interest, to note survey system adjustments or to provide an *aide memoir* for the operator. When the survey is complete, the paper record can be cut into individual lines and laid out in rough georeferenced position to each other to provide an overall view of the survey, thus facilitating the interpretation of the data.

More frequently, data are gathered and stored digitally, and this digital information may be presented using a variety of methods. The favoured method of post-processing is to georeference the data using bespoke software packages and produce a mosaiced image of the backscatter information. This technique effectively presents the data as a map with all survey lines georeferenced to each other (Figure 30). This image would normally be

viewable on a PC screen. However, the scale at which sidescan sonar surveys are routinely carried out are not easily represented on a relatively small PC screen. If the entire survey is viewed at once, little detail can be observed. If it is necessary to view small-scale features, only a small portion of the survey can be viewed on the screen and the overall survey may not be viewed in context. It is therefore useful to produce a paper version of the mosaic at a scale that allows much of the small-scale detail to be viewed in relation to the survey area as a whole. This can be achieved with the use of large format printers and continuous paper rolls. A disadvantage of the computerised presentation is that an expensive viewing software package must be owned by each person wishing to view the survey in that format. A distinct advantage of the computerised version is that the software generally allows the surveyor to overlay other relevant datasets such as bathymetry, sampling positions, outlines of extraction sites etc onto the backscatter data (Figure 30). These multi-layer plots can then be printed out as large format paper records as described above, and aid significantly in the interpretation of the data.

The digital dataset may be used to provide a layer towards any Geographical Information System (GIS) that might be prepared as part of the overall survey work.

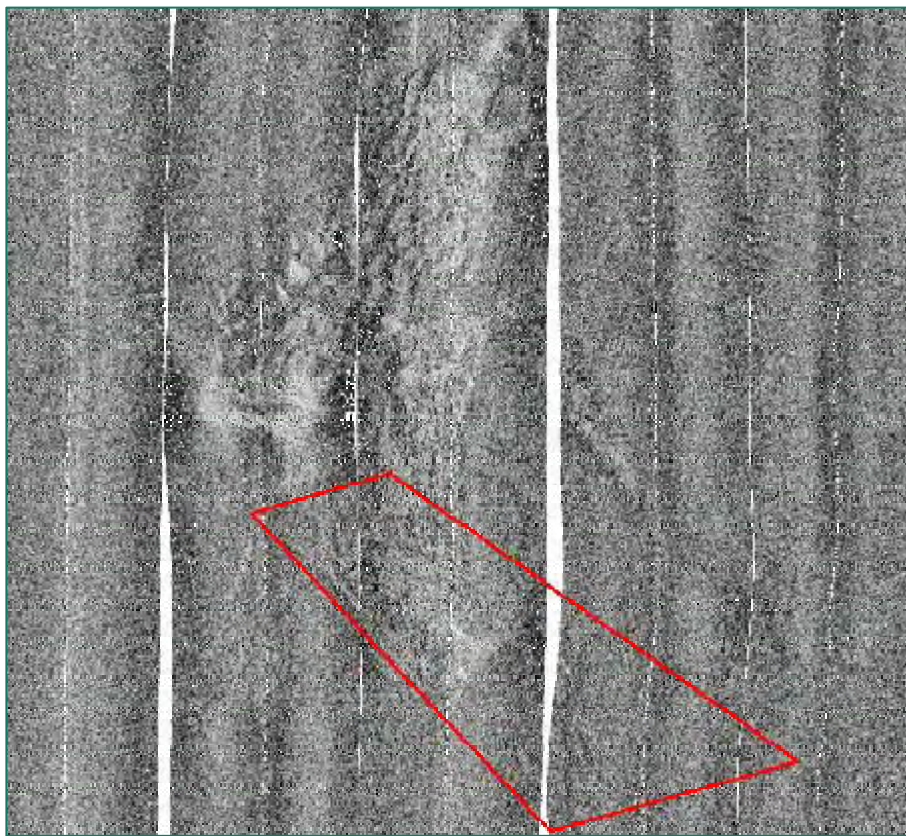


Figure 30 Example of a section of a mosaiced sidescan sonar survey. Bespoke software enable, in this case, five sidescan sonar lines to be geographically referenced, and aligned with each other to provide a sidescan sonar coverage map over which other datasets may be viewed. Seabed features which extend over more than one survey line can be more readily viewed in mosaic form than is possible when they are viewed as individual lines. The red box indicates the limits of an aggregate extraction site

5.6. Archiving acoustic data

The archiving of data is becoming increasingly complex as the size of acoustic datasets increase. Most new data are electronically stored in digital format. This means that, with cost per unit decreasing, it is possible and economic to duplicate and back-up data as they are collected. The long-term storage aspects must also be considered, for example, with magnetic media the deterioration with age is a recognised process. The newer optical media are not as well researched with no track history available. If possible, data should be duplicated on more than one type of medium.

Various compression techniques exist to reduce dataset sizes. This is acceptable for electronic transfer of data and for duplicate data but, if at all possible should not be employed on original archival material. Many smaller files are also more resilient to data loss than a few large files; this should be factored into survey operations.

It is not possible to be prescriptive for archiving methods. However, a robust process should be employed which is easily understood, and will stand up to external scrutiny. It is also essential that all relevant details on the methods and circumstances of data collection are archived; without this information the data integrity can easily be challenged.

CHAPTER 6

Oceanographic surveys

The significance of oceanographic factors, particularly the hydrodynamics of an area, for controlling the distribution of benthic species has been recognised for many years. For example, Cabioch (1968) noted the important influence of tidal current action on the structure of benthic communities, mediated through its effect on substratum characteristics, from large-scale surveys of gravelly substrata in the English Channel. Warwick and Uncles (1980) also correlated the variability in the fauna of the Bristol Channel to bed stresses arising from tidal currents. Their findings were comparable with those of Rees *et al.* (1999) who examined the benthic biodiversity around the U.K. coast and demonstrated a link between the degree of physical disturbance of sediments and broad trends in the numbers and densities of taxa. On the basis of such evidence, it has been suggested that it is the hydrodynamic regime (mainly the tidal currents) that largely determines the characteristics of superficial sediments of an area and which is ultimately responsible for determining broad scale community patterns. It is therefore apparent that any changes in the status of benthic assemblages in areas which have been subjected to commercial aggregate extraction will need to be referenced against variations in sediment particle size distributions (see Chapter 7) and the hydrodynamic regime. The local hydrodynamics will also affect the dispersal of sediment plumes arising from marine aggregate extraction. It is essential that such information is accounted for in the design of 'baseline' benthic surveys in order to address any secondary consequences of dredging, especially the release and then redeposition of fines beyond the boundaries of the extraction permit. Much of this information (e.g. on tidal currents and wave climate) already exists and therefore new surveys to characterise the hydrodynamic regime may not always be required (see Chapter 2).

The following chapter briefly describes the range of oceanographic techniques which can be employed to help ascertain the hydrodynamic regime and, in particular, to determine the wave climate and the strengths and direction of tidal currents for a locality. However, care must be taken when extrapolating data obtained during short periods of observation, especially in areas known to experience wide variations in oceanographic conditions. For a comprehensive review of oceanographic techniques which may be employed during surveys of marine aggregate extraction sites, reference should be made to general texts such as UNESCO (1988, 1993), Emery and Thompson (1997) and ICES (2000).

6.1. Currents and tidal elevation

For any survey site, it is important to understand the tidal conditions present in terms of mean, maximum and minimum tidal currents, directions and residual current rate and direction. Either a string of single point current meters, a current profiler, or an Acoustic Doppler Current Profiler (ADCP) can be used to observe the current dynamics. An ADCP

emits an acoustic signal from a series of transducers and measures the Doppler Shift in a series of depth strata (bins) thus giving a profile of currents vertically through the water column. Backscatter information from the bins may also give additional information on the suspended sediment profile. ADCPs can either be mounted on the seabed and be directed vertically upwards or mounted on a vessel and be directed downwards. The time-series should ideally be long enough to observe spring to neap tidal variations i.e. to resolve the M_2 tide (Principal Lunar tide - 28 days) and the data should be collected at a sufficiently high capture rate to correctly monitor the daily tidal regime. Measurements of current velocities close to the seabed can be used to calculate the shear stress exerted on the seabed and, from this, the range of sizes of sediment particles which can be set in motion by the prevailing tidal currents can be deduced.

Several current meter locations may be required in areas where the current varies significantly in either speed or direction. Typically this could be due to bathymetric changes or the convergence/divergence of two or more tidal streams.

Data from current meters should be calibrated in accordance with standard oceanographic procedures (ICES, 2000) and analysed to produce time-series of currents, histograms of current speed and direction, residual tidal drift and so on. Tidal elevations measured using a tidal gauge mounted on the seabed give site-specific information on the daily tidal curve. Abnormal events such as tidal surges will also be evident.

6.2. Suspended sediment and turbidity

The suspended load climate, measured in terms of concentration and mean particle size, is an important influence on the benthic community. Measurement of the suspended sediment concentration should be collected over a sufficiently long period to observe any tidal resuspension due to spring tides, and should also be at sufficiently high resolution to observe short-term events such as waves and anthropogenic disturbance events e.g. dredging activity, fishing activity or cable laying, which might occur during a deployment. This can be used to determine the driving mechanism of suspended sediment transport. The suspended load can be monitored by two types of sensors: optical backscatter sensors for the fine particles in suspension and acoustic backscatter sensors for the coarser sands in suspension. These instruments should be deployed as close as possible to the seabed and configured in such a way that they encounter minimum impedance of current flow generated by the structure upon which they are mounted, as shown in the CEFAS Minipod seabed lander system (Figure 31) or the CEFAS loggerpot (Figure 32). Water samples can also be taken using a variety of modern oceanographic samplers (e.g. Rosette, Niskins and displacement water bottles) at various depths, times and positions. The analysis of the sediment contained within such samples can provide a view of the suspended sediment climate.



Figure 31 **CEFAS Minipod.** The Minipod consists of a hard-disc based burst logger, capable of recording the current velocities (from a Nortek Vector® Acoustic Doppler Velocimeter), pressure (using a DigiQuartz® sensor), suspended sediment sensors (acoustic for sands and optical for finer material) and seabed position. Passive and timed sediment traps (Booner tubes) are also evident on two legs

6.3. Waves

Exposure to waves, especially winter waves, is an important factor in controlling the stability of the seabed and hence the benthic environment. An assessment of the exposure to waves, from all directions and all seasons, can be used as a disturbance indicator. Wave statistics such as significant wave height (H_{sig}), wave period (T), significant wave height for a return period of 50 years (H_{50}), combined with water depth, can give estimates of the wave orbital velocity at the seabed which can be contoured to show regional variations.

Waves can be recorded by two main groups of instruments, namely surface-mounted buoys and seabed mounted pressure recorders. The former use accelerometers to record wave dynamics, whereas the latter use pressure sensors to record pressure variations. The latter should not be used in deep water (> 30 m water depth) as the short waves are attenuated with depth. Surface buoys normally give direction information but pressure recorders need an auxiliary velocity recorder to infer directional information.



Figure 32 **CEFAS loggerpot which contains an ESM2 burst logger recording suspended sediment concentration, tidal elevation, wave statistics, conductivity and temperature. Also mounted in the Loggerpot is a Falmouth Scientific Instrument 2D Acoustic Current Meter (ACM)**

6.4. Sediment dynamics

Sidescan sonar surveys can be used to give an indication of the sediment transport pathways (see Chapter 5.5). Sediment transport features such as sand waves, sand ribbons and scour marks can be interpreted to predict transport vectors. Care must be taken in interpreting these surveys as the image represents the most recent sediment transport event and not necessarily long-term pathways.

Sediment traps can also give useful information on the timing, rates, and direction of horizontal sediment transport around an aggregate extraction site. This may be important in regions where active sediment transport is taking place, e.g. at the edges of sandbanks, or during storms. Sediment traps measure rates of horizontal sediment transport and usually take three forms: passive, active or directional. Passive traps are simple and widely used, whereas active traps include some sort of mechanism to infer the timing or sequence of sediment transport events. Direction traps infer the directional source of the material. These data can be used to calibrate the suspended sediment sensors and, when combined with the current information, provide an indication of the sediment transport direction. Bedload transport can also be estimated using traditional bedload transport formulae (Soulsby, 1997).

6.5. Horizontal and vertical structure (temperature or salinity)

Horizontal or vertical gradients of temperature or salinity (due to freshwater inputs) may exist over a survey area and can affect distributions of species. These can be assessed by either vertical CTD (Conductivity, Temperature and Depth) and Rosette casts (Figure 33) or by undulating CTD systems.

The Rosette can carry up to 24 Niskin bottles for collecting water samples for various determinands. The CTD system sends conductivity, temperature and pressure (depth) data via a cable in real-time to a surface control system. Water samples can then be taken either at the seabed, at the sea surface, in thermoclines or at other locations of scientific interest. Auxiliary sensors include transmissometers, suspended sediment sensors and fluorometers.



Figure 33 **CEFAS Rosette and CTD system being deployed from *RV Corystes***

CHAPTER 7

The collection and analysis of sediment samples for particle size analysis (PSA)

7.1. Introduction

The following account describes recommended methods for generating particle size data which may then be associated with the analysis of benthos samples, but they do not exclude other suitable methods. The Standard Operating Procedure (SOP) described in Annex III is included as an example of one recommended analytical approach for the analysis of aggregate samples. Other standard procedures such as those contained within BS1377 may also be adapted for this purpose (British Standards Institution, 1990). An SOP for the analysis of the fine fraction has not been included, as the analytical methodologies used for this fraction vary widely.

7.2. Field methods

7.2.1. Subsampling sediment for particle size analysis from a macrofaunal sample

Sampling of sediments for later particle size analysis (PSA) is an essential accompaniment to macrofaunal surveys. Small-scale heterogeneity at the seabed dictates that a PSA sediment sub-sample should be collected from the same sample as that collected for the benthic fauna. PSA samples must also be collected from each replicate biological sample. This allows the macrofaunal data to be accurately referenced against variations in particle size characteristics.

The currently recommended quantitative sampling device for the collection of benthic samples at aggregate extraction sites is the Hamon grab. A description of the use and operation of this grab is given in Chapter 3.2.1. The Hamon grab collects a sediment sample in such a way that an undisturbed sediment surface is rarely available. Samples that do retain some degree of integrity on retrieval can be viewed and sampled before the grab is emptied, by means of an access door fitted to the uppermost surface of the grab bucket. However, it is most often the case that the sample will be mixed to some degree prior to subsampling.

After the contents of the grab have been emptied into a sample container, it is important that the subsample which is removed for PSA is as representative of the whole sample as possible. For coarser substrata, this demands that proportionally larger quantities are required than would be the case for sand or muds. However, a balance must be struck between the quantity of sample that is removed for particle size analysis, and the amount of sample that remains for the assessment of macrofaunal species composition. Typically when using a 0.1 m² Hamon grab, a sub-sample of approximately 500 ml is removed using a plastic scoop. After the sample has been emptied from the Hamon grab into a sample bin, a plastic scoop should be used to remove a number of randomly distributed aliquots to generate the 500 ml PSA sample. This procedure should allow for sorting of the sediment within the sample container. The PSA sample should be stored frozen in a sealed container, preferably in the dark, prior to later laboratory analysis. If cobbles (>63 mm) are present in the sample, they should not be included as part of the PSA subsample. Cobbles should be measured across their smallest axes so that they can be included in later data analyses. Methods for the field analysis of the particle size distribution of the coarsest material do exist (R. Nunny, *pers. comm.*) but have not been widely assessed.

Whilst the relatively small sample size specified above would generally not satisfy geological criteria for accurate characterisation of particle size distributions (e.g. in connection with industry-scale resource surveys), it represents a practical compromise which best serves the primary survey objective of evaluating macrofaunal community structure in relation to the physical habitat.

7.3. Laboratory analysis of sediment samples

The results generated as a result of the PSA of sediment samples provide important insights into the interpretation of benthic faunal, acoustic and hydrodynamic data. Sediment samples collected from aggregate extraction sites frequently possess a wide particle size distribution. A typical sample collected from an aggregate extraction site might comprise an admixture of cobbles, gravel, sand and silt/clay. The following text describes how the particle size distribution of a typical aggregate sample should be determined. An example of a more detailed Standard Operating Procedure is provided in Annex III.

7.3.1. Splitting the sample into a coarse and fine fraction

It is not possible to accurately analyse the coarser end of the particle size range of a typical aggregate sample using the same methods as those employed for the analysis of the finer end. Therefore the whole sample should initially be wet sieved on an automated sieve shaker (Figure 34) using a 500 μ m sieve if optical techniques are to be used for the analysis of the finer fraction, or a 63 μ m sieve if settling techniques are to be used. Sediment that is finer than the mesh size of the sieve being used will be washed through the sieve into a collecting pan. Material coarser than the aperture size will remain on the



Figure 34 The automated wet sieve shaker is used to split a sediment sample into a coarse fraction and fine fraction. The coarse fraction remains on the sieve, and the fine fraction passes through the sieve to be retained in a collecting pan. The two fractions may then be treated separately for further particle size analysis

sieve. Before the sieving process begins care should be taken to ensure that lumps of consolidated fine material are disaggregated and pass through the sieve. In addition, care should be taken to ensure that all material finer than the sieve aperture size has passed through the mesh during at this stage.

The coarser fraction should be dried to constant weight in an oven at a temperature of not more than 80°C. The subsequent treatment of the fine fraction will depend on the intended method of particle size analysis to be used.

7.3.2. Analysis of the coarser fraction using a dry sieving process

The oven-dried coarser fraction is left to cool to room temperature. It should then be sieved on a double gyratory jolting sieve shaker (e.g. Pascall Inclyno™) using a stack of sieves nested at 0.5φ intervals. The coarsest sieve, placed at the top of the stack, would typically have a mesh size of 63 mm and the finest sieve at the base of the stack would have a mesh size of either 500 μm or 63 μm depending on the method of subsequent analysis of the finer fraction. A collecting pan at the bottom of the stack retains the fraction passing through the finest sieve. The sample should be tipped onto the coarsest sieve, and the sieve stack should be shaken for a standard time (at least 10 minutes). At the end of this time, the components of the sample will have been shaken as far down the sieve stack as their diameter will allow. The weight of the sediment in each sieve should be recorded, as well as relevant observations on the nature of the material present (e.g. shell material or organic debris). The weight of the sediment in the collecting pan should also be recorded.

7.3.3. Analysis of the finer fraction

The fine fraction of the sediment should be either freeze-dried, air dried or oven dried at a low temperature ($<30^{\circ}\text{C}$) to reduce the likelihood of concretion of the silt/clay fraction during the drying process. The analysis of the finer fraction may be carried out in a number of ways. Commonly used methods include settling techniques such as pipette and Sedigraph® analysis and optical methods such as laser sizing (Figure 35). It is important that comprehensive SOPs, produced by laboratories experienced in the use of these techniques for the analysis of marine sediments, are followed.



Figure 35 Coulter™ LS 130 laser sizer. This equipment uses laser diffraction technology to measure particle diameters. It is most frequently used to measure the finer component ($<500\ \mu\text{m}/<63\ \mu\text{m}$) of a sediment sample

7.3.4. Synthesis, expression and reporting of results

Particle size can either be quoted in metric (millimetres, microns) or logarithmic (Phi) units (Krumbein, 1934). Sediment descriptions as defined by their size class should be based on the Wentworth classification system (Wentworth, 1922). Sediment mixtures should be described using the classification system developed by Folk (1974). Statistics relating to particle size distributions should be calculated and described using the formulae given in Dyer (1986).

The data generated from the analysis of both the coarse and the fine fractions should be combined to produce a complete particle size distribution for each sample, which can then be plotted. When the full distribution has been constructed the sample should be assigned a description based on the Folk classification system.

Statistics which should typically be calculated for a distribution include the following:

1. Percentage gravel, percentage sand, percentage silt/clay
2. Mean particle size
3. Sorting coefficient
4. Skewness
5. Modal size
6. Kurtosis

The grain size composition of a sample may also be presented according to a standard classification system such as that produced by Folk (1970). It is extremely useful to provide graphical representations of particle size distributions in the form of size frequency histograms (Figure 36), or cumulative frequency curves to accompany these statistics.

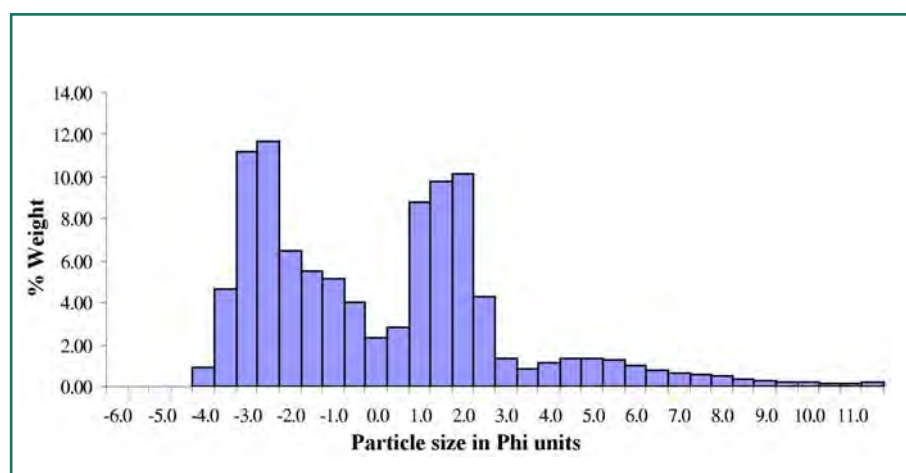


Figure 36 **Histogram showing particle size distribution of a typical mixed sediment sample. The Phi scale along the x axis ranges from coarse material at the left to fine material at the right**

7.3.5. Quality Control Procedures

The application of appropriate QC procedures when conducting particle size analysis is essential. The use of certified reference material to check the performance of laboratory equipment is recommended. Additionally, the use of an internally produced standard sediment is another valuable method of checking equipment on a more frequent basis.

Subscription to accredited QC schemes, such as the NMBAQC Scheme (see Chapter 9.1) and the Laser Diffraction Proficiency Testing Scheme (LDPTS) introduced by Beckman Coulter UK Ltd., is recommended. BS1377 also lists recommendations for laboratory apparatus specifications and calibrations which are valuable for checking analytical performance.

CHAPTER 8

Methods for data analysis of benthic samples

8.1. Objectives of data analysis

The objectives of the analysis of data arising from the monitoring of marine aggregate extraction sites include:

1. the identification of spatial patterns in the macrofaunal assemblage(s) under investigation and the relationship of these to environmental information including the spatial extent of any dredging related disturbance (baseline/exploratory data);
2. the detection and quantification of effects and temporal trends which are attributable to aggregate extraction, and the identification of other forcing factors (ongoing monitoring data);
3. the monitoring of the recolonization of aggregate extraction sites following the cessation of dredging until a 'stable' state is demonstrated (post-dredging data).

A typical dataset arising from a survey of a marine aggregate extraction site in U.K. waters usually contains well over 100 species. There are numerous techniques that can be employed to simplify and elucidate structure in the data. The following section outlines a basic suite of statistical approaches for analysis of biological data typically obtained during the monitoring of marine aggregate extraction sites. Each of these techniques can be used to partially fulfil the objectives of data analysis. However, it is recommended that parallel application of a range of techniques will help both to differentiate patterns and confirm real trends in the data. For a comprehensive review of statistical methods, the reader is referred to general texts such as Green (1979), Sokal and Rohlf (1987), Clarke and Warwick (1994) and Underwood (1997). For convenience, emphasis in the following account is placed on statistical techniques which are included in the PRIMER (Plymouth Routines In Multivariate Ecological Research) software package developed at the Plymouth Marine Laboratory (Clarke and Warwick, 1994; Clarke and Gorley, 2001). This is because the package is widely employed and has gained general acceptance as a tool for analysing benthic datasets. However, it is also recognised that there are many other software packages and statistical techniques which are equally suited to the task of handling benthic community datasets such as CANOCO (Jongman *et al.*, 1987). It should be noted that both novel statistical approaches for the analysis of biological data and new statistical software packages are continually emerging.

In addition to biological data, analysis will generally include consideration of physical data such as sediment particle size distributions and other environmental variables. Many of the approaches described below can be applied equally to other forms of data. However, non-parametric methods may be more appropriate than parametric measures when analysing count data.

8.2. Initial data processing

Prior to data analysis, there are several stages of initial data processing that must be conducted. These stages are summarised by Clarke and Green (1988) and are briefly considered below (see Figure 37). Firstly, the data must be collated and classified using a coding system based on hierarchical taxonomic levels such as that described by Howson and Picton (1997). A species-sample matrix is then created of taxon abundance per replicate sample. This should document both quantitatively and qualitatively measured taxa. In addition, a matrix detailing wet-weight biomass of individual taxa by sample can be prepared and then converted to ash-free dry weight (AFDW) using standard conversion factors (Rumohr *et al.*, 1987; Ricciardi and Bourget, 1998). Finally, a matrix of the corresponding physical data should be prepared.

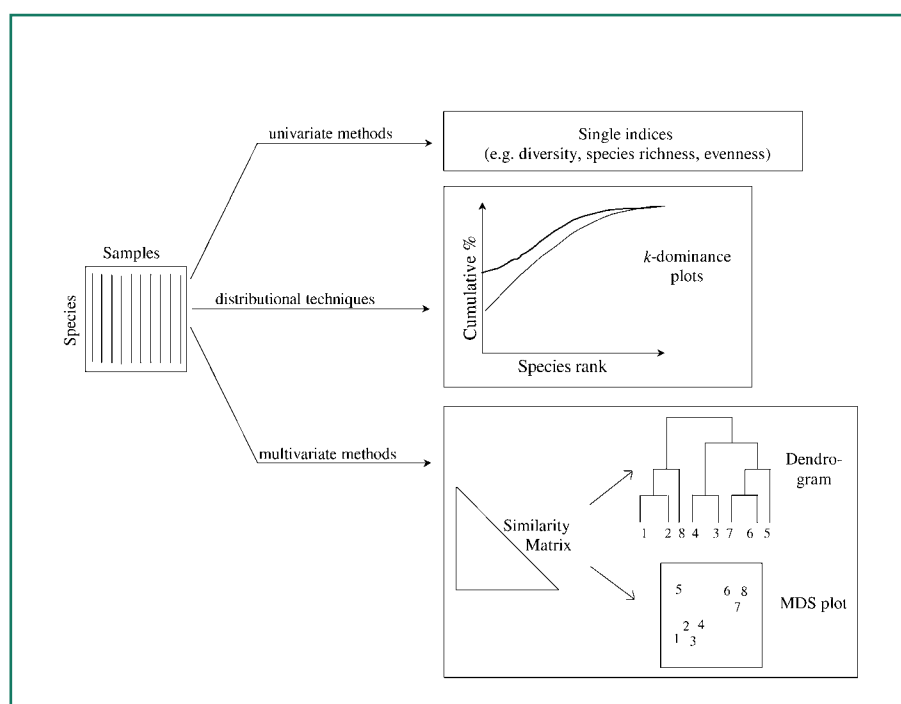


Figure 37 **Statistical methods used to analyse macrobenthic assemblage structure (after Schratzberger, 1998)**

Once data are collated in a suitable matrix, it may be appropriate, in some cases, to remove rarer species from the data analysis. However, if such a procedure is followed then the criteria adopted and reasoning behind species removal should be transparent. Colonial species, which are not amenable to counting, are normally removed from datasets prior to analysis of quantitative data. Again, although this is common practice, the action should be clearly documented in any reports.

Statistical methods used for describing assemblage structure can be grouped into three categories:

- (1) Univariate methods
- (2) Distributional techniques
- (3) Multivariate methods.

For each of these classes, appropriate statistical tests have been developed to determine the significance of differences between replicated samples.

8.3. Univariate methods

Diversity measures take into account two factors. These are species richness (number of species) and species evenness (how equally abundant the species are). Distribution-free indices are commonly used since they make no assumption about the underlying species abundance distribution. There are two categories of distribution-free indices (Magurran, 1988):

- (1) Information theory indices (e.g. Shannon-Wiener Index H').
- (2) Dominance indices (e.g. evenness).

More information about the structure of assemblages and their change due to aggregate extraction can be obtained by the use of a variety of different univariate indices including total number of individuals, total number of species, diversity (Shannon-Wiener Index H'), dominance (Simpson Index C), species richness (Margalef's d) and evenness (Pielou's J'). In general, such measures tend to be highly correlated and therefore there is limited value in calculating a large number of indices, as many will show similar trends in the data. Those indices that are less dependent on sample size (see Table 3) may be more appropriate for data arising from coarse substrata.

8.3.1. Characteristics of univariate measures

Magurran (1988) provides a summary of the performance and characteristics of a range of univariate indices to show their relative merits and shortcomings (Table 3). The column headed "richness or evenness/dominance" shows whether an index is biased towards either species richness or evenness.

There are indices which reflect the species richness element of diversity and measures which express the degree of evenness in the data. The number of species detected in a sample usually changes much more in relation to sample size or sampling intensity than does the distribution of relative abundances (Huston, 1996).

Therefore, indices in the first category are generally better at discriminating between samples but are more affected by sample size than the evenness of diversity measures.

Table 3 Summary of the performances and characteristics of diversity statistics (modified from Magurran, 1988)

	Discriminant ability	Sensitivity to sample size	Richness or evenness/dominance	Calculation
Diversity (H')	moderate	moderate	richness	intermediate
Dominance (C)	moderate	low	dominance	intermediate
Species richness (d)	good	high	richness	simple
Evenness (J)	poor	moderate	evenness	simple

8.3.2. Biodiversity indices

The latest version of PRIMER (version 5) which has recently become available (Clarke and Gorley, 2001) allows the calculation of new biodiversity indices including taxonomic distinctness indices. These indices capture the structure not only of the distribution of abundances amongst species but also the taxonomic relatedness of the species in each sample. In practice, these taxonomic distinctness indices have the important attribute that they are not, generally, dependent on the degree of sampling effort involved in the data collection, implying that results can be compared across studies with differing and uncontrolled degrees of sampling effort (Clarke and Warwick, 1999). Although these indices are now beginning to be used more widely in the marine field, they are still in need of methodological refinement and wider testing (Clarke and Warwick, 1999).

8.3.3. Analysis of variance (ANOVA)

When the species abundance information in a sample is reduced to a single univariate index, the existence of replicate samples from each treatment allows formal statistical treatment by one-way analysis of variance (ANOVA) (Clarke and Warwick, 1994). This analysis relies on the following assumptions:

- (1) that the data follow a normal distribution,
- (2) that the variance of the sample is independent of the mean, and
- (3) that the components of the variance are additive.

In general, the variance and mean tend to increase together and therefore the second condition is never fulfilled. Transformations are an essential procedure before the application of most methods associated with the normal distribution (Elliott, 1971).

In cases of significance, multiple comparisons tests can be performed to identify assemblages that are significantly different at $p < 0.05$.

8.4. Distributional techniques

Diversity profiles can be visualised by plotting k -dominance curves (Lamshead *et al.*, 1983) (Figure 38). Species are ranked in decreasing order of dominance along the x-axis and the percentage cumulative abundance (k -dominance) is then plotted against the species rank k (Platt *et al.*, 1984). The purpose of such curves is to extract information on the dominance pattern within a sample, without reducing the information to a single summary statistic, such as a diversity index.

Diversity can only be assessed unambiguously when the k -dominance curves from the assemblages to be compared do not overlap. In this situation the lowest curve will represent the most diverse assemblage. If the curves overlap it is impossible to discriminate between the assemblages according to diversity as different diversity indices may rank them in opposite ways. Diversity indices focus on one aspect of species abundance relationships and emphasise either species richness or dominance. Plots which overlap therefore illustrate the shift of dominance relative to that of species richness (Magurran, 1988).

Sets of macrofauna species counts and biomass can be summarised in abundance and biomass k -dominance curves applying the ABC procedure (Warwick, 1986) (see also Figure 38). This method is based on the assumption that, in the event of environmental disturbance, the distribution of numbers of individuals among species in macrobenthic assemblages behaves differently from the distribution of biomass. Under stable undisturbed conditions, the biomass will become increasingly dominated by one or a few large species, each represented by rather few individuals which are in equilibrium with the available resources. However, the numerical dominants, are smaller species which are out of equilibrium with resources and thus an undisturbed state is indicated if the biomass k -dominance curve falls above the abundance curve throughout its length. As disturbance becomes more severe, macrobenthic communities become increasingly dominated numerically by one or a few very small species, and few larger species are present although these will contribute proportionally more to the community biomass in relation to their abundance than will the small numerical dominants. A strongly disturbed state is therefore indicated if the abundance k -dominance curve falls above the biomass curve throughout its length.

8.5. Shortcomings of univariate methods and distributional techniques

Univariate methods and distributional techniques allow a visual interpretation of any trends (e.g. increasing or decreasing diversity at different sampling locations) and their statistical significance. However, both procedures share the property that comparisons between samples are not based on the identity of species. Two samples can have exactly the same diversity or distributional structure without possessing a single species in common (Clarke and Warwick, 1994). In order to better address the complexity of ecological systems, with their numerous species and discordant time-courses of change in populations, species-dependent multivariate analysis of community structure is required (Underwood, 1996).

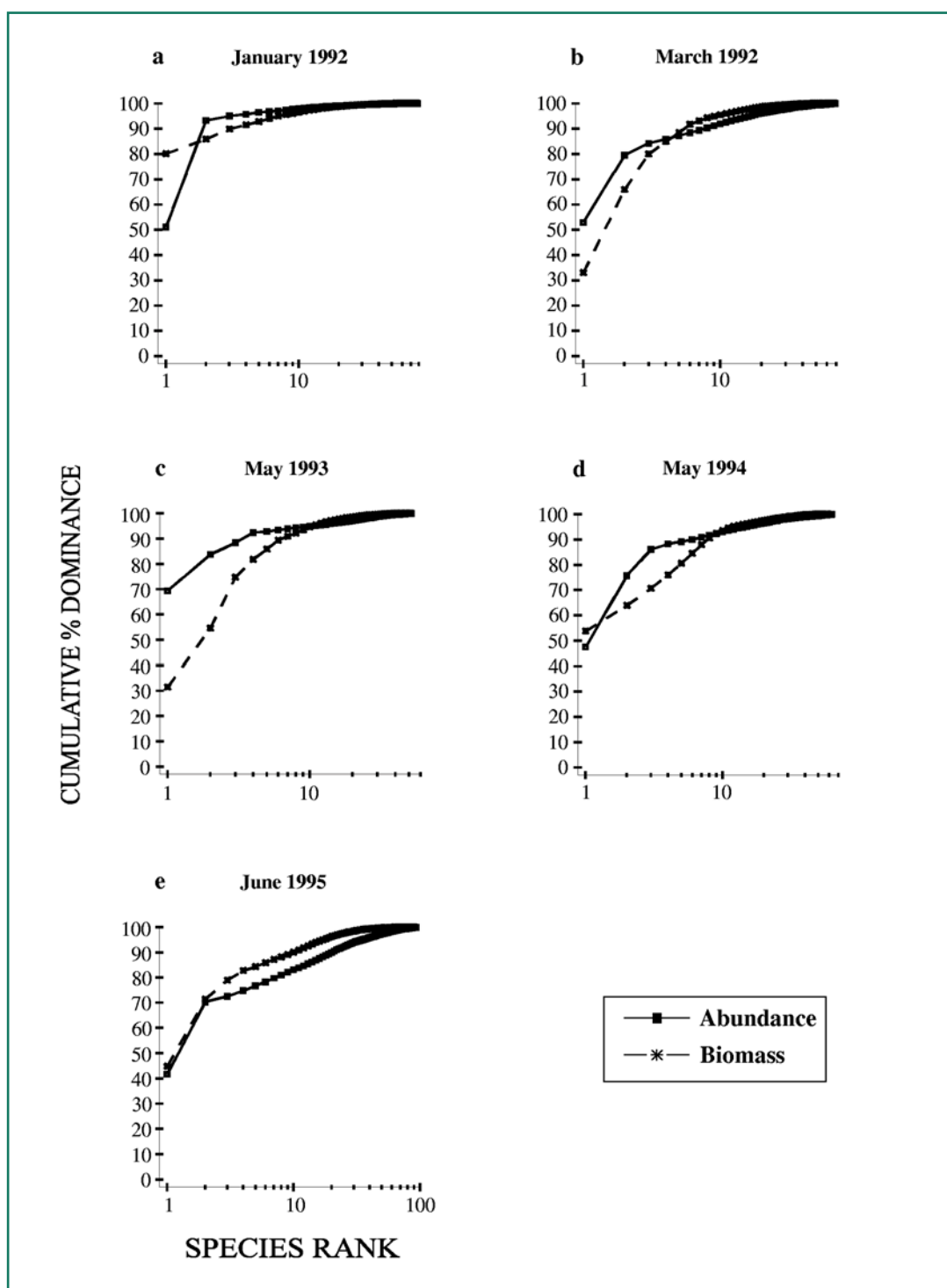


Figure 38 **Abundance and Biomass Comparison k -dominance curves (ABC plots) for macrofauna at an experimentally dredged site. Dredging was carried out in April 1992 (after Kenny *et al.*, 1998)**

8.6. Multivariate methods

Multivariate analyses are conducted to determine whether biological assemblages respond to different types of disturbance by small, but consistent changes in the relative abundances of species. These changes might not be detected by comparisons of univariate indices.

Field *et al.* (1982) described the steps involved in the multivariate analysis of marine biological survey data:

(1) Data Transformation

Several options are available on analytical outcomes. Untransformed data may have the undesirable property of accentuating the influence of very abundant species. In such cases, increasingly powerful transformations will have the effect of increasing the influence of rarer species at the expense of the commoner ones. For example, log-transformation has the powerful effect of ‘scaling down’ very abundant species and thus increasing equitability of the dataset. The square-root transformation has a similar effect in reducing the weighting of abundant species but has the advantage that, when similarity is assessed by the Bray-Curtis measure, the similarity coefficient is invariant to a scale change (i.e. it doesn’t matter whether scores are expressed per cm² or m²).

(2) Similarity Measurement

The overall similarity between every pair of samples is expressed, taking all the species into consideration. The Bray-Curtis measure gives more weight to abundant species than to rare ones.

(3) Classification

Hierarchical sorting strategies are used to produce a dendrogram from the similarity matrix. The most commonly used method in marine benthic studies is group average sorting (Lance and Williams, 1967), which joins two groups of samples together at the average level of similarity between all members of one group and all members of the other.

(4) Ordination

An ordination of the n samples is produced in a specified number of dimensions. In the multi-dimensional scaling (MDS) ordination, the identity of each species is retained and used integrally with, for example, abundance data to compare assemblages (Austen and Warwick, 1989). The purpose of the MDS is to construct a configuration (“map”) of samples, which attempts to satisfy all the conditions imposed by the underlying similarity matrix. The distances between pairs of samples in the resulting plot reflect their relative dissimilarity in species composition (see Figure 39 for an example of a MDS ordination using data from an experimentally dredged site).

Initially, the samples are placed in two-dimensional space at entirely arbitrary locations, and then their relative positions are gradually refined by an iterative analytical process. The intention is to move samples into positions in which the rank order of their distances from each other becomes ever closer to the rank order in the original similarity matrix. The extent to which the two disagree is reflected in the stress value (Clarke and Warwick, 1994). This coefficient indicates the degree to which the two-dimensional plot provides an acceptable summary of the multi-dimensional sample relationships. Stress values of < 0.05 indicate an excellent representation with no prospect of misinterpretation, whereas MDS plots with stress values > 0.3 should be treated with caution as the points are close to being arbitrarily placed in the two-dimensional ordination space (Clarke and Warwick, 1994).

Non-parametric multi-dimensional scaling (MDS) ordination, employing the Bray-Curtis similarity measure (Bray and Curtis, 1957), is a commonly used analytical technique which is available on the PRIMER software package (Clarke and Warwick, 1994; Clarke and

Gorley, 2001). MDS ordinations can be carried out on data which have been transformed in a variety of ways.

Analysis of similarity (ANOSIM) (Clarke, 1993) can be conducted to test for statistically significant differences in macrofaunal assemblage structure between samples or stations.

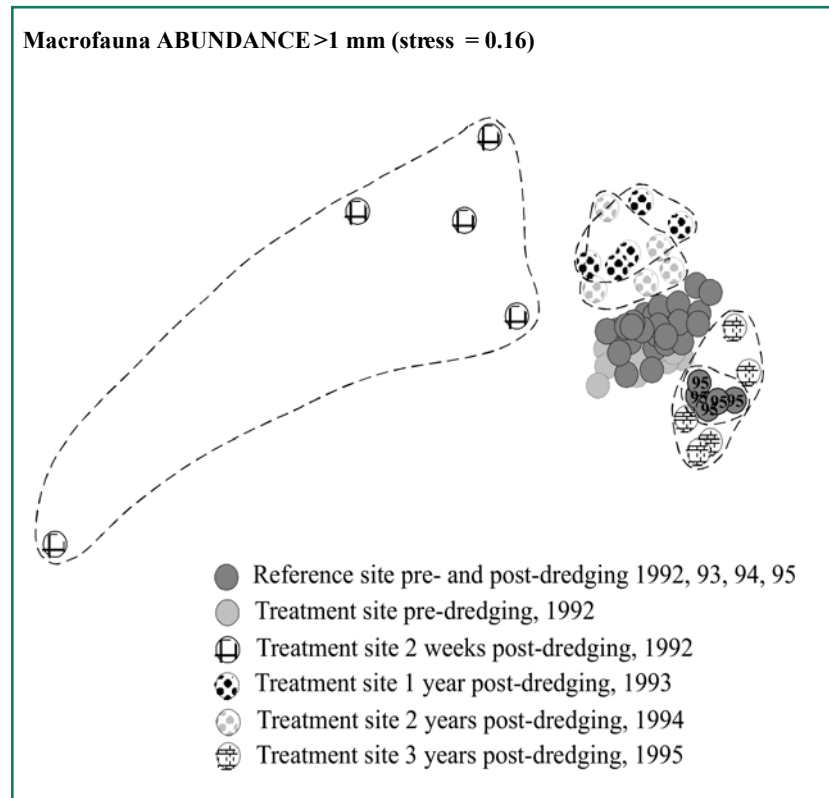


Figure 39 **An example of a non-metric multidimensional scaling ordination (after Kenny *et al.*, 1998)**

8.6.2. Species analyses

It is important to establish which species contribute to observed differences in the data. This can be achieved by ranking species in terms of abundance or by examining the degree to which species contribute to measures of similarity/dissimilarity between individual samples or sample groups (SIMPER) (Clarke and Warwick, 1994). Dominant species can be identified from the original raw data but, often, those species are not the ones that discriminate between an impacted and a reference site. The strength of the SIMPER analysis lies in identifying the discriminant species. In the case of large and complex data sets, this would be impossible without computerised programmes such as SIMPER.

8.7. Linking biological data with environmental information

The techniques described above are not ends in themselves; they only identify patterns in the faunal data and do not attempt to establish the causes of the faunal distributions. This can, however, be partially achieved by further statistical analyses, if the physical characteristics of the sediment have been determined or other properties of the habitat have been established. Analysis of variance can be used to determine which environmental variables are significantly different between the groups of stations, and correlation analyses can show which variables are correlated with features of the faunal data. Therefore, insights into the causative factors may be gained through computing correlations between environmental variables and faunal attributes such as the densities of selected species, diversity indices, or numbers and densities of all species at each station. More sophisticated techniques employing multivariate approaches to data analysis can also be used to link biological patterns to environmental variables (see e.g. Clarke and Warwick, 1994). One useful visual approach is to superimpose environmental data upon the output from station ordination or classification of biological data (see Figure 40).

8.8. Interpretation of the data

For the final stage in the interpretation of the results, a knowledge of the biology of the various species (e.g. feeding habits, environmental preferences, functional significance) is required to assess whether variables which are empirically related to the faunal distributions might be causative factors. Thus, it is possible to assess which environmental factors, either natural or resulting from marine aggregate extraction or other anthropogenic perturbations, are affecting the benthic environment and to what degree. This information may then be employed in a predictive manner to assess the likely consequences of any alterations in the intensity of aggregate extraction in a given area.

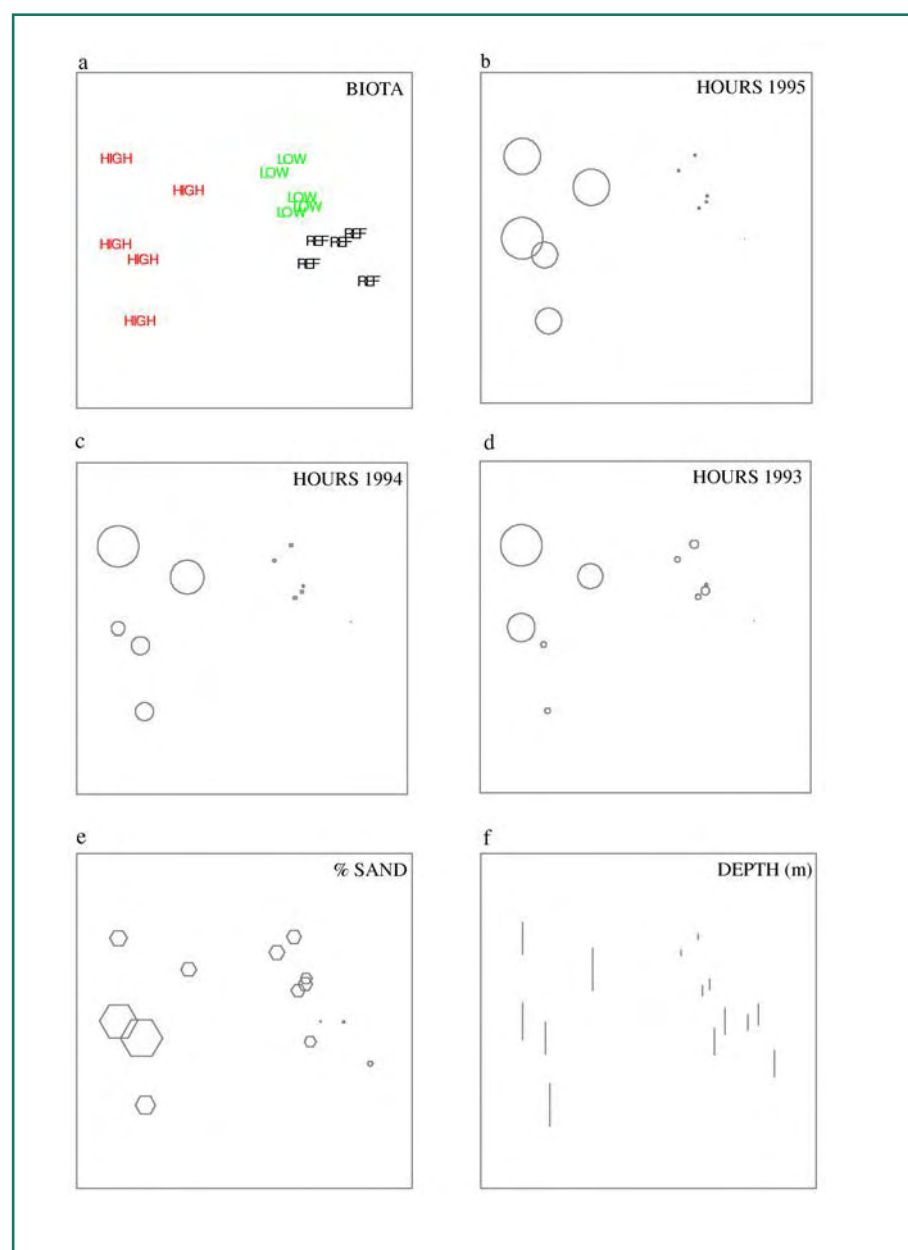


Figure 40 a) MDS of Bray-Curtis similarities from double square-root transformed species abundance data at three stations of different dredging intensity; b-f) the data are shown with superimposed symbols on the original faunal groupings in linear dimensions proportional to the selected environmental variables b-d) hours of recorded dredging derived from EMS for each year; e) % sand and f) depth of water (Stress = 0.09) (Boyd *et al.*, 2002)

CHAPTER 9

Quality assurance

9.1. Definitions and scope

Quality Assurance (QA) is the total management scheme required to ensure the consistent delivery of quality controlled information fit for a defined purpose. The scheme must take into account as many steps of the analytical chain as possible in order to determine the contribution of each step to the total variation. Analytical Quality Control (AQC) encompasses procedures which maintain the measurements within an acceptable level of accuracy and precision.

A QA strategy should be evolved at the outset of an investigation, and should encompass the objectives and design of programmes, as well as practical matters relating to their execution. Thus the adoption of consistent and reliable practices in accordance with documented procedures, both at the field sampling and laboratory analytical stages, will provide confidence in the validity of the output but cannot make up for a sampling design which no longer serves its intended purpose. QA must therefore include regular re-evaluation of reported outcomes in relation to the original objectives of a study.

For benthic ecological studies, all-encompassing QA/AQC systems are still evolving, but the trend is towards increased involvement by individuals and institutes, especially those engaged in collaborative work requiring the synthesis of data from several sources. In the UK, an example of this trend is the recent establishment of a National Marine Biological AQC scheme. Although designed principally to service the needs of the National Marine Monitoring Programme, participation (at cost) is available to a variety of other interested parties. Further details are available at www.NMBAQCS.org. Another example, involving certification of individual competence in species identification, is the IdQ scheme operated by the Natural History Museum, details of which may be obtained from www.nhm.ac.uk/science/consulting/text/te.html.

Draft guidelines for the setting up of quality systems are given in Anon (2002), with the emphasis on marine biological studies. The degree of sophistication will clearly depend upon laboratory size, and it would be inappropriate to attempt to cover the needs of all recipients in the present document. However, one of the most important practical tools in a QA system is the Standard Operating Procedure, details of which are given below.

9.2. Standard Operating Procedures

Standard Operating Procedures (SOPs) are an integral part of any Quality Assurance programme and help to ensure that data collected by a laboratory are scientifically valid, comparable and adequate to meet the study objectives. A SOP is defined as 'a written

procedure which describes how to perform certain routine laboratory tests or activities normally not specified in detail in study plans or test guidelines' (Good Laboratory Practice Regulations, 1997). An absolute requirement that all laboratories carry out tasks in exactly the same way would be unrealistic, as procedures are often legitimately tailored to local circumstances (e.g. vessel size). However, where approaches differ between laboratories, it is essential to establish that these do not have adverse implications for the comparability of data. Specific examples relating to studies at aggregate extraction sites are given at Annex II and III. The following general guidance on the structure and content of an SOP is taken from Anon (2002).

A well-written SOP will help inexperienced members of staff in a laboratory to quickly develop expertise in a sampling or analytical area which is consistent with past practice at that laboratory, while being compatible with established approaches elsewhere. For those seeking laboratory accreditation, the production of SOPs will be essential as part of a wider QA package but, even for those who are not, they provide an important means to foster good practice internally. However, SOPs are clearly not, in themselves, guarantors of data quality.

SOPs should describe all steps performed in biological measurement. They should be established to cover the following areas of activity:

- station selection and location, navigational accuracy;
- handling, maintenance and calibration of field and laboratory equipment;
- handling and use of chemicals (i.e., fixatives, preservatives, reagents) used in marine environmental surveys;
- collection of biological material;
- storage of biological material including labelling and the checking of preservation status;
- distribution of biological material to external contractors/taxonomic specialists;
- analytical methods for biological material;
- identification of biological material including taxonomic expertise of the personnel;
- recording of biological and environmental data; data management;
- analysis of biological and environmental data;
- QA of report writing and documentation including signed protocols in all steps of analysis.

In considering "best practice", it is recommended that SOPs should:

- be structured logically by heading and sub-heading to cover the full sequence of activities in field sampling and laboratory analysis;
- carry an issue number, date and name(s) of the individual(s) responsible for its drafting and updating. This anticipates a likely requirement for changes to SOPs in response to new equipment, guidelines and so on;
- document in-house AQC procedures;
- account for the specific practices of the individual laboratory. At the same time, SOPs must of course reflect agreed guidelines applicable at national or international level, for example, relating to nomenclature and coding systems employed in documenting the outcome of the analysis of field-collected specimens;

- contain a full listing of taxonomic keys used for laboratory identification, and other useful reference works relating to procedures;
- be filed as paper copies in an accessible place, as well as being available on a computer network;
- be freely available to all interested parties (especially funding agencies);
- contain explicit instructions for the tracking of samples from the point of collection to the point of archiving of analysed material.

SOPs may usefully contain:

- diagrams depicting gear, especially where local modifications to equipment are made;
- a summary flow-chart as an accompaniment to a lengthy SOP, as an *aide memoire* for field and laboratory bench operators;
- details of local suppliers, manufacturers, etc., where relevant.

SOPs should not:

- contain vague generalisations;
- contain excessive detail: a sensible balance needs to be achieved which takes into account the basic level of training and common sense that a new operator will possess;
- cover too many activities: for example, it is logical to have separate SOPs for field and laboratory procedures. Different types of field activity such as intertidal core sampling and shipboard sampling are also sensibly treated separately.

The preparation of SOPs to cover field and laboratory analytical activities is one of the most important practical steps that a laboratory/institute can take in seeking to improve the quality and consistency of its scientific products and is, therefore, to be strongly recommended. This having been done, interlaboratory comparisons of SOPs may then provide a useful tool in identifying any remaining inconsistencies, and hence in promoting harmonisation of methodology at a national and international level (see, for example, Cooper and Rees, *in press*). Such periodic comparisons of SOPs are also to be strongly recommended.

CHAPTER 10

Format for reporting findings from environmental surveys

The appropriate authority should be consulted at an early stage regarding the requirements for reporting findings from benthic surveys. It is recommended that paper copies should be the default report form unless recipients specify otherwise. For example, it may be acceptable to supply electronic copies of reports and these should be in a format readily accessible (e.g. pdf format) to the Regulator, nominated agencies, consultees and industry consortia. For electronic reports, it is recommended that these are posted on industry or Government websites.

Guidelines for the structure of a report on the outcome of a benthic survey are as follows:

- Title page including authorship and date
- Executive Summary
- Introduction
- Materials and Methods
- Results
- Discussion
- References
- Appendices

All reports detailing the findings of marine aggregate extraction monitoring should include relevant raw data and basic statistics as appendices, including details of sub-sampling procedures adopted. Each report should include an appendix containing taxonomic and faunal notes. It may also be useful to include an appendix containing relevant photographic images of samples and equipment.

The methods adopted throughout the environmental appraisal should be clearly described and any modifications to standard procedures should be highlighted. Limitations to the chosen methodology should also be reported. A figure showing the location of sampling stations in relation to the boundaries of the proposed or existing extraction permit should be included in the report. It is also useful to incorporate a figure of block analysis of EMS data for those sites exposed to ongoing extraction effort. The faunal patterns can then be compared with the level of dredging effort within an area. Simple graphical presentations should also be used where possible to summarise major trends in the data. A statement detailing the results of QA exercises should be included in the report as well as references to SOPs and guidelines followed.

All reports should stand alone without the need for reference to previous reports, and all reports should be freely available.

10.1. The use of Geographical Information Systems (GIS)

The use of Geographical Information Systems (GIS) for presenting and reporting data is a relatively recent development, but the use of such systems is likely to become more widespread and therefore their future utility is discussed below.

A GIS is a computer-based system designed to input, store, manipulate, analyse and output spatially referenced data. Its application in an environmental context serves a number of purposes. A database provides the basis for any GIS and offers an efficient and manageable format for the storage of all types of information generated as part of an environmental survey. Once stored in the database the information can be easily extracted, and discrete but related datasets can be georeferenced and visualised together. A simple visualisation may take the form of a two dimensional map of the distribution of a number of variables. For example, plots of faunal distributions could be superimposed over values of recorded dredging intensity allowing inferences to be drawn concerning the relationships between the two spatially referenced datasets. Furthermore, the addition of a bathymetric dataset allows insights into the relationships between a number of variables viewed in three dimensions. Datasets which provide 100% coverage maps such as those produced during sidescan sonar surveys can also be draped over, for example, bathymetric plots within a GIS. A further advantage of a GIS is that it allows the inclusion of photographic images or video clips within the GIS, which can be reviewed during subsequent data interpretation. GIS also provides an opportunity to display and compare time-series data. For example, changes in particle size distributions due to changes in the intensity of dredging activity over time could be observed and quantified using GIS. In addition, some systems enable the scientist to interrogate and analyse the information stored within the database.

A number of GIS e.g. Mapinfo™ and ARC View™ are readily available for use by the environmental scientist. GIS lend themselves to wider dissemination in CD format. However, an alternative to the inclusion of bespoke viewing packages is to distribute the GIS maps in pdf format.

CHAPTER 11

Future developments

The approaches described above are those which can be routinely applied when conducting baseline surveys of a proposed application area or in assessing the effects of aggregate extraction. However, work continues on the development of new or improved monitoring methods for application in the field, in the laboratory and in the work-up of the resulting data. Significant developments from ongoing areas of research will be incorporated into proposed future editions of these guidelines and/or reported in the wider published literature. A summary of areas of continuing CEFAS research that are likely to have future utility in the assessment of the effects of marine aggregate extraction are briefly described below. Ongoing developments that are being pursued by other organisations are discussed under appropriate earlier sections.

11.1. Assessment of cumulative environmental impacts

Cumulative impacts have been defined as effects on the environment, either from the summation of individually minor but collectively significant impacts, or as a result of the interaction of impacts from one or more source (DETR, 2001). This definition includes both additive and interactive effects and is not limited to consideration of a single type of human activity such as aggregate extraction.

Surveys designed to assess the potential for cumulative environmental impacts arising from a prospective aggregate extraction site should consider its likely effect in combination with the sum of individual impacts already established for other sites, both in space and time (including changes projected into the foreseeable future).

Thus the main features which distinguish cumulative environmental impact assessment from conventional seabed surveys can be summarised as follows:

- Emphasis is placed on interactions between impacts arising from aggregate extraction and/or impacts of other perturbations. For example, it considers the additive impacts of multiple small-scale actions which might otherwise have been dismissed or judged to be insignificant for a single extraction application or other activity.
- It aims to evaluate the combined impacts of extraction activity on larger-scale ecological processes including effects on valued resources.

Methods for the assessment of the potential for cumulative impacts arising as a result of aggregate extraction are still evolving and will be presented in due course, following completion of CEFAS research.

11.2. Habitat mapping techniques

The facility to map the distribution of physical habitats and their associated biological assemblages is essential to evaluations of the acceptability of proposed or ongoing dredging activity. For example, the production of a habitat map prior to the commencement of dredging may allow subsequent physical changes to the seabed, and the associated benthic communities, to be assessed during follow-up monitoring surveys. This may be achieved using conventional grab sampling techniques, but cost considerations invariably limit the degree of spatial resolution in areas of habitat complexity. Presently, a number of alternative mapping techniques are under investigation by CEFAS and other research institutes.

Acoustic methods, such as sidescan sonar, and the acoustic ground discrimination systems QTC™ View and RoxAnn™, used in conjunction with traditional benthic macrofauna sampling techniques, such as those covered under Chapter 3, are under evaluation to assess their utility for high resolution mapping of benthic assemblages.

Preliminary findings (e.g. Brown *et al.*, 2000; Brown *et al.*, 2001; Brown *et al.*, 2002) suggest that acoustic methods can be used to divide an area into discrete seabed types, which can then be used to derive an optimal sampling design for determination of the spatial distribution of associated benthic communities. Results to date indicate that, in areas of high substratum homogeneity, a close correlation between discrete assemblage types and acoustically distinct regions can be established, which may thus have predictive value. However, the relationship between acoustically detectable habitat regions and discrete benthic assemblages is less obvious in areas of complex, heterogeneous sediments. Whilst the outcome of this work is promising, further research into appropriate techniques and methodology is required before the approach can be routinely adopted.

11.3. Assessment of meiofauna

As outlined in Chapter 1.2, the assessment of the effects of aggregate extraction has conventionally consisted of an analysis of large visible organisms, i.e. the macroinfauna and epifauna (> 1mm), that can readily be counted and identified. Due to their small size, the meiofauna, an assemblage of marine benthic metazoa with dimensions between 500 and 63 μm , has been largely neglected in applied sampling programmes (but see e.g. Somerfield *et al.*, 1995; Boyd *et al.*, 2000; Schratzberger *et al.*, 2000a). This size spectrum separates a discrete group of organisms whose morphology, physiology and life history characteristics have evolved to exploit the interstitial matrix of marine sediments.

There are a number of devices suitable for sampling the macrofauna from gravelly sediments (see Chapter 3.2 and 3.3) whereas time- and cost-effective meiofauna sampling is currently restricted to areas of finer sediments. Compared with studies of the macrofauna, the time and effort required for processing of meiofauna samples prior to species identification is generally higher due to the extended effort involved in the extraction of fauna in the laboratory.

The labour- and time-intensive task of meiofauna sample collection and processing must be weighed against the high intrinsic information value of each sample. Thus, as a discrete benthic component the meiofauna have an important role in ecosystem function and as a result of their high abundance, ubiquitous distribution, rapid generation times and fast metabolic rates, the status of meiofauna assemblages may therefore reflect the overall health of the marine benthos (Kennedy and Jacoby, 1999).

Although published information on meiobenthic communities inhabiting marine gravel is currently limited, studies of meiofaunal taxonomy and ecology have increased considerably in the last 20 years. Meiobenthic assemblages have also increasingly been used to assess the effects of perturbations in the marine environment and, in the last 25 years, more than 200 meiofauna papers have been published with a pollution theme (see review by Coull and Chandler, 1992).

Due to their small size, meiofauna assemblages are ideal for follow-up laboratory work, and experiments to simulate the effects of aggregate extraction, using samples of the indigenous fauna as test material may be envisaged. Information from such experimental studies may offer important insights into the processes operating in perturbed assemblages and may provide a cost-effective way to develop and improve future field sampling designs (Katz and Elias 1996; Schratzberger *et al.*, 2000b and c).

CHAPTER 12

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ANNEX I

Steering Group members

	AFFILIATION
Dr Tom Simpson (Chairman)	Department for Transport, Local Government and the Regions
Mr Roger Orpin (Contract Manager)	(as above)
Mr Alan Clayton	(as above)
Dr Richard Emmerson	Department for Environment, Food and Rural Affairs
Mr Graham Boyes	(as above)
Mr Paul Leonard	(as above)
Mr David Calderbank	(as above)
Mr Chris Morgan	National Assembly for Wales
Dr Tony Murray	The Crown Estate
Dr Paul Gilliland	English Nature
Mr Mark Russell	British Marine Aggregate Producers Association

ANNEX II

An example of an SOP for the collection and analysis of macrofaunal samples using a Hamon grab

	Procedure No. FET 002
	Page of
	Issue no. 2
BENTHOS QUALITY MANUAL	Issue Date: September 2001
TITLE OF PROCEDURE	Issued by:
Grab Sampling for Marine Sub-tidal Gravelly Sediments	Authorised by:



1. INTRODUCTION

Sediments, and particularly the associated benthic fauna, can act as a useful indicator of environmental disturbance and as a result samples are routinely collected for analysis of a wide variety of biological and physical determinands. For gravelly sediments in the vicinity of marine aggregate extraction sites, sampling is aimed principally at assessing the biological and physical impacts of such activities.

Many samplers (e.g. Day grab and Box corer) are unsuitable for use in gravelly sediments as coarse particles of sediment prevent the effective operation of the devices resulting in a loss of sampled material. However, the Hamon grab (Oele, 1978), has proved to be an effective sampler of coarse sediments.

This grab consists of a rectangular frame forming a stable support for a sampling bucket attached to a pivoted arm. On reaching the seabed, tension in the wire is released which activates the grab. Tension in the wire during in-hauling then moves the pivoted arm through a rotation of 90°, driving the sample bucket through the sediment. At the end of its movement, the bucket locates onto an inclined rubber-covered steel plate, sealing it completely.

This procedure deals specifically with the collection of samples, from areas of coarse sediment, for the analysis of the benthic macrofauna and particle size distribution.

2. SAMPLING VESSELS

CEFAS Research Vessels conform to the International Maritime Organisation's '*International management code for the safe operation of ships and prevention of pollution*'. These vessels do not require checks for suitability.

If using a charter vessel, the CEFAS document '*Standing Instructions for the use of Vessels other than Research Vessels in the Directorate's Field Programmes, January 1993*' [currently being updated] should be consulted. For the purposes of grab sampling, the vessel should have a winch with a ≥ 1 tonne capacity, fitted with sufficient wire to extend beyond the sampling depth. The wire should lead from the winch to either a derrick, gantry or 'A' frame which allows the grab to be deployed safely clear of the vessel. The boat should have sufficient deck area to carry out the processing of samples. The vessel should also be fitted with a DGPS satellite positioning system and a deck-wash hose.

3. PERSONNEL

In addition to the skipper and crew, personnel must comprise a minimum of two scientists, at least one of whom is experienced in benthic sampling, according to the procedure described below. One person should also be experienced at operating the winch (normally the skipper or member of the crew of the vessel).

4. SAFETY

Hazards are presented by the improper use of reagents used in the procedure. Survey staff should be familiar with the use of hazardous substances and should be provided with the relevant safety documentation in the form of COSHH and risk assessment forms. Copies should also be provided to the captain or nominated safety officer of the survey vessel.

The working environment on board the sampling vessel also presents a number of hazards. Personnel must have the appropriate training and safety equipment and be aware of the risks associated with working onboard ships at sea.

5. EQUIPMENT

1) 0.1 m² Hamon grab (see Figure 1).

The grab consists of a rectangular frame forming a stable support for an articulated sampling bucket. On reaching the seabed, tension in the wire is released allowing uncoupling of the release hook. This allows the lifting arm to rotate through 90° driving the bucket laterally through the sediment. At the end of its movement, the bucket locates on a rubber-covered steel plate, sealing the bucket mouth completely, and preventing any wash-out of sample material. The device samples an area of 0.1 m² and penetrates up to 15 cm into the seabed.

Lead weights can be attached to the grab, allowing greater penetration of the sediment, and should be adjusted according to the prevailing substratum type.

A larger version of the same device, sampling an area of 0.25 m², is available for use in certain circumstances, but the smaller (0.1 m²) version has now been adopted for general use because of its versatility and ease of handling.

2) Grab stand (see Figure 2).

This metal structure supports the grab before and after sampling. The stand allows enough space beneath the grab for a box to be inserted for sample collection.

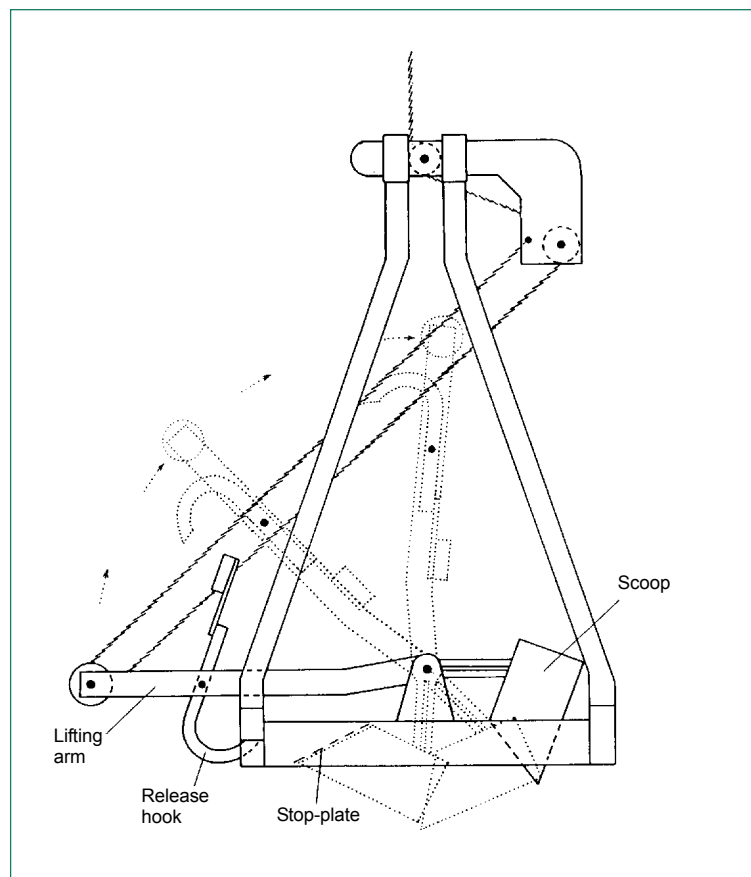


Figure 1 Hamon grab, showing mode of action. The lifting arm rotates through 90° to drive the scoop through the sediment, closing against the stop plate. (Reproduced from Eleftheriou and Holme, 1984)

3) Large 50-70 litre sample containers

Suitable watertight boxes, small enough to be placed under the grab stand but with sufficient capacity to receive the collected sediment and supernatant water without spillage should be used. These containers typically have a capacity of 50-70 l and may be calibrated for determining sediment volume. There should be sufficient containers to allow processing to be carried out at a later stage, if replicate samples are being taken.

4) Sieve table

This device consists of an open-ended box whose interior sides slope towards an outlet pipe (see Figure 3). The interior of the box is coated with epoxy resin that facilitates easy washing and which also prolongs the life of the device. Small blocks mounted on the interior of the box provide support for a removable, square stainless steel frame with a 10 mm or 5 mm square mesh aperture. The entire device is supported on legs that can be adjusted to allow the table to be positioned at a suitable height (normally waist height) for ease of use.

5) Sieve holder

This device consists of an aluminium frame designed to support a circular sieve of 1mm or 0.5 mm square-mesh aperture (30 cm diameter 'Endecotts' Laboratory Test Sieves certified to BS410; (0.5 mm, 1.0 mm and 2.0 mm stainless steel meshes). The sieve holder is supported on the top of an open plastic box, which allows the sieve to be positioned underneath the outlet pipe of the sieve table (see Figure 3). The choice of sieve mesh size will depend on the objectives of the investigation. Sieves should be discarded at the first sign of damage to the mesh.

6) Plastic funnel and stand

A large, wide-bore funnel, the spout of which will fit into the necks of the sample containers, should be used. The stand holds both the funnel and smaller sample containers, minimising the risk of loss of material (see Figure 4). Where larger (e.g. 10 l) buckets are to be used, the funnel may be placed directly inside, for transfer of the sample contents.

7) Sample containers

Sample containers should be spill proof, air tight and strong enough to withstand rough handling during transport and storage. The size of the container will be determined by the size of the sample. Choose from 125 ml, 250 ml, 500 ml, 1000 ml bottles and 2.5 l, 5 l, and 10 l buckets.

8) 500 cm³ plastic scoop

This is used for the collection of aliquots of sediment for subsequent particle size analysis.

9) Waterproof pen and labels

Labels made from water resistant paper are used inside the sample container. Water resistant ('Nalgene® Polypaper') sticky labels should be used for external labels. All labels should be annotated with a permanent marker.

10) Log book

A standard field log should be used. Pencil should be used to record information in the log. The log should be annotated with prompts for all the information required. The following information should be routinely recorded (highlighted information will be recorded on the bridge by the crew on CEFAS research vessels): cruise details, station number and code, **coordinates of sampling position**, survey positional datum, equipment used and any modifications to the equipment (including addition of weights), type of sample taken, mesh size used for sieving, depth or volume of sediment sample obtained, brief description of the sediment including any artefacts, **water depth**, time of sample collection (GMT), size of container(s) used to store preserved samples, any deviation from standard operating procedure, personnel involved, **tide direction and strength**, **wind direction and strength** and **sea state**. On charter vessels it will be necessary to record all of the above information.

11) Surveying software (SEXTANT™)

This is a software package that allows station positions to be accurately recorded at the precise moment of sampling. Positional information is taken from a DGPS receiver interfaced to the computer. The system is particularly useful on large research vessels as it allows any offset between the position of the DGPS receiver and the position of the grab to be taken into account. The software also allows the vessel to be positioned within a set distance of a pre-determined sampling location. On smaller vessels where this system is not available the position of the vessel as indicated by the DGPS should be recorded manually as the sampling position.

12) 500 ml standard laboratory 'wash bottle'

13) Calibrated measuring bucket (minimum 10 litre capacity)

14) 0.75 l plastic boxes for PSA samples

15) Chemical aspirator for the storage of 10% formaldehyde

16) Water hose / deck wash (ideally with variable pressure)

6. REAGENTS

Preservative – 10% formaldehyde solution

Composition: formaldehyde 30%, pH 7.0 (buffered with sodium acetate trihydrate 25g/litre)

– seawater

At CEFAS, buffered 30% formaldehyde solution is stored in 10 litre drums at the Lowestoft Laboratory. A working solution of 10% formaldehyde is prepared by diluting approximately 3-fold with clean seawater.

Formaldehyde is a toxin, a carcinogen and an irritant and should only be handled whilst wearing eye protection, disposable gloves and waterproof clothing. All containers must be clearly labelled. A funnel must be used when transferring the neat chemical from container to container. All samples fixed with formaldehyde must be thoroughly washed under fume extraction before they are handled in the laboratory.

6.1. Preparing dilutions of formaldehyde

At sea, prepare dilutions of formaldehyde on deck, whilst wearing safety glasses, gloves and waterproof clothing. Details on procedures for dilution, storage and transport of the chemical are contained in the relevant Control of Substances Hazardous to Health (COSHH) Risk Assessment (Sea_COSHH_01: Storage of 30% formaldehyde solution, dilution of 30% formaldehyde to 10% and use of 10% formaldehyde for preservation of benthos samples). The aspirator used for the storage of 10% formaldehyde solution should be labelled with the following information: 10% formaldehyde solution, toxic, carcinogen as well as the carrying of Harmful and Flammable adhesive tape labels. The container should also be securely lashed to the deck of the vessel. When working on small vessels it may be advisable to preserve samples on return to the laboratory. The length of time between the collection of samples and returning to the laboratory will determine whether this is feasible.

Sample stain - Rose Bengal

Rose Bengal, a vital stain, may be added to the fixation fluid to enhance the colour contrast between specimens and the sediment, thereby potentially increasing subsequent sorting efficiency.

Rose Bengal is an extremely hazardous carcinogen and, in its powder form, should only be handled under fume extraction. It should therefore be added to the concentrated formaldehyde solution in the laboratory or made up as aqueous solution for use in the field. The final concentration of Rose Bengal should be around 0.1 g l^{-1} .

6.2. Preparation of concentrated Rose Bengal solution

The concentrated solution should be stored in labelled “safe break” Winchester bottles inside plastic carrying containers. Both the Winchester and the plastic container should be suitably labelled. The 1% Rose Bengal solution should be added to the 10% formaldehyde solution in a ratio of 1 cm^3 to 1000 cm^3 to give the required concentration of Rose Bengal (approximately 0.01%).

6.3. Use of Rose Bengal in the field

Measure out the required volume of concentrated Rose Bengal solution (0.01%) using a measuring cylinder. Add this solution to the aspirator containing the 10% buffered formaldehyde. Ensure the solutions are well mixed. This procedure should be carried out in a well ventilated area whilst wearing safety glasses, disposable gloves and waterproof clothing.

7. PROCEDURE

7.1. Pre-survey checks

At the laboratory, all items required for field survey work, including disposables, should be checked against the equipment list and inspected for damage (e.g. damaged sieve meshes). Replace or repair damaged items as necessary. Once on board the survey vessel ensure all equipment is present and safely stowed.

8. PREPARATION OF EQUIPMENT

Position the grab and stand beneath the derrick or gantry and attach the wire of the Hamon grab to the winch wire from the survey vessel using a shackle and swivel. Check that the weights are securely fastened.

Set the Hamon grab by pulling the lifting arm down from the vertical position allowing the release hook to engage (see Figure 1).

Wash the grab thoroughly with the deck hose prior to deployment.

Place a clean, large plastic box under the grab stand hopper.

9. DEPLOYMENT AND RECOVERY

When the boat is stationary and the skipper has given permission, the grab is deployed, typically at a rate of approximately 1 ms^{-1} . As the grab approaches the seabed the wire should be released more slowly to avoid the creation of a 'bow wave' which could wash away surface material. Once the Hamon grab has reached the seabed, slackening of the winch wire provides a signal to stop the winch. The grab should then be raised, initially very slowly to maximise sampling efficiency. When the grab reaches the surface it should be stabilised and then swung on-board, as soon as possible, as the device presents a danger on a rolling vessel. The grab is then lowered gently onto the supporting frame. Enough winch cable should be released to enable the lifting arm (and grab contents) to be released.

In rough seas, the vessel should be orientated 'head to wind' thus minimising roll and reducing the risk of loss of control of the grab during deployment and recovery. An inhauler should be used to facilitate safe retrieval. This device consists of a rope attached to a winch



Figure 2 Hamon grab primed and ready for deployment. Note the winch controlled lateral supporting rope for increased stability and therefore safety during deployment and recovery. It is unhooked before the descent of the sampler

which is then attached to the grab by means of a hook (see Figure 2 for set-up). As the grab is lifted above the rail of the vessel, the inhauler is used to pull the grab on board.

10. COLLECTION OF SAMPLES

Should the bucket of the grab fail to engage fully with the stop plate (e.g. as a result of a stone obstructing closure), resulting in the loss of sample material, the contents should be discarded and the grab re-deployed.

Slowly release the sediment into the sample container by pulling down the lifting arm to the horizontal position. The container should be moved in synchrony with the grab bucket. Any material remaining in the grab should be carefully washed into the container.

The volume of the sample should be measured by transferring it into a calibrated bucket. This action should be carried out over the sieving table so that any water within the sample is not lost. Samples with a volume of less than 5 litres of sediment are discarded and a repeat sample taken. At least three attempts should be made at each sampling station before abandonment of sampling at the station position. At the discretion of the Scientist-in-Charge a smaller sample may be accepted if there is some merit in obtaining indicative (e.g. qualitative) information from a location. Alternatively, further attempts can be made at increasing distance (typically 50-100 m intervals) from the original site. Again this will be at the discretion of the Scientist-in-Charge.

Once an acceptable sample has been obtained, the volume of sediment and the nature of the material should be recorded in the log book (e.g. 'gravel', 'sandy gravel'). In describing the nature of sediments, the component making up the smallest fraction of the sample should be described first. For example, sediment composed of mainly fine sand with a little gravel would be described as 'slightly gravelly fine sand'.

10.1. Particle size analysis

Using the plastic scoop, transfer a representative sub-sample of 500 ml of sediment to a sealable plastic bag which should then be placed inside a 0.75 l plastic box. Add labels (see Section 13) and freeze the samples.

11. SIEVING THE SAMPLE USING A PURPOSE-BUILT SIEVING TABLE

After measuring the volume of the sample the sediment should be washed, using gentle hose pressure, whilst still in the calibrated sample container. This should be conducted over the sieving table and the appropriate meshes and sieves should be in place. This will allow many of the lighter organisms to be released from the sediment with the minimum amount of damage to specimens. Allow the supernatant water, containing any fine sediments and benthic organisms, to overflow from the sample container and pass through the 5 mm sieve. The remaining sediment should then be gently washed over the 5 mm removable square mesh screen. Larger individual animals retained on the 5 mm mesh and all encrusting fauna present on shell and gravel are removed and transferred to plastic bottles or buckets (depending on the size of the sample). Any sediment remaining on the 5 mm screen (with no attached concealed fauna) may be discarded. The nature of the coarse material,

including the presence of any artefacts, should be recorded in the log. If any material is lost a repeat sample should be taken.

The material passing through the 5 mm mesh is sieved over a stainless steel sieve with either 1 mm or 0.5 mm precision steel mesh screens, the choice depending on the objectives of the investigation. This sieve is held within a sieve holder beneath the outlet pipe of the sieving table. Temporary blockage of fine meshes can occur and care should be taken to ensure that there is no loss of animals as a result of overflow. Periodically, the sieve should be removed from beneath the outlet pipe, and replaced by another. Accumulations of fine sediment on the mesh screen can usually be removed by gentle ‘puddling’ in a large plastic container filled with seawater (using a vertical motion as horizontal motion can cause animals to be damaged through abrasion).

12. SAMPLE PRESERVATION

On completion of the sieving process, retained animals and residual sediment on the mesh screens are transferred to plastic bottles via a large funnel in a frame support (Figure 3). The stainless steel sieve should be supported at about 45°, and rinsed using a hose under gentle water pressure from top to bottom. This whole process should be carried out within a large plastic container so that any accidental spillages can be contained and rinsed back onto the sieve. If the water pressure from the hose is too high and cannot be adjusted, a 500 ml wash bottle should be used. Any material trapped within the mesh of the sieve should be carefully removed using forceps. A scoop should not be used to remove material from the sieve as this may cause damage to specimens.

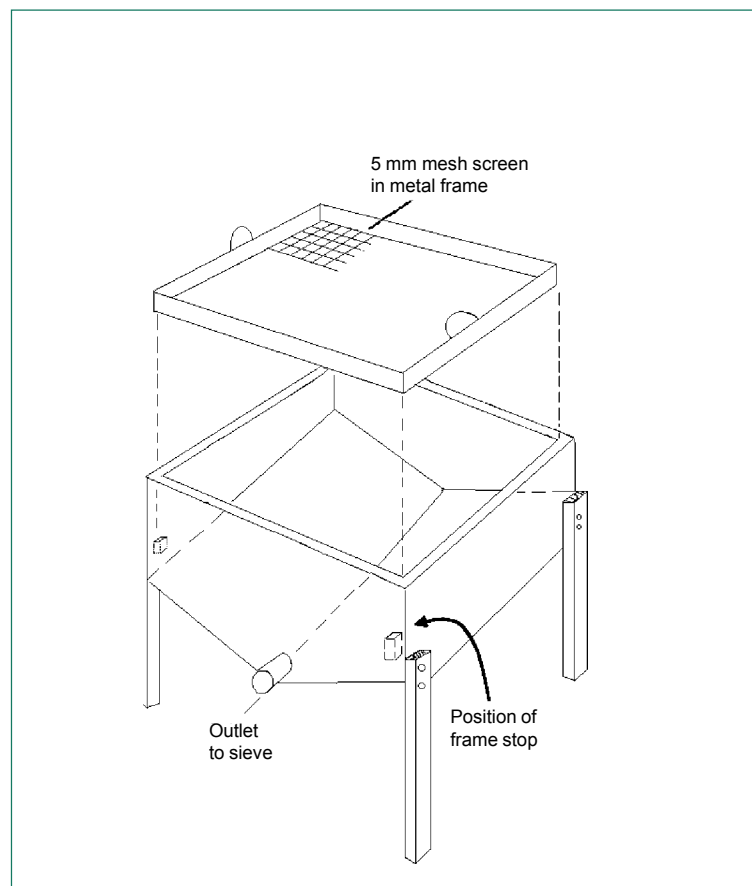


Figure 3 **Sieving table used for the processing of grab samples**

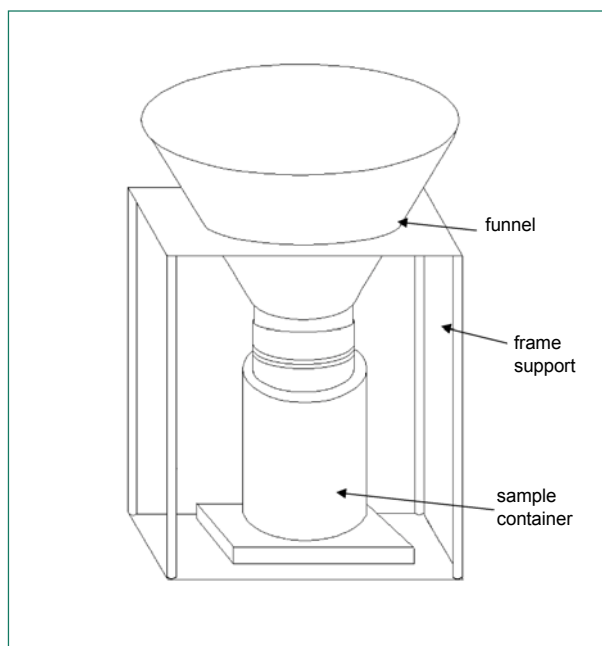


Figure 4 Funnel in frame support

The 10% formaldehyde preservative solution, with or without added Rose Bengal (see Reagents), should be added to fresh samples with the aim of achieving a final concentration of 5% of formaldehyde in the sample; i.e. add approximately the same volume of the 10% formaldehyde solution as the volume of fresh sample (including any liquid).

13. SAMPLE LABELLING

An adhesive label should be attached to the outside surfaces of the sample container and an internal waterproof label inserted (so that any damage to the external label does not prevent the later identification of the sample). Polythene bags for sediment sub-samples should be labelled directly onto the panel of the bag, prior to use. The plastic boxes used for subsequent storage of PSA samples should also be directly labelled. All labels should contain the following information:

- Research cruise number or code (e.g. prefix - vessel name: Cir – Cirolana, Cor – Corystes followed by cruise number/year)
- Date
- Station number and code (stations are numbered sequentially from the start of a cruise).
- the type of sample (e.g. macrofauna, PSA etc)
- Survey area

14. SAMPLE STORAGE AND TRACKING PROCEDURE

Details of the samples taken are recorded in the cruise log book. This acts as the sample record. On completion of the cruise this should be signed and dated by the Scientist-in-Charge. On return to the laboratory, samples and log book data should be dealt with in accordance with the storage and sample tracking procedure (FET 004).

15. QUALITY CONTROL

Check operation of position-fixing equipment, winch and deck-wash prior to departure.

Check the condition of the sampling equipment (particularly sieves and large volume sample containers) and replace as necessary.

Comply with the criteria for sample rejection.

16. ANALYTICAL PROCEDURES

For analysis of macrobenthic samples see Procedure FET 003.

For analysis of sediment particle size, refer to the appropriate SOPs.

17. REFERENCES

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Oele, E., 1978. Sand and gravel from shallow seas. *Geologie en Mijnbouw*, 57: 45-54.

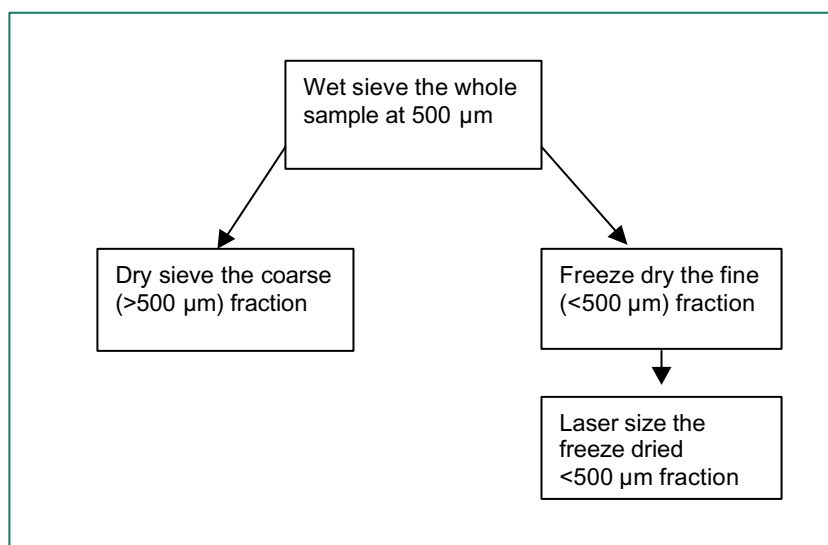
ANNEX III

An example of an SOP for the laboratory particle size analysis (PSA) of samples collected from coarse substrata

	Procedure No.
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	Issue no. 2
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BENTHOS QUALITY MANUAL	Issued by:
TITLE OF PROCEDURE	Authorised by:
An example of an SOP for the laboratory particle size analysis of coarse substrata	

INTRODUCTION

The SOP outlined here is one example of many possible SOPs available for the PSA of coarse substrata.



Flow chart showing the breakdown of the main processes involved in completing this type of PSA

1. WET SIEVING AT 500 μm

Check that all sieving equipment is clean, in working order, and that sufficient stocks of consumables (bags, labels, foil trays etc.) are available. If necessary, remove a sub-sample from the whole sample prior to analysis. Prepare the sieving apparatus by placing a clean bucket in the sink with the closed off drain tap lying in it, and mounting a clean 500 μm sieve with receiving pan onto the sieve shaker.

Place the sample onto the 500 μm sieve and screw down the lid.

Pour sufficient tap water through the hole in the shaker lid to cover the sample and then insert the rubber bung into the hole to prevent leakage during operation.

Adjust the amplitude of vibration to a level high enough for water to splash onto the lid of the sieve shaker. Set the timer dial to ten minutes and begin the sieving process.

Label a clean plastic bucket lid (for the resultant <500 μm fraction) and a foil tray (>500 μm coarse fraction). After ten minutes of sieving, open the drain tap and allow the fine material (<500 μm) to run into the plastic bucket. Close the drain tap and add more tap water to the sample (following instructions above). Sieve for a further five minutes. Drain off the water again, and repeat this step until the water in the top of the sieve, and the water being drained, is clear. Remove the lid of the sieve shaker, and, using a washbottle, wash any sediment from the lid of the sieve shaker onto the sieve. Remove the sieve, and use a washbottle to wash any sediment from the retaining pan into the bucket. Cover the bucket and leave to settle.

Using a clean plastic scoop, remove the bulk of the material retained on the sieve into the foil tray, and wash the remainder out with tap water from a washbottle. Place the foil tray into an oven at $80^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for at least twelve hours. Clean the sieving apparatus in preparation for the next sample by washing water through the retaining pan and tubing. Wherever possible, avoid interruptions whilst wet sieving a sample. Where interruptions are unavoidable, finish the processing of the current sample before leaving the laboratory for more than one hour.

2. DRY SIEVE ANALYSIS OF THE >500 μm COARSE FRACTION

Remove the coarse fraction from the laboratory oven and allow to cool to room temperature.

Sediment samples are dry sieved using stainless steel laboratory test sieves, with mesh sizes at $\frac{1}{2}$ phi intervals. The coarsest sieve used should be larger than the largest particle in the sample. The finest sieve has a mesh size of 500 μm (+ 4 phi), followed by a collecting pan. The dry sieve shaker can accommodate a stack of up to 12 standard height sieves, plus the collecting pan and lid. Given the wide range of particle sizes encountered when analysing aggregate samples it is frequently necessary to use two stacks of sieves, the coarse stack ranging from 2.8 mm upwards, and the fine stack from 2.8 mm to 500 μm . If both stacks are to be used for one sample, the samples should be sieved through the coarse stack first. The sample retained in the collecting pan from this first process should then be sieved through the fine stack.

Prepare the sieves by ensuring firstly that they are clean. If particles are visible either on, or trapped within the mesh of the sieves, brush them using a nylon sieve brush (a hard bristle for the coarse sieves and a soft bristle for the finer sieves i.e. 90 μm and less). Stack sieves in phi class order (coarsest at the top), including a lid and collecting pan for every stack used. Pour the sample from the foil tray into the top of the selected stack of sieves. Ensure that no sample remains in the foil tray by gently tapping and brushing it onto the sieve. Place the lid onto the stack. Place the sieve stack into the sieve shaker, and clamp the retaining plate down. Switch the shaker on by turning the timer to ten minutes, then close the door to the sound proofed cabinet. After ten minutes the shaker will switch itself off, and the sieve stack can be removed.

Place a clean foil tray onto a top-pan balance and tare it. Remove the lid of the stack, then remove the coarsest sieve. Carefully pour the contents of the sieve into the foil tray, brushing any residual sediment into the tray using a clean sieve brush. Record the weight to 0.01 g on a data sheet. Weigh each successive sieve in the same way. If the coarse stack of sieves is being used, the contents of the collecting pan should be poured into the top of the fine stack of sieves and sieved as above. If the fine stack is being used, the contents of the collecting pan should be weighed and recorded. Place the sieved sample into a labelled sealable plastic bag. Ensure that the sieves are clean, then re-stack them and load another sample.

3. FREEZE DRYING OF THE <500 μm FINE FRACTION IN PREPARATION FOR LASER SIZING

Remove the majority of the supernatant from the plastic bucket using a tap fitted filter pump valve system. Take care not to disturb or remove any sediment during this process. Pour the remaining contents of the bucket into a labelled plastic petri-dish (or dishes if necessary), washing any remaining sediment from the bucket using a washbottle containing tap water. Place the lid on the dish and place into a freezer at -10°C until the sample has frozen solid.

When the samples are frozen, switch on the freeze dryer. Close the chamber door and allow the temperature to drop to between -40° and -60°C . Take the samples from the freezer, remove the lids and place them under the base of each petri dish. Place the samples onto the shelves of the freeze dryer as quickly as possible to prevent them from thawing. Cover the samples with the plastic bell-housing, close the drain tap and switch on the vacuum pump. Apply pressure to the chamber door to ensure that a vacuum is created. The samples may take upto 5 days to dry. Observation of the underside of the petri-dishes will usually reveal whether all of the ice has been removed. A dark patch is evidence that some ice remains, and that freeze drying is not yet complete.

When the samples are dry, switch off the vacuum pump, and gradually open the drain tap to release pressure. Once the pressure has equalised, the drain tap may be fully opened, and the bell housing removed. Remove the samples from the freeze dryer and replace the lids. Allow the freeze dryer to defrost. Transfer the sample from the petri-dish to a tared, labelled, sealable plastic bag. Weigh the sediment and the bag to 0.01 g on a top pan-balance. Record this weight on the bag.

4. LASER SIZER ANALYSIS OF THE <500 μm FINE FRACTION USING THE COULTER™ LS130 LASER SIZER

The Coulter™ LS 130 Laser sizer is capable of analysing sediments with a particle size of up to 900 μm , although it is more routinely used for the analysis of particles up to 500 μm in diameter. Analysis is carried out by a series of measurements of the angle of diffraction of a laser across sediment particles. Actual analysis of one sample takes approximately 90 seconds, although the full cycle of rinse and calibration takes around 6 minutes.

It is important that the laser sizer is NOT switched off (except for emergencies) as warm-up takes up to 4 hours. The laser sizer is operated via a PC running Coulter™ LS software. The laser sizer computer should be kept on. If it is switched off, turn on the PC and double click on the LS icon to open the software.

It is important that the laser sizer is rinsed at the start of each day in order that any material which may have settled is removed. This procedure should be carried out as follows. From the menu bar, select Control, then Rinse. The water in the sample vessel should begin to flush up and down. If the vessel empties completely use blue roll to dry the metal sensors in the sample vessel.

After approximately 2 minutes, click Cancel in the fluid module box. The sample vessel should automatically fill. Check that the water in the vessel is clean. If particles are visible, repeat the rinse, as above.

The appropriate quality control should be run prior to any samples being analysed. The Coulter™ control samples should be run on the first day of the week that the laser sizer is used. On each day that the laser sizer is used a test sand sample should be run. The results should be checked to ensure the samples are within acceptable limits.

The procedure for running a sample is as follows.

From the menu, select Run, then Cycle. Click on the New Sample button. Accept the defaults for rinse, calibration etc. Click on Start. The machine will run a series of measurements for offsets, alignment and background. Once Obscuration:PIDS is reached, observe the percentages gradually decreasing as the machine rinses. The two numbers should read around zero percent before the sample can be added. If this looks unlikely, it may be that a full manual rinse needs to be carried out.

Weigh out ~1.5 g of the sample into a 50 ml glass beaker. Add 40 ml of 0.1% sodium hexametaphosphate. Place the beaker in an ultrasonic bath and sonicate for 10 minutes. Add a magnetic stirring rod and stir the sample at a speed that ensures all the sample is mobilised (i.e. none of it is settling in the bottom of the beaker).

When Obscuration and PIDS are at around zero percent, add sample using a pipette as described. While the sample is mobilised take a subsample using a pipette. This should be done with care to ensure a representative sample is taken. Place the end of the pipette at the bottom of the beaker and raise it diagonally through the liquid at a steady rate to remove a subsample. Drop the subsample into the laser sizer sample vessel. Ensure that the pipette is shaken in a downward motion to get a fair representation of each subsample into the sample vessel. Repeat pipetting until the laser sizer indicates that sufficient sample has been added, and that the obscuration level is at around 45%. Click on Done. A sample details dialogue box will appear.

Complete the sample details as appropriate. In the comment box, insert details such as the fraction size and also the sediment weight.

Click OK. A run information box appears. Check that the default run length is 90 seconds, and that the optical model is Fraunhofer and that PIDS is included. Select OK. The sample will now run for 90 seconds. Following this, the screen displays a histogram of particle size distribution, which prints automatically. Close the graph by double clicking in the top left hand corner.

At the end of the day, it is important that the laser sizer is cleaned by running a manual rinse (see above). Because the laser sizer is not switched off, it is essential that the pump is not left running. On the PC, select Control from the menu, then Pump Off. Switch off the pump at the plug.

Development Department



Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

IPC

27 SEP 2010

Ref: P/10/01659/CON

REF:

Our Ref: P/10/01659/CON (ACK8)

Your Ref:

Date: 23rd September 2010

Dear Sir / Madam

REFERENCE: P/10/01659/CON (Please quote in all communication)
LOCATION: Zone 6 Round 3 Off The South Coast (Brighton Area) Out Of The Borough And Miscellaneous Reigate Surrey
DESCRIPTION: Consultation on the request for a scoping opinion, under the provisions of the Environmental Impact Assessment Regulations 2009, for an offshore wind farm and the associated infrastructure that may affect the Borough of Reigate and Banstead BC.

Thank you for sending me details of the above application. This matter was registered on 20th September 2010 under the above application number.

The Council's comments on the application are currently due to be determined by the Head of Building & Development Services. Consultations that are referred to Planning Committee, and which meet the required criteria, will be eligible for public speaking. If this happens, the applicant will be offered a right of reply. More information regarding this can be obtained from the Council's web site www.reigate-banstead.gov.uk or by telephoning the Council's Help Line on 01737 276000.

Please address any communication or enquiries to the case officer, whose details appear at the foot of this page.

Yours faithfully

Mark Harbottle

for Head of Building and Development Services



INVESTOR IN PEOPLE

Contact: Darren Williams
Direct Line: 01737 276172
Fax No: 01737 276018
Email: Darren.Williams@reigate-banstead.gov.uk

Town Hall, Castlefield Road
Reigate, Surrey RH2 0SH

Helpline 01737 276000
DX54102 - Reigate 2
www.reigate-banstead.gov.uk

From: [Peter Davies](#)
To: [IPC Scoping Opinion;](#)
Subject: Rampion Offshore Wind Farm - Your Ref EN010032_243108
Date: 07 October 2010 09:14:13

Dear David

Thank you for the opportunity to view the Scoping and Screening Documents for the proposed Rampion Offshore Wind Farm by E. ON.

The documents are very comprehensive and the Port Authority has no comments to make.

Please can you make me your contact point at Shoreham Port Authority for any future correspondence and send it to our new head quarters – see address below.

Kind Regards

Peter

Peter Davies
Development Director
[Shoreham Port Authority](#)

Nautilus House
90-100 Albion Street
Southwick
Brighton
BN42 4ED

tel: +44 (0) 1273 598127
mobile: +44 (0) 7785 295992
website: www.shoreham-port.co.uk

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From: somptingclerk@tiscali.co.uk
To: [IPC Scoping Opinion;](#)
Subject: Proposed offshore wind farm, west sussex
Date: 27 September 2010 12:03:22

Dear Sirs

Your ref 140910_ENO10032_243108

Thank you for consulting Sompting Parish Council on the above project.
The Council has considered your letter and ask that the impact on using the A27 and / or A259 for construction and operational use be considered in the environmental statement.

Yours faithfully

D Porter
Clerk

David Porter
Parish Clerk and Responsible Finance Officer
Sompting Parish Council
71 St Thomas's Road, Worthing BN14 7JN
Tel: 07813484857
Email: somptingclerk@tiscali.co.uk
Website: www.sompting.org.uk

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I P C

11 OCT 2010

REF:



FAO OWAIN GEORGE
Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

National Park Planning Team
Victorian Barn
Victorian Business Centre
Ford Lane
Ford, Nr Arundel
West Sussex, BN18 0EF

Ref:MS/rampion
Date: 8th October 2010

Dear Sir,

**Proposed Rampion Offshore Wind Farm
E.ON Climate and Renewables
Infrastructure Planning (Environmental Impact Assessment) Regulations 2009**

Thank you for your letter of 14th September 2010 re the above.

The site of this proposed wind farm lies off the coast of Sussex. The boundary of the South Downs National Park extends to the coast to the east of Brighton, at Telscombe Cliffs and between Seaford and Eastbourne, a stretch of coastline defined as Heritage Coast. The main concern for the National Park Authority would therefore be the potential visual impact of the proposed windfarm from these stretches of coastline and from the higher ground of the Downs near the Coast. The EIA should therefore include a seascape/visual impact assessment.

The Seven Sisters Voluntary Marine Conservation Area lies to the west of the proposed windfarm, and the EIA should include an assessment of ecological impacts, including any on the VMCA.

The landfall of the power line from the proposed windfarm would be somewhere in the vicinity of Shoreham, from where it would head north through the National Park towards the existing 440kv line at Bolney. I do not know if this element of the scheme also falls within the scope of the EIA, but if so, then the impact of this line on landscape, archaeology and ecology should also be considered.

Thank you.

Yours faithfully,

A handwritten signature in blue ink that reads "Martin Small".

Martin Small
Interim Planning and Policy Manager
South Downs National Park Planning Team

Tel: 01243 55870
e-mail: msmall@southdowns-aonb.gov.uk

Interim South Downs National Park Authority
Interim Chief Executive: Richard Shaw
Email: info@southdowns.gov.uk
Tel: 01730 817285

From: [Jane Griffin](#)
To: [IPC Scoping Opinion](#);
cc: [Emma Crickmay](#); [Jaki Jay](#); [Nick Woolfenden](#);
Subject: Proposed Rampion offshore wind farm FAO Owain George
Date: 29 September 2010 15:14:25

Thank you for consulting SEEDA on this scoping opinion.

I have only looked at the section on socio economic impacts which is very short and is not likely in its present form to cover the full range of impacts which need to be assessed.

Can I suggest the following should be included?

- Number of direct jobs to be created permanent and temporary (i.e. construction)
- Number of indirect jobs to be created (through the supply chain)
- Opportunities for local businesses
- Analysis of local skills and assessment of training needs.
- Economic impact on local economy – possible increase in GVA? – this impact could be significant on economically depressed areas such as Newhaven

Kind regards

Jane Griffin

Jane Griffin
Planning and Infrastructure Policy Manager

SEEDA
Cross Lanes
Guildford
GU1 1YA

01483 470197

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As a public authority, please note that all documentation held by SEEDA is subject to the Freedom of Information Act 2000.

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From: [McKeown, Mike](#)
To: [IPC Scoping Opinion;](#)
Subject: Proposed Rampion Offshore Wind Farm
Date: 07 October 2010 10:49:01

FAO Owain George

Thank you for your letter dated 14th September 2010, regarding the PROPOSED RAMPION OFFSHORE WIND FARM (the Project) E. ON CLIMATE AND RENEWABLES (the Applicant) INFRASTRUCTURE PLANNING REGULATIONS 2009 SI 2263.

I can confirm that Southern Water is the statutory wastewater undertaker in the South East of England. Our only interest in this development is in relation to our long sea outfalls, unfortunately we could not access the pdf referred to in your letter. We suspect that the development will be so far offshore to leave these outfalls unaffected in operation, though obviously we will have concerns over any impact on our marine infrastructure during project construction.

For information, our 'Cleaner Seas for Sussex' outfall Friars Bay LSO which serves the Peacehaven WTW is at NGR 541710 098040N and we would expect that construction activities and final configurations are designed to ensure no adverse affect on dispersal of effluent from our outfalls.

Otherwise we have no comment to make

Regards

Mike McKeown
Wastewater Strategy Manager
01903 272330
07899 878264

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Without prejudice to the above prohibition on unauthorised copying and

Contact: Dr Jessica Salder
Tel: 020 8541 7109

Location: Room 398
E-mail: jessica.salder@surreycc.gov.uk



Mr Owain George
Infrastructure Planning Commission
Temple Quay House
Temple Quay
Bristol
BS1 6PN

IPC
20 SEP 2010
REF: _____

The Environment Service
County Hall
Kingston upon Thames
Surrey KT1 2DY

16th September 2010

Dear Mr George,

EIA Scoping Opinion Consultation on the Proposed Rampion Offshore Wind Farm
Your Reference: 140910_EN010032_243108

Thank you for consulting Surrey County Council with respect to the EIA scoping opinion that the Commission has been asked to provide for the proposed Rampion Offshore Wind Farm.

Please be advised that Surrey County Council has no comments to make on the proposed scope of the EIA for the scheme as outlined in the prospective applicant's Scoping Report, as the onshore and offshore areas that would be affected by the proposal are not located within or immediately adjacent to the boundaries of Surrey.

Yours sincerely

Dr Jessica Salder
Senior Environmental Assessment Officer

From: John.Cartwright@sussex.pnn.police.uk
To: [IPC Scoping Opinion;](#)
Subject: Rampion Offshore Wind Farm - Ref: 140910_EN010032_243108
Date: 28 September 2010 08:49:36

Dear Sir/Madam,

Thank you for your letter to the Chief Constable of Sussex Police, dated 14 Sep 10, regarding the proposed Rampion offshore wind farm. I have been asked to respond on behalf of the Chief Constable.

Sussex Police has reviewed the proposal and documentation and has no comment.

Yours sincerely,

John Cartwright
Head of Facilities

Facilities Department, Sussex Police HQ, Lewes, BN7 2DZ
Tel: 01273 404013 Ext. 44059 Mob: 07771 833086

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From: [Navigation Directorate](#)
To: [IPC Scoping Opinion;](#)
Subject: Your ref 140910_EN010032_243108 Rampion Offshore Wind Farm
Date: 12 October 2010 10:02:04

FAO Owain George

Your ref:- 140910_EN010032_243108

Our ref:- OWF/SC/10

Dear Owain

Response by Trinity House to the request for comments on the EIA Scoping for the proposed Rampion Offshore Wind Farm.

I refer to the letter of 14 September from David Price under the above reference seeking comments on the Environmental Scoping Report dated September 2010 submitted by RSK Group PLC on behalf of E.ON Climate and Renewables UK Rampion Offshore Wind Limited for the proposed Rampion (Round 3) Offshore Wind Farm off the Sussex coast.

Trinity House is the General Lighthouse Authority for England & Wales with responsibilities for advising the appropriate consenting / licensing authorities how developments in the offshore marine environment should be required to be specifically marked as a risk mitigation measure in the interests of safety of navigation and in accordance with the international system of marine navigational marking. Our particular interest is therefore concerned with the interaction between the development (during construction, operation, decommissioning and removal if thereafter any obstruction remains which is considered at the time to be a danger to navigation) and all types of shipping (including commercial, commercial fishing and leisure).

We concur with the need for the further navigation studies identified in the scoping report, including those required to satisfy the requirements of the Maritime and Coastguard Agency Marine Guidance Note 371 (MGN 371). In particular the need for the survey of all the vessel traffic in the vicinity of the site over a 4 week period (taking account of seasonal variations) to further inform future discussions and decisions regarding the exact boundary of the site and the orientation and layout of structures within it as a means of mitigating the risk.

We look forward to the further discussions envisaged with the developer during the environmental impact assessment regarding the layout of structures within the proposed wind farm and the requirements for marine navigational marking during construction and operation. The marking that we will specify as being necessary will generally be in accordance with the requirements of the IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) Recommendation O-139 (section 2.4) on the Marking of Man-made Offshore Structures. This may necessitate the provision and maintenance thereafter by the developer / operator of aids to navigation (such as lighted buoys) to mark the boundary of the site (or parts of it) in addition to obstruction marking on (some of) the structures themselves.

It is also considered that the environmental impact assessment should also briefly address the environmental impacts of decommissioning, removal, and any residual impacts post decommissioning in so far as it is realistically possible at this time. This should include in particular an acknowledgement by the developer of the necessity to provide and maintain any navigational marking that may be required of obstructions attributable to the construction, operation or removal of the wind farm that remain on completion of decommissioning and removal if such obstructions are considered at the time to be a danger to navigation. It is however appreciated that a full decommissioning plan is not necessarily required prior to consent.

I hope that these comments are useful at this stage.

Regards

John Cannon
Navigation Services Officer
Trinity House.

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12/10/10

**WEST SUSSEX COUNTY COUNCIL
LOCAL DEVELOPMENT SERVICES CONSULTATION**

FROM: Don Baker

TO: IPC/Keith Morgan

SCOPING OPINION

PROPOSAL: Proposed Rampion off-shore windfarm by Eon

SITE: Rampion off-shore windfarm (Eon), 8-15 miles off the coast, stretching 17 miles from, Worthing, to Newhaven

RECOMMENDATION:

Advice	☒	Modification	☐	More Information	☐
Objection	☐	No Objection	☒	Refusal	☐

This response collates the opinions from Landscape, Archaeological, Ecological, Highway and Environmental Resource specialists.

In addition to the comments and recommendations below and given the potentially significant impact on the West Sussex environment it is strongly recommended that pre-application consultation is undertaken with WSCC to avoid possible difficulties later.

Landscape

1. Good to see that the WSCC Landscape Character Analysis is listed, as is the Sussex Historic Landscape Character Analysis.
2. The Mid-Sussex Landscape Capacity Study 2007 by Hankinson Duckett Associates may also be of value as reference but only part of the route is surveyed.
3. Need to establish the 'Planting restrictions in close proximity to the Cable route' This will clearly have an impact on restoration possibilities and needs to be identified early on in the process.
4. Management proposals for the restoration works - how is this going to be addressed? Will there be a Management Plan, or will it be left to the landowner? How will establishment and remedial work be monitored? It is a potentially large tract of complex land.
5. Assessment of any long term impacts following route identification -
 - Potential loss of historic field boundaries, mature trees and restrictions on the long term reinstatement.
 - Any permanent access arrangements for maintenance (entrances and tracks)
 - Particular long-term maintenance requirements given the unknown planting restrictions around the cable route (ie what clearance will be maintained?)
 - Signage, security fencing and any other safety/ management fixtures.

6. Any possible long term opportunities for landscape restoration in accordance with the WSCC Land Management Guidelines to offset losses which may be experienced as the result of above.

Environmental Resources

Environmental Resource Team are happy with the policy and strategic sections. The big question is how they are going to fit in with the Marine Conservation Zones but as they are at an advanced stage to the MCZs will the MCZs will fit around them rather than vice versa?

The scoping doc covers all the areas expected and so we look forward to seeing the results of the shoreline modelling and full SEA.

Archaeology

The Scoping Report is concise and its onshore methodology broadly acceptable. In addition to the stated methodology, it should address the potential impact of the onshore works on the *settings* of designated historic assets, such as Scheduled Ancient Monuments and Listed Buildings, and nationally important but undesignated historic assets. It is accepted in principle that these impacts in large part would be temporary, because the cables' working width will be reinstated.

Regarding para. 6.6.3.1 (desk-based assessment), inspection of relevant aerial photographs should include the National Monuments Record's aerial photograph collections covering the proposed cable routes, and should include data reported upon in English Heritage's National Mapping Programme report - *The South Downs NMP Pilot Area 1 - Worthing to the Weald* (2008), which includes detailed mapping of aerial photographs for the southern part of the cable corridor. The report is available for download online at : http://services.english-heritage.org.uk/ResearchReportsPdfs/011_2008WEB.pdf

Also in respect of para. 6.6.3.1, the desk-based assessment should consider the potential impacts of onshore works upon geoarchaeological deposits, i.e. the Sussex coastal plain sequence of Pleistocene Raised Beach deposits and Sussex Weald river terrace deposits, which are known in some instances to contain significant early prehistoric flint artefacts and associated faunal remains; and dry valley and alluviated river valley deposits, both of which may contain ancient artefacts and associated palaeoenvironmental material (e.g. microfossils and pollen that can provide information on the changing local ancient environment of human occupation sites). In this respect one of the several specialist geoarchaeologists with detailed knowledge of the Sussex Raised Beach and wealden river terrace sequences should be consulted.

Finally in respect of para. 6.6.3.1, for the sections of the cable routes that run through the Sussex Weald, i.e. north of the South Downs, where aerial photography shows little, and where there has been much less previous archaeological survey and observation than on the Downs and coastal plain, available relevant high-resolution LiDAR aerial photography (principal holdings with the Environment Agency) should be obtained and inspected, with advice on interpretation of the aerial LiDAR photography from a nationally recognised archaeological LiDAR specialist, such as the Forestry Commission's LiDAR officer.

The proposal for consultation (6.6.3.4) is welcomed, in respect of intended consultation of West Sussex County Council's archaeological officer at the outset of the project, to determine that the scope of (archaeological assessment) work is acceptable for the purposes of the ES, and for the County Council's views on recommendations for further assessment and/or mitigation.

Highways

Whilst the site is situated some distance off shore, there will still be some impact upon the highway network during the construction phase. Traffic generation in broad capacity terms is

likely to be insignificant with there being relatively few movements and these only temporary in nature. As necessary, consideration will need to be given to the location of on-shore construction compounds and stores of materials, and consequently routes to these, particularly in terms of HGV access. Abnormal loads would be subject to the currently applied procedures adopted by WSCC with the haulier required to give notice. If works are required within the public highway, the Applicants would be required to obtain the appropriate consents. It would seem appropriate as part of any planning application for information to be included relating to traffic generation, vehicle routing and other temporary/accommodation works that may be necessary within the limits of the public highway. Given the scale of the works, it is likely for the on-shore works to affect other neighbouring Highway Authorities as well as potentially the Highways Agency, and as such the requirements of these should also be sought and addressed through any planning submission.

Ecology

Subject to the recommendations below there is no objection to the EIA proceeding as described.

There are four marine SNCIs in close proximity:

- Looe Gate at TQ273009
- South West Rocks at TQ262009
- Worthing Lumps at TV123857
- HMS Northcoates at SZ996857

A significantly sized cable corridor is proposed requiring a trench up to 40m wide stretching from the coast to Bolney c20km. The corridor polygon as shown in the scoping report contains a large number of ecologically sensitive areas. Unfortunately, route options are not indicated.

With reference to fig 6.4 the ancient woodland data used for the scoping report appears out of date. Following the 2010 review of the ancient woodland resource many more have been identified. Please be aware that there are two ancient woodlands to the north and south of the Bolney substation. WSCC has recently updated and added to the West Sussex SNCI list.

A trench and permanent easement through ancient woodland and some types of SNCI will be resisted (ref: PPS9 and local policy). The trench and easement will be expected to accord with BS5837:2005.

Ecological Recommendations

1. Contact Sussex Biodiversity Record Centre to obtain accurate and up to date sites' data particularly for ancient woodland and SNCIs.
2. All survey data current and historical to be appended to the Environmental Statement.
3. A clear graphic indication of the cable route options being considered.
4. Details of all methodologies, mitigation and avoidance measures that will minimise ecological damage onshore and offshore.
5. A clear indication that all opportunities to provide ecological enhancement have been taken.
6. All communication with the Environment Agency and Natural England to be appended.
7. A clear description of how the easement for the cable will look and be expected to be maintained.

APPENDIX 3

PRESENTATION OF ENVIRONMENTAL STATEMENT

APPENDIX 3

PRESENTATION OF THE ENVIRONMENTAL STATEMENT

An environmental statement is described under the EIA Regs as a statement:

- ‘(a) that includes such of the information referred to in Part 1 of Schedule 4 as is reasonably required to assess the environmental effects of the development and of any associated development and which the applicant can, having regard in particular to current knowledge and methods of assessment, reasonably be required to compile; but
- (b) that includes at least the information required in Part 2 of Schedule 4’.

(EIA Regs regulation 2)

The EIA Regs Schedule 4, Parts 1 and 2, set out the information for inclusion in an ES. Part 2 sets out the minimum requirements and is included below for reference:

Schedule 4 Part 2

- a description of the development comprising information on the site, design and size of the development;
- a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects;
- the data required to identify and assess the main effects which the development is likely to have on the environment;
- an outline of the main alternatives studies by the applicant and an indication of the main reasons for the applicant’s choice, taking into account the environmental effects;
- a non-technical summary of the information provided [*under the four paragraphs above*].

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 SI 2264 set out the requirements for information which must be provided as part of the DCO application. Applicants may also provide any other documents considered necessary to support the application. Information which is not environmental information (this is defined in Regulation 2 of the EIA Regs) need not be replicated or included in the ES.

The Commission advises that the ES should be laid out clearly with a minimum amount of technical terms and should provide a clear objective and realistic description of the likely significant impacts of the proposed development. The information should be presented so as to be comprehensible to the specialist and non-specialist alike.

The Commission recommends that the ES be concise with technical information placed in appendices.

ES Indicative Contents

The Commission emphasises that the ES should be a 'stand alone' document in line with best practice and case law.

Schedule 4 Part 1 of the EIA Regs sets out the aspects of the environment likely to be significantly affected by the development which should include '*in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors*' (paragraph 19).

The content of the ES should include as a minimum those matters set out in Schedule 4 Part 2 of the EIA Regs. This includes the consideration of 'Alternatives' which the Commission recommends could be addressed as a separate chapter in the ES.

Traffic and transport is not specified as a topic for assessment under Schedule 4; although in line with good practice the Commission considers it is an important consideration *per se*, as well as being the source of further impacts in terms of air quality and noise and vibration.

Balance

The Commission recommends that the ES should be balanced, with matters which give rise to a greater number or more significant impacts being given greater prominence. Where few or no impacts are identified, the technical section may be much shorter, with greater use of information in appendices as appropriate.

The Commission considers that the ES should not be a series of disparate reports and stresses the importance of considering combined and cumulative impacts.

Physical Scope

In general the Commission recommends that the physical scope for the EIA should be determined in the light of:

- the nature of the proposal being considered;
- the relevance in terms of the specialist topic;
- the breadth of the topic;
- the physical extent of any surveys or the study area; and
- the potential significant impacts.

Therefore, the Commission recommends that the study area for the EIA should include at least the whole of the application site, and include all offsite works. For certain topics, such as landscape and transport, the study area will need to be wider. The study area for each specialist topic should be clearly

defined and determined by establishing the physical extent of the likely impacts in accordance with good practice.

The Commission considers that the study areas should be agreed, wherever possible, with the relevant statutory consultees and local authorities.

Temporal Scope

The assessment should consider:

- environmental impact during construction works;
- environmental impacts on completion/operation of the development;
- environmental impacts a suitable number of years after completion of the development in order to allow for traffic growth or maturing of any landscape proposals; and
- decommissioning.

In terms of decommissioning, the Commission acknowledges that the further into the future any assessment is made, the less reliance may be placed on the outcome. However, the purpose of such a long term assessment is to enable the decommissioning of the works to be taken into account in the design and use of materials such that structures can be taken down with the minimum of disruption, materials can be re-used and the site can be restored or put to a suitable new use. The Commission encourages consideration of such matters in the ES.

The Commission recommends that these matters should be set out clearly in the ES and that the suitable time period for the assessment should be agreed with the relevant statutory consultees.

The Commission considers that the duration of effects should use a standard terminology, which should be defined.

Baseline

The Commission recommends that the baseline should describe the position from which the impacts of the proposed development are measured. The baseline should be chosen carefully and, where possible, be consistent between topics.

The identification of a single baseline is to be welcomed in terms of the approach to the assessment, although the Commission considers that care should be taken to ensure that all the baseline data remains relevant and up to date. The Commission recommends that the baseline environment should be clearly explained in the ES, including any dates of surveys. Wherever possible the baseline should be agreed with the appropriate consultees.

For each of the environmental topics, the data source(s) for the baseline should be set out together with any survey work undertaken with the dates.

Identification of Impacts and Method Statement

Legislation and Guidelines

In terms of the EIA methodology, the Commission recommends that reference should be made to best practice and any standards, guidelines and legislation that have been used to inform the assessment. This should include guidelines prepared by relevant professional bodies.

In terms of other regulatory regimes, the Commission recommends that relevant legislation and all permit and licences required should be listed in the ES where relevant to each topic. This information should also be submitted with the application in accordance with the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 SI No. 2264.

In terms of assessing the impacts, the ES should approach all relevant planning and environmental policy – local, regional and national (and where appropriate international) – in a consistent manner.

Assessment of Effects and Impact Significance

The EIA Regs require the identification of the *'likely significant effects of the development on the environment'* (Schedule 4 Part 1 paragraph 20). Therefore, the Commission considers it is imperative for the ES to define the meaning of 'significant' in the context of each of the specialist topics` and for significant impacts to be clearly identified.

The Commission recommends that the criteria should be set out fully and that the ES should set out clearly the interpretation of 'significant' in terms of each of the EIA topics. Quantitative criteria should be used where available. The Commission considers that this should also apply to the consideration of cumulative impacts and impact interactions.

Potential Environmental Impacts

The Commission considers these under Section 3: the EIA Topic Areas of this opinion.

Impact Inter-actions/Combined Impacts

Multiple impacts on the same receptor should be taken into account. These occur where a number of separate impacts, eg. noise and air quality, affect a single receptor such as fauna.

The Commission considers that the combined effects of the proposed development should be assessed and that details should be provided as to how interactions will be assessed in order to address the environmental impacts of the proposal as a whole.

Cumulative Impacts

The ES should describe the baseline situation and the proposed development within the context of the site and any other proposals in the vicinity.

Other major development in the area should be identified beyond the proposal itself including any associated development. The Commission recommends that this should be identified through consultation with the local planning authorities on the basis of major developments that are:

- built and operational;
- under construction;
- permitted application(s), but not yet implemented;
- submitted application(s) not yet determined, and if permitted would affect the proposed development in the Scoping Report; and
- identified in the Development Plan (and emerging Development Plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.

Details should be provided in the ES, including the types of development, location and key aspects that may affect the EIA and have been taken into account as part of the assessment.

Associated development

The ES should give equal prominence to any development which is associated with the proposed development to ensure that all the impacts of the proposal are assessed.

The Commission recommends that the applicant should distinguish between development for which development consent will be sought and any other development. This distinction should be clear in the ES.

Alternatives

The ES must set out an outline of the main alternatives studied by the applicant and provide an indication of the main reasons for the applicant's choice, taking account of the environmental effect (Schedule 4 part 1 paragraph 18).

Matters should be included, such as *inter alia* alternative design options and alternative mitigation measures. The justification for the final choice and evolution of the scheme development should be made clear. Where other sites have been considered, the reasons for the final choice should be addressed.

The Commission advises that the ES should give sufficient attention to the alternative forms and locations for the off-site proposals, where appropriate,

and justify the needs and choices made in terms of the form of the development proposed and the sites chosen.

Mitigation Measures

Mitigation measures may fall into certain categories: namely avoid; reduce; compensate or enhance; and should be identified as such in the specialist sections (Schedule 4 part 1 paragraph 21). Mitigation measures should not be developed in isolation as they may relate to more than one topic area.

The effectiveness of mitigation should be apparent. Only mitigation measures which are a firm commitment should be taken into account as part of the assessment.

The application itself will need to demonstrate how the mitigation would be delivered, and only mitigation which can be shown to be deliverable should be taken into account as part of the EIA.

It would be helpful if the mitigation measures proposed could be cross referred to specific provisions and/or requirements proposed within the draft development consent order. This could be achieved by means of describing the mitigation measures proposed either in each of the specialist reports or collating these within a summary section on mitigation.

Trans-boundary Effects

The Commission recommends that consideration should be given in the ES to any likely significant effects on the environment of another Member State of the European Economic Area. In particular, the Commission recommends consideration should be given to discharges to the air and sea and to potential impacts on migratory species.

Presentation

The Commission recommends that all paragraphs in the ES should be numbered. This is for ease of reference. Appendices must be clearly referenced, again with all paragraphs numbered. All figures and drawings should be clearly referenced.

Cross References and Interactions

The Commission recommends that all the specialist topics in the ES should cross reference their text to other relevant disciplines. Interactions between the specialist topics is essential to the production of a robust assessment, as the ES should not be a collection of separate specialist topics, but a comprehensive assessment of the environmental impacts of the proposal and how these impacts can be mitigated.

As set out in EIA Regs Schedule 4 Part 1 paragraph 23, the ES should include an indication of any technical difficulties (technical deficiencies or lack

of know-how) encountered by the applicant in compiling the required information.

Terminology and Glossary of Technical Terms

The Commission recommends that a common terminology should be adopted. This will help to ensure consistency and ease of understanding for the decision making process. For example, 'the site' should be defined and used only in terms of this definition so as to avoid confusion with, for example, the wider site area or the surrounding site.

A glossary of technical terms should be included in the ES.

Summary Tables

The Commission recommends that in order to assist the decision making process, the applicant may wish to consider the use of tables to identify and collate the residual impacts after mitigation. This would include the EIA topics, and combined and cumulative impacts.

A table setting out the mitigation measures proposed would assist the reader and the Commission recommends that this would also enable the applicant to cross refer mitigation to specific provisions proposed to be included within the draft Order.

The ES should also demonstrate how the assessment has taken account of this Opinion and other responses to consultation. The Commission recommends that this may be most simply expressed in a table.

Bibliography

A bibliography should be included in the ES. The author, date and publication title should be included for all references.

Non Technical Summary

The EIA Regs require a Non Technical Summary (EIA Regs Schedule 4 Part 1 paragraph 22). This should be a summary of the assessment in simple language. It should be supported by appropriate figures, photographs and photomontages.

Consultation

The Commission recommends that any changes to the scheme design in response to consultation should be addressed in the ES.

It is recommended that the applicant provides preliminary environmental information to the local authorities.

Consultation with the local community should be carried out in accordance with the SoCC which will state how the applicant intends to consult on the preliminary environmental information (this term is defined in the EIA Regs under regulation 2 'Interpretation'). This preliminary information could include results of detailed surveys and recommended mitigation actions. Where effective consultation is carried out in accordance with s47 of the Planning Act, this could usefully assist the applicant in the EIA process – for example the local community may be able to identify possible mitigation measures to address the impacts identified in the preliminary environmental information. Attention is drawn to the duty upon applicants under s50 of the Planning Act to have regard to the guidance on pre-application consultation.

Environmental Management

The Commission advises that it is considered best practice to outline in the ES, the structure of the environmental management and monitoring plan (EMMP) and safety procedures which will be adopted during construction and operation.