6 ASSESSMENT METHODOLOGY – THE OFFSHORE COMPONENTS

6.1 INTRODUCTION

This section identifies the assessment methods which have been adopted for the offshore aspects of the Rhyl Flats project. The offshore components comprise the following:

- the wind turbines;
- the subsea cables to shore and within the wind farm site;
- the landfall;
- the substation option at sea; and
- the meteorological masts.

The Guidance Note for Environmental Impacts Assessments of Offshore Windfarms, published by CEFAS, DLTR and DEFRA (November 2001), has been taken into consideration in determining the scope and methodology for each assessment. Consultation with the relevant bodies has been undertaken as recommended in this guidance document.

The assessments also take account of generic guidance and legislative requirements for offshore wind energy developments and EIA including:

- *Offshore Windfarm Consents Process* - DTI 2001;
- *Electricity Works (EIA) (England & Wales) Regulations 2000* (DTI 2000);
- *Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999* (DETR 1999);
- Planning Guidance (Wales) *Planning Policy* (1999 revision); and
- Technical Advice Note 8: *Renewable Energy* (1996).

6.2 HYDRODYNAMICS AND GEOMORPHOLOGY

6.2.1 Introduction

The presence of the wind farm has the potential to cause changes to hydrodynamics and geomorphology, which in turn may cause the following impacts:

- changes to suspended solids in the water column during construction;

- near-field changes to erosion and sedimentation patterns, potentially causing scour and/or sedimentation.

- changes in suspended solids in the water column due to changes in near-field erosion/sedimentation patterns post-construction;

- near-field and far-field wave effects;

- far-field changes to erosion/sedimentation effects, potentially effecting coastal geomorphology.

In order to fully address these concerns, HR Wallingford has undertaken a number of modelling studies.

6.2.2 Guidance

The advice provided by the CEFAS, DLTR and DEFRA guidance note (November 2001) has been taken into consideration and the scope of the hydrodynamic and geomorphological work was discussed in advance with CEFAS.

6.2.3 Study Area

The assessment undertaken covers the potential for both near-field and far-field impacts *ie* the studies enable the prediction of any impacts to geomorphology at the coastline.

6.2.4 Approach

Modelling undertaken by HR Wallingford includes the following studies:

- tidal flow modelling;

- desk based assessment of the monopiles on waves, taking into consideration the effective size of the pile base including changes to the bed due to scour;

- an assessment of the average littoral drift on the coast at the proposed cable landfall location; and

- sediment transport modelling.

These studies were undertaken using standard methodologies approved by CEFAS.

The assessment of impacts is based on professional judgement, taking into consideration the results of the HR modelling studies, the degree to which hydrodynamic processes are anticipated to change as a result of the presence of the wind farm and the sensitivity of receptors to such changes. The natural variability of the hydrodynamic system has been used as a benchmark to assess the significance of any impacts.

6.3 SEDIMENT DISTURBANCE

6.3.1 Introduction

Disturbance of marine sediments could give rise to elevated concentrations of suspended solids and potential mobilisation of contaminants with secondary effects on water quality and smothering of marine organisms.

6.3.2 Guidance

The Oslo and Paris standards (1) have been used to determine the condition of the sediment in the vicinity of the proposed wind farm (*Table 6.1).*

Table 6.1 Sediment Standards set out in the Oslo and Paris Convention

	Cu	Zn	Cd	Hg	Pb	Va	Cr	Fe	Ni
Min	2.20E-03	8.80E-03	7.00E-06	3.40E-06	1.80E-03	1.20E-02	9.00E-03	1.20E-04	4.40E-03
Max	5.70E-03	1.80E-02	3.00E-05	6.60E-06	4.00E-03	2.20E-02	2.00E-02	1.26E-03	9.10E-03

Although it is possible to apply international standards to the disposal of dredged spoil, there are no applicable standards for disturbance of sediment.

6.3.3 Study Area

The area over which sediment disturbance impacts have been explored is broadly defined by the area which;

- is likely to be physically disturbed during construction activity; or
- might experience hydrodynamic changes once the wind farm structures are in place (see *Section 6.2*).

6.3.4 Approach

Sediment samples were taken as part of the benthic survey both within the proposed lease area and at representative sites between the proposed lease area and the shore. The sediment quality has been assessed in light of the standards set out in the Paris and Oslo Convention. Professional judgement has been used to identify whether the proposals are likely to result in any impacts to existing sediment quality. The assessment has taken into account the degree to which sediments could be mobilised by the activities proposed, sediment composition and the sensitivity of receptors to impact.

Marine sediments could also be a receptor for contamination from discharges, with the potential for knock-on effects on organisms that dwell in and on the seabed. The assessment method concerning smothering impacts to marine organisms is described in *Section 6.4*

(1) for the Protection of the Environment of the North East Atlantic (OSPAR Convention 1992)

6.4 MARINE ECOLOGY

6.4.1 Introduction

This section outlines the assessment method used to determine impacts to marine ecology. This assessment method was used to determine impacts to;

- intertidal flora and fauna;
- sub tidal flora and fauna (benthos);
- marine mammals; and
- fish.

The assessment of noise impacts to fish and marine mammals is discussed in *Section 6.5.*

6.4.2 Guidance

The CEFAS, DLTR and DEFRA guidance note (2001) has been taken into account in this assessment. The scope of the benthic survey was agreed in advance with CEFAS and CCW.

6.4.3 Study Area

Relevant published literature was obtained and reviewed for the north Wales coast and Liverpool Bay area whilst site specific surveys included:

- intertidal survey at the two cable landfall locations; and

- benthic survey of the wind farm area and cable routes to shore.

The benthic survey included some sites outside this area (which can be used as controls) and two cable route options to shore. The cable route options surveyed are not exactly the same as the proposed cable route options presented in this report, however the survey results are indicative of sediments and benthos present along the route to shore. In light of the relatively uniform nature of the sediments in the vicinity of the proposed lease area and cable route options, extrapolation from the existing data is considered to be adequate.

6.4.4 Approach

A desk based study was undertaken which involved collecting all relevant information concerning marine ecology within the wider study area. This information was supplemented by the results of the site specific benthic and intertidal studies.

The scope of work for the benthic survey included;

- retention of benthic fauna on a 1 mm and 0.5 mm sieve, followed by preservation in formaldehyde solution;

- sampling of the sediment for particle size analysis, metals and hydrocarbon compounds;
- water sampling for turbidity and suspended solids concentration;
- recording of dissolved oxygen;
- trawl samples from four tows within the study area;
- appropriate analysis and processing of samples.

The intertidal survey included a qualitative survey of the habitats and species present at the proposed landfall locations.

The significance of impacts to marine ecology has been evaluated using professional judgement taking account of the following factors:

- the magnitude of the impact as determined by its intensity, its extent in space and time, and the likelihood of its occurring;
- the vulnerability of the habitat or species to the change caused by the impact;
- the ability of that species or habitat to recover; and
- the value, in nature conservation and ecological terms, of affected receptors including species, populations, communities, habitats, landscape and ecosystems.

In categorising the magnitude of impacts, a semantic scale of minor, moderate and major has been used (*Table 6.6.2*). Habitat and fauna/flora have been categorised as locally, nationally or internationally important. It is the interaction of these two elements that determine significance. Significance is therefore high for impacts of a large magnitude on receptors of high value and lower for smaller impacts on receptors of lower value.

Table 6.6.2 Criteria for Assessing the Significance of Ecological Impacts

	Minor Impact	Moderate Impact	Major Impact
Locally important habitat or flora/fauna	Minor	Minor	Moderate
Nationally important habitat or flora/fauna	Minor	Moderate	Major
Internationally important habitat or flora/fauna	Moderate	Major	Major

A minor impact can be described as an impact which causes short-term disturbance or affects only a limited part of a site.

A moderate impact can be described as an impact which affects one critical season (ie breeding) or affects an area such that the functioning of the ecosystem becomes impaired.

A major impact can be described as an impact which causes permanent change to a habitat (or a change lasting for more than 5 years) or affects the future viability of a species or population.

6.5 SUBSEA NOISE IMPACTS

6.5.1 Introduction

The potential effects of noise on marine organisms can be categorised as follows:

- potential for changes in behaviour (including avoidance and attraction);
- potential for interference with acoustic communication; and
- potential for physical damage (including damage to hearing).

For an organism to respond to introduced sound sources such as drilling or operational noise, the sound has to exceed that of the ambient noise, which has either non-biological or biological origins.

As both construction and operation of the proposed wind farm have the potential to create subsea noise, a desk study and project specific noise prediction study have been carried out as part of the Rhyl Flats EIA.

6.5.2 Guidance

The CEFAS, DLTR and DEFRA guidance note (2001) has been taken into account in this assessment.

6.5.3 Study Area

Noise predictions have been made over a range of distances from the proposed wind farm. To determine the potential range over which such effects may occur, predictions have been performed of piling noise at distances from the pile of 5 m and 20 km.

6.5.4 Approach

Desk based studies have been undertaken which draw on recent experience from the Netherlands (Danish Institute for Fisheries Research 2000) and UK Research and Development studies commissioned by the DTI and undertaken by the University of Liverpool (Vella et al 2001).

In addition, COWL have commissioned the Hayes McKenzie Partnership to carry out project specific noise studies. As part of this study, a series of noise predictions were carried out by QinetiQ.

The Hayes-McKenzie Partnership and QinetiQ work has formed the basis of the assessment of impacts to marine mammals and fish. The scope of the work includes the following:

- identification of the potential audibility of the piling operations;
- identification of the potential for temporary threshold shifts (TTS) of fish and marine mammal hearing; and
- identification of the potential for permanent threshold shifts (PTS) of fish and marine mammal hearing.

The significance of impacts to marine mammals and fish has been based on professional consideration of the likelihood of temporary and permanent threshold shifts along with the relative occurrence of the organism within the project area.

6.6 ORNITHOLOGY

6.6.1 Sources of Information

Information that has been used in this assessment has been obtained from the following sources:

- boat field surveys undertaken by John Clark for ERM during the period January to March 2002 at dawn, to record scoter movement and during the day to record flight height of all birds across the wind farm site;
- aerial field surveys conducted by the Wildfowl and Wetlands Trust (WWT) for CCW as part of their survey of common scoter in Welsh waters in December 2001 and January 2002;
- report evaluating the findings of the aerial bird surveys including influence of environmental variables (*eg* water depth, currents) by the National Environmental Research Institute (NERI) in Denmark (1).
- review of existing published information including:
  - the JNCC seabirds at sea atlas (Stone *et al*, 1995),
  - various data on seabird status (*eg* the Seabird Colony Register, Lloyd *et al*, 1991, Barne *et al*, 1996),
  - aerial survey data on scoter collected for CCW in 2000/2001 (Oliver *et al*, 2001),
  - National Breeding Birds Atlas (Gibbons *et al,* 1993),
  - Wetland Birds Survey (Webs) (Musgrove *et al,* 2001),
  - local bird reports produced by the Clwyd Bird Recording Group

(1) Internal Report for COWL.

(1989 – 1999);

- consultations with a range of organisations including:
  - Countryside Council for Wales (CCW);
  - English Nature (EN);
  - Joint Countryside Advisory Group (JCAS);
  - Joint Nature Conservation Committee (JNCC);
  - Liverpool Bay Coastal Group (LBCG);
  - Marine Conservation Society (MCS);
  - Royal Society for Protection of Birds (RSPB);
  - The Wildlife Trusts;
  - Wildfowl and Wetlands Trust (WWT).

Further details on the issues raised by consultees can be found in *Section 1.1.2* below.

6.6.2 Consultations

Discussions with consultees has suggested that the EIA should address the following:

- effects on sites in the area which are designated (1) for their bird interest including (see *Figure 7.9* in *Table 7.7)*:
  - Dee Estuary SPA/Ramsar site/SSSI/Aber Afon Dyfrdwy pSAC;
  - Y Fenai a Bae Conwy / Menai Strait and Conway Bay cSAC/SSSI;
  - Traeth Lafan SPA/SSSI;
  - Puffin Island SSSI;
  - Great Ormes Head pSAC/SSSI/LNR/Country Park;
  - Little Ormes Head SSSI;
  - Gronant Dunes and Talacre Warren SSSI / Gronant Dunes LNR.

- effects on birds (all species) including:
  - effects of direct loss of habitat for feeding and roosting /loafing;
  - effects from construction disturbance;
  - effects to birds from on-shore construction and storage areas.
  - effects of the turbines on bird behaviour, including effect on flight lines and the risk of collisions;
  - effects of turbines in deterring birds from feeding in areas which cannot be accessed without passing through the turbines, or causing birds to avoid otherwise accessible areas around the turbines.
  - effects from routine and emergency operations and maintenance works;
  - effects of decommissioning.

- specific effects on the following groups and species:
  - wintering, passage and moulting common scoter, divers, other waterfowl such as scaup and shorebirds;

(1) For explanations of the designations (see *Section 7.7*).

- wildfowl and waders moving between the SPAs in Liverpool Bay;
- breeding seabirds (especially terns in the Dee Estuary SPA including Gronant Dunes and Talacre Warren SSSI);
- breeding seabirds on the Great and Little Ormes Heads SSSIs including guillemot, razorbill, kittiwake, fulmar and cormorant.

- cumulative effects on the above, particularly wintering/non-breeding scoter and divers.

6.6.3 *Survey Methodologies and Limitations*

Study Area

The consultations process identified the need to consider the impacts on bird species and populations, particularly associated with designated sites along the North Wales Coast (see above). Previous surveys had recorded concentrations of common scoter, a key species that is likely to be a qualifying interest species in any future SPA designation of Liverpool Bay, along the North Wales coast. Hence for the purposes of this assessment, a study area was chosen that was much wider than the wind farm site project area (*ie* the wind farm site and route of sub-sea cable connecting the wind farm to the land). The study area chosen covers approximately 1680 square kilometres (excluding land) along the North Wales coast extending from the eastern coast of Anglesey to the southern flank of the entrance to the Ribble Estuary, as shown in *Figure 6.1*.

Figure 6.1 Study Area (Source: Fox & Petersen, 2002b / ERM)

Closer in to the Dee/Mersey, there is considerable tidal flux, sediment transport and shipping activity, all of which represent a physical and environmental interruption to the continuity of inshore waters between the

North Wales and Merseyside coastlines. Hence it seems that such a discrete break in shoreline conditions makes this stretch of coastline (Angelsey-Ribble) a natural biographical unit for the purposes of this assessment.

It is acknowledged that the behaviour of the birds, especially common scoter populations in Liverpool Bay is yet to be fully established and that important concentrations of common scoter do exist further north in the Bay (along the Formby coast, south of Southport), and interchange with the populations off the North Wales coast is likely. For the purposes of this assessment it has been assumed that the feeding grounds off the North Wales coast are the only areas available to the birds that may be displaced from the Rhyl Flats wind farm site and its surrounds. It is clearly possible that birds could forage outwith this area but for this assessment a worst case scenario has been assumed. The cumulative ornithological impacts of the scheme are discussed in *Section 8.6.5.*

CCW Aerial Bird Surveys

For the purposes of this assessment, aerial bird surveys have been used as the main method of collecting data on bird populations and their distribution in the study area. This methodology is recognised as an effective way of obtaining data on birds that occur over large areas offshore, and for species such as common scoter that are known to be sensitive to disturbance caused by boats and that are often beyond the limits of visibility of land-based surveys.

CCW commissioned Casella Science & Environment Limited to co-ordinate and report on aerial surveys of common scoter in Liverpool Bay for the winter period November 2000 to February 2001 (Oliver *et al*, 2001). This was the first attempt to comprehensively survey this area for common scoter. The methodology adopted was reviewed by the National Environmental Research Institute (NERI) in Denmark, a recognised authority in surveys for common scoter. They concluded that the approach was likely to have caused disturbance to birds, influencing their distribution, resulting in some inaccuracy in the identification and counting of birds (see Fox, Petersen & Clausager, 2001; Fox & Petersen (2002a)(1)). The resulting data, therefore, lacks numerical and spatial precision, and hence it is not suitable for use in detailed analysis as part of the assessment of the proposals for the Rhyl Flats wind farm project

CCW since commissioned a further aerial survey over the winter of 2001/2002 that covers all the coastal waters along the entire Welsh coast including the waters off the North Wales coast in which the Rhyl Flats proposals are located. It uses a revised methodology following the recommendations from the review by NERI. Five surveys in the study area have been conducted during the period November 2001 – January 2002 (Fox & Petersen, 2002a). The objective of these surveys was to gain the maximum possible precision in

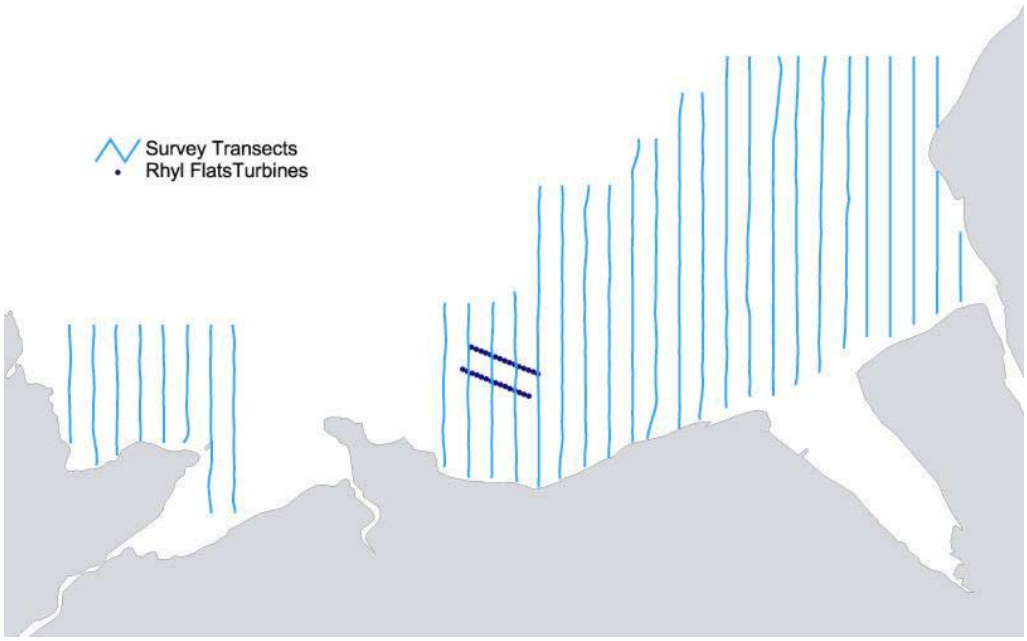
(1) Internal briefing note for COWL.

recording the position of individual or groups of birds in the open sea. An overview of this revised methodology is given below. Further details are contained within the report produced by NERI (Fox & Petersen, 2002b).

The aerial survey enabled the counting and identification of birds from a fixed wing aircraft, the flight trajectory of which was carefully monitored using Global Positioning System (GPS). The Rhyl Flats study area was covered by 39 north south transects flown at parallel 2 km intervals at a height of 78 metres, from the east coast of Anglesey to the English coast at Formby (see *Figures 6.2 – 6.6*). The majority of the surveys were undertaken when the wind speed was 6 m/s or less (1). Experienced surveyors made observations from both sides of the aircraft, including species, numbers, behaviour (on the water, diving, flushing, or flying), transect band and time. Birds were assigned to transect bands using an inclinometer (2), excluding a band 49 metres wide beneath the aircraft on either side that was not visible (3) . The flight position was tracked using GPS with longitude, latitude and time for each record. A computer programme was then used to assign a more accurate position for each record within the relevant transect band.

It was then possible to determine the distribution of birds of different species in the general area of the North Wales coast and specifically to relate the proportions of birds present on the wind farm site to those in the study area.

Figure 6.2 ***Aerial Bird Survey Transects 03.11.01 (Transect length of approximately 626 km)(Source: Fox &Petersen, 2002b)***



(1) The detectability of birds is severely reduced during surveys in stronger wind speeds.
(2) Uses angles below the horizontal measured abeam flight direction to define each of the three bands either side of the aircraft.
(3) Band A = 49-174m; Band B = 175-459m; Band C ≥460m.

Figure 6.3 ***Aerial Bird Survey Transects 07.12.01 (Transect length of approximately 538 km)(Source: Fox &Petersen, 2002b)***

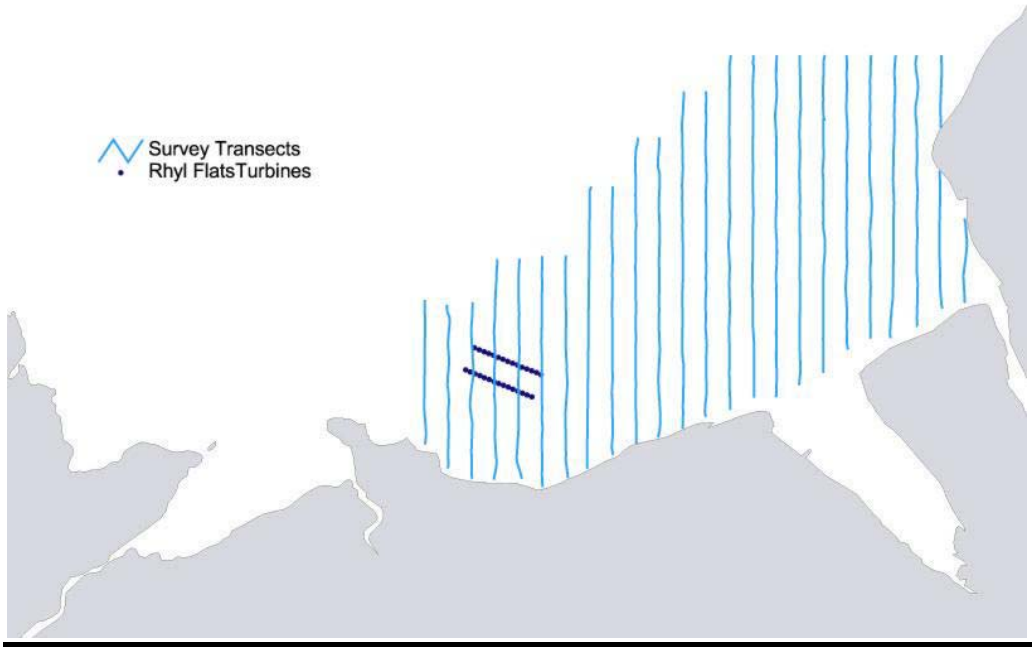


Figure 6.4 ***Aerial Bird Survey Transects 17.12.01 (Transect length of approximately 248 km)(Source: Fox & Petersen, 2002b)***

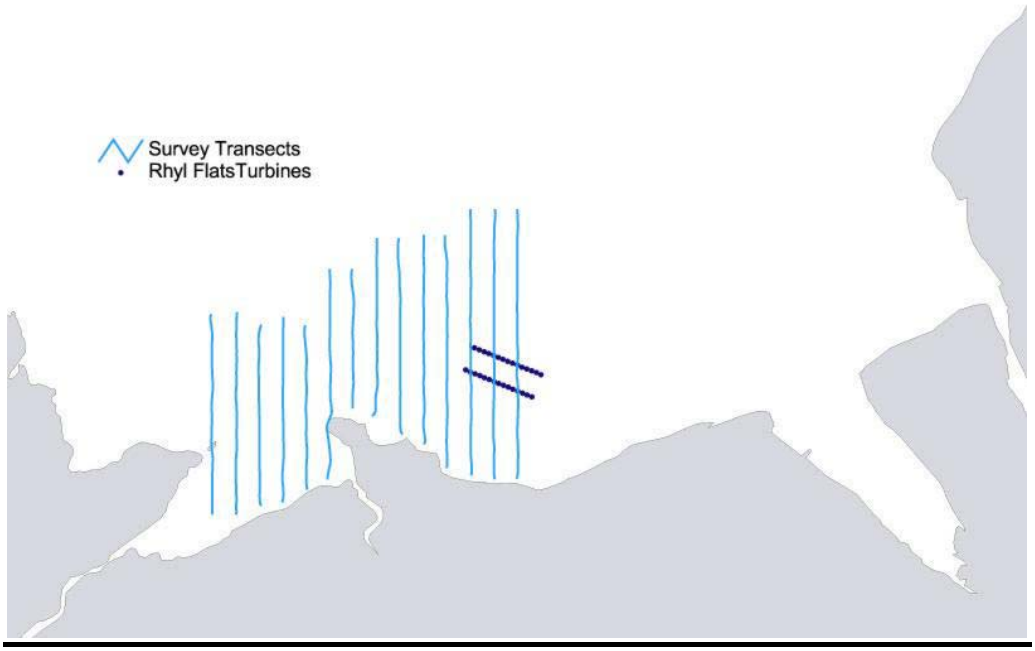


Figure 6.5 ***Aerial Bird Survey Transects 15.01.02 (Transect length of approximately 581 km)(Source: Fox & Petersen, 2002b)***

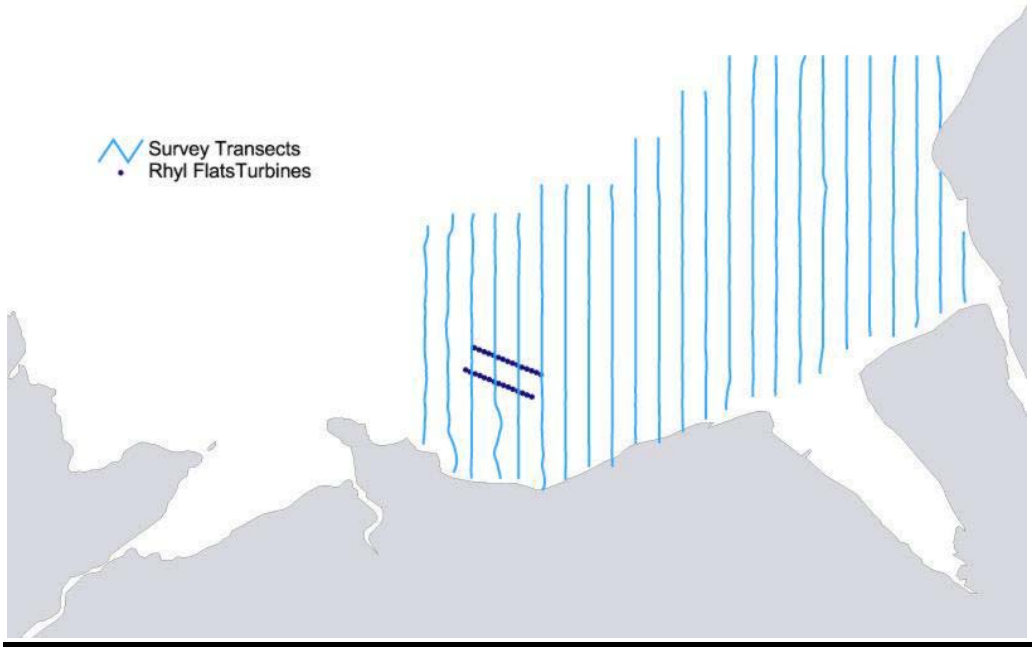
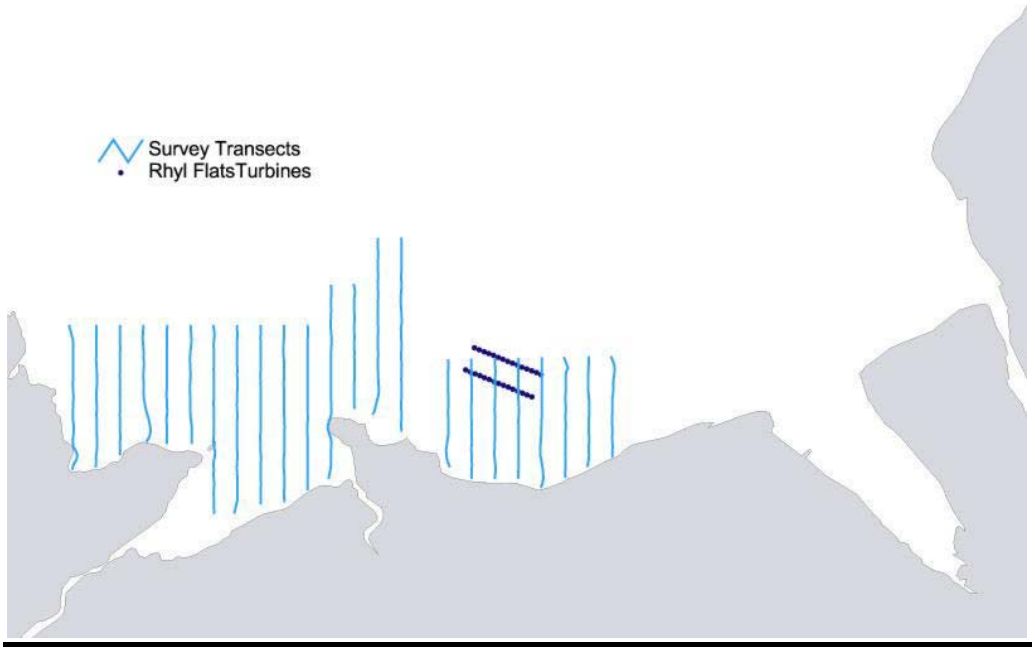


Figure 6.6 ***Aerial Bird Survey Transects 16.01.02 (Transect length of approximately 281 km)(Source: Fox & Petersen, 2002b)***



Boat Based Surveys

Additional information on bird flight movements (including species, flight height *etc*) was obtained from the boat surveys listed below and was used to inform the collision risk assessment.

- Surveys undertaken during the daylight hours on the windfarm site to assess the movement of birds across the site. Records were made from 10 sample point locations (five evenly spaced on each turbine row) and included time of observation, species and numbers, distance and direction to each bird/flock from the observation point, estimated height above the water and direction of flight.

- During the boat surveys above, additional information on birds was recorded along transects between the above sample point locations. The recording method was based on the standard seabirds at sea methodology (Komdeur, 1992), using the 300m transect band and the 180° survey scan, with snapshots.

- Specific surveys were undertaken at dawn to monitor the movements of scoter that have drifted from their feedings areas overnight to determine whether they were flying back to feeding areas across the wind farm site.

- Additional survey points were included close to known locations of scoter to observe movements and behaviour of this species.

Such boat-based surveys could not be undertaken simultaneously with the aerial surveys, as the presence of the boat might have affected the natural distribution of the birds, especially common scoter, which are known to fly at some distances from boats.

Limitations of the Surveys

The CCW aerial surveys are ongoing. Data from the visits in February and March were unavailable prior to completion of this report. These surveys will continue to provide further information about the distribution of birds in the survey area over the coming months.

6.6.4 Data Analysis

Data analyses were carried out on the raw data from the aerial surveys between November 2001 to January 2002 to:

- assess distribution of the birds and relative densities in the study area;

- identify the preferences of the birds for the wind farm site compared with other parts of the study area;

- generate estimates of the minimum populations in the study area; and

- assess the influence of environmental factors on the distributions of common scoter.

Each of these is considered further below and further details are contained in Fox & Petersen (2002b). Reference has also been made to the findings of benthic surveys and known information on fish species and populations in the study area (see *Sections 7.4* and *7.5* respectively).

Distribution Analyses, Relative Densities and Wind Farm Site Preference

- Bird encounters (individuals or flocks) were plotted directly on to maps to give a visual impression of bird distribution. Further analysis however, was restricted to a comparison of the relative density of birds in 2x2 kilometre grid squares, where the bird encounter rate was adjusted to take account of the differing degree of coverage of the study area during the surveys (see *Figure 6.7*) (1).

- A Jacobs' selectivity index (Jacobs, 1974) was used to describe the preference of each species for the wind farm area compared with other parts of the study area, based on encounter rates in the wind farm area, the wind farm area plus 2 kilometres and the wind farm area plus 4 kilometres from the aerial survey data of 2001/2002 (see *Figure 6.8*). This is an approach that has been adopted for several wind farms sites in Denmark (*pers comm* Tony Fox, 2002).

The significance of the difference between the observed number of birds in the wind farm area compared to the expected number, given the relative size of the wind farm, relative to the size of the study area, was calculated (2).

(1) Due to the variation in coverage of the study during the different aerial surveys (see *Figures 6.2 - 6.6*), some parts of the study were surveyed more often than others (*ie* the darker the green the more transects flown across the area).
(2)This was undertaken using a one sample chi squared test (see Fox & Petersen, 2002b).

Figure 6.7 ***Aerial Bird Survey Transect Coverage Intensity (Source: Fox & Petersen, 2002b)***

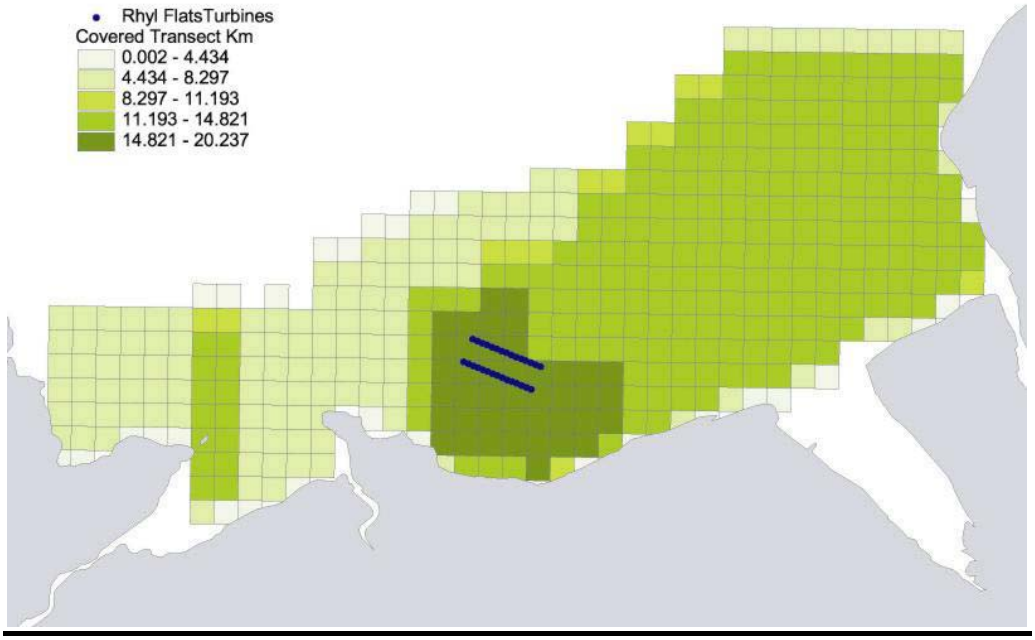


Figure 6.8 ***Windfarm Site Plus Surrounding 2 and 4 km Zones (Source: Fox & Petersen, 2002b)***

Population Estimates

The counts of total bird numbers and their relative distribution represent a sample (*ie* a proportion of the whole) of the total number present. Because the

detectability of birds falls off rapidly with increasing distance from the plane, seabirds sitting on the sea are more likely to be detected close to the aircraft than further away. Such an effect can be modelled using conventional techniques known collectively as distance sampling (see Buckland *et al*., 2001).

This technique was used by NERI to provide estimates of the total numbers of birds, for those species that were present in the study area in sufficient numbers (*ie* cormorant, common scoter, kittiwake and auks). The population estimates generated apply only to the particular surveys visits and to the area covered during each survey visit (which as shown in *Figures 6.2 – 6.7* differed between survey visits). Hence the population estimates for any one is a minimum estimate of the populations that might be present in the study area for the day of the particular survey visit.

The programme DISTANCE (version 4 beta 2, Thomas *et al* 2001) was used for line transect analyses, based on the distributions of birds reported from various transect bands for those species in numbers sufficient to generate total estimates. Birds recorded flying were converted into an encounter rate, corrected for the total transect length flown and added to the total generated from the DISTANCE analysis.

Relative Densities

The relative densities of birds were calculated to take into account the variation in survey coverage effort based on encounter rates. Observations were summarised on the basis of the 2 x 2 kilometre grid.

Environmental Analysis

Analysis of the environmental conditions that may influence distribution was undertaken for common scoter. This is one of the more abundant species that characterises the coast and has a more predictable distribution than the other species recorded, based on previous research experience which has assessed factors that are influential in their distribution (Fox & Petersen, 2002b). Existing information on habitat use by common scoter in the Western Palearctic (1) was reviewed. Available information on scoter food preferences was analysed, including the prey species, favoured substrate of prey species and its availability and profitability (size and water depth).

Environmental conditions along the North Wales coast, including current and tidal information, water depth, disturbance levels, habitats and the benthic communities present, were determined as part of the environmental assessment. The distribution of common scoter in relation to water depth was analysed (2) as was their distribution in relation to current. The latter used ebb tide current fluxes, modeled for the positions where birds of each species were

(1) Includes Europe, Asia Minor, northern Arabia and northern Africa (see OUP, 1998)
(2)The frequency distributions of all bird species encounters, based on two metre depth intervals, were tested against that of the transects overall, using Kolmogorov-Smirnov tests.

encountered, and compared them with current characteristics sampled at five second intervals along the flown transects.

All these environmental factors were considered in combination with the population, distribution and relative density of birds in the study area to provide baseline information from which to assess the likely impacts of the scheme on these populations.

6.6.5 Methods of Prediction and Assessment Criteria

The potential for impacts on ornithological interests has been assessed in the light of habitats and the species that will be affected by the proposals. The significance of impacts has been evaluated taking into account the following factors:

- the magnitude of the effect, as determined by its intensity and by its extent in space and time;
- the vulnerability of the habitat or species to the change caused by the development;
- its ability to recover;
- the value, in nature conservation and ecological context, of affected species, populations, communities, habitats and ecosystems.

Further details are provided in *Annex E.*

Reference has been made to the Draft Guidelines for Ecological Evaluation and Impact Assessment that are currently being prepared by the Institute of Ecology and Environmental Management (1), and to the Draft Methodology for Assessing the Effects of Wind Farms on Ornithological Interests being prepared for Scottish Natural Heritage (SNH) and the British Wind Energy Association (BWEA).

6.7 COMMERCIAL FISHERIES ASSESSMENT

A desk based study was undertaken which involved the collection and analysis of DEFRA overflight and landings data. This study was carried out in order to identify any trends in fishing activity such as seasonality, vessel type, number of hours fished, most important species landed by weight and by value. As this study only applies to vessels more than 10 m in length, a scheme specific fisheries consultation exercise was also undertaken.

(1) These can be found at http://www.ieem.co.uk/devproj.html.

Consultations were initially undertaken with fisheries umbrella organisations and subsequently with fishing organisations which were identified as potentially being affected by the proposals.

The assessment of impacts to fishing and angling communities is based on professional judgement, taking consideration of the degree to which commercial fisheries and angling initiatives are likely to be affected by the presence of the proposed wind farm.

6.8 TOURISM AND AMENITY

An initial review of the available literature was carried out in order to identify the key recreational activities and tourism interests within the proposed wind farm area. In addition, consultation was undertaken with pleasure boating (power boating and yachting) interests as these represent the main tourism interests in the area. Diving organisations were also consulted.

As pleasure boating was identified as being the most important marine based activity in the area, a desk study was undertaken by Anatec in order to identify the main pleasure boating routes in the vicinity of the proposed wind farm and the level of use of these routes.

The study area is confined to the area in the vicinity of the proposed lease area. The scope for indirect impacts outside this area is limited.

The assessment of impacts to tourism and amenity is based on professional judgement, taking consideration of the degree to which the recreational interests identified in the desk study are likely to be affected by the proposed wind farm given our knowledge of the extent of the recreational activity and the details of construction and operation of the proposed wind farm.

6.9 SHIPPING AND NAVIGATION

6.9.1 Introduction

In order to fully address the potential for impacts to shipping and navigation from the presence of the proposed wind farm, Anatec have carried out a desk based study.

6.9.2 Study Area

The study area is limited to the area surrounding the proposed wind farm (within approximately 18.5km) as the scope for impacts outside this area is limited.

6.9.3 Consultation

During the course of the study, a visit was made to the ports of Mostyn and Liverpool to discuss the navigational issues with port personnel and vessel operators, and collect data for the assessment.

6.9.4 Approach

The main objectives of the Anatec study were as follows:

- to update the shipping traffic information for the offshore wind farm at Rhyl Flats based on comments received during the Phase I consultation;

- to review the likely effect of the development on shipping navigation and predict the revised routeing pattern following establishment of the wind farm and associated buoyage/exclusion zone;

- to estimate the risk of the following types of collisions with the wind farm:
  - powered passing vessel;
  - drifting passing vessel;
  - anchor dragging / drifting vessel;

- based on the current and anticipated routeing pattern, to estimate the effect of the Rhyl Flats wind farm on the following general shipping accident frequencies:
  - ship/ship collision;
  - grounding;
  - foundering;
  - fire/Explosion;
- to review the effect of the construction phase on shipping;

- to assess the potential cumulative impacts associated with the development of both the COWL Rhyl Flats and NWP North Hoyle wind farms; and

to present recommendations to manage the risks and minimise disruption to shipping.

The significance of the impacts to shipping and navigation has been determined on the basis of professional judgement, taking into account the degree by which shipping and navigation will be affected as a result of the proposed wind farm.

6.10 AIRBORNE NOISE

6.10.1 Introduction

The assessment of noise from the proposed wind farm considers the effects of noise resulting from the operation and construction of the wind turbines.

6.10.2 Guidance

Planning Policy Guidance associated with the development of wind farms currently only deals with onshore developments. In the absence of detailed Planning Guidance concerning the development of offshore wind farms and noise emissions, best current practice for onshore developments has been referred to.

Planning Policy, British Standards and other Guidance can be summarised as follows (*Annex I, Volume V*):

- Planning Guidance (Wales): Planning Policy: First Revision;
- Planning Guidance (Wales) Technical Advice Note (Wales) 11: Noise (TAN 11);
- Planning Guidance (Wales) Technical Advice Note (Wales) 8: Renewable Energy (TAN 8); and
- The Assessment and Rating of Noise from Wind Farms: ETSU-R-97.

Sleep Disturbance Criteria

Guidance concerning the effects of noise on sleep are covered in a number of documents discussed by the DTI Noise Working Group. In general, if internal noise levels are limited to a range of no more than 30 - 35 dB L_{Aeq}, then sleep disturbance and any adverse effects of noise upon sleep will be minimised. Since the issue of the DTI Noise Working Group recommendations, further guidance as been issued by the World Health Organisation (Guidelines for Community Noise), in March 2000, which has been adopted within BS 8233 : 1999 Sound Insulation and noise reductions for buildings – Code of Practice.

The guidance in BS 8233 follows the advice contained within the WHO report which states that unoccupied indoor ambient noise levels within bedrooms are a "good" design when around 30 dB L_{Aeq} and "reasonable" when around 35 dB L_{Aeq}. Individual noise events should also be limited to no more than 45 dB L_{Amax}, however, these internal noise level criterion are not relevant to wind turbine noise as it refers to individual, discrete noise events.

The WHO guidance also advises as to what is an acceptable external noise level for a bedroom and gives a value of 45 dB L_{Aeq} as being sufficiently low to

protect the sleep of an occupant of a building even when windows are open for ventilation.

Noise Impact Assessment Criteria

To assess the acceptability of the development when operating, wind turbine noise has been assessed in accordance with the guidance contained in the DTI NWG Recommendations, ETSU-R-97.

To assess the effects of wind turbine noise at night, the guidance for internal noise levels within bedrooms contained within BS 8233 and the guidance values within WHO Guidelines for Community Noise have been considered.

6.10.3 Approach

An assessment has been performed that takes account of the predicted noise emissions from the wind turbines and the existing noise environment at locations along the shoreline between Rhos-on-Sea and Rhyl.

An assessment has been performed of the construction noise associated with piling operations for the wind turbine monopile foundations.

Operational and construction noise effects upon the marine environment due to noise being transmitted from the turbine support structure or monopile into the water are dealt with within *Section 8.2.4*.

Site Visit

The baseline noise survey was conducted between 6th and 18th December 2001, a total measurement period of 13 days. Measurements were performed using Larson-Davies LD-820 Type I sound level meters which were set to log noise data using ten minute measurement periods. Apart from the background $L_{A90,10\ min}$ noise levels, data was collected for the following indices for each 10 minute period, L_{A05}, L_{A10}, L_{A50}, L_{A75}, L_{A95}, L_{A99}, L_{Amax}, L_{Amin}, L_{Apeak}, $L_{peak,}$ L_{ASEL} and L_{Aeq}, although only the $L_{A90,10min}$ and $L_{Aeq,10min}$ have been used in the analysis.

The locations and findings of the site visit are described in *Section 7.8.6*.

6.11 TRAFFIC

6.11.1 Introduction

This section describes the approach to the assessment of transport and traffic effects of the offshore elements of the proposed wind farm *ie* impacts relating to installation and maintenance. The affected part of the highway network, the scale of the construction activity and the likely traffic and related environmental effects of the onshore elements are described in *Sections 11 and 12*.

The Port of Mostyn has been assessed within the EIA as the local port and staging area for the construction and maintenance of the project. Opportunities do exist at other locations serving the region. These include: Port of Liverpool; Rhyl Harbour; and Conwy Harbour. However, Port of Mostyn is the most likely and has been assessed in the EIA.

6.11.2 Scope

The assessment of traffic and transport impacts covers the impacts arising from the construction and operation of the wind farm and takes account of the following:

- changes in traffic conditions in terms of delay and congestion;
- changes in traffic-related noise levels and air quality;
- the effects on other road users, *ie* pedestrians and cyclists; and
- people adjacent to the road network, *ie* occupants of residential and commercial premises and users of any amenity facilities.

Due to the nature of the construction project and the likely routes for construction and operation workers serving the development the use of the public transport network is considered unsuitable and has been scoped out of the assessment.

The assessment of transport and traffic effects has been undertaken as follows.

- Identification of existing baseline conditions including a description of the existing transport networks, existing traffic flows and receptors that are potentially sensitive to road traffic impacts.
- Identification of traffic and transport impacts predicted to arise both during construction and operation.
- Identification of mitigation measures to avoid, minimise or eliminate predicted impacts.

Sources of Information

The traffic and transport assessment has been undertaken using data from the following sources:

- traffic counts obtained from Flintshire County Council;
- consultation with Flintshire County Council highways department;

- traffic counts commissioned by COWL from 18th December 2001 to 14th January 2002;

- discussions with the Port of Mostyn;

- estimated traffic based on the projected development programme; and

- liaison with other specialist consultants concerning shipping studies and potential wind farm construction methodology.

6.11.3 General Approach

At the time of writing, advice was due to be published by the Department of Transport, Local Government and the Regions (DTLR) on the content and preparation of Transport Assessments (TAs). This advice will replace current guidance on the preparation of Traffic Impact Assessments (TIAs) (1). In the absence of the TA guidance, the existing TIA guidance has been used in this assessment.

The impacts of generated traffic during the construction and operational phases of the wind farm development are based on the difference between baseline flows (*ie* those which would occur in the absence of the development) and traffic flows predicted to occur as a result of the development during both construction and operation.

6.11.4 Traffic Conditions

Based upon the criteria set out in the TIA guidelines, it is considered that the traffic impacts of a development will potentially cause a significant impact and may require a TIA where:

- generated traffic levels cause baseline two-way traffic on the adjoining highway to increase by over 10%, or 5% where the adjoining highway is already congested; or

- the development generates over 100 movements (a return journey is two movements) in a peak hour.

With reference to the thresholds outlined above it is important to understand that the guidelines state "*it is...not possible to provide any hard and fast rules as to what constitutes a significant traffic impact and hence for which a full traffic impact assessment should be undertaken*". The IHT guidelines for TIA are intended to assist in determining over what area a TIA should be undertaken. *Paragraph 3.1.3* of the IHT guidelines states that:

"*In considering the threshold at which TIAs should, as a matter of course, be undertaken, the Guidelines have taken note of two traffic flow characteristics, namely*:

(1) Institute of Highways and Transportation (1994) Traffic Impact Assessment, IHT

- *Traffic flow on any uncongested road frequently varies by up to 10% on a day to day basis. In congested conditions where flow variations are smaller it may be difficult, if at all possible, to distinguish these variations from traffic specifically related to a new development.*

- *The environmental conditions on a road do not change significantly with changes of traffic of less than some 30% (see IEA Guidelines on the Environmental Impact of Road Traffic) unless there are major changes in the flow composition*."

Assessment of Traffic-Related Environmental Impacts

The assessment of traffic-related environmental impacts is based on the Institute of Environmental Assessment (IEA) guidelines (1).

The IEA Guidelines (at *Section 3.15*) propose two rules for defining the area in which the assessment should be undertaken;

> *Rule 1 - include highway links where traffic flows will increase by more than 30% (or the number of heavy goods vehicles will increase by more than 30%).*
>
> *Rule 2 - include any other specifically sensitive areas where traffic flows have increased by 10% or more.*

Section 3.17 of the guidance states that "*research has identified that the most discernible environmental impacts of traffic are noise, severance, pedestrian delay and intimidation*". *Section 3.20* continues that "*any affected link in a sensitive location should be included, for example an accident black spot, conservation areas, hospital, links with high pedestrian flows etc.*

> "*Normally it would not be appropriate to consider links where traffic flows have changed by less than 10% unless there are significant changes in the composition of traffic, e.g. a large increase in the number of heavy goods vehicles.*"

Where receptors are in close proximity to the road network and increases of over 30% are predicted, the IEA guidelines note that a more detailed assessment should be undertaken to establish the extent of any impact.

6.11.5 Summary of Criteria

The criteria which have been used in the assessment of traffic-related impacts are summarised in *Table 6.3*.

(1) Institute of Environmental Assessment (1993) **Guidelines for the Environmental Assessment of Road Traffic**, Guidance Notes No 1, IEA

Table 6.3 Criteria for the Assessment of Traffic Related Impacts

Potential Impact	Assessment	Assessment Criteria
Traffic conditions	Percentage change in traffic flow	Potentially significant impact if: • traffic flows increase by > 10% • traffic flows increase by > 5% (where network is sensitive) • trips (in/out combined) increase by >100
Impacts on Cyclists and Pedestrians	Percentage change in traffic flow	Significant impact if traffic flows increase by >30%
Traffic-related environmental impacts	Percentage change in traffic flow	Potentially significant impact if: • average/daily traffic flows or HGV flows increase by > 30% • average/daily traffic flows or HGV flows increase by > 10% (where network is sensitive)

6.12 OTHER MARINE COMMERCIAL INTERESTS

An initial review of the existing literature was undertaken in order to establish the other marine interests in the area. In addition, broad consultations were undertaken in order to establish details of the other commercial interests in the area.

The assessment is based on professional judgement, taking consideration of the degree to which commercial interests are likely to be affected by the proposed wind farm.

6.13 MARINE ARCHAEOLOGY

6.13.1 Introduction

The approach to the assessment of potential effects of the proposals on marine archaeology is described in the following sections.

6.13.2 Marine Study Areas for the Archaeological Assessment

In order to set data relating to the wind farm area in context, two larger 'Marine Study Areas' (MSA1 around the wind farm area and MSA2 around the cable options) were defined for collating information. The Marine Study Areas comprised two rectangular boxes connected by a corridor shown on *Figure 6.9*.

6.13.3 Approach and Guidance

The methodology adopted for the archaeological assessment reflects best practice in carrying out archaeological desk-based assessments, as codified by the Institute of Field Archaeologists (IFA) Standard and Guidance for Archaeological Desk-based Assessment (IFA 1999).

Although much of this assessment is based on desk-based (*ie* secondary) sources, provision was also made for the archaeological interpretation of new primary data arising from a marine geophysical survey of the wind farm area.

Although there is little formal guidance in the UK on how the archaeological heritage should be addressed in carrying out Environmental Assessment, the following stages are commonly applied:

- scoping;
- consultation;
- baseline description of known and potential archaeological resource; and
- assessment, including:
  - identification of development-related impacts on the archaeological heritage, based on information about the construction and operation of the proposal;
  - consideration of the significance of the effects – including indirect, secondary and cumulative effects – of any such impacts, taking into account previous disturbance and the importance of the known and potential archaeological heritage;
  - proposals for mitigating significant adverse effects on the archaeological heritage; and
  - identification of any residual effects, being effects that will occur notwithstanding mitigation.

Sources of Information

The following organisations were the principal sources (other than the references listed) of information for the desk-based assessment of the marine aspects of the proposal:

- Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW);
- Clwyd-Powys Archaeological Trust – Services (SMR);
- Receiver of Wreck, Maritime and Coastguard Agency (MCA);
- UK Hydrographic Office (UKHO) – Wrecks Office;
- UK Hydrographic Office (UKHO) – Archives;
- Cadw: Welsh Historic Monuments;

- Naval Staff (Secretariat), MOD;
- Flintshire Record Offices; and
- Fugro UDI Ltd - sidescan data.

Organisations consulted as sources were also invited to raise any curatorial concerns that they might have regarding the application.

Consultation

In addition to those organisation listed above, consultations were carried out with the following organisations during the assessment.

- Countryside Council for Wales; and
- Joint Nautical Archaeology Policy Committee (JNAPC).

Site Visit

A site visit was undertaken on 25 September 2001 to examine the terrestrial routes of proposed buried cables at Rhyl and Abergele.

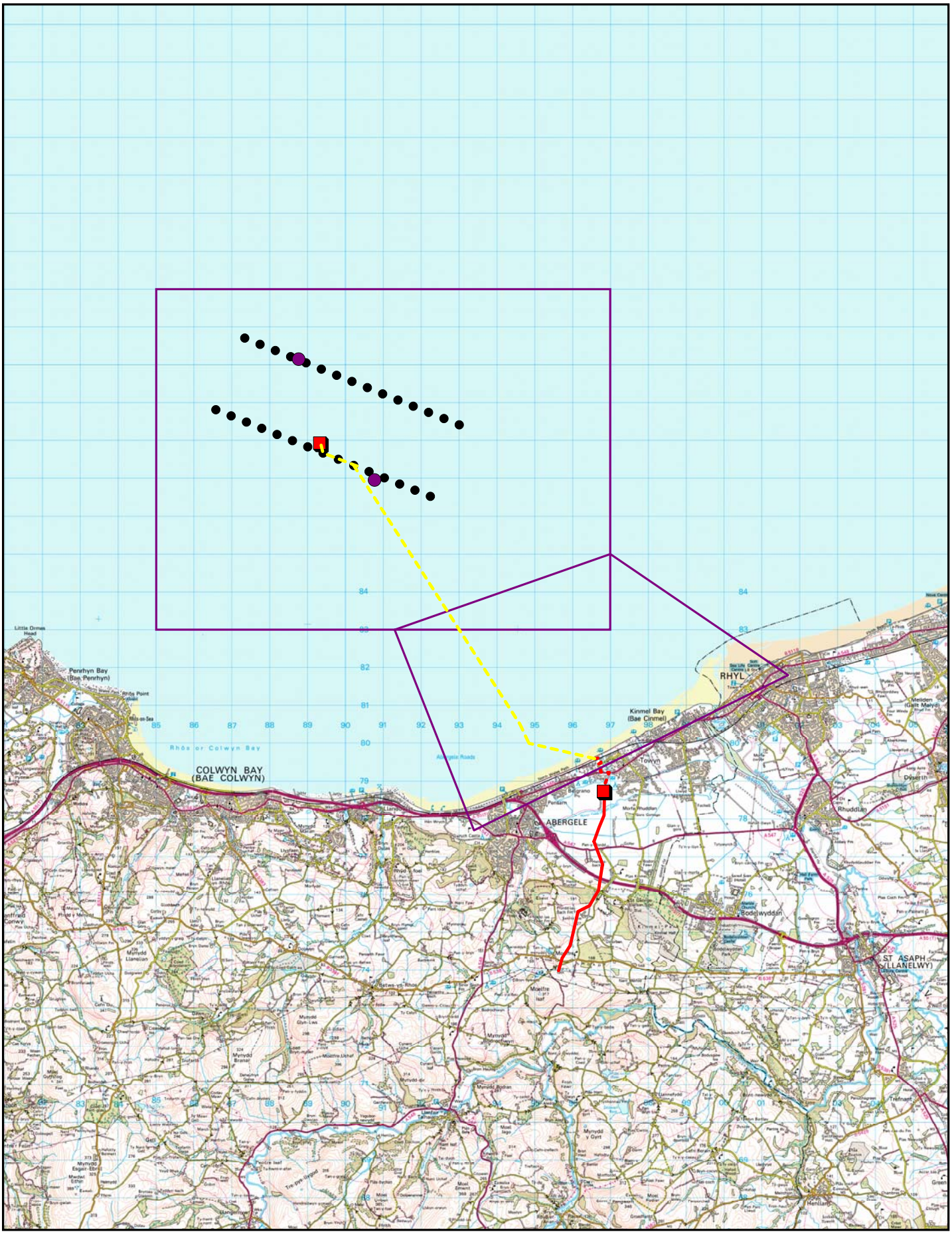


Figure 6.9 Study Areas for the Marine Archaeological Assessment

6.13.4 Relevant Legislation, Planning Documents and Policy

Relevant legislation and policy documents include the following sections.

Protection of Wrecks Act 1973

The wind farm lies within UK territorial waters, in which the Protection of Wrecks Act 1973 applies. Under the 1973 Act, wrecks and wreckage of historical, archaeological or artistic importance can be protected by way of designation. It is an offence to carry out certain activities in a defined area surrounding a wreck that has been designated unless a licence for those activities has been obtained from the Government. Generally, the relevant Secretary of State must consult appropriate advisors prior to designation, though it is also possible to designate a wreck in an emergency without first seeking advice.

In Wales, the Protection of Wrecks Act 1973 is administered by Cadw. Specialist advice is sought from the Advisory Committee on Historic Wreck Sites (ACHWS) and a team of professional diving archaeologists employed on contract. Licenses can be obtained to carry out survey, excavation and other activities that would be otherwise prohibited.

Merchant Shipping Act 1995

The ownership of underwater finds that turn out to be 'wreck' is decided according to procedures set out in the Merchant Shipping Act 1995. Finders should assume at the onset that all recovered wreck has an owner. Ownership of wreck lies in the original owner or their successor, unless they fail to make a claim to the Receiver of Wreck within one year of notification. Ownership of unclaimed wreck from within territorial waters lies in the Crown or in a person to whom rights of wreck have been granted; unclaimed wreck from beyond territorial waters is returned to the salvor.

The Receiver of Wreck has a duty to ensure that finders who report their finds as required receive an appropriate salvage payment. In the case of material considered being of historic or archaeological importance, a suitable museum is asked to buy the material at the current valuation and the finder receives the net proceeds of the sale as a salvage payment. If the right to, or the amount of, salvage cannot be agreed, either between owner and finder or between competing salvors, the Receiver of Wreck will hold the wreck until the matter is settled, either through amicable agreement or by court judgement.

Protection of Military Remains Act 1986

Under the Protection of Military Remains Act 1986, all aircraft that have crashed in military service are protected, and the Ministry of Defence has powers to protect vessels that were in military service when they were wrecked. The Ministry of Defence can designate named vessels as 'protected places' even if the position of the wreck is not known. In addition, the Ministry of Defence can designate 'controlled sites' around wrecks whose

position is known. In the case of 'protected places', the vessel must have been lost after 4 August 1914, whereas in the case of a wreck protected as a 'controlled site' no more than 200 years must have elapsed since loss. In neither case is it necessary to demonstrate the presence of human remains. Diving is not prohibited at a 'protected place' but it is an offence to tamper with, damage, move or remove sensitive remains. However, diving, salvage and excavation are all prohibited on 'controlled sites', though licences for restricted activities can be sought from the Ministry of Defence. Additionally, it is an offence to carry out unauthorised excavations for the purpose of discovering whether any place in UK waters comprises any remains of an aircraft or vessel which has crashed, sunk or been stranded while in military service.

In November 2001, the MoD reported on the Public Consultation on Military Maritime Graves and the Protection of Military Remains Act 1986 (MOD 2001). The report recommended that a rolling programme of identification and assessment be established to designate all other vessels, in military service when lost, as Protected Places. The assessment is to be carried out against criteria that include:

- whether lives were lost;
- evidence of sustained disturbance or looting;
- likely effectiveness of designation;
- public criticism or approval; and
- historical significance.

JNAPC Code of Practice for Seabed Developers

The Code of Practice (CoP) for Seabed Developers, which was prepared by the Joint Nautical Archaeology Policy Committee (JNAPC), extends the principles of development-led archaeology on land to development at sea. The CoP was endorsed by the Department of National Heritage (now Department of Culture Media and Sport) following discussions between archaeologists and many industry groups (including the UK Offshore Operators Association). The provisions of the Code are set out in *Annex A*.

6.14 SEASCAPE, LANDSCAPE AND VISUAL AMENITY

6.14.1 Introduction

This section presents a summary of the methods used to collate and evaluate the baseline environment, to identify the potential effects of the proposals on this environment and to assess the residual impacts (after mitigation) on seascape, landscape and visual amenity of the study area. A detailed explanation of the methodology is provided in *Annex K* (*Volume V*).

6.14.2 Current Assessment Guidance and Source Data

The methods used to characterise and evaluate the baseline environment and assess the potential effects of the proposals on this baseline have been based on current guidelines for seascape, landscape and visual assessment. These include:

- Seascape character assessment - *Guide to Best Practice in Seascape Assessment* (CCW 2001).

- Landscape character assessment - Interim Landscape Assessment Guidance (LUC 1999) and LANDMAP – the Landscape Assessment and Decision Making Process (CCW 2001).

- Assessment of effects - Guidelines for Landscape and Visual Assessment (LI/IEA 1995).

- Cumulative effects - A Guide to Assessing the Cumulative Effects of Wind Energy Development (LDA 2000).

The assessment also takes account of other guidance and legislative requirements for offshore wind energy developments and EIA, such as *Offshore Windfarm Consents Process* (DTI 2001), the *Electricity Works (EIA) (England & Wales) Regulations 2000* (DTI 2000), the *Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999* (DETR 1999), Planning Guidance (Wales) *Planning Policy* (1999 revision), Technical Advice Note 8: *Renewable Energy* (1996) and PPG20 *Coastal Planning*.

6.14.3 Study Area

Theoretically, the tip of a turbine (152.5 m above mean sea level) would be just above the horizon seen by a viewer at 2 m above mean sea level about 53 km away. With shorter turbines, this distance would decrease, but from more elevated locations, this distance would increase. This distance is the result of earth curvature, calculated on the basis of a perfect sphere with a diameter of 12,736 km, with no intervening land to screen the horizon and allows for light refraction.

However, the slenderness of the structures, the limits of human visual acuity and the variable visibility of different weather conditions mean that the human eye is unlikely to actually perceive turbine tips at this distance. Furthermore, the purpose of environmental impact is to examine potentially *significant* effects and it is unlikely that turbine tips, 53 km away, would have a significant effect on seascape character, landscape character or visual amenity. Therefore, it has not been considered necessary to define a study area that extends as far as 53 km in all directions.

In order to assess the full range of viewpoints requested by the Countryside Council for Wales (CCW) and the Local Authorities during the consultation phase of the project, an initial study area was identified that extended:

- West to east - from Ynys Moelfre on the Isle of Anglesey to Hoylake on the Wirral, a distance of approximately 75 km.

- North to south – from the seaward edge of all the seascape units (approximately 23km offshore) to Moel Famau, the highest point on the Clwydian Hills (17km inshore), a distance of approximately 40 km.

Accordingly, this study area has been used for the seascape, visual and cumulative assessments.

However, as the result of the seascape assessment and the zone of visual influence (ZVI) for the final turbine layout, the landscape assessment has concentrated on the landscapes within the Llandudno Bay and Colwyn Bay seascape units, a study area that extends:

- West to east - from Great Ormes Head to Point of Ayr at the entrance to the River Dee, a distance of approximately 37 km.

- North to south – from the coastline to the Aled Hiraethog Hills (10km onshore).

All the offshore and onshore distances quoted above are relative to the coastline at Llanddulas, directly south of the Rhyl Flats offshore site.

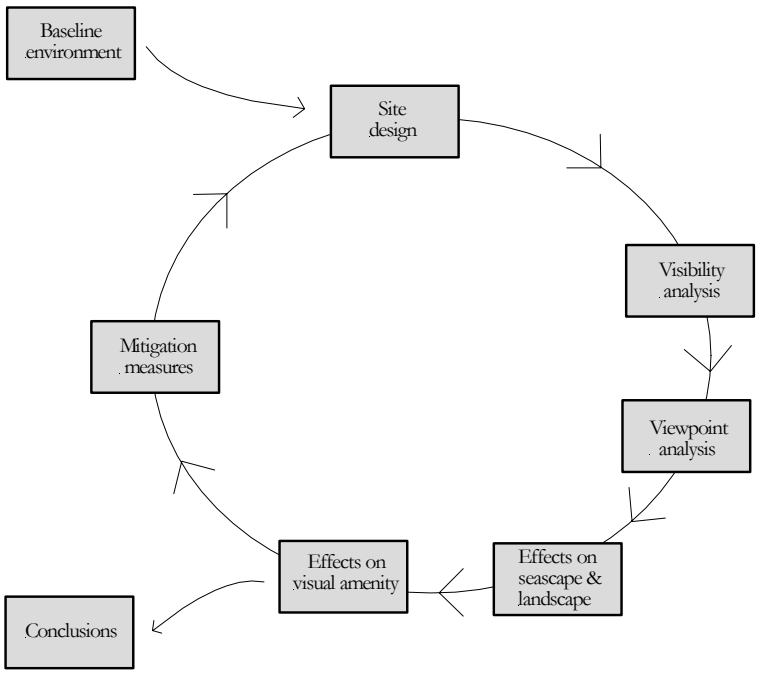
6.14.4 Approach

The assessment process draws on all the legislation and guidance documents described above. It broadly follows the various assessment processes advocated in the guidelines (*eg* CCW 2001, LUC 1999, LI/IEA 1995) but with some modifications and additions. It is described in detail in *Annex K* in *Volume V* and is summarised below.

The assessment process has been part of an iterative process of design and assessment that has examined various designs and has identified mitigation measures that have been incorporated into the final design of the development. This iterative process is illustrated in *Figure 6.10.*

All the stages have involved information review, consultations, fieldwork observations and photography, computer-based data processing and analysis, and the application of subjective professional judgement. The key steps in the process are as follows.

Figure 6.10 Seascape, Landscape and Visual Assessment Process



- Baseline environment – a review and assessment of the seascape, landscape and visual context to identify the seascape and landscape units and their key characteristics, landscape designations, seascape and landscape quality[1], the nature of views, and the location of visual receptors.

- Potential effects and mitigation - a review of the visual characteristics of the proposed developments, to identify the elements with the potential to cause an effect on seascape, landscape and visual amenity, the mitigation measures that would avoid, reduce or compensate for these effects, and the residual effects that have then been examined in the assessment.

- Visibility analysis – a computer-generated zone of visual influence (ZVI) to identify the locations in the study area where landform would permit or screen views of the proposed wind turbines, *ie* the zones of "no visibility" and the zones of "potential visibility" which have been examined in more detail in the viewpoint analysis.

- Viewpoint analysis – fieldwork observations combined with computer-generated wireframes, photography and subjective professional judgement to predict the likely magnitude of effect at a selection of fixed viewpoints, along linear routes and in marine-based locations in the study area.

(1) [1] See Glossary (Volume V, Annex K) for definition of "seascape and landscape quality"

- Assessment of effects on seascape and landscape character – an assessment of the significance of the predicted effects on seascape and landscape character.

- Assessment of effects on visual amenity – an assessment of the significance of the predicted effects on the visual amenity of receptors in the study area.

- Assessment of cumulative effects – a cumulative visibility analysis, a cumulative viewpoint analysis and an assessment of the cumulative effects of the offshore components of the Rhyl Flats and North Hoyle offshore wind farms on seascape and landscape character, and visual amenity.

- Conclusions – on the predicted changes to the seascape, landscape and visual amenity of the study area.

Source Data

Source data for the assessment include Local Development Plans produced by Anglesey, Conwy, Denbighshire and Flintshire Councils, and landscape character assessments carried out by, or on behalf of, some of these local authorities, Ordnance Survey 1:25,000 Outdoor Leisure maps, UK Hydrographic Office Admiralty Charts and the official route map for the Sustrans National Cycle Route along the North Wales coast.