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5 PROJECT ALTERNATIVES

5.1 PROJECT LOCATION

The Rhyl Flats site was selected by COWL after a three year site selection process which began in 1998. The aim of the study was to identify a preferred site and evaluate the prospects of the site from relevant technical, economic and environmental perspectives.

Initially a sieve approach was adopted based on the following key factors:

- water depth;
- tidal range;
- navigational channels; and
- undersea commercial activities.

During the initial data review, over 35 potential areas for development were identified throughout the UK. Technical, institutional and environmental constraints were then defined and applied to the potential sites in order to avoid conflicts with:

- undersea pipelines;
- undersea cables;
- oil and gas exploration licence areas;
- oil and gas platforms;
- sand and gravel licensed dredging areas;
- waste dumps including sewage, colliery spoil, industrial waste and dredge spoil;
- military firing ranges, radar, microwave and radio links;
- radar for shipping;
- commercial and recreational navigational issues;
- fishery interests;
- marine and coastal designated areas; and
- visual amenity and landscape designations.

The following technical issues were also considered as part of a desk study:

- wind resource;
- sea bed geology and conditions;
- waves;
- currents; and
- grid connection.

Through consideration of all the above factors and through consultation with various non-statutory and statutory consultees, seven potential areas for development were shortlisted and registered with the Crown Estate. These included sites in both England and Wales.

Of these seven areas, Rhyl Flats was identified as the most suitable opportunity and therefore COWL's preferred site, for the following reasons:

- water depth and tidal range are within technically acceptable criteria, at sufficient distance from the coast to minimise visual and noise intrusion;
- the local and national grid network runs adjacent to the coast, at a suitable distance from the site;
- commercial use of the seabed in this area is limited to small-scale fishery interests;
- wind resources at this site are good;
- the seabed geology is favourable for the installation of wind turbines;
- there were no perceived conflicts with other development consortia;
- no conflicts were identified with Civil Aviation Authority or Ministry of Defence interests;
- no specific areas of undersea importance, Marine Nature Reserves or Sensitive Marine Areas are located within the immediate vicinity of this site; and
- A study funded by the Countryside Council for Wales (CCW) of the relative visibility from the land of areas of the sea around Wales identified the sea in the vicinity of Rhyl Flats as an area of relatively low visibility in the context of the Welsh coastline.

5.2 PROJECT DESIGN OFFSHORE

5.2.1 Introduction

The project design for this site has advanced in tandem with a continuing process of site assessment and consultation with interested parties. The design has also been guided by the Crown Estate regulations on offshore wind farms, as follows:

- maximum 30 turbines;
- maximum site area 10 km^2; and
- minimum distance to adjacent projects 10 km.

5.2.2 Turbine Selection

Offshore turbine technology is developing rapidly. Turbine models which are likely to be available in 2004, when the Rhyl Flats project is scheduled for

construction, are currently being prototyped. Therefore it is not possible to define at this stage which model will be most suitable for the site. Turbine models available in 2004 are likely to be in the range 2.5 to 5 MW.

Construction in 2004 will allow COWL to take advantage of the larger capacity turbines which are suitable for the site, as this will deliver increased environmental and economic benefits for marginal increases in the size of the turbines. For example, a 25% increase in blade length can deliver a 50% increase in power output and hence emissions savings.

Turbine models under consideration are indicated in *Section 3*. All of the models are three bladed designs, as viable two bladed designs are not currently being prototyped. All turbine types have tubular steel tower designs rather than lattice.

5.2.3 Turbine Layout

The layout of the turbines seeks to optimise their exposure to the prevailing south-westerly winds while respecting environmental and technical constraints.

The optimum layout from a wind resource perspective would entail a single row of turbines. This was considered to present too wide a view angle from the shore and therefore a two row layout was considered.

Within a two row concept, various layouts were assessed from a visual perspective, for example straight lines, wavy lines, concave and convex curves. The geometry of the wavy, concave and convex curves was not easily perceived from any of the shoreline views, indeed the arrangement of the turbines appeared random in most views, so these designs were not considered to offer an advantage in visual terms. However, the structure of the two straight lines could be clearly seen from certain viewpoints, particularly in shoreline views along the turbine rows and in elevated views.

This was seen to be a benefit as this simple, formal layout appeared more in keeping with the open and uniform character of Colwyn Bay. Therefore two straight rows were selected as the preferred layout.

In determining the optimum spacing between the turbines within each of the two rows, consideration was give to the need to avoid the wake effects (which can occur when turbines are positioned too close to each other). This effect reduces the efficiency of the wind farm, hence reducing overall output, and can lead to additional stresses on the blades. Existing ornithological research has also indicated that a line of turbines can present a barrier to bird movements. This effect has been noted for closely spaced turbines (*eg* less than 200m minimum distance between adjacent rotor blade tips). The layout of the Rhyl Flats turbines ensures minimum distance of 320 m between rotor blade tips.

The final layout reflects the following design issues:

- good exposure to prevailing winds and maximum output through minimising wake losses;
- shipping route to the north and west;
- channel to Mostyn Docks to the east;
- another wind farm development to the east; and
- desired set back distance from the coast to the south and south-west.

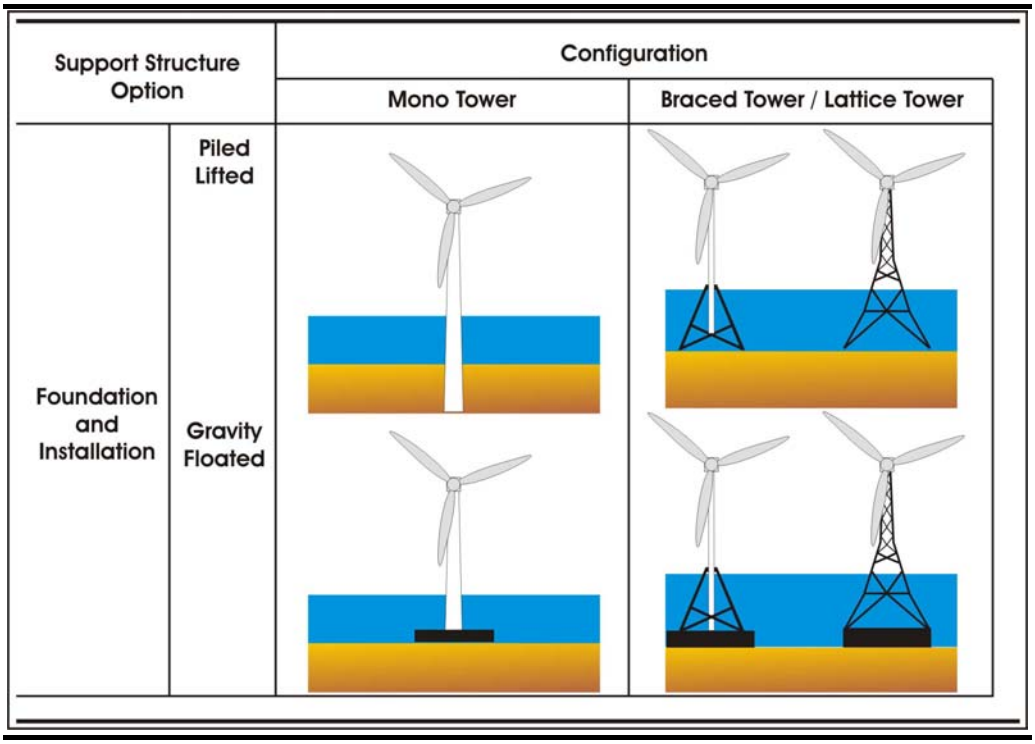
5.2.4 Foundation Type

A number of different foundations were considered, as follows:

- steel monopile;
- concrete caisson (gravity based); or
- multi-pod.

These different types are illustrated in *Figure 5.1* below.

Figure 5.1 Different Potential Foundation Concepts



Geophysical and geotechnical surveys, together with modelling of physical site characteristics, have indicated that the monopile construction is likely to be preferred. This design minimises the footprint of the project while ensuring the integrity of the turbine structures.

5.2.5 Cable Routes

Two cable route options were considered between the wind farm and the shore, as indicated in *Figure 5.2*. The two routes were initially identified on the

basis of broad route options for the onshore grid connection and the availability of connection points to the existing electricity network. Geophysical, geotechnical and environmental survey of the two options indicated that both routes had similar characteristics. The western route corridor was selected as the preferred option following identification of the landfall location and onshore grid connection route.

5.2.6 Landfall

The location of the landfall presented in this ES is indicated on *Figures 1.1* and *1.2*. Several landfall locations were considered and reviewed against the following criteria:

- sea defences and flood risk;
- environmental sensitivity;
- availability of suitable areas on the landward side of the landfall for construction activities and equipment;
- ability to connect to appropriate onshore grid connection routes; and
- technical feasibility.

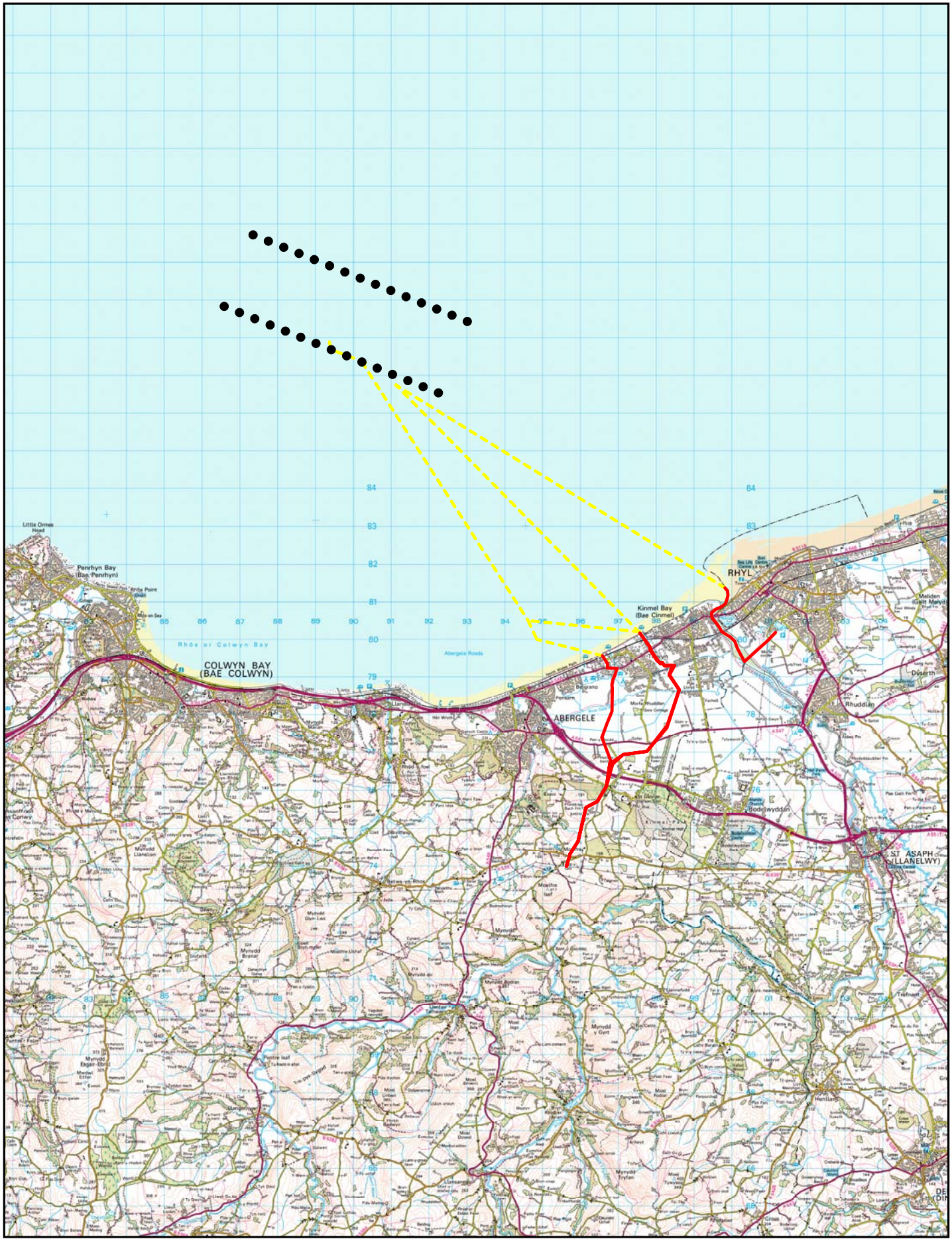
All of the options considered are shown on *Figure 5.4*

The chosen landfall point ensures minimum disruption to the sea defences during construction. It also avoids the environmental and potential cumulative issues associated with installation of cabling within the Clwyd Estuary. This is discussed further in *Section 5.3*.

5.2.7 Offshore Substation

There are environmental and technical issues to consider in the decision between installing an onshore and offshore substation, which will ultimately be made by COWL on the basis of the technology available:

- for the link to shore, four medium voltage (MV) cables provide redundancy and therefore increased security of supply over a single 132kV cable;
- maintenance of an offshore substation would be more complex than that of an onshore substation;
- transmission losses would be reduced using a single 132kV cable; and
- construction at the landfall point and on land would be simpler using a single 132kV cable.



Turbines

Offshore Cable Route Options

Onshore Cable Route Options

0 4

kilometres

Figure 5.2
Subsea Cable Route Options and Landfall Options

5.3 PROJECT DESIGN ONSHORE

5.3.1 Introduction

Discussions with the Distribution Network Operator (DNO) have indicated that there are two options for connecting the Rhyl Flats wind farm to the existing electricity network. These involved extending an existing substation to the south west of Rhyl (NGR 301200 380200), or constructing a simple T-connection to the existing 132kV line running east-west about 7 km from the coast. The latter would involve construction of an MV/ 132kV substation either onshore or offshore, and a metering / switchgear building if the offshore substation option is chosen.

The route alternatives considered are described below:

- using the River Clwyd to access the existing Rhyl substation; or
- a landfall further west (two options were considered) with a route across land to the existing grid connection route approximately 7 km to the south.

5.3.2 Connecting into Existing Rhyl Substation

An engineering consultancy was commissioned to review detailed routing options and construction issues.

Three cable routing options were considered, using the river corridor to gain access to the substation:

- within the river;
- alongside the river within the flood banks; and
- alongside the river within the adjacent land.

All three options would require routing from the estuary to the substation. Crossing of the river was considered using either the railway bridge, conventional cut and fill, or Horizontal Directional Drilling. Various routes from the estuary to the substation were evaluated, with consideration given to the need to avoid a disused landfill site adjacent to the river.

In consultation with the Environment Agency and Countryside Council for Wales, concern was expressed over the potential environmental impacts associated with these options and with the associated works, including cable installation, positioning of junction chambers along the route and possible effects during operation. Issues highlighted included:

- sedimentation affecting habitats and Rhyl beach;
- impact on saltmarsh vegetation, water voles and migratory fish; and
- operational issues associated with exposure of the cabling by natural movements of the river channel.

While these did not preclude the use of this route, the estuary route was discounted because connection proposals made by another wind farm developer raised cumulative issues and also restricted the available capacity at Rhyl substation.

5.3.3 'Eastern Route'

A full Environmental Impact Assessment of the eastern overhead route shown on *Figure 5.2* was undertaken. While there were no over-riding issues of significance to indicate that the route was not suitable, the following constraints were noted:

- extensive sea defences at the proposed landfall point, reinforced after the Towyn floods in 1990 and perceived locally as sensitive to construction disturbance;
- high cost of engineering solution at the landfall point (Horizontal Directional Drilling - HDD);
- proving the suitability of HDD at this location would require extensive local geotechnical investigation; and
- difficulties with routing the cabling around a proposed industrial development in the vicinity of Tir Prince racetrack.

5.3.4 'Western Route'

A full Environmental Impact Assessment of the western overhead route shown on *Figure 5.2* was undertaken and is reported in Volume Three of this Environmental Statement. This route has been identified as suitable for the Rhyl Flats wind farm grid connection for the following reasons:

- the route is shorter than the eastern route;
- the landfall is located at an existing break in the sea defences, which simplifies construction and also allows the restoration of the sea defences to a higher standard than currently exists;
- there is sufficient area on the landward side of the sea defences for the required construction works; and
- the route is further from the parkland and 'essential setting' (Kinmel Park).

The western route had a number of advantages over the eastern route and was, therefore, adopted.