5.3.3 Regional and Local Planning Policy

The proposed wind farm spans the former Port Talbot Borough Council and Borough of Neath Council Areas. These authorities were reorganised into the County Borough Council of Neath Port Talbot. As a result there are a number of Local Plans which impact directly upon the proposed site.

Relevant to the determination of the application.

- Southwest Wales Regional Planning Guidance;
- West Glamorgan Structure Plan (Review No 2) 1991-2006. Adopted February 1996;
- Upper Afan Valley District Plan. Adopted June 1982;
- Borough of Neath Local Plan. Adopted 1994;
- Port Talbot Local Plan. Deposit Draft Approved for Development Control Purposes 1996;
- Also within the reorganised Neath Port Talbot area the Cwmafan, Bryn, Goytre Valley and Rural Margam Local Plan 1989;
- Emerging Neath Port Talbot Unitary Development Plan. Pre-consultation deposit 2000. (Proposal will not be assessed against the content of this document but its inclusion to highlight the future direction of Neath Port Talbot is of interest).

Adjoining Authorities which could be impacted upon by the proposal.

- Mid Glamorgan Replacement Structure Plan 1991-2006. Adopted January 1999;
- Ogwr Borough Local Plan. Adopted April 1995;
- Emerging Bridgend Unitary Development Plan. Deposit Plan March 2001;
- Rhondda Local Plan 1991-2006. Adopted February 1998;
- Cynon Valley Local Plan 1991-2006. Inspectors Report 2000;
- Brecon Beacons Local Plan Adopted May 1999;
- Emerging Brecon Beacons Unitary Development Plan. Deposit March 2002.

Table 5.1 summarises the status of the development plans at the time of production of this ES.

Table 5.1 Development Plan Status

Regional Planning Guidance			
Southwest Wales Regional Planning Guidance			
Structure Plans			
West Glamorgan Structure Plan (Adopted)		Mid Glamorgan Structure Plan (Adopted)	
Local Plans			
Neath and Port Talbot County Borough Council	**Bridgend County Borough Council**	**Rhondda Cynon Taf County Borough**	**Brecon Beacons National Park Authority**
Upper Afan Valley District Plan (Adopted)	Ogwr Local Plan (Adopted)	Rhondda Local Plan (Adopted)	Brecon Beacons Local Plan (Adopted)
Cwmafan, Bryn, Goytre Valley and Rural Margam Local Plan (Adopted)	Bridgend Unitary Development Plan (Deposit Draft)	Cynon Valley Local Plan. (Adopted)	Brecon Beacons Unitary Development Plan (Deposit Version)
Borough of Neath Local Plan (Adopted)			
Port Talbot Local Plan. Deposit Draft (approved for Development Control Purposes).			
Neath Port Talbot Unitary Development Plan - Deposit anticipated Autumn 2002.			

The following table summarises the main points of the detailed review of regional and local planning policy included as Appendix A. It also identifies the context of Ffynnon Oer against these policies.

Table 5.2 Summary of Relevant Regional and Local Planning Policy and Context for Ffynnon Oer

Planning Policy Document and Detail	Ffynnon Oer Context
Southwest Wales Regional Planning Guidance "Support the development of suitable renewable and sustainable energy projects at appropriate locations within the area."	ES addresses issue of appropriate location
West Glamorgan Structure Plan 1996 • EQ1 encourages renewables • EQ2 identifies constraints which renewable energy and proposals must meet to be permitted • Policy C5 identifies constraints on development in the open countryside	ES Addresses issue of appropriate location EIA process has contributed to mitigation development and ES assesses proposals against constraints. Site is not within Brecon Beacons Park and has no nature conservation The ES provides an assessment of effects on sector economics and community and describes existent nature conservation and agricultural conditions
Upper Afan Valley District Plan 1982 • No policies, allocations or designations considered relevant to the proposals	Not applicable
Cumafan, Bryn, Goytre Valley and Rural Morgan Local Plan • Plan encourages development that is appropriate and does not have adverse effects on environment and amenities amongst other aspects • No particular policies on renewable energy are stated	ES sections on socio-economics, landscape and nature conservation consider these effects
Port Talbot Local Plan – Approved for Development Control Purposes • E13 protects low quality agricultural land of nature conservation value • E18 protection to designated landscape protection areas unless can be demonstrated that there is no detrimental effect on the ecology and landscape and these qualities are enhanced	ES section on nature conservation considers this ES section on landscape considers effects. Enhancement and compensation for nature conservation addressed in Section 14. Various ES sections address these aspects of the proposals
Borough of Neath Local Plan In addition to a number of general policies to protect sensitive environments • E64 Archaeology identifies constraints to development affecting archaeological interests	ES section on cultural heritage assesses these effects

5.4 References

- Afan Borough Council and West Glamorgan County Council. Upper Afan Valley Local Plan 1982;

- Borough of Port Talbot Cwmafan, Bryn, Goytre Valley and Rural Margam Local Plan 1990;
- West Glamorgan County Council. West Glamorgan Structure Plan 1996;
- Port Talbot Borough Council. Port Talbot Local Plan 1996;
- Borough of Neath. Neath Local Plan 1994;
- Neath Port Talbot County Borough Council. Neath Port Talbot Unitary Development Plan. Pre Deposit Consultation 2000;
- Ogwr Borough Council. Ogwr Local Plan Written Statement and Proposals Map 1995;
- Bridgend County Borough Council. Bridgend Unitary Development Plan Deposit 2000;
- Brecon Beacons National Park Authority. Brecon Beacons Local Plan 1999;
- Brecon Beacons National Park Authority. Brecon Beacons Unitary Development Plan Consultation Draft 2002;
- Rhondda Cynon Taff County Borough Council. Mid Glamorgan Replacement Structure Plan 1999;
- Rhondda Cynon Taff County Borough Council. Rhondda Local Plan (including waste policies) 1998;
- Rhondda Cynon Taff County Borough Council. Cynon Valley Local Plan Deposit Version 1997;
- Rhondda Cynon Taff County Borough Council. Cynon Valley Local Plan Proposed Response to the Inspectors Report and Proposed Modifications to the Deposit Local Plan 2000;
- Welsh Office. Technical Advice Note 8 (1996) Renewable Energy;
- National Assembly Wales. Planning Policy Wales 2002;
- National Assembly Wales. Economic Development Committee, Report for Consultation. Review of Energy Policy in Wales. Part 1: Renewable Energy. 2002;
- National Assembly Wales. Climate Change, Learning to Live Differently 2001.

6. Site Selection and Alternatives

6.1 The Renewables Obligation

The Renewables Obligation (RO) came into effect on the 1 April 2002. From this date all licensed electricity suppliers were required to provide 3% of their electricity sales from renewable sources in the period to March 2003, rising to 10.4% of sales for the year ending March 2011. For the longer term, even more ambitious targets are expected to be set. The UK Government intends that the Obligation will form the framework for the development of renewable energy in this country up until at least 2027.

The RO effectively replaces the Non Fossil Fuel Obligation (NFFO) system, which had been the main driver behind renewables. Unlike the NFFO system, there is no competitive bidding for power purchase contracts. Under the RO, the electricity supply company pays a penalty (currently 3p/kWh) if it does not meet its obligation and the resulting penalties are recycled back to the supply companies in proportion to how much renewable energy they have supplied.

NWP is a wholly owned subsidiary of Innogy which is an integrated energy company and who are part of the RWE group. A sister company to NWP is Npower, the country's leading licensed electricity supply company. For this reason Npower has the largest Renewables Obligation within the UK which will, in part, be met by wind farms developed by NWP. Innogy Hydro, another division of Innogy also supply Npower with renewable electricity.

6.2 Site Selection process

This section describes the process and criteria by which potential wind farm sites are selected by National Wind Power (NWP). It explains how they where used to identify the Ffynnon Oer Wind Farm location and how consideration was given to other locations within the County Borough of Neath Port Talbot.

The selection of an appropriate site for a wind farm is a complex and lengthy process that involves the examination and balancing of a number of technical, commercial and planning and environmental issues.

6.2.1 Land Acquisition

Acquiring land for wind farm development has two possible start points. The first is a top down approach in a given area e.g. a Unitary Authority, prioritising areas for renewable development based on selection criteria. The second is assessing land that has been suggested by individual or groups of landowners as a result of their own initiative or in response to advertisements. Critical to either approach is the ability to secure the land under an agreement.

There are economies of scale to be considered in selecting sites for wind farms. Larger sites that can accommodate larger numbers of turbines will be more viable than smaller sites. It is therefore important to consider the 'potential wind power installed capacity' alongside other factors considered below.

6.2.2 Technical and Environmental

Irrespective of the start point, a desk study of each potential site must be undertaken to establish its suitability, viability and likely planning prospects. Such a desk study includes but is not limited to the following criteria:

Practical Considerations:

- Wind characteristics (initially based on the Noabl average);
- Availability of suitable grid connection;
- Construction considerations (including ground conditions, access and highway issues among others, availability of roadstone on or close to site).

Planning and Environmental Considerations:

- Planning policies at regional and national levels;
- Noise levels and relative proximity to sensitive receptors;
- Ecological considerations and presence of designated habitat and use of site by designated species;
- Existing land use and opportunities for enhancement;
- Existing site infrastructure;
- Archaeology and historic landscape issues;
- MOD and civilian aircraft issues (including radar and low flying).

This scoping process may also identify additional sites in the locality, or requirements for additional land in order to make the original site viable. If the process indicates that a site does have potential, NWP seek to carry out on site measurements and surveys to confirm its suitability. Such site work is carried out on the basis of reaching a formal agreement with the landowner(s) to allow for access, the siting of test equipment and surveying activities to be carried out.

Where tests suggest a site will be viable, a legally binding long term contract is agreed with the participating landowner(s). This allows for access, the siting of the wind turbines and access tracks and for the operation of the wind farm throughout its life, whilst minimising any disruption to the landowner's existing agriculture or land management activities. Given the capital investment required for the planning and construction of the wind farm these agreements are entered into prior to the submission of the planning application.

6.3 The Ffynnon Oer Wind Farm Site

6.3.1 Site History

The Ffynnon Oer Wind Farm site first came to the attention of NWP in 1993 following the landowner responding to advertisements in the local farming media. The above practical, planning and environmental considerations were applied in assessing the site's suitability as a

site for a wind farm. In addition to this a preliminary Landscape and Visual Assessment was undertaken by ADAS, which concluded:

> "*My preliminary evaluation is that the site is a favourable one for the location of a wind farm as there would be few primary or significant views of the wind farm from surrounding settlements. The fact that most of the site lies outside specially designated landscape areas is also an advantage*"
>
> (Mike Davis, Landscape Architect, ADAS, 1994)

The results of the site selection considerations are detailed below and do not include for the detailed investigations that have formed part of this EIA process. From the assessment it can be seen that the site was considered an excellent location for a wind farm and so following a successful period of wind speed monitoring an application was made for a power purchase contract under the third tranche of the Non Fossil fuel Obligation (NFFO) system. At the time the NFFO system was the enabling mechanism for renewable energy projects. Unfortunately the Ffynnon Oer Wind Farm site was unsuccessful with its application as it could not compete with the very windiest sites available in England and Wales. The site was not progressed further until 2001 when it was known that the RO was likely to become legislation.

6.3.2 Preliminary Considerations

Land Area:
The Ffynnon Oer site has around 150 ha of useable land on which to site wind turbines, which is ideal for a medium sized wind farm.

Wind Speed Assessment:
An anemometer mast was successfully installed at the site at SS846988 during the summer of 1995 and wind speeds were successfully recorded for several months. The results from this exercise confirmed that the site has a sufficient wind resource for a viable wind farm project. A second area to the north of the site SN845005 was also monitored, however the average wind speed was found to be too low for a viable wind farm project.

Grid Connection:
Preliminary studies showed several grid connection options, one to the Northeast (33 kV) and a second to a sub-station (66 kV) to the South.

Construction Considerations:
The proposed site is one of a relatively flat plateau on two levels, one at approximately 400-450 m above sea level and the second at 350-400 m above sea level. Although an area of degraded (drained) peat lies in the centre of the site, this would be largely avoidable through design and micro-siting.

Site access would be possible via existing forest access tracks from the A4061. These access tracks were found to be of the highest grade that the Forest Enterprise construct. Prior to the forest access tracks the A4061, A465 and the M4 were all deemed suitable. No villages or towns would be impacted upon along this route.

Whilst not essential, the existence of a open cast site with the potential to supply road stone without using public roads was also identified as having the potential to reduce the local effects of the project.

6.3.3 Planning and Environmental Considerations

Planning Policy
No national designations were found to apply. A review of local designations concluded that part of the site was classified as a Special Landscape Area within the Port Talbot Local Plan 1996-2006. Note this plan had not been formally adopted.

Noise
No local communities were within 2 km of the centre of the site and the closest property was at approximately 600 m. Initial modelling therefore showed that a wind farm could be designed with the relevant criteria regarding noise.

Ecological Consideration
A full study would be required, however the land was generally improved grassland used for grazing of sheep and cattle. The area of peat at the centre of the site had been drained to improve the grazing potential and surface grips added to improve grazing potential.

Existing Land Use
The existing land use (grazing) would be able to continue following the construction of a wind farm. No PROWs cross the site although several are close by.

Existing Infrastructure
Forest access tracks would reduce the need for new tracks to be constructed. On the actual site, several kilometres of existing tracks, albeit in bad repair, were found to exist.

Military and Civilian Aircraft
The area lies outside MOD low flying areas and over 30 km from civilian and military airports.

6.4 Alternatives in the Neath Port Talbot County Borough Area

In early 2002, the selection criteria were used to assess the potential for other wind farms within Neath Port Talbot County Borough. This was driven by the UK wide move towards devolved targets based on what an area can contribute and aimed at ensuring that every area plays its part in reaching the target of 10% of electricity supply being generated by renewable methods. Table 2.2 shows how the area of Neath Port Talbot County Borough can be reduced from an initial 450 to 69 square kilometres following the application of the selection criteria as described.

An additional screening criteria involving land under current forestry use has been included. It is the view that this land is not openly available to wind development companies, until it is cleared it has an existing permanent land use.

The result of this process was that a total of approximately 13 square kilometres was defined as being suitable for a medium sized wind farm development with Neath Port Talbot County Borough.

Table 6.1 Neath Port Talbot Land Area Assessed Using NWP Criteria

Column Heading	Area ($km^{2)}$
Total Area	450
Area with windspeed > 7 m/s	80
Area > 7 m/s, > 600 m from residences	69
Area > 7 m/s > 600 m from residences, non forested	13

The remaining 13 kilometres were then subject to desk studies which at all times used the Ffynnon Oer site as a benchmark. The following brief descriptions summarise the rationale for concluding that the Ffynnon Oer site provided the best prospects. Other sites were viable though presented a broader range of unresolved technical, planning and environmental issues.

6.4.1 Mynydd Marchwell SN760025

Wind speed prediction models estimate this site has a sufficiently high annual wind slightly lower than the Ffynnon Oer site. The site is of a ridge nature with the spine of the ridge aligned in unpreferred SW/NE direction. The ridge has steep access gradients, which could create difficulties for construction in relation to Ffynnon Oer.

6.4.2 Mynydd-y-Gaer SS765935

Wind speed prediction models estimate this site has a sufficiently high annual wind speed albeit slightly lower than the Ffynnon Oer site. The site is of a "point" nature with a very small plateau compared to Ffynnon Oer, and has an archaeology feature occupying most of the area suitable for turbines. Site access would be via C class roads, which may require upgrading and via a relatively large community with housing directly adjacent to the road including at critical junctions.

6.4.3 Foel Trawsant SS840942

Wind speed prediction models estimate this site has a lower annual wind speed than the Ffynnon Oer site. The site is of a plateau nature similar in size to the Ffynnon Oer site. Site access would be via either of two A class roads, however following the driving of these routes it is expected that significant upgrading would be required if access was possible at all. This is in contrast to the Ffynnon Oer site.

6.4.4 Cefn Morfudd SS790973

Wind seed prediction models estimate this site has a lower annual wind speed than the Ffynnon Oer site. The site is of a plateau nature similar in size to the Ffynnon Oer site, however a

significant percentage of the plateau is forested. Site access would require the use of A- C class roads via communities with steep gradients and sharp bends, which have housing adjacent. This is contrast to the Ffynnon Oer site.

6.4.5 Ergyd Isaf SS795887

Wind speed prediction models estimate this site has a similar wind speed to the Ffynnon Oer site. The site is of a plateau nature similar in size to the Ffynnon Oer Site. Access is via A-C class roads, the later of which is likely to require some upgrading unlike the Ffynnon Oer site. Final access would be via forestry tracks due to gradients within the forest. The land is completely designated as an SLA, in contrast to Ffynnon Oer site.

6.4.6 Mynydd Uchaf SN720100

Wind speed prediction models estimate this site has a similar wind speed to the Ffynnon Oer site. The site is of a plateau nature similar in size to the Ffynnon Oer Site. Access to the site would be via A-C class roads, which are likely to need upgrading. Although no local or national designation applies to the site, it is closer to the Brecon Beacons National Park (being approx 3 km from the Park boundary).

6.4.7 Hirfynydd SN825055

Wind speed prediction models estimate this site has a similar wind speed to the Ffynnon Oer site. The site is of a ridge nature with the ridgeline in the unpreferred SW/NE direction. The East facing slope is currently forested reducing the area available. A small plateau does exist. Access would be off A class roads, however a preferred route is not obvious. No local or national landscape designation applies to the site, however it is within 5 km of the Brecon Beacons National Park.

6.5 Conclusion

Whilst it is several years since the Ffynnon Oer site came to the attention of National Wind Power, the initial analysis and reason for selection are still valid. Although a benchmarking exercise involving all land deemed available within the Neath and Port Talbot County Borough has identified a number of sites which could be appropriate, Ffynnon Oer is judged to offer best fit in terms of Practical, Planning and Environmental criteria.

7. Socio-Economic and Community Issues

7.1 Introduction

The development of the wind farm may give rise to a number of socio-economic and community impacts which require assessment. These potential impacts may affect principally the local communities of Resolven, Croeserw Abercregan, Cymer Duffryn and Glencorrwg all of which are located within a 4 km radius of the site and within the district of Neath and Port Talbot. However the implications of siting the Wind Farm on the perceptions of visitors to the area, particularly those intending to visit existing and proposed attractions will also be considered.

7.2 Methodology

Published information provided by Neath and Port Talbot County Borough Council and the National Assembly of Wales has been used to provide a socio-economic and visitor profile of the area within which the wind farm would be located. The potential impacts of the proposed development on this baseline is then assessed using information commissioned by a range of organisations including National Wind Power into the public perception of wind turbines both throughout Wales and in respect of the communities surrounding this proposal.

7.3 Baseline Description

7.3.1 The Socio Economic Profile

Neath Port Talbot CBC

In March 2000 the unemployment rate of Neath Port Talbot was 6.1% against a Welsh average of 5.9% and UK average of 4.9%. Basic unemployment rates however do not in themselves provide a true picture of the socio-economic conditions of an area. This is better provided by an Index of Multiple Deprivation against which Neath Port Talbot ranks from the third to the sixth most deprived local authority area in Wales. These different positions arise because of the number of different methodologies used by the National Assembly to assess relative deprivation. The Neath Port Talbot Community Plan 2002-2012 refers to the Welsh Multiple Deprivation Index that was complied by Oxford University in 2000 on behalf of the National Assembly. This index is based upon a range of factors that can be used to judge the relative deprivation of one area compared to another, and include income, employment, health, education, housing, accessibility and child poverty. The areas used in the index are the 865 electoral wards in Wales, the 100 most deprived awards are being targeted by the Assembly for resources.

The proposed wind farm development is located principally within the Cymmer Ward with part in Pelenna and Resolven Wards. The settlements of Croeserw, Abercregan, Cymmer and Duffryn to the south of the site, are within the Cymmer Ward. The settlements of Tonmawr and

Efail-fach are within Pelenna Ward and Resolven is within the Resolven Ward. The site is also adjacent to the Glyncorrwg Ward which has the settlement of Glyncorrwgy within. Cymmer is ranked as the 8th and Glyncorrwg as the 24th most deprived wards in Wales, first and second in terms of deprivation within Neath and Port Talbot. Resolven is ranked at 278 in Wales.

The ranking for Cymmer and Glyncorrwg wards against the range of factors is shown in Table 7.1.

Table 7.1 Cymmer and Glyncorrwg Relative Deprivation

Factor	Welsh Ranking (lower figures indicate greatest deprivation)	
	Glyncorrwg	Cymmer
Employment	10	1
Health	6	3
Income	98	70
Education	74	29
Child Poverty	92	71
Overall Ranking (out of 865)	24	8

Source: Neath Port Talbot Community Plan 2002-2012

In order to address issues of deprivation the Neath Port Talbot Community Plan seeks amongst other things to tackle many of the inherent weaknesses that it has identified in the economy. It notes that jobs are fundamental to community prosperity, providing the basic income that determines local living standards and in turn the quality of life and the health and social well being of communities. The area has witnessed an increasing number of job losses, over 5700 partly offset by 3000 job gains. The availability of Objective 1 monies has enabled the Council to develop a strategy founded upon the development of skills and capabilities within the communities. Specific targets are laid down to be achieved by 2006, they include a reduction in unemployment and the delivery of community development initiatives in the 10 most deprived wards.

7.3.2 Tourism

The Neath Port Talbot Tourism Study was published by the County Borough Council and Wales Tourist Board in November 2000. This study sought to profile tourism in the County Borough. The table below demonstrates that its share of the market sector is generally small compared with the three other local authorities that make up Southwest Wales (Pembrokeshire, Carmarthenshire and Swansea).

Table 7.2 Visitors to Neath Port Talbot

1998	Percentage of Wales Share			Percentage of S W Wales Share		
	Trips %	Nights %	Spend %	Trips %	Nights %	Spend %
UK Visitors	1.0	1.0	0.7	3.8	3.9	2.4
Overseas Visitors	1.3	1.3	1.0	6.8	6.7	4.8
Tourism Day Visits	2.3	-	2.8	11.7	-	15.7

Source: Wales Tourist Board - taken from the Neath Port Talbot Tourism Study 2000

The table also illustrates the relatively increased strength of the day visitor market to the County Borough compared with longer stays.

In order to improve the attractiveness of the County Borough the Tourism Study suggested the following strategy:

- raise the profile of the tourism product by building upon existing strengths;
- re-focus, rationalise and brand promotional print;
- raise the quality of the existing tourism infrastructure;
- create stronger partnerships within the industry.

This strategy leads into the Action Plan which contains a range of actions to promote Neath Port Talbot as a visitor destination. Actions considered relevant to the wind farm development proposal are:

- Development of Afan Forest Park:

  The Park is one of South Wales's leading cycling resources. It is attempting to position itself as a future centre of excellence for off-road cycling, with walking and orienteering as supporting product offers.

- Cycle Route Development:

  The County Borough Council aims to fill in the gaps identified in the existing cycle route network including:

  - Cymmer to Glyncorrwg;
  - Extension of the Bryn Cycletrack to provide a circular route in Bryn and a link to the COED Morgannwg Way.

7.3.3 Other Developments

There are also proposals for an adventure holiday park just to the west of Croeserw for which a planning application has been submitted. This potentially provides a significant source of employment in this area.

7.3.4 Public Attitudes to Wind Farms

Public Attitudes to Wind Energy in Wales, Friends of the Earth Cymru

Published in September 2002 this short study sought to identify the level of public support for wind energy in Wales. A total of 500 adults were interviewed by telephone between 23 August to 2 September 2002. Quota were placed on gender and region. Five regions were used including 'Valleys' which consisted of Blaenau Gwent, Caerphilly, Merthyr Tydfil, Neath Port Talbot, Rhondda Cynon Taff and Torfaen. The results of the study should that 71% of adults stated that they would support a doubling of wind turbines on land in Wales. Support was highest in the SE Wales region (75%) followed jointly by Valleys and North West Wales (71%).

RSPB Research

The RSPB undertook a survey of 1000 people between September and October 2001 to investigate public opinion on energy issues, specifically:

- Awareness of different sorts of electricity power station and views on building them in future;
- Views on the disadvantages of particular methods of electricity generation;
- Awareness of the contribution to climate change made by certain methods of electricity generation;
- Whether views on the future of energy differ depending on whether people know about the perceived links between certain methods of electricity generation and their contribution to climate change.

Amongst other things the research found that:

- Two thirds of the public (68%) do not think nuclear power stations should be built in Britain in the next ten years and four fifths (82%) would not want a nuclear power plant built within three miles of their home;
- Nearly 4 in ten of the public (38%) think coal-fired power stations should not be built in Britain in the next ten years, while three in ten (29%) do not want oil-fired power stations to be built. Furthermore, 45% of the public would not like coal-fired power stations within three miles of their homes, while 38% reject the idea of oil-fired stations within three miles of home;
- By contrast, only 3% of the public are opposed to building on-shore wind farms in Britain, and only 14% do not want on-shore wind farms within 3 miles of their home.

The research also found that the public was generally well informed of the climate change debate and could link power generation through fossil fuels to production of greenhouse gasses.

Research Thesis on Behalf of the Welsh Tourism Board

Published in May 2001 this research sought to investigate the impact of wind farms on tourism in Wales. It combined desk-based and fieldwork research including a questionnaire survey of 905 domestic and foreign visitors from which there was a 14.5% (138) response rate.

The findings that came out of the questionnaire were that most people believe that the contribution of wind farms to clean energy production outweighs their impact on the landscape. Almost all visitors questioned (96%) said that they would not be put off visiting Wales if more wind farms were to be developed and 69.3% would visit an information centre if it was built.

Other General Research

Between 1990 and 1996 there were 13 studies by different independent research groups into attitudes to wind power in the UK. In total these studies have canvassed the opinion of over 3500 people. All the studies show that the majority of residents who live near a wind farm are in favour of generating power from the wind and are comfortable with a wind farm in their area. The principle issues of concern in all cases were noise and visual impact. However once operating it was shown that the majority of residents were unconcerned with these aspects. Table 10.4 shows the overall results of the surveys and included in the table are three further studies completed between 1997 and 2002.

Further to these studies, the Scottish Executive in 2002 completed a detailed study of people living in different zones of proximity to wind farms in Scotland. The results are summarised in the following bullet points:

- Respondents were generally positive about wind farms. Those who live nearest a wind farm are more likely to provide positive responses when asked about the wind farm than those in the other zones. For example, while 67% overall reported that there was something they liked about the wind farm, this proportion increases to 73% of those living in the high proximity zone (up to 5 km from a wind farm);
- The proportion of respondents who had anticipated problems prior to the development (40%) was far higher than the proportion who actually experienced problems after the development (9%). Actual noise caused by the turbines or the visual impact of the wind farm did not feature as issues for the large majority of respondents;
- Only 2% of respondents said that they disliked the wind farm because it was noisy, and although 12% of respondents had expected to experience a problem with noise, only 1% had actually experienced a problem;
- Respondents showed low levels of awareness of consultation by either the wind farm developer or the local authority. Twenty percent were aware of consultation being conducted by the wind farm developer and 17% were aware of consultation by the local authority. The most common source of information about the wind farm was local newspapers (42%), with only 7% gaining information from the local authority or the developer;
- When asked about potential future wind farm development, the positive attitude towards the wind farm is reflected in the fact that only 14% of respondents would be concerned if extra turbines were added to the existing wind farm;
- Respondents would be more concerned if a new wind farm development was proposed for their local area, with 27% saying they would be fairly or very concerned.

Although respondents were generally positive about the farms and most would not be concerned about future development, the majority think that wind farms should be located in uninhabited areas and high on hills.

Table 7.3 Findings of Research into Public Attitudes Towards Wind Farms

Location	Sponsor/Organiser	Date	In Favour	Against	Don't Know
Delabole	DTI	1992/1993	84%	4%	11%
Cemmaes	DTI	1992/1993	86%	1%	13%
Llandinam	CCW	1992/1993	83%	3%	14%
Llangwyryfon	CCW	1992/1993	78%	8%	14%
Llandinam	BBC	1994	76%	17%	8%
Rhyd-y-Groes	BBC	1994	61%	32%	7%
Taff Ely	BBC	1994	74%	9%	17%
Kirkby Moor	National Wind Power	1994	82%	9%	9%
Bryn Titli	National Wind Power (pre construction)	1996	68%	14%	19%
Bryn Titli	National Wind Power (open day)	1996	94%	3%	3%
Trysglwyn	National Wind Power (open day)	1996	96%	4%	-
Coal Clough	Liverpool University Dissertation	1996	96%	4%	-

7.4 Predicted Impacts and Effects

7.4.1 Construction

The construction of the wind farm, which will involve an investment of £16 million by National Wind Power which will in turn bring the opportunity for significant direct economic benefits to Neath and Port Talbot and the region.

Subject to planning permission being granted, National Wind Power would put the contract for the supply of the turbines and the construction of the wind farm out to competitive tender. Criteria for selecting the wind turbine manufacturer and civil and electrical contractors would be based on price specifications and guarantees to ensure that performance and technical specifications are met in full. Bids for some aspects of this work can be anticipated to be likely from local companies. This could result in as much as £3 million being spent in the region with local firms.

The assumption provided above are based upon the experience of National Wind Power in the development of the Wind Farms throughout the UK.

In addition to the potential economic benefits to the Region the development of renewable energy presents opportunities for Welsh companies to benefit in the longer term from a reliable source of energy at a competitive price. This is recognised in the Consultation Report of

April 2002 issued by the Economic Development Committee of the National Assembly. This was referred to earlier in this document.

7.4.2 Operational

Following the completion of the wind farm the on-going servicing and maintenance will require 1-2 people to visit the site twice a month. Minor and major servicing will take place at six and twelve month intervals respectively. Depending on the nature of the work required servicing could be carried out either by NWP or contractors.

Following construction National Wind Power propose to erect interpretative signage along the Coed Morgannwg Way as it crosses the site of the proposed wind farm. These signs will explain the importance of renewable energy to users of the footpath and identify local points of interest.

Tourism and leisure sectors offer some opportunities for increasing employment and economic activity within the district. The results of the thesis commissioned by the Welsh Tourist Board demonstrate that the presence of the wind farm may not be detrimental to these new opportunities and indeed may become a point of interest in its own right. There is the potential for a positive effect associating the renewable technology with the positive environmental image of cycling and outdoor recreation activities.

It is NWP company practice to establish a fund to support local communities that include, or are adjacent to an operational wind farm. Two options are provided, the first which provides £21 000 pa for the life of the project, the second which provides a lump sum, followed by lower annual payments in later years. Due to the Assisted Areas status of Neath Port Talbot there is a third option that is open to the communities surrounding Ffynnon Oer. NWP are investigating the possibility of securing European Regional Development Fund Objective 1 funding from the Welsh European Funding Office to allow the community to purchase one of the 16 wind turbines. This would allow the community to earn all the revenue generated by this turbine, between £120 000 to £140 000 pa for 20 years. NWP would contract to manage and maintain the turbine and the sale of its output on behalf of the community.

7.5 Evaluation of Effects

7.5.1 Criteria for Evaluation

The criteria for evaluation have been summarised in section 2 of the ES. In respect of the policy context the definitions used for the socio-economic assessment are:

- National (UK/Wales), regional (Southwest Wales), district (Neath Port Talbot) or local (within 5 km of the site boundary) importance.

7.5.2 Evaluation

Table 7.4 summaries the effects of the proposed development upon the socio-economic and community factors and assesses the significance of those effects.

Table 7.4 Effects and Evaluation of Significance

Socio-Economic Effect	Type of Effect	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance Level	Significance Rationale
Contribution to the overall percentage of renewable energy generated	+ve	Certain	UK/National	Medium	Minor	Development would contribute kWhr/annum of renewable energy.
Maintenance of and increase in existing employment (both direct and indirect) during construction	+ve	Certain	Regional/Local	High	Minor	Maintain and increase construction jobs in areas which rely more heavily on that sector than others.
Maintenance of and increase in existing employment (both direct and indirect) during operation	+ve	Unlikely	Regional/Local	Low	Minor	The level of jobs created by the development will be 1-2.
Installation of interpretation signage along Coed Morgannwg Way	+ve	Likely	Local	Medium	Minor	Improvement to interpretation facilities.
Adverse effect on economy and employment in tourism and leisure sector	-ve	Unlikely	District	Low	Not significant	Survey findings show that most visitors are broadly neutral to the concept of wind farms.
Positive effect of economy and employment in tourism and leisure sector	+ve	Unlikely	District	Low	Not significant	Survey findings show that most visitors are broadly neutral to the concept of wind farms
Establishment of Community Fund and possible community purchase of one turbine	+ve	Likely	Local	High	Major	A regular substantial income for community groups if funding is provided to purchase one turbine

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	- = Negative + = Positive ? = Unknown 0 = Neutral	Certain Likely Unlikely	UK National (Wales) Regional District Local	High Medium Low None	Major Minor Not Significant

7.6 Summary and Conclusions

Neath Port Talbot continues to suffer from a declining manufacturing base and this is evidenced by the higher than average unemployment figures. Furthermore the Borough contains wards which are some of the most deprived in Wales. Cymmer itself ranks 8th.

The wards which include or adjoin Ffynnon Oer are Resolven, Cymmer, Glyncorrwg and Pelenna with the first three containing settlements close to the site. The Neath Port Talbot Community Plan recognises that the inherent weaknesses within the economy need to be addressed in order to improve the overall quality of life for residents. Tourism can play an important role in the economy of the area. Whilst visitors do come to Neath Port Talbot few stay for more than one day and the Council, through its Tourism Strategy has outlined a number of actions to improve the Borough as a visitor destination.

Recent research demonstrates that the majority of residents and visitors to areas with wind farms do not consider them to be detrimental to the quality of their experience and indeed recognise them as a point of interest within the landscape. The development of Ffynnon Oer should support the aims of the Tourism Strategy.

It is also probable that the development of the wind farm will inject financial resources into the local economy and community. It should provide support the construction sector within the region.

7.7 References

- Neath Port Talbot County Borough Council Economic Development Strategy 1999-2002;
- Neath Port Talbot Economic Development Review and Action Plan 2001-2002;
- Neath Port Talbot CBC and Wales Tourist Board Tourism Study - Strategy and Action Plan;
- Neath Port Talbot Community Plan 2002-2012;
- Statistics for Wales - Mapping Social Exclusion. National Assembly for Wales March 2000;
- The GB public's views on energy issues: RSPB 2001;
- A Summary of Research Conducted into Attitudes to Wind Power from 1990-1996. British Wind Energy Association;
- The Impacts of Wind Farms on Tourism in Wales May 2001. Nicole Hofmans. Thesis, Netherlands Institute of Tourism and Transport Studies;
- Public attitudes to wind energy in Wales. Friends of the Earth Cymru, by Market Research Wales Ltd. September 2002.

8. Cultural Heritage

8.1 Introduction

This section assesses the effect of the development on features of cultural heritage. The study has been carried out by Entec UK Ltd. Figure 8.1 shows the location of features and areas of cultural heritage interest discussed in the text, in relation to the proposed development. This is an indicative plan for ease of reference.

8.2 Methodology

Cultural heritage is represented by a wide range of features, both visible and buried, that result from past human use of the landscape. These include standing buildings, many still in use, sub-surface archaeological remains and artefact scatters. It also includes earthwork monuments as well as landscape features such as field boundaries and industrial remains.

The importance of cultural heritage remains is recognised in both legislation as well as national and local policy. Certain features that are deemed to be of particular importance are given legal protection through the *Ancient Monuments and Archaeological Areas Act 1979* (Scheduled Ancient Monuments), and through planning legislation (Listed Buildings).

Further advice on how archaeology should be treated in Wales was formerly given by Planning Policy Guidance Note (PPG) 16 (Wales). This was partially superseded by Planning Guidance (Wales) *Planning Policy* (1996), but both were replaced by Welsh Office (W.O.) Circular 60/96: *Planning and The Historic Environment: Archaeology*, 1996. This states that '*Archaeological remains are a finite, and non-renewable resource, in many cases highly fragile and vulnerable to damage and destruction*' and that '*care must be taken to ensure that they are not thoughtlessly or needlessly destroyed*'.

Further advice on planning and the historic environment is given in W.O. Circular 61/96: *Planning and The Historic Environment: Historic Buildings and Conservation Areas* (and amendment Circular 1/98), which is the equivalent for Wales of the English guidance in PPG 15, *Planning and the Historic Environment* (1994).

The presence of cultural heritage features is therefore a consideration in determining planning applications, and early consultation with the local authority is encouraged in planning guidance (including that discussed above). Where there is a reason to believe that cultural heritage features may be affected by a development proposal then the first step is often the preparation of a desk-based assessment. This involves the collection of existing information that can assist in the assessment of the likely or potential impact of the development.

Site-based investigations may subsequently be required to clarify further the nature and extent of identified features. This is termed archaeological evaluation and includes field walking, geophysical survey and limited area excavation. A local authority archaeologist may request that such investigations are carried out prior to determination of a planning application if there

is insufficient information available from desk-based research to allow an 'informed and reasonable' decision to be reached.

8.2.1 Scope

In completing a desk-based assessment of the effects on cultural heritage of development it is crucial to define the known and potential nature of features that may be involved. This requires consideration of a number of factors:

- Development can affect features of cultural heritage interest not only through direct impacts (e.g. land take) but also indirect impacts, such as the setting of monuments.
- Desk-based assessment involves a review of current information only and there may be further features within the site that are not yet known. The potential for this may be assessed from the conditions of the site, features within the wider area and a history of land use within the site.
- Not all cultural heritage features are considered of equal "importance" and it is important to identify the significance of the features. This is done through reference to legislation, policy guidance and professional judgement.

8.2.2 Direct Effects

Information is required on any features that are known to be or could potentially be within the area directly affected by the proposed development. This includes the footprint of both the built area and those to be landscaped and managed as part of the overall scheme. To this end the following data sources were consulted:

- Sites and Monuments Record (SMR; a county based register of known archaeological and historical sites);
- The National Monuments Record (NMR);
- Register of Landscapes, Parks and Gardens of Special Historic Interest;
- Cartographic and historic documents;
- Aerial photographs;
- Place and field name evidence;
- Published sources.

These were obtained from the following organisations:

- Glamorgan Gwent Archaeological Trust (GGAT);
- CADW: Welsh Historic Monuments Executive Agency;
- Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW);
- West Glamorgan County Archive Service (WGCAS).

The assistance of these bodies is gratefully acknowledged.

A site walkover was also undertaken in order to view known sites of potential significance and to assess the general ground conditions.

In order to place the proposed development in its local context and to help identify the potential for known and unknown features of cultural heritage interest, data was collected for a study area extending 500 m from the proposed application area.

N.B. This assessment was originally undertaken to include a proposed access route from Glyn Gwilym Farm to the application area using existing farm tracks. Since the inception of the EA use of existing forest rides for access to the proposed wind farm has been agreed with the Forestry Commission. Features of cultural heritage interest identified as a result of the original scheme (i.e. coinciding with the access route originally proposed, and within a study area extending 500 m from it), which do not lie within 500 m of the current application area, are not considered by the following text, but remain in the tables of data (Tables 8.1 and B1) where they are marked by an asterisk (*).

The Curatorial Division of GGAT provides planning advice to Neath Port Talbot County Borough Council in respect of cultural heritage related issues. This report was undertaken in full consultation with, and according to a written brief prepared by GGAT Curatorial Division, acting on behalf of Neath Port Talbot County Borough Council.

8.2.3 Indirect Effects

Indirect effects on features of cultural heritage interest can occur as a result of significant changes to the setting of a feature, whether permanent or temporary. Based on national policy guidance, this is normally considered more relevant to designated features of national importance, such as Scheduled Ancient Monuments and Listed Buildings.

Indirect effects on features of cultural heritage interest are further discussed in the following text.

8.3 Baseline Description

8.3.1 Existing Baseline

Designated Features

Registers of designated sites have been reviewed and these show that there are no nationally designated cultural heritage features within the application area or surrounding 500 m study area.

SAMs identified by the original assessment which are outside the present study area include a Roman Marching Camp (SAM County No. GL367, 1) and a nearby defended hillside enclosure (GL366, 18), which lie to the north of the application area. CADW were consulted according to the original proposal as to the potential effects of the development on these features, but these will not now be affected. The settings of these features have nevertheless been considered in Section 8.5.

Other Recorded Features

Consultation with the GSMR resulted in the identification of 6 features of cultural heritage interest within the proposed application area, and a further 39 features within the (current) 500 m study area. Those features identified within the proposed application area and those which are encountered by the proposed access route are shown on Table 8.1. Features that lie outside the application area, but fall within the 500 m study area are shown on Table B2 (which is reproduced at Appendix B). The locations of all these features are shown on Figure 8.1. For ease of reference recorded features are numbered, whereas those identified during this assessment are located alphabetically. Features have, where possible, been numbered in a general trend from north to south.

Table 8.1 Features of Cultural Heritage Interest Within the Application Area

Entec No	GSMR/ NMRW No and Status	Grid Ref.	Name: Description	Distance from Development
2	02230w	SS84209910	Stray finds of 3 worked flints: flake, one tool type and other . No function ascribed. Exposure not specified. GGAT 66 Lithics survey 2000 -pre	
3	00686w	SS84069858	Circular earthwork, probably a cairn -BA All cairns are listed on the GSMR as 'damaged'	
4	00684w	SS83919816[1]	Circular earthwork, probably a cairn -BA	
5	00683w	SS83899813	Circular earthwork, probably a cairn -BA	
6	00685w	SS84059801	Circular earthwork, probably a cairn -BA	

AP = Aerial Photograph(s); BA = Bronze Age; C = Century; Ed = Edition; Rom = Roman; RB = Romano-British; Med = Medieval; OS = Ordnance Survey (map source); pMed = post Medieval

Compass points given as N, S, E, W, etc

No Designated Features

The principal remains of cultural heritage interest within the application area are either prehistoric monuments or industrial remains.

It should be noted that little targeted archaeological work has been undertaken within the application area. Furthermore, the relatively undeveloped nature of the site would be expected to have benefited the survival of archaeological remains.

Medieval features are not recorded within the application area and are not expected to be encountered by the proposed access route. However features thought to be of this date survive outside the application area to the north and it is possible that remains of this date may extend within the application area.

[1] The grid reference given by GSMR records appears to be inaccurate. The grid reference as noted by GPS during the site walkover is SS 83907 98199.

8.3.2 Historical Landscape Character

The area is designated by the 'Landscape Study for Neath Port Talbot -History Aspect Technical Report' (Graves-Brown, May 2000) within the 'Afan Wallia' character area (named after the former manor of the same name, see below), but the area to the north, including Glyn Gwilym Farm, is within the 'Vale of Neath' character area. The area is considered to be of high value for reasons including the survival of archaeological remains and a stated management aim for the character is as follows (pp. 66): '*The Melincwrt marching camp* [1] *is in a poor state and would benefit from protective measures to mitigate erosion*'.

The application area is dominated by the upland area of Cefn Mawr, which is a steep-sided hill surmounted by a level plateau, much of which, particularly to the north and west is covered by the earthwork remains of previous coal mining. The site also encompasses a lower lying area in the form of a natural terrace to the south and west. The identifiable prehistoric and historic components of the landscape are mostly restricted to the discreet prehistoric features discussed elsewhere in the text, and later changes to the landscape wrought by enclosure and industry. The prehistoric landscape would have been noticeably different to the existing one, and the surviving features, perhaps with the exception of the barrow on Cefn Mawr (**3**), are not defining aspects of the current landscape. Some historical features, namely land boundaries and mining remains, are still prominent, but the character of the present landscape is largely defined by existing commercial forestry and to a lesser extent modern agricultural improvement. Historical aspects worthy of note are the drystone walling on Cefn Mawr, which partly marks the original parish boundary between Glyncorrwg and Michaelston-super-Avon (before turning into Glyncorrwg parish towards Tyle Mawr), and the remains of Blaen-y-Cwm and Cefn Mawr collieries to the north of the application area.

Landscape character is further discussed in Section 9 of this report.

8.3.3 Features Identified During this Assessment

Documentary research and a site walkover undertaken during the course of this assessment has identified a further 21 features of potential cultural heritage interest within the application area, which have not previously been identified from other sources consulted. These are summarised in Table B3 (Appendix B), and their locations are shown on Figure 8.1. For ease of reference those features identified during this assessment are numbered alphabetically in a general trend from north to south. Of those features identified, one (**V**) lies outside the study area to the northwest and has been identified at the foot of the table. Sources consulted during the assessment are further discussed below.

Aerial Photographs

A comprehensive search of aerial photographs was undertaken at the NMRW. The search resulted in 35 photographs, dating from 1946 to 1992, and all of these were viewed. The search made at the NMRW incorporated those photographs held at the Central Register of Air Photography for Wales, and photographs contained within GSMR records were also consulted.

Four features of potential cultural heritage interest were identified from those aerial photographs consulted. Brief descriptions of these are given in Table 8.3 and their approximate locations are shown on Figure 8.1. Three of these (**C**, **M**, **N**) appeared to be roughly circular and would be consistent with either cropmarks indicative of sub-surface features or visible intrusions associated with mineral extraction. The fourth was a square feature (**A**) close to the northwest of Ffynnon Oer, which may represent the footings of a building or even a standing structure.

Other features of potential cultural heritage interest, as discussed elsewhere in this report were also visible within the proposed development area on those aerial photographs viewed.

Documentary Sources

A range of documentary sources were consulted at the NMRW and WGCAS. Published sources and historic maps were consulted.

The boundaries of several parishes meet within the application area. The bulk of Cefn Mawr, and the area to the south and east of the site lies within Glyncorrwg Parish, which is bordered to the north by the parish of Resolven and to the northwest by Clyne; lying to the east and west of Melin Court Brook respectively. These and Michaelston-super-Avon to the west represent only small 'wedges' of the application area. The modern parish boundaries largely reflect the historic boundaries and township sub-divisions of the former parishes of Llantwit-juxta-Neath (or Llantwit Lower) and Michaelston-super-Avon, within the Hundred of Neath, and Glycorrwg. However Michaelston-super-Avon (Higher) formerly extended much further to the east, encompassing most of Cefn Mawr. Resolven and Clyne were formerly hamlets within the larger parish of Llantwit-juxta-Neath, until Clyne became a parish in its own right and Resolven Parish was formed in 1850. The southern part of the site was formerly the township of Michaelstone-super-Avon Higher, forming the northern part of the larger parish of Michaelstone-super-Avon.

The entire area was also historically part of the Manor of Avon (Welsh; Afan) Wallia, which included the parishes of Clyne, Glyncorrwg and Michaelston-super-Avon, in addition to those of Baglan (Higher and Lower) and Blaenwrach. According to deeds held by WGCAS, the manor was in existence from at least 1687 until 1884.

The available Tithe maps and associated apportionments covering the application area and access route were consulted. Those available were Llantwit-juxta-Neath; Resolven and Clyne hamlets, and Glyncorrwg Parish. The route of Cefn Ffordd is clearly marked and named, and other tracks are also shown following very similar courses to the present, including the present route to Glyn Gwilym Farm and the '*Road from Glyncorrwg to Neath*'. Other boundaries also remain substantially unaltered, but there are no indications on this map of any archaeological features. Place and field names shown are mostly landscape descriptions, such as '*Ffynnon Oer*'; 'cold spring', or '*Tarren Cefn Mawr*'; 'great back knoll'. The area to the north of the study area containing Melin Court Camp and the IA hillfort is named simply as '*Caed cae blaen y cwm*' probably 'field at the head of the valley', although '*cae*' has various meanings including fence, hedge and clasp'. The most unusual name identified is '*Gwain pentlwyn du*' given for the western part of Carn Caca, outside the study area to the north, where '*Gwain*' means sheath or scabbard and '*du*' means black, but no translation could be found for '*pentlwyn*' (possibly a personal name). Melin Court Brook is shown here as '*Nant y Banwen*'. No references appear to be shown to coal mining within the application area or along the proposed access route.

The OS 1st Edition of 1884 details coal levels in the general location of Garth Merthyr Colliery, although no name is given. '*Blaen-y-cwm Colliery*' is also shown outside the application area to the north, serviced by a tramway, as shown on current OS editions. Earthworks are also marked in locations denoted on current OS editions as disused trial levels near the southeast boundary of the application area, although it should be noted that the 2nd Edition marks these as old quarries. The dismantled tramway that borders the south of the site is shown in use on this edition. The boundary between Michaelston-super-Avon and Glyncorrwg parishes follows Nant Cregan. A tumulus is shown on this edition in the location of **3**, but none other of the archaeological

features identified elsewhere are shown. The track around '*Taren Cefn-mawr*' (**J**), which follows part of the current parish and district boundary, is also marked as Cefn Ffordd (see also **25**) on this edition, and there is a spring shown at the foot of Cefn Mawr to the northwest, adjacent to this track. Ffynnon Oer is also shown, and several benchmarks are shown along the parish boundary to the east of it.

The OS 2nd Edition of 1900, which represents a revision of the 1st Edition in 1897 shows few more details within the application area than the previous edition. The District boundary between Glyncorrwg and Neath is now shown in its current position. An '*Old Quarry*' is shown in the side of Cefn Mawr directly to the west of Cairn **3** and trial levels are shown further to the west just outside the application area, in the location of the Waun levels. More coal levels are shown at Garth Merthyr Colliery, although here it is shown as '*Gored Merthyr Colliery*'. Blaen-y-cwm Colliery has also developed, and a '*Pile of Stones*' is shown in the location of **23**.

The OS Edition of 1921 identifies 'Cefn Mawr Colliery' in the location where coal workings had already been shown on the 2nd Edition. The tramway marked on current editions is also now shown to the west of Melin Court Brook. Gored Merthyr and Blaen-y-cwm Collieries are now shown as disused. '*Old Trial levels*' and a '*Coal Level*' are now shown in locations marked on current OS editions around Tarren Cefn Mawr. '*Posts*' are shown in various locations around Ffynnon Oer. An '*Old Sheepfold*' is shown at *c.* SS 8410 9905, just outside the application area.

The OS revision of 1914 with additions in 1948, and subsequent editions, show few significant features, although it is worth noting that the revisions of 1948 still omit the cairns **4**, **5** and **6** to the southwest of the application area. The commercial forestry plantation that currently surrounds the application area to the east, west and south is not complete until the edition of 1964, although a large area to the southwest denoted '*Michaelston Forest*' is present by 1948. The only additional feature of potential cultural heritage interest is an unidentified small circular earthwork, which is shown in the approximate location of a cropmark identified during this assessment (**N**, to the north of 'Bol Las').

No features of potential cultural heritage interest other than those discussed were identified.

Site Walkover

A site visit was made on 14 May 2002, by one of Entec's archaeologists. This was aimed at confirming the presence, condition and extent of previously recorded features of cultural heritage interest and identifying any other visible features of cultural heritage interest. General ground conditions were also noted.

A written description of visible features of cultural heritage interest was made and photographs taken. The location of and extent of each feature was measured approximately using a hand-held GPS working with an accuracy of up to 4 m. This is considered an appropriate level of detail for this study.

In the lower lying area of the application area; the natural terrace to the south and west of Cefn Mawr, peat deposits had been revealed by modern drainage channels. Past experience of such deposits suggests that the potential for the preservation of archaeological deposits, and particularly ecofactual evidence within peat deposits, is generally very high, although the extensive agricultural improvement and drainage of the land is likely to have substantially reduced the potential for the survival of such remains within the application area.

No significant boundaries, mature trees or hedgerows were noted that are not indicated on current maps. Several boundaries across the summit of Cefn Mawr represent parish boundaries, one of which is partly represented by a drystone wall (see Section 8.3.2.) and might be considered to be of historic importance.

8.3.4 Predicted Trends

Present land uses within the site include:

- Rough (and some improved) grazing;
- Unrestored past coal workings.

There is some evidence for the degradation of the earthwork remains of cairns within the southwest of the site, since the original survey records were made in the 1950s. In particular the cist internal to one of the cairns (**5**) on the lower lying ground to the southwest of Cefn Mawr is quite prominent. It is not clear whether this is a result of the use of the land for rough grazing, land improvement techniques or environmental factors. This gradual degradation may be expected to continue as a result of present land use.

No significant change to the status of any presently unrecorded sub-surface remains within the application area would be expected from the continued use of the site for current purposes. However commercial forestry activities can be highly damaging to archaeological remains and any expansion of forestry activities into the proposed application area would certainly damage any archaeological remains present.

8.3.5 Information Gaps

There is no further information that could usefully or reasonably have been collected as part of this desk-based assessment.

Where reasonably practicable and where such items exist and were available for the application area, the list of sources stated in the brief prepared by GGAT Curatorial, have been consulted. Exceptions are as follows:

- Complete OS coverage after 1948 has not been obtained. There are sufficiently few changes after this date that later editions were unnecessary;
- Aerial photographs held by NMRW (RCAHMW), Central Register of Air Photography for Wales and GSMR, including those from the OS, RAF and commercial photographs were consulted as part of this assessment. This is considered sufficient for the purposes of this assessment;
- No local archaeological or historical societies were identified with an interest application area.

8.4 Mitigation and Enhancement

There are known features of cultural heritage interest within the application area.

Planning guidance (WO Circular 60/96) states that there is a presumption in favour of preserving *in situ* archaeological sites of national importance. Current proposals do not pose any threat to such sites.

It is appropriate for significant aspects on features of archaeological interest of less than national importance to be mitigated by a programme of archaeological field investigation and preservation by record, if their destruction is unavoidable. Every effort is being made to tailor proposals in order to avoid known features of cultural heritage interest. When a layout has been established there will be the further provision for small changes to turbine locations through micro-siting. Where damage to known features of less than national importance is unavoidable, archaeological recording would represent suitable mitigation.

8.4.1 Further Mitigation

Known features of cultural heritage interest have been avoided where possible. Access tracks will cross the following features according to current proposals:

- Drystone wall (shown on Figure 8.1) on Cefn Mawr;
- Dismantled tramway (**J**) to west of Cefn Mawr;
- Revetted ditch (**R**) in southwest of application area.

A very small portion of these features will be affected and their extent is in any case already recorded by existing OS maps. These features were also photographed during the site visit undertaken for this assessment. A watching brief on works affecting **J** and **R** as part of a 'strip and record' exercise, may provide details as to their construction.

The enclosure feature (**S**) identified during this assessment to the southwest of the application area may be affected by the construction of the access track between turbines 10 and 16, according to current proposals. The extent, nature, quality and date of this feature, and the effect of construction upon it could be established by trial trench evaluation in order to inform any mitigation required. Alternatively there is scope for this feature to be avoided by micro-siting.

Known features within the application area and within the wider area suggest the potential for the survival of further archaeological features and deposits, particularly of a prehistoric date, which have not previously been recorded. Intrusive activity associated with development may therefore encounter archaeological features and deposits, especially in the lower-lying area to the south and west of Cefn Mawr, which is a suitable area for settlement. As noted in Section 8.2.1, there is also a potential for unknown archaeological remains to be present within or beneath the peat noted in this area.

In areas of intrusive activity, such as the excavations of turbine footings, where remains are not known to survive, archaeological monitoring and preservation by record, without prior field evaluation is likely to represent sufficient mitigation. In areas where the topsoil only will be removed and the resulting surface protected by a geotextile membrane, a 'strip and record' exercise may be sufficient.

Table 8.2 Mitigation Incorporated into the Proposed Development

Impact	Mitigation Incorporated into the Proposed Development	Impact Wholly Mitigated?
Construction Phase of Development		
Damage to /destruction of known archaeological remains	• Known remains have been avoided by layout design where possible. Further 'micro-siting' of turbine locations will be used as necessary	No
Damage to /destruction of previously unrecorded sub-surface archaeological remains	• Where such remains are encountered they will be suitably recorded. Further 'micro-siting' of turbine locations may be used to avoid archaeological features identified during construction	Yes
Operational Phase of Development		
No effects identified		

8.4.2 Enhancement

There is the possibility for enhancement of archaeological features as proposals are likely to cause a decrease in the intensity of grazing and a cessation of the improvement of land for agriculture, which can be damaging to earthwork features and sub-surface archaeological remains. It is proposed that the agricultural drainage of the lower lying areas within the application area will be halted, which may have a beneficial effect on sub-surface archaeological remains in that it will stop any further desiccation of any waterlogged remains that may be present.

It is also proposed that the maintenance of an archaeological watching brief on construction could be combined with the survey of some of the features noted during this assessment, in order to enhance the archaeological record. Features which would benefit from this are the possible cairn (**T**) and enclosure (**S**) identified to the southwest of the application area. There is also the possibility of recording cross sections through the linear features affected by access track construction (**J** and **R**).

The presence of the wind farm would also prevent the further encroachment of commercial forestry.

8.5 Evaluation of Effects

In order to assess the importance of an effect upon cultural heritage, features of cultural heritage can be classified in terms of whether they have a local, county or national significance. This can be a subjective process, with features being assessed in terms of their rarity, state of preservation, date, group value and historical associations.

Some sites have a national designation and therefore will always be considered to be of national importance. This applies to scheduled ancient monuments and listed buildings. Listed buildings are graded in importance, with grades I (most important), II* and II. It is worth noting that programmes for reviewing designations are ongoing, so sites that are not designated may be of local, regional or national importance. Criteria for the designation of scheduled ancient monuments and listed buildings are published in WO 61/96 and WO 60/96 respectively.

Effects are also considered in terms of the probability of occurrence and magnitude. Magnitude can be considered in terms of how much impact the development will have on a particular feature. Work which affects only the edge of a feature can be considered to have an effect of lower magnitude, than that which affects more of it.

8.5.1 Evaluation Criteria

Four criteria have been used in our evaluation of the predicted effects of the proposed development:

i) The type of effect, (i.e. whether it is positive, negative or unknown).

ii) The probability of the effect occurring based on the scale of certain, likely or unlikely. If there is uncertainty this will be noted.

iii) The policy importance (or sensitivity) for the evaluation, (i.e. international, national, county, district or local/parish importance). An effect can have a policy importance (or sensitivity) at more than one level.

iv) The magnitude is quantified using a simple scale of major, some, minor or no effect. In some cases it is not possible to quantify the magnitude of impact and therefore not quantified is used in these instances.

The findings in relation to all of these criteria are brought together to give an assessment of significance for each effect, based on professional judgement. Effects are considered to be of major, minor or no significance. Those effects rated "major" equate to the term "significant effects" in the EIA Regulations 1999.

This information is presented in Table 8.3.

In addition to those effects identified in the Table 8.3 the indirect effects on the setting of the SAMs outside the north of the study area was also considered in the early stages of this assessment, and during the site visit. Although there will be some visibility between these and aspects of the development, the nature of the development is such that sight-lines will not be affected. The landscape has already been substantially affected by features which post-date these scheduled sites, particularly industrial activity (coal mining) and commercial afforestation. In addition, the effect caused by development is largely reversible; removal of the wind turbines would restore the original character of the area (with the residual effect of remaining infrastructure). Given these factors and the intervening distance between the SAMs and the application area (over 600 m), the magnitude of effect of the proposed development is therefore considered to be minor and of low significance.

Table 8.3 Effects and Evaluation of Significance

Environmental Effect	Type of Effect	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Construction:						
Damage to known features of cultural heritage interest - prehistoric remains	-	Unlikely	Local/ Regional	None	Not Sig	It is thought that these features will be avoided by development design
Damage to known features of cultural heritage interest - mining remains and boundary features	-	Certain	Local	Minor	Minor	Remains which may be affected are limited to boundary features and a former tramway, only small parts of which will be affected. The extent and progression of these features is recorded on OS maps, aerial photographs and by photograph as part of this assessment
Damage to known features of cultural heritage interest - other remains	-	Likely	Unknown	Some	Unknown	The enclosure feature (**S**) identified during this assessment to the southwest of the application area may be affected by the construction of the access track between turbines 10 and 16, according to current proposals. The effect of construction on this feature could be established by trial trench evaluation or alternatively the feature could be avoided by micro-siting
Potential for damage to previously unidentified sub-surface archaeological remains	-	Unknown	Unknown	Unknown	Unknown	Potential is reduced by the limited area of intrusion. Preservation by record is likely to represent appropriate mitigation Trial trench evaluation would further establish the presence or absence of such remains
Opportunity for further archaeological investigation	+	Likely	Unknown	Unknown	Unknown	The potential exists for further remains to be encountered. However, intrusive development is limited in area, and this limits opportunity

Table 8.3 (continued) Effects and Evaluation of Significance

Environmental Effect	Type of Effect	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Operation						
No effects identified						

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	- ve	Certain	International	Major	Major
	+ ve	Likely	National	Some	Minor
	? = Unknown	Unlikely	County	Minor	Not Significant (Not Sig)
		Unknown	District	None	Unknown
			Local/Parish	Unknown	
			Unknown		

8.6 Summary and Conclusions

Current proposals pose no direct threat to the designated features identified by this assessment. Indirect effects on the setting of such features will effectively be less than changes already caused by commercial forestry, and the effect is largely reversible in the event of the removal of the turbines. It should be noted that any proposals which directly affect the SAM of the Roman Camp, which is crossed by the existing track from Glyn Gwilym Farm, would require Scheduled Monument Consent. This SAM is also specifically mentioned by the Neath Port Talbot Landmap Project.

The potential effects of the proposed development on known features of cultural heritage interest identified within the application area will be avoided wherever possible by development design; namely the siting of the wind turbines. Unavoidable damage to known features will be limited to earthwork remains relating to mining activity and boundary features, which are of local importance and already sufficiently recorded by such sources as OS maps.

There is the possibility that development will encounter further archaeological remains that have not previously been identified. Archaeological trial trench evaluation of any larger areas of ground disturbance would further assess the potential for this and inform as to any mitigation required. The archaeological monitoring of smaller areas of intrusive works is likely to represent sufficient mitigation.

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WILD 586 82/136, frames 102 -4, 1982.

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9. Landscape and Visual Assessment

9.1 Introduction

9.1.1 Scope of the Landscape and Visual Assessment

This section analyses the potential landscape and visual changes and consequences resulting from the construction and operation of the proposed wind farm development at Ffynnon Oer. The assessment includes full consideration of the impacts and consequent effects of the access road, any associated buildings and the connection to the national grid. The assessment has been based upon the "*Guidelines for landscape and visual assessment*" (GLVIA) jointly published in 1995 by the Landscape Institute and the Institute of Environmental Management and Assessment[2] and the second edition published in March 2002[3].

9.1.2 Definition of the Study Area

The definition of the study area is a crucial element of the assessment and was undertaken during the Scoping Study. In accordance with paragraph 6.5 of the Countryside Council for Wales guidelines[4] the normal study area radius of 15 km has been extended to a radius of 20 km. This is to ensure that adequate consideration is provided of the potential landscape and visual impacts and consequent effects upon the southern-most fringes of the Brecon Beacons National Park. The closest area of National Park lies approximately 10 km to the north of the proposed wind farm site at the Waterfall Walk in Pontneddfechan. Overall the Brecon Beacons National Park accounts for 16% (195 km^2) of the 1257 km^2 study area.

A study area of a radius of 20 km from Ffynnon Oer will encompass large tracts of open countryside and commercial forestry as well as the towns of Neath, Port Talbot, Bridgend, Maesteg, Hirwaun and the eastern portion of the City of Swansea. It also includes several important valleys with the linear settlement development that is characteristic of this part of South Wales including the upper Rhondda Valley, the Tawe Valley north of Swansea and the Ogmore Valley. Overall the majority of the study area's population live towards its fringes, in particular its southern and southwestern fringes.

The study area also includes a number of important communications corridors that potentially could provide sequential views of the proposed wind farm and both sequential and cumulative views of the proposed Ffynnon Oer Wind Farm and other existing, permitted and proposed wind farm developments in the region (see section 9.8.1). Amongst the potential key road routes are

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[2] Guidelines for Landscape and Visual Impact Assessment. The Landscape Institute and the Institute of Environmental Assessment. Spon Press, London. 1995.

[3] Guidelines for Landscape and Visual Impact Assessment: Second Edition. The Landscape Institute and the Institute of Environmental Management and Assessment. Spon Press, London. 2002.

[4] CCW Wind Policy and Checklists. Undated CCW publication.

the M4 between junctions 35 and 46, the A465(T) along the Vale of Neath, A4067 along the Tawe Valley, the A4107, A4063 and A4061.

It is important to remember that the study area does not provide a boundary beyond which the wind farm will not be seen. Instead it defines the area within which the wind farm may have a significant landscape or visual effect. The process of specific definition of a study area as described above allows the detailed assessment to concentrate upon the area within which the potential significant effects of the wind farm are most likely to occur.

9.2 Methodology

9.2.1 General

The landscape and visual assessment was prepared according to a methodology developed by Entec based upon the previously referenced guidelines. Neath Port Talbot County Borough Council the local authority within whose boundaries the proposed wind farm site and most of the study area are located; have only recently commenced their LANDMAP landscape character assessment. There is therefore no landscape character assessment information available in the recognised LANDMAP format. Hence as part of the baseline studies the methodology of LANDMAP was used to develop a landscape character assessment for the study area. LANDMAP is the recognised tool of the Countryside Council for Wales for Landscape Character Assessments.

Photography is an essential tool in landscape and visual assessment, conveying landscape character and illustrating key views. The second edition of the Guidelines for Landscape and Visual Impact Assessment suggest that a 35 mm film format with a 50 mm focal length lens should be used as the 50 mm cameral lens is commonly accepted to best represent the naked eye. This is the format that this assessment uses for the annotated photographs in Figures 9.7a-g. However we have taken note of the best practice put forward by Scottish Natural Heritage with regard to the landscape and visual assessment of wind farms[5]. This states that experience in assessing wind farms in Scotland demonstrates that with regard to the crucial issue of photomontages, the most accurate visualisations are generated by the use of a 70 mm lens. The photomontages produced to accompany this assessment have been produced in this (70 mm) emerging best practice format.

9.2.2 Baseline Studies

The definition of the study area is followed by the baseline study, which records the existing landscape and visual resource within the study area. The baseline study is presented in five sections; firstly, an overview of the contextual landscape conditions of the study area; secondly, a more specific description of the site area; thirdly, an outline of general visibility across the study area; fourthly a description of landscape designations that are relevant in the evaluation of the landscape and visual resource; and finally a description of the factors affecting visibility.

[5] Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

9.2.3 Landscape Assessment

Introduction

Landscape impacts consist of the changes in the fabric, character and quality of the landscape. They include changes to the landscape as a resource such as the loss of elements or features or the alteration of the balance of features in a landscape causing a shift in the perceived landscape character.

The assessment of the predicted landscape effects is based upon information gathered through the baseline studies concerning the following factors which, in combination, make up the landscape:

- physical factors - geology, landform, soils, drainage, ecology and climate;
- human factors - archaeology/history, land-use and settlement patterns;
- aesthetic factors - visual and sensual considerations;
- associations - cultural and historic.

Landscape Receptors

The introduction of the wind farm will have *indirect* and *direct* effects on the landscape, with *indirect* effects being those that affect the landscape character and *direct* effects those that physically alter landscape elements. Four aspects of the landscape resource are considered in the assessment, with these being identified through site survey:

- On-site landscape elements that may experience *direct* physical effects;
- The contextual patterns and dynamic of development and broad scale characteristics found throughout the study area that may be *indirectly* affected through the introduction of the wind farm, and these are encompassed in the grain of the landscape;
- The various landscape character types that comprise the study area and that may be *indirectly* altered through the introduction of the wind farm. Landscape character types are drawn from the relevant SNH landscape character assessment documentation and corroborated on site;
- Designated features, such as gardens and designed landscapes and listed buildings that may be *indirectly* altered through the introduction of the wind farm.

Other than the landscape grain, which is considered as a single receptor, each of these categories covers a number of landscape receptors, which are components of the landscape that will be affected by the wind farm.

Types of Landscape Effect

The effect of the wind farm on each identified landscape receptor is classified according to its ability to accommodate the wind farm. This ability is expressed as a variable in the significance classification for the effect upon each landscape receptor, with the following definitions being used:

- **Beneficial** where it is felt to complement or contribute to the landscape, strengthening it or adding positive characteristics and qualities that were not previously available;
- **Neutral** where it neither contributes to nor detracts from the landscape, and can be accommodated comfortably by the landscape context;
- **Adverse** where it introduces elements that are not currently found in the landscape and cannot be accommodated without some detrimental effect.

The ability of landscape receptors to accommodate the wind farm is assessed through professional judgement based on the factors considered in the evaluation of the sensitivity of receptors and the magnitude of the effects and on the knowledge of the study area as a whole that the assessors have gained.

The significance of the effect of the wind farm on each of these landscape receptors is assessed through a combination of their sensitivity and the magnitude of the change that they will experience.

Magnitude

The magnitude of change is an expression of the degree of addition, change or loss that would be experienced by the baseline landscape conditions and is classified as high, medium, low or none.

The following factors are considered in the evaluation of magnitude of change:

- The **nature** of the perceived contrast, or integration, of any new features or changes with the existing landscape including the nature of the turbine layout;
- The **scale** of change in the landscape with respect to the proportion of the landscape affected by the wind farm and the degree to which it is affected;
- The **duration** and **reversibility** of the effect on the landscape.

Sensitivity

The sensitivity of each landscape receptor is dependent on its value and its ability to accommodate the wind farm, and is classified as high, medium or low. This classification is derived from consideration of a number of variables:

- **Landscape quality**: an appraisal of the state of repair or condition of landscape elements, the integrity and intactness of the landscape, and the extent to which its distinctive character is apparent in a particular area.
- **Landscape value**: an appraisal of the importance of the landscape, with consideration given to any national and local designations that may apply, the perceived value of the landscape to users and other consultees, and any intrinsic aesthetic characteristics of the landscape such as scenic quality or sense of place. These may be derived from literature, films, television programmes and guides.
- **Development of the landscape**: the ability of the landscape to accommodate the wind farm will be dependent to a large degree on the existing development within

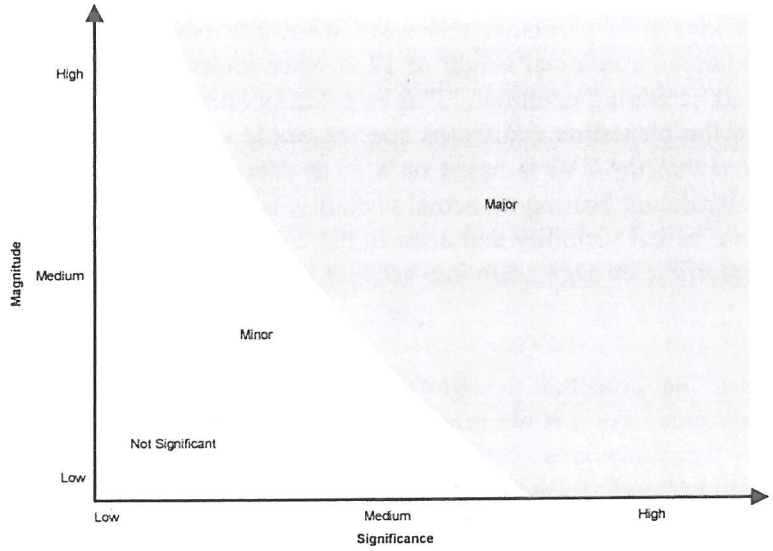
the study area, especially in cumulative views. Landscapes that are already influenced by development similar in some way to the type proposed generally have a greater capacity to accommodate the proposed changes, while those lacking any influence from built form or other human elements may be more susceptible. In this assessment the evaluation of the sensitivity of landscape receptors does assume knowledge of the nature of the development proposed.

- **Scale of the landscape**: this also affects the ability of the landscape to accommodate the wind farm. A large scale landscape of simple landform generally has a greater capacity to absorb a development of the scale of the proposed Ffynnon Oer wind farm than a smaller scale, complex setting where misleading comparisons of scale may occur.
- **Visibility**: whilst visibility is primarily a visual concern, the extent of enclosure and variation in topography has a role to play in determining the sensitivity of a particular landscape to change.

The manner in which these considerations are evaluated to derive a sensitivity category is set out in Section 9.7.1.

Significance

The significance of the effect of the proposed wind farm upon each identified is a product of the sensitivity of each receptor and the magnitude of change sustained. It must be emphasised that this is not a simple linear relationship and is dependent upon the use of professional judgement. The relationship between magnitude and sensitivity and the resultant significance levels are illustrated in the following diagram:



On the basis of experience of similar large scale assessments, it has been decided that there are three thresholds of significance have been adopted: major; minor; and not significant. The assessment of significance is on a qualitative basis and therefore as a scoring system it does not avoid subjectivity and it is recognised that to an extent it is reliant upon careful use of professional judgement.

9.2.4 Visual Assessment

Introduction

The visual assessment is based upon the identification of potential visual receptors for the wind farm. In accordance with the GLVIA the effects sustained by visual receptors within the estimated visual area are assessed as a product of their sensitivity to visual change and the predicted magnitude of that change.

Visual impacts relate to views of the landscape available from publicly accessible areas and residential dwellings and the predicted effects of these visual changes on the public and residents, i.e. receptors. Visual effects include the loss of important elements in a view, the obstruction of views or the introduction of new features or elements. Visual changes can be caused by a change of scale, bulk, colour or texture of an existing view. As with landscape effects, change can be beneficial as well as adverse or neutral. Assessment of some other subjects within this ES includes a consideration of the likely occurrence of the predicted impacts i.e. certain; likely; possible etc which are set out in the significance evaluation tables. With regard to the landscape and visual assessment no such column has been included. This is because the assessment consistently assesses the worst case scenario and as such it is considered that all effects are certain: to state that they are only 'possible' or 'likely' would be to add an unhelpful element of uncertainty into the assessment.

The visual assessment is based initially on the production of a zone of visual influence diagram (ZVI), which indicates those areas of the site surroundings that theoretically gain views over the wind farm. The ZVI generated by "Wind Farm" software programme is illustrated in Figure 9.1. It is important to remember that the ZVI is based on landform data and therefore does not normally include the screening effects of vegetation, buildings and other features that provide a visual barrier. However the potential for the screening of views by extensive Forestry Commission plantations is of particular relevance in the Ffynnon Oer study area. Hence we have given all plantations a nominal height of 12 m when undertaking the ZVI calculations to take account of their screening potential. This is a conservative estimate as under favourable conditions many of the plantation coniferous species would reach heights exceeding 20 m. It should also be noted that the ZVI is based on a 50 m data grid, and thus localised landform, which can have a significant bearing on actual visibility, is not always represented. Anomalies between the ZVI and actual visibility that arise in the course of site survey and are relevant in the evaluation of specific views are taken into account in the course of the assessment.

Visual Receptors

The wind farm has the potential to significantly effect visual receptors and their views throughout the study area. As it is not practical to individually identify and assess each of the visual receptors in the study area, potential changes to the visual resource are represented through a series of views and routes that are identified on the ZVI – and confirmed through site visits and wireline illustration production as having visibility over the wind farm site. Wireline illustrations are produced for each of the selected views and indicate the theoretical visibility of the wind farm from each receptor viewpoint. The wirelines are constructed to indicate just the turbines as these are the most highly visible of the development components.

A total of 28 views and 6 routes representing the most populous and/or potentially sensitive receptor groups are used to assess the wind farm's potential visual impacts and consequent

effects on the study area. The location of these receptor groups and their views are indicated on Figure 9.2.

- Views are chosen to represent the various types of views available to potential key visual receptors and include views where the wind farm will be seen on the skyline from a wide variety of points ranging from major roads, settlements and recognised viewpoints, to areas designated for their landscape and recreational importance such as the Brecon Beacons National Park. Whilst the views are not specifically utilised in the *landscape assessment*, consideration is given to the landscape character types to ensure that the selected views are representative of the various parts of the study area.

- Routes used in the assessment are those that have potential for sequential visibility, which may occur where a viewer following the route gains an outlook of the wind farm progressively or intermittently over a period of time. The routes selected are those considered to be of particular importance due to their high *theoretical* sequential visibility of the wind farm, their traversing of the study area, their proximity to the site and the level of usage of the route.

The potential for cumulative visibility is also considered in the visual study. Cumulative visibility may occur either where more than one wind farm is visible at the same time from a single cumulative viewpoint or, more commonly, as sequential cumulative effects where more than one wind farm may be seen whilst moving along a route within the study area.

Types of Visual Effects

The type of effect sustained by receptors located at each view or route is evaluated and classified as follows:

- **Beneficial,** where it is felt to complement or contribute to the view, strengthening it or adding positive characteristics and qualities that were not previously available;

- **Neutral,** where it neither contributes to nor detracts from the view or route, and can be accommodated comfortably by the visual context;

- **Adverse,** where it introduces elements that differ in terms of scale, form or character from the existing nature of the view and cannot be accommodated by the visual resource without detrimental effect.

The ability of views and routes to accommodate the wind farm is assessed through professional judgement based on the factors considered in the evaluation of sensitivity and the magnitude of the effects, and on the knowledge of the study area as a whole that the assessors have gained. Whilst the classification of the ability of views and routes to accommodate the wind farm is determined through this professional judgement, it is acknowledged that people have wide-ranging opinions of the effects of wind farms and that subjective judgements are frequently made as to their appearance. Opinions are therefore likely to vary and this classification may not reflect the feelings of all viewers.

The visibility study determines through the process of assessment whether or not the views and routes will be significantly effected by the construction and operation of the proposed wind farm. The significance of the effect on views and routes is assessed through a combination of their sensitivity and the magnitude of the change that they will sustain.

Magnitude

The magnitude of change is an expression of the degree of addition, change or loss undergone by the baseline views and routes and is classified as high, medium, low or none.

The following factors are considered in the evaluation of magnitude of change on views:

- The nature of the change, including the perceived contrast or integration of any new features or changes in the view, including the appearance of the turbine layout and the way that the wind farm is perceived within the context of the view;
- The duration and reversibility of the effect;
- The angle of the view over the site in relation to the main activity or orientation of the receptor;
- The extent to which the wind farm is visible in the view and the proportion of the view that is occupied by the wind farm;
- The distance of the viewpoint from the wind farm;
- The nature of the view – whether it is a transient or progressive view of the wind farm, and whether it appears on or below the skyline.

The criteria used for the nature of the change in the magnitude of change on routes is assessed slightly differently, being based on the nature of the views over the wind farm along the route rather than the contrast between the wind farm and the existing views. The definition of the nature of the change on routes is defined as follows:

- The nature of the change to the visual experience of the route, including the frequency, length and number of views, and the various aspects over the proposed location of the wind farm that are available. A fragmented series of views generally constitutes a greater change to the visual experience of a route than a continuous progressive view due to the variety of fragmented 'snapshot' situations in which the wind farm may appear, thus drawing the attention of the viewer repeatedly to the wind farm. Likewise a route that twists around with the wind farm appearing alternately closer and then further away in quick succession will constitute a greater change than a logical route where the wind farm gets progressively and steadily closer or further away. A perception of the presence of several wind farms may arise should the turbines appear at intervals along the route with a varying character, scale and appearance.

Sensitivity

The sensitivity of each view and route is classified as high, medium or low through consideration of:

- Visual quality: an appraisal of the quality of the view relating to its amenity and its integrity and intactness;
- Visual value: an appraisal of the importance given to the view, as indicated by factors such as its recognition as a tourist viewpoint with facilities provided for its enjoyment or its location within an area covered by a landscape designation.

Based on the *Guidelines for Landscape and Visual Assessment. Second Edition* the different receptor categories identified in the Ffynnon Oer Wind Farm baseline are ranked in order of their sensitivity to visual impacts as set out in Table 9.1. It should be stressed that this table is indicative only as it would be impossible to rigidly tabulate sensitivity to change.

Table 9.1 Sensitivity of Visual Receptors

Visual Receptor Categories	Sensitivity
• Public Rights of Way	**High**
• Residential communities	↓
• Private residential properties	
• Public and private recreational open space	**Medium**
• Rights of way associated with highways	↓
• Businesses and industry	**Low**

Significance

The sensitivity of each view or route and the magnitude of change on it are combined to arrive at a classification of significance of the effect of the wind farm. The correlation between these variables is the same as for the landscape significance matrix as illustrated in the previous section.

As with the assessment of the significance of visual effects, it must be stated that the relationship between magnitude, sensitivity and subsequent predicted significance is not a straight forward linear one and the resultant assessment of visual significance will always contain an element of professional judgement.

9.2.5 Cumulative Effects

This assessment takes account of the potential cumulative effects of Ffynnon Oer Wind Farm. Cumulative effects may be found where two or more wind farms (either existing or proposed) have an incremental effect, and can occur either where there is intervisibility of the wind farms so that they may both be viewed from a specific point, or where a viewer may gain progressive views of two or more wind farms along the course of his route. In the latter instance, the wind farms may not be intervisible at the same time, but can combine to have a cumulative effect on the viewer as he moves through the environment having a sequential series of views.

The assessment takes into consideration wind farms that are already built, those that have planning permission, and those for which the applications for consent have been submitted and are still within the determination process.

For the purpose of the assessment of cumulative effects a specific radius has been covered for each wind farm as being indicative of the area within which that wind farm may have a significant visual effect. In accordance with the CCW guidelines this radius has been set at a distance of 20 km for all the identified existing, permitted and proposed wind farms within

40 km of the Ffynnon Oer site. The desk study has demonstrated that there are two existing, permitted or proposed wind farms that need to be assessed as part of potential cumulative effects. These wind farms are listed below:

- Taff Ely an existing wind farm, grid reference 980 865, approximately 19 km southeast of Ffynnon Oer;
- Margam Wind Energy Cluster; a proposed wind farm, grid reference: 834 884, approximately 11 km south of Ffynnon Oer and adjacent to it a proposed two turbine farm at Lluest Wen.

The location of these wind farms are indicated on **Figure 9.3.**.

9.2.6 Visualisation techniques

The visual assessment is supported by careful use of visualisation techniques utilising wire frame representations and photomontages. Wire frame representations have been generated from 19 locations. Through use of digital topographical data (Ordnance Survey Panorama) and a computer generated representation of the proposals, a model of the turbines as it would appear in the landscape is produced. However whilst this process takes into account factors such as the curvature of the earth, the data used means that no account can be taken of surface features such as vegetation or man-made elements such as buildings. OS Panorama data has an accuracy of ±3 m.

The use of photomontages provides an accurate visual representation of the impact of proposals, it is a well established technique in environmental assessment. With regard to wind farm developments specific guidance has been produced, and certain aspects of the standard photomontage production process have been modified, to improve the accuracy of the images used in Wind Farm ES. Firstly the location of the seven viewpoints from which the photomontages were produced was agreed in conjunction with the relevant planning authorities and based upon the preliminary ZVIs generated using the industry standard Wind Farm software programme. Secondly at each viewpoint a panorama and a telephoto picture were taken over the course of two site visits to maximise the visibility which is a particularly important factor in the views available from the more distant agreed points. Thirdly panoramas were made up of three 50 mm focal length photographs digitally stitched together to provide the necessary site context. Finally a 70 mm focal length photograph centred on the site was taken following recent good practice in wind farm EIAs, in accordance with the previously referenced SNH guidance. It is considered that 70 mm focal length photographs most closely represent the detail that is perceived by eye when focussing upon a distant object i.e. a turbine.

The photomontages are then produced using the Wind Farm software programme. A wireframe of the site is matched to the topography in the photograph so the turbines can be rendered to produce a photo-realistic impression of the wind farm.

The final output of the photomontage process includes the panorama including the location of the 70 mm frame which is shown in outline, the topographical wireframe showing the location of the turbines and the 70 mm photomontage itself. A critical factor when looking at the photomontages is the viewing or focal distance from the eye. This is calculated by measuring the length of the uncropped negative of the picture and multiplying it by the length of the final print, then dividing it by the camera lens length. The viewing distance varies between prints

because of differences in the amount of the negative cropped in the photographic development and printing process.

9.3 Baseline Studies

The baseline study records the existing landscape and visual resource within the study area and is presented in five sections: firstly a consideration of the landscape elements within and immediately around the Ffynnon Oer site that could potentially be directly impacted by the construction and operation proposals; then an overview of landscape characteristics of the wider area, including characteristic patterns and combinations of landscape features, scenic quality and tranquillity; thirdly at a study area scale it is necessary to have an understanding of landscape character i.e. the distinct and recognisable pattern of elements that is found consistently in a particular type of landscape, and how this pattern is perceived by people; fourthly the baseline lists all the relevant landscape planning designations and policies that need to be considered in the determination of the sensitivity of landscape receptors; and finally it is necessary to provide an overview of the visibility within the study area as a whole and the ZVI in particular.

9.3.1 Landscape Elements

Landscape elements are the individual components that makeup the landscape such as woods, trees, valleys, buildings and roads.

The Proposal Site

The proposed site is situated on an upland plateau with the highest point (464 m Above Ordnance Datum) marked by a trig point. The trig point is located to the eastern area of the proposed site, approximately 250 m from the edge of Cefn Mawr forest. From the trig point the land gently falls away to the southwest before it drops steeply down to a second plateau at approximately 380 m AOD. To the north of the trig point the land falls away more into a narrow valley containing Melin Court Brook which descends from approximately 300 m AOD.

The land cover is predominately acid grassland with blanket bog located on the highest ground. Surrounding the south, east and west boundary grow the maturing coniferous plantations of Mynydd Mant-y-bar, Pelenna Forest and Cefn Mawr which screen much of the site from external views.

The remains of a drystone wall crosses the highest point of the site running a few metres from the trig point in a southeast direction towards Cefn Mawr. The old field boundary is now marked by a post and wire fence. A number of unsurfaced tracks cross the southern section of the site. One of these tracks is an old tramway; a remnant of former mining activities which were widespread throughout the surrounding area.

Woodland and Other Vegetative Cover

The proposed wind farm is sited on an area of open upland grassland surrounded by extensive coniferous forest plantations which dominate the majority of valley sides and hilltops between the Neath and Rhondda Valleys. The majority of the forests, particularly those covering the Afan Valley are made up of blocks of single coniferous species. Japanese Larch is planted

mainly on the lower fertile slopes of the valley, with Scots and Corsican Pine at higher elevations and Sitka Spruce on the most exposed, wet plateaux [6].

To the south of the proposed site, coniferous plantations continue to cover the higher ground around the town of Maesteg. On the lower levels the landscape is covered by small irregular fields of arable, pasture and meadow. Field boundaries are marked by hedgerows containing the occasional mature hedgerow tree and linear stretches of broad-leaved woodland follow the course of streams. Tall hedgerows also edge and enclose a number of the minor roads, which at times are no wider then single tracks.

Drainage Pattern

Around the study area numerous streams emerge from the mountainous uplands to feed into the larger rivers that flow in a southeasterly direction such as the Neath and the Afon, or a southerly direction such as the Llynfi, the Afon Gawr and the Ogwr Fawr. The nature of the terrain and flow of the streams and rivers has created an area rich in waterfalls, particularly within the Vale of Neath.

Other Power and Communications Features

An overhead electricity transmission line runs from north of Bridgend past the western edge of Maesteg and approximately 5 km to the west of the site of the proposed wind farm. Pylons carrying the line are visible crossing the many valleys, becoming more visually dominant when traversing elevated areas where they break the skyline. The study area contains several examples of radio and television masts situated at elevated locations that break the skyline and are visually prominent man made additions within the landscape. Pertinent examples are located at:

- Werfa south of the A4107 - Grid Ref: 914948 Altitude 565 m AOD;
- TV relay station, Maesteg - Grid Ref 842913 Altitude 250 m AOD;
- Foel Fawr, west of Croeserw - Grid Ref 858953 Altitude 340 m AOD;
- Foel Fynyddau, north of Cwmafan - Grid Ref 783936 Altitude 370 m AOD;
- Varteg Hill, eastern side of Swansea Valley - Grid Ref 777078 Altitude 352 m AOD.

Settlement Pattern

The predominant and distinctive settlement pattern is linear ribbon development situated along the route of the valleys. The dominant style of housing is long terraced rows running along the lower levels of the valleys to the extent that many valleys consist of interlinked small towns and villages. The majority of this housing dates from the nineteenth century industrial heyday of South Wales. There are remnants of the pre-industrial settlement pattern in the form of small hamlets or more frequently farmsteads that are generally located on the middle slopes of the main valley sides or at the bottom of ancillary valleys where they would have had ready access to the seasonal grazing on the upper areas on the ridgelines separating the valleys. It is

[6] Afan Forest Park leaflet, Forest Enterprise.

important to note that the upper altitude limit for such farmsteads appears to be 250 m with few being located above the 200 m contour. The upper reaches of the higher ground separating the valleys contains no settlements or isolated residential properties.

Road Network

Within the study area the road network pattern is dictated by the topography with the primary network roads running along the valley floors linking the ribbon settlements. The main route from the south is the A4063 from Bridgend which links to Maesteg and finally Cymer where is joins the A4017 which runs in an east to west linking Rhondda and Port Talbot through the Afan Valley. To the north of the proposed site the dualled A465(T) is a prominent feature running through the valley floor of the Vale of Neath. Approximately 9 km to the west of the proposed site runs the major route of the M4 linking the coastal towns and cities of South Wales. It is rare for any surfaced roads to cross directly from one valley to another over the intervening higher ground. The restriction caused by the topography also results in settlements in the more remote valleys being accessed by dead end roads which peter out beyond the settlement e.g. the road up Glyn Corrwg which ceases at Glyncorrwg; the village 2.5 km to the east of the site of the proposed wind farm.

9.3.2 Landscape Characteristics

The key characteristics of the study area are:

- Elevated landform with steep sided valleys;
- Upland landscape shaped by the influences of nature and man, particular past industrial uses of mining and smelting;
- Well wooded ridges and valleys with coniferous plantations dominating the higher levels and broad-leaved woodlands situated along the lower slopes;
- Farmland and sheltered valley landscapes at lower altitudes with woodlands, dry stonewalls, and hedgerows;
- Numerous waterfalls, streams and rivers twisting across the valley floors;
- Contiguous linear settlements situated along length of valleys;
- The strong contrast between the urban and industrial development in many valleys (especially to the east of the site) and the empty, open upland areas;
- The relative simplicity of the arrangement of the main elements of the upland landscapes and the strong contrasts in colour and texture between the forestry plantations and extensive open upland grassland;
- The availability of panoramic long distance views from open, elevated locations and the role of the forestry plantations in framing views and screening outward views.

9.3.3 Landscape Character

The landscape character is a product of a combination of a wide range of factors that contribute to the creation of a unique setting. Landscape combines geological features, geomorphic processes, plant and wildlife associations with social, economic and cultural forces. The study area covers a number of different landscape types, which as part of this assessment have been classified with reference to the methodology of LANDMAP. Due to the length of time required to produce a detailed Landscape Character Assessment using LANDMAP, the classification of landscape character areas has grouped (where appropriate) landscape types together. The following eleven landscape character areas have been identified and are illustrated on Figure 9.4.

Upland Forest /Plateau Moorland

The central region of the study area, which includes the Ffynnon Oer site, is dominated by coniferous forest plantations which cover the majority of mountain tops and valley sides. The majority of the plantations, particularly those cover the Afan Valley were planted during the 1930's and 1950's as part of an extensive afforestation programme to create a renewable national timber resource[7].

Few upland areas have remained clear of forest plantations, but in such areas patches open unenclosed grasslands exist. Moorland plateaux on mountain tops covered by rough grass (and in wet areas sphagnum moss and fragments of raised bog) enable open views and the lack of tall vegetation and boundaries creates a sense of exposure.

Although large areas of this upland are covered by modern forestry, it is given a high value by both the areas of surviving upland pasture and the wealth of archaeological remains. Within these areas are remnants from past human activity which date back from the Bronze Age to the recent industrial era. Most recent are the spoil heaps and disused mines from the twentieth and nineteenth centuries. Many of these might not seem to have much immediate value, but are non the less and important part of the area's heritage and landscape[8].

Exposed Upland / Brecon Beacons

The study area extends into the southern region of the Brecon Beacons encompassing the lower sections of the Black Mountain and Forest Ffaw. The Black Mountain is a collective of mountains that range in height from approximately 353 m AOD to 802 m AOD (although the highest level within the study area lies at approximately 500 m AOD). The mountains offer no shelter and are exposed wild landscapes which are characterised by steep sided ridges, rocky outcrops and numerous mountain streams. There are also the remnants of past human activity in the form of small quarries which scar the mountain sides.

Forest Ffaw is also a collective of mountains although its lower regions are not as open and exposed as the Black Mountain. Large pockets of coniferous plantation mixed with small clusters of deciduous woodland and a patchwork of field boundaries creating a greater sense of diversity and enclosures. The waterfalls along the route of Afon Mellte and Nedd Fechan are a distinct landscape element of the river valleys in this area.

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[7] Afan Forest Park leaflet, Forest Enterprise.

[8] Neath Port Talbot LANDMAP Project, NPT/H/26 Afan Wallia.

The height of the mountains provides the perfect opportunity for panoramic views of the surrounding landscape making them a popular tourist attraction for walkers. The natural diversity and the lack of development of this upland landscape reflect the high sensitivity of this landscape area.

Rolling Farmland

Rolling farmland tends to dominate the lower levels of the study area below the steep valley sides. Small irregular field enclosures are delineated largely by lush hedgerows, but also post and wire fencing whose location continues to reflect an early field enclosure system. Hedgerow trees are a common feature within the hedgerows as are linear clusters of deciduous woodlands that follow the route of streams running along valleys bottoms.

The landscape is relatively unspoiled however tall structures such as pylons and radio/TV masts are notable elements on the skyline. The landscape is diverse, but as the same time simple with a patch work of colour created by the contrasting types of vegetation cover.

The open nature of this landscape and the lack of modern development make this an important landscape character area of high sensitivity.

Coastal Developments

Along the southwest periphery of the study area lie a number of coastal towns and the city of Swansea. Situated around Swansea Bay the settlements have developed outwards from the mouth of the rivers that support them. The settlement developed as ports, using the rivers as transport corridors to ship metals and coal out of the valleys. Today past industrial activities have been superseded, chimneys and pipes have become common landscape elements along the coast with the development of oil refineries from the oil industry.

Running around the outskirts of settlements is the M4 a large transport corridor and a dominate feature of the landscape. This landscape area has been subjected to change and large scale development over the years.

Afan Valley

Afan Valley is a narrow steep sided valley. In prehistoric times dense broad-leaved woodland covered much of the valley but much has since been cleared over the centuries due to the activities of agriculture and mining. What remnants of native woodland that have survived are mainly restricted to the lower slopes along where the Afon Afan flows.

Within the valley are relics of former human activity such as abandoned mines, tramways and railways. In the lower part of the valley the availability of coal for smelting metal ore led to the growth of iron, copper, steel and tin plate works. Since the decline of the mining industry, forestry has taken its place and the vast majority of the steep sided slopes have been covered by modern coniferous plantations. As a result of this and the topography many views are restricted to within the valley.

Vale of Neath

The Vale of Neath is characterised by a glaciated U-shaped valley running in a northeast - southwest direction. The high valley sides are dominated by coniferous plantations with deciduous woodland covering the lower levels. Where the land is not covered by forest and woodland, pasture enclosures cover the valley slopes.

Dominating the valley floor is the A465(T) which detracts from the rural character of the valley. Ribbon settlements of various sizes nestle into the southern side of the valley bottom linked together along the B4434. Running through the bottom of the Valley is also the railway line and the watercourses of the River Neath/Afon Nedd and the Neath Canal. These watercourses are fed by numerous rivers and streams which flow from the surrounding mountains. Both provided an important function during the regions industrial period. Within the Vale there is a richness and diversity of waterfalls created by the deep gorges of the rivers Mellte, Hepste and Nedd Fechan. As well as the Aberdulais falls which were once used to power a variety of mills and factories.

Llynfi Valley

The dominant characteristic of the Llynfi Valley is a glaciated U-shaped valley created during the Ice Age. The socio-economic roots of the Valley began with iron making which expanded with the introduction of coal mining in the nineteenth century. The landscape is generally dramatic with extensive views across and out of the Valley. However, as with many of the coalfield valleys, this quality and character is undermined by the density and form of urban development in the valley floor. Ribbon settlements dominate the valley floor with 'long row' terraced housing style a common feature.

Upon higher ground moving away from the valley floor the biodiversity follows a linear patter from improved grassland to more open valley tops. Broadleaved woodland colonises the lower levels whilst the upper levels are dominated by coniferous plantations.

Rhondda Valleys

The Rhondda Valleys are dominated largely by two glaciated U-shaped valleys which run in a northwest - southeast direction; Rhondda Fawr, the largest of the two valleys and the smaller Rhondda Fach. The landscape of the valleys contain a number of glaciated features which include incipient criques and corries. The ridges of Graig Fawr and Graig Fach are prominent features of the local landscape and offer spectacular views across the valleys.

The area is closely linked with coal mining activities which are accountable for the dense settlement pattern which occurs within the mid regions of the valley. The valley floors are dominated by continuos ribbon settlements which have few boundaries to define each settlement. As typical of coalfield settlements the street pattern is dominated by the classic 'long row' form of terraced housing.

Large areas of the valley sides are covered by coniferous plantations however, within the upper region the landscape is distinctly undeveloped with rivers running through the valley floor and the land covered by marsh grassland.

Cynon Valley

As with the valleys of Rhondda, the Cynon Valley is a glaciated valley running in a northwest - southeast direction. As with much of the study area the landscape is compromised by the extent and form of the urban and industrial developments, a major example of this are the opencast sites around Rhigos. The development pattern varies, reflecting the change in the openness of the valley floor. Along the narrow valley floor settlements exist which reflect the traditional 'long row' character.

Much of the habitats within the area reflect the topography and geology of the area, together with previous history of traditional land management. On the valley sides and upland areas the landscape is largely open moorland which provides spectacular views across the valley. Patches of coniferous plantations are dispersed between areas of enclosed pasture, upland heath and grassland. Within the valley floor and lower valley levels small clusters of deciduous woodland follow the river corridor.

Bridgend and Environs

The area includes the settlement of Bridgend, its suburbs and surrounding settlements, as well as the converging valleys of Ogmore, Cwm Garw and Llyfi Valley. Large sections of the area dominated by built form and industry which obscures minor variations is topography. The M4 corridor is a dominate feature of the landscape which splices it way through the mid section of this Landscape Character Area.

The upper section of the area where Ogmore, Cwn Garw and Llyfi Valley converge the landscape is covered by wooded pasture, marshy grassland combined with areas of woodland and improved grassland. These form the southern extent of a number of habitats that extend up into and around the coalfield valleys to the north.

Swansea Valley and Environs

Within this character area runs a number of valleys, the largest of which is the Swansea Valley. A U-shaped glaciated valley running on a northeast - southwest orientation with a number of tributary valleys converging from the north. To a large extend Swansea Valley floor is covered by dense built form and industry increasing in the areas where tributary valleys converge. On the valley sides the landscape is covered by small enclosures of improved grassland combined with clusters of deciduous woodland lining the lower levels and valley floor. On the northern facing valley side is a large area of coniferous plantation.

Further west the landscape becomes more undulating with wide shallow valleys. The character is more rural and the built form is reduced to scattered settlements and hamlets within a landscape covered by enclosed fields. Deciduous woodland line the river corridors of Lower Clydach River and Upper Clydach River and hedgerows containing hedgerow trees mark many field boundaries.

9.3.4 Landscape Planning Designations and Policies

Landscape planning designations and policies are used to provide an indication of the value attributed to the landscape or visual resource by national and local government. Due to the location and size of the study area for Ffynnon Oer a number of council districts are covered.

Landscape planning designations and policies are considered in the determination of the sensitivity of landscape receptors and views as they provide an indication of the value attributed to the landscape or visual resource by other professionals.

Because of the location of the proposed wind farm and the size of the study area a number of relevant local authority landscape designations are covered, as well as the National Park designated by central government. The relevant designations are listed below and illustrated in Figure 9.5.

- *National Parks:* Situated to the north of the site lies the Brecon Beacons National Park. Visibility of the proposed wind farm development would be limited to landform which slopes towards the site, particularly those areas with the highest elevations. It should be noted however that visibility of the proposed wind farm would be dependant on clear weather conditions.

- *Landscape Protection Areas (LPA)*: The upland areas overlooking Port Talbot, Baglan and Cwmafan, Afan Forest Park and Margam Park and their environs lie within the southwest region of the study area. The ZVI demonstrates visibility would be restricted to views from upper parts of the hills that slope towards the site. However, in the draft unadopted Port Talbot Local Plan the southern section of the proposed site is designated as a LPA. Within clear upland areas the proposed wind farm would be visible.

- *Special Landscape Areas (SLA)*: The study area covers a number of a number of SLAs within regional and local levels. Much of the Vale of Neath situated to the northwest of the site is largely covered by SLAs. Visibility of the wind farm from this region would again be restricted to the upper parts of hills that slope towards the site. Situated further east of the proposed site within the Valleys of Rhondda and the Cynon Valley are designated SLAs. Along the western boundary of Cynon Valley lies an area designated as an SLA. Much of the landscape within the Valleys of Rhondda is designated as Strategic Coalfield Plateau and Associated Valley Sides which is also a SLA. The ZVI demonstrates that there would be no views of the proposed wind farm from these two areas.

- *Strategic Coalfield Plateau and Associated Valley Sides:* To the south and southeast of the study area lies the area of the Strategic Coalfield Plateau and associated Valley Sides designated as an SLA as identified in the Ogwr Local Plan. The area stretches from the western edge of Llynfi Valley top over to the eastern edge of Mynyndd Maesteg, excluding valley floors dominated by ribbon settlements. The ZVI demonstrates that views would be restricted to higher elevations of mountain sides facing the proposed site.

- *Historic Landscape*: On the southwest edge of Maesteg, approximately 9 km due south of the site lies an area of historic landscape. The ZVI demonstrates that visibility from this area would, on the whole, be restricted to small number of turbines.

- *Landscape Conservation Area (LCA)*: South of the proposed wind farm lie a number of areas designated as LCA's. On the whole these lie within the area covered by Bridgend County Borough Council. Views of the wind farm from these areas would largely be restricted by topography and screening vegetation.

In addition to these designations, the site is covered by a number of Structure and Local Plan policies. Those relevant to the landscape and visual assessment are as follows:

- Port Talbot Local Plan, Deposit Draft, policy E18;

- Borough of Neath Local Plan adopted July 1994, policies E61 and E60;

- Mid Glamorgan (Rhondda Cynon Taff County Borough Council), Replacement Structure Plan 1991-2006, policy EV4;
- Owgr Borough Council Adopted Local Plan, Policy EV8, this policy is also reflected in the Bridgend UDP Deposit Plan, policy EV10;
- Cynon Valley Local Plan, Deposit Version October 1997, policy proposal ENVP2.

9.3.5 Visibility and the Zone of Visual Influence (ZVI)

ZVI

The general visibility of the proposed wind farm reflects closely the landform of the contextual area, with uplands, plateau and valleys being mirrored in the ZVI which has been predicted for the 16 proposed turbines and depicts the visibility of turbines to their blade tip within the previously defined 20 km radius study area. This is shown in Figure 9.1. It is important to note that the boundary of the study area is not intended to be finite beyond which it would not be possible to see the wind farm, but instead it identifies the area within which the wind farm may have a significant effect on the landscape and/or visual effect.

It is important to note that the visibility shown within the ZVI plan reflects the inclusion of woodland and coniferous plantations at the height of 12 m. Many of the plantations within the study area, particularly within the Afan Valley where planted during the 1930's and 1950's and will be taller than figure. One of the smallest trees growing within the plantations is Japanese Larch which grows to a height of 25 - 30 m, compared to Sitka Spruce, one of the tallest trees which can grow to a height of 50 m. However the ZVI calculations and the assessment have used a worst case scenario based on tree heights being limited by potentially harsh environmental conditions in order that potential visual impacts are not under-estimated.

Landscape and visual assessment best practice requires that account is taken of the potential worst case scenario. With regard to the ZVI the worst case scenario is that the availability of potential screening elements is minimised. In the case of Ffynnon Oer this refers primarily to the potential screening that is predicted would be provided by the existing large-scale forestry plantations as discussed in the preceding paragraph. It is possible, although perhaps unlikely, that these commercial plantations will be substantially clear felled over the life span of the proposed windfarm. Hence the need to consider if such an action would have notable consequences on the extent of the ZVI as shown in Figure 9.1. Figure 9.1A shows the ZVI for the blade tips without the assumed 12m height for all the woodland areas shown on the Ordnance Survey 1:25 00 map. As anticipated the ZVI is extended with the majority of the areas that it is predicted would now have views of one or more of the turbines being concentrated within a 10 km radius of the proposed windfarm site. There are very few extensions to the ZVI in the Brecon Beacons National Park or in the more urbanised areas on the southern coastal plain. The new areas within the ZVI are generally located upon the sites of the felled plantations which are on the steeper valley sides or ridgelines. Given that they are presently afforested these areas contain very few residential receptors, nevertheless they are traversed by considerable sections of PROWs. However it could be argued that at least in the initial years following any large-scale clear felling the dominant visual elements for the recreational users of PROWs crossing these areas would be the visual consequences of the clear felling in all close distance views and in the foreground of most of the long distance views in which the windfarm would now be a component.

Determinants of Visibility

The proposed site lies within an upland area surrounded by ridges and valleys. To the north and east, ranging to a distance of 10 km, the majority of the elevated landform is covered by maturing coniferous plantations which screen and filter visibility. Further north the most elevated parts of the study area are located at the foothills of the Brecon Beacons approximately 13 km from the proposed site. From this area visibility is restricted to higher elevations of the Black Mountain and clear regions of Forest Fawr. To the west, around the Rhondda Valleys no views are available due to the incised nature of the landform and the large blankets of coniferous plantation situated on elevated ground.

To the south, visibility of the proposed wind farm is restricted to highest regions on the north facing side of Afan Valley. This includes the village of Croeserw and the proposed location for Afan Valley Holiday Park. The area of visibility also stretches over to Werfa and sections of the A4107. Further south a linear wedge of visibility is apparent from upland areas on the northeast facing ridge of the Llynfi Valley. From the west visibility within a 10 km radius of the proposed site is restricted to clear upland areas devoid of coniferous plantations, although there is a large area from which the site is potentially visible from more elevated parts of Swansea.

It is important to state in relation to the areas described above that whilst receptors have theoretical views of the site, intervening and close by built development and planting is always likely to screens and filters views. This situation particularly applies to more urban areas such as the parts of Swansea noted in the previous paragraph. Hence in reality there are likely to be a relatively small number of publicly accessible locations and private residences that would have uninterrupted views of the proposed wind farm.

The Influence of Weather

In addition to physical elements of the study area effecting the predicted visibility of the proposed wind farm, atmospheric condition will be a crucial consideration upon visibility, especially in long distance views. The proximity to the coast and the elevated areas produces changeable weather conditions. Low lying cloud, high rainfall and haze will all effect the clarity of which the proposed wind farm would be viewed. Data from the meteorological office[9] shows on average the rainfall for the area is 100 mm or greater for seven months of the year and on average it rains for 13 days a month. Visibility of the proposed wind farm would therefore be reduced by rainfall for approximately 25% of the year i.e. one day in four. On average there are also 27 days of the year when air frost would impact on visibility. During the summer months hazy conditions will also reduce visibility from distant locations as was demonstrated during the field assessment survey.

Cumulative Views

Opportunities for potential cumulative views, where more than one wind farm, including Ffynnon Oer, can be seen simultaneously are limited as demonstrated by Figure 9.3. This is due primarily to the visual environment of the study area, as localised screening by buildings or

[9] http://www.met-office.gov.uk/climate/uk/averages/sites/48.html Neath (62m AMSL) 1961-90 Station Averages.

other structures, tree planting, road cuttings and other local topography frequently prevents *actual* visibility despite the indication of *theoretical* visibility on the ZVI.

9.4 Mitigation and Enhancement

Mitigation of potential landscape and visual effects and opportunities for enhancement of the Ffynnon Oer site have been considered throughout the inception, siting, layout and design stages of the project. Where possible, and where it has been compatible with other factors that require consideration, mitigation and enhancement measures have been incorporated into the final scheme.

Mitigation is considered at two levels: firstly, the avoidance of potential effects that is achieved through the design of the proposals; and secondly the reduction of effects, whereby the design and layout of site components is specifically considered in order that potential effects are minimised. The nature of wind farm development is such that avoidance or reduction of effects is generally more effective than a third type of mitigation; the more superficial remediation of effects through screening with planting or mounding. This type of mitigation is also considered to be inappropriate at Ffynnon Oer, where such landscape elements would detrimentally contrast with the exposed and large-scale landform of the site and could not be of a large enough scale to be effective for any but a small number of specific receptors or views located immediately alongside such mitigation works.

9.4.1 Avoidance of Effects

The avoidance of potential landscape and visual effects is primarily effective at the site selection stage as, due to the nature of the effects, complete avoidance is difficult to implement within the restricted area of a site. There is, however, potential for the avoidance of specific localised or small-scale effects.

The initial site review process as described in Section 6 included consideration of a wide range of factors including potential landscape and visual effects. The Ffynnon Oer site was found to be favourable in respect of many of these factors, including the absence of national or regional landscape designations and its comparative lack of visibility from the main centres of population i.e. potential residential visual receptors, which are located overwhelmingly in valley bottoms and along the urbanised coastal strip.

9.4.2 Reduction of Effects

The potential for reduction of environmental effects has been considered throughout the design and assessment process for the proposed wind farm. The principal opportunity for the reduction of effects – especially visual - is through the design of the turbine layout, and the iterative design process as set out in Table 2.2 has allowed the adjustment of turbine positions as a result of the effects that become apparent through the course of the assessment.

The principal change to the turbine layout resulted from evaluation of the initial photomontage and wireline illustrations.

The following considerations have also been made with regard to reduction of potential landscape and visual effects:

- Layout - use of existing forestry access road in mature forest.
- The colour and finish of the turbines has been chosen to minimise the contrast between them and the background against which they will be viewed, which is, in the majority of situations, the sky. Based upon NWP's experience form other similar sites, a mid-grey matt finish is most likely to be used and has been incorporated within the photomontages. This selection reflects the fact that the western parts of the South Wales Valleys is subject to variable weather conditions with clouder conditions prevailing with the associated predominance of white/grey skies as illustrated in the series of photomontages. Given their elevated location in the majority of views , it is considered that the majority of views in each the turbines were an element, they would be seen against the sky. Hence a pale grey colour would be appropriate with a semi-matt finish to minimise surface reflectance.
- The alignment of the access tracks with the site and the positioning of the turbines has been designed to minimise the need for earthworks and other site disturbance. Any disturbed ground will be restored to match in with the adjacent vegetation. Also a proportion of the excavated material will be utilised to form low mounds of height of approximately 30 cm on the downhill side of any new access roads. These will be seeded with an appropriate seed mix and will aid in the visual assimilation of the new access tracks within the wider landscape by reducing visual contrast.
- Alternative designs of turbine layout considered starting with a standard grid layout and modifying the layout to take account of the characteristic s of the site with particular regard to topography and ecology.
- Take account of opportunities and constraints inherent within the site as set out in the baseline surveys.
- The site compound and sub-station have been located on one of the lowest points of the site to reduce intrusiveness and take advance of the screening provided by adjacent forestry and to ensure that in most views the background is provided by the more elevated areas of the site.
- Turbines have been located to ensure a minimum separation of 100 m from any Public Rights of Way (PROWs).The site will have no lighting during construction or operational periods thereby removing any potential for light pollution.
- Appropriate materials for buildings will be utilised where ever feasible. The external faces of the sub-station will be screened with local stone and roofed with slate to reflect the prevalent local vernacular style.

9.4.3 Compensation

The construction and operation of the proposed wind farm will provide limited opportunities for compensation for certain limited receptor groups who may sustain substantial adverse landscape and visual effects. To this end National Wind Power have instigated consultation with SUSTRANs with regard to the potential for improvements to the existing local cycle network.

SUSTRANS have requested "that resources from the developer are used for this purpose [accommodation of existing routes]"

Opportunities for enhancement of the landscape and visual resource have been identified through the professional survey and analysis of the site, and through the process of public consultation, which raised issues that local residents feel could be addressed by the wind farm development.

- National Wind Power would like to provide a series of interpretation boards at agreed locations on the local PROW network. These would explain the function of the wind farm and how it fits in with long term national energy policies and set the development in the context of the surrounding landscape and man's influence upon its development as exemplified by the nearby Roman camp and legacies from historical mining activities.
- The changes in the land-use of the site provides opportunities for habitat enrichment and a more ecologically sensitive management regime to be instigated. The main changes are likely to include the damming of land drains restore waterlogging, the cessation of the use of chemical fertilisers on site and the introduction of a less intensive grazing regime. More details are set out in Section 15.7.4.

9.5 Predicted Landscape Changes and Consequences

9.5.1 Construction Period

The principal activities that could have an impact upon the existing fabric, quality and character of the landscape during the seven month construction period are set out below in Table 9.2. Those associated with the necessary permanent land-take are considered in the subsequent operational section. The table facilitates a brief consideration of the potential landscape changes for each identified construction activity with the potential landscape changes being noted against the first three landscape categories of landscape receptors as set out in the preceding baseline section: landscape elements; landscape characteristics and landscape character. Landscape policies and planning designations can be considered separately for the construction activities as a whole.

9.5.2 Operational Period

The principal activities that could have an impact upon the existing fabric, quality and character of the landscape during the 20 year operation period are set out below in Table 9.3.

9.5.3 Overview of Landscape Changes Including Planning Policy and Designations

Tables 9.2 and 9.3 demonstrate that there may be a number of impacts upon the different components that make up the landscape during the construction and operation of the proposed wind farm. A development of this scale cannot be integrated into the landscape without having direct impacts on the landscape of the proposed site and direct and indirect impacts upon at least some of the surrounding areas.

Construction of the proposed wind farm will bring about the initial changes to the landscape character of the site. Introduction of vehicles and plant equipment represent the introduction of elements alien to this landscape character type which have a detrimental effect on the landscape character. This impact will be generated through the diminishment of existing high levels of calmness and tranquillity due to the movement of vehicles. The use of the forestry access roads to link the site will mean that these positive aesthetic characteristics are reduced over an area much larger than just the wind farm site. However the use of the existing track which requires minimal widening at certain pinch points and no strengthening means that impacts and any consequent negative landscape effects are lower than would have been the case if a new track were being constructed with the associated loss of landscape elements and changes to existing views. In addition it should be noted that the movement of forestry vehicles is an established landscape characteristic within and around most of the extensive forestry plantations within the study area.

Table 9.2 Construction Period - Predicted Landscape Changes and Consequences

Identified Activity	Landscape Change	Predicted Landscape Consequences
Movement of plant and vehicles	Landscape elements - introduction of new elements	New elements will increase movement in relatively static area
	Landscape characteristics - increased complexity	Increase in movement and disturbance will have negative impacts and generate new patterns in landscape
	Landscape character - changes over small proportion of defined landscape character area	Temporary loss of calm and tranquil upland moor, but insufficient scale to alter overall landscape character area
Use of cranes to set turbines in place	Landscape elements - introduction of temporary but very tall feature(s)	Locally predominant landscape element(s) will act as visual focus
	Landscape characteristics - contrast with existing characteristics	Undermine surrounding rural characteristics through scale and contrast with existing naturalistic characteristics
	Landscape character - changes over small proportion of defined landscape character area	Size and movement of cranes reduces calm and tranquil environment of site and is redolent of urban areas
Construction of internal site access roads	Landscape elements - loss of some elements (sections of stone wall, areas of acid grass land and modified blanket bog)	Increase of elements which already exist around the site and within forest, depending on route within the site boundary
	Landscape characteristics - trackways already a strong feature in and around the site hence extension of existing characteristic	Open moorland partitioned and divided by creation internal roads will change balance of existing elements modifying characteristics reducing sense of isolation and subdividing previously open area increasing complexity
	Landscape character - potential undermining by sub-dividing area when landscape character is partly determined by the extensive, open upland areas	Incremental changes to landscape character with particular reference to simplicity, calm and tranquillity. Predicted to be of insufficient scale to constitute a discernible change to the existing landscape character type within which the site is located

Table 9.2 (continued) Construction Period - Predicted Landscape Changes and Consequences

Identified Activity	Landscape Change	Predicted Landscape Consequences
Materials stockpiles within main compound	Landscape elements - introduction of new elements potentially with contrasting colours and textures, however will be located within main compound on the lower part of the site, set against slope	Precise consequences will depend upon the size, height and colour of any stockpiles however location within main compound will reduce the magnitude of any landscape impacts
	Landscape characteristics - increase complexity	Along with other new temporary elements they would modify landscape characteristics by making the upland plateau a more complex, less naturalistic landscape
	Landscape character - undermine the important (but erroneous) sense of naturalness on local scale but insufficient scale to undermine landscape character area	Incremental changes to landscape character with particular reference to simplicity, colour and texture. Predicted to be of insufficient scale to constitute a discernible change to the existing landscape character type within which the site is located
On-site accommodation and contractors' offices within main compound	Landscape elements - introduction of incongruous elements	Incremental increase in number of man-made elements however impact magnitude likely to be reduced by concentrating al facilities in a single location
	Landscape characteristics - increase complexity	Temporary negative consequences from contrast with existing naturalistic characteristics
	Landscape character - undermine the important (but erroneous) sense of naturalness on local scale but insufficient scale to undermine landscape character area	Incremental changes to landscape character with particular reference to simplicity, colour and texture. Predicted to be of insufficient scale to constitute a discernible change to the existing landscape character type within which the site is located
Lighting	Landscape elements - no lighting to be used	No new elements
	Landscape characteristics remain as present	No change in prevailing characteristics with regard to lighting levels
	Landscape character - no change	No change

Table 9.2 (continued) Construction Period - Predicted Landscape Changes and Consequences

Identified Activity	Landscape Change	Predicted Landscape Consequences
Temporary protection and security fencing	Landscape elements - introduction of another man-made, contrasting elements in form of chespale fencing around excavations and metal palisade fencing around main compound	Introduction of incongruous temporary landscape elements
	Landscape characteristics - sense of man-made enclosure very low in present upland landscape	Enclosure of open landscape altering landscape characteristics
	Landscape character - at site scale temporary enclosures will not undermine the openness that is a key component of the landscape character type	Dependent upon the scale and design of any temporary enclosures, but will not be of a sufficient scale to undermine landscape character type much beyond the site boundary
Disposal areas for excavated material (assuming not to be taken off-site)	Landscape elements - introduction of new elements, although given the long history of mining in area, the new elements have numerous precedents	Introduction of incongruous temporary landscape elements
	Landscape characteristics - increase complexity	Will combine with other listed new elements to substantially modify characteristics of site and immediate environs
	Landscape character - mining spoil is already a component of landscape character, albeit generally not an immediately obvious one	Assuming that re-vegetation will be encouraged and the material profiled into sympathetic small-scale landforms there should be no negative consequences for existing character

Table 9.3 Operation Period - Predicted Landscape Changes and Consequences

Identified Activity	Landscape Change	Predicted Landscape Consequences
Operation of the towers and turbines	Landscape elements - introduction of major new elements centring upon the 16 towers and turbines	Introduction of large scale structures with moving elements visible from a distance
	Landscape characteristics - scale and associated movement will determine a new arrangement of landscape characteristics	Introduction of new land-use whose principal elements are of sufficient scale to substantially modify landscape characteristics. However their scale is in accordance with the scale of many of the present site characteristics
	Landscape character - substantial change within the site with potential to modify at landscape character type scale	The landscape character type will remain as at present: Upland forest and plateau moorland. The scale of the 16 turbine wind farm proposal is insufficient to undermine the defined character, especially the key characteristics such as tranquillity, isolation, simplicity and openness. It must also be noted that that wind farms, pylons, radio and telecommunications masts are relatively common features on hilltops across the study area and in Welsh uplands in general. They can help to emphasise some of the prime determinants of these areas' landscape character such as openness, exposure and the visual dominance of ridgelines.
Land-take required for turbines	Landscape elements - potential loss of existing features such as stone walls and modified blanket bog/acid grassland balanced by introduction of new vegetative features due to damming of land drains	Negative impacts due to small-scale loss of characteristic elements unlikely to directly have negative consequences upon landscape partly countered by the habitat recreation generated by increased waterlogging.

Table 9.3 (continued) Operation Period - Predicted Landscape Changes and Consequences

Identified Activity	Landscape Change	Predicted Landscape Consequences
	Landscape characteristics - one of the prime determinants of change in landscape characteristics	Permanent change of landuse for duration of operation but vegetation can be re-established up to the base of the tower reducing the loss of bog/acid grassland. Likely to lead to mosaic of different land-uses which could locally modify textures and colours in landscape
	Landscape character - potential to locally modify landscape character	Direct loss of existing naturalistic areas will not be on a large enough scale to have negative effects upon existing landscape character type
Operation of access route	Landscape elements - potential for very small scale loss of landscape elements at specific locations along access route where localised widening may be required otherwise no elements lost as using existing route as used during construction period	Any loss of landscape resources i.e. trees and edge scrub would be very localised
	Landscape characteristics - only impacts can arise from slight increase in usage	Increase in vehicle use within forest tracks would have limited impact on landscape characteristics / character and present use of forest tracks by quarrying and logging vehicles Any tree losses too small scale to impact upon existing landscape characteristics
	Landscape character - increased usage has potential to locally modify landscape character	Given the low visibility of the access route and the slight increase in levels of use it is unlikely that there will be notable consequences for the landscape character type
Movement associated with on-site maintenance activities	Landscape elements - no new elements except occasional vehicles	Small-scale temporary modifications to existing levels of calm and tranquillity
	Landscape characteristics - occasional vehicles will temporarily add to the complexity of landscape characteristics	As above
	Landscape character - increase in movement and undermining strong sense of isolation	Temporary changes will not be of sufficient magnitude to have any negative consequences upon landscape character

Table 9.3 (continued) Operation Period - Predicted Landscape Changes and Consequences

Identified Activity	Landscape Change	Predicted Landscape Consequences
Movement associated with on-site maintenance activities	Landscape elements - no new elements except occasional vehicles	Small-scale temporary modifications to existing levels of calm and tranquillity
	Landscape characteristics - occasional vehicles will temporarily add to the complexity of landscape characteristics	As above
	Landscape character - increase in movement and undermining strong sense of isolation	Temporary changes will not be of sufficient magnitude to have any negative consequences upon landscape character
Signs and boundary treatments	Landscape elements - very small-scale introduction of new elements	If well designed and carefully located could enhance public appreciation of site and landscape context
	Landscape characteristics - compared with other landscape changes will be insignificant	As above
	Landscape character - no direct changes but could be useful for explaining landscape to the wider public	No direct effects upon landscape character but could help in interpretation
Land-take associated with connection to the National Grid network	Landscape elements - introduction of new landscape elements in form of line of wooden telegraph poles between the site and grid reference SS863951 south of Creoserw	The connection will utilise wooden telegraph poles thereby resembling an overhead phone line and as such will be an incremental increase in the extent of an existing landscape element. Levels of impacts reduced as most of the route will be within existing mature forestry plantations.
	Landscape characteristics - unnatural elements although frequently found in south Welsh landscapes	
	Landscape character - such linear features are an established part of the landscape character of all the identified character areas	

The site presently has a strong sense of unity due to the small number of landscape elements that interact within it making a relatively simple landscape. This will change with the introduction of a wider variety of landscape elements during the six month construction period. It is more informative to consider their cumulative impacts rather than their individual impacts. Such a diversity of elements is not characteristic of open upland areas and most of their impacts will stem from the contrast between these new temporary elements and activities and both the present site and the surrounding areas. The impacts upon present levels of calm and tranquillity that will be caused by the movement of plant and vehicles and the associated noise is extensively noted. Likewise all activities that involve changing the surface of the land such as excavations for internal access roads and turbine foundations and their arisings will have impacts upon dominant colours and textures which are particularly important in defining the subtle landscape character of open upland areas. However whilst the level of disturbance and associated negative landscape impacts and consequent effects will be considerable within the site and its immediate environs, they are considered to be of an insufficient scale in such a large scale landscape to have such notable impacts over the entire landscape character type or the study area as a whole.

During the operation period which lasts for forty times as long (twenty years as opposed to six months) the number of sources of potential landscape impacts reduces with in particular amounts of ground level movement reverting to something akin to present very low levels. The cessation of construction works will result in the removal of the majority of the elements that contrast most sharply with the existing colours in the landscape. Elements which are not removed can be partly or completely mitigated by re-establishment of appropriate vegetation. However the two dominant impacts remain:

- the land-take for the turbines and internal access roads;
- the introduction of the sixteen 91 m high turbines and their consequent movement.

Their elevation means that their impacts and consequent effects are sustained far beyond the confines of the site extending into areas subject to designations at least partly based upon their perceived landscape quality, most notably the Brecon Beacons National Park.

Whilst the turbines and their movement provide a contrast with the existing remote, largely tranquil and open site, it is important to note that they are still landscape elements that are strongly associated with remote upland locations, particularly in mid-Wales. Hence in some ways their presence is indicative of the degree of remoteness and exposure of the site and any negative effects that they generate beyond the site itself should be considered as visual effects being concerned with intrusiveness, as opposed to landscape effects. Similarly it must be emphasised that the turbines are not permanent landscape features. At the end of the 20 year operational period they will be decommissioned, dismantled and moved off the site which will then be returned to its present use.

Within the southern end of site a large proportion of land falls within an area designated as a Landscape Protection Area (LPA) in the unadopted Port Talbot Local Plan 1996. Policy E18 of this Local Plan states that there are a number of areas of the countryside which "*by virtue of their location or landscape appearance are deserving of retention for their own sake*". Consequently in LPAs "*...planning consent for development will only be granted where it can be clearly demonstrated that there is no detrimental effect on the environment, ecology and*

landscape of the area but rather (the development) *seeks to enhance these qualities*"[10]. Construction and operation of the proposed wind farm will impinge on this designations by changing some of the qualities of the existing landscape of the area. However the construction period will be short lived and, as mentioned above, wind turbines are landscape elements associated with remote upland locations and would therefore be seen in this context within the existing landscape. Also they will not require the loss of any landscape resources, impact upon other existing uses for the site, represent a sense of historical continuity as the site and surrounding area have a long history of exploitation of primary resources, and the wind farm development is not a permanent change of land-use.

Beyond the LPA designation lies the Special Landscape Area (SLA) of the Strategic Coalfield Plateau and associated Valley Sides as defined in the Ogwr Borough Council Local Plan (Policy EV8) and Mid Glamorgan (Rhondda Cynon Taff County Borough) Replacement Structure Plan (Policy EV4). These policies are particularly concerned with the control of development that has the potential to be visually intrusive with regard to the SLAs which are themselves defined on the basis of their perceived visual sensitivity "*...due to their being visible over a wide area*"[11]. The nearest SLA lies approximately 4 km south of the proposed site. The development is unlikely to have an adverse affect on the landscape setting of this area which extends from the southern edge of Croeserw west towards Werfa before stretching north to encompass the valleys of Rhondda. Much of the area contained within this designation is largely exposed upland with open moorland, grassland and forestry plantations. Although the height of the turbines is of sufficient scale to have negative landscape impact, the distance from the Strategic Coalfield Plateau and the large scale of the landscape character area is such that the construction and operation of the turbines would be a visual intrusion of "*acceptable levels*". A similar conclusion also applies to the potential intrusion upon the SLA situated further to the east.

At a smaller scale are the nineteen Landscape Conservation Areas (LCAs) designated in 1991 and listed in the Mid Glamorgan Replacement Structure Plan from some of which it is possible that the proposed wind farm will be visible. However these designations are principally concerned with the preservation of the distinctive characteristics of the landscapes which were considered to be under threat from the extension of the built up areas and inappropriate alterations to buildings as well as the impacts of intrusive developments. As the wind farm site is located well away from any of these LCAs and there will be no loss of resources it is not considered that the wind farm will impinge upon this designation.

9.6 Predicted Visual Changes and Consequences

9.6.1 Construction Period

This section of the assessment considers the predicted effects of the six month construction period that would be required for the proposed Ffynnon Oer wind farm upon identified visual receptors within the zone of visual influence (see Figure 9.1). A total of 28 potentially key

[10] Port Talbot Local Plan, Deposit Draft, policy E18.

[11] Mid Glamorgan (Rhondda Cynon Taff County Borough) Replacement Structure Plan 1991-2006 para 6.5.3.

groups of visual receptors, plus 6 routes, were identified during the baseline survey. These are set out in Table 9.4 and their locations shown in Figure 9.2. It should be noted that by choosing only receptors that are potentially in the ZVI several nearby communities such as Tonna, Blaengwrath and Morfa Glas are not included in the subsequent assessment tables as no views will be available.

9.6.2 Overview of Predicted Visual Changes During Construction Period

The scale of the construction works has the potential to be visually intrusive over a considerable area. For the most part ground level construction activities will not have a dramatic visual impact on the majority of visual receptors. Instead it is predicted that most adverse impacts will be caused by the use of cranes with their associated intrusion on the skyline making them a focal point especially in middle and long distance views.

Apart from those receptors within close proximity of the site, for example users of St Illtyd's Walk, Table C1 in Appendix C, setting out the predicted visual impacts during the construction period, indicates that the level of impacts for most of the considerable number of receptors living, working and undertaking recreational activities within the study area will be reduced or diminished by a combination of factors. Key factors in reducing the severity of the visual effect include:

- The influences of local topography is critical with regard to a number of areas. Although the height of the cranes will be an intrusion visible on a section of the skyline, receptors within one of the many valley floors are located within 'blind spots' created by topographical variations. A good example is Afan Valley Country Park situated located within the floor to Afan Valley. The steep sides of the valley foreshortens northeasterly views preventing views of ground level construction activities within the site.

- The screening provided by large coniferous forest plantations are a landscape characteristic of the area. Situated predominately on more elevated ground, the forest cover restricts the number of receptors impacted by views of ground level construction activities.

- The built environment of the settlements located around the site interrupts and obscures views of the majority of receptors located within and close to them. A good example of this are potential receptors situated in the northern quarter of Swansea where possible views of the site would be reduced by the density of surrounding buildings foreshortening or severely framing views.

- A final factor that will play a significant role regarding visibility of crane activities will be the weather. The majority of the receptors are located over a 5 km distance away from the site, intervening weather conditions such as rain and haze will significantly reduce visibility of the site and activities that occur within it. In particular this will reduce the availability of long distance views from the Brecon Beacons.

Overall the receptors that are predicted to sustain the greatest changes to their existing views are those in the following locations:

- Users of the St Illtyd's Walk;

- Cyclists on the Celtic Trail/High level route 47;
- Users of the Coed Morgannwg Way;
- Residents of Croeserw;
- Residents at Bryn-Caws Farm.

9.6.3 Operational Period

This section of the assessment considers the predicted effects of the twenty year operational period that would be required for the proposed Ffynnon Oer wind farm upon the same range of identified visual receptors. In order to aid visualisation the predicted view for each group of receptors or route is shown as a wire frame illustration in Figures 9.6 a-m, or photoviewpoint with wire frame illustrations in Figures 9.7 a-i, or as a Photomontage in Figures 9.9-9.15.

9.6.4 Overview of Predicted Visual Changes During Operational Period

The height of the proposed turbines is of scale which has the potential to be visually intrusive over a considerable area. Within the immediate vicinity of the site it will be inevitable that large visual impacts will be sustained, for example users of the public rights of way that surround the site.

Table C2 in Appendix C which analyses the predicted visual impacts during the operational period, however, indicates that the level of impacts for most of the considerable number of receptors living, working and undertaking recreational activities within the study area will be reduced or diminished by a number a combination of factors. Key factors in reducing the severity of the visual effect include:

- The influences of local topography is critical with regard to a number of areas. As shown on the ZVI (see Figure 9.1) a large area in the west of the study area will not be susceptible to views of the proposed wind farm. The valley topography interrupts views of a number of receptors located within valley floors, for example road users on the A4061 travel within a narrow valley which foreshortens views out of the valley and prevents views of the turbines. This is also the case for the Afan Agroed Country Park situated approx. 5 km southwest within Afan Valley.
- The screening provided by large blankets of coniferous forest plantations works in combination with the topography. Situated predominately on elevated locations, the forest cover restricts and filters a number of views experienced by receptors. The forest cover also limits the amount of the turbine tower visible for example views from the village of Croeserw. The potential for clear felling operations to substantially alter the nature of views is acknowledged but cannot be accurately predicted. See photomontage Figure 9.11 a-c.
- The built environment to the east of the site interrupts and obscures views of the majority of receptors located within and close to them.
- A final factor that will play a significant role regarding visibility of the turbines will be the weather. The majority of the receptors are located over a 5 km distance away from the site, intervening weather conditions such as rain and haze will

significantly reduce visibility of the site and activities that occur within it. In particular this will have an impact on long distance views from the Brecon Beacons. See photomontage Figures 9.9a-c and 9.10a-c.

Overall the receptors that are predicted to sustain the greatest changes to their existing views are those in the following locations:

- Residents of Croeserw;
- Residents of Cilfrew;
- Bryn-Caws Farm;
- Proposed Afan Valley Holiday Park;
- Users of the St Illtyd's Walk;
- Cyclists on the Celtic Trail / High Level Route 47;
- Users of the Coed Morgannwg Way;
- Users of public rights of way on Foel Trawsnant.

9.7 Evaluation of Landscape Effects

9.7.1 Criteria

The significance of landscape effects reflects the sensitivity of the categories of landscape resources to change (see Table 9.5) and the magnitude of that change (see Table 9.6). The evaluation of criteria and thresholds is primarily based upon professional judgement and is tailored to suit individual locations. It is important to use sensitivity criteria of an appropriate scale for the development. In some cases where criteria are chosen to reflect national sensitivities, such as designated National Parks or Areas of Outstanding National Beauty it is possible that issues of local importance are under emphasised. The opposite is also true. If the highest significance is assigned to nationally designated landscapes and the study area falls within one, there is the assumption that all of the land within that study area is of the highest sensitivity to change. This is patently not true and the sensitivity criteria should be altered accordingly. Sensitivity criteria should be reviewed on a case by case basis.

The intention of identifying criteria is to aid in the separation of fact from interpretation and to assist in demonstrating the nature and extent of the identified landscape effects. The criteria in this case for evaluating sensitivity of landscapes and the positive and negative magnitudes of effect are outlined below:

Table 9.5 Sensitivity of Landscape Resources

Landscape Resource Categories	Sensitivity
Important components or landscapes of particularly distinctive character and therefore likely to be subject to national or local designation and be vulnerable to relatively minor changes	High
	↓
Moderately valued characteristics reasonably tolerant of change	Medium
	↓
Relatively unimportant / immature or damaged landscapes tolerant of substantial change	Low

Table 9.6 Magnitude of Landscape Effects

Predicted Landscape Effects	Level
Notable changes in landscape character over an extensive area or intensive change over a more limited area/complete loss of notable features or elements	High
	↓
Moderate changes over a localised area/partial loss/alteration of notable features or elements	Medium
	↓
Little change in any landscape feature	Low

9.7.2 Significance of Landscape Effects

There has been a general consensus in recent landscape assessments on the recognition of three thresholds of significance that are derived from different combinations of landscape resource sensitivity and impact magnitudes. Once again the appraisal reflects the principles laid down with the LI/IEMA Guidelines. The three significance categories used are:

- '**Major**' meaning any combination of high or medium sensitivity with high impact magnitude;
- '**Minor**' meaning low sensitivity or low magnitude;
- '**Not Significant**'.

The assessment of significance is on a qualitative basis, as a scoring system does not avoid subjectivity and suggests a certainty that may not be present.

9.7.3 Significance of Construction and Operational Landscape Effects

The significance of the identified landscape impacts during the six month long construction period and the operational period are summarised in Tables C3 and C4 contained within Appendix C.

9.7.4 Summary of Significant Landscape Effects

Table C3 and C4 in Appendix C describe the significance of the identified landscape impacts doing construction and operational periods. Significant adverse landscape effects are predicted to be generated by four separate aspects of the six month construction period. The identified construction activities are use of cranes which will be for a short period of 1 month maximum; construction of internal site roads, temporary fencing and materials stockpiles. During the subsequent operational period the movement of the turbines will have significant neutral effects upon both landscape characteristics and landscape character.

The significant construction adverse effects are all predicted to be sustained by the landscape characteristics level of landscape resources i.e. these activities have effects upon the characteristic patterns and combinations of landscape features that contribute to the landscape character, sense of place and scenic quality. Characteristics such as openness, simplicity, harmony and tranquillity are all important components of the landscape of the site and immediate environs which will be temporarily undermined by those identified construction activities. Also they ensure that the landscape is relatively sensitive and not particularly tolerant to changes being unable to easily absorb such activities. The construction activities do not have notable impacts upon landscape elements and the elements potentially impacted are all common within the landscape character area.

Similarly at the landscape character area scale the identified individual construction impacts are not predicted to be of a sufficient magnitude to generate significant adverse effects that would alter the distinct and recognisable pattern of tangible and intangible elements that interact to form the upland forestry/plateau moorland landscape character area. The construction period is too short-lived and most of the effects are relatively localised to significantly alter the landscape character area.

The effects associated with the operational period are not all considered to be adverse, although it is recognised that this judgement will not necessarily accord with that of all receptors. The removal of all the plant and materials required for the construction period and the associated high levels of movement will allow a return to existing levels of calm and isolation, with a return to the dominance of natural colours. Nevertheless it is recognised that the movement of the 62 m diameter turbines will have landscape effects of 'major' significance upon landscape characteristics and landscape character. Their movement will remove the existing stillness from the landscape, however it is arguable that the graceful movement of the three blades does generate a sense of calmness in the landscape. Likewise wind farms are becoming an increasingly recognised element in many upland landscapes, especially mid-Wales, northern Cornwall and parts of Scotland. Their presence can emphasis certain of the more intangible elements of upland plateau landscapes such as their exposure, isolation and starkness. Hence it is considered that the effects are neutral as opposed to adverse. Their operation will not have a negative effect upon the integrity of the landscape character area as the turbines could only function in a location that exhibits many of the characteristics that underlie the definition of the landscape character area.

Finally consideration must be given to the potential for cumulative landscape impacts and consequent effects to be generated, especially in the construction period where there are numerous individual activities occurring across the site. Hence it is predicted that when considered together, all the individual listed construction activities cumulatively generate a 'major' adverse landscape effect at a landscape characteristics scale for this six month period due

to the range of new colours, forms and textures they generate and the associated noise and movement of the construction teams.

9.8 Evaluation of Visual Effects

Drawing on the previous description of predicted visual effects, this section evaluates their significance. As set out in Section 9.2.4 visual significance is dependent on two factors:

- the sensitivity of the receptor to the effect;
- the magnitude of the predicted changes as measured along an agreed continuum.

For example, motorists using the A4017, especially westbound ones, have long distance views in which the flat summit of the proposed wind farm forms a section of the western horizon. This existing view is illustrated in Figure 9.15. The wireframe and the photomontage demonstrate that all 16 turbines will be at least partially visible above a section of the horizon representing a moderate change to the existing view in good weather conditions. The magnitude of visual impact is increased by this breach of the horizon and the contrast in form between the turbines and what is otherwise a landscape with few readily apparent man-made features. This leads to an overall prediction of a 'medium' level of magnitude of impact. This evaluation when combined with the comparatively low level of sensitivity the motorist category of visual receptors is ascribed under the adopted methodology leads to a predicted operational period significance level assessed as 'minor'.

The evaluation of the previously identified visual receptor viewpoints and routes for the seven month construction period is set out in Table C5 and that for operational period in Table C6, both in Appendix C.

9.8.1 Cumulative Visual Effects

The assessment has identified that a number of the viewpoint and route visual receptors that are likely to have views of two or more of the existing, permitted or proposed wind farms in and around the study area. The cumulative ZVI is shown in Figure 9.3. Of the locations listed in Tables C5 and C6, those that are predicted to potentially sustain cumulative visual effects are listed below with a note of which wind farms will potentially be visible, along with their distance and direction and an indication of the significance of the cumulative visual effect. Sequential cumulative effects for receptors using routes through the study area i.e. users of public rights of way and motorists on key roads are assessed in a separate part of the table.

Table 9.7 Assessment of static and sequential Cumulative Visual Effects

Visual Receptor Viewpoints and Routes	Approx. Distance to Ffynnon Oer (km)	Direction of View	Name of Other Wind Farm in View and Distance (km)	Potential Significance of Cumulative Effect
Static				
Croeserw	4.5	Southeast to northwest	Margam Wind Energy Cluster Approx 9 km	Properties on elevated ground situated on the southern edge are likely to sustain mid distance views of Ffynnon Oer wind farm combined with long distance views of Margam wind farm. The significance of the cumulative effect is likely to be low due to the distance of the Margam site and the requirement of clear atmospheric conditions for the effect to be sustained
Llangynwd	10	Southwest to North	Margam Wind Energy Cluster Approx. 3.5 km	The significance of cumulative effect is limited by the orientation of buildings within the village, although close distance views of Margam wind farm are likely
Llangynwd	10	North to East	Taff Ely Approx. 13 km	As mentioned above the orientation of the buildings within the village will effect the likelihood of cumulative effect. This combined with the distance of the two wind farms and the requirement for clear weather significantly limits the cumulative effect
Properties within the northern quarter of Swansea	18	East	Margam Wind Energy Cluster Approx. 18 km	Long distance views of Proposed Ffynnon Oer and Margam wind farms, however availability of clear views would be restricted by urban development and clarity of weather conditions. The opportunity for cumulative effects is therefore considered not significant
Sequential				
Sarn Helen	5	South - Southeast	Margam Wind Energy Cluster Approx. 16 km	Users of Sarn Helen, approx. 3 km northeast of Tonna, are likely to sustain middle distance views of a high number of turbines within Ffynnon Oer Wind Farm combined with long distance views Margam Wind Farm where 1 to 5 turbines would be visible. To sustain a cumulative effect the receptor would need to be looking in the correct direction and would require clear weather conditions. The cumulative effect is therefore considered to be low

Table 9.7 (continued) Assessment of static and sequential Cumulative Visual Effects

Visual Receptor Viewpoints and Routes	Approx. Distance to Ffynnon Oer (km)	Direction of View	Name of Other Wind Farm in View and Distance (km)	Potential significance of Cumulative Effect
Ogwr Ridgeway walk	12	Northwest	Margam Wind Energy Cluster Approx. 1 km	Users of the walk would sustains close distance views of the proposed Margam Wind Farm combined with long distance views of Ffynnon Oer Wind Farm leading to both potential sequential and cumulative views. In theory a range of between 21 to 27 turbines could be viewed, however, the clarity of views containing Ffynnon proposal would strongly dependent upon weather conditions. Therefore the sequential cumulative effect is considered to be low
Ogwr Ridgeway walk	12	Northeast	Taff Ely Approx. 14 km	Sequential and cumulative long distance views of both wind farms would ensure that they were seen as part of the wider landscape composition and not focal elements within the landscape. Combined with the requirement for clear weather conditions and intervening vegetation and topography restricting the number of turbines visible, the cumulative significance is therefore considered to be low
PROW leading up to the Black Mountain in the Brecon Beacons	17	Southeast	Margam Wind Energy Cluster Approx 27 km	Long distance views of the two wind farms would require clear weather. The distance between the receptor and wind farms would ensure that any turbines visible would be viewed in context of the wider landscape composition and therefore the cumulative significance would be low
A4063	3 km at nearest section	West to North (North bound)	Margam Wind Energy Cluster Approx. 4 km at nearest section	Although Margam Wind Farm would be visible from a number of places along the road the sequential cumulative effect is likely to be limited due to the restriction of built environment and topography interrupting views of Ffynnon Oer, therefore the significance of effect will be low
M4	12 km at nearest section	North to East (North bound)	Margam Wind Energy Cluster Approx. 4 km at nearest section	As previously mentioned in the above table views of Ffynnon Oer Wind Farm would be glimpsed at speed and would require road users to be looking away from the road. Longer lived views could be sustained of Margam Wind Farm however, these would also require road users to look away from the road. Cumulative effect is therefore limited and not considered to be significant

9.8.2 Summary of Significant Visual Effects

The significant visual effects of the construction period are generally limited to those receptors situated close to the proposed site. Although the use of cranes to raise the turbines will allow a key construction activity to be seen from further afield, the crucial ground level construction activities will generally only be seen by receptors with close distance views i.e. under 2.0 km. The use of cranes is likely to be restricted to a short period of approximately 1 month. Beyond this distance of 2.0 km the local topography and the screening provided by the large-scale mature, coniferous plantations severely limit the range of available views in which receptors could clearly discern the ground level activities. Consequently potential receptors in settlements such as Abercregan and Glyncorrwg which are both within 2.0 km of the edge of the site are predicted to only have partial views of the crane activities which generates predicted visual effects assessed as only 'minor' significance. The receptor groups who are predicted to sustain 'major' adverse visual effects and the reasons for this assessment are set out below:

- Croeserw - being located above the bottom of the Afan Valley on a north-facing valley side that faces the wind farm site some of its Croeserw's residents will have good views of the operation of the cranes which will intrude prominently above a section of the horizon producing a strong visual contrast.
- The Celtic Trail, St Illtyd's Walk and other public footpaths that cross or bound the site - close distance views with minimal opportunity for screening in open upland landscape hence sweeping views of all ground level construction activities.
- The Coed Morgannwg Way - as above but additional adverse impacts due to its use as access road for 2 km.

Uninterrupted views of the site in which the ground level construction activities are likely to be visible are limited to longer distance views from similarly elevated locations. At the distances involved it is considered unlikely that individual activities will be readily discernible and the clarity of the views will be dependent upon prevalent weather conditions. A good example of this situation is Byrn-Caws Farm which is located 7.5 km to the west at elevation of 210 m and has clear long distance views (see Figure 9.7f) in which the site is an element on the eastern horizon with no intervening screening planting or topographical features. Individual construction activities are unlikely to be discernible, except the cranes. This situation applies to the long distance views available from locations in the southern fringe of the Brecon Beacons National Park where receptors are considered to be particularly sensitive.

During the subsequent operational period there will be an increase in the number of visual receptors and the magnitude of visual impacts generated due to the height and movement of the turbines. Although slimmer than the turbine towers, the introduction of the 31 m diameter blades will increase the overall height of the structures thereby increasing their visual intrusiveness which in turn is compounded by their movement. Whilst masts, pylons and large aerials are existing visual elements in many views in the study area, Ffynnon Oer would be at a larger scale than any other developments on their horizons and as such a key consideration is its intrusiveness. Once again distance, prevailing weather conditions, topography and forestry plantation screening are key determinants and account for the absence of views from many potential middle distance receptor groups, particularly communities and isolated residential receptors located on lower valley sides. The receptor groups who are predicted to sustain 'major' adverse visual effects and the reasons for this assessment are set out below:

- The public footpaths on Werfa - intrusiveness on horizon and lack of any intervening screening elements;
- The bridleway and byway on Foel Trawsnant - intrusiveness on horizon and lack of any intervening screening elements;
- The Celtic Trail - for certain sections there is an absence of screening, compounded by proximity and predicted magnitude of change;
- The Sarn Helen long distance bridleway - intrusiveness on horizon and lack of any intervening screening elements along certain sections with the potential for cumulative and sequential visual impacts;
- The Coed Morgannwg Way - paucity of screening alongside some sections, proximity and magnitude of change;
- St. Illtyd's Walk; - as above;
- Some of the residents on the eastern edge of Cilfrew - visibility of a large number (13-16) of the turbines on the skyline;
- Some of the residents in Cymmer - partial middle distance views of upper parts of turbine and blade movement will form prominent intrusion on large section of northwestern horizon;
- Some of the residents in Abercregan - as above;
- Some of the residents and visitors to Croeserw and the adjacent proposed Afan Valley Holiday Park - as above.

For the remainder of the large number of potential visual receptors with middle or long distance views the assessment considers that the magnitude of visual change that will be generated by the wind farm i.e. the turbine and blades, will not be sufficient to generate effects of 'major' significance.

9.9 Summary

A development of the scale and location of the Ffynnon Oer Wind Farm will almost inevitably generate visual impacts which have consequent effects over a large area. There is an ongoing debate on to whether wind farm turbines in locations such as Ffynnon Oer have adverse, neutral or beneficial effects upon the existing views available to receptors. Research work and public attitude surveys discussed in the previously referenced guidance documents demonstrate that people have widely differing opinions on the types and importance of visual effects caused by wind farms. Opinions are influenced by socio-economic and educational background, recreational interests and the location of the people being polled. However in the Ffynnon Oer visual assessment we have consistently assumed a worst case scenario with the consequence that all visual effects have been classified as being 'adverse'.

The GLVIA guidance makes it clear that one of the key influences upon the magnitude of potential visual impacts is the design of the access to the wind farm. Unsympathetically designed new roads potentially cut across open hillsides to form very incongruous visual elements in their own right as well as leading the eyes of receptors to the turbines. Hence it is

important to point out that this situation will not arise at Ffynnon Oer as the access road will utilise an existing forestry track whose entire length is within the mature forestry plantation. This minimises potential views of the movement of construction and then maintenance vehicles and the potential visual intrusion and landscape impact of the track itself.

Apart from the much shorter length of time that the visual impacts will be generated from the construction period compared with operational period, there are other potentially important differences. There are predicted to be more receptors for the operational period when there are 16 turbines each with a height of 91 m as opposed to the construction period when there will only be one or two elements of a similar height i.e. the cranes. Given that one of the main predicted visual differences relates to views of the ground level activities, it is predicted that receptors sustaining greatest contrasts between the two periods will be the recreational receptors using the relative extensive network of PROWs within and around the site. Nevertheless the magnitude of the visual impacts sustained by the PROW users in both periods is such that the significance of the visual effects for both periods is assessed as being 'major'.

One of the key conclusions drawn from the assessment is the influence of distance upon magnitudes of impact. The photomontages from the Brecon Beacons National Park (Figures 9.9a-c and 9.10a-c) illustrate that at distances of 18.5 km each, the relatively small number of turbines proposed for Ffynnon Oer are not predominant visual elements. Nevertheless it is acknowledged that the movement of the blades will help to draw the eye towards them. Once again the influence of the weather on the turbines visibility must be emphasised, especially the fact that 1 in every 4 days is rainy or cloudy thereby preventing long distance views.

In addition the nature of the wind farm development, with no large new visual masses e.g. buildings, means that the potential for substantially screening or foreshortening existing views does not arise, except for internal views from some PROW sections. Instead the impacts generated by the operational wind farm will be concentrated on the potential of the turbine towers and blades to frame and/or filter close or middle distance views and most importantly to form an intrusive element in sections of existing views and/or form a focal point due to their skyline location.

The elevation of the Ffynnon Oer Wind Farm and the height of the turbines will ensure that there is an extensive Zone of Visual Influence (ZVI) which in turn implies potentially a large number of visual receptors. However the ZVI shown in Figure 9.1, which uses a conservative height estimate of 12 m for all the coniferous plantations, demonstrates that the ZVI only covers approximately fifteen percent of the 1257 km^2 study area. These are overwhelmingly the more elevated areas and as such does include a proportion of areas covered by local landscape designations. Along with forestry cover, topography is the dominant influence upon the extent of the ZVI as well as the regional and road pattern. Hence a very high proportion of the potential visual receptors located in valley bottoms or on lower valley sides, thereby assuring that they are much less likely to be included within the ZVI. The corollary of this baseline situation is that there are relatively few receptors with potential close distance views i.e. views from within 2.0 km of the wind farm in which the turbines would be the dominant visual element.

Wind farm proposals usually generate concerns that they will have adverse effects upon existing landscape character which is one of the primary criteria under which landscapes are designated to provide protection against unsuitable development. The southern part of the site of is covered by a local landscape designation; the unadopted Port Talbot Local Plan Landscape Protection

Area (LPA), whilst there are other landscape designations: Special Landscape Areas (SLAs) and Strategic Coalfield Plateau and Associated Valley Sides within the study area, whilst impacts upon the nationally designated Brecon Beacons National Park has been discussed above. The key landscape designation is the unadopted LPA: whilst the landscape assessment demonstrates that no important landscape elements will be lost to cause any detrimental landscape (or environmental or ecological) effects, it is unlikely to directly enhance existing landscape qualities.

The impacts of the construction and the operation of the wind farm upon landscape elements are very limited. They will concentrate upon the loss of areas of acid grassland and raised blanket bog plus possibly short sections of a dilapidated dry stonewall; all of which are very widespread features in regional upland moorland landscape character areas. It is important to note that by utilising existing forestry roads for access the proposal avoids one of the usual adverse landscape effects associated with wind farm development, namely the requirement to construct a new access road with the associated potential loss of landscape elements and adverse impacts upon landscape characteristics.

The construction and operation impacts and consequent effects upon landscape characteristics generally have a higher level of significance, although for the operational period the assessment considers that the effects are neutral as opposed to adverse during the short-lived construction period. The wind farm's operation would modify some of the more intangible landscape characteristics such as openness, simplicity, harmony and tranquillity, especially during construction activities. The introduction of the 16 turbines would also modify tangible characteristics such as colour, movement and the balance between man-made and apparently naturalistic landscape characteristics. However it is important to bear in mind that the present landscape is itself largely a result of human activities, as witnessed by the evidence of past mining, and that the predicted landscape changes are not permanent.

Overall it is considered that the magnitude of the predicted changes during both construction and operational periods will not be sufficiently large to undermine the upland forest/plateau moorland landscape character area or any of the other defined character areas. There are many precedents within the study area of man-made features in prominent locations such as communication masts and pylons which have not undermined existing landscape character areas. The simple and large-scale character is a robust and can incorporate a development of the type and scale of the proposed wind farm. Wind farms are gradually becoming accepted features in this landscape type in Britain and Europe and their presence and associated movement can highlight many of the components of the landscape character such as exposure and remoteness.

9.10 References

Guidelines for Landscape and Visual Impact Assessment. The Landscape Institute and the Institute of Environmental Assessment. Spon Press, London. 1995.

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Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

Afan Forest Park leaflet, Forest Enterprise.

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http://www.met-office.gov.uk/climate/uk/averages/sites/48.html Neath (62m AMSL) 1961-90 Station Averages.

10. Public Access

10.1 Introduction

The following section assesses the impact of the development upon existing public rights of way (PROWs) which cross or run close to the proposed wind farm site at Ffynnon Oer. The construction and operation of the wind farm could have direct and indirect impacts and consequent effects upon the users of the range of PROWs:

- Direct impacts are those that would be generated by any temporary or permanent closure or diversion of existing PROWs; whilst;
- Indirect impacts are those environmental impacts and their consequent effects that could potentially be sustained by users of the PROW network and are likely to focus upon visual and acoustic effects. These impacts are assessed in greater detail in the relevant sections (Landscape and visual - Section 9, Noise - Section 12).

Given the importance of the upland areas of South Wales for recreational activities, especially walking and riding, and the consequent presence of a number of designated long distance footpaths it was considered necessary to consider impacts upon public access in a separate section.

10.2 Methodology

Three criteria have been used in evaluating the predicted effects of the proposed development on public rights of way and recreational facilities:

i) The type of effect: direct or indirect with the latter sub-divided into visual and acoustic effects;

ii) The nature of the identified effect (i.e. whether it is adverse, beneficial or neutral);

iii) The policy importance for the evaluation of the sensitivity of the PROWs. The assessment has divided the local PROW resources into four categories based upon their perceived importance to the public and likely levels of usage (although no figures for usage levels are available). In descending order of importance these four categories are:

- National trails or recreational paths e.g. the Coed Morgannwg Way;
- Bridleways, Roads used as public paths (RUPPs) and Byways open to all traffic;
- Public footpaths;
- Other forms of public access including informal access and permitted paths in Forestry Commission plantations which are covered by an open access policy.

The magnitude of the predicted impacts sustained is quantified using a simple scale of high, medium, low or none. In some cases it is not possible to quantify the magnitude of impact and therefore "not quantified" is used in these instances.

The findings in relation to all of these criteria are brought together to give an assessment of significance for each effect, based on professional judgement. Hence significance is a product of sensitivity or policy importance of the individual PROW and the magnitude of the identified impacts. Effects are considered to be "major", "minor" or "no significance". Those effects rated "major" equate to the term "significant effects" in the EIA Regulations 1999.

For all PROWs direct and indirect effects will be considered separately for the construction phase. However as the operation of the wind farm will definitely not require the closure or diversion of any PROWs it is considered that the only effects could be indirect ones.

10.3 Baseline Description

10.3.1 Introduction

Potential direct impacts and consequent effects during the construction period are only considered to apply to PROWs within the defined site or along the proscribed access routes. As demonstrated in the landscape and visual assessment potential views of the wind farm will be available from distances as far away as at least 20 km and the study area was defined in response to this. However it is not considered to be helpful to consider potential indirect effects upon the myriad number of PROWs that are found in a 40 km diameter study area. Hence in defining the PROW study area, and in the absence of specific guidance from CCW, we have had regard to the assertion on page 16 of the most recent SNH guidance on the environmental impacts of wind farms[12] that turbines and blades are usually seen as a dominant focus when viewed from distances of up to 2 km.

Similarly noise assessment guidelines consider that only noise levels above 35 decibels have the potential to generate significant effects for acoustic receptors and a noise contour for this value has been plotted for the proposed wind farm. This demonstrates that by adopting a public access study area of 2.0 km radius the assessment will include all PROW users that could potentially sustain significant acoustic effects.

10.3.2 The Public Rights of Way Network

The PROWs within the study area have been identified using the relevant 1:25 000 Explore OS map and confirmed by Neath and Port Talbot County Borough Council's Definitive Maps. The vast majority have been walked by members of the assessment team. The referenced PROWs are illustrated in Figure 10.1.

In overview the site enjoys a good level of formal and informal public access. PROWs that cross or bound the site and which could therefore sustain direct impacts are listed below:

- St Illtyd's Walk - definitive map ref: 6/6A;

[12] Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

- Bridleway running south from a cairn near turbine no 1 to the mountain centre near Tonmawr - definitive map ref: 6;
- A short section of public footpath linking the above two PROWs along the western boundary of the site: - definitive map ref: 5.

In addition there are a number of un-surfaced tracks crossing the site allowing access for 4WD vehicles. Also the Coed Morgannwg Way; a national trail, runs northeast to southwest and passes very close to the eastern boundary of the site, although it is crucially this section of the trail is at an elevation that is a minimum of 20 m below that of the site. Sections of the Coed Morgannwg Way and St. Illtyd's Walk have been incorporated into the Celtic Trail High Level Cycle Route that has recently been defined by Sustrans. This runs from Neath to Pontypridd and has been clearly marked with trailmarkers and interpretation boards, including the Millennium Mile Post at the junction of Coed Morgannwg Way and St. Illtyd's Way to the immediate north of the site.

It is important to note that the proposed access route from the A4061 will use approximately 2.6 km of the length of the forestry access track that forms the route of the Coed Morgannwg Way to the immediate north of the site.

Beyond the boundaries of the site up to the edge of the nominal 2.0 km radius study area in addition to the continuation of the PROWs that cross the site , there are sections of the following PROWs as shown on Figure 10.1:

- St Illtyd's Walk/Celtic Way - Definitive Map Reference 6/6A;
- Coed Morgannwg Way/Celtic Way;
- Bridleway - Definitive Map Reference 32;
- Bridleway - Definitive Map Reference 27;
- Bridleway - Definitive Map Reference 14;
- Bridleway - Definitive Map Reference 6;
- Bridleway - Definitive Map Reference 50;
- Bridleway/Public Footpaths - Definitive Map Reference 28/68/73/74/49;
- Bridleway/Public Footpaths - Definitive Map Reference 24/32/33;
- Bridleway - Definitive Map Reference 6B;
- Public Footpath - Definitive Map Reference 55;
- Public Footpath - Definitive Map Reference 15;
- Public Footpath - Definitive Map Reference 16/17;
- Public Footpath - Definitive Map Reference 5;
- Public Footpaths - Definitive Map Reference 33/35/14.

In addition it is noted that the study area contains considerable areas of Forestry Commission plantation to which the open access policy applies.

10.3.3 Predicted Trends

The PROW network around the Ffynnon Oer site is considered unlikely to significantly alter in the near future; only the southern section of the Coed Morgannwg Way has been added since the compilation of the Definitive Map in 1971. The only exception is the possible definition of a companion 'low level cycle route' which could potentially utilise some of the existing forestry and access tracks to the immediate south of the site.

10.3.4 Information Gaps

There are no information gaps with regard to the identification of all PROWs, however Neath and Port Talbot County Borough Council have no available information upon the levels of usage of any of the PROWs. Anecdotal evidence and a weekend site visit indicate that the principal PROWs are relatively popular at weekends for walkers, horse riders and mountain cyclists.

10.4 Mitigation and Enhancement

This section considers the mitigation that will be required to offset the likely impacts of the development upon existing provision both during the six month construction phase and the subsequent operational period.

10.4.1 Temporary Land-Use Change and Construction

None of the PROWs that cross or run close to the site or the access road are proposed to be temporarily closed or diverted and will continue to operate as at present when the users have to accommodate periodic use by forestry vehicles. To reduce the potential negative impacts that would be generated by having construction materials spread across the site it has been agreed that all construction plant and materials will be stored in a secure compound located in a visually unobtrusive area on the east of the site. Also the potential for confusion amongst PROW users due to uncertainty about the purpose and duration of the construction activities will be removed by the introduction of temporary information boards located at appropriate locations on the PROW network.

10.4.2 Permanent Land-Use Change and Operation

Once again none of the PROWs will be diverted or closed, however NWP will erect a series of interpretation boards at key locations on the local PROW network. These will explain the operation of the wind farm in a local and national context as well as providing interpretation information for the wider landscape. The process by which the site was selected and the layout of the turbines determined is set out in Table 10.2.

NWP have contacted Sustrans with regard to the possible improvement of cycle paths within the vicinity of the site.

10.5 Evaluation of Effects

10.5.1 Direct Effects on PROWs - Construction Period

The working plan for the construction period indicates that NWP do not foresee the need to temporarily close or divert any of the PROWs that cross the site. (Hence there are predicted to be no direct effects, however there are likely to be some potential direct effects with regard to the use of the 2.6 km length of the Coed Morgannwg Way as an access route. Based on the fact that the Coed Morgannwg is already jointly used as a PROW and a forestry access track with no apparent problems it is considered that joint usage should be possible with clear signage sited at the main access points. Also widening will take place at key pinch points to reduce risks of conflict between recreational pedestrians and lorries. Hence direct effects are likely to be minor.

10.5.2 Direct Effects on PROWs - Operation Period

The operation of the turbines will not directly impact upon the use of the present PROW network within the site. Experience from other wind farm sites demonstrates that there is generally no problem in retaining existent PROW access within wind farm sites and this would be the case at Ffynnon Oer.

10.5.3 Indirect Effects on PROWs - Construction Period

As previously stated the assessment considers indirect effects on users of the PROW network to primarily consist of visual and acoustic impacts and their subsequent effects. As such, reference should be made to the comprehensive assessments contained in the relevant sections, however the potential for cumulative effects needs to be considered. Visual and acoustic effects with adverse significance levels assessed as both being 'minor' may cumulatively generate an adverse effect of 'major' significance upon the walkers (or cyclists' or riders') enjoyment of the PROWs, especially as it can be assumed that the relative isolation and tranquillity of the area is one of the attractions that draws PROW users to the area. However with Ffynnon Oer it is considered that the likelihood of indirect impacts would be reduced as construction would take place during weekdays rather than at weekends and Bank Holidays when the PROWs will be more heavily used. Furthermore construction will cease during the RAC Rally. The effect is therefore determined to be 'minor'.

10.5.4 Indirect Effects on PROWs - Operation Period

Once again reference should be made to the relevant landscape and visual and noise sections, however where clear views of the turbines and the movement of the blades are available coupled with the ambient sounds of the operation, they could have a detrimental effect upon the levels of enjoyment sustained by the PROW users. The sections of PROWs which pass across open land are considered particularly sensitive as, where they pass through established forestry plantations, views will be severely restricted and noise levels reduced. In particular users of bridleways 6, 11, 32 and 50 and public footpaths 5 and 14/33/35 could sustain indirect negative impacts as they will have good views of at least some of the turbines and access roads and hear the movement of the blades.

The levels of potential disturbance generated by the use of a section of the Coed Morgannwg Way for access by maintenance vehicles will be of a very low magnitude. It is predicted

vehicular movements will be limited to 2 movements per month and as such they will generate no additional impacts and effects upon PROW users compared with the present situation with regard to the occasional use of the Way by forestry vehicles.

10.6 Evaluation of Effects

10.6.1 Criteria

The magnitude of impact is considered to be high when clear views are available and low when views and operational/construction noise are heavily filtered by forestry plantations. Sensitivity criteria areas laid out in 10.1.2 iii). As previously noted no information is available on levels of usage by individual PROWs or season, however the construction of the wind farm will take place during summer months when levels of usage are likely to be at their highest increasing the magnitude of impacts. In order to consistently assess a worse case scenario the assessment consistently evaluates all the effects as being negative, however as stated elsewhere in the ES research indicates that members of the public impacted by wind farms such as PROW users do not necessarily consider them as detrimental.

10.6.2 Evaluation

Table 10.1 summarises the effects of the proposed development upon public rights of way and recreational facilities and assesses the significance of those effects.

Table 10.1 Effects and Evaluation of Significance for Direct Impacts in Construction Period

PROW reference (see Figure 10.1)	Length of PROW impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Direct Effect	Significance	
					Level	Rationale
6/6A St Illtyd's Walk/Celtic Way	1.8 km (1.8 km)	Adverse	National	Medium	Major	Important PROW and publicised long distance route crossing heart of the site hence potential for disruption
Coed Morgannwg Way/Celtic Way	2.6 km (0 km)	Adverse	National	Medium	Minor	Important PROW which does not cross site, but approx 2.6 km length to be used as access road mitigation should ensure that there is limited disruption from construction vehicles
6	1.5 km (1.5 km)	Adverse	Local	Medium	Minor	All turbines to east therefore unlikely to require closure or temporary diversion
5	1.3 km (1.3 km)	Adverse	Local	Medium	Minor	As above

Key:	Type of Effect	Policy Importance	Magnitude	Significance
	Adverse	National	High	Major
	Neutral	Regional	Medium	Minor
	Beneficial	Local	Low	Not Significant
			None	

Table 10.2 Effects and Evaluation of Significance for Indirect Impacts in Construction Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
St Illtyd's Walk/Celtic Way 6/6A	3.5 km (2.6 km)	Adverse	National	Medium	Major	Although construction activities only visible and audible for a proportion of path they will be dominant experience for that section of a long distance footpath
Coed Morgannwg Way/Celtic Way	2.6 km (0 km)	Adverse	National	Medium	Minor	No views of construction activities but movement of access vehicles will be feature along relevant section of the long distance footpath
Bridleway 32	2.9 km (1.4 km)	Adverse	Local	Low	Not Significant	Only impacts likely to be some southern views from section across open ground
Bridleway 27	2.2 km (0 km)	Adverse	Local	Low	Not Significant	Only impacts will be aural from elevated site
Bridleway 14	1.6 km (0.7 km)	Adverse	Local	Medium	Minor	Likely to be some views of blades being attached from open section looking northeast
Bridleway 6	3.4 km (1.9 km)	Adverse	Local	Major	Major	Construction activities will dominate open section
Bridleway 50	2.3 km (1.4 km)	Adverse	Local	Medium	Minor	Close enough to site to have good views and hear construction works
Bridleway/Public Footpaths 28/68/73/74/49 in Glyn Corrwg	2.8 km (0.9 km)	Neutral	Local	None	Not Significant	Distance means no noise and valley bottom location means no views due to difference in elevation
Bridleway/Public Footpath 24/32/33	3.7 km (0 km)	Neutral	Local	Low	Not Significant	Possibly some noise from access road

Table 10.2 (continued) Effects and Evaluation of Significance for Indirect Impacts in Construction Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
Bridleway 6B	2.0 km (2.4 km)	Adverse	Local	Medium	Minor	Proximity to site
Public Footpath 55	2.4 km (0.3 km)	Neutral	Local	None	Not Significant	No views or noise due to differences in elevation and dense forestry
Public Footpath 15	1.2 km (0 km)	Neutral	Local	Low	Not Significant	No views due to dense close by forestry and probably little used
Public Footpath 16/17	2.5 km (0 km)	Neutral	Local	None	Not Significant	No direct relation to site
Public Footpath 5	2.6 km (1.3 km)	Neutral	Local	None	Not Significant	No direct relation to site
Public Footpaths 33/35/14	3.2 km (3.2 km)	Adverse	Local	Medium	Minor	Limited views but impacts from noise

Key:	Type of Effect	Policy Importance	Magnitude	Significance
	Adverse	National	High	Major
	Neutral	Regional	Medium	Minor
	Beneficial	Local	Low	Not Significant
			None	

Table 10.3 Effects and Evaluation of Significance for Indirect Impacts in Operation Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
St Illtyd's Walk/Celtic Way 6/6A	3.5 km (2.6 km)	Adverse	National	High	Major	Close proximity and no mitigating factors ensure that wind farm will dominate relevant section of long distance footpath
Coed Morgannwg Way/Celtic Way	2.6 km (0 km)	Adverse	National	Low	Minor	Glimpsed views and sound of turbines
Bridleway 32	3.7 km (1.4 km)	Adverse	Local	Medium	Minor	Visually dominant for the 1.4 km section across open ground
Bridleway 27	2.2 km (0 km)	Adverse	Local	Low	Not Significant	Glimpsed views through canopy and some background noise
Bridleway 14	1.6 km (0.7 km)	Adverse	Local	Medium	Minor	Some noise and views of rotating blades from sections crossing open ground
Bridleway 6	3.4 km (1.9 km)	Adverse	Local	High	Major	Turbines will be dominant element in northern section across site
Bridleway 50	2.3 km (1.4 km)	Adverse	Local	High	Minor	Distance and openness mean wind farm will turbines dominant element in all northern views once bridleway attains the top of the ridgeline and open ground
Bridleway/Public Footpaths 28/68/73/74/49 in Glyn Corrwg	2.8 km (0.9 km)	Neutral	Local	None	Not Significant	Distance means no noise and valley bottom location means no views due to difference in elevation

Table 10.3 Effects and Evaluation of Significance for Indirect Impacts in Operation Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
Bridleway/Public Footpath 24/32/33	3.7 km (0 km)	Adverse	Local	Low	Minor	Only effects sustained will be on 33 due to openness of southwestern views
Bridleway 6B	2.0 km (2.4 km)	Adverse	Local	Medium	Minor	Movement of blades dominant element on ridgeline
Public Footpath 55	2.4 km (0.3 km)	Neutral	Local	None	Not Significant	Distance, change in elevation and forestry screening result in users being unable to discern wind farm's operation
Public Footpath 15	1.2 km (0 km)	Adverse	Local	Low	Minor	Footpath probably little-used (bridleway 14 more direct) and only glimpsed views of blade movement
Public Footpath 16/17	2.5 km (0 km)	Adverse	Local	Low	Minor	Only glimpsed views through dense forestry
Public Footpath 5	2.6 km (1.3 km)	Adverse	Local	Low	Minor	Only glimpsed views through dense forestry
Public Footpaths 33/35/14	3.2 km (3.2 km)	Adverse	Local	High	Major	The turbines and blades will be dominant features for walkers heading in southeastern direction

Key:	Type of Effect	Policy Importance	Magnitude	Significance
	Adverse	National	High	Major
	Neutral	Regional	Medium	Minor
	Beneficial	Local	Low	Not Significant
			None	

10.7 Summary of Key Issues

The site and its immediate environs act as a nodal point for a number of PROWs including two long distance footpaths and a national Saustrans cycle trail. The construction of the Ffynnon Oer wind farm will cause a degree of disruption to the existing recreational provision on the site. However the effects of the short-lived construction period are limited in spatial extent to the PROWs within and immediately around the site and the access road.

During the operational period the noise and visual impacts principally from the rotation of the blades will have effects on a wider extent of PROWS. Indeed the topography and extensive forestry of the surrounding area will result in most views being longer distance views form elevated PROWs on other ridgelines. Many of the PROWs in the 2 km radius area where the wind farm would be the dominant element are at lower elevations crossing or descending the valley sides and therefore allowing very limited views of the wind farm. These views and the noise of the operation are further reduced by the extensive dense forestry cover although it is recognised that over 20 years the distribution of forestry could change with clear felling of some tracts. A good example of the mitigating effects of topographical variation and forestry screening is provided by the Coed Morgannwg Way which runs within 200 m of the southeastern edge of the site. However it is a minimum of 30 m below the level of the wind farm site in mature forestry hence it is predicted that impacts will be restricted to ambient noise and glimpsed views of the rotation of the blades of the eastern-most turbines.

With regard to mitigation, especially during construction there are a number of key issues that come out of this assessment which, if adopted, will ensure that any adverse effects will be reduced:

- parts of the site under construction should be adequately secured from existing areas of open space and footpaths;
- it will be necessary to publicise the construction period to potential users and to ensure that there is adequate supervision of users whilst construction is underway;
- Any unforeseen need to temporarily close a PROW will need to be legally completed before it can be actioned.

Finally note should be taken of the opportunities provided by the wind farm to increase formal access across the site and to provide a limited interpretation facilities for walkers, riders and cyclists.

10.8 References

Guidelines on the Environmental Impacts of Wind Farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

11. Traffic and Transportation

11.1 Introduction

This section details the assessment of traffic and transportation impacts and effects associated with the proposed Ffynnon Oer Wind Farm development. It can be anticipated that the main impacts of traffic generation will occur during the construction period, associated with movements of material to and from the site, with impacts reduced once the site is operational.

Consideration has been given to the proposed access route to the site, the impacts of changes in vehicle numbers and the opportunities for adopting appropriate management principles to vehicle movements to minimise the effects.

11.2 Methodology

11.2.1 Introduction

This assessment of the impacts of traffic has considered the:

- potential impacts on local roads and the users of these roads;
- potential impacts on land uses and environmental resources fronting those roads, including the users and occupiers of these.

Additional traffic on surrounding roads may be generated during the construction and commissioning of the various elements that comprise the scheme, and during future operation of the Wind Farm. The following elements are considered.

- Construction of the Wind Farm. The peak flow of large goods vehicle traffic to and from the development during construction is anticipated to be during the period when access track construction, deliveries of ready mixed concrete, wind turbines and other equipment are required. Roadstone is required for the construction of access tracks between the turbines, and it is intended to source this from an existing open cast site within the forest at grid co-ordinates 287000, 203500 (identified on Figure 11.1) via existing forestry roads. Sourcing from here eliminates the need for bringing this material from other locations thus avoiding a substantial number of lorry movements on the highway. Light vehicle traffic is also likely throughout the construction period and this was included in the assessment in order that the realistic worst case for impacts from traffic during construction was considered.
- Commissioning of the Wind Farm (which will be considered as part of the construction period).
- Operation of the Wind Farm. there will be no permanent staff on site there will be occasional visits from maintenance and repair staff and materials responding to predictable maintenance needs and unpredictable repair needs.

11.2.2 Consultations

The Highways officers of Neath and Port Talbot County Borough Council and Rhondda Cynon Taff County Borough Council, were advised of the scheme, including the type and number of anticipated vehicle movements and the proposed scope of the assessment. They were asked for their comments and for sources of data on traffic movements on the relevant parts of the highway network. Responses have been received from both authorities. Neath and Port Talbot CBC being of the opinion that traffic and transport issues could be scoped out of the assessment. It was the opinion of Rhondda Cynon Taff CBC that existing traffic data collected by Glamorgan Engineering Consultancy for the A4061 north of Tower Colliery in 1997 and 1999 (with a factor applied for 2002) would be acceptable and that the spare capacity and lack of sensitive receptors south of the colliery was such that increases in vehicle movements as a result of the development will be acceptable.

Rhondda Cynon Taff CBC have asked that NWP consider whether there will need to be any physical works required along the existing highway infrastructure to accommodate the abnormal loads required to transport the wind turbines. A survey has been undertaken by the haulage company appointed by NWP to transport the wind turbines. It considers that the access route is capable of accommodating the vehicles.

11.2.3 Methodology

The methodology used in this assessment is based on a comparison between predicted traffic flows on potentially affected roads, with and without the development, for the construction and commissioning stage as well as the operational stage. Criteria are then applied to establish whether significant environmental effects are likely, taking into account the sensitivity of the receptors or the resources likely to be affected; and any changes in the composition of traffic, specifically where a higher proportion of heavy goods vehicles (HGVs are defined as heavy goods vehicles exceeding 7.5 tonnes gross vehicle weight) is anticipated.

The methodology is based on guidance given in *'Guidelines for the Environmental Assessment of Road Traffic'*, published in 1993 by the Institute of Environmental Management and Assessment (IEMA), formerly the Institute of Environmental Assessment. The methodology includes two rules of thumb whereby assessment is undertaken only on:

1. highway links where traffic flows will increase by more than 30% (or the number of large goods vehicles will increase by more than 30%).
2. any specifically sensitive areas (schools etc) where traffic flows have increased by 10% or more.

No specifically sensitive areas have been identified on the road links anticipated to be used to serve the proposed development. The threshold for assessing whether an effect is likely, and assessment is therefore required, is a 30% increase in either total traffic flows or in HGV flows.

Existing traffic flows on the A4061 have been established from traffic counts obtained from Glamorgan Engineering Consultancy. Predictions of future traffic in 2002 have been obtained by applying growth factors to this existing actual count data.

The transportation company appointed to delivery the turbine blades and towers have inspected the proposed access route. They have confirmed that it is possible to access the site without recourse to highway works.

11.2.4 Phasing

Construction
For a development of this type the majority of the changes will occur during the construction period rather than during the operational phase of the development. It is anticipated that the duration of the construction period will be approximately 7 months (though this is weather dependent and could be affected by the ground conditions encountered), and hence any impacts identified will only occur over this relatively short period of time.

Operation
Changes may also occur during the operation of the Wind Farm due to traffic from visits by permanent and maintenance staff. The anticipated numbers and significance are expected to be minor and are discussed in subsequent sections.

11.3 Baseline Description

11.3.1 Existing Situation

Local Highway Network
The local road network relevant to this study is shown on Figure 11.1.

Potential Routes to and From the site
During the construction period there are several potential routes on the local road network which could be used for vehicles to gain access to and from the site. However given the need to avoid sensitive receptors all vehicles will be required to approach the site access from Hirwaun using the A4061.

Routes to be Considered
The main route that the majority of vehicles will use to gain access to and from the site has been identified as:

- the M4 motorway, junction 43;
- then the A465 east to Hirwaun;
- the A4061 south towards Treherbert;
- accessing the forest, south of Mynydd Beili Glas.

It has been assumed, for the purposes of the assessment, that upon reaching the M4 motorway the effects of traffic will be negligible.

The main route has been described travelling into the site, assuming that the access into the site will be located at the existing forestry access located on the A4061 at OS Grid Reference 292500E 202500N. A reversal of this route is anticipated for movements from the site.

The wind turbine components are most likely to be delivered by sea to a port either in Wales or at Bristol. It is not envisaged that there will be any problems associated with the vehicles required to transport the wind turbines in the vicinity of the dock, or of any other docks that

potential turbine suppliers could use, as the only docks of interest to turbine suppliers have road connections that have been specifically designed or upgraded to accommodate loads of this type.

During the operational phase, the traffic accessing the site for maintenance and emergencies will also use the A4061.

Main Route Description

The A465 is a dual carriageway trunk road between the M4 motorway and Hirwaun. East of Hirwaun it becomes single carriageway and links Merthyr Tydfil, Abergavenny and ultimately Hereford. The Hirwaun roundabout provides access to the A4061, this road heads westwards to the Hirwaun Industrial Estate where at a roundabout, it turns south to Treherbert. The stretch of the A4061 from Hirwaun to Tower Colliery in industrial in nature. Beyond Tower Colliery the A4061 is rural in nature passing through forestry plantations.

A survey of the access route has been undertaken by the company appointed by NWP to deliver the turbines. They are of the opinion that all vehicles required for the development will be physically able to use the main route from the M4 to the site entrance. Some loads will be subject to abnormal load restrictions and will require prior police notification and possibly escort.

Existing Traffic Flows

Traffic count data for the locations agreed with the highways authorities is summarised in Table 11.1.

Table 11.1 Existing Two-Way2 Average Weekday 12 hour Traffic Flows (0700-1900 hours)

Count Location	Date of Count	Actual Count - Total Vehicles	Actual count - HGVs[1]	HGVs as a Percent of the Total Vehicles
A4061 immediately to the east of the Hirwaun Industrial Estate roundabout	8th June 1999	6451	1130	17.55%
A4061 immediately to the south of the Hirwaun Industrial Estate roundabout	17th June 1997	2560	412	16.1%

Source: Glamorgan Engineering Consultancy.
Notes:
[1]HGVs are Heavy Goods Vehicles exceeding 7.5 tonnes gross vehicle weight
2 Two-way (sometimes referred to as two-way movements) is defined as the total number of vehicles passing the point from either direction of travel. For example 50 two-way movements could comprise 50 vehicles passing in a single direction, or the same 25 vehicles going past left to right and then right to left.

11.3.2 Predicted Trends

It is accepted practice that traffic survey data should be no more than three years old. However both the Glamorgan Engineering Consultancy and the Highways department of Rhondda Cynon

Taff CBC are of the opinion that the existing traffic data as reproduced above is acceptable for the purposes of this assessment provided a growth factor for the year 2002 is applied.

The growth factors which will be used are those provided by the Glamorgan Engineering Consultancy as agreed with the Highways Department of Rhondda Cynon Taff CBC. The background and predicted traffic flows, after application of growth factors are detailed in Table 11.2.

Table 11.2 Actual Count and Predicted Baseline Count for Assessment of Construction Traffic - Existing Two-Way Average Weekday 12 hour Traffic Flows (0700-1900 hours) year 2002

Count Location (Year of Actual Count)	Actual Count - Total Vehicles	Actual Count - HGVs[1]	HGVs as a Percent of the Total Vehicles	Traffic Growth Factor to 2002	Predicted Total Baseline Traffic 2002	Predicted HGV[1] Baseline Traffic 2002
A4061 immediately to the east of the Hirwaun Industrial Estate roundabout	6451	1130	17.55%	1.0289	6637	1163
A4061 immediately to the south of the Hirwaun Industrial Estate roundabout	2560	412	16.1%	1.0417	2667	429

Source: Glamorgan Engineering Consultancy.
Note: [1]HGVs are Heavy Goods Vehicles exceeding 7.5 tonnes gross vehicle weight.

11.3.3 Information Gaps

Following consultation with both the highway authorities through which traffic generated by the development will pass it is considered that no information gaps now exist. The data can be considered appropriate to provide a robust assessment of impacts and effects of the wind farm development.

11.4 Mitigation and Enhancement

The measures that have been identified to date relate to mitigation, although some mitigation measures also extend into enhancement (see Table 11.3). Further measures, in particular relating to the use of abnormal loads, may be identified following conclusion of the discussions with police and local authorities.

Table 11.3 Mitigation Incorporated into the Proposed Development

Impact	Mitigation Incorporated Into the Proposed Development	Impact Wholly Mitigated?
Construction		
Mud and debris on public roads on the routes used to gain access to and from the site.	The contractor will adopt measures to ensure that public access and roads are kept clear of mud and debris. Wheelwash facilities will be provided if deemed necessary. Note that the majority of vehicles leaving the site will only have travelled on the internal track network, rather than off-road.	Partially
Roadstone, if brought from offsite will generate an estimated 1920 vehicle movements	Roadstone will be sourced from an existing open cast site within the forest using the existing quarry vehicles. This will wholly eliminate the need for the vehicle movements that would otherwise be required -.	Yes
Ready-mix concrete required to be brought to site by road, this will generate 1280 vehicle movements.	Vehicles will be required to use a defined route from the concrete plant avoiding settlements wherever possible	Partially
Effect of abnormal loads delivering plant and components to the site on road traffic flows	Police escorts would be required for all such loads and there is potential for deliveries to be timed for quieter overnight periods 1900hrs to 0700hrs. This is subject to discussions with relevant authorities.	Partially
Effect of abnormal loads delivering plant and components to the site on highway infrastructure.	Any accommodation works necessary to be agreed with local authorities following consent	Partially
Changed traffic flows on surrounding roads	Specified routes for materials to be delivered have been identified and will eliminate effects except on the identified movement routes.	Partially
Site Staff travelling to site in private vehicles	Some site Staff will be transported to site by minibuses	Partially
Operation		
None identified	None identified as necessary.	Yes

11.5 Evaluation of Effects

11.5.1 Construction

It is anticipated that the construction phase will take place over a 7 month period as illustrated within the Construction Programme provided at Section 2.3. The main activities during the construction phase are anticipated to be:

- Construction of hard standing and temporary office facilities;

- Upgrading and construction of access tracks within the Wind Farm site;
- Construction of the tower bases (turbine foundations) and transformer bases;
- Construction of site substation;
- Excavation of trenches and cable laying adjacent to the site tracks;
- Connection of distribution and signal cables;
- Erection of wind turbines;
- Commissioning of site equipment;
- Site restoration.

Pre-Construction

Prior to construction a small number of low-loaders will be required to bring general construction plant and site office accommodation. It is assumed that this would comprise approximately 8 deliveries (16 two-way vehicle movements) over a one week period at the beginning and end of the construction period (total 32 two way movements).

Construction of Access Tracks

An estimated 6.2 km of track will be required to link the turbines and control compound. The existing network of on-site forest tracks will be utilised and the on-site track layout has been designed to minimise the length of track required. It is anticipated that of the total track required, 3.2 km will be new tracks. The design of the tracks is provided in Section 2.

It is intended that the stone for use in the geogrid reinforced tracks will all be sourced from the adjoining forest where suitable rock has been identified within an operational quarry subject to a separate planning permission. This avoids the need for the estimated potential 1920 two-way vehicle movements that would be required if the material had to be brought onto site. The roadstone will be quarried using existing excavators, it will be crushed and graded within an existing crushing plant at the quarry. Transportation between the quarry and wind farm will be via existing quarry vehicles.

The geogrid material that is necessary for the floating tracks is delivered in rolls. It can be assumed that each lorry can transport 50 rolls per delivery. With approximately 840 rolls required for the construction of the track there will be 17 deliveries during the period. Assuming that there are approximately 45 working days for the track construction period (5 day week over anticipated 2.25 months this will equate to around two deliveries every five days (4 two way movements).

During track construction there will be a requirement for approximately 4 excavators, 2 rollers and 2 dumptrucks to move material around the site. This equipment would arrive on site at the start of the track construction process and leave the site at the end of this process. It is assumed that each item will be delivered on a low loader necessitating 6 deliveries (12 two-way movements) at the start and end of track construction (32 two way movements total).

Construction of the Turbine Bases

The proposed wind farm will consist of 16 wind turbines. The materials required for the construction of the turbines and their bases will partly be brought to site by road as well as being

sourced on site. For the purpose of this assessment we have assumed that all of the concrete will be brought to the site by road.

The wind turbine foundations will comprise a reinforced concrete base slab over stone. In total 640 standard cement lorries (1280 vehicles movements) will be required to deliver the material.

Installation of Cabling

Underground cabling will be installed on-site to connect the turbines and the substation and will, in the main, follow the routes of the access tracks. The trenches will require excavation using a JCB backhoe excavator (brought in at the start and included under pre-construction equipment). The cables will be on drums, these would be delivered to site on standard HGV lorries. A maximum of 32 deliveries (64 two-way movements) are assumed to be required.

Construction of the Wind Turbines

Wind turbine towers and nacelles will be transported via low bed trailers. In total 48 deliveries will need to be made for the turbine towers (96 vehicle movements) and a further 16 deliveries for the nacelles (32 vehicle movements). The wind turbine blades will be delivered to site on 35 m long rear steered vehicles (48 vehicle movements). Erection of the towers and blades is undertaken using two cranes of 500 t and 100 t lifting weight respectively. The total vehicle movements expected to be required for the wind turbine construction and commissioning are summarised in Table 11.4.

In addition other facilities to establish will include a substation and transformer compound and a temporary construction compound. General construction materials will also need to be brought to the site. These are estimated to require 10 lorry deliveries over the construction period and the substation to require 5 concrete lorry deliveries, 3 deliveries of electrical components, 5 deliveries of other building materials and 1 delivery of the transformer.

For the purposes of this assessment, it has been assumed that deliveries will take place on-site on 5 days per week for the worst case.

Table 11.4 Vehicles Required to Deliver Materials and Equipment for the Construction of the Wind Turbines and Associated Facilities

Construction Element	Material/ Equipment Required	Total Deliveries Required	Total Deliveries Required for the Construction of 16 Turbines
Turbine Towers, and nacelle		4 deliveries per turbine	64 lorries
Turbine Blades		1.5 per turbine	24 35 m lorries
Turbine Cables and Controllers		2 deliveries per turbine	32 lorries
Blade Hub	1 delivery per turbine	1 flat bed trailer load per turbine	16 lorries
Turbine base rings	1 ring per base	3 base rings can be delivered on 1 flat bed trailer type lorry	6 lorry deliveries
Cranes for erection / general purpose		2 mobile road-going cranes required	2 - assumes that both arrive on-site at the start of turbine erection and leave on completion.
Substation and compounds	Concrete, building materials, electrics	24 deliveries	24 deliveries
Total Deliveries			**168**
Total Movements			**336**

Source: National Wind Power

Construction Site Staff

It is estimated that a maximum of 80 people will be directly employed during the construction of the wind farm at any one time. However, due to the staggered nature of site activities and also the fact that more than one shift may be worked at peak times, taking advantage of appropriate weather and daylight conditions, it is likely that this figure will often be much less. Assuming an average occupancy of 5 people per vehicle (which allows for some arriving by car, but most in minibuses), the maximum number of vehicle arrivals would be 16 or 32 two way movements.

Total Traffic During the Construction Period of the Proposed Development

As discussed previously it is envisaged that during the 7 month construction period there will be a time when many of the above described activities will occur on-site concurrently. Therefore a worst case scenario can be identified for vehicle movements associated with the development.

Table 11.5 provides a summary of the total traffic generated by the wind farm development and identifies the anticipated phasing of activity, based on the indicative programme of operations given in Section 2.3. Average vehicle movements have been rounded up (to the nearest two-way movement)) and the worst case construction period has been defined in a way that ensures that the possibility of overlaps between activities is fully taken into account in defining peak values. This has been defined by assuming that:

- The peak delivery rate of materials (and thus of lorry movements) is derived by assuming the materials arrive over the probable activity period (the shortest realistic timetable anticipated).
- This peak delivery rate could occur at any time over the possible and probable activity periods, but is modified by assuming that materials may start to be delivered in the month prior to the earliest possible activity period, but that deliveries are complete in the month prior to the last probable activity period.
- Equipment for construction will arrive either in the month prior to the earliest possible activity period or (for activities commencing in month 1) in week 1 of month 1. Equipment will leave in the month after the latest possible activity month, or in month 7 for activities running through to the end of the construction period.

Inevitably, therefore, the values given in Table 11.5 and 11.6 overstate the total movements associated with the development. They do, however, provide a realistic assessment of the worst case peak daily movement levels.

Table 11.5 Summary of Vehicle Movements During Construction

Construction Element (all Following Specified Access Route Except Where Stated)	Total Vehicle Movements Required by Type (Two-Way Vehicle Movements) (HGVs Unless Stated)	Worst Case (Construction Period)	Two-Way Vehicle Movements per Month, Week or Day (using 4.5 Weeks per Average Month)
Pre-Construction Preparations			
Delivery and removal of site accommodation etc	32	Months 1 & 7	4 per day, week 1 Month 1 and week 31 7
Construct Access Tracks			
Machinery deliveries to and from site	32	Week 4 Month 1 & Week 31 Month 7	4 per day, week 4 Month 1 and week 31 month 7
Geotechnical Membranes deliveries	34	Months 2 & 3	4 per week Months 2 and 3
Roadstone - from within forest	N/A	N/A	N/A
Prepare Turbine Bases			
Concrete deliveries	1280	Months 3 & 4	30 per day, months 3 and 4
Foundations	64	As above	2 per day, months 3 and 4
Electricity Infrastructure			
Delivery of cables	64	Month 5	14 per week, month 5
Substation			
Substation equipment and transformer, compounds	48	Month 2	Average of 2 per day months 2, 3 and 4

Table 11.5 (continued) Summary of vehicle movements during Construction

Construction Element (all Following Specified Access Route Except Where Stated)	Total Vehicle Movements Required by Type (Two-Way Vehicle Movements) (HGVs Unless Stated)	Worst Case (Construction Period)	Two-Way Vehicle Movements per Month, Week or Day (using 4.5 Weeks per Average Month)
Turbine Erection and Commissioning			
Delivery of towers and nacelles	128	Month 5	6 per day Month 5
Delivery of Blades	48	As Above	4 per day month 5
Delivery of blade hubs, electrics	32	As Above	2 per day month 5
Delivery of turbine base rings	12	As Above	2 per day month 5
Road-going cranes arriving and leaving site	4	As Above	2 in week 1, month 1 and 2 in week 31 month 7
Tools and Generator for erection team, 1 trailer loaded with 40ft container	4		2 in week 1, month 1 and 2 in week 31 month 7
Fuel Deliveries			
Construction plant fuel deliveries (1 per two weeks)	30		2 each alternate week
Site Staff			
Estimated two-way minibus/car movements per day	32 per day		32 per day

To establish the significance of any effect the above total movements are converted to an assessment of the peak levels of traffic activity arising as a result of the development in each period. This is presented in Table 11.6. Note that the vehicle movements have been rounded up to the nearest 2 two-way movements. For example 12 deliveries in a week, representing 24 two-way movements averages out at 4.8 movements per day. For the purposes of the assessment this has been rounded up to 6 two-way movements (or 3 deliveries per day). The only exception is for road-going cranes which arrive on the site and do not leave for several months in which case the value is rounded up to whole numbers only.

Table 11.6 Anticipated HGV Movements During Construction (two-way movements peak daily values)

Month	1	2	3	4	5	6	7
Pre construction equipment and facilities							
Equipment in and out	4						4
Construct Access Tracks							
Machinery	4						4
Road stone	N/A						
Geogrid membrane		2	2				
Prepare Turbine Bases							
Concrete deliveries			30	30			
Foundations			2	2			
Electricity Infrastructure							
Delivery of cables					4		
Substation Construction							
Equipment and material deliveries		2	2	2			
Turbine Erection & commissioning							
Delivery of towers and nacelles					6		
Delivery of Blades					4		
Delivery of Blade Hubs, and electric infrastructure					2		
Turbine Base Rings					2		
Road-going and Crawler cranes arriving and leaving site	1						1
Erection tools and equipment					2		
Fuel deliveries							
Fuel deliveries	2	2	2	2	2	2	2
Expected total peak daily HGV movements in construction month	11	6	38	36	22	2	11

The daily peak HGV traffic generated by the construction activities is expected to be 38 two-way movements per day (month 3 of the 7 month construction programme). This peak level of HGV generation does not occur on each day of construction and is substantially lower for much of the period. The anticipated increase in HGV two-way traffic movements the A4061 is as follows:

A4061 east and west 38 two way movements.

In addition, the construction will also see additional vehicle movements for construction staff, estimated to comprise 32 two-way movements per day at the peak of construction activity. The peak additional total vehicle movements including HGVs and these other vehicles on the key road sections are as follows:

A4061 east and west 70 two way movements.

Table 11.7 Anticipated Changes in Traffic Flows as a Result of Construction Generated Traffic Based on Average Weekday 12 Hour Two-way Traffic Flows (0700-1900 hours)

Count location	Traffic Movements 2002	HGV Movements 2002	Total Daily Generated Traffic Movements	Total Daily Generated HGV Movements	Percentage Increase in Total Traffic Movements	Percentage Increase in HGV Movements
A4061 east	6451	1130	6521	1168	1%	3.4%
A4061 south	2560	412	2630	450	2.7%	9.2%

Source: Glamorgan Engineering Consultancy, Entec UK Ltd and National Wind Power, all percentages rounded to nearest whole number.

The data in Table 11.7 indicates that, no further assessment is required for the sections of road considered. This is because the change in total traffic and HGV traffic on the road links considered is less than the 30% significance threshold in the IEMA guidelines described in Section 11.1. Furthermore it falls below the 10% threshold for sensitive uses, although none have been identified along the route considered. Any effects on users of these roads will therefore be insignificant.

11.5.2 Operation

Normal Wind Farm Operational Activities

During the normal operation of the Wind Farm, routine inspection of the turbines is carried out twice a month. The main service being at 12 monthly intervals and a minor service at 6 months. Routine inspection would be via the route used by construction traffic.

At regular intervals throughout the wind turbine's life, oils and components, such as blades and gear boxes will require extra attention and changes. Routine maintenance such as this will still only require small numbers of workers accessing the site and will extend the duration of service time workers spend on the site, rather than increasing the number of personnel required.

Gearbox oil changes are required approximately every 18 months. Changing the oil and worn components will extend each turbine service by 1 day. Blade inspections will occur as required,

probably between every two and five years, and will utilise a 'cherry picker' or similar, but may sometimes require a 50T crane and man basket. It could take two or three weeks to inspect the blades on the whole site. Repairs to blades would utilise the same equipment but minor damage on every blade (which is not anticipated) would more than double the inspection period. Access would be via the A4061 and forestry track.

Track Maintenance During Wind Farm Operation

Track maintenance may also be required to be carried out during the operation of the Wind Farm. The frequency of this will be dependent on the weather conditions and the volume and nature of traffic requiring access to the site, with heavy plant being particularly wearing. This maintenance will be ongoing during the summer months when weather conditions would be expected to be most favourable.

Snow Clearance

Safe access to the site and especially to the substation is required all year round. It may occasionally be necessary to clear snowdrifts to facilitate site access using a JCB. It is anticipated that this would normally occur between December and March inclusive.

Emergency Operations

In the event of an emergency, and depending upon its nature, the maximum number of vehicles to be involved would be two cranes, one 35 m vehicle and two support vehicles. Ten two way movements.

Total Traffic Generated During Operation of the Proposed Development

Establishing the number of vehicles accessing the site under operation is therefore difficult to predict due to the variety of circumstances that may be encountered. A worst case scenario can be assumed for the assessment based on a scenario that during operation there was a period at which:

- normal servicing was being carried out (2 two way movements per day by fitters in minibus);
- at the same time all the emergency operations were being undertaken (10 two-way movements);

This would result in a total of 12 two way vehicle movements. These movements are below those identified during the construction phase of the development. Consequently when assessed against the IEMA guidelines the effect of operational traffic upon the highway will be insignificant.

11.5.3 Decommissioning

The predicted lifespan of the Wind Farm is 20 years. At the end of this period the Wind Farm could be decommissioned and the land reinstated. Given the changes in transport that are likely to occur over this time period, it is not considered appropriate to consider the traffic implications of wind farm decommissioning in this ES. Alternatively, and subject to planning conditions, a planning application may be submitted to retain the existing turbines or replace them with new ones.

11.5.4 Criteria for Evaluation

The criteria used for the evaluation are subjective but take into account the numbers affected.

Four criteria have been used in evaluating the traffic and transport impacts of the proposed development:

- the type of effect, i.e. whether it is positive, negative, neutral or uncertain;
- the probability of the effect occurring based on the scale of certain, likely or unlikely;
- the policy importance or sensitivity of the resource under consideration, in a geographical context:- international, national (UK), regional (the motorway and trunk road network of Wales), district (the A road network) or local (the road network in the vicinity of the site excluding motorways and trunk roads);
- the magnitude of the effect in relation to the resource that has been evaluated, quantified if possible or, if not, using the scale high, medium, or low.

Professional judgement is used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. Effects are considered to be of major or minor significance, or not significant.

11.5.5 Evaluation

The evaluation of effects is set out in Table 11.8.

Table 11.8 Effects and Evaluation of Significance - Traffic

Environmental Effect on Receptors	Type of Effect[1]	Policy Importance (or sensitivity)[2]	Magnitude of Effect[3]	Prob-ability of Effect Occurring[4]	Significance	
					Level[5]	Rationale
Construction						
Increased off-site construction traffic on local roads (A4061)	-ve	District	Low	Certain	Not significant	The percentage increase in total traffic and HGVs on the A4061 are both below the 30% threshold stated in the IEMA guidelines for even an extreme worst case scenario.

Table 11.8 (continued) Effects and Evaluation of Significance - Traffic

Environmental Effect on Receptors	Type of Effect[1]	Policy Importance (or sensitivity)[2]	Magnitude of Effect[3]	Prob-ability of Effect Occurring[4]	Significance	
Operation						
Increased operational traffic due to the development, on the A4061	-ve	District	Low,	Certain	Not significant	The percentage increase in total traffic and HGVs on the A4061 are both below the 30% threshold stated in the IEMA guidelines for even an extreme worst case scenario.

Key/footnotes:		
1.Type of effect	2. Policy importance	3. Quantified and/or scaled as high/medium/low
-ve = negative	I = international	
+ ve = positive	N = national (UK)	4. Certain/likely/unlikely
neutral	R = regional	
? = uncertain	D = district	5. Major/minor/not significant
	L = local	

11.6 Summary and Conclusions

The traffic and transportation assessment has involved identifying the environmental effects arising from the vehicle movements that are anticipated during construction and operation of the proposed Wind Farm. A plausible worst case approach has been taken to the analysis, and it is expected that for much of the construction period the level of vehicle movements will be substantially less than the peak value, which is expected to be in month 3.

In consultation with the highway authorities of Neath and Port Talbot and Rhondda Cynon Taff it has been agreed that the possible impact of vehicle movements on the regional network can be scoped out and that it is the impact upon the A4061 only that need be assessed. This would see the highest number of vehicles during month 3 of the construction phase. There are considered to be no sensitive receptors along the stretch of highway over which the construction and operational traffic will pass. Peak movements will be less than 30% of the total vehicle flows and based on the IEMA guidance there will therefore be no significant effect.

12. Noise

12.1 Introduction

This chapter presents an assessment of the noise impact of the proposed Ffynnon Oer Wind Farm on the residents in the vicinity of the proposed site. The proposed wind farm comprises 16 wind turbines each with a maximum capacity of 1.3MW. For the purposes of this noise assessment, noise predictions are based on the noise specifications of one of the candidate machines, namely the Bonus 1.3MW wind turbine.

Noise can have an effect on the environment and on the quality of life enjoyed by individuals and communities. The impact of noise can therefore be a material consideration in the determination of planning applications. The aim of this chapter is to determine the impact of noise at the nearest properties to the proposed wind farm site and to identify how any adverse noise effects can be mitigated. This assessment therefore considers the impact of noise arising from the construction phase of the project as well as from the operation of the wind farm.

Wind turbines may emit two types of noise: firstly aerodynamic noise, which is a natural sounding noise produced by the movement of the rotating blades through the air; and secondly mechanical noise, which may emanate from gearboxes or generators. There has been rapid progress in reducing both aerodynamic and mechanical noise from wind turbines, and new designs are much quieter than those of a few years ago. Mechanical noise in particular is negligible with modern turbine designs. Aerodynamic noise is usually only perceived at a distance when the wind speeds are fairly low. In higher winds, it is generally masked by the normal sound of wind blowing through trees and around buildings. One of the primary objectives of the assessment is to establish this relationship between wind turbine noise and the existing background noise at residential properties surrounding the proposed wind farm.

The assessment of wind farm noise was undertaken in two distinct phases. Initially the sound levels resulting from the operation of the wind farm experienced at the closest residential receptors were calculated using noise propagation software. These predictions showed that noise levels experienced at the closest receptor were slightly above those which governed whether a detailed noise monitoring programme was required. NWP decided that the detailed monitoring should be undertaken in accordance with current best practice in July and August 2002.

12.2 Methodology

12.2.1 Noise Terminology

The ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. Because of the wide range a scale based on a logarithmic basis is used in noise level measurement. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear has the ability to recognise a particular sound depending on the pitch or frequencies found at the source. Microphones cannot differentiate noise in the same way as the

ear, and to counter this weakness the noise measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) is internationally accepted and has been found to correspond well with people's subjective reaction to noise.

- L_{WA} is the sound power level. It is a measure of the total noise energy radiated by a source of noise, and is used to calculate noise levels at a distant location.
- L_{eq} is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. The L_{Aeq} is the A-weighted.
- L_{A90} index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background noise level.

Typical dB(A) noise levels for familiar noises are given in Table 12.1.

Table 12.1 Typical Noise Levels

Approximate Noise Level dB(A)	Example
0	Limit of hearing
30	Rural area at night, no wind or adverse weather conditions
40	Library
50	Quiet office without noisy machinery, such as typewriters
60	Normal conversation
70	In car noise without radio
80	Household vacuum cleaner
100	Pneumatic drill
140	Threshold of pain

Source : Entec

12.2.2 Guidance and Policy

General guidance and policy concerning noise associated with new developments in Wales is presented in the following documents:

- Technical Advice Note 8: Renewable Energy [1].
- Technical Advice Note 11: Noise[2].

Paragraph A28 of TAN 8 states that:

"Well designed wind turbines are generally quiet in operation."

Paragraphs A29 to 31 in the TAN 8 present a discussion of the broad issues surrounding the assessment of noise from wind farms. This discussion concludes that the use of BS4142:1999 [3] (which is traditionally used for the assessment of industrial noise affecting residential areas) is generally inappropriate for wind farms, and that assessments should be undertaken by reference to the nature and character of the area, with the concluding statement:

> *"Experience from mainland Europe has shown that there is unlikely to be a significant noise problem for any residential property situated further than 350-400 metres from the nearest turbine. Lesser separation distances may be acceptable depending on the turbines used and the specific conditions at a site."*

Advice about the impact of noise from construction is included in:

- BS5228:1997: Noise and Vibration Control on Construction and Open Sites [4].

As wind farms started to be developed in the UK about ten years ago, it became apparent that existing noise standards did not fully address the issues associated with the unique characteristics of wind farm developments and there was a need for an agreed methodology for assessing the impact of noise emission from wind farms. This methodology was developed for the Department of Trade and Industry (DTI) by the Noise Working Group (NWG).

The NWG comprised a number of interested parties including, amongst others, environmental health officers, wind farm operators, independent acoustic consultants and legal experts who *"...between them have a breadth and depth of experience in assessing and controlling the environmental impact of noise from wind farms"*. In this way it represented the views of all the stakeholders that are involved in this area of wind farm development. The recommendations of the NWG are presented in the DTI Noise Working Group Report – *The Assessment and Rating of Noise from Wind Farms* [5].

The basic aim of the NWG in arriving at the recommendations was the intention to provide:

> *"Indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding to the costs and administrative burdens on wind farm developers or local authorities."*

The DTI Noise Working Group report makes it clear from the outset that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that would arise through the development of renewable energy sources.

> *"The planning system must therefore seek to control the environmental impacts from a wind farm whilst at the same time recognising the national and global benefits that would arise through the development of renewable energy sources and not be so severe that wind farm development is unduly stifled."*

The DTI Noise Working Group recommendations provide a robust basis for assessing the noise implications of a wind farm and have become a well-respected and accepted standard for such developments within the UK. Furthermore, experience has now demonstrated that the implementation of these recommendations has enabled the construction of wind farms without giving rise to operational noise difficulties. This methodology has therefore been adopted for the present assessment.

12.2.3 Overview of Assessment Procedure

The DTI Noise Working Group assessment procedure specifies that wind farm noise limits should be set relative to existing background noise levels at the nearest properties, subject to a fixed minimum limit, and that these limits should reflect the variation in both turbine source noise and background noise with wind speed. The wind speed range that should be considered ranges between the cut-in speed[13] for the turbines and 12 ms^{-1}, with wind speeds being referenced to a 10 metre measurement height.

Separate noise limits apply for daytime and for night-time. Daytime limits are chosen to protect a property's external amenity i.e. the amenity of people in the curtilage of the building, and night-time limits are chosen to prevent sleep disturbance indoors. Absolute lower limits, which are different for daytime and night-time, are applied where very low levels of background noise would be unduly restrictive on such developments.

The daytime noise limit is derived from background noise data measured during so-called 'quiet periods of the day' [5] at residential properties, which comprise:

- All evenings from1800 to 2300; plus
- Saturday afternoons from 1300 to 1800; and
- All day Sunday 0700-2300.

This data is plotted against the concurrent wind speed data measured at the proposed wind farm site and a 'best fit' correlation established. The quiet day-time noise limit, or 'criterion curve', is then based on a level 5 dB(A) above this best fit curve over a 0 - 12 ms^{-1} wind speed range. Where the criterion curve is found to be below a fixed level in the range 35 - 40 dB(A) then the criterion curve is set at that level. The precise choice of criterion within the range 35 – 40dB(A) depends on a number of factors, including the number of noise affected properties and the potential power output of the wind farm.

The night-time noise limit is derived from background noise data measured during the night-time periods, with no differentiation being made between weekdays and weekends [7]. This is plotted against the concurrent wind speed data and a 'best fit' correlation established. The night-time noise limit is again based on a level 5 dB(A) above the best fit curve over a 0 - 12 ms^{-1} wind speed range. Where the criterion curve is found to be below 43 dB(A), it is fixed at 43 dB(A).

To undertake the assessment of noise impact in accordance with the foregoing methodology, the following steps were undertaken:

- measure the background noise levels as a function of site wind speed at the nearest residential receptors;
- determine the quiet day-time and night-time criterion curves from the measured background noise levels at the nearest residential receptors;
- specify the type and noise emission characteristics of the wind turbines;
- specify the number and locations of the wind turbines;

[13] The cut-in speed is the minimum windspeed that needs to be attained before the turbine starts to rotate.

- identify the locations of the nearest, or most noise sensitive, receptors;
- calculate the noise levels due to the operation of the wind turbines as a function of site wind speed at the nearest neighbours;
- compare the calculated wind farm noise levels with the derived criterion curves and assess in the light of planning requirements.

These steps as applied to the Ffynnon Oer Wind farm are now set out in the following sections.

12.3 Baseline Situation

12.3.1 Background Noise Survey Details

In general subjective terms, the existing ambient noise environment around the Ffynnon Oer Wind Farm site is controlled by 'natural' sources such as wind noise, running water and livestock. Human activity noise is also evident in some areas, mainly that associated with local traffic movements particularly those in the village of Abercregan and to a lesser extent those on the A4107 approximately two kilometres to the south of the site.

Two noise monitoring locations at residential properties were agreed with the Local Authority as being representative of the background noise environment around the wind farm site. These are shown in **Figure 12.1** and listed in Table 12.2 below. Elevations have been determined from OS digital terrain data.

Table 12.2 Noise Monitoring Locations

House Name	Easting	Northing	Elevation (m)
Troed y Rhiw Farm	284440	197400	229
No 24 Prossers Terrace	285250	196550	227

The equipment used for the background noise monitoring exercise comprised 2no. RION NL-31 logging sound level meters. These were enclosed in environmental cases with sufficient battery power to enable approximately 7 days continuous logging at the required 10 minute averaging periods. All measurement systems were also fitted with appropriate wind and rain protection for the microphones to maintain Type 1 measurement accuracy. The microphones were all positioned between 1.2 m and 1.5 m above local ground level and were located on the wind farm side of the property in question, and away from obvious local sources of noise, such as running water or boiler flues. The equipment at Troed y Rhiw was located over 10 metres from any building façade and away from trees as prescribed by the methodology. At Prossers Terrace this was not possible as the garden contained a number of trees. At this location the microphone was positioned as far from the building façade and the closest trees as possible.

All measurement systems were calibrated on deployment on 17 July 2002, with recalibrations and battery changes at approximately weekly intervals until the equipment were removed from site on 21 August 2002. No significant (>0.2dB(A)) drifts in calibration were found to have

occurred on any of the meters. The first week of data recorded at Prossers Terrace between 17 and 25 July became corrupted and could not be used for this assessment. This corruption was caused by a fault in the sound level data logger, this problem was rectified by swapping the faulty equipment for another RION NL-31 sound level data logger.

All measurement systems were set to log the $L_{A90,10min}$ and $L_{Aeq,10min}$ noise levels continuously over the deployment period. The internal clocks on the sound level meters were all synchronized with the timer on the 10 m high meteorological mast, from which wind data was simultaneously collected for the analysis of the measured background noise as function of wind speed and direction.

12.3.2 Measured Background Noise Levels

Figure 12.2 shows the range of wind conditions experienced during the noise survey period. The wind speeds were all measured on a 10m high mast located within the boundary of the proposed wind farm site. **Figures 12.3(a)** to **12.4(b)** show the results of the background noise measurements at each of the locations. The results are presented in terms of $L_{A90,10min}$ background noise levels plotted as a function of 10 m height wind speed. Two plots are shown for each location, one for quiet day-time periods and the other for night-time periods. It is apparent from all the plots that the correlation between background noise level and wind speed is very weak and is a result of the sensitive receptors being located in areas relatively sheltered from the wind.

12.4 Mitigation Measures

The agreed mitigation during the construction stages is set out in Table 12.3. This takes the form of generic mitigation measures. The proposed wind farm layout presented in this document has evolved as a result of balancing energy capture against environmental impact considerations, including noise impacts.

Table 12.3 Mitigation Incorporated into the Construction of the Wind Farm

Impact	Mitigation incorporated into the proposed development	Impact wholly mitigated?
Construction and Decommission Noise		
Increased ambient noise levels	• Use of equipment fitted with effective silencers/insulation.	No
	• Appointment of site contact to whom complaints/queries about construction activity can be directed. Any complaints to be investigated and action taken where appropriate.	Yes
	• Restrictions on the proposed hours of operation to avoid sensitive periods and in particular no night time working without prior agreement.	Yes
	• All construction activity to be undertaken in accordance with good practice as described by British Standard 5228:1997 Noise and Vibration Control on Construction and Open Sites. Decommissioning activity to be undertaken with regard to best practice in place at time of decommissioning.	No
Operation Noise		
Increased ambient noise levels	• Turbine noise will be governed by strict limits relating to windspeed and background noise levels	No

12.5 Calculation of Construction Noise Levels

It is anticipated that the overall duration of the construction stage would be approximately seven months as detailed in the construction programme in Section 2.3. During the construction period a range of different activities would take place within the site, for example, there would be delivery of materials to the site, earthmoving within the site, construction and equipment installation activity. The initial phase of works to lay access tracks will take place across the greater part of the proposed wind farm site. Once access roads are completed then the main plant locations will be at the proposed turbine locations shown on Figure 12.1. There will also be construction plant located at the proposed substation during the course of the construction programme. The greatest potential for noise generation is during the track laying stage and excavating and laying the turbine foundations which is programmed to occur simultaneously during Month 3. This worst case has been used for this assessment.

Construction activities will normally be restricted to between 07:00 – 19:00 hours on weekdays and 07:00 – 16:00 on Saturdays. Evening and night-time working is not expected although it is possible that limited 24 hour working may be required to meet specific demands. However, this would be with prior agreement from the Local Planning Authority. Similarly, working on Sundays or Bank Holidays is not expected unless a specific requirement arises, but again, this would require prior agreement.

Construction noise mainly arises through the operation of large items of plant such as excavators, dump trucks and the delivery and handling of materials. Miscellaneous equipment

including compressors, hand tools, generators, etc. would also be required. However, these have a significantly lower noise output than the large items of plant and any potential noise impacts can be effectively controlled by means of siting and screening.

In order to predict the likely site-attributable noise at any point, the contribution of noise from all individual sources must be included. The main items of plant which are likely to be used are detailed in Table 12.4. Noise data for these sources have been obtained from BS5228 Noise and Vibration Control on Construction and Open Sites 1997 [4].

As the actual types of equipment are not known at this stage, typical source noise data for the construction plant have been obtained from information in BS 5228 which gives an indication of noise levels from construction plant taken from measurements at various sites. It should be noted that as the plant noise levels from BS5228 that are used in the assessment are worst case there is scope for mitigation and reduction by use of modern, quieter plant.

Typically, construction equipment are based on diesel engines which have more low frequency (63Hz to 250 Hz) noise content than domestic equipment. Vehicle sound power levels will typically range from L_{wA} 100dB to L_{wA} 120dB depending on type and operation mode.

Delivery vehicles generate noise levels in the order of L_{wA} 108dB when in motion. However, these types of plant usually pass a reception point quite quickly and when stationary will be in idle which significantly lowers the noise output to the environment.

Miscellaneous equipment including hand tools, etc. would also be required. However, these have a significantly lower noise output than the plant in Table 12.4. As such their contribution is unlikely to be significant.

Table 12.4 Expected Plant Inventory during Track Laying and Foundation Laying

Expected Plant	Number	Assumed Sound Power Level dB(A)	Estimated on-time of activity %	Equivalent Continuous Sound Power Level
1. Track Laying				
Mechanical Excavator	4	112	100	115
Dump Truck	2	115	100	115
Roller	2	116	100	116
2. Foundation Laying				
Mechanical Excavator	2	112	100	112
Cement Mixer Truck	1	112	100	112

12.5.1 Choice of Noise Propagation Model

There are many ways available to predict noise propagation in the environment. For construction noise a defined method of prediction is contained in BS5228. This document forms the basis for the majority of construction works assessments throughout the United Kingdom. The prediction method allows for assessment of:

- distance attenuation;
- defined working areas;
- power on-times;
- working average noise levels;
- screening.

The BS5228:1997 calculations have been applied to the stages with the greatest potential for noise during construction of the proposed wind farm, these are the track building and foundation laying. Calculations have been made for the closest residential receptors as detailed in Table 12.2.

12.5.2 Predicted Construction Noise Levels

Day to day activities would vary and not all the equipment listed in Table 12.4 would be operational at all times. However, in order to assess potential construction noise impacts, worst case predictions for noise during the works have been made. As a detailed construction programme has not been made available the calculations have assumed that all plant is operational simultaneously at the closest part of the site to the sensitive receptors. Clearly, in reality this situation would not occur, as plant would operate at different positions around the site. For this assessment the following assumptions have been made:

- Two track laying teams each comprising 1 excavator, 1 roller and 1 dump truck:
  - the first team located between Turbine 16 and Turbine 10;
  - the second team located between Turbines 11 and 6.
- Two foundation teams each comprising 1 excavator and 1 cement mixer truck:
  - the first team laying the foundations at Turbine 16;
  - the second team laying the foundations at Turbine 11.

Predictions for the civils stage have been made for the closest receptors and the results are summarised in Table 12.5.

Table 12.5 Construction Noise Predictions, $L_{Aeq, 1hour}$ dB

Location	Predicted Noise Level
Troed y Rhiw	45.0
No. 24 Prossers Terrace	37.7

Source : Entec

The detailed construction noise calculations are given in Appendix D. Included in the calculations are assumed separation distances for each of the different operations taking place.

The distances are the closest to the sensitive receptors that activities are considered likely to occur during the civils stage.

12.6 Calculation of Operation Noise Levels

12.6.1 Noise Emission Characteristics of the Proposed Wind Turbine Type

The candidate turbine used in this assessment is the Bonus 1.3MW machine with a hub height of 60 metres. A Technical Note [6] on the measurement of noise emission from a similar turbine but with a slightly lower hub height (45m), contains the following information:

- a sound power level, L_{WA}, of 99.0 dB(A), for a 10 m height wind speed (v_{10}) of 8 ms^{-1};
- a gradient increase/decrease of 0.42 dB/m/s;
- an estimated uncertainty on L_{WA} of ± 2 dB;
- octave band spectra in reference conditions as shown in Table 12.6.

Table 12.6 Octave Band Spectrum for Candidate Wind Turbine in reference wind speed conditions (v_{10} = 8 ms^{-1})

Octave Band Hz	Sound Power Level dB(A)
63.5	82.7
125	89.6
250	91.6
500	92.8
1000	91.3
2000	90.7
4000	87.3
8000	78.4
OVERALL dB(A)	**98.8**

12.6.2 Proposed Wind Turbine and Nearest Neighbour Locations

The Ffynnon Oer wind farm is to comprise 16 wind turbines, the locations of which are shown in **Figure 12.1**. Elevations of turbine locations were determined from OS digital terrain data. Table 12.7 shows the distance to the nearest turbine for the selected residential receptors at which background noise levels were measured, as shown in **Figure 12.1** and listed in Table 12.2. As can be seen, the minimum separation distance between any turbine and the nearest residential property is approximately 660 m.

Table 12.7 **Distances to Nearest Turbines (in metres)**

House Name	Nearest Turbine	Distance (m)
Troed y Rhiw Farm	16	660
No. 24 Prossers Terrace	16	1700

12.6.3 Choice of a Noise Propagation Model

Whilst there are several noise propagation models available, here the ISO 9613-2 model has been used [7] to calculate the wind farm noise levels at the selected nearest residential receptors. This model has been identified as most appropriate for use in predicting far-field noise radiation from wind turbines in such rural sites. In this instance, the model took account of:

- geometric divergence;
- air absorption;
- ground reflections.

To make the predictions, it was assumed that:

- the turbines are identical;
- the turbines radiate noise at the power specified in Table 12.6;
- each turbine can be modelled as a point source at hub-height.

Noise levels arising from the operation of the proposed wind farm at Ffynnon Oer have been calculated using the ISO 9613-2 algorithm option in the LIMA commercial noise propagation software. The software package uses as its acoustic input data the octave band sound power output of the turbines and calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption, and ground effects. It was decided to set the inputs to the model to give the worst case scenario and as such the highest levels of predicted noise. In order to do this it was necessary to exclude ground cover (ie vegetation) from the predictions as it is non permanent and may be subject to change during the life of the wind farm. In reality, the wind passing through trees and other forms of vegetation will help mask the noise generated by the wind farm by increasing the background noise levels. Similarly, the model assumed hard ground between the turbines and the receptors, as hard surfaces appear to have virtually no absorption properties whereas maximum attenuation occurs over grassland. Topography can also have a significant effect on noise propagation but the effects can be quite unpredictable and as such has been omitted from the model. By excluding topographic features the model illustrated how the wind farm noise would propagate over flat ground which in reality is unrealistic but adds to the worst case scenario. The noise model predicts noise levels in terms of L_{Aeq}, in order to convert these levels to L_{A90} levels, which are recommended by the NWG report, a simple subtraction of 2 dB has been made to all levels.

The ISO 9613-2 algorithm has been chosen as being the most robust prediction method, based on the findings of a recent joint European Commission research project into wind farm noise propagation over large distances. The title of the research project was 'Development of a Wind Farm Noise Prediction Model', JOULE project JOR3-CT95-0051. The final report is given as reference [8].

Whilst it is impossible to specify exact error bands on noise predictions, the ISO 9613-2 model was found to be the best available, both in flat and complex terrain. This model, like all the others, tends to over-estimate the noise at nearby dwellings, rather than under-estimate it. The overriding conclusion of the work undertaken as part of the EC research study was that the ISO 9613-2 algorithm tended to predict noise levels that would generally occur under downwind propagation conditions. The probability of non-exceedence of the levels predicted by the ISO 9613-2 algorithm was around 85%. The other important outcome of the research was to clearly demonstrate that under upwind propagation conditions between a given receiver and the wind farm, the wind farm noise level at that receiver will be as much as 10dB(A) to 15dB(A) lower than the level predicted using the ISO 9613-2 algorithm.

All noise level predictions, both day and night, are undertaken using a receiver height of 2.0 m above local ground level.

12.6.4 Predicted Wind Farm Noise Immission Levels

Table 12.8 shows the predicted wind farm noise levels, L_{A90}, likely to be experienced at the residential receptors for each 10m height wind speed from 4 ms^{-1} to 12 ms^{-1} inclusive. These levels were predicted using no topographical features and can therefore be taken to be worst case. All wind farm noise levels in this report are presented in terms of the L_{A90} noise indicator, in accordance with the recommendations of the NWG Report [5].

Under the recommended reference wind speed, i.e. v_{10} equal to 8 ms^{-1}, predicted wind farm noise levels at 2.0 m height are 38.2 dB(A) at Troed y Rhiw Farm and 29.9 dB(A) at No. 24 Prossers Terrace.

Figure 12.5 shows the L_{A90} isobel (ie noise contour) plots for the site at the reference wind speed of v_{10} equal to 8 ms^{-1}. Such plots are useful for evaluating the noise 'foot print' of a given development.

Table 12.8 Predicted Wind Farm Noise Levels ($L_{A90,T}$ dB) at 2.0m height at Receptor

House Name	Reference Wind Speed (v_{10})/ms^{-1}								
	4	5	6	7	8	9	10	11	12
Troed y Rhiw Farm	34.5	34.9	35.4	35.8	36.2	36.6	37.2	37.6	38.2
No. 24 Prossers Terrace	26.2	26.6	27.1	27.5	27.9	28.3	28.7	29.2	29.6

12.7 Evaluation of Noise Impact

12.7.1 Construction Noise

The predicted construction noise levels have been compared to the daytime background noise levels at the receptors. The comparison is given in Table 12.9 below.

Table 12.9 Comparison of Measured Background Noise Levels and Predicted Construction Noise Levels

Receptor	Predicted Construction Noise $L_{Aeq\ 10\ hour}$ dB	Background Noise	
		$L_{Aeq\ 10mins}$ dB	$L_{A90\ 10\ Mins}$ dB
Troed y Rhiw	45.0	32.3 - 61.4	30.9 - 53.7
No 24 Prossers Terrace	37.7	35.7 - 64.6	33.9 - 46.5

Comparison of the day-time ambient noise levels in terms of the L_{Aeq} dB index indicates that the predicted construction noise levels are similar to, or lower than, the prevailing levels. Comparison of the predicted construction noise levels with the prevailing L_{A90} dB background noise levels (the underlying noise level at quiet day-time periods) indicates that for some periods of the programme the difference could be up to approximately +15 dB(A).

Given the foregoing observation, construction noise can be expected to be distinctly audible at quiet times during the working day at periods when works are close to each receiver location. However, the ambient noise climate, including natural sources such as running water and the wind blowing through vegetation, and local vehicles will provide some masking noise reducing the subjective audibility.

DOE advisory leaflet AL72 [9] provides current information regarding the potential impacts of construction site noise. It gives advice as to the maximum levels of construction site noise at adjacent occupied buildings during daytime hours (07:00 to 19:00 hours).

The area around the site is rural and as such, the relevant criteria from AL72 are as follows:

Daytime (07:00 - 19:00) facade[14] $L_{Aeq\ 12\ hour}$	70 dB(A) – for rural, suburban and urban areas
Evening (19:00 - 22:00) facade $L_{Aeq\ 12\ hour}$	60 dB(A) – no construction anticipated
Night-time (22:00 - 07:00)	no construction.

The predicted construction noise levels during the worst-case track laying and foundation stage relate to free field conditions. Predicted values are within the criterion for daytime construction noise levels. Noise generating activities are not anticipated to occur during the evening or night-time periods. Although construction noise is likely to be audible at the closest properties, particularly during working in the closest areas of the site, it would be well below generally accepted criteria for maximum levels of construction noise.

[14] Note – façade noise levels are those within 1 m of the affected building where the effects of noise reflections occur.

12.7.2 Operation Noise

Figures 12.6(a) to **12.7(b)** show the predicted wind farm noise levels received at the receptors overlaid on the criterion curves derived from the background noise measurements (**Figures 12.3(a)** to **Figure 12.4(b)** inclusive) in accordance with the NWG recommendations.

It can be seen from **Figures 12.6(a)** to **12.7(b)** that the quiet day-time criterion is met at both properties and for all wind speeds and, like the quiet daytime situation, the night-time criterion is again satisfied at both properties for all windspeeds.

12.7.3 Evaluation of Noise Impacts

Table 12.10 below summarises the noise effects of the proposed development and assesses their significance.

Four criteria have been used in evaluating the noise effects of the proposed development:

- the type of effect, i.e. whether it is positive, negative, neutral or uncertain;
- the probability of the effect occurring based on the scale of certain, likely or unlikely;
- the policy context for the evaluation based on the following:
  - international (trans-national boundaries);
  - national (Wales wide);
  - regional (South Wales);
  - district (greater than 2 km beyond the site, but less than 20km);
  - local (within a 2 km radius of the site boundary);
- the magnitude of the effect in relation to the resource that has been evaluated, i.e. high, medium, low or no effect.

The findings in relation to all of these criteria are brought together to give an assessment of significance for each effect. Effects are considered to be of major, minor or no significance. This assessment relies on professional judgement rather than any scoring of the criteria.

Table 12.10 Effects and Evaluation of Significance

	Type Of Effect	Probability Of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance Level	Rationale
Construction Phase						
Noise at properties and recreational receptors due to construction activity	-	Likely	Local	Mostly - Minor, however, could be short periods of Some effect during specific works	Low	High noise levels would be short-term and would generally vary over the construction phase. Mitigation measures would be used to reduce effects and noisy activities would be restricted to day-time periods
Operation Phase						
Operational Noise	-	Unlikely	Local	Minor	Low	Mitigation to meet agreed design criteria levels will ensure no effect at closest properties

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	-ve = Negative	Certain	International	Major	High
	+ve = Positive	Likely	National (UK)	Some	Low
	? = Unknown	Unlikely	Regional	Medium	Not Significant
	0 = Neutral		District Local	Minor	
				None	

12.8 Summary of Key Findings and Conclusions

12.8.1 Construction Noise

The potential impact of noise generated through the construction of the wind farm has also been addressed. This noise impact has been assessed in accordance with guidance given in:

- Technical Advice Note 11: Noise [1];
- BS5228:1997: Noise and Vibration Control on Construction and Open Sites [4].

12.8.2 Wind farm Noise

The acoustic impact of the operation of the proposed Ffynnon Oer wind farm on the local environment has been assessed in accordance with the accepted guidance on wind farm noise assessment as issued in the DTI publication 'The Assessment and Rating of Noise from Wind Farms' [5]. The assessment has also accounted for other appropriate relevant standards and guidelines, including:

- Technical Advice Note 8: Noise [1];
- Technical Advice Note 11: Renewable Energy [2].

The assessment has been undertaken of the noise impact at two properties, Troed Y Rhiw which is the closest property to the site and therefore subject to the greatest potential noise impacts and Prossers Terrace whose location was agreed as being representative of other potential receptors in the area. These properties are listed in **Table 12.2** and shown on **Figure 12.1.**

The proposed wind farm comprises 16 wind turbines with a minimum separation distance of approximately 675m between any residential property and the nearest turbine.

Calculations have been undertaken for the candidate Bonus 1.3MW turbine. Predicted noise levels under reference wind speed conditions ($8ms^{-1}$ measured at 10 m height) are 36.2dB(A) at Troed y Rhiw and 27.9dB(A) at Prossers Terrace. The DTI NWG Guidelines recommend that during the day-time periods the allowable wind farm noise limit be set to 5dB(A) above the measured background noise level with a minimum level set in the range of 35 to 40dB(A), (minimum level not used in these cases as the background noise is above 35dB(A)at all wind speeds at which the turbines would be operational). However, during night-time periods, when most people would be expected to be indoors, a higher noise level is permissible than during day-time. In this instance, if the background noise level falls below 38dB(A) then the night-time absolute fixed noise limit is set to 43dB(A).

Applying the foregoing noise limits to the Ffynnon Oer Wind farm at the agreed assessment locations results in compliance at all properties for all wind speeds.

12.9 References

1 Technical Advice Note 8: Renewable Energy, Welsh Office, 1996.

2 Technical Advice Note 11: Noise, Welsh Office, 1997.

3 BS4142:1997: Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas, British Standards Institute, HMSO, 1997.

4 BS5228:1997: Noise and Vibration Control on Construction and Open Sites, HMSO, 1997.

5 The Working Group on Noise from Wind Turbines: 'The Assessment and Rating of Noise from Wind farms', ETSU Report ETSU-R-97, 1996.

6 'Measurement of Noise Emission from a Bonus 1.3MW Wind Turbine Situated Kassøvej 26, DK-6230 Rødekro', Delta Noise and Vibration, 2000.

7 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation', International Standards Organisation, ISO 9613-2, 1996.

8 'Development of a Wind farm Noise Propagation Prediction Model', Bass J H, Bullmore A J, Sloth E, Final Report for EU Contract JOR3-CT95-0051, 1998.

9 Advisory Leaflet 72 Noise Control on Building Sites, Department of the Environment, 1976.

13. Hydrology and Hydrogeology

13.1 Introduction

This section describes the existing site hydrology, the local surface water environment and groundwater conditions at the site and surroundings. It also describes an approach for managing surface water during the construction and operation of the proposed development. Based on the sensitivity of the local water environment a strategy for managing and protecting water resources is described.

13.2 Methodology

The methodology is based on the collection of a wide range of data and published material, plus consultations with statutory bodies, relating to the site and surrounding water environment. The data collected and other sources of information reviewed are listed in Table 13.1. Consultations and data collection were undertaken with the Environment Agency (EA) and the Neath Port Talbot County Borough Council. These consultations focused on the use of the local water environment for water supplies. Additional EA data was collected from their website (www.environment-agency.gov.uk).

The assessment has been undertaken primarily using a qualitative assessment based on professional judgement and statutory and general guidance. Such guidance includes the following:

- PPG 25 Development and Flood Risk;
- Groundwater Regulations 1988;
- Environment Act 1990;
- EA Pollution Prevention Guidance Notes (PPG);
- EC Fisheries Directive (78/659/EEC);
- EC Dangerous Substances Directive (76/464/EEC);
- Private Water Supply Regulations 1991;
- Forestry Commission 'Forests and Water Guidelines' 2000.

Table 13.1 Sources of Information: Hydrology and Surface Water Quality

Topic	Source of Information
Climate	
Rainfall	Centre for Ecology and Hydrology (CEH) national river flow archive (website www.nwl.ac.uk/ih/nrfa)
Surface waters	
Water quality and pollution incidences	Environment Agency website (www.environment-agency.gov.uk)
River flows	Centre for Ecology and Hydrology (CEH) national river flow archive (website www.nwl.ac.uk/ih/nrfa)
Water abstractions	Environment Agency and Neath Port Talbot County Borough Council
Groundwater	
Groundwater vulnerability	Groundwater Vulnerability Map of West Glamorgan, Sheet 35
Abstractions and Discharges	
Licensed abstractions	Environment Agency Consultation
Private Water Supplies	Neath Port Talbot County Borough Council Consultation
Consented Discharges	Environment Agency Consultation
Soils Environment	
Soil type	Soils of England and Wales, Sheet 5, Southwest England

13.3 Baseline Information

13.3.1 Site Description and Topography

The site is located in an elevated position with a high point of 464 mAOD which forms part of a larger ridge referred to as Cefnmawr. Since this is a high point a number of drainage catchment areas are located within the site. The site itself is situated on gently sloping ground, whereas beyond the site slopes become steeper. To the north and beyond the site the flat plateau gives way to a narrow valley leading to the Vale of Neath. This is a wide flat bottom valley which is glacial in origin. To the south and west of the site small valleys give way to Cwm Afan.

13.3.2 Climatic Conditions

Rainfall data for the general area is available for the river flow gauging station at Resolven (SN 815017) sourced from the National River Flow Archive (www.nwl.ac.uk/ih/nrfa). Annual average rainfall for the period 1961-1990 is 1949 mm. This reflects the rainfall at the gauge which is located at an elevation of 15.1 m AOD, compared to an average level of 440 m AOD within the site. Therefore since the effect of altitude can increase rainfall a higher annual average rainfall value is expected within the site. The National River Flow Archive also quotes losses from the gauge to equal 652 mm, and this is an approximate of evaporative losses at the gauge. Deducting rainfall from evaporative losses gives an indication of net rainfall, which is

defined as the quantity of rainfall that becomes available for runoff. Net rainfall for the site equates to ~1300 mm, though the effects of altitude within the site boundary would tend to result in a slightly higher value. However, this value of net rainfall illustrates how the site will be subjected to heavy rainfall and significant potential will exist for the derivation of runoff from the site throughout the year.

13.3.3 Surface Water Environment

Existing Surface Drainage

Due to the elevated location of the site runoff flows to three separate catchments (Figure 13.1). Approximately 0.36 km^2 drains northwards to a tributary of the Melin Court Brook. This tributary flows within the site and is sourced from a spring and a well called 'Ffynnon Oer' which are both located within the proposed site (Figure 13.1). Still within the site the stream flows into a small pond feature, which reflects an area of flatter topography. Just beyond the proposed site boundary the stream enters an area of overgrown vegetation and marshy ground. The stream is less well defined in this area. Further tributaries enter the Melin Court Brook though these are located outside the proposed site boundary, and some of these are fed by springs. The Melin Court Brook follows a relatively straight course and passes over a number of waterfalls. The Melin Court Brook eventually flows into the River Neath.

Drainage to the west flows towards an area of forestry and drains approximately 0.45 km^2 of the proposed site. A small drainage channel carries some drainage and water from the 'Ffynnon Oer' spring, and is perhaps a relic of previous water management within the area. A number of drainage channels are present within the forest and these ultimately drain to the Nant Twynpumerw and the Nant Y Cywion and subsequently into the Nant Blaenpelenna (Figure 13.1).

The remaining catchment area drains southwards and is the largest area draining the site at approximately 0.79 km^2. This area is wetter than the remainder of the site, with areas of wet grassland in the southern section of the site. Drainage from this area is sourced from springs along with the wet grassland areas. A number of small channels drain this area and feed the Nant Cregan. There is a change in land use at the site boundary where upland grassland gives way to forestry. The Nant Cregan drains a predominantly forested catchment. The Nant Cregan flows within an incised valley and outflows into the River Avan (Figure 13.1).

Surface Water Quality

The EA have not carried out any specific water quality monitoring within any of the surface watercourses of the site. In general surface water within the site will consist primarily of rainfall and any spring discharges, the quality of which are expected to be generally good and unpolluted.

Water quality data is available for a number of surface watercourses near the site, based on the EA General Quality Assessment (GQA) classification scheme. To the southwest of the site the EA monitor a minewater discharge at Twyn Pumerw, which enters the Nant Bleaenpelenna (Figure 13.1). Agency data, sourced from their website, indicate a 'good' chemical and biological quality of water with low nitrates and phosphates. Data is also available for the Neath Canal Weir, and as with the Twyn Pumerw discharge, water quality is classified as 'good'. Water quality that has been classified as 'good' under the GQA scheme is classified as water that would be suitable for abstraction and for both salmonid and cyprinid fisheries.

13.3.4 Groundwater Environment

Groundwater Flow

Geological mapping shows the site to be underlain by Carboniferous Upper Coal Measures strata. The conjectured outcrop of the Mountain coal seam is shown in the north and south of the site - essentially following the hilltop relief. In the west of the site the Graigola seam is also brought to outcrop by the north - south trending Pen-y-Castell fault. Superficial deposits are not shown at the site. However in the west and north of the site, on the slopes to the higher ground, landslipped ground is shown.

Based on the Groundwater Vulnerability Map of West Glamorgan and following consultation with the EA the site overlies strata that is classified as 'minor' aquifer. Minor aquifer is defined as having variable permeability due to fractures within low primary permeability rocks. They tend not to produce large quantities of groundwater for abstraction, though they can be locally important for local supplies and in supplying base flow to rivers. The Groundwater Vulnerability Map of West Glamorgan also classifies the soil overlying geological strata, in terms of its ability to convey water and contaminants into groundwater from the surface. The soils at the site are classified as having a low potential to convey water and contaminants into groundwater.

A number of groundwater features are present within the site, with the Melin Court Brook being fed by the Ffynnon Oer spring. In addition a number of issues result across the site and these will probably reflect the drainage of rainfall over Cefn Mawr through soils and near surface strata.

Groundwater movement and flow in the area is likely to have been effected by historical mining. The effects of mining will have been to create preferential flow paths, and to alter water levels particularly during mining. Most of the mining is historical and it is expected that water levels would have recovered to normal levels. It is not expected that any future springs will occur over the site from recovering minewater levels.

Groundwater Quality

No groundwater quality information is available for sources within the site. However, some of the surface watercourses within the site are fed by groundwater springs, and these surface watercourses do not appear to suffer from any particular water quality problems. Since the area local to the site has historically been subject to coal mining the potential exists for discharges of groundwater from mines. Such discharges could be contaminated with typical minewater pollutants, such as iron pyrite which oxidises at the surface to form ferric iron. Ferric iron or iron ochre can become deposited on the bed of watercourses and lead to environmental problems, such as reduced oxygen content and smothering of channel beds.

Such minewater discharges do occur within the locality of the site, with minewater treatment projects implemented in the River Neath catchment at Ynysarwed and on the River Pelenna, which is a tributary of the River Afan. Following consultation with the EA it is not believe that there are any minewater discharges within or close to the site that result in water quality problems. The minewater discharge at Twyn Pumerw, which enters the Nant Bleaenpelenna, is defined by the Agency as being of 'good' quality. However, the potential exists for such minewater discharges to occur from the old mineworkings located within the locality of the site, though the risks of such discharges are small particularly as no discharges have occurred to date.

13.3.5 Soils Environment

Soils information for the site is based on the Soils Map of England and Wales, Sheet 5, Southwest England. Information on the soils environment provides useful data for interpreting the hydrological regime of a site.

The major soil type underlying the site is the Gelligaer Association (654c) which consist predominantly of loamy permeable soils with a wet peaty surface. They can often have deposits of iron forming 'ironpans' which form an impermeable barrier to water movement. To the northwest of the site the soils belong to the Wilcocks 1 Association (721c). These are classified as slowly permeable loamy soils over clayey soils with peat surface horizons. Soils also differ to the southwest of the site. Soils here are more peaty and belong to the Crowdy 2 Association (1013b).

13.3.6 Abstractions and Discharges

There are three EA licensed abstractions within a 2 km radius beyond the site. These licences are located approximately 1.75 km from the boundary of the site and are used for lake top up and through flow. In addition to EA licensed abstractions, additional abstractions for private water supplies can be found. These abstractions are typically less than 20 m^3/day and are generally for the supply of drinking water to individual dwellings. Consultation with Neath Port Talbot County Borough Council has identified that there are three private water supplies located close to the site, with the closest approximately 1.2 km from the site boundary. The location of these private water abstractions are illustrated on Figure 13.1. Whilst these abstractions are located relatively close to the site, none are located within catchment areas that are drained by the site. Water quality data provided by Neath Port Talbot County Borough Council indicate that the quality of each of these sources meets the Private Water Supply Regulations 1991.

The EA has also provided details relating to licensed discharges. The EA is aware of two groundwater discharges, one of which is located within the site, and the remaining one located approximately 1.25 km from the site. These discharges are for the disposal of sheep dip direct to ground. The authorisation for the sheep dip disposal on the site allows a maximum discharge rate of spent sheep dip of 0.5 m^3/day and a maximum of 1.5 m^3/annum. The location of both licences are illustrated on Figure 13.1.

13.3.7 Hydrological Regime

The site is located within a relatively wet climate since annual net rainfall is over 1000 mm. This wet climate is reflected in the development of peat soils at the site, since these need to remain perennially wet to develop. Peat soils have a relatively high water storage capacity and therefore the site and surrounding will remain wet underfoot for the majority of the year. Excess rainfall not taken into soil storage will result in runoff from the site. This is directed into a number of small streams which radiate from the site. In addition areas of ponded water develop creating areas of wet grassland. Areas adjacent to the site have been forested and it is apparent that these areas have been artificially drained since there are a number of drainage channels within these areas.

Groundwater is present beneath the site, most probably in small quantities, and supports a number of the small streams radiating from the site. The majority of groundwater most probably represents rainfall over Cefn Mawr draining through soils and near surface strata. In places groundwater will have been effected by historical mining. Mining will most probably

have created preferential flow paths, though the extent of mining is limited beneath the site to shafts and small scale near surface adits. These features will not particularly have effected groundwater flow paths beneath the site.

13.4 Mitigation Incorporated into the Proposed Development

13.4.1 Introduction

Table 13.2 sets out the proposed mitigation measures to limit adverse impacts on the water environment. Mitigation proposals are divided into those relating to the construction and operational phase.

13.4.2 Construction Phase

Access Roads

Access roads within the site will be constructed using a standard floating road design. The access roads will also avoid areas of deeper peat to ensure that there will be no damage in these areas.

Drainage from roads will also be directed into adjacent areas to directly replenish soils. Limited lateral drains will be provided for surface water runoff which may collect on the uphill side of roads running parallel to contours. Access roads will be cambered to ensure that drainage is quickly shed off the roads onto surrounding land. This is designed to minimise the flow of water along roads causing erosion of road surfaces. The design of the access roads and drainage will be such that sediment erosion and transportation is minimised to ensure that the input of sediments into any watercourse is minimised. In particular it will be necessary to ensure that the private water supply located on the Nant Cregan is protected. Water quality leaving the site and entering the Nant Cregan will be monitored throughout the construction phase to ensure that there is no deterioration in stream quality.

Access roads will need to cross a number of streams within the site. Stream crossings will use a standard approach most likely to be sulphate resistant concrete culverts. Limited bank stabilisation works, using geotextile or other natural and sustainable materials, will be required either side of the stream crossings to ensure that stream erosion does not occur in these areas, particularly if any disturbance to banks has occurred during construction. Stream crossings will consist of culverts of sufficient size to convey maximum likely flows, to ensure that there is no risk of water backing up behind the culverts which could place pressure on the roads and lead to bankside erosion of peat in the vicinity of the crossing.

Electric Cables

The laying of electric cables, to connect the wind turbines with the on site substation, will be in small trenches, to minimise damage to the properties of soils. Trenches would be dug during drier periods, if possible, and any spoil material will be placed on the uphill slope to reduce the likelihood of runoff entering the excavations. The electric cables will be quickly placed within the trenches and soils replaced to minimise the ingress of water into the trenches.

Wind Turbines and Crane Pads

The installation of the wind turbines and crane pads will require the excavation of soils to provide a firm structural footing.

The wind turbines will be constructed on concrete support plinths, which will be placed on a solid footing i.e., solid strata or mineral soils. The support foundations will be formed by pouring concrete into the excavations. Sulphate resistant concrete will be used so that acid rich waters do not have a corrosive effect on the turbine bases.

Wind turbines will be positioned far enough away from watercourses to ensure that any accidental spillage of concrete during concrete pouring will not pose a risk to surface water. The consistency of the concrete will also be such that there is no potential for the concrete to enter the soil water environment and be transported through the soils either to groundwater or surface water sources. Spill response measures will be put in place to ensure that any accidental spillages at the surface can be contained and quickly removed from the site.

Excavated soils for the turbine foundations will in general be replaced on the turbine footing or used to restore other parts of the site. However, it may be necessary to excavate and remove from site any soils excavated within the area where sheep dip disposal currently occurs. Such soils would be removed from site and disposed of within an appropriately engineered disposal site.

Source of Roadstone

The construction of the access roads will require the sourcing of roadstone from an opencast located within the adjacent areas of forestry. The roadstone will need to be crushed and sorted within that site. This will avoid erosion of sediments entering nearby watercourses at Ffynnon Oer.

Site Working Practices

As with similar construction operations there will be heavy plant and machinery on site, and this results in the need to store oils and diesel. With such storage and during refilling and maintenance operations there is the potential for accidental spillages. As a result the storage of oils and diesel will be within either the temporary put down compound or close to the roadstone processing plant. Storage will be within impervious storage bunds with 110% capacity, so that any spillages will be contained. Refuelling of machinery will also be undertaken within designated areas, so that any spillages can be easily contained.

Throughout the construction phase best working practices will be adopted and measures to protect the water environment will be made by adopting recommendations set out in the following EA Pollution Prevention Guidance Notes (EAPPG):

- EA PPG 1 General Guide to the Prevention of Water Pollution;
- EA PPG 2 Above Ground Oil Storage Tanks;
- EA PPG 5 Works in, near or liable to affect watercourses;
- EA PPG 6 Working at Construction and Demolition Sites.

A risk assessment of activities will be undertaken to ensure that nearby private water supplies are protected throughout the scheme, as stated earlier.

13.4.3 Operation Phase

Apart from the operation of the wind turbines and general maintenance of the turbines, there will be few on-site activities during the operational phase. However, the developed site has the potential to affect the water environment beyond the construction phase resulting in the need to develop a longer term sustainable mitigation strategy.

Access Roads

The proposed mitigation for the potential impacts of the access roads on hydrology and soils was described under the construction phase, and will continue to function throughout the operational phase of the site. Methods incorporated into the scheme are designed to be sustainable and to cope with storm events. Therefore only routine maintenance is envisaged to be necessary for the road network within the site during the operational phase.

Site Working Practices

As stated earlier, there will be very little in the way of on-site activities during the operation of the wind farm. However, there will still be the need to carry out regular maintenance of the wind turbines and this will require regular access by maintenance crews. During such activities there may be the need to bring oils, greases and other substances, bringing with it the potential for accidental spillages. Such spillages are likely to be very small and since site drainage will be limited the risk to downstream watercourses from such spillages would be very low.

However, throughout the site operation best working practices will be adopted and measures to protect the water environment will be made by adopting recommendations set out in the following EA Pollution Prevention Guidance Notes (SEPPG):

- EA PPG 1 General guide to the prevention of water pollution;
- EA PPG 5 Works in, near or liable to affect watercourses.

To reduce the risk of pollution by sheep dip, via new pathways created by the wind farm development, NWP will arrange for the disposal of the spent sheep dip off site at an appropriate disposal site.

Table 13.2 Mitigation Incorporated into the Construction and Operational Phases of the Wind Farm

Impact	Mitigation Incorporated into the Proposed Development	Impact Wholly or Substantially Mitigated?[1]
Construction Phase		
1. Access Tracks		
Tracks, leading to disturbance of peat and drainage regimes	• Access tracks are to be constructed to standard wind farm design • Deep areas of peat will be avoided • Filter drains will be constructed either side of access tracks • Lateral drains will allow drainage to watercourses	Partially
Tracks crossing streams leading to channel bank disturbance, and sediment input	• Stream crossings have been kept to a minimum, but where crossings are necessary bank stabilisation works and culverts will be used to minimise impacts	Partially
Track drainage could result in the entrainment of sediment	• The track surfaces will be compacted to reduce the likelihood of sediment becoming entrained within runoff • Tracks will be designed to shed runoff quickly • Water quality leaving the site will be monitored to ensure there is no deterioration of quality in streams and to ensure that the private water supply abstraction from the Nant Cregan is protected	Mostly
2. Electric Cables		
Trench digging during cable laying could lead to collection of runoff, erosion of soils and sediment laden runoff	• Where possible the digging of trenches will be undertaken during dry periods	Mostly
3. Wind Turbine foundations and Crane Pads		
Accidental spillages of concrete which could enter streams	• Turbine locations will be set a minimum distance of 50m from streams to avoid concrete spillages entering watercourses • Spill response plans will be developed to ensure that any spillages will be contained and removed from site	Yes
4. Roadstone Quarry		
Discharge of sediment charged waters if borrow pits require de-watering	• Any de-watering will be passed to a small settling lagoon for removal of suspended sediments	Yes
5. Site Working Practices		
Accidental spillages of oils and diesel from heavy plant and machinery, or suspended sediments	• Best working practices will be adopted when working with oils and diesel • Spill response measures will be put in to place to ensure any spillages are quickly controlled	Mostly

Table 13.2 (continued) **Mitigation Incorporated into the Construction and Operational Phases of the Wind Farm**

Impact	Mitigation Incorporated into the Proposed Development	Impact Wholly or Substantially Mitigated?[1]
	• EA Pollution Prevention Guidance Notes will assist with the development of an environmental management plan for the site	
Operational Phase		
1. Access Tracks		
Permanent impact on site hydrology due to access tracks	• Lateral drains where tracks run parallel to contours will ensure drainage of surface water runoff • As described under Construction Phase, runoff will be shed off access tracks onto adjacent soils. Where soils are dry, infiltration drains will be installed	Partially
Erosion of access track surfaces during heavy rainfall events	• Tracks will be constructed to ensure that water is shed quickly	Partially
2. Site Working Practices		
Accidental spillages of oils and diesel from heavy plant and machinery, or suspended sediments	• Best working practices will be adopted when working with oils and diesel • Spill response measures will be put in to place to ensure any spillages are quickly controlled	Mostly

Note - [1] Key to predicted success of mitigation

Yes - Impact fully mitigated and no effects predicted.
Partially - Mitigation would be successful at reducing impacts, but some effects likely. These effects are discussed in section 13.4.
Mostly - Mitigation would be successful at reducing impact in most cases. Some effects possible under abnormal conditions (e.g. extreme weather conditions). These effects are discussed in section 13.4
No - Mitigation not possible to reduce level of predicted impact

13.5 Predicted Impacts and Effects

13.5.1 Introduction

This section describes the likely residual impacts and effects following the incorporation of mitigation and enhancement measures. It addresses those impacts presented in Table 13.2 that are not wholly mitigated i.e., those impacts where mitigation is either partially successful or not possible.

13.5.2 Construction Phase

Access Tracks

The track construction will result in unavoidable changes to the hydrological regime, and in particular the way surface water runoff occurs over the site. These changes will be limited in extent to points where access tracks run parallel to contours, with simple drains diverting this runoff to Melin Court Brook or Nant Cregan. During heavy rainfall events there is the potential

for the erosion of track surfaces and excavated soil material, which could lead to sediment entrainment within runoff. This runoff will be shed quickly off these tracks and any sediments will be filtered naturally by vegetation adjacent to the tracks. Therefore no deterioration in water quality within any of the watercourses draining the site from sediment input is expected, and thus local private water supplies would be protected.

Electric Cables

Due to the temporary nature of the small trenches that would be constructed to hold electric cables there will be few residual effects. It is possible that during particularly wet conditions water could collect within these trenches and entrain sediment. However these trenches would not be dug close to watercourses or allow drainage water to enter surface watercourses. Therefore no significant effects are predicted.

Site Working Practices

Site working practices would be formalised during the construction phase. This will assist in reducing the likelihood of accidental occurrences and providing response measures to deal with potentially polluting spillages. However rigorous these controls might be the potential for uncontrolled releases to watercourses within the site would still exist. The likelihood and magnitude of these effects will be small given the best practice measures adopted. Measures will also be tailored to ensure that nearby private water supplies are protected throughout construction and it is envisaged that these will no be effected by the scheme.

13.5.3 Operational Phase

Access Tracks

As for the construction phase, erosion of access track surfaces may be unavoidable during extremely heavy rainfall periods. This could lead to the progressive damage to track surfaces and the entrainment of suspended sediments within drainage. However roadside drainage and natural filtration by adjacent vegetation would ensure there is limited sediment entrained runoff entering surface watercourses. In places the access tracks will divert drainage from its natural flow path. These effects will be localised and will not effect the regimes of nearby streams or threaten private water supplies.

Site Activities

As discussed within Section 13.4.3 site working practices will be formalised to ensure appropriate environmental management of the site. This will assist in reducing the likelihood of accidental occurrences and providing response measures to deal with potentially polluting spillages. However rigorous these controls might be the potential for uncontrolled releases to watercourses within the site will still exist. It is considered that local private water supplies will not be affected, as for the construction phase of development.

13.6 Evaluation of Effects

13.6.1 Introduction

This section outlines the evaluation of the predicted residual impacts and effect and presents the methods by which this has been determined.

13.6.2 Criteria

Four criteria have been used in evaluating the hydrological and hydrogeological effects of the proposed development:

- the type of effect, i.e. whether it is positive, negative, neutral or uncertain;
- the probability of the effect occurring based on the scale of certain, likely or unlikely;
- the policy context for the evaluation based on the following:
  - international (trans-national boundaries);
  - national (Wales wide);
  - regional (South Wales);
  - district (greater than 2 km beyond the site, but less than 20 km);
  - local (within a 2 km radius of the site boundary);
- the magnitude of the effect in relation to the resource that has been evaluated, i.e. high, medium, low or no effect.

The findings in relation to all of these criteria are brought together to give an assessment of significance for each effect. Effects are considered to be of major, minor or no significance. This assessment relies on professional judgement rather than any scoring of the criteria.

13.6.3 Evaluation

Table 13.3 summarises the hydrological impacts and effects of the proposed development and assesses the significance of effects.

Table 13.3 Effects and Evaluation of Significance

Hydrology	Type of Effect	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Construction Phase						
Changes to the hydrological regime of the site	-ve	Certain	Local	Minor	Not Signt	Access tracks will alter the drainage regime, but only on a small scale, plus the design will mitigate impacts
Erosion of sediments during construction of access tracks which could enter surface watercourses	-ve	Likely	Local	Minor	Not Signt	The access tracks have been designed to shed water quickly to minimise runoff and erosion potential

Table 13.3 (continued) Effects and Evaluation of Significance

Hydrology	Type of Effect	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Soil erosion entering surface watercourse during the laying of electric cables	-ve	Likely	Local	Minor	Not Signt	Cable trench will be dug during dry periods and will be temporary features
Accidental spillages of oils and diesel	-ve	Unlikely	Local	Minor	Not Signt	Best practice measures will be adopted
Operation Phase						
Changes to the hydrological regime of the site	-ve	Certain	Local	Minor	Not Signt	Access tracks will alter the drainage regime, but only on a small scale, plus the design will mitigate impacts
Erosion of sediments from access tracks which could enter surface watercourses	-ve	Likely	Local	Minor	Not Signt	The access tracks have been designed to shed water quickly to minimise runoff and erosion potential
Accidental spillages of oils and diesel	-ve	Unlikely	Local	Minor	Not Signt	Best practice measures will be adopted

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	-ve = Negative	Certain	International	Major	High
	+ve = Positive	Likely	National (UK)	Some	Low
	? = Unknown	Unlikely	Regional	Medium	Not Significant
	0 = Neutral		District Local	Minor	
				None	

13.7 Conclusions

This Section describes the existing conditions of the surface water environment and describes the nature of underlying groundwater. Streams radiate from the site with the main stream, the Melin Court Brook having its source on the site at the Ffynnon Oer spring. Groundwater is present beneath the site, though in limited quantities, and may well have been affected by historical mining activities.

Overall the impacts and effects will be restricted mostly to the construction phase of the development, though the effects are not predicted to be significant. This has been achieved by ensuring that the key hydrological and hydrogeological features were identified prior to the design of the wind farm layout, and through the introduction of a range of mitigation measures.

The main process effecting the hydrological regime will be the introduction of access tracks to the site, which may lead to the generation of sediment charged runoff during construction and through into operation. The access tracks have been constructed however to ensure that runoff is quickly shed to avoid the generation of large volumes of runoff.

The site has been designed and will be operated in accordance with best management practices, particularly with regard to the avoidance of pollution issues. All oils and diesel held on the site during construction will be kept with a designated area, where any accidental spillages can be controlled.

13.8 References

Institute of Hydrology, (1998). *Hydrological Data UK- Hydrometric Register and Statistics 1991-95.*

Environment Agency, Pollution Prevention Guidance Notes (PPG)1 *General Guide to the Prevention of Water Pollution.*

Environment Agency, Pollution Prevention Guidance Notes (PPG) 2 *Above Ground Oil Storage Tanks.*

Environment Agency, Pollution Prevention Guidance Notes (PPG) 5 *Works in, near or liable to affect watercourses.*

Environment Agency, Pollution Prevention Guidance Notes (PPG) 6 *Working at Construction and Demolition Sites.*

Forestry Commission, (2000). *Forest and Water Guidelines.*

14. Geology

14.1 Introduction

This section describes the site geology, based on available information, and notes impacts to the geology from the proposed site development. Mitigation measures are also referenced.

In addition constraints to the development from the geological conditions are also discussed and it is recommended that a ground investigation is undertaken at the site to inform final micro-siting.

14.2 Methodology

The methodology is based on interpretation of the following published geological map.

- British Geological Survey of Great Britain 1:50,000 Sheet 248 Drift.

In addition a Coal Authority mining report has been obtained for the site, this includes a plan identifying known mine workings.

14.3 Baseline Description

The 1:50 000 geological map shows the site to be underlain by Carboniferous Upper Coal Measures strata. The conjectured outcrop of the Mountain coal seam is shown in the north and south of the site - essentially following the hilltop relief. In the west of the site the Graigola seam is also brought to outcrop by the north - south trending Pen-y-Castell fault. Superficial deposits are not shown at the site. However, in the west and north of the site, on the slopes to the higher ground, landslipped ground is shown.

The Coal Authority (CA) mining report states the following:

- The site is within the likely zone of influence on the surface from workings in six seams of coal, at shallow to 1020 m depth, the last date of working being 1968;
- The site is not within the zone of likely physical influence on the surface from any present underground coal workings;
- The property is not within a geographical area for which a licence to extract coal is awaiting determination by the CA. However reserves of coal exist and the site is within a geographical area for which a licence to extract coal by underground methods was granted in October 1996. The grant of this licence is conditional on the applicant securing other rights, permissions (including planning permission) and consents to enable him to carry out his operations;
- The site is not within the zone of likely physical influence at the surface of future workings for which the CA have plans;

- Within, or within 20 m of the site, there are thirty-six mine entries. The CA do not have records of what steps, if any, have been taken to treat the mine entries. They also note that their records may be incomplete and therefore mine entries may exist in this locality about which they have no knowledge;
- The site is not located within the geographic boundary of an opencast coal site, nor is it within 800 m of an opencast site with a granted licence, or licence awaiting determination;
- The site is within a geographical area where notices of entitlement to withdraw support were published in 1949, 1953 and 1956;
- The site is not within an area where a notice for payments to owners of former copyhold land has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

14.4 Mitigation and Enhancement

Impacts to the geological environment during the construction phase activities are similar to those considered in the hydrology and hydrogeology section of this ES (Section 13). Namely: construction of access roads, laying of electric cables, construction of wind turbine and crane pads, and excavation of borrow pits for recovery of material for use as roadstone. The potential impacts of these activities to the hydrological and hydrogeological environments are discussed in Section 13. The hydrogeological environment is part of the geological environment and is the only aspect of the geological environment realistically at risk. Impacts to the geological environment are therefore covered by the hydrogeological considerations.

Turbines have been sited away from the landslipped ground and away from the locations of known mine entrances. Consolidation of known or presently unknown mineworkings may be required to ensure stability of the turbine foundations (see Section 14.6, below). Again the potential effect of this impact on the geological environment is in fact an impact on the hydrogeological environment. This potential impact is also discussed in Section 13.

14.5 Evaluation of Effects

As noted above the impacts to the geological environment are more accurately described as impacts to the hydrogeological environment. The evaluation of these effects is discussed in Section 13.

14.6 Constraints to the Development

The available information (see Section 1.2 above) has indicated the following four potential geological constraints to developments at the site.

- Geological faults;
- Landslipped ground in the northwest and west of the site;
- Shallow mineworkings;

- Mine entrances.

For clarity a figure is presented showing these constraints, Figure 14.1.

The influence of these constraints (extent and nature of fault zone, extent and nature of any shallow open voids from coal mining, stability of the landslipped ground and condition of mine entrances) will need to be investigated further as part of a ground investigation at the site. Such an investigation, which will also obtain information for temporary works and foundation design, should be designed when an approved scheme has been finalised. It is however likely to involve trial pitting, cable percussion and rotary drilling with appropriate laboratory and *in situ* testing. Geophysical work may also be recommended.

It is worth noting at the stage that if future works are undertaken that intersect, disturb, or interfere with any coal or coal workings then permission is required from the Coal Authority.

14.7 Summary and Conclusions

The site is underlain by Carboniferous Upper Coal Measures strata.

The effects of the proposed development on the site geology have been discussed and are considered to be hydrogeological effects, see Section 13. The construction phase activities for the proposed development are: construction of access roads, laying of electric cables, construction of wind turbine and crane pads, and excavation of borrow pits for recovery of material for use as roadstone. The hydrogeological environment is the only aspect of the geological environment realistically considered to be at risk.

There a number of geological constraints to development at the site. The strata at the site are known to have been worked at shallow depth and there are thirty-six recorded mine entrances within the site area (unrecorded entrances may exist). In addition, the site is crossed by a fault, and landslipped ground is present in the northwest and west. Turbines have been sited to avoid the landslipped ground and known mine entrances. A phased ground investigation will be required at the site to better understand these geological constraints and assist with the technical elements of the design of the scheme for the most economic and environmentally appropriate solution.

15. Ecology & Nature Conservation

15.1 Introduction

15.1.1 Scope of the Ecological Assessment

This section describes the potential ecological changes and consequences resulting from the construction, operation and decommissioning of the proposed wind farm development.

It should be noted that, although the contribution of the wind farm to reducing national carbon dioxide emissions and the amelioration of climate change is acknowledged, it is impossible to quantify the effects of this specific contribution on the flora and fauna present at the site.

15.1.2 Scope

A scoping opinion was sought as well as information on statutory and non-statutory designated conservation sites and records of species that are afforded legal protection or are otherwise of nature conservation concern within the search area (a 2 km radius of the application site) from the following organisations:

- Countryside Council for Wales;
- Neath & Port Talbot County Borough Council;
- Glamorgan Wildlife Trust;
- Forest Enterprise, Coed-y-Cymoedd Forest District; and the
- Environment Agency.

The scoping opinion from the Countryside Council for Wales (CCW) identified no issues of particular concern. CCW recommended that, with respect to nature conservation, the following points (amongst others) should be addressed in the Environmental Statement.

- The presence of nearby statutory and non-statutory designated nature conservation sites;
- Reference to the *UK Biodiversity Action Plan* (*UKBAP*) (UK Biodiversity Steering Group, 1994) and the *Local Biodiversity Action Plan for Neath & Port Talbot (LBAP)* (Glamorgan Biodiversity Advisory Group, 2001);
- Assessment of temporary and permanent habitat loss or damage;
- Assessment of direct or indirect effects on habitats and species of nature conservation concern; and
- Details of habitat enhancement and creation.

There are no statutory or non-statutory designated nature conservation sites within the search area.

Some of the habitats present at the survey site are the subject of the *UKBAP* and the *LBAP*. Purple moor grass & rush pasture and blanket bog are two Priority Habitats that occur at the application site, for which targeted action has been prepared in the *UKBAP*. Targeted action for purple moor grass & rush pasture is included within the *UKBAP* and *LBAP*. Targeted action for blanket bog is also included within the *UKBAP* and is a habitat of international importance listed in Annex 1 of the Council Directive 92/43/EEC: *Conservation of Natural Habitats and Wild Fauna and Flora Directive* (Commission of the European Communities, 1992). We therefore considered it was necessary to undertake a Phase 1 Habitat Survey of the survey site, and a more detailed survey of the marshy grassland and blanket bog habitats.

Some of the species recorded from the survey site are the subject of the *UKBAP* and the *LBAP*. Skylark (*Alauda arvensis*) and reed bunting (*Emberiza schoeniculus*) are two Priority Species that are listed in the *UKBAP* which occur at the application site. There was a possibility that marsh fritillary (*Eurodryas aurinia*) and brown hare (*Lepus europaeus*), also Priority Species listed in the UKBAP and LBAP, and lapwing (*Vanellus vanellus*), an LBAP species, may inhabit the survey site. Lapwing, skylark and reed bunting are also the listed in the *Birds of Conservation Importance* (JNCC, 1996). We therefore considered it was necessary to conduct surveys for invertebrates (particularly marsh fritillary), breeding birds and mammals (particularly brown hare).

15.2 Methodology

15.2.1 Field Survey

Habitats

During the site visits of early May and mid June 2002, the vegetation at the survey site was recorded. Two main approaches were used:

Identification and Mapping of Habitat Types

A Phase 1 Habitat Survey was conducted to determine whether there are any habitats of nature conservation concern at the site. This survey is a standardised system for classifying and mapping British habitats (Joint Nature Conservation Committee, 1993) which involves producing an annotated habitat map and target notes for features of nature conservation interest.

More Detailed Description of the Vegetation Types

The habitat types present were surveyed in more detail to determine the main plant community types as defined in the National Vegetation Classification (Rodwell, 1991 *et seq*). Plant species cover-abundance and depth of peat (if present) in each quadrat was recorded.

This sampling regime ensured the identification of habitats and plant species that are afforded legal protection or are of nature conservation concern.

Fauna

During the site visits of early May and mid June 2002, the presence of faunal species that are afforded legal protection or are of nature conservation concern at the survey site were recorded. The survey focused on three taxonomic groups.

Invertebrates

The survey site was assessed for the invertebrates it supports and particularly for those species which receive legal protection or are of nature conservation concern, by:

- Determining any existing invertebrate records within the search area; and
- Performing a site walkover to determine habitat suitability in terms of its existing value for invertebrates, particularly marsh fritillary.

Birds

The survey site was assessed for the birds it supports and particularly for those which receive legal protection or are of nature conservation concern, by:

- Determining any existing bird records, main migration routes, nesting and foraging sites within the search area; and
- Performing a breeding bird survey using standard methodology for censuring upland breeding waders (Brown & Shepherd, 1993). The survey site was assessed for its potential to support nesting lapwing, skylark and reed bunting. The coniferous plantations surrounding the application site were also scanned for raptors.

Mammals

The survey site was assessed for the mammals it supports and particularly for those which receive legal protection or are of nature conservation concern, by:

- Determining any existing mammal records within the search area; and
- Performing a site walkover and searching for evidence of brown hare and other mammal activity, particularly badger, otter and water vole.

15.3 Baseline Description

The survey site is located on an exposed mountain ridge which is situated between two parallel river valleys to the northwest and southeast. The main semi-natural habitats on the mountain ridge are blanket bog on the high ground and acid grassland on the slopes, which have both been improved for grazing. Surrounding the survey site, most of the mountain ridge has been planted with extensive stands of coniferous trees some of which have recently been clear felled.

The survey site is centred on Cefn Mawr, and includes all land between the 250 m contour and its peak at 464 m AOD, within 500 m of the proposed turbine locations. A blanket bog occurs on the highest part of the mountain. The main habitat on the mountain is acid grassland which occurs on the north, west and south slopes. At the base of the mountain slopes are several acid flushes that are the source of tributaries that flow north, west and south of the site. Surrounding the acid flushes are extensive areas of marshy grassland that occur on the lower slopes of the

mountain. There are several stone walls and the derelict remains of buildings on the lower slopes to north and south of the mountain. To the north of the application site there are some derelict buildings and vegetated spoil heaps that are associated with former coal mining activities.

15.3.1 Habitat Types

The results of the Phase 1 Habitat Survey are presented in Figure 15.1, which indicates the distribution of habitats across the survey site.

Blanket Bog

Wet modified blanket bog occupies approximately 22 ha (14%) of the application area. Blanket bog occurs on the highest ground at Cefn Mawr. The peat is 0.5 m deep around its margins and is expected to be deeper towards the centre of the bog. This habitat is best described as wet modified blanket bog because it has been improved for grazing. The northeastern part of the bog has been extensively drained in the past, with drainage channels (grips) cut into the peat. Consequently, this part of the bog has begun to dry out and supports a dense cover of soft rush (*Juncus effusus*). The southwestern part of the bog has been weed-swiped but has not been drained. This part of the bog remains relatively waterlogged and soft rush is restricted to its margins.

Blanket bog (Target Note 1) is characterised by the presence of small hollows with bog mosses (*Sphagnum* spp.), although at Cefn Mawr they are relatively scarce but widespread throughout the bog. Bog mosses that are present include (*Sphagnum papillosum*) and (*Sphagnum capillifolium*). Other bryophytes present include the mosses (*Campylopus paradoxus*), (*Polytrichum commune*), (*Dicranum scoparium*) and also the liverwort (*Calypogeia trichomanis*). The vegetation is dominated by tussocks of purple moor-grass (*Molinia caerulea*) which support growths of hare's-tail cottongrass (*Eriophorum vaginatum*). Wavy hair-grass (*Deschampsia flexuosa*) and bilberry (*Vaccinium myrtilus*) are also present but are relatively scarce. This vegetation type is most similar to M20a *Eriophorum vaginatum* blanket and raised mire, species-poor sub-community.

The sward in the northeastern part of the bog (Target Note 2) is approximately 500 mm high and it supports a more diverse assemblage of plants probably because it has not been weed-swiped. Soft rush is dominant, and other plant species present include foxglove (*Digitalis purpurea*), cuckooflower (*Cardamine pratensis*), common sedge (*Carex nigra*), common spike-rush (*Eleocharis palustris*), meadow thistle (*Cirsium dissectum*), marsh thistle (*Cirsium palustre*), lady fern (*Athyrium felix-femina*), narrow buckler fern (*Dryopteris carthusiana*), cross-leaved heath (*Erica tetralix*), bog stitchwort (*Stellaria uliginosa*), bog asphodel (*Narthecium ossifragum*) and round-leaved water-crowfoot (*Ranunculus omiophyllus*).

Acid Grassland

The combination of unimproved and semi-improved acid grassland occupies approximately 54 ha (34%) of the application area. In addition, species poor grassland which has been improved for grazing occupies approximately 32 ha (20%) of the application area. Acid grassland occurs on the slopes of Cefn Mawr around the blanket bog. Most of the acid grassland at Cefn Mawr has been improved for grazing and is very variable in condition. The steep slopes of Cefn Mawr support species-rich unimproved acid grassland, but on gently sloping ground the grassland is species-poor.

The unimproved acid grassland (Target Notes 3 & 4) comprises a mixture of dwarf shrubs, forbs and grasses. Dwarf shrubs that are present include bilberry which is abundant, heather (*Calluna vulgaris*) which is relatively scarce and gorse (*Ulex europaeus*) which is rare. Characteristic forbs found within the grassland include heath bedstraw (*Polygala serpyllifolia*), tormentil (*Potentilla erecta*), sheep's sorrel (*Rumex acetosella*) and dandelion (*Taraxacum* sect. *Spectabilia*). The unimproved acid grassland is dominated by common bent (*Agrostis canina*) with abundant sheep's fescue (*Festuca ovina*), and with frequent mat-grass (*Nardus stricta*) and wavy-hair grass. Soft rush, heath rush (*Juncus squarrosus*) and field wood-rush (*Luzula campestris*) are occasional. Sweet vernal grass (*Anthoxanthum odoratum*) and heath grass (*Danthonia decumbens*) are also present but relatively scarce. The unimproved acid grassland supports a diverse assemblage of mosses that include (*Rhytidiadelphus squarrosus*), (*Hypnum cupressiforme*), (*Dicranum scoparium*), (*Polytichum commune*) and (*Dicranella heteromalla*). This vegetation type shows close agreement with U4e *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Vaccinium myrtillus-Deschampsia flexuosa* sub-community.

The species-poor grassland (Target Note 5) occurs on the gently sloping ground on the northwest side of Cefn Mawr. Plants such as tormentil and heath bedstraw are noticeably absent, and are replaced by white clover (*Trifolium repens*) and perennial ryegrass (*Lolium perenne*). Other common species include common bent, Yorkshire fog (*Holcus lanatus*), smooth meadow-grass (*Poa pratensis*), sweet vernal grass, common mouse-ear (*Cerastium fontanum*), yarrow (*Achillea millefolium*), creeping thistle (*Cirsium arvense*), spear thistle (*Cirsium vulgare*) and common nettle (*Urtica dioica*). Bryophytes are relatively scarce but include the mosses (*Rhytidiadelphus squarrosus*) and (*Hypnum cupressiforme*). This vegetation type shows poor agreement with MG6a *Lolium perenne - Poa pratensis* grassland, typical sub-community.

Acid Flush

Acid flush occupies approximately 10 ha (6%) of the application area. Acid flushes occur along the spring lines around the base of Cefn Mawr, where the peat substrate is at least 0.5 m deep. This vegetation type is characterised by a carpet of mosses overlain by rushes (*Juncus* spp.) and sedges (*Carex* spp.). The vegetation is dominated by tussocks of purple moor-grass and soft rush. The tussocks also support hare's-tail cottongrass and wavy hair-grass. Between the tussocks there are lawns which support tormentil and heath rush which are abundant.

This vegetation type (Target Note 6) includes the following mosses: (*Sphagnum papillosum*), (*Sphagnum capillifolium*), (*Sphagnum cuspidatum*), (*Calliergon cuspidatum*), (*Polytrichum commune*), (*Dicranum scoparium*), (*Hypnum cupressiforme*) and (*Rhytidiadelphus squarrosus*). The acid flush also supports other grasses and sedges which are less frequent, such as creeping bent (*Agrostis stolonifera*), Yorkshire fog, sweet vernal grass, field wood-rush, star sedge (*Carex echinata*) and common sedge. Other plant species present include common marsh-bedstraw (*Galium palustre*), cross-leaved heath, marsh thistle (*Cirsium palustre*), meadow thistle, marsh willowherb (*Epilobium palustre*), marsh valerian (*Valeriana officinalis*), narrow buckler fern, lady fern, foxglove, common nettle, common sorrel, lesser spearwort (*Ranunculus flammula*), marsh pennywort (*Hydroctoyle vulgaris*), common spike-rush, bog stitchwort and cuckooflower. This vegetation type agrees most closely with M25c *Molinia caerulea-Potentilla erecta* mire, *Angelica sylvestris* sub-community.

Peat Pool

The peat pool occupies approximately 0.8 ha (0.5%) of the application area. The Ffynnon Oer peat pool (Target Note 7) which is situated at the base of the northwest facing slope of Cefn Mawr supports a different vegetation type. The vegetation is characterised by bog pondweed (*Potamogeton polygonifolius*), pond water-crowfoot (*Ranunculus peltatus*), lesser spearwort, marsh pennywort, common cottongrass (*Eriophorum angustifolium*), round-leaved sundew (*Drosera rotundifolia*), common spike-rush, yellow sedge (*Carex viridula* ssp. *viridula*) and common sedge. Mosses that are present include (*Sphagnum cuspidatum*), (*Sphagnum papillosum*) and (*Polytrichum commune*). This vegetation type agrees most closely with M29 *Hypericum elodes-Potamogeton polygonifolius* soakway community.

Valley Bog

Outside of the application area, to the northwest of Ffynnon Oer peat pool, is a small valley bog (Target Note 8). The vegetation is characterised by common cottongrass, bog asphodel, cross-leaved heath, round-leaved sundew, carnation sedge (*Carex panicea*) and common spike-rush. Mosses that are present include (*Sphagnum cuspidatum*), (*Sphagnum papillosum*) and (*Polytrichum commune*). This vegetation type agrees most closely with M21b *Narthecium ossifragum-Sphagnum papillosum* valley mire, *Vaccinium oxycoccos-Sphagnum recurvum* sub-community.

Marshy Grassland

Marshy grassland occupies approximately 39 ha (25%) of the application area. Marshy grassland occurs on level or gently sloping ground adjacent to the acid flushes and other watercourses where the peat substrate is less than 0.5 m deep. The marshy grassland is characterised by a mosaic of unpalatable soft rush tussocks (that have a cover-abundance of greater than 25%) interspersed with tightly grazed 'lawns'. In the dense stands of soft rush, species such as common marsh bedstraw, greater bird's-foot-trefoil, cuckooflower and tormentil are frequent. Between the tussocks there are 'lawns' that support common sorrel, marsh thistle, creeping buttercup, Yorkshire fog, creeping bent and sweet vernal grass. This vegetation type bears most resemblance to M23b *Juncus effusus/acutiflorus-Galium palustre* rush pasture, *Juncus effusus* sub-community.

15.3.2 Invertebrates

There were no records of previous surveys of the site for invertebrates. It was considered that the habitats present at Cefn Mawr support a range of groups, including dragonflies, butterflies, hoverflies, craneflies, beetles, bugs and spiders. The acid flushes and marshy grassland habitats are structurally quite diverse, and may support relatively high densities of invertebrates. The site surveys involved a search for marsh fritillary, as well as its larval food-plant Devil's-bit scabious (*Succisa pratensis*). However, neither marsh fritillary nor Devil's-bit scabious were recorded.

15.3.3 Birds

The results of the breeding bird survey are presented in Figure 15.2, which indicates the approximate locations of all breeding birds across the survey site.

Within the application area, meadow pipit was the most abundant breeding bird, with at least 25 territories. Skylark was the next most abundant breeding bird, with at least 19 territories.

Meadow pipit territories were closely associated with blanket bog, acid flush and marshy grassland habitats. Skylarks were found to be more closely associated with drier terrain, particularly acid grassland with a rush cover-abundance of <25%. The greatest combined density of meadow pipits and skylarks was found to be on the highest parts of Cefn Mawr.

In comparison with meadow pipits and skylarks, the abundance of all other species recorded during the survey was low. Three pairs of wheatear (*Oenanthe oenanthe*) and a single pair of pied wagtails (*Motacilla alba*) were found nesting in stone walls near the southern boundary of the application area. Two pairs of reed bunting were considered to be nesting within the acid flushes, although only one pair was present within the application area. A single pair of stonechats (*Saxicola torquata*) were nesting outside the application area within an area of coarse vegetation within marshy grassland habitat. No wader species were recorded at the survey site.

Non-breeding birds that frequent the hill-pasture at Cefn Mawr include an abundance of corvids that associate with the sheep, particularly carrion crow (*Corvus corone*) and raven (*Corvus corax*). Mistle thrush (*Turdus viscivorus*), blackbird (*Turdus merula*), song thrush (*Turdus philomelos*) and chaffinch (*Fringilla coelebs*) were also observed foraging within the application area, but were probably nesting in the adjacent coniferous plantations.

Birds recorded foraging within the coniferous plantations that border the application area include robin (*Erithacus rubecula*), blackcap (*Sylvia atricapilla*), willow warbler (*Phylloscopus trochilus*), goldcrest (*Regulus regulus*), coal tit (*Parus ater*), siskin (*Carduelis spinus*) and crossbill (*Loxia curvirostra*). Single buzzard (*Buteo buteo*) and kestrel (*Falco tinnunculus*) were observed on one date only over the plantation to the west of the site. A single red kite (*Milvus milvus*) flew low over Cefn Mawr on one date only. Red kite is a *LBAP* species which receives protection under Schedule 1 of the *Wildlife and Countryside Act 1981* (as amended). The nearest known red kite nest site is approximately 10 km northeast of the application site (Tucker *pers comm.*, 2002).

15.3.4 Mammals

A single brown hare was flushed from the northeastern part of the blanket bog just on one survey visit. There are no records of other mammal species of note from the site, and no signs of any were noted during the survey visit.

15.4 Evaluation

This section evaluates the nature conservation value of the site with respect to the habitats present and their importance for invertebrates, birds and mammals. The value of the site is determined in terms of its nature conservation importance in local, regional (Neath & Port Talbot County Borough), national and international contexts.

15.4.1 Blanket Bog

Active blanket bog, along with other peatland habitats, such as lowland raised bog, have been identified as Priority Habitats in the *UKBAP*. Active blanket bog is defined as:

> *"...still supporting a significant area of vegetation that is normally peat forming"*

Although the blanket bog at Cefn Mawr is very variable in condition because it has been drained and otherwise improved for grazing, it is still considered to be active and capable of peat formation.

The publication *Guidelines for Selection of Biological SSSIs: Bog* (JNCC, 1994) advises that areas of blanket mire vegetation over 25 ha that show peat-forming capability should be considered for selection as SSSIs. The wet modified blanket bog within the application area is unlikely to qualify for designation as a statutory nature conservation site because it:

- occupies an area <25 ha (21 ha);
- exhibits limited variation in microform topography;
- exhibits limited variation in plant community/subcommunity composition;
- has <25% *Sphagnum* cover.

However, the blanket bog may be of importance within Neath & Port Talbot County Borough.

The site surveys revealed that the blanket bog vegetation is variable in condition, having been affected by drainage, agro-chemical application and over-grazing in places. The most diverse vegetation is on the deepest peat on the centre of the bog, which supports the greatest cover-abundance of *Sphagnum* moss. The blanket bog is considered to be unlikely to support a diverse invertebrate fauna.

15.4.2 Acid Grassland

The most important areas of acid grassland are found on the steeper slopes of Cefn Mawr. We consider these unimproved grasslands to be of local nature conservation importance within Neath & Port Talbot County Borough.

The site surveys revealed that the grasslands are variable in condition, having been affected by agro-chemical application and over-grazing. Species-poor grasslands are found on the northwest side of Cfen Mawr and are considered to be of very limited nature conservation value.

15.4.3 Acid Flush

The acid flushes that occur along the spring lines around the base of Cfen Mawr, where the peat substrate is at least 0.5 m deep. We consider that these acid flushes are likely to be of nature conservation importance within Neath & Port Talbot County Borough. The main acid flush NVC community type is M25c, which is included within the "Purple Moor-grass and Rush Pasture" Priority Habitat in the *LBAP*.

15.4.4 Peat Pool

We consider that the peat pool is likely to be of nature conservation importance within Neath & Port Talbot County Borough.

15.4.5 Valley Bog

We consider that the valley bog is likely to be of nature conservation importance within Neath & Port Talbot County Borough.

15.4.6 Marshy Grassland

The marshy grassland occurs on the level and gently sloping ground surrounding Cefn Mawr, where the peat substrate is <0.5 m. The marshy grassland is characterised by a mosaic of rush tussocks and closely grazed lawns. The vegetation community type that most closely matches this habitat is M23b, which is included within the "Purple Moor-grass and Rush Pasture" Priority Habitat in the *LBAP*.

15.4.7 Invertebrates

The acid flushes and marshy grassland habitats were found to be structurally diverse, and we consider them suitable to support a range of common invertebrates.

15.4.8 Birds

Skylark had a breeding density of approximately 16 pairs km^2 within the application area, which is typical for an upland area (Brown & Shepherd, 1991). Skylarks were found to be most abundant where the rush cover-abundance in the acid grassland is <25%. While skylark are a *UKBAP* priority species, this is largely as a result of recent declines in population density in lowland farmland, and they remain common and widespread. The national decline in the population of skylark, particularly in lowland areas is thought to be related to the wide-scale intensification of agriculture, rather than as a result of the cumulative effect of individual developments. Given that no significant effects have been recorded on territorial skylarks and meadow pipits during recent studies of wind farms (Thomas 1999).

Meadow pipit had a breeding density of approximately 12 pairs km^2 within the application area, which is typical for an upland area (Brown & Shepherd, 1991). Meadow pipits were found to be most abundant on the blanket bog on Cefn Mawr.

A low density (2 pairs) of breeding reed buntings were recorded in the acid flush habitat at the base of Cefn Mawr.

A single red kite was observed flying over Cefn Mawr, presumably searching for food within the application area on one survey date only. The nearest known red kite nesting site is approximately 10 km from the application area, and we consider that breeding birds are more likely to forage closer to their nest sites.

15.4.9 Mammals

The application area was found to be little used by mammals. A single brown hare was recorded on the acid grassland on one survey date only. We consider that the application area only supports a small population of brown hares. Brown hares have large home ranges and are therefore likely to wander over the adjoining marshy grassland and acid grassland habitats.

15.5 Predicted Trends

15.5.1 Blanket Bog

The main factors affecting vegetation change in the blanket bog are grazing and drainage. The current grazing levels at the site are relatively high, but the site surveys revealed only a few signs of overgrazing in places. This may be because the grazing is concentrated on the fringes

of the blanket bog. Drainage of the blanket bog has probably had more effect on vegetation dynamics. The northeastern part of the bog was drained about 15 years ago and it has begun to dry out. The southwestern part of the bog, unlike the northeastern part, has been cut and weed swiped, which has led to a marked reduction on the abundance of soft rush. Purple moor-grass and hare's-tail cottongrass have increased in cover due to drainage and are now abundant across much of the site. Both are vigorous, tussocky species, and it is unlikely that *Sphagnum* moss (the main peat-former) will be able to out-compete it and increase in cover. Therefore, under current grazing levels, it is predicted that the blanket bog vegetation will persist in its present condition.

15.5.2 Acid Grassland

Grassland vegetation dynamics depend on management, principally by grazing. The current grazing pressure is relatively high on the acid grassland and if that is sustained, it may be expected that unpalatable species such as mat-grass and soft rush will increase in cover. The acid grassland on the steep slopes of Cefn Mawr is not overgrazed and vegetation changes are not expected. If grazing ceases entirely, the grassland would undergo succession to other habitats. The species most likely to colonise at first are dwarf shrubs such as bilberry, heather and gorse, but it may also be expected that trees will gradually become established.

15.5.3 Acid Flush

The main factors affecting vegetation change in the acid flushes are grazing and drainage. The current grazing levels at the site are relatively high, but the site surveys revealed only a few signs of overgrazing in places. This may be because the grazing is concentrated on the fringes of the acid flushes. Access road construction across several of the acid flushes has had affected their drainage and has probably had more effect on vegetation dynamics. As a result the extent of acid flush has diminished with plants more usually associated with drier conditions colonising their margins.

15.5.4 Marshy Grassland

Grassland vegetation dynamics depend on management, principally by grazing. The current grazing pressure is relatively high on the marshy grassland and if that is sustained, it may be expected that unpalatable species, particularly soft rush will increase in cover. If grazing ceases entirely, the grassland would undergo succession to other habitats. The species most likely to colonise at first are trees such as goat willow (*Salix caprea*) and downy birch (*Betula pubescens*).

15.6 Information Gaps

No significant information gaps have been identified.

15.7 Avoidance, Mitigation, Compensation and Enhancement

This section describes measures to reduce impacts on flora and fauna. This includes avoidance of potential effects achieved through the design proposals, and the reduction of effects, whereby

the layout of components of the development is specifically considered in order to minimise the potential effects. Mitigation that will be incorporated into the development during the construction and operation phases is described. Short-term impacts due to construction activity are considered under the construction phase and long-term impacts that occur as a result of the development are considered under the operation phase. Where impacts cannot be adequately mitigated, appropriate compensation measures are proposed. Opportunities to enhance the nature conservation value of the site are also proposed.

The details of exactly how the identified mitigation, compensation and enhancement measures are to be implemented have not yet been determined. However it is intended that following the grant of consent an outline habitat management plan and monitoring plan will be prepared to guide their implementation, and that the programme and nature of these will be agreed with the planning authority. It is also intended that their implementation will be secured through appropriate planning conditions and/or legal agreements.

15.7.1 Avoidance

There is potential for the avoidance of specific localised or small-scale areas of ecological sensitivity.

The initial site search and selection process (described in Section 6) included consideration of a wide range of factors including potential ecological effects. The Cefn Mawr site was found to be favourable in respect of many of these factors, including the absence of international, national or local nature conservation designations applying to any land within 2 km.

Following the selection of the site, findings of all specialist reports and assessments have been considered throughout the iterative design and assessment process of the proposed wind farm e.g. adjustment of the access track layout and turbine locations to minimise effects on acid flush and blanket bog habitats (see Table 2.2). Hence significant environmental effects have been avoided where possible, and reduced where avoidance has not been possible.

15.7.2 Mitigation

Construction Phase

Access Roads

The mechanisms by which damage may occur to the blanket bog vegetation are mainly through changes in hydrology. Therefore, the mitigation measures proposed to avoid or reduce effects on the hydrology of the blanket bog (Section 13), such as using a floating road construction, will also reduce impacts on the vegetation.

Electric Cables

The laying of electric cables, that will link the wind turbines with the on-site sub-station, will be in small trenches (500 mm wide by 750 mm deep) adjoining the edge of the access tracks, which will be back-filled with compacted fill.

Wind Turbines and Crane Pads

The mitigation measures proposed to reduce the impacts on hydrology (Section 13) will also reduce the impacts on vegetation, because the characteristic vegetation communities are dependent on the peat remaining waterlogged. It is estimated that the total volume of peat to be

excavated from the 5 turbine foundations (numbers 6, 7, 12, 13 and 14) will be about 198 m^3. However, micro-siting of turbine foundations will endeavour to locate no more than two of these five turbines on the blanket bog. This peat will be used to fill in the existing drainage channels (grips) to improve the condition of the wet modified blanket bog.

Site Working Practices

During construction, activity will be limited as far as possible to the areas under development. Storage of surplus materials will avoid sensitive habitats, such as blanket bog, acid flush and unimproved acid grassland. The storage compound is situated close to the sub-station in an area of marshy grassland that has been improved for grazing. Other mitigation measures to prevent spillages of pollutants into watercourses (described in Section 13) will also prevent spillages onto sensitive vegetation.

Operational Phase

This section describes the mitigation measures that will be incorporated into the development during the operational phase to reduce impacts on flora and fauna. Apart from the operation of the wind turbines and general maintenance of the turbines, there will be little on-site activity during the operational phase.

Access Tracks

Any impacts on the blanket bog surrounding the access roads are expected due to changes in hydrology. Therefore, the mitigation measures proposed in Section 13 are applicable here.

Site Working Practices

Site working practices will be formalised, as will the environmental management of the site during the construction phase. This will ensure that there is minimum disturbance to sensitive habitats and assist in reducing the likelihood of accidental occurrences and providing response measures to deal with potential polluting spillages.

Table 15.1 summarises the mitigation incorporated into the wind farm development.

Table 15.1 Mitigation Incorporated into the Wind Farm Development

Impact	Mitigation Incorporated into the Proposed Development	Extent to Which Impact Mitigated *
Construction		
1. Disturbance of hydrological regime of blanket peat and consequent changes in vegetation composition due to construction of access tracks, laying of electric cables and construction of wind turbines and crane pads	• Layout of access roads and turbine locations avoid deep peat • Micro-siting of access tracks and turbines, with specialist advice • Access tracks are to be of geogrid reinforced construction to prevent compaction of soils and allow free movement of water through the body of the peat • Laying of electric cables in slits where possible. Where trenches have to be dug, topsoil and peat will be carefully replaced • Topsoil and peat will be carefully replaced in cable trenches • Top soil, including peat will be kept separate from subsoil during the excavation of turbine platforms • Peat will be loosely stored to ensure compaction of the material is kept to a minimum, and stored for the minimum amount of time possible • Peat will be replaced into the excavation where possible. Any excess will be reused on site to infill drainage channels • Deep open pits within the peat will be supported with sheet piling to avoid slumping of surrounding peat soils	Substantially
2. Damage to sensitive vegetation and watercourses due to spillages of pollutants	• Spillages will be contained, preventing impacts on flora and fauna • Avoid storage of surplus materials on vegetation or beside watercourses	Fully
Operation		
1. Land take due to 6.2 km of access roads (5 m excavated width): New track 3.2 x 1000 x 5 = total area 16000 m^2; Widening existing track by an additional 2 m width; 3 x 1000 x 2 = 6000 m^2; Total land take = 22000 m^2 = 2.2 ha	• Mitigation as described for Hydrology (Section 13), e.g. geogrid reinforced track construction reduces risk of peat drying at edges of tracks. Other habitats are less sensitive than the blanket bog	Partially

Table 15.1 (Continued) Mitigation Incorporated into the Wind Farm Development

Impact	Mitigation Incorporated into the Proposed Development	Extent to Which Impact Mitigated *
2. Land take due to turbine foundations and crane pads: Each turbine foundation area ~17 m^2, each crane pad Area 1 = ~243 m^2 (approx.), each crane pad Area 2 = ~124 m^2. Total landtake due to 16 turbines = ~0.6 ha	• Excavation of ~198m^3 of peat from 5 turbine foundations (assuming an approximate peat depth of 3 m)	Partially
3. Site Working Practices Accidental spillages of oils and diesel from heavy plant and machinery	• Best working practices will be adopted when working with oils and diesel • Spill response measures will be put in to place throughout operation to ensure any spillages are quickly controlled	Substantially
4. Land take due to substation and compound	• The selected location of substation and compound are on areas of marshy grassland which have been improved for grazing and are of limited nature conservation value	Fully

*** Key to Predicted Success of Mitigation:**

Fully - Impact fully mitigated and no effects predicted.

Substantially - Mitigation would be largely successful at reducing impact. Some effects possible, which are discussed in Section 15.8.

Partially - Mitigation would be successful at reducing impacts, but some effects likely. These effects are discussed in Section 15.8.

15.7.3 Compensation

The main negative impact of the proposed development is the landtake of blanket bog vegetation due to access tracks and turbine bases. There are 5 turbines on the blanket bog, constituting a total of 85 m^2 of landtake (although following micro-siting it is anticipated that only 2 are likely to be positioned fully on the blanket bog). There are approximately 1.1 km of on-site access roads across the blanket bog, equating to a total landtake of 4400 m^2. Based on an assumed average turbine foundation depth of 3 m excavation into the peat, the 5 turbines would result in approximately 198 m^3 of peat for the restoration. Peat removed from the excavations for the turbines will be used within the site for the improved management of the blanket bog, by infilling of the drainage channels on the blanket bog with excavated peat to restore waterlogged conditions.

15.7.4 Enhancement

Details of the measures that will be taken to enhance the nature conservation value of the site during construction and operation are:

- Removal of soft rush from the northeastern part of the blanket bog;

- Conversion of species-poor grassland to a less intensively managed grassland habitat by cessation of agro-chemical applications; and
- Maintenance of an appropriate grazing regime on all grasslands.

15.8 Predicted Changes and Consequences

15.8.1 Construction Impacts

Access Tracks

Construction activity will cause some disturbance of vegetation either side of the access tracks. The vegetation of the grassland areas is fairly resilient, although disturbance of the peat surface either side of the access tracks across the blanket bog is predicted to have adverse impacts on sensitive species, principally *Sphagnum* moss, and allow the increase in cover of the tussocky purple moor-grass and hare's-tail cottongrass. If disturbance is severe, some peat may be left bare, running the risk of erosion. An appropriate grazing will facilitate the natural regeneration of vegetation during the operational phase of the wind farm.

Electric Cables

Where small trenches have to be dug there will be unavoidable temporary disturbance to the peat. In addition these trenches will enhance the drainage of the peat, by creating a preferential flow path. It is possible that vegetation changes will occur in response; probably soft rush will colonise and expand the way it already has adjacent to the grips in the northeastern part of the bog.

Wind Turbines

During construction, the area surrounding the turbine base, crane pads and laydown areas will be subject to a high level of disturbance. Vegetation is likely to be trampled, leading to the development of bare peat and possible erosion. The total affected area of construction activity per turbine is approximately 2500 m^2 (which constitutes the temporary landtake required for two crane pads and movement of materials), of which only ~17 m^2 is landtake (see operation impacts). The vegetation within the ~17 m^2 area of disturbance around each turbine will, according to the habitat type, recolonise at different rates. For example, it is likely that the bare peat in the blanket bog will take at least 5 years to become revegetated, unlike the grassland which will recover more quickly.

15.8.2 Operation Impacts

Access Tracks

There are 6.2 km of access tracks across the application site. Approximately half of the access tracks (3 km) at the application site will utilise existing farm vehicle tracks which will be widened by 2 m. The new access tracks (3.2 km) will be excavated to 5 m, with the final width, excluding shoulders, of 4 m wide. The total land take due to the creation of new access tracks and widening of existing tracks is estimated to occupy a total area of ~2.2 ha reducing to 1.88ha when the shoulders are reinstated and seeded.

In the absence of previous experience of running such heavy machinery on floating roads, it is difficult to predict the medium to long-term impact of floating roads on hydrology and hence on vegetation either side of the roads. If the floating roads do indeed float and do not sink into the peat surface causing compaction then impacts on hydrology and vegetation will be minimal. If the integrity of the peat is affected, then changes to the hydrological and vegetational system will occur a similar , but lesser extent, to those occurring around the crane pads and turbine bases are to be expected (see below).

Wind Turbines

The total permanent landtake for each turbine is ~17 m^2. The total permanent landtake due to 16 turbines foundations is ~272 m^2. The maximum turbine working area is ~50 m x 50 m (which comprises the turbine foundations and two crane pads Area 1 and Area 2). The total maximum turbine working area affected by the 16 turbines is therefore ~4 ha. This figure represents only 2.5% of the total application area. The habitat of the highest nature conservation value within the survey site is the blanket bog, which will support a maximum of 5 turbines which constitutes ~85 m^2.

Disruption of the hydrological regime due to insertion of impermeable concrete into the peat will cause changes in the vegetation around each turbine and crane pad. The spatial extent and the severity of change will vary across the site, and depend on the current distribution of vegetation communities. In the blanket bog vegetation, it is predicted that vegetation types indicative of the drier peat (*Eriophorum vaginatum - Deschampsia flexuosa* blanket mire) will expand at the expense of the *Sphagnum*-dominated communities. The changes in vegetation should be monitored, to determine whether remedial or ongoing management will be required. The changes in blanket bog vegetation are likely to be permanent, unless other factors favour trajectories in other directions (e.g. changes in grazing pressure, pollution, climate change).

Invertebrates

We consider that there will be no adverse impacts to the invertebrate populations that inhabit the application area.

Birds

We consider that the birds that frequent the application area will become acclimatised to the wind turbines. The risk of collision with the wind turbines is considered to be low, as most birds do take avoiding action. They may detect either an entire wind farm array, or an individual wind turbine, and alter their flight lines so as to avoid the structures; or they may at close quarters see an oncoming blade and take emergency avoiding action (SNH, 2000).

Mammals

We consider that there will be no adverse impact to the brown hares that frequent the application area.

15.8.3 Decommissioning Impacts

Decommissioning is expected to take place approximately 20 years after construction. Turbine removal will cause disturbance of the vegetation surrounding the turbines. It is likely that the vegetation on the blanket bog immediately surrounding the turbines will not have recovered from construction disturbance by this time. Therefore, decommissioning may further degrade

the vegetation. Although turbine foundations will be buried, vegetation changes will be permanent.

Decisions on access track removal will be taken during the decommissioning phase in conjunction with the landowners. If the access tracks are no longer required they will be partially reinstated with topsoil and sown with a suitable seed mixture.

15.9 Evaluation of Effects

Four criteria have been used in evaluating the ecological and nature conservation impacts of the proposed development.

- the type of effect, *i.e.* whether it is positive, negative, neutral or uncertain;
- the probability of the effect occurring based on the scale of certain, likely or unlikely;
- the policy importance or sensitivity of the resource under consideration, in a geographical context: international, national (UK), regional (Neath & Port Talbot County Borough), or local (site and its vicinity, including areas of habitats contiguous with or linked to those on site);
- the magnitude of the effect in relation to the resource that has been evaluated, quantified if possible, if not using the scale high, medium, or low.

Professional judgement is used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. Effects are considered to be of major or minor significance, or not significant.

Table 15.2 summarises the ecological and nature conservation effects of the proposed development and assesses their significance.

Table 15.2 Effects and Evaluation of Significance

	Type of Effect	Probability of Effect Occurring	Policy Importance or sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Construction						
1. Disturbance of peat in blanket bog and consequent changes in vegetation either side of access roads due to construction activity and laying of electric cables	-	Likely	Regional	Estimate up to 1m either side of access tracks for a total area of ~0.2 ha (1.6% of the blanket bog)	Minor	Although blanket bog is a UK BAP Priority Habitat, that present at Cefn Mawr does not merit a statutory nature conservation designation and the proportion of the habitat affected is low

Table 15.2 (continued) Effects and Evaluation of Significance

	Type of Effect	Probability of Effect Occurring	Policy Importance or sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
2. If trenches have to be dug for laying of electric cable, a preferential flow path for water may be created, causing vegetation change (possible invasion of soft rush) in blanket bog and other habitats	-	Unlikely	Regional	Low	Not sig.	Most cables will be laid in slits with minimal impact on vegetation
3. Disturbance of area around turbine bases and crane pads situated on blanket bog, causing trampling of vegetation and possible erosion of peat	-	Certain	Regional	17m^2 per turbine, 5 turbines on peat = 85m^2	Minor	Although blanket bog is a UK priority habitat, that present at Cefn Mawr does not merit designation and the proportion of the total habitat affected is low
4. Removal of soft rush from the northeast part of the bog	+	Certain	Regional	Medium	Minor	Enhancement of the blanket bog to increase the extent of high quality bog vegetation
5. Excavation of peat and peaty gleys from turbine bases on blanket bog	+	Certain	Regional	1983 m^3 from 5 turbines	Minor	Infilling of the drainage channels on the blanket bog with excavated peat to restore hydrological and vegetational system
6. Disturbance of breeding birds	-	Likely	Local	Low	Not sig.	Disturbance will be temporary. No medium or long-term effects on populations
7. Disturbance to red kites	-	Unlikely	National	Low	Minor	Disturbance will be temporary. No medium or long-term effects on population
8. Disturbance of brown hares through construction activities	-	Likely	Local	Low	Not sig.	Home ranges are large, and the effect temporary. No medium or long-term effects on population
Operation						
1. Land take due to the creation of new or widening of existing access tracks	-	Certain	Regional	~2.2 ha (1.46% of land cover within the application area))	Minor	A relatively small area is affected

Table 15.2 (continued) Effects and Evaluation of Significance

	Type of Effect	Probability of Effect Occurring	Policy Importance or sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
2. Gradual drying of peat surface either side of roads and consequent changes in blanket bog vegetation	-	Unlikely	Regional	Estimate 1 m either side of roads	Minor	Floating construction should have minimal effect on hydrology and area affected is small
3. Land take due to turbine foundations	-	Certain	Regional	265 m^2 of the application area will be lost; of which 0.4% of blanket bog will be affected	Minor	Although blanket bog is a UK priority habitat, that present at Cefn Mawr does not merit designation and the proportion of the total habitat affected is low Loss of habitat and peat excavation will enable restoration elsewhere
4. Vegetation change around impermeable turbine bases and crane pads	-	Likely	Regional	Up to 10 m radius around bases and pads	Minor	Although blanket bog is a UK priority habitat, that present at Cefn Mawr does not merit designation and the proportion of the total habitat affected is low
5. Improved hydrological condition of blanket bog arising from damming of drains	+	Certain	Regional	Medium	Minor	Although this would undoubtedly lead to an improvement in bog condition, the bog is only of regional importance
6. Increased extent of high quality bog vegetation arising from soft rush removal	+	Likely	Regional	Low	Minor	Although this would probably lead to a localised improvement, the extent of improvement is uncertain, and the bog is only of regional importance
7. Conversion of species-poor grassland to a less intensively managed grassland habitat by cessation of agro-chemical applications	+	Likely	Local	Low	Minor	Enhancement of the grassland to promote the development of a more floristically diverse sward
8. Maintenance of an appropriate grazing regime on all grasslands	+	Likely	Local	Low	Minor	Enhancement of the grassland to promote the development of a more floristically diverse sward

Table 15.2 (continued) Effects and Evaluation of Significance

	Type of Effect	Probability of Effect Occurring	Policy Importance or sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Decommissioning						
1. Disturbance of vegetation around turbine foundations	-	Certain	Regional	~214 m^2 per turbine, 5 turbines on peat = 0.1 ha	Minor	Although blanket bog is a UK priority habitat, that present at Cefn Mawr does not merit designation and the proportion of the total habitat affected is low. Floating track construction on the blanket bog means that vegetation will recover following decommissioning

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	- = Negative	Certain	International	High	Major
	+ = Positive	Likely	National (UK)	Medium	Minor
	Neutral	Unlikely	Regional	Low	Not Significant
	Unknown				
			Local	Quantified	

15.10 Summary & Conclusions

The activities that will have most effect on the ecology of the survey site are the access road construction and turbine erection. This section describes the current nature conservation value of the site, then presents mitigating measures to be incorporated in the scheme design, and then evaluates the predicted residual effects of the proposed development.

Within the application area, blanket bog appears to be the most sensitive habitat to construction. Impacts on hydrology and subsequent vegetation change have been mitigated by using a floating road construction and the overall land take due to turbine foundations is 0.4% of the extent of blanket bog habitat on site.

The main mitigating (compensation and enhancement) measures which will have a positive effect include:

- Infilling of the drainage channels on the blanket bog with excavated peat to restore waterlogged conditions;
- Removal of soft rush from the northeastern part of the blanket bog;

- Conversion of species-poor grassland to a less intensively managed grassland habitat by cessation of agro-chemical applications; and
- Maintenance of an appropriate grazing regime on all grasslands.

15.11 References

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16. Existing Infrastructure, Telecommunications, Television, Aviation and Safety

16.1 Introduction

This section considers the potential impacts the proposed Ffynnon Oer Wind Farm will have on existing infrastructure, telecommunications, television and safety on the site. Wind turbines, as with any large structure, can potentially interfere with electromagnetic signals, particularly television and radar. The quality of television reception may be affected, and viewers may suffer loss of picture quality and acoustic interference. Where this occurs it is of a predictable nature and can generally be alleviated by the installation or modification or a local repeater station or cable connection. The turbines also have the ability to affect radar performance and interfere with communication networks. Construction activity will also have to take cognisance of existing ground based infrastructure and aviation safeguarding requirements.

All of these matters have been addressed in the development of this Wind Farm through consultation with system operators and the iterative design of the wind turbine layout.

16.2 Methodology

The basis of this section has been consultation with a number of organisations known to have an interest in telecommunications, television and infrastructure in the area. The consultation list was drawn together based on advice given in Technical Advice Note 8: *Renewable Energy - 1996* Annex A. The consultees relevant to this section are listed in Table 16.1.

Table 16.1 Consultations Made With Respect To Existing Infrastructure, Telecommunications, Television, Aviation and Safety

Telecommunications Consultees
BT Cellnet
Cable and Wireless (Mercury)*
Department of Trade and Industry (Radio Communications Agency)
Liberty Communications Ltd
National Transcommunications Ltd. (ntl) (also in relation to their telecommunications network)*
Ionica
One 2 One
Orange*

Table 16.1 (continued) Consultations Made With Respect To Existing Infrastructure, Telecommunications, Television, Aviation and Safety

Telecommunications Consultees
Vodafone
Public Service Telecommunications Users
Maritime and Coastguard Agency*
Trinity House*
Home Office Police Department
Aviation Safety Consultees
Civil Aviation Authority *
NATs *
Military Aviation Safety Consultees
Ministry of Defence *
Television Consultees
British Broadcasting Corporations (BBC) *
Crown Castle *
ITC *
Infrastructure and Other Consultees
The Coal Authority *
Health and Safety Executive *
Transco *

* Reply Received

16.3 Baseline Description

The consultation responses have enabled a baseline to be established. The following briefly summarises the responses.

16.3.1 Telecommunications Providers

Cable and Wireless (Mercury)

The development will not impact on Mercury microwave radio links.

Orange
Holding reply received. Request for OS grid reference of site supplied. No further resonse received.

NTL
Predict that the wind farm should not have a detrimental affect on any NTL links.

16.3.2 Public Service Telecommunication Users

Trinity House
The installation is sufficiently distant from Trinity House Stations, no objection.

Maritime and Coastguard Agency
They foresee no problems with the site.

16.3.3 Aviation Safety

CAA
The Authority has determined that there are no significant Aeronautical Radio Stations within 30 km of the proposed site.

NATS
Following examination of the proposed development there is no objection to the proposal.

16.3.4 Military Aviation Safety

Ministry of Defence
Confirmation that there is no objection to the proposal subject to the notification of dates of commencement/completion and other complementary information following any grant of planning permission.

16.3.5 Television

BBC
The proposed wind farm is located within an area assigned to the BBC. Domestic reception of UHF analogue television within the area is provided from the broadcaster's transmitters at Wanvoe, Kilvey Hill, Rheola, Glyncorrwg, Croeserw and Abergwynfi. Their assessment shows that viewers of these transmitters should not suffer interference as a result of the proposal. The wind farm development should not have a detrimental effect upon national or local BBC radio reception.

ITC
The area of the development is one for which the BBC has a watching brief on frequency planning matters.

Crown Castle
The area of the development is one for which the BBC has a watching brief on frequency matters.

16.3.6 Infrastructure and Others

Health and Safety Executive
There are no high pressure gas pipelines or other notifiable hazardous installations in the vicinity of the proposed development. The wind farm itself is not a notifiable installation, therefore the HSE has no observations or comments on the proposed development.

Transco
Transco has a National Transmission pipeline in the vicinity, 600 mm Rhigos to Dyffyn Clydach No 2 Feeder. The pipeline is subject to a deed of easement which typically have a width of 24 m (i.e. 12 m either side of the pipeline) and prohibits certain activities in proximity to the pipeline, i.e. permanent or temporary buildings or structures, modifications to ground levels etc. No work should commence in the vicinity of Transco apparatus until a Transco representative has visited the site.

Coal Authority
The Coal Authority has indicated areas within the vicinity of the proposed wind farm which have been the subject of past mining activity. It is within the likely zone of influence on the surface from workings in 6 seams of coal, the last date of working being 1968. It is not within the zone of likely influence from any present underground coal workings. Furthermore the site is not within a geographical area for which a licence to extract coal by underground methods is awaiting determination by the Coal Authority. There are however reserves of coal in the locality that could be worked at some time in the future subject to feasibility, licences and planning consent. There is no record of the risk of the land being affected by subsidence being given under S.46 of the Coal Mining Subsidence Act 1991.

Within or within 20 m of the site there are 36 mine entries.

In view of the mining circumstances a prudent developer would seek appropriate technical advice before works are undertaken on site. No activities should be undertaken that intersect, disturb or interfere with any coal or mines of coal or mines of coal without permission of the Coal Authority.

16.4 Mitigation and Enhancement

Responses to the consultation identify that the development will not affect communications. Correct site practices and further consultation with Transco and the HSE should ensure that the development can be implemented safely.

Construction
During the construction phase of the development, the relevant statutory requirements would be adhered to. All potentially hazardous areas such as the gas pipeline, excavations and electrical installation works would be fenced off and all unattended machinery would be stored in the site compound or immobilised to prevent unauthorised use.

After completion of construction works and commissioning of the wind farm, the wind turbines and roads will be openly accessible to visitors subject to rights of access to the land.

Operation

Wind farms have a proven track record for safety. The minimum desirable distance between wind turbines and occupied buildings calculated on the basis of expected noise levels and visual impact will always be greater than that necessary to meet safety requirements. The build up of ice on turbine blades is also unlikely to present problems on the majority of sites[15].

The operation of the Wind Farm would comply with relevant health and safety regulations. Appropriate warning signs would be installed concerning restricted areas such as transformers, switchgear and metering systems which would be fenced.

Table 16.2 Mitigation Incorporated into the Proposed Development

Impact	Mitigation Incorporated into the Proposed Development	Impact wholly or Substantially Mitigated?
Turbine bases close to gas pipeline	Base foundations sited outside of the 12 m easement. No temporary buildings or equipment allowed within easement.	Yes

16.5 Evaluation of Effects

The proposed Wind Farm has been designed to take account of almost all infrastructural, telecommunications, television, aviation and safety constraints. There is only one outstanding issue relating to the impacts of the proposed Wind Farm, which is its potential impact on future development of telecommunications infrastructure.

16.6 Summary and Conclusion

In accordance with planning policy guidance a range of consultees have been informed about the development proposal. All of those who have replied foresee no problems with the proposal, it should not interfere with communication transmissions nor with television reception. Providing appropriate advice is taken with the relevant bodies prior to the commencement of construction the development should not interfere with the gas pipeline and it will be possible to undertake the appropriate engineering measures to erect the turbines close to former coal addits.

[15] Technical Advice Note (TAN) 8 Renewable Energy -1996 paragraph A21

17. Summary of Predicted Effects

The EIA regulations state that significant effects should be identified and evaluated. In this ES these are classed as effects of major significance. In the preceding sections effects of minor and no significance have also been identified in order that consultees and decision-makers are provided with a full picture of the environmental implications of the proposed development.

Summaries of the predicted significant effects, both adverse and beneficial are tabulated below, further discussion is contained within the relevant sections.

17.1 Significant Adverse Effects

Following the incorporation of mitigation highlighted in the preceding technical sections, it is predicted that the following significant adverse effects would result from the construction and operation of the proposed development. These relate to impacts on public rights of way, visual and landscape effects and are summarised in Tables 17.1 to 17.7.

Table 17.1 Significant Direct Effects on Public Rights of Way During Construction

PROW reference (see figure 10.1)	Length of PROW impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Direct Effect	Significance	
					Level	Rationale
6/6A St Illtyd's Walk/Celtic Way	1.8 km (1.8 km)	Adverse	National	Medium	Major	Important PROW and publicised long distance route crossing heart of the site hence potential for disruption

Table 17.2 Significant Indirect Impacts on PROW during Construction

PROW reference (see figure 10.1)	Length of PROW impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Direct Effect	Significance	
					Level	Rationale
St Illtyd's Walk/Celtic Way 6/6A	3.5 km (2.6 km)	Adverse	National	Medium	Major	Although construction activities only visible and audible for a proportion of path they will be dominant experience for that section of a long distance footpath
Bridleway 6	3.4 km (1.9 km)	Adverse	Local	Major	Major	Construction activities will dominate open section

Table 17.3 Significant Indirect effects on PROW during Operation

PROW reference (see figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Direct Effect	Significance	
					Level	Rationale
St Illtyd's Walk/Celtic Way 6/6A	3.5 km (2.6 km)	Adverse	National	High	Major	Close proximity and no mitigating factors ensure that wind farm will dominate relevant section of long distance footpath
Bridleway 6	3.4 km (1.9 km)	Adverse	Local	High	Major	Turbines will be dominant element in northern section across site
Public Footpaths 33/35/14	3.2 km (3.2 km)	Adverse	Local	High	Major	The turbines and blades will be dominant features for walkers heading in SE direction

Table 17.4 Significant Effects on Landscape Resources: Construction

Identified Activity	Landscape Resource Impacted	Type of Effect	Sensitivity of Resource	Magnitude of Direct Effect	Significance	
					Level	Rationale
Cranes	Landscape characteristics	Adverse	High	High	Major	Introduces a new moving large - scale element into the landscape that is out of proportion with other elements. However tall structures such as radio masts are not uncommon within surrounding landscape
Construction of internal site access roads	Landscape characteristics	Adverse	High	Medium	Major	Loss of acid grassland/raised blanket bog would be localised but undermine the visual harmony of the site by partitioning it into separate parcels..
Material Stockpiles	Landscape characteristics	Adverse	High	Medium	Major	Introduction of numerous alien elements into landscape characterised by its simplicity, unity and openness temporarily undermining these valued characteristics and introducing new, unnatural patterns and combinations of elements

Table 17.5 Significant Effects on Landscape Resources: Operational

Activity	Landscape Resource Impacted	Type of Effect	Sensitivity	Magnitude of Impacts	Significance	
					Level	Rationale
Operation of turbines	Landscape Characteristics	Neutral	High	High	Major	The 16 turbines will be the tallest elements within the landscape introducing a regular, mechanised type of movement into the landscape. This combination of elements and movement undermines existing tranquillity
	Landscape character	Neutral	Medium	High	Major	The effects upon the landscape character area will be both adverse and beneficial. However they will not undermine the prime constituents of this character. Turbines emphasise the elevation and openness of the landscape but demonstrate that it is essentially man-made. Patterns of movement, light, shade and colour will be accommodated within this robust character type.

Table 17.6 Significant Visual Effects: Construction

Visual Receptor Viewpoints and Routes	Distance Between Wind Farm and Receptor Viewpoint	Type of Effect	Receptor Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Public Rights of Way						
Coed Morgannwg Way	Close	Adverse	High	High	Major	Very close views of access road, limited views of construction from some sections
St Illtyd's Walk	Close	Adverse	High	High	Major	Very close clear views from northern edge of site
Celtic Trail / High Level Route 47	Close	Adverse	High	High	Major	Very close clear views from northern edge of site
Residential communities						
Croeserw	Middle	Adverse	High	High	Major	Views of construction activities screened by topography and coniferous plantations on mountaintops. But possible views of crane movements elevated above plantations producing a stark visual contrast
Proposed Afan Valley Holiday Park	Middle	Adverse	High	Medium	Major	At time of writing no information available about development period of holiday park proposal. It is not expected to be built or occupied during construction period.

Table 17.7 Significant Visual Effects: Operation

Visual Receptor Viewpoints and Routes	Distance Between Wind Farm and Receptor	Type of Effect	Receptor Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Coed Morgannwg Way	Close	Adverse	High	High	Major	Very close views of access road. glimpsed views of turbines through forest plantation with full view on a number of turbines at junction of St Illtyd's Walk and Cefn Ffordd
St Illtyd's Walk	Close	Adverse	High	High	Major	Very close, full views of the wind farm from northern end of site See Figure 9.7a
Sarn Helen	Middle / Long	Adverse	High	High	Major	Turbines would be a dominant feature of the on the skyline and blade rotation would visible from sections nearer the site. From distant sections of Sarn Helen visibility would greatly be affected by clarity of atmospheric conditions. See Figures 9.6b and 9.9a-c
Celtic Trail / High Level Route 47	Close	Adverse	High	High	Major	Very close, full views of the wind farm from northern end of site
Bridleway and Byway on Foel Trawsnant	Middle	Adverse	High	High	Major	Prominent views of turbine towers and blades from both PROWs.
Footpath on Werfa	Long	Adverse	High	High	Major	Long distant views of wind farm on the skyline affected by atmospheric conditions.

Table 17.7 (continued) Significant Visual Effects: Operation

Visual Receptor Viewpoints and Routes	Distance Between Wind Farm and Receptor	Type of Effect	Receptor Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Residential communities						
Abercregan	Close / Middle	Adverse	High	High	Major	Intervening plantations and topography combined with orientation of properties limits visibility and number of turbines. Blades and top sections of towers will be clearly visible.
Cymmer	Middle	Adverse	High	High	Major	Intervening topography and forestry plantations limits the number and height of turbines seen. Turbines will be a major feature of views due to distance from site. See Figure 9.7c
Croeserw	Middle	Adverse	High	High	Major	High numbers of turbine towers and blades clearly visible on skyline. See Figure 9.11a-c
Proposed Afan Valley Holiday Park	Middle	Adverse	High	Medium	Major	Glimpsed view of turbines through forestry plantation. Visibility of wind farm / turbines also dependant on amount of forest removed / retained. See Figure 9.12a-c. (Visibility shown at present time with no tree removal)
Properties on eastern edge of Cilfrew	Middle / Long	Adverse	High	High	Major	Visibility of a large proportion of the wind farm on the skyline. Visibility restricted by orientation of some properties and tall vegetation along the roadside obscures some views. See Figure 9.13a-c

17.2 Cumulative Effects

Cumulative effects of the development that have been identified relate to landscape and visual impacts associated with the presence of the Ffynnon Oer wind farm in association with other existing wind farms and those currently submitted for planning consent. No significant effects have been identified.

17.3 Significant Positive Effects

In addition to the identification of significant adverse effects it is anticipated that the following significant positive effect will occur.

Table 17.8 Significant Positive Effects: Operation

Socio-Economic Effect	Type of Effect	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Establishment of Community Fund and possible community purchase of one turbine using European Funds	Positive	Likely	Local	High	Major	A regular substantial income for community groups if funding is provided to purchase one turbine

18. Conclusion

The development of a 16 turbine wind farm at Ffynnon Oer will contribute to both the Welsh Assembly's and the UK Government's target of 10% renewable energy generation by 2010. Thereby it will assist in reducing the amount of greenhouse gases emitted into the atmosphere which are widely acknowledged as being the main contributors to global warming.

The construction of the turbines will impact upon some of the individual elements which make up the environmental capital of the proposed development site. Surveys have been undertaken using methodologies agreed by relevant statutory bodies and consultees. An analysis of survey results demonstrates that significant adverse effects will be caused to the certain landscape resources and visual receptors along with temporary disruption to users of public rights of way during construction and operation. No other significant adverse effects have been identified nor are any of the cumulative effects considered to be major. It is anticipated that the development could make a major annual financial contribution to the local communities which surround the site.

Appendix A
Review of Regional and Local Planning Policy

10 Pages

Entec

Southwest Wales Strategic Planning Group. Regional Planning Guidance. April 2000

The Southwest Wales Regional Planning Guidance (RPG) was prepared by the Southwest Wales Strategic Planning Group. This group is comprised from representatives of the following authorities; Carmarthenshire County Council, Neath Port Talbot County Borough Council; Pembrokeshire County Council, the City and County of Swansea Council; and the Brecon Beacons and Pembrokeshire Coast National Park Authorities. The guidance contained within the RPG is intended to provide a regional framework for the preparation of Unitary Development Plans within Southwest Wales.

The issue of energy generation is considered within the RPG which highlights that Southwest Wales is a net importer of energy. With specific consideration of Wind Power the RPG acknowledges that areas of extensive coastal and upland areas are suitable for wind turbines due to the levels of wind speeds. The RPG also indicates that much of this potential is constrained as a result of specific designations e.g. National Parks, Areas of Outstanding Natural Beauty, or other sensitive areas such as unspoiled landscape or upland moors. In light of this the RPG in its recommendations on renewable energy indicates that, at 4.58, it will;

"Support the development of suitable renewable and sustainable energy projects at appropriate locations within the area."

West Glamorgan Structure Plan 1996

The approved West Glamorgan Structure Plan contains a number of policies relevant to the determination of the proposed wind farm at Ffynonn Oer. It has policies specific to renewable energy developments which are outlined below:

EQ1. *The County Council will seek to secure progress towards sustainable development and to ensure maintenance of biodiveristy. Accordingly, encouragement will be given to development proposals in appropriate locations that:*

i. *Reduce the consumption of energy and non-renewable resources,*

ii. *Make effective use of renewable resources or waste procedures.*

EQ2: *Proposals for the development of renewable sources of energy will be encouraged, particularly where there are benefits to the local economy, and will be permitted provided that the proposed development:*

i. Would not adversely effect the special character of the Gower AONB, the Brecon Beacons National Park or any other statutorily designated area or site of nature conservation or heritage conservation interest or heritage coasts; and

ii. Would not cause demonstrable harm to:

- *Other areas of special landscape value or sites of special nature conservation or heritage interest to be defined in local plans; or*
- *Areas or facilities of special importance for tourism and recreation; or*
- *The amenity of nearby dwellings or residential areas; and*

iii. Would not dominate any particular prominent skyline or maritime vista to be defined in local plans; and