

**Carraig Gheal Wind Farm**  
**Amendment**



October 2005

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## Notes for the Reader

This Amended Environmental Statement serves to update the Environmental Statement (November 2004) in the light of the changes proposed in the Amended Proposed Development. It should be read alongside the following documents:

- Environmental Statement: Main Report (November 2004);
- Environmental Statement: Appendices (November 2004);
- Environmental Statement: Figures (November 2004);
- Amended Environmental Statement: Figures.

This set of documents constitutes the Environmental Statement for the Amended Carraig Gheal Wind Farm.

### Structure of the Documents

To aid the reader, the structure of the documents reflects that of the Environmental Statement (November 2004). Chapter numbering, figure numbering and appendix numbering all correspond, with those that have been amended or replaced.

Amendment Chapters 1-15 all highlight changes or present further information from that presented in the ES (November 2004) and therefore should be read alongside those chapters.

Amendment Chapters 16, 17 and 18 contain the summary and conclusions in full for the Amended Proposed Development and supersede the corresponding chapters in the ES (November 2004).

### Nomenclature

Figures (including visualisations, visibility maps etc) and appendices presented in the Amendment are referred to prefixed by "A", e.g. Figure 2 of the Environmental Statement (November 2004) is replaced by Figure A2 of this Environmental Statement Amendment. Several revised Appendices have been included in the Amendment and have been assigned the numbers of the Appendices which they replaced, prefixed with an A. Two new Appendices are included as Appendix 14 and 15.

The turbine locations in the Proposed Development (November 2004) were numbered 1-24; the turbine locations of the Amended Proposed Development are numbered A1-A20, as shown in Figure A2. Appendix A1 provides a table indicating which turbines have moved and the renumbering process. Where a turbine location is referred to as T1, T2 etc then it may be assumed that this related to the Proposed Development (November 2004). Where a turbine location is referred to as TA1, TA2 etc then it may be assumed that this relates to the Amended Proposed Development.



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# **PART I**

## **Part I - Introduction**

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## Summary

This is a formal application to amend the Application (including the Environmental Statement) for consent relating to the proposed Carraig Gheal Wind Farm, submitted to the Scottish Ministers by GreenPower (Carraig Gheal) Limited on 15 November 2004.

### 1.1 INTRODUCTION

This Amendment to the Environmental Statement has been prepared on behalf of GreenPower (Carraig Gheal) Ltd (hereafter referred to as "GreenPower" and also "the Applicant") and is submitted to accompany an application for consent (hereafter referred to as "the Amended Application") to develop a wind farm of up to 20 wind turbines and associated infrastructure (hereafter referred to as "the Amended Proposed Development" and also "Amended Carraig Gheal Wind Farm") on Fernoch Farm in Argyll & Bute, Scotland (hereafter referred to as "the Development Site"). A project location plan is shown in Amendment Figure A1.

This amendment refers to the Application for consent for Carraig Gheal Wind Farm and all accompanying documentation, submitted in, and since, November 2004 to the Scottish Ministers under Section 36 of the Electricity Act 1989 (hereafter referred to as "the Application").

This Amendment to the Environmental Statement: Main Report is one volume of a set of Amendment documents which are listed below in Section 1.6.

### 1.2 PURPOSE OF THIS AMENDMENT TO THE ENVIRONMENTAL STATEMENT: MAIN REPORT

The purposes of this document are:

- To provide a report of all the environmental impact assessments that have been conducted to assess the potential environmental impacts of the Amended Proposed Development;
- To revisit the environmental impact assessments of November 2004 and identify where the Amended Carraig Gheal Wind Farm alters the assessment of the potential environmental impacts of the Proposed Development (November 2004);
- For the amended environmental impact assessments presented in this document, provide suggested forms of mitigation, a Schedule of Environmental Commitments and overall conclusions;
- To comply with the requirements of Regulation 4 of The Electricity Works (Environmental Impact Assessment (Scotland) Regulations 2000) and so enable Scottish Ministers to determine the Application by providing all relevant environmental and developmental information.

### 1.3 THE AMENDMENT

This is a formal application (hereafter referred to as "the Amendment") to amend the Application (including the Environmental Statement) submitted to the Scottish Ministers by GreenPower (Carraig Gheal) Limited on 15 November 2004 in accordance with Section 36 and Schedules 8 and 9 of the Electricity Act 1989, Section 57(2) of the Town and Country Planning (Scotland) Act 1997, The Electricity (Applications for Consent) Regulations 1990 and The Electricity Works (Environmental Impact Assessment)(Scotland) Regulations 2000 (hereafter referred to as the "2000 Regulations") in respect of the proposed Carraig Gheal Wind Farm.

The Amendment is submitted in terms of the procedural requirements of Regulations 13 and 14 of the 2000 Regulations.

### 1.4 THE APPLICANT

There has been no change in the Applicant since the Application.

The Applicant, GreenPower (Carraig Gheal) Ltd, was established for the principle purpose of developing the Carraig Gheal Wind Farm. It is a Scottish company and is part of a group of companies engaged in the development of wind and hydro projects within Scotland.

An affiliated business, GreenPower Developments Ltd, has been appointed to project manage the Carraig Gheal Wind Farm project, including co-ordination of the production of this Environmental Statement. GreenPower Developments Ltd is based in Alloa, Clackmannanshire.

## 1.5 THE CONSULTANTS

All consultants that have project managed and/or have made contributions to the Amendment are listed in the tables below.

In order to ensure continuity with the Application, the same external consultancies have been employed in the assessment of the Amendment as authored the material presented with the Application.

<b>Overall Project Management</b>	<b>Contact</b>	<b>Company</b>
Environmental Statement and Impact Assessment Coordination, Collation and Project Management	Robert Forrest Mark Evans	GreenPower Developments Ltd
Supporting Document Coordination, Collation and Project Management	Robert Forrest Mark Evans	GreenPower Developments Ltd

<b>Environmental Impact Assessment</b>	<b>Contact</b>	<b>Company</b>
Ecology – Vegetation (Chapter 6 of Environmental Statement)	Mark Bates	Heritage Environmental Ltd.
Ecology – Protected Mammals (Chapter 7 of Environmental Statement)	Mark Bates	Heritage Environmental Ltd.
Ecology – Ornithology (Chapter 8 of Environmental Statement)	Simon Lawrence	Lawrence Environmental Consultants
Hydrology (Chapter 9 of Environmental Statement)	Sheila Ross	The Environmental Advice Centre Ltd.
Landscape and Visual (Chapter 10 of Environmental Statement)	Rebecca Rylott	Entec UK Ltd
Archaeology (Chapter 11 of Environmental Statement)	Simon Atkinson	Entec UK Ltd
Noise (Chapter 12 of Environmental Statement)	Andy McKenzie	Hayes McKenzie Partnership

<b>Legal Assessment</b>	<b>Contact</b>	<b>Company</b>
Planning and Environmental Law	Robin Priestley	Anderson Strathern Solicitors

## **1.6 THE AMENDED CARRAIG GHEAL WIND FARM ENVIRONMENTAL STATEMENT**

A number of volumes comprise the full Environmental Statement for the Amended Carraig Gheal Wind Farm. These are:

- Amended Environmental Statement;
- Amended Environmental Statement: Non-Technical Summary;
- Amended Environmental Statement: Figures;
- Environmental Statement: Main Report (November 2004);
- Environmental Statement: Appendices (November 2004);
- Environmental Statement: Figures (November 2004).

This volume, the Amended Environmental Statement, refers to supporting information presented in the Amended Environmental Statement: Appendices (bound in this volume) and to Figures, Maps and Visualisations presented in the volume Amended Environmental Statement: Figures (bound at A3 size).

The Amendment to the Non-Technical Summary of the Environmental Statement presents a summary in full of the findings of the Environmental Statement (November 2004) and Amendment in a simple and non-technical style.

Additional information in support of the Environmental Statement (November 2004) was submitted in the form of a Needs and Benefits document and a Design Statement. The Needs and Benefits document is updated and reproduced in full in an Amendment version. No amendment is proposed to the Design Statement.

## **1.7 STRUCTURE OF THE DOCUMENTS**

To aid the reader, the structure of the documents reflects that of the Environmental Statement (November 2004). Chapter numbering, figure numbering and appendix numbering all correspond, with those that have been amended or replaced.

Amendment Chapters 1-15 all highlight changes or present further information from that presented in the Environmental Statement (November 2004) and therefore should be read alongside those chapters.

Amendment Chapters 16, 17 and 18 contain the summary and conclusions in full for the Amended Proposed Development and supersede the corresponding chapters in the Environmental Statement (November 2004).

## **1.8 NOMENCLATURE**

Figures (including visualisations, visibility maps etc) and appendices presented in the Amendment are referred to prefixed by "A", e.g. Figure 2 of the Environmental Statement (November 2004) is replaced by Figure A2 of this Environmental Statement Amendment. Similarly Appendices that have been updated are included here, labelled with their original numbering and prefixed with an A. Two new appendices have been included in the Amendment, which have been assigned numbers A14 and A15.

The turbine locations in the Proposed Development (November 2004) were numbered 1-24; the turbine locations of the Amended Proposed Development are numbered A1-A20, as shown in Figure A2. Appendix A1 provides a table indicating which turbines have moved and explaining the renumbering process. Where a turbine location is referred to as T1, T2 etc then it may be assumed that this related to the Proposed Development (November 2004). Where a turbine location is referred to as TA1, TA2 etc then it may be assumed that this relates to the Amended Proposed Development.

## **1.9 THE STRUCTURE OF THIS AMENDED ENVIRONMENTAL STATEMENT**

The structure of this Amended Environmental Statement: Main Report follows that of the Environmental Statement: Main Report (November 2004). Where possible, to avoid repetition,

the work detailed in the Environmental Statement submitted with the Application is referred to. The structure of this document is as follows:

- Part I – Introduction, provides a general introduction and summary description of the of the Amended Proposed Development;
- Part II – Methodology describes the design process through which the Amendment has emerged and the methodology by which the EIA has been revised;
- Part III – Impact Assessments, presents the independent environmental impact assessments that have been carried out to assess the potential environmental impacts of the Carraig Gheal Wind Farm making reference to both the Environmental Statement (April 2004) and revision of the impact assessment, where appropriate, to take account of the Amendment;
- Part IV – Other Evaluations, provides a re-consideration of infrastructure, telecommunications and access issues in the light of the Amendment;
- Part V – Summary Effects and Mitigation, provides a summary of all potentially significant environmental effects, the proposed mitigation, the Schedule of Environmental Commitments and an overall conclusion. This is presented in full.

### **1.10 DOCUMENTATION CORRESPONDENCE AND AVAILABILITY**

The Needs and Benefits document and the Non-Technical Summary volume of the Environmental Statement are available free of charge from GreenPower on request. The complete set of Environmental Statement (November 2004) volumes is available from GreenPower for £10 on CD<sup>1</sup> or for £200 as a printed set<sup>2</sup>. The documentation relating to the Amended Carraig Gheal Wind Farm is available free of charge to all those who purchased the November 2004 Environmental Statement set. Otherwise, The Amendment is available for £10 on CD<sup>1</sup> or for £200 as a printed set<sup>2</sup>.

All queries regarding content or availability of any of the Environmental Statement volumes submitted in support of the Application should be directed to the Project Manager, GreenPower Developments Ltd (see contact details, inside-cover page).

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<sup>1</sup> CD-ROM for personal computer.

<sup>2</sup> Whilst stocks last.



*Introduction*

The complete set of Environmental Statement (November 2004) volumes and the Amendment to the Environmental Statement volumes submitted in support of the Application is available for viewing at the following locations:

<b>Location</b>	<b>Opening<sup>3</sup></b>	<b>Address</b>	<b>Tel No.</b>
Scottish Executive Library	Mon - Thurs 0830 - 1700 Fri 0830 - 1630 <b>By appointment only.</b>	Saughton House, Broomhouse Drive, Edinburgh EH11 3XD	0131 244 4547
Argyll & Bute Council Headquarters	Mon - Fri 9am - 5pm	Kilmory Lochgilphead PA31 8RT	01546 602127
Argyll & Bute Council Office	Mon – Fri 9am – 5pm	Lorn House, Albany Street, Oban PA34 4AR	01631 567930
Oban Library	Monday: 10am – 1pm ; 2pm – 7pm Tuesday: Closed Wednesday: 10am -1pm ; 2pm – 7pm Thursday: 10am – 1pm ; 2pm – 6pm Friday: 10am – 1pm ; 2pm – 5pm Saturday: 10am – 1pm	Corran Halls Oban PA34 5AB	01631 571444

<sup>3</sup> These opening times are indicative only and believed to be correct at the time of publication.



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**2.1 INTRODUCTION**

The site description as presented in Chapter 2 of the Environmental Statement: Main Report (November 2004) stands and as such no amendment to that chapter is proposed here.



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## Summary

The Amendment proposes:

- Reduction in the number of turbines from 24 to 20;
- 9 turbines have a hub height of up to 65m and an upper blade tip height of up to 110m (previously 6 turbines with hub height up to 70m and an upper blade tip height of up to 112m);
- 11 turbines have a hub height of up to 80m and an upper blade tip height of up to 125m (previously 19 turbines with hub height up to 85m and an upper blade tip height of up to 127m);
- Reduced and revised track route to serve the amended turbine locations;
- Revised wind monitoring mast locations.

### 3.1 INTRODUCTION

The Amended Proposed Development consists of up to 20 wind turbines, a reduction of 4 from the 24 wind turbines previously proposed, and associated infrastructure to accommodate their installation, operation, maintenance and the export of electrical power. This will include foundations, areas of hard standing, access tracks, electrical cabling, transformers, site substation and control room facilities and anemometry on two separate wind monitoring masts.

The elements of the project and the principles of its construction, operation and decommissioning are described in more detail in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development, with additional notes in respect of turbine location changes presented in Appendix A1 in this volume.

### 3.2 ELEMENTS OF THE WIND FARM

In this section, the elements of the Carraig Gheal Wind Farm are summarised with reference to the Amendment Figures.

#### 3.2.1 Location

There is no proposed change to the location of the Development Site which is illustrated in Amendment Figure A1.

#### 3.2.2 Project Infrastructure

The Site Plan of Amendment Figure A2 illustrates the positions of turbines, track routes and other permanent infrastructure features as well as the Development Site boundary for the Amendment to the Proposed Development.

An amendment to the track route to accommodate changes to the number of turbines and some of their locations is shown in Amendment Figure A2. Details regarding the design and construction of the on site tracks remain as those submitted in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development.

The Amendment proposes the removal of 4 turbines from the 24 turbines in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development. In the Amended Proposed Development, turbines numbered TA1, TA4, TA5, TA9, TA12, TA17, TA18, TA19 and TA20 will have a hub height of up to 65m and a maximum upper blade tip height of 110m. All remaining turbines will have a hub height of up to 80m and a maximum upper blade tip height of 125m.

Details regarding the construction and operation of the wind turbines remain as previously submitted in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development.

Substation and control room details remain as those submitted in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development.

### **3.2.3 Project Construction**

Project Construction details remain as those submitted in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development.

### **3.2.4 Grid Connection**

Each turbine will be capable of generating an electrical output of up to 3MW, hence the peak output from the Wind Farm will be up to 60MW.

The form and design for the grid connection to the Amended Proposed Development remain as previously submitted in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development.

### **3.2.5 Wind Monitoring**

New positions are identified on Amendment Figure A2 for two wind monitoring masts associated with the Amended Proposed Development. One mast has been added since the Environmental Statement: Proposed Development document, November 2004. Other details in relation to the previously described wind monitoring masts, for example detail regarding their form or construction, remain as described in the Environmental Statement (November 2004): Proposed Development.

### **3.2.6 Operation and Maintenance**

Operation and maintenance details remain as those submitted in the Environmental Statement (November 2004): Proposed Development.

### **3.2.7 Decommissioning**

Decommissioning details remain as those submitted in the Environmental Statement (November 2004): Proposed Development.

## **3.3 OTHER ACTIVITIES ASSOCIATED WITH THE PROJECT**

### **3.3.1 Public Highway Works**

Details regarding Public Highway Works remain as those submitted in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Proposed Development.

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## **Chapter 4**

### **Project Design and EIA Methodology Amendment**

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#### **4.1 INTRODUCTION**

Project Design and EIA Methodology as presented in Chapter 4 of the Environmental Statement (November 2004): Main Report stands and as such no amendment to that chapter is proposed here.





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## 5.1 INTRODUCTION

Chapter 5 of the Environmental Statement: Main Report (November 2004) described the site selection criteria used to identify the Carraig Gheal site and the key stages in the evolution of the Carraig Gheal Wind Farm design.

Further information is presented here regarding the design of the Amended Carraig Gheal Wind Farm. A fully revised appendix detailing “mitigation incorporated in the project design” is presented in Amendment Appendix A5a and a fully revised Schedule of Environmental Commitments is presented in Appendix A5b.

## 5.2 AMENDMENT DESIGN EVOLUTION

As part of the statutory process of consultation, a number of responses have been provided to GreenPower by the Scottish Executive and Argyll and Bute Council. In the same way that feedback and consultation informed the design detailed in the Environmental Statement: Main Report (November 2004), this feedback has informed further design that has led to the Amended Proposed Development. Specific feedback that has contributed to the Amendment is highlighted against the changes below.

### 5.2.1 Turbine Locations

The following section details the changes to turbines locations, described by geographical grouping.

#### 5.2.1.1 Removal of Turbines from SW part of the Site

Turbines T5, T12, T13, T14 and T20 have been removed from the SW part of the site as a precautionary approach due to proximity to a sensitive bird species, based on dialogue with SNH and RSPB.

The reduction in turbine numbers provides an additional benefit by limiting the overall extent of the development.

#### 5.2.1.2 Relocation of Turbines

Several turbines have been relocated around the site, primarily to address Landscape and Visual issues raised by SNH, with T4 & T24 relocated due to the bird sensitivities mentioned above. The remaining relocations served 2 purposes:

- To reduce the isolation of turbines at the edge of the layout when viewed from certain viewpoints (caused by the removal of turbines that previously tied the layout together);
- To reduce the instances of overlapping turbines in the views.

These relocations are described below in relation to several of the viewpoints assessed in the Landscape and Visual Impact Assessment of this document and the Environmental Statement (November 2004).

##### Viewpoint 2: Balliemeanoch

The removal of turbines at the SW end of the site left TA4 isolated at the left hand side of the view when seen from this location. The next turbine in the view (moving rightwards) is TA20, which cannot be moved S to bring it closer to TA4 in this view due to other constraints. The nearest turbine that can be relocated to have the desired effect is TA5. Movement of this turbine SW creates a more regular pattern of turbines and a more balanced layout.

##### Viewpoint 3: Waterfall, Loch Awe

To address the isolation of TA1 when viewed from this location, TA8 has been relocated further E. TA1 has also been moved slightly further S to also address this issue, but is constrained by the technical spacing criteria for wind turbines.

Various other adjustments have been made to various turbine locations in order to minimise the instances of overlapping turbines in any of the views, some of which had been introduced by the movements described above.

#### **5.2.1.3 Allocation of Hub Heights for Amendment Design**

A desire was expressed by SNH and The Council to endeavour, where possible, to create a structure in the layout such that the outline of the wind farm would appear to be gently domed where it appeared above the skyline. By using 2 different hub heights for the wind turbines, the undulations in the landform of the Site can be accounted for to achieve this desired structure. 3 turbines which were previously assigned a 85m hub height have been reduced to the lower 65m hub height.

#### **5.2.2 Turbine Size**

A change in the likely availability of the intended turbine unit has necessitated a change in proposed dimensions of the wind turbine proposed at Carraig Gheal Wind Farm. The revised turbine unit has a reduced hub height (a reduction of 5m for most turbines) and reduces slightly the upper blade tip height from that specified for the Proposed Development (November 2004) (reduction of 2m in the main). This is detailed in the Environmental Statement: Amendment Appendix A1.

An investigation of the likely landscape and visual impact was made and the change in turbine geometry was deemed to have a negligible effect.

#### **5.2.3 Meteorological Mast Locations**

An amendment is proposed to the locations and number of the meteorological monitoring masts as described in the Environmental Statement: Amendment (Chapter 3). This revision has been made for technical reasons in the light of the revised turbine locations, additional wind analysis and commercial requirements.

### **5.3 MITIGATION INCORPORATED INTO THE DESIGN**

A fully revised appendix detailing “mitigation incorporated in the project design” is presented in Amendment Appendix A5a. This identifies the mitigation measures resulting from the iterations between design and impact assessment process which have been adopted in the final layout design process and those incorporated since November 2004 as a result of consultee feedback.

The Summary of Sensitivities Map of Amendment Figure A14 illustrates how the Amended Proposed Development has been shaped to avoid the sensitivities.

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## Summary

The amendment to the proposed Carraig Gheal Wind Farm is not predicted to result in any material changes to the assessment prepared for vegetation and flora presented within the Environmental Statement (November 2004).

It is predicted that the proposed Carraig Gheal Wind Farm will result in small-scale direct loss and localised indirect impacts on vegetation resulting from construction of the access tracks and turbines. Mitigation is recommended to reduce impacts on vegetation in line with good practice. There is no predicted impact on notable or rare species of flora.

## 6.1 INTRODUCTION

This report has been produced as an amendment to the impact assessment reported in Chapter 6 of the Environmental Statement (November 2004) for the proposed Carraig Gheal Wind Farm. This follows an Amendment to the Proposed Development. The information presented here should be read in conjunction with the Environmental Statement (November 2004).

### 6.1.1 Company Capability

This amended Chapter has been prepared by Heritage Environment Ltd (HEL), who prepared the ecological chapter for vegetation and flora in the Environmental Statement (November 2004) for the proposed Carraig Gheal Wind Farm. HEL therefore has a good overview of the site in order to assess potential ecological effects of the revised proposals.

HEL are specialists in ecological impact assessment for development projects. The key to our approach is the provision of independent and objective reporting based upon sound scientific data collection and analysis. HEL has considerable experience of wind farm projects, and specifically have undertaken assessments for vegetation and flora throughout Scotland.

Principal authors and technical reviewers for this amended Chapter were as follows:

- Mark A. Bates HND (Conservation management), AIEEM – Principal Ecologist and Ecological Impact Assessment Specialist;
- Rebecca L. Osborn BA (Hons Oxon), MSc, MIEEM – Senior Ecologist.

### 6.1.2 Consultations

Consultation with Scottish Natural Heritage (SNH) and Argyll and Bute Council in respect of this Amendment has been ongoing since November 2004.

## 6.2 ASSESSMENT METHODOLOGY

The methodology and scope of this assessment is in keeping with that described in Section 6.2 of the Environmental Statement (November 2004). The information gathered during the survey (also reported in the Environmental Statement (November 2004) is used here to assess any potential impacts of the proposed Amendment.

## 6.3 RESULTS AND EVALUATION

The results of the habitat survey and evaluation of habitats are presented in the Environmental Statement (November 2004).

## 6.4 ANALYSIS OF AMENDMENT

The Amendment is shown with the previously published survey results in Amendment Figures A15a, A15b and A15c. This amended Chapter considers the following changes contained within the Amendment:

- Reduction in the number of turbines from 24 to 20 with associated reduction in footprint;
- Alterations to the positions of several turbines;

- Amended track route to serve the Amended layout with a reduction in length from 15km to 12.995km;
- Repositioning of 1 and addition of 1 met mast.

In general, as discussed below, the amendments to the scheme, comprising a reduction in footprint area and a reduction in track length, lead to either no change, or a reduction in impacts on the vegetation resource.

## 6.5 ASSESSMENT OF IMPACTS

Section 6.5 of the Environmental Statement (November 2004) provides an assessment of impacts on protected mammals, for the construction, operational and decommissioning phases of the Amended Carraig Gheal Wind Farm. The following provides a revision of this assessment for vegetation and flora, based on the Amendment. Additional information is provided where impacts are predicted to vary from those previously reported.

The method of determining the scale of impacts and significance of effects are described in section 6.5 of the Environmental Statement (November 2004). In this assessment, impacts of moderate or major significance are considered to be a *likely significant effect* (as referred to in the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 1999.

### 6.5.1 Vegetation Community - Sensitivity to impacts

For the purposes of this report and as guidance in assessing the sensitivity of vegetation to impacts, the following assumptions have been made:

- Habitats of International or National Value and of High Local Value (if having a large area within the Study Site, or are especially fragile communities) may be regarded as having high sensitivity to impacts;
- Habitats of High Local Value (but having a small area within the Study Site) and of Moderate Local Value may be regarded as having medium sensitivity to impacts. Within this category especially fragile or hydrologically sensitive communities may be regarded as Medium High, with Medium Low for more widespread, robust or degraded types;
- Habitats of Low Local or Negligible Value may be regarded as low sensitivity to impacts.

These sensitivities to potential impacts are shown on Amendment Figure A15b. Assessment of habitat sensitivity has been used to help inform the assessment process and as a design aid to sensitively locate turbines and access tracks.

### 6.5.2 Vegetation - Construction Phase

#### 6.5.2.1 Turbine Construction

##### Permanent direct loss of habitats to the footprint of the turbines

The Amendment results in a predicted permanent loss of habitats (including dry, wet heath and blanket mire) in the order of 1,000m<sup>2</sup>, compared to 1200m<sup>2</sup> reported in the Environmental Statement (November 2004).

There is no revision to the assessment presented within the Environmental Statement (November 2004) as a result of the Amendment. A non-significant impact is predicted for direct loss of habitats to the footprint of the turbines.

<b>Impact Magnitude:</b>	<b>Low</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Partial</b>

Temporary direct loss of habitats in the construction area beyond the footprint of the turbines

The reduction in the number of turbines proposed for the Amendment will result in a lesser overall impact relative to total the areas affected.

There is no revision to the assessment presented within the Environmental Statement (November 2004). A non-significant impact is predicted for temporary direct loss of habitats in the construction area beyond the footprint of the turbines.

<b>Impact Magnitude:</b>	<b>Low</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible</b>	<b>Partial</b>

The M17 blanket mire is of large extent within the Study Site, but is less robust and consequently more vulnerable to disturbance due to the vegetation community, especially the *Sphagnum* mosses, being sensitive to physical damage and changes in hydrology within the peat substrate. Any damage to blanket mire is unlikely to be permanent but result in a long-term (>25 years), temporary impact. Turbines A3, A4, A7, A9, A13, A14, A16 and A20 in the Amendment are located, at least partly, on blanket mire or blanket mire-wet heath mosaic. Although some of the turbines have moved locations, the total number of turbines on this habitat type is the same and therefore there is no revision to the assessment presented within the Environmental Statement (November 2004). A significant pre-mitigated impact is predicted for temporary direct loss of M17 blanket mire in the construction area beyond the footprint of the turbines.

<b>Impact Magnitude:</b>	<b>Medium</b>
<b>Impact Significance:</b>	<b>Moderate</b>
<b>Mitigation Possible</b>	<b>Partial</b>

Permanent indirect impacts through alterations to hydrology

It is considered that the siting of turbines on habitats with wet soils may result in an alteration to both the surface water and groundwater regimes, with a strong possibility that the vegetation composition of nearby habitats may also be altered. Vegetation types likely to suffer from potential adverse impacts would be M10 basic flush, M17 blanket mire, and M1 and M3 bog pools. No turbines will be located on M10 basic flush, M1 or M3 bog pools. However, 8 turbines (A3, A4, A7, A9, A13, A14, A16 and A20) of the Amendment are located, at least partly on blanket mire or blanket mire- wet heath mosaic. The effects of alteration to hydrological regimes on these peatland habitats from the turbines are likely to be localised and of limited extent with minor changes in vegetation structure and composition, e.g. increase in Ling *Calluna vulgaris* in areas subject to drying.

Although some of the turbines have moved locations, the total number of turbines on this habitat type is the same and therefore here is no revision to the assessment presented within the Environmental Statement (November 2004). A significant pre-mitigated impact is predicted for temporary direct loss of habitats in the construction area beyond the footprint of the turbines.

<b>Impact Magnitude:</b>	<b>Medium</b>
<b>Impact Significance:</b>	<b>Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

Vegetation type M6 poor-fen, although considered to be only of *Low Local Value* within the Study Site, has an important role to play in regulation of water quality and quantity. Permanent alteration to the water regime in these flush habitats, which flow in to and out of the wet communities of high sensitivity may therefore have a potentially adverse impact. However, given that the siting of turbines have been located to avoid these hydrologically sensitive habitats, with the amendment now avoiding the M6 flush, where the previous Turbine T7 was proposed. It is considered that alteration to hydrology will be very limited and of low magnitude effect.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Low</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

Temporary indirect impacts during construction

Temporary, indirect impacts potentially include dust, pollution incidents and sudden variations in the hydrological regime, including silt-laden run-off. Of these potential impacts, the vegetation types most at risk would be the wet habitats within the site. This would include: M15 wet heath and M17 blanket mire of *High Local Value*. 8 Turbines (A3, A4, A7, A9, A13, A14, A16 and A20) of the amended scheme are located on blanket mire or blanket mire-wet heath mosaic and which therefore may be subject to potential temporary, indirect impacts.

Although some of the turbines have moved locations, the total number of turbines on this habitat type is the same and therefore there is no revision to the assessment presented within the Environmental Statement (November 2004), with a potential pre-mitigated significant impact predicted.

<b>Impact Magnitude:</b>	<b>Potentially Medium</b>
<b>Impact Significance:</b>	<b>Potentially Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

**6.5.2.2 Access Tracks and Grid Connection**

The impact of the construction of the access tracks is based on a track of 8m width of direct disturbance. The working corridor for the construction of these tracks is estimated to be 18 m. The Proposed Development (November 2004) included c. 15 km of tracks within the Study Site boundary, compared to c. 13 km proposed as part of the Amendment. The proposed off-site grid connection will be subject to a separate S37 consent, and is not considered here.

Permanent direct loss of habitats to access tracks

The M6 flush is very limited in extent within the Study Site. The vegetation itself is of *Low Local Value*, but impacts which affect the water flow are more important, as they feed other watercourses. The proposed access track system will cut across sections of acid flush vegetation at a number of locations, including at 6 locations (compared to 5 locations reported in the Environmental Statement (November 2004)). These occur between where the track enters the site at the north-east corner and turbine A1, between turbines A1 and A2, between turbines A3 and A4, between turbines A6 and A11, between turbines A6 and A7, between turbines A16 and A17, between turbines A9 and A10, between turbines A1 and A8, and between turbines A9 and A14. In total, c 500 m (compared to c. 475 m reported in the Environmental Statement

(November 2004)) of track will cross this vegetation type, representing a loss of c. 0.4 ha from a total resource of 41.4 ha.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Low</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Partial</b>

The H10 dry acid heath and M15 wet heath communities of *High Local Value* are of large extent within the Study Site. Direct habitat loss to access tracks will not result in a significant reduction in total area. There is approximately 11 km of proposed track (compared to 14 km assessed in the Environmental Statement (November 2004)), crossing dry and wet heath communities. The total area permanently lost by construction, therefore, will be c. 8.8 ha, which is a relatively small loss in comparison to the total area of 649ha within the Study Site.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Low</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Partial</b>

The M17 blanket mire is also of large extent within the Study Site (>200 ha. including that which forms part of a mosaic with other NVC communities). As with the Proposed Development (November 2004), there is approximately 1.6 km of proposed track, crossing mire communities. The total area permanently lost by track construction will be c. 1.3 ha, which is a relatively small loss in comparison to the total area within the Study Site.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Low</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Partial</b>

Temporary direct loss of habitats within the track construction corridor

Movement of plant and soil storage during the construction of the access tracks is likely to damage vegetation and compact soils within the track construction corridor. The significance of this disturbance will depend on the working methods adopted and robustness of the vegetation types, but good levels of recovery are predicted in the medium-term, i.e. 5-15 years, given appropriate restoration.

The H10 dry heath, M15 wet heath and M17 blanket mire habitats of *High Local Value* are of large extent within the Study Site, with only a relatively small extent likely to be affected. However, the construction activities associated with approximately 13 km of track (compared to c. 15km for the Proposed Development (November 2004)) will have a cumulative effect on the vegetation impact throughout the Study Site, resulting in a predicted medium impact magnitude.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a significant pre-

mitigated impact predicted for temporary direct loss of habitats within the track construction corridor.

<b>Impact Magnitude:</b>	<b>Medium</b>
<b>Impact Significance:</b>	<b>Moderate</b>
<b>Mitigation Possible:</b>	<b>Partial</b>

Permanent indirect impacts through alterations to hydrology

Beyond the zone of direct disturbance there will be a further zone of effect involving indirect change arising mainly from changes in hydrology as a result of access track construction. The significance of this disturbance will depend on the access track design adopted and robustness of the vegetation types, but some permanent changes in vegetation are predicted.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a significant pre-mitigated impact predicted for permanent indirect impacts through alterations to hydrology.

<b>Impact Magnitude:</b>	<b>Medium</b>
<b>Impact Significance:</b>	<b>Moderate</b>
<b>Mitigation Possible:</b>	<b>Partial</b>

Temporary indirect impacts during construction

Temporary, indirect impacts potentially include dust, pollution incidents and sudden variations in the hydrological regime. Of these potential impacts, the vegetation types most at risk would be the wet habitats and the ones with restricted distribution within the site. This would include M15 and M17 of *High Local Value*.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a potentially significant pre-mitigated impact predicted for temporary indirect impacts during construction.

<b>Impact Magnitude:</b>	<b>Potentially Medium</b>
<b>Impact Significance:</b>	<b>Potentially Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

All other vegetation types within the Study Site would experience *Low/Negligible* significance of impacts. This also requires no revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

### 6.5.3 Flora - Construction Phase

The Study Site supports a number of plant species considered to be *Locally Notable*, *Locally Scarce* or *Nationally Scarce*, occurring mostly within open water, wet peat or basic grassland habitats. No plants of conservation significance are considered to be present within the habitats subject to direct and/or indirect habitat loss or disturbance resulting from the construction phase of the amended scheme.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted..

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

#### 6.5.4 Vegetation and Flora - Operational Phase

The operational phase will entail routine maintenance of turbines and ancillary plant, with vehicle access gained from the constructed tracks. Impacts may arise from potential pollution events due to poor operational management or accidents, e.g. oil spillage resulting in pollution to watercourses.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a potentially significant pre-mitigated impact predicted during the operational phase.

<b>Impact Magnitude:</b>	<b>Potentially Medium</b>
<b>Impact Significance:</b>	<b>Potentially Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

#### 6.5.5 Decommissioning

Details on decommissioning of the wind farm are not known at present. However, dismantling of turbines, removal of foundations and potential removal of access tracks could have significant impact on both vegetation and flora, in line with the same range of effects as outlined for construction.

There is no revision to the assessment presented within the Environmental Statement (November 2004), with a potentially significant pre-mitigated impact predicted during the operational phase.

<b>Impact Magnitude:</b>	<b>Potentially Medium</b>
<b>Impact Significance:</b>	<b>Potentially Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

### 6.6 MITIGATION MEASURES

Section 6.6 of the Environmental Statement (November 2004) provides a comprehensive mitigation package in order to reduce and/or eliminate predicted impacts on vegetation and flora of moderate or high impact significance (i.e. significant impacts), to fulfil any legal requirements, or to employ “best practice” guidelines when undertaking activities which impact upon the environment.

No additional mitigation measures are considered to be required as a result of the Amendment.

### 6.7 CONCLUSIONS

The amendment to the proposed Carraig Gheal Wind Farm is not predicted to result in any material changes to the assessment prepared for vegetation and flora presented within the Environmental Statement (November 2004).

The ecological base-line study confirmed that the vegetation of the proposed Wind Farm Site is comprised of upland types, dominated by moorland of dry (NVC types H10 and H21) and wet (NVC type M15) heaths and blanket mire (NVC types M1, M3 and M17) considered to be of *High Local Value*. Additional upland vegetation types of *Negligible – Low Local Value* include acid grassland (NVC type U4) and bracken (NVC type U20), and a series of oligotrophic lochs support characteristic aquatic (NVC types A7 and A22) and swamp vegetation (NVC types S8 and S9) of *High Local Value*. An example of limestone pavement formation is also present, supporting calcareous grassland (NVC type CG10), which was assessed to be of *Regional Value*. The flora includes a number of notable and rare species.

It is predicted that the proposed Carraig Gheal Wind Farm will result in small-scale direct loss and localised indirect impacts on vegetation resulting from construction of the access tracks and turbines. Mitigation is recommended to reduce impacts on vegetation in line with good practice. There is no predicted impact on notable or rare species of flora.

**6.8 REFERENCES**

Carraig Gheal Wind Farm Environmental Statement, GreenPower (Carraig Gheal) Ltd., November 2004.



## **Chapter 7**

### **Mammals Impact Assessment Amendment**

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## Summary

The amendment to the proposed Carraig Gheal Wind Farm is not predicted to result in material changes to the assessment prepared for protected mammals presented within the Environmental Statement (November 2004). The Amended Carraig Gheal Wind Farm will not have any significant effect on protected mammal species.

Evidence of Otter (in the form of two spraints) were recorded on the shore of the un-named loch south of Ban Lon (Grid Ref NM 97448 19741), approximately 50m from the nearest proposed turbine. No resting up sites were confirmed in the vicinity of this loch, and impacts on this species are considered to be negligible to low.

Potentially suitable habitat for Water Vole was confirmed at two watercourse locations, namely the Allt na Maoile and Allt Gleann na h Airigh. However, the presence of this species was not confirmed. A pre-construction survey is recommended to confirm the results of the ecological baseline study, and, if confirmed, to agree acceptable mitigation recommendations with SNH.

### **7.1 INTRODUCTION**

This report has been produced as an amended Chapter to the impact assessment reported in Chapter 7 of the Environmental Statement (November 2004) for the proposed Carraig Gheal Wind Farm. This follows an amendment to the proposed layout and associated infrastructure. The information presented here should be read in conjunction with the Environmental Statement (November 2004).

### **7.2 COMPANY CAPABILITY**

This amended Chapter has been prepared by Heritage Environment Ltd (HEL), who also prepared the mammals' chapter in the Environmental Statement (November 2004) for the proposed Carraig Gheal Wind Farm. HEL therefore has a good overview of the site in order to assess potential ecological effects of the revised proposals.

HEL are specialists in ecological impact assessment for development projects. The key to our approach is the provision of independent and objective reporting based upon sound scientific data collection and analysis. HEL has considerable experience of wind farm projects, and specifically have undertaken assessments for all protected mammals present throughout Scotland.

Principal authors and technical reviewers for this Chapter were as follows:

- Rebecca L. Osborn BA (Hons Oxon), MSc, MIEEM – Senior Ecologist and Mammal Specialist;
- Mark A. Bates HND (Con Man.), AIEEM – Principal Ecologist and Ecological Impact Assessment Specialist.

### **7.3 CONSULTATIONS AND DESK STUDY**

Section 7.3 of the Environmental Statement (November 2004) provides information on consultations and desk study undertaken as part of the assessment. This information is used here to assess impacts of the proposed Amendment.

## **7.4 ASSESSMENT METHODOLOGY**

### **7.4.1 Policy and Guidance**

The protected mammal impact assessment has been undertaken with regard to advice and legislative requirements given in the following:

- The Conservation (Natural Habitats &C) Regulations 1994;
- Nature Conservation: Implementation in Scotland of the Habitats and Birds Directives: Scottish Executive Circular 6/1995 as amended June 2000;
- Wildlife and Countryside Act, 1981 (as amended);
- The Protection of Badgers Act, 1992;
- National Planning Policy Guidance (NPPG) 14: Natural Heritage;
- The UK Biodiversity Action Plan (BAP).

### **7.4.2 Scope**

The scope of the assessment includes an assessment of the following mammals with enhanced statutory protection defined above, which geographically could be present:

- Otter *Lutra lutra*;
- Water Vole *Arvicola terrestris*;
- Badger *Meles meles*;
- Pine Marten *Martes martes*;
- Wildcat *Felis silvestris*;
- Red Squirrel *Sciurus vulgaris*;
- Bats (All species).

The fieldwork for the assessment was undertaken by an experienced mammal surveyor (Mark Bates, Principal Ecologist) and was completed in August 2004. This involved a total of 2 person survey days, to ensure a comprehensive assessment.

### **7.4.3 Survey Methodologies**

Section 7.4.3 of the Environmental Statement (November 2004) describes the methods used to describe and assess the protected mammal resource within the proposed Wind Farm. The information gathered during the surveys reported there is used here to assess any potential impacts of the Amendment.

#### **7.4.3.1 Limitations**

The surveys were not considered to be subject to significant limitations (see relevant sections on each species within section 7.4.3 of the Environmental Statement (November 2004)).

## **7.5 RESULTS**

Section 7.5 of the Environmental Statement (November 2004) provides a detailed description of the protected mammal resource within the Study Area. Figure A16 shows the results of the mammal survey, and Appendix 7 (within the Environmental Statement (November 2004) document set) provides detailed target notes.

## 7.6 EVALUATION OF MAMMAL RESOURCE

### 7.6.1 Levels of Value

Section 7.6.1 of the Environmental Statement (November 2004) provides a description of the process used for assessing the nature conservation value of the protected mammal resource within the proposed Carraig Gheal Wind Farm. Sections within each of the species accounts of the Environmental Statement (November 2004) provide an overview of the legislation relating to the conservation of protected mammals and their habitats within the UK.

### 7.6.2 Evaluation of Species and Habitats

The evaluation for each species for the Amendment remains unchanged from the Environmental Statement (November 2004) and may be found in sections 7.6.2 to 7.6.8 of Environmental Statement (November 2004).

## 7.7 ASSESSMENT OF IMPACTS

### 7.7.1 Introduction

Section 7.7 of the Environmental Statement (November 2004) provides an assessment of impacts on protected mammals, for the construction, operational and decommissioning phases of the proposed Carraig Gheal Wind Farm. The following provides a review of this assessment for each protected mammal species, in light of the Amendment. Additional information is provided where impacts are predicted to vary from those previously reported.

The method of determining the scale of any impacts and significance of any effects are described in section 7.7 of the Environmental Statement (November 2004). Impacts of moderate or major significance are considered to be a *likely significant effect* as referred to in the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 1999.

### 7.7.2 Otter

The un-named loch south-west of Ban Lon (Grid Ref NM 97448 19741) approximately 50m from the nearest proposed turbine (Turbine A3), used for foraging within the study site is considered to be of Moderate Local Value, with the remainder considered to be of Negligible Value.

#### 7.7.2.1 Construction Impacts

##### Potential Loss of and Disturbance to Holts and Resting-up Sites

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not Required</b>

##### Risk of Pollution during Construction and Operations

No revision to the assessment presented within the Environmental Statement (November 2004), with a precautionary approach being recommended to prevent risk of pollution during the construction and operational phases.

<b>Impact Magnitude:</b>	<b>Potentially Medium</b>
<b>Impact Significance:</b>	<b>Potentially Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

Increased Road Traffic Injury and Mortality

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

**Impact Magnitude: Negligible**  
**Impact Significance: Low**  
**Mitigation Possible: Not Required**

Alteration of Littoral and Riparian Habitats

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

**Impact Magnitude: Low**  
**Impact Significance: Low**  
**Mitigation Possible: Not Required**

Severance of Travelling Routes

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

**Impact Magnitude: Low**  
**Impact Significance: Low**  
**Mitigation Possible: Not required**

**7.7.2.2 Impacts During Operational Phase**

Potential Disturbance to Holts and Resting Up Sites

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

**Impact Magnitude: Negligible**  
**Impact Significance: Low**  
**Mitigation Possible: Not Required**

**7.7.3 Badger**

No evidence of Badger setts, runs or latrines was confirmed during the protected mammal survey, and habitat suitability is considered to be low. The study site is currently considered to be of Negligible Value for Badger.

**7.7.3.1 Construction and Operational Impacts**

No Badger activity was recorded on the site during the protected mammal survey and habitat suitability is considered to be low. Therefore there are no predicted impacts on this species, either during the construction or operational phase of the proposed wind farm as reported within the Environmental Statement (November 2004).

**Impact Magnitude: Negligible**  
**Impact Significance: Low**  
**Mitigation Possible: Not required**

#### 7.7.4 Water Vole

No populations of Water Vole were confirmed during the protected mammal survey. Limited potentially suitable habitat was noted, in particular along the Allt na Maoile and Allt Gleann na h Airigh. However, no evidence of field signs were confirmed at these locations. The study site is currently considered to be currently of *Negligible Value* for Water Vole.

##### 7.7.4.1 Construction Impacts

###### Potential Loss of Habitat

No revision to the assessment presented within the Environmental Statement (November 2004), with a precautionary approach to the assessment of effect given the presence of potentially suitable habitat.

No signs of Water Vole were found throughout the study site. However, there are small areas of potentially suitable habitat within the study site (the Allt na Maoile and Allt Gleann na h Airigh), some of which could be negatively impacted on by the development as a consequence of access track construction. In particular, the main access track runs parallel (within 50m) with the Allt na Maoile for approximately 900m with the potential to result in loss and alteration of the associated riparian habitat. A precautionary mitigation approach is proposed, particularly given the fact that the Water Vole resource may change pre-construction.

<b>Impact Magnitude:</b>	<b>Potentially Medium</b>
<b>Impact Significance:</b>	<b>Potentially Moderate</b>
<b>Mitigation Possible:</b>	<b>Yes</b>

#### 7.7.5 Pine Marten

From the results of the mammal survey it is considered that Pine Marten are not currently present within the study site. The study site is considered to be currently of *Negligible Value* for Pine Marten.

##### 7.7.5.1 Construction and Operational Impacts

No dens (breeding or otherwise) or temporary resting-up sites were identified within the study site. Consequently, there will be no impacts during the construction or operation of the proposed wind farm as reported within the Environmental Statement (November 2004).

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not required</b>

#### 7.7.6 Wildcat

No signs of Wildcat were recorded during the mammal survey, and it is considered that Wildcat are not currently present within the study site. The study site is currently considered to be of *Negligible Value* for Wildcat.

##### 7.7.6.1 Construction and Operational Impacts

No dens (breeding or otherwise) or temporary resting-up sites were identified within the study site. Consequently, there will be no impacts during the construction or operation of the proposed wind farm as reported within the Environmental Statement (November 2004).

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not required</b>

### 7.7.7 Red Squirrel

The study site is unsuitable for Red Squirrel and of *Negligible Value*.

#### 7.7.7.1 Construction and Operational Impacts

The study site is not suitable for Red Squirrel. Consequently, there will be no impacts during the construction or operation of the proposed wind farm as reported within the Environmental Statement (November 2004).

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not required</b>

### 7.7.8 Bats

The study site is considered to be of *Negligible Value* for Bats.

#### 7.7.8.1 Construction Impacts

##### Loss of Roosts

No bat roosts were identified throughout the study area. The construction of the proposed wind farm will not therefore impact on Bat roost sites as reported within the Environmental Statement (November 2004).

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not Required</b>

##### Potential Loss of Foraging

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Potentially Low</b>
<b>Impact Significance:</b>	<b>Potentially Low</b>
<b>Mitigation Possible:</b>	<b>Not required</b>

##### Potential Loss of Commuting Routes

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not required</b>

#### 7.7.8.2 Impacts During Operational Phase

##### Collision mortality

No revision to the assessment presented within the Environmental Statement (November 2004), with a non-significant impact predicted.

<b>Impact Magnitude:</b>	<b>Negligible</b>
<b>Impact Significance:</b>	<b>Low</b>
<b>Mitigation Possible:</b>	<b>Not required</b>



## **7.8 MITIGATION RECOMMENDATIONS**

Section 7.8 of the Environmental Statement (November 2004) provides a comprehensive mitigation package in order to protect any mammal resource or habitats that may be present within the Site.

No additional mitigation measures are considered to be required as a result of the proposed Amendment.

The following summarises the mitigation proposals outlined in the Environmental Statement (November 2004):

- Site Environmental Management Procedure;
- Ecological Watching Brief;
- Pre-construction survey in potentially sensitive areas for Water Vole (on the Allt na Maoile and Allt Gleann na h Airigh);
- Limitations on working areas and methods; and
- Appropriate consideration will be given to protected mammal species during decommissioning of the site or should the turbines be replaced following the end of their operational lifetime.

## **7.9 ADDITIONAL INFORMATION: DRAGONFLIES AND DAMSELFLIES**

Anecdotal information during the assessment process has highlighted the potential presence of Brilliant Emerald *Somatochlora metallica*, a nationally rare dragonfly, within the wind farm area. In Scotland, this species breeds in sheltered mesotrophic or weakly oligotrophic lochs (generally avoiding small lochans and bog pools), containing white water-lily and bog-bean with extensive Sphagnum moss margins. Suitable breeding habitat is present at several locations within the wind farm area, including the un-named loch north of Maol Mor at NM 99302 21487 and the un-named loch south of Ban Lon at NM 97448 19741.

No detailed survey has been undertaken to assess potential impacts on Brilliant Emerald, as it is predicted that the Amendment to the proposed Carraig Gheal Wind Farm will also have no significant effects on potential breeding waterbodies.

## **7.10 ADDITIONAL INFORMATION: BUTTERFLIES**

At the request of SNH, a desk based study was undertaken to consider the potential impacts of the development on the potential suite of butterfly species on the site. A full report of this study may be found in Appendix A14 of this document.

The report concludes that the Proposed Development is unlikely to have any significant impacts on those butterfly species considered. However, it is recommended that a pre construction butterfly survey be undertaken to identify butterfly populations within the Site and guide any mitigation (e.g. micro-siting) should it be required.

## **7.11 REFERENCES**

Carraig Gheal Wind Farm Environmental Statement, GreenPower (Carraig Gheal) Ltd, (November 2004).



## **Chapter 8**

# **Ornithological Impact Assessment Amendment**

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## **Summary**

The amendment to the proposed Carraig Gheal wind farm is not predicted to result in any material changes to the original ornithological impact assessment, as presented within the Environment Statement (November 2004) Chapter 8. It may help to refer to Appendices 8a, 8b and 8c of that report.

The reduction in the number of turbines and associated access tracks within areas of open moorland will result in a reduction in disturbance, reduced habitat loss, a reduction in indirect habitat displacement effects and in a reduced risk of collision for a raptor listed on Annex 1 of the EU Wild Birds Directive.

Overall, the assessed impact significance of the amended proposal is predicted to be not significant provided that all proposed mitigation measures are adopted.”

## **8.1 INTRODUCTION**

### **8.1.1 Overview**

This Chapter has been prepared as an amendment to the original ornithological impact assessment in Chapter 8 of the Environmental Statement (November 2004). This amended assessment has been undertaken following changes to the extent of the wind farm and the location of some turbines, plus related changes in the access tracks. This amended assessment also considers concerns raised by SNH and RSPB in relation to the potential for impacts upon a raptor listed on Annex 1 of the EU Wild Birds Directive.

This chapter should be read in conjunction with the original ornithological impact assessment in Chapter 8 of the Environmental Statement (November 2004) and the related Appendices to that report (8a, 8b and 8c).

- This Section 1 explains the purpose of the assessment and who has carried it out;
- Section 2 sets out the overall methodology adopted in the assessment of the amendment;
- Section 3 reports on the assessment of the amendment;
- Section 4 outlines the proposed mitigation measures;
- Section 5 provides a summary of the ornithological assessment of the amendment.

### **8.1.2 Company Capability**

This amended assessment has been prepared by Lawrence Environmental Consultants (LEC), specialists in ecological impact assessment, with specific experience of the impact assessment of wind farm proposals in the UK.

LEC has considerable experience in the assessment of the potential ornithological effects of wind farms (more than 40 projects in the UK and Ireland since 1993) and this is supplemented by experience of the assessment of actual impacts of wind farms through post-construction monitoring surveys (Blyth Harbour since 1991; Tangy Wind Farm, Argyll and Tappaghan Wind Farm, Fermanagh, both since 2002).

The principal author of this work is:

- Simon Lawrence PhD.

## **8.2 METHODOLOGY**

### **8.2.1 Introduction**

This amendment to the ornithological impact assessment uses the ornithological survey data from the Carraig Gheal Environmental Statement: Main Report (November 2004), in conjunction with the amended proposed layout in order to re-assess the potential ornithological effects of the amended proposal.

The methodology used for this assessment is the same as that described in the Carraig Gheal Environmental Statement (November 2004): Main Report, Chapter 8, except that, based on updated guidance from the Institute of Ecology & Environmental Management in 2005 the categories “high, moderate, low” etc. of magnitude of impacts, sensitivity and their cross tabulation to derive significance have not been used in a prescriptive manner and has been replaced with the consultant’s assessment of whether significant ecological impacts are likely to occur.

## 8.2.2 Purpose

The purpose of the Ornithological Impact Assessment is to:

- Identify the potential effects of the proposed wind farm on key sensitive bird species or habitats;
- Propose what mitigation measures would be appropriate;
- Assess the residual effects if those mitigation measures are adopted.

The principal focus of the assessment is on identifying potentially significant effects on sensitive species and habitats. Significant effects are defined in Section 8.5. Sensitive species and habitats are considered to be:

- Bird species listed under Annex 1 of the EU Birds Directive;
- Bird species listed under Schedule 1 of the Wildlife and Countryside Act (1981, as amended);
- Bird species occurring in nationally or internationally significant numbers;
- Bird species that regularly migrate through the site which are recognised as being either rare or sensitive to change;
- Habitats or sites that are designated important for birds at an international level (e.g. SPAs, pSPAs, RAMSAR sites);
- Habitats or sites that are designated important for birds at a national level (e.g. SSSIs, NNRs);
- Habitats or sites that are designated important for birds at a regional level (e.g. SINCs, local wildlife sites).

However, the scope of works also recognises the protection provided for all wild birds under the Wildlife and Countryside Act (1981, as amended).

In addition to identifying appropriate mitigation measures (avoidance, reduction and compensation of impacts), the assessment also identifies opportunity for enhancement.

The Ornithological Impact Assessment played an important part in defining the original design of the proposal. The amendment to the layout and the reduction in turbine numbers has taken place arising directly from consideration of potential sensitivities on Annex 1 bird species.

## 8.3 ASSESSMENT OF AMENDMENT

### 8.3.1 Summary of Impact Assessments

The evaluation focuses on the key bird species and the overall quality of the moorland bird community. Professional judgement is employed to decide on the significance or non significance of the amended proposal.

#### 8.3.1.1 Red-throated Divers

Alterations to the location and access tracks for wind turbines A8, A9, A14, A15, A18 relevant to the diver breeding area are minor (<50m) and these changes do not alter the conclusions on residual effects of the Environmental Statement (November 2004).

Red-throated Divers bred successfully in one of the three years of species- specific surveys and switched between lochs in different summers. They are an important component of the upland bird community in local, regional and national terms and are classified as of *moderate sensitivity* (Appendix 8c, Table 8c-1). Based on the site

selection criteria at the landscape scale, there are relatively few 11km<sup>2</sup> blocks of moorland in the 60 km<sup>2</sup> to the east of Oban that would have no diver sensitivity. Thus the selection of the Carraig Gheal site is relatively typical of surrounding terrain.

Within a distance of 300m to a nest site the activity of machinery and people is likely to lead to direct disturbance and nest failure (a temporary adverse impact of *high magnitude*). This can be mitigated by the maintenance of a 300m distance to the nearest sections of the development and the scheduling of works outside April to September if within the 300m. The resultant residual effect is classified as not significant.

Based on the accumulated flights over the moorland at Fernoch there would be a direct effect of high magnitude via bird strike for wind turbines placed east and north east of Carraig Gheal. This can be mitigated by a site design for the wind turbines that accommodates the bird's access to Loch Nant to the north east and to the Sior Lochs to the north west of the study area. In addition, as a precautionary measure this constraint zone should be extended to cover potential flights to and from Loch Awe - the southeast sector. These constraints were taken into account in the final project layout. The frequency of diver flights over the final proposed development area and turbine locations for Carraig Gheal was relatively low c.f.<sup>1</sup> and the predicted collision risk is estimated to be one bird every 30 years<sup>2</sup>. The residual effect is classified as permanent and of *low magnitude* and therefore *not significant*.

The potential overall indirect effect of the proposal in terms of unrestricted visitor disturbance is predicted to be of *moderate* to *high magnitude*. This effect could be mitigated by the provision of information to minimise human disturbance to the sensitive parts of the site during the breeding season. The residual effect is classified as *low* and therefore *not significant*, given the sensitivity of the receptor as *moderate*.

The potential for pollution of water bodies could lead to indirect habitat loss over the short or medium term. Such an effect of the proposal is predicted to be of *moderate* to *high magnitude*. This effect could be mitigated by the stipulation of re-fuel locations away from the sensitive water catchments. The residual effect is classified as *low* and therefore *not significant*, given the sensitivity of the receptor as *moderate*.

Based on the potential interaction of a number of the low residual effects, it would be prudent to undertake positive management measures that would lead to potential for increased breeding output of the local diver population. These recommendations are included under general mitigation measures in the following section.

### 8.3.1.2 Golden Eagle

Alterations to the location and access tracks for seven wind turbines A4, A5\* 12\*, 13\*, 14\*, 20\* & 24) relevant to the Golden Eagle range are significant and these changes alter the conclusions on residual effects of the Environmental Statement (November 2004). These are the removal of turbines 12, 13, 14 and 20 (in the original layout) and the relocation of turbines A4, A5 and A20 (formerly turbine 24). The amended design reduces the original site envelope of c. 300ha by c. 20%.

The neighbouring pair of Golden Eagles is an important component of the upland bird community in local, regional and national terms and are classified as of *high sensitivity* (Appendix 8a, Table 8a-3).

The site selection criteria place the 11km<sup>2</sup> block of moorland at Carraig Gheal equidistant from array of occupied Golden Eagle territories in this sector of Argyll. Thus the selection of the Carraig Gheal site towards the periphery of known ranges is predicated on the potentially less sensitive terrain for this species.

Based on this species' preference for uplands with low human activity, there is predicted to be a temporary avoidance of sections of the site during the more intense periods of construction (which will be sequential and episodic in nature over 12 months). This represents an indirect loss of habitat of a temporary nature. Since the frequency of use of this moorland was low, the effect is classified as *low magnitude*, and *not significant* on the viability of the adjacent pair of Golden Eagles.

The effect of permanent habitat exclusion for Golden Eagles from parts of the moorland at Carraig Gheal is predicted to be of *low magnitude* for their survival and of *low magnitude* for the viability of the regional or UK population. In the context of

the wider moorland in this part of Lorn, the amended project encompasses a smaller moorland envelope. The marginal effect in terms of the existing low frequency of habitat use by the nearest breeding pair is predicted to remain as assessed in the Environmental Statement (November 2004).

The range of collision rates predicted from theoretical collision models for the original 24 wind turbines, indicates a low accumulated frequency of collisions over the life span of this project (1 collision per 13 years on a precautionary 95% avoidance assumption; or 1 collision per 162 years on a 99.6% avoidance rate- based on US data). The amended design with 4 fewer wind turbines has been assessed to give a collision rate of between 1 collision per 15 years to 1 collision per 195 years for the two avoidance rates above respectively. A pro-rata basis for the analysis assumes equal usage of the entire site. Over the short time of monitoring at the two Scottish wind farm sites relevant to Golden Eagles the current avoidance rate is likely to be 100%<sup>3</sup>. The overall ecological effect of collisions that might arise from the proposal on this species is classified as *not significant*.

The direct effects of land take of the proposal are not expected to result in a measurable or significant change in the prey resource available on site for Golden Eagles. The land take of the amended design is c. 20% less than the original proposal. From monitoring in upland sites with wind turbines in the UK there has been no evidence for the medium or long-term reduction in the abundance or distribution of their main prey- Rabbits, Mountain Hares or Red Grouse.

There is an opportunity to undertake positive management measures that would potentially lead to increased breeding output of the local eagle population. These recommendations are included under general mitigation measures in the following section.

### 8.3.1.3 Merlin

The amended site layout involves minor to negligible changes in relation to the sensitivities associated with breeding Merlin at this site. Turbine A19 is located 50m closer and A15 is 50m more distant.

The pair of Merlin that breed intermittently within the survey area are an important component of the upland bird community in local, regional and national terms. They are classified as of *moderate sensitivity* (Appendix A8a-3).

The site selection criteria of the 11km<sup>2</sup> block of moorland at Carraig Gheal lies partly on an array of Merlin nest sites in this sector of Argyll. There are approximately an equal number of similar sized blocks of moorland without known Merlin breeding sites in the zone of search. This is based on the assumption that there are no undiscovered nest sites, which is unlikely. Thus at the landscape scale of site selection, the amended Carraig Gheal site lies on or near to potentially sensitive terrain for this species.

The probability and magnitude of a significant and measurable disturbance effect would be high at distances closer than 300m to a nest. This effect is likely to be more pronounced during the construction activities compared with those associated with the operation phase. There would therefore be the potential for a temporary, adverse effect of *high magnitude* on this *moderate sensitivity* receptor. This can be mitigated by both a timing constraint and a site design to include a set back distance of 300m. It is recommended to adopt a breeding season timing constraint for the construction phase of the nearest three wind turbines (A15, A18 & A19). If this mitigation is adopted the residual effect is predicted to be *not significant*.

The original site design recommendations apply to (and are incorporated in) the amended site design and these cater for the alternative nest locations. There is predicted to be no significant direct or indirect effect of the amended wind farm layout on the selection of this pair's alternative breeding sites.

The potential for displacement from the moorland associated with the highest areas of their activity is classified as a permanent effect of moderate magnitude. In mitigation it is recommended to design the wind farm to maintain an area without the built infrastructure in this constraint zone. This avoidance has been adopted in the amended project layout. On this basis the residual effect on the viability of this breeding pair is predicted to be *non significant*. With a reduction in site envelope of



the amended project, there is anticipated to be a *low magnitude*, permanent effect of habitat displacement from the wider area of moorland that is used by this pair. The project is therefore predicted to result in an effect on their breeding success at this site, classified as *not significant*.

The direct effects of land take of the amended proposal are not expected to result in a measurable or significant change in the prey resource available on site for the Merlin. From monitoring in upland sites with wind turbines in the UK there has been no effect on the abundance or distribution of their main prey, Meadow Pipits and Skylarks.

The predicted collision rate over the life span of the amended project is predicted to be very low for this species (on the assumption that all 94s of flights recorded took place at rotor height- 1 collision per 12 years on a precautionary 95% avoidance assumption; or 1 collision per 148 years on a 99.6% avoidance rate- based on US data for other raptor species). The overall ecological effect of collisions that might arise from the proposal on this species is classified as *not significant*.

#### 8.3.1.4 Golden Plover

The amended site layout involves changes in relation to the potential sensitivities associated with one of the two breeding locations for Golden Plover at this site: wind turbines 12 & 14 are removed from the amended application.

The breeding pairs of Golden Plover that breed within the survey zone are important components of the upland bird community in local and regional scales. They are classified as of *moderate sensitivity* (Appendix 8a, Table 8a-3).

The probability and magnitude of a significant and measurable disturbance effect could be moderate at distances around 150-250m to a nest. This effect is likely to be more pronounced during the construction activities compared with those associated with the operation phase. There would therefore be the potential for a temporary, adverse effect of high magnitude on this moderate sensitivity wader. This can be mitigated by both a timing constraint and a site design to include a set back distance of 250m. It is recommended to adopt a breeding season timing constraint for the construction phase of the nearest three wind turbines (A11, A12, & A16 and southern anemometer mast). The residual effect is likely to be of *low magnitude* and therefore *not significant*.

Wind turbine numbers A16 and A12 potentially lie closer than 250m to one or both territory centres. In terms of this species reaction over the medium to long term to operational wind turbines, there would be the potential for a permanent, adverse effect of *low to moderate magnitude* on this *moderate sensitivity* wader.

There would be a small reduction in landtake of the amended proposal due to the removal of wind turbines 12 & 14. The direct effects of land take of the amended proposal are expected to result in a *low magnitude* loss of habitat available over the sector of the site where they breed. This effect is classified as *not significant*.

The indirect effects of the amended proposal are expected to result in a permanent, *low magnitude* change to some of the habitat types selected for breeding by this species. The main feature in mitigation is the amended site layout that avoids the most sensitive hydrological features. The residual impact is classified as not significant.

The potential for pollution of water bodies could lead to indirect habitat loss over the short or medium term. Such an effect of the proposal is predicted to be of moderate to high magnitude. This effect could be mitigated by the stipulation of re-fuel locations away from the sensitive water catchments (e.g. bog pools). The residual effect is classified as *not significant*.

The predicted direct effect of the amended wind farm in terms of bird strike on Golden Plover is classified as *low magnitude* and therefore the proposal is predicted to have an effect that is considered *not significant*.

There is the potential interaction of a number of the low and medium residual effects listed above. It is recommended to undertake positive management measures that would lead to increased breeding output of the local population. These

recommendations are included under general mitigation measures in the following section.

#### **8.3.1.5 Other species**

Individual pairs of Little Grebe, Red Grouse, Snipe and Wheatear breed within or on the edge the site area (Environmental Statement (November 2004), Figure 17). There are anticipated to be no residual significant direct or indirect effects of the proposal if the mitigation measures listed above are enacted. Skylark breed within the development zone that includes the proposed access track route. There would be the potential for a low magnitude effect through the direct loss of a proportion of the nest sites if construction took place in summer. Without mitigation this temporary effect would not result in a significant decline in the local population.

#### **8.3.1.6 Habitat quality**

The site at Carraig Gheal is not part of an internationally or nationally designated site or proposed site (i.e. SPA, SAC, SSSI).

The 11km<sup>2</sup> surveyed at Carraig Gheal supports an upland bird community that is typical of the 60km<sup>2</sup> to the east of Oban. Based on the 1991 surveys and when taken as a single, large land unit the latter area supported an upland bird community that was of SSSI quality (high sensitivity). When assessed in its own right the moorland at Fernoch farm would not reach the wading bird density criteria for selection as an ornithological SSSI. In addition it lacks a variety of species listed under Schedule 1 of the Wildlife & Countryside Act 1981 or within the EEC's Bird Directive. The assemblage as a whole at Fernoch achieves a score of 25.5 that is below the threshold of 45 for consideration of SSSI quality<sup>4</sup>.

Based on the magnitude of the residual combined direct and indirect effects on individual species listed above there is anticipated to be no major change to the moorland bird community on this site. Thus there is anticipated to be no significant effect on the integrity of the wider 60 km<sup>2</sup> and its classification as potentially of SSSI status.

#### **8.3.1.7 Cumulative effects**

At the regional scale within Argyll there are five operational wind farms within broadly similar habitats. There are also a cluster of three wind turbines on lowland farmland on the Isle of Luing and two on Gigha. Due to the sensitive nature of information on Schedule 1 listed birds the full baseline information on all the projects is not available in the public domain, which limits the current assessment. As yet, with short term monitoring, there are no examples where individual wind farms have resulted in significant local, regional or national declines in sensitive bird species. Theoretically, based on the precautionary principle, then the long term effects of the current wind farms in Scotland should be monitored in order to identify any significant impacts on birds. The mechanisms by which individual wind farms could result in cumulative effects relate to low collision rates, subtle examples of habitat exclusion and the interaction of different low or medium magnitude effects. Under certain circumstances, the cumulative result could alter the population viability of some species over the whole of Argyll.

For the regional population of Black and Red-throated Divers (8-12 and 50-100 pairs in Argyll respectively) three of the five wind farms incorporated habitat gain or mitigation features. The residual effects on the latter species of diver from the amended Carraig Gheal proposal are unlikely to result in a significant adverse, cumulative decline in the viability of the regional population.

For the regional population of a maximum of 62 pairs of Golden Eagle three of the five wind farms include site design and mitigation features for this species. The emerging and preliminary findings suggest that wind farms may represent an impact of habitat exclusion<sup>5</sup>, although contradictory results have been recorded elsewhere. There have been an unknown number of wind farm proposals within Argyll that have been retracted or relocated by reference to proximity to breeding Golden Eagle sites. The residual effects on this species from the amended Carraig Gheal proposal are unlikely to result in a significant adverse, cumulative decline in the viability of the regional population.

For species such as Hen Harrier and Short-eared Owl none of the five projects were assessed as having the potential to change these regional populations. One wind farm site has accommodated breeding at close proximity by the above two species. They are not present within the survey area for the amended Carraig Gheal proposal and therefore there can be no cumulative effect on their regional populations.

None of the existing wind farms were known to support breeding Merlin and therefore cumulative effects of the amended Carraig Gheal development are not anticipated on this aspect. In the absence of observations, there may be the potential for subtle habitat or collision risk effects that cumulatively affect Merlin as they forage over wide areas of moorland that could include the existing wind farms. The potential magnitude of such a permanent, direct cumulative effect is classified as very low.

None of the five projects involved specific mitigation measures for upland waders (other than site selection and alterations to site layout). This reflects the general lower sensitivity of this upland group of birds in Argyll and in some cases site selection away from known breeding sites. The residual effects on Golden Plover predicted for amended Carraig Gheal project are not repeated at the other five sites and therefore there is no significant cumulative effect.

None of the five projects were assessed as having the potential for significant effects on migrant birds. Carraig Gheal is anticipated to add a very small magnitude, cumulative, direct loss of, for example nocturnal migrants to the other wind farms. However the biological significance of this cumulative effect would be negligible on the receptor species.

A single existing project is sited adjacent to a SPA for wintering geese and the remaining four projects are remote from nationally designated bird sites. Thus the potential for significant cumulative effects on sites designated for ornithology in Argyll is classified as remote.

## **8.4 SUMMARY OF MITIGATION**

### **8.4.1 Purpose of Mitigation**

Mitigation measures are designed to off-set the potential deleterious effects that could arise from the installation of the wind farm and associated infrastructure in the wider survey area. These are summarised in Appendix 8c and relate to potential effects where these rate as significant. The aim is to maintain the ornithological biodiversity of the site and hence render the potential effects non-significant.

### **8.4.2 Generic Approach to Mitigation**

The aim is to undertake sufficient measures in line with the likely magnitude of changes on each of the key species or habitats. Where possible site layout design changes have been recommended in order to safeguard the local sensitivities and these have been adopted in the amended proposed design.

### **8.4.3 Mitigation Proposals**

#### **8.4.3.1 Mitigation Inherent in Project Design**

The location of the project in the wider landscape of this region of Argyll is one factor that seeks to mitigate effects on key species. At the local scale, the amended site design and associated access route have taken into consideration key sensitive nest sites, territories (range use) and flight access routes. In particular the amended layout includes the removal of wind turbines and set back of re-positioned wind turbines from moorland that has the potential to be used by raptors. Compared with the original design, the reduced number of wind turbines of the amended project and corresponding reduced envelope will reduce the potential effects. The nature of this type of development introduces relatively few forms of emission to the environment and those with the potential to occur can be controlled and managed with known techniques.

#### **8.4.3.2 Generic Construction Mitigation**

Best practice methods are advised in order to mitigate for the potential for disturbance to nest sites, breeding territories and flight routes. This includes the timing and frequency and relatively short duration of construction activities. It is advised that contactors are fully briefed as to the site's sensitivities and this includes the avoidance and emergency procedures associated with pollution events. The full range of guidance and regulations should be incorporated within a construction method statement and managed through the Site Environmental Management Procedures. The flexibility for micro-siting construction activities will be used to maintain small features of local value.

#### **8.4.3.3 Generic Operational Mitigation**

The low frequency of operation and maintenance activities will mitigate for the potential for disturbance/displacement of the key species. The nature of sound production for the operational plant is currently understood not to affect birds in an upland environment.

#### **8.4.3.4 Specific Mitigation Measures**

It is recommended to deploy and maintain three or more artificial nest rafts on lochs in the surrounding area and to undertake predator control of mink and hooded crows. It is recommended to introduce some control over the expanding feral population of Canada Geese in the area, as they may reduce the breeding success of a range of the native species of wildfowl. Over the project lifespan these measures would be expected to result in a greater number of Red-throated Diver young produced from the local area in comparison to that without the habitat management associated with the proposal. Thus with mitigation the residual effects of the proposal are rated as neutral or of low positive significance. There may also be benefits to the breeding rate of Black-throated Divers in the local area since they are known to utilise artificial nest rafts<sup>6</sup>.

Over the medium to long term it is recommended to safeguard the native woodland associated with stream sides and gorges since there are relatively few options for the use of crows nests by Merlin in the surrounding moorland. The opportunity to expand the native woodland should be explored in line with the existing pastoral land use.

To minimise disturbance, it is recommended that the summer timing construction constraints are applicable for the north eastern portion of the development in respect of merlin and divers. This would maintain a wide zone around the group of lochs to the northeast of Carraig Gheal for the benefit of birds of prey, divers and other species of wildfowl that were recorded.

It is recommended to implement a breeding bird timing constraint for the construction phase for the tracks and foundations closest to the two Golden Plover territories. Flexibility is also required and an ecological clerk of works should be appointed to identify the relevant sensitive territory locations prior to construction and amend the constraint areas noted above. The potential for predator control should be explored to increase the breeding success of all ground nesting birds (grouse, waders, merlin, and passerines).

The grazing regime will be analysed and adjusted to enhance the moorland habitats both for the intrinsic botanical value and also to increase the capacity to support prey for raptors. In order to ensure measurable changes this should be undertaken over as large an area as possible. It is recommended to employ the PAT model for Golden Eagles in order to identify the optimum locations for habitat enhancement/restoration and that this could include some of the surrounding forestry. In particular the aim should be to produce a mosaic of ages and classes of heather, reduce grazing off-take from the base rich grassland and heath to the north east of the development and enable scrub to develop in some localities. The carrion resource should be monitored and managed both within the wind farm area and off site for the benefit of Golden Eagles.

It is proposed to undertake post construction monitoring of the key bird species and associated mitigation measures.

## **8.5 SUMMARY**

The field surveys and desk-top assessment concluded that the key species for which there was potential for significant effects from the wind farm were:

- Merlin;
- Red throated diver;
- Golden eagle; and
- Golden plover.

The assessment determined that the location of turbines and access tracks was very important to avoid the potential for moderate to high magnitude impacts to key species from direct disturbance during construction and operation as well as bird strike. The final amended layout has accommodated layout changes to reflect these sensitivities.

The assessment put forward key recommendations to facilitate the implementation of mitigation measures. On the assumption that all mitigation measures are followed, the assessment concluded that all residual impacts would be not significant.

## **8.6 REFERENCES**

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<sup>1</sup> Scottish Power (2002a) Environmental impact statement for the Inverliever windfarm proposal.

<sup>2</sup> Based on SNH Band et. al. collision model, with precautionary 95% avoidance rate, with the accumulated observed flight time of divers at risk height within the wind farm development area.

<sup>3</sup> Walker, D, McGrady, M., McClusky, A., Madders, M. and D.R.A. McCloud 2005: Resident Golden Eagle Ranging Behaviour before and after construction of a wind farm in Argyll (Scottish Birds 25, 24-40).

<sup>4</sup> NCC (1989) Guidelines for the Selection of Ornithological SSSIs.

<sup>5</sup> McGrady M.J. & Grant J.R. (1995) Report on the reproduction and movements of eagles in the Glen Nant/Glen Lonan area of Argyll 1991-1993. Unpublished report RSPB Edinburgh.

<sup>6</sup> (D. Merrie pers. comm.. 2004)



## **Chapter 9**

# **Hydrology Impact Assessment**

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## Summary

The loss of 5 turbines, the addition of one new turbine and the slightly modified locations of a further 12 turbines and associated access track and cable trenches in the amended layout results in a net reduction of 2.94km of track and cable trenches, including a net loss of three track crossings of small areas of peat mire. These modifications mean that the overall hydrological impact will be reduced, particularly in relation to streams and waterbodies to the south and south west of the site.

This assessment of the amended Carraig Gheal Wind Farm layout has confirmed that the seven types of potential hydrological impacts identified in the Environmental Statement (November 2004) are still appropriate for the amended layout. The standard and specific mitigation measures proposed, including the use of strict codes of working practices in proximity to streams and peat mires and the use of floating track designs on areas of wet peat mire is assessed to prevent any adverse impacts and reduce the residual impact to a level of minor or negligible. These levels of residual impact are considered to be acceptable for the project.

The assessment concludes that once mitigation measures have been implemented, no significant adverse impacts will occur in relation to hydrology and that the amended layout will have a slightly lesser overall impact on site hydrology than that originally proposed.

## 9.1 INTRODUCTION

This chapter evaluates the amendments to the Proposed Carraig Gheal Wind Farm in relation to their impact on the surveyed site hydrological conditions and any previously omitted impacts. This chapter should be read in conjunction with Chapter 9 of the Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report.

This chapter contains two main sections: (a) an analysis of site hydrology conditions in relation to the new wind farm layout and (b) a re-assessment of potential hydrological impacts in relation to the Amendment.

### 9.1.1 Company Capability

The Environmental Advice Centre (EAC) was contracted to carry out a hydrological impact assessment of the proposed Carraig Gheal Wind Farm, south of Taynuilt, Argyll, Scotland. EAC Ltd is a private, multidisciplinary environmental consultancy, employing 20 members of staff in two offices located in North Wales and Northern England. Although EAC is a young company (only 5 years old) seven of the senior consultants have, between them, over 115 years of environmental consultancy experience both in the UK and worldwide. EAC staff have provided hydrological impact assessments for over 15 different wind farm projects throughout the UK and the Republic of Ireland.

### 9.1.2 Methodology

This amendment to the hydrological impact assessment uses the hydrological baseline conditions surveyed for and presented in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report, together with the amended layout for the Proposed Carraig Gheal Wind Farm, to re-consider all of the hydrological issues which were assessed in the Environmental Statement (November 2004).

The methodology used for this re-assessment of hydrological impacts, including the evaluation of value/sensitivity and the significance of impacts, is the same as that described and used in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report, Chapter 9.

This hydrological assessment for the amended layout identifies, describes and re-assesses all impacts which were assessed in the Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report. As in that report, all impacts assessed as being of moderate or major significance are considered to require mitigation. Similarly, all residual impacts whose significance is assessed as being minor or less after implementation of mitigation are considered to be acceptable for the project.

For each impact which was described and assessed in the Environmental Statement (November 2004), both the original level of impact significance and the re-assessed level of impact is provided.

## 9.2 ANALYSIS OF AMENDMENT

In the Amendment, there are no changes to the locations of the substation control room, temporary construction compound, borrow pits or stone crushing activities. For ease of discussion, the analysis of amendments in relation to hydrological conditions is divided into two parts: those relating to changes in turbine location and those relating to changes in routes of access tracks (and associated cable trenches). Since a total of 5 turbines have been lost from the layout and one new turbine location added, this assessment will refer to the new turbine layout numbers prefixed by the letter "A". Where an "old" turbine number is referred to, this will be prefixed with letter "T" (see Amendment Figure A2 and the Hydrology Amendment Figures A18a and A18b).

A two-part summary of the analysis of the amended layout in relation to hydrological conditions is provided in Tables 1 and 2 at the end of this Section.

### 9.2.1 Analysis of changes to the locations of turbines

This section provides a description of the location of all turbines in each of four hydrological sections of the new layout. The descriptions of soil, peat and vegetation conditions are not reproduced here since they remain the same as in the Environmental Statement (November 2004).

#### 9.2.1.1 Around Ban Lon (A1, A2, A3; A6, A7, A8, A9, A10)

Three turbines (A1, A2 and A3) lie along the SE facing flank of Ban Lon. The location of A2 remains unchanged to ensure avoidance of any adverse impacts on the hydrology of a wet peat mire to the west. The locations of A1 and A3 are very slightly modified but both new locations lie outside identified zones of hydrological sensitivity.

The locations of both A6 and A7 have been moved south west by approximately 250m and 400m respectively from the original locations of T7 and T8. Both new locations avoid any area of hydrological sensitivity, with A6 located beyond the edge of a peat mire. Micrositing in advance of site construction will ensure that the optimum location is chosen for this turbine to avoid any hydrological impact on the mire.

A new turbine is located at A8. This location lies beyond the north easterly edge of a peat mire and uphill and over 200m north west of an area of flush feeding the headwaters of a small stream which is a tributary of the Allt na Maoile. Since it avoids these areas, no effects on hydrology are anticipated.

The locations of A9 and A10 remain unchanged and hence the hydrological impacts are the same as those outlined in the Environmental Statement (November 2004).

#### 9.2.1.2 Carn Dearg south to Inverinan Forest (turbines A4, A5, A11, A12; T5, T13, T12, T14 and T20)

The new location of A4 has been moved slightly north east. There are no new hydrological implications of this location. The new location of A5 is around 200m uphill to the south west of the old T6. There are no hydrological implications associated with this site.

Five turbines have been removed from this southern and south western part of the site: T5, T13, T12, T14 and T20. The removal of these five turbines will result in a reduced overall hydrological impact due to less excavation, reduced potential for dewatering of heathland plant communities, less generation of spoil, less vehicle/heavy plant/mechanical activity and less potential for off-road trafficking and fuel spillages.

The new location of A11 has been very slightly moved west compared to the original location of T11. This location lies outside the hydrologically sensitive zones of two small streams and has slightly less potential to impact on hydrology than the original location.

The new location of A12 is the same as the original T15 and hence there are no different hydrology effects.

**9.2.1.3 Around Carraig Gheal (turbines A16, A17, A18, A19, A20)**

The locations of A16 and A17 are unaltered from the locations of T19 and T21 respectively. There are thus no new hydrological effects associated with these turbines.

The new location of A20 is approximately 150m north east of the original T24, slightly upslope and hence beyond the edge of the large peat mire and pool complex to the east. The micrositing exercise prior to construction will determine the exact location for this turbine to ensure avoidance of any hydrological effects.

The location of A19 has been moved slightly north east of the original T23. This new location lies in an area of relatively shallow (approximately 50cm) peat over rock. The location of A18 has been moved slightly east of the original T22. Neither new locations have any different hydrological effects compared to the original locations.

**9.2.1.4 North/Central Section of the Site (turbines A13, A14, A15)**

The locations of A13 and A14 remain the same as the original T16 and T17, respectively, and hence there are no new hydrological effects. The location of A15 lies slightly south west of the original T18, upslope and well away from any areas of hydrological sensitivity. There are no different hydrological effects associated with the revised locations of turbines in this group.

**9.2.2 Summary of altered turbine locations in new layout**

A summary of the altered turbine locations in the new wind farm layout is provided in Table 1 below.

**Table 1. Summary of likely effects of the amended wind farm turbine layout on site hydrology**

Type of change	No. of turbines	Turbines	Effect on hydrology
<b>Turbines removed</b>	5	Loss of "old" T5, T12, T13, T14 and T20.	Reduced overall hydrological impact due to less excavation, reduced potential for dewatering of heathland plant communities, less generation of spoil, less vehicle/ heavy plant/ mechanical activity (less potential for off-road trafficking and fuel spillages) .
<b>No change to turbine location</b>	7	A2, A9, A10, A12, A13, A14, A17.	None.
<b>Very Slight modified location of turbine</b>	8	Slight modified location for A1, A3, A4, A11, A15, A16, A18, A19	None
<b>Movement of turbine &gt;100m</b>	4	Moved location for A5, A6, A7, A20,	None
<b>New turbine location</b>	1	New A8	None

**9.2.3 Analysis of changes to access tracks and associated cable trenches**

**9.2.3.1 Alteration to on-site access tracks**

The amended layout mainly uses the original route of the access track which was assessed in the Environmental Statement (November 2004). The sections below discuss alterations to that route and any possible hydrological implications.

There are no changes to the access track from the site entrance to the location of turbine A1. Since this track location and length remains identical to that described in the Environmental Statement (November 2004), there are no changes to the hydrological impact.

There are 8 locations where the proposed routing of the access/connecting track is altered compared to the original track layout described in the Environmental Statement (November 2004). These locations and their hydrological conditions are described below.

#### **9.2.3.2 Connecting track between A1 and A7**

The new route between A1 and A7 follows a shorter, more direct route, cutting off a loop which impinged on a small peat mire to reach "old" T8. Although the new route also unavoidably impinges on the same mire, the length of track is reduced by approximately 400m. There are thus similar types of hydrological impact to those identified in the original Environmental Statement (November 2004) but the extent of these impacts is reduced.

#### **9.2.3.3 Connecting track between A4, A5 and A11**

The shorter track to the new location of A4 combined with the re-routing of the track to A5 and on to A11 results in a net loss of approximately 100m of track. Between A3 and A5 this new route crosses the same peat mire crossed by the original track route but in a slightly different location. The same stream crossing (location B) just south west of A11 is also crossed by this re-routed track. Thus, there are identical types of hydrological impacts to those identified in the original Environmental Statement (November 2004) but the extent of these impacts is slightly reduced.

#### **9.2.3.4 Connecting track between A11 and A12**

A new, shorter spur track connects A12 to the main track. This new route results in a net loss of approximately 480m of track. No hydrologically sensitive areas are crossed by the new route and no new hydrological effects are anticipated.

#### **9.2.3.5 New connecting track to A8**

A new connecting spur track to the new turbine A8 adds a further 110m of track which crosses an area of flush which supplies the headwaters of a small stream leading into the Allt na Maoile. The small area where the track crosses the flush has been identified as a hydrological sensitive area and appropriate working practices (outlined in the Environmental Statement (November 2004)) will be adopted.

#### **9.2.3.6 Connecting track between A6 and A11**

The re-routing of the track to service A6 adds a very small extra length of track (approximately 50m). This track route runs along the border of a peat mire and appropriate working practices (outlined in the Environmental Statement (November 2004)) will be adopted.

#### **9.2.3.7 Connecting track between A6 and A7**

The connecting track between A6 and A7 follows a new route compared to that described in the Environmental Statement (November 2004). The new route lies very slightly to the west of the old route. This is beneficial with respect to site hydrology since the track borders the north west edge of a large peat mire and the new route places the track further from the mire.

#### **9.2.3.8 Connecting track between A12 and A17**

The new connection track through a flat basin area containing areas of wet, deep (>50cm) peat mire and pools adds 600m of new track. This route also adds a further stream crossing constraint site and crosses an area of peat mire identified as a hydrologically sensitive area. Similar hydrological impacts will be associated with the construction of this track as were identified for other stream crossing points and areas of peat mire in the Environmental Statement (November 2004).

#### **9.2.3.9 New track spur at A14**

A small track spur is proposed at A14 to prevent the need for a tight bend in the track at this point. The overall length of track is the same as in the original layout and no new hydrological impacts will occur.

**9.2.3.10 Removed stretches of track and cable trench**

The removal of five turbines from the south western end of the site will result in the net loss of 2.94km of track (for exact stretches of track lost see the summary in Table 2 below).

## 9.2.4 Summary of altered track and cable trench locations in new layout

A summary of the altered track and cable trench locations in the new wind farm layout is provided in Table 2 below.

**Table 2. Summary of likely effects of the amended wind farm access track layout and cable trench on site hydrology**

Loss or addition of track	Site location	Access tracks	Length of track (m)	Explanation	Effect on hydrology
	Site entrance track	No change		No change	No changes
loss	South west	Loss of track connecting "old" T5, T13, T12, T14, T20	-2750	Loss of turbines and resultant loss of connecting track	<b>Overall loss of 3.70km of access track</b> will result in reduced overall hydrological impact due to less excavation, reduced potential for dewatering of heathland plant communities, less generation of spoil, less vehicle/ heavy plant/ mechanical activity (less potential for off-road trafficking and fuel spillages) .
loss	North east	Loss of looped connecting track between A1 and "old" T8/A7.	-400	Shorter connecting track	
new	South west	New connecting track between A4, A5 and A11	Net -100	Net loss of track length since the new track reduces the length of a Y-junction.	
new	South west	New connecting track between A11 and A12	Net -480	Net loss of track due to shorter connecting spur	
new	North east	New short connecting track between A1 and A7	+110	Shorter connecting track	<b>Overall addition of 160m of new access track.</b> Neither of the new stretches of track have further hydrological effects.
new	Centre	New short connecting track between A6 and A11	Net +50	Slightly longer looped connecting track	
new	South west	New connecting track between A12 and A17	+600	New connection track through a flat basin area containing peat mire and pool complex.	<b>Addition of 600m of new track.</b> This route adds a further stream crossing constraint site and an area of peat mire.
new	North	New spur track at A4	Net 0	New spur track to A4 to cut off a track loop	None
new	Centre	New routing of connecting track between A6 and A8.	Net 0	Slight re-routing of track does not alter overall length.	Beneficial to hydrology since new route lies slightly further from a peat mire

Approximately 3.70km of access track and cable trench have been removed from the new layout. Approximately 760m of new track will be added to service the slightly modified turbine locations. This amounts to a *net loss* from the proposal of the Environmental Statement (November 2004) of approximately 2.94km of access track.

### 9.3 ASSESSMENT OF IMPACTS

The hydrological assessment in the Environmental Statement (November 2004) contained four sections:

- (a) Description of the types of effects that excavation activities can have on peat hydrology;
- (b) Description of the different potential hydrological impacts during each phase of the wind farm project:
  - (i) The construction phase;
  - (ii) The operational phase;
  - (iii) The decommissioning phase.

For the amended wind farm layout, all types of effects caused by excavation activities are still appropriate and only part (b) above, pertaining to impacts caused during the construction of the wind farm, during its operation and during the decommissioning need to be re-considered here. These re-assessments are provided below.

#### 9.3.1 Potential Impacts during the Construction Phase

Seven types of potential hydrological impacts during the construction phase were identified in the Environmental Statement (November 2004). The reassessment of impacts associated with the proposed wind farm in light of the new layout will not change the different *types* of hydrological impacts compared to those described for the original layout. In the amended layout, all seven types of impact are still relevant.

The following section assesses each of the modified turbine, track and trench locations to confirm whether there are any changes to the assessment of impact significance.

##### 9.3.1.1 Changes to turbine locations

Overall, 5 turbines will be lost and one new turbine added to the layout which was submitted in 2004, resulting in the new layout containing 20 turbines and associated connecting track. The loss of these 5 turbines will have the effect of reducing the overall amount of excavation, spoil generation and heavy plant movements. Although none of the turbine locations to be lost lay close to any hydrological constraint site or hydrologically sensitive area, there will be an overall reduced potential for dewatering of peaty soils and associated heathland communities as well as a reduced potential for sediment and surface runoff from excavated spoil.

There are no changes to the location of 7 turbines. These are turbines: A2, A9, A10, A12, A13, A14 and A17. There is no change to the hydrological impact assessment for these locations.

Small modifications to the location of 12 turbines are likely to cause a small reduction in the overall hydrological impact. For all 12 of these turbines, (turbine numbers A1, A3, A4, A5, A6, A7, A11, A15, A16, A18, A19 and A20) the modified locations will have identical types of impacts (and hence no additional effects on site hydrology) to those assessed in the Environmental Statement (November 2004).

The addition of one new turbine location (A8) will have the effect, during the construction phase, of adding slightly to the existing hydrological effects identified in the Environmental Statement (November 2004). No new types of hydrological effects will occur.

##### 9.3.1.2 Changes to access tracks and associated cable trenches

Overall, with the loss of 5 turbines and the addition of one new turbine, the length of access track construction and associated cable trench excavation has been reduced by approximately 2.94km. This overall reduction of track and associated cable trenches in the new layout will reduce the general hydrological impact associated with runoff from the tracks and cable trenches and possible erosion of nearby peaty soils.

Although there are five locations associated with turbines A4, A5, A12, A6 and A14, where there are small modifications/additions to the track route, none of these tracks are close to any hydrological constraint site or area of hydrological sensitivity and

thus have no potential to add to the impacts assessed in the Environmental Statement (November 2004). The track to new turbine location A8 crosses a very small area of flush which supplies the headwaters of a small stream and this has been identified as a hydrologically sensitive area where appropriate working practise will be followed.

The new stretch of track between A12 and A17 includes a new stream crossing which has been identified as a new constraint site where appropriate working practise will be followed. The route also crosses a short stretch of wet peat mire which has been identified as an area of potential hydrological sensitivity where appropriate working practises and techniques will be adopted.

Overall, the loss of stretches of connecting track in the south west of the site and the addition of other areas of new track results in the net removal of four crossings of areas of small areas of wet flush or peat mire. One small stream crossing point is removed and a new stream crossing point is added, resulting in no net change in the number of steam crossing points.

### 9.3.2 Potential Hydrological Impacts During the Construction Phase

In the Environmental Statement (November 2004), seven *types* of potential hydrological impacts were identified (Section 9.6.2), which could result from construction activities related to the project. These impacts are all still relevant for the amended layout and are listed below:

- (1) **Impacts on amount of ponded water, groundwater table levels and stream water quantity (and hence freshwater biology and ecology)**, caused by construction of tracks, turbine bases, hard standings (such as the substation and laydown areas), cable trenches, excavation of borrow pits, use of water for machine and vehicle washing and the dumping of construction wastes;
- (2) **Impact on soil moisture storage, water movement in peat and on the integrity of the peatland vegetation community and rushy stream headwater areas** caused by the construction of turbine bases, tracks and cable trenches;
- (3) **Impact directly on soil and peat resulting in soil erosion**, caused by construction of tracks, turbine bases, hard standings (such as the substation and laydown areas) and cable trenches;
- (4) **Impact on wet peat on or close to a topographic gradient, causing it to be compressed, lose its strength and cause a peat slide**, caused by loading on top of wet and soft peat. Loading could be caused by dumping of excavated spoil (construction of turbine bases or tracks) or laydown of construction materials;
- (5) **Impact on the quality of stream water and resultant impacts on freshwater ecology, including fisheries**, caused by construction of access tracks, cable trenches, excavation of borrow pits, use of water for vehicle washing and concrete mixing, crushing of rock, generation of dust from construction activities (particularly tracks), drainage and runoff from all construction activities, including tracks, hardstandings and cable trenches, accidental spillages of fuels or chemicals;
- (6) **Impact on the quantity and quality of private domestic water supplies** caused by construction of access tracks, cable trenches, excavation of borrow pits, use of water for vehicle washing and concrete mixing, crushing of rock, generation of dust from construction activities (particularly tracks), drainage and runoff from all construction activities, including tracks, hardstandings and cable trenches, accidental spillages of fuels or chemicals.
- (7) **Impact of accidental spillages of fuels and other chemicals on wet peat and mire vegetation communities** caused by accidental spillages of fuels and other chemicals, such as cement and alkaline waters.

Each of these are briefly re-assessed below in relation to the amended layout.

#### 9.3.2.1 Impacts on amount of ponded water, groundwater table levels and stream water quantity (and hence freshwater biology and ecology),

Three different potential impacts were identified under this heading:

- (i) Impact of excavation activities on disruption of peat water flows, and altered stream water quantities;



- (ii) Impact of abstraction of water for vehicle and equipment washing on stream water quantity;
- (iii) Impact of dumping rock or construction waste on stream water quantity.

Impacts (i) and (ii) were assessed as being of moderate significance while (iii) was considered to be of only minor significance. The levels of significance for these impacts are not changed in the new layout.

### 9.3.2.2 Impact on soil moisture storage, water movement in peat and on the integrity of the peatland vegetation community and rushy stream headwater areas

A number of locations where the track and cable trench cross bog and blanket peat vegetation were identified in the Environmental Statement (November 2004). For the new layout, these locations have been slightly altered and the new list of locations is provided in Table 3 below.

**Table 3. Wet mire and flush locations crossed by the track and cable trench**

Hydrological Target Note	NGR	Description
H3	NM 993 216	A small valley flush north of the loch which forms part of Allt na Maoile
North East of H9	NM 985 208	A small valley flush draining into the <i>Eriophorum</i> mire complex at the head of the Allt na Maoile valley
H11	NM 982 204	An <i>Eriophorum</i> mire with <i>Erica tetralyx</i> , where peat is >1m deep, at the head of a small burn flowing South West. This flush complex is crossed by the main track and a spur track to A8.
H12	NM 981 204	An <i>Eriophorum</i> mire forming the headwaters of a tributary of the Allt Gleann na h-Airigh
South of H15	NM 977 202	<i>Eriophorum</i> and <i>Juncus</i> mire feeding seepage water into a tributary of the Allt Gleann na h-Airigh
North of H19	NM 972 199	<i>Eriophorum</i> basin mire with peat depths > 2m
South of H36	NM 972 205	Marshy riparian areas bordering the upper reaches of the Allt Gleann na h-Airigh
South west of H34	NM 969 209	Narrow western section of <i>Eriophorum</i> mire which extends from south of Carraig Gheal to rocky outcrop west of Lochan Dubha
South of H62	NM 975 213	Eastern limb of a larger area of <i>Eriophorum</i> mire whose western section is eroded into a series of peat hags
East of H30	NM 964 208	Eastern extension of a large <i>Eriophorum</i> mire consisting of deep peat and pools, south of Carraig Gheal summit.

Five mire and flush crossing points on the connecting track have been removed with the removal of five turbines in the south west of the site. Only one new mire crossing point has been added: that at H30, associated with the track which connects A12 to A17. Thus, compared to the original layout, the new route of tracks and cable trenches four fewer flush and wet mire areas.

As in the original layout, a few areas of blanket peat will be affected by the excavation of turbine bases, although none of these is on peat deeper than 1m.

The hydrological impacts associated with excavation of turbine bases and track construction are identical to those described in the Environmental Statement (November 2004). As for the original layout, care has been taken in designing the amended site layout to avoid as many areas of wet peat and mire as possible and to avoid deeper (>1m) areas of peat.

Two impacts were identified in the Environmental Statement (November 2004):

- (i) Impact of construction on wet peat and mire vegetation communities;
- (ii) Impact of dumping rock or construction waste on peatland and peat vegetation communities.

The level of significance of impact (i) was assessed to be major and that of impact (ii) was assessed to be minor. These impact ratings remain unchanged in the amended layout.

### 9.3.2.3 Impact on soil and peat, resulting in erosion and peat slides

It was identified in the Environmental Statement (November 2004) that there is the potential for construction activities in areas of blanket peat, particularly the excavation of cable trenches, but also construction of tracks, hard standings and the excavation of turbine bases to cause both peat erosion due to dewatering, and soil erosion. There is also the potential for there to be peat slips or slides. In the amended layout these impacts are still possible and the descriptions and assessments made in the Environmental Statement (November 2004) are still valid.

As for the original layout, the amended layout has been designed so that no turbine location lies in any area of peat deeper than 1m, or in any area where there is existing peat erosion and peat haggling. In addition, turbine locations have been chosen to avoid slopes with gradients steeper than a few degrees. The track and cable route has also been chosen to avoid all areas where there is existing peat erosion or peat haggling and to minimise the number of locations where the peat depth is > 3m. Despite these precautions, there are still several areas where there is the potential for peat erosion to occur.

Two potential impacts were identified in the Environmental Statement (November 2004):

- (i) Impact of excavation activities on soil and peat erosion;
- (ii) Impact of dumping spoil or laydown of materials on generating peat slides.

Both of these impacts were assessed to be of major significance. The level of significance of these impacts remains unchanged in the amended layout.

### 9.3.2.4 Impacts on the *quality* of stream water and resultant impacts on freshwater ecology, including fisheries

The main streams which drain the site (Allt Coire Odhair, Allt na Maoile, Allt Gleann na h-Airigh), as well as numerous smaller, un-named streams are clear water streams, with stony channels. The impact was identified in the Environmental Statement (November 2004) that there is the potential for wind farm-related construction activities, particularly the construction of new track and associated stream crossing points, turbine bases and cable trenches, to cause sediment runoff into streams and hence to impair water quality and adversely impact freshwater biology, including fisheries. The impact was also identified that there was the possibility that fuels and other chemicals could be accidentally spilled or leaked into small streams, causing adverse effects on freshwater ecology and fisheries.

Two potential impacts were identified in the Environmental Statement (November 2004) as follows:

- (i) Impact of sedimentation in runoff into streams and adverse effects on freshwater ecology, including fisheries;
- (ii) Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and adverse effects on freshwater ecology, including fisheries.

It was recognised in the Environmental Statement (November 2004) that there is the potential for the above activities to cause sedimentation of stream beds and adversely affect trout spawning grounds. Since the streams which drain the site and their freshwater ecology, including trout populations sensitive ecological receptors, this impact was assessed as being of moderate to major significance, despite the likely short-term nature of the impact. The significance of these impacts remains unchanged in the new layout.

The removal of 5 turbines, the addition of one new turbine and the minor relocation of a further 12 turbines will result overall in less excavation and hence less potential to generate soil erosion and sediment runoff which could impair water quality in the many small streams which drain the site. The net removal in the amended layout of approximately 2.94km of access track and cable trenches will remove the need for four crossings of areas of small areas of wet flush and mire. These are located to

the south and south west of Carn Dearg, in the location of the “old” turbines T5, T14 and T20. The removal of these crossing points from the new layout will have the effect of reducing overall the potential for interruption of hydrological continuity in flushes and mires and will also remove the possibility of sediment runoff into streams feeding Loch na Criathraich. In relation to the whole site, the reduction in sediment generation due to the removal of turbines in the new layout will not change the overall significance of the impact, which was rated as moderate to major in the Environmental Statement (November 2004).

It was considered in the Environmental Statement (November 2004) that the main activity likely to cause an adverse impact on streams, their water quality and their freshwater biology is the construction of new track crossing points. The removal of one small stream crossing point and the addition of one new small stream crossing point will result in no net overall difference in the assessed level of significance

#### **9.3.2.5 Impact on the quantity and quality of private domestic water supplies**

In the Environmental Statement (November 2004), one geographical area was identified, with two private water supplies, which lie downstream of the wind farm development at Carraig Gheal. The assessment of these private water supplies and likely impacts of the amended wind farm layout and its construction remains identical to the assessment in the Environmental Statement (November 2004). No private water supplies are known to use any of the streams which drain the south and eastern part of the site. In addition, all of these streams are tributaries of either the Allt Gleann na h-Airigh in the south, the Allt na Maoile, or the Berchan River in the east, all three of which are intercepted by the Nant “aqueduct”, approximately 600m beyond the site boundary.

Two impacts were identified in the Environmental Statement (November 2004):

- (i) Impact of construction activities on quality and quantity of private domestic water supplies;
- (ii) Impact of accidental spillages of fuels and other chemicals such as concrete on water quality of private domestic water supplies.

The assessment was made that there are no negative impacts on private water supplies due to the construction of the wind farm at Carraig Gheal. There is no change to this assessment in the new amended layout.

#### **9.3.2.6 Impact of accidental spillages of fuels and other chemicals on wet peat and mire vegetation communities**

There is the potential that accidental spills and leaks of fuels as well as other chemicals such as concrete and alkaline waters could be spilled directly onto oligotrophic and acidic vegetation communities. The impact identified in the Environmental Statement (November 2004) is described below:

##### *Impact of accidental spillages of fuels and other chemicals on wet peat and mire vegetation communities*

The impact was assessed to be of negligible to moderate significance respectively (Environmental Statement (November 2004): Main Report, Section 9.6.2.6. This level of significance remains the same for the amended layout.

## **9.4 CONCLUSIONS ON HYDROLOGICAL IMPACTS**

The loss of 5 turbines, addition of one turbine and modified locations of 12 other turbines and their associated tracks and cable trenches, results in a slightly reduced overall hydrological impact compared to that of the Environmental Statement (November 2004). This is mainly due to the loss of track in the southern and south western part of the site. The route of the new track between A12 and A17 cuts across a small stretch of wet peat mire which was previously unaffected. This slightly increases the potential impact on peat mire communities.

Although there is assessed to be a slightly reduced level of impact on flushes, peat mires and small streams for the amended wind farm layout overall, levels of significance assessed for all the above hydrological impacts remains unchanged compared to those presented in the Environmental Statement (November 2004).

## **9.5 SUMMARY OF GEOGRAPHICAL LOCATIONS WHERE HYDROLOGICAL ISSUES HAVE BEEN IDENTIFIED (HYDROLOGICALLY SENSITIVE AND HYDROLOGICAL CONSTRAINT SITES)**

A number of areas were identified in the Environmental Statement (November 2004) as being hydrologically sensitive and a further series of locations were identified as hydrological "constraint" sites where prescribed working practices and techniques were required during the construction phase of the wind farm. These were illustrated in Figure 18b of the Environmental Statement (November 2004). Updated constraints are shown with the amended layout in Amendment Figure A18b with a map of hydrological features shown in Amendment Figure A18a.

The areas of hydrological sensitivity remain unchanged since these relate to the site and its conditions (namely small streams, wet flushes and peat mires). 22 small and one larger constraint site were identified in the Environmental Statement (November 2004). Three types of constraint site we identified, relating to (a) the section of access track which straddles a narrow rocky ridge, bordered on either side by peat mires (labelled "A"), (b) locations where the track crosses a small stream or significant seepage zone (labelled "B"), (c) stretches of track which cross areas of wet mire and deep peat (>2-3m) (labelled "C"). These areas were described in detail in the Environmental Statement (November 2004). A table was provided in that document which described the required type of mitigation for each type for constraint site, and these are still appropriate for the amended layout. For the amended wind farm layout, there are six minor locational adjustments to constraint sites (see below) but the types of mitigation described in the Environmental Statement (November 2004) remain unchanged. Appendix 14 in the Environmental Statement (November 2004) describes constraint sites according to whether simple, standard mitigation measures (such as re-routing or standard cross-track drainage construction measures can be adopted) or whether more customised mitigation is required. The same descriptions are appropriate for the amended layout. There are several areas on the Carraig Gheal site where floating road designs are prescribed. Indicative designs for these and associated cable trunking are provided in the description of the proposed development contained in Appendix 1 of the Environmental Statement (November 2004).

Mitigation measures are described in more detail in Section 9.7 of the Environmental Statement (November 2004) and are re-assessed in Section 9.9 below.

### **9.5.1 Hydrological constraint sites and sensitive sites**

#### **9.5.1.1 Constraint Site A**

This constraint site follows the route of the access track route along a narrow rock ridge running NE to SW, with wet peat mires on either side. This route and the proposed mitigation methods remain unchanged from those described in the Environmental Statement (November 2004).

#### **9.5.1.2 Constraint Sites type B**

All locations where the track crosses both main and minor streams which drain the site are considered to be hydrologically sensitive sites since there is potential for a number of adverse effects, particularly during the construction of the development. One small stream crossing point will be lost in the amended layout (at NGR NM 963 204) and one new small stream crossing will be added (at NGR NM 967 207).

It was assessed in the Environmental Statement (November 2004) that the main potential impacts would be:

- Increased sediment loading due to site erosion and run off during construction;
- Adverse impacts of necessary in-channel engineering such as stream culverting;
- Potential alterations in streams flows and possible subsequent effects on freshwater ecology, due to an increase in runoff (e.g. through road drainage) or a decrease in runoff due to changes in site hydrology as a result of activities such as cable trenching.

In all cases where the track and cable trench cross a small stream, special measures were recommended to be taken to minimise the impact on the stream. These measures were discussed in detail the Environmental Statement (November 2004).

### 9.5.1.3 Constraint Sites type C

Each location where the access track crosses deep peat and/or wet peat mires is considered to be a hydrologically sensitive site since there is potential to interrupt hydrological flows, compress peat and irreparably damage mire vegetation communities. It is anticipated that construction activities in these locations will require the use of a floating track design, to spread the vehicle/equipment weight and to prevent peat compression and damage to peat hydrology. Of the locations identified where a floating track design was considered potentially appropriate in the Environmental Statement (November 2004), four locations have been removed from the layout, two locations have been slightly modified and there is one new location. Overall, there are 12 type “C” constraint sites in the amended layout. These modified locations of constraint sites type “C” in Figure 18b of the Environmental Statement (November 2004) are given in Table 4 below:

**Table 4 – Modified Locations of Constraint Sites Type “C”**

Location on site	Constraint Site Type “C” (track crossings of mires)			
	Site remains unchanged	Site removed	Site location slightly modified	Site added
Site entrance	NM 000 218			
Site access track	NM 991 214			
Between T/A1 and T/A8	NM 982 205			
Between T/A1 and T/A7			NM 981 206	
Between T/A2 and T/A3	NM 978 202			
Between T/A2 and T/A3	NM 977 201			
Between T/A3 and T/A4		NM 977 201		
Between T/A4 and T5		NM 968 196		
Between T/A3 and A5			NM 972 199	
Between T6 and T/A11		MN 970 203		
Between A11 and A6	NM 972 205			
Between A7 and A6	NM 976 205			
Between T14 and T20		NM 963 204		
Between A9 and A10	NM 977 209			
Between A12 and A17				NM 966 208
<b>Total nos constraint sites</b>	<b>Unchanged: 8</b>	<b>Removed: 4</b>	<b>Modified: 2</b>	<b>Added: 1</b>

In summary, the majority of constraint sites (Type “C”) remain unchanged, with 2 locations slightly modified and one new constraint site added. Since three constraint sites (Type “C”) have been removed, the net effect has been to reduce slightly the length of access track which may need to be of a “floating” design.

Mitigation using floating tracks was discussed in more detail in the Environmental Statement (November 2004) and remains appropriate for the amended layout.

## **9.6 PROXIMITY OF TRACKS, TRENCHES OR TURBINE BASES TO STREAMS AND AREAS OF INTEREST FOR FRESHWATER BIOLOGY AND FISHERIES**

The proposed turbine locations in the amended layout have been located to avoid streams and stream banks and there are no turbine locations close to any of the sensitive stream areas marked on Figure 18b of the Environmental Statement (November 2004).

There are several locations where tracks and cable trenches cross main and minor streams. In the Environmental Statement (November 2004) it was recognised that in places where the track crosses even small streams or ditches, there is the potential for water to be interrupted or possibly re-routed, potentially resulting in lower flows in drainage ditches and small streams. A full discussion in that document was given of the likely impacts, such as low flows, exposure of bare soil and peat, soil/peat erosion and potential alteration of stream water quality.

Several locations were identified where the access track route crosses an area of *Eriophorum* bog with peat depths > 1m. The main locations were highlighted in the Environmental Statement (November 2004) as constraint sites (type C). There are also several locations where turbine locations lie close to areas identified as being hydrologically sensitive or identified as having a peat depth of > 2m. Turbine locations which fall into this category include the following:

- Turbine A2: Located just to the north east edge of an area of peat which is >3m deep;
- Turbine A3: Slightly re-located in the amended layout but still located between two marshy stream headwater areas;
- Turbine A6 (old T7): Slightly re-located in the amended layout but still located on the western boundary of an area of peat mire with peat depths between 1-2m. The turbine locations lies on the western slope, approximately 4-5m above the mire;
- Turbine A11: Slightly re-located in the amended layout but still located between two small streams in an area of peat approximately 1.5-2m deep;
- Turbine A12: Although close to an extensive area of eroded mire, this turbine is located on a bluff overlooking the mire;
- Turbine A17/T21: Located on the northern boundary and uphill of an extensive area of *Eriophorum* mire;
- Turbine A18/T22: Very slightly re-located in the amended layout but still located on the northern boundary of an extensive mire and pool complex;
- Turbine A9: Located just west of an area of peat mire with peat depths between 2-3m.

It was identified in the Environmental Statement (November 2004) that in the above turbine locations, care should be taken at the micro-siting stage and when determining the orientation of the hardstanding areas, to ensure that areas of peat mire and deep peat are avoided if at all possible. This will still apply to the amended layout.

## **9.7 POTENTIAL FOR HYDROLOGICAL IMPACTS DURING THE OPERATIONAL PHASE**

Whether there are hydrological impacts during the operational phase of the project depends very much on whether successful mitigation measures have been implemented during the construction phase. Four types of impacts were identified in the Environmental Statement (November 2004) during operational phase. These were:

- Runoff water from access tracks during rainstorms could (a) erode the track, (b) cause soil/peat erosion and/or (c) adversely affect vegetation communities in the vicinity of the track;
- Floating tracks could obstruct water flow within peat and cause water ponding and erosion of mire peat, thus damaging peat vegetation communities;
- Turbine bases constructed in deeper peat could act as a “sump” and cause localised dewatered and saturated zones in adjacent areas of shallow blanket peat, which in turn could dry out or waterlog wetland plant communities and cause them to be degraded or completely damaged.

- Cable trenches, which cut through mires and marshy areas could provide preferential channels for drainage waters. This could dewater wetland plant communities and cause them to be degraded or completely damaged through drought.

In the cases identified above, the elements of the receiving environment which could be impacted would be peat and sensitive peatland vegetation communities. All four impacts were assessed as being of minor to moderate significance and these significance ratings remain unchanged for the amended layout. Mitigation for these impacts was provided in the Environmental Statement (November 2004) and these measures are re-assessed in Section 9.9 below.

## **9.8 POTENTIAL FOR HYDROLOGICAL IMPACTS DURING THE DECOMMISSIONING PHASE**

Since decommissioning of the project will occur at least 25 to 30 years in the future, it was assessed in the Environmental Statement (November 2004) that it is likely that different environmental values will prevail and different engineering technologies will be available. For this reason, a further scoping and environmental impact assessment was advised prior to the start of decommissioning so that the most appropriate choices of decommissioning techniques could be chosen. In the absence of such a process, impact assessment assumed that decommissioning activities would be broadly similar to those during the construction phase. It was also assumed that, as a minimum, the same (high) environmental standards would be applied to decommissioning of the development as is recommended to be applied during its construction.

Three main types of potential impacts were identified in the Environmental Statement (November 2004) during decommissioning. There were:

- i) Decommissioning Impact on stream water quality and freshwater ecology;
- ii) Decommissioning Impact on peat and mire vegetation communities;
- iii) Decommissioning Impact on peat erosion and causing peat slides.

The first two of these impacts were assessed as being of moderate to major significance. The third impact was assessed as being of minor to moderate significance. A full description of the assessment of these impacts was provided in the Environmental Statement (November 2004). These levels of significance remain unchanged for the new wind farm layout.

## **9.9 MITIGATION MEASURES**

In the Environmental Statement (November 2004) a full suite of “standard” mitigation measures were proposed for the construction phase of the wind farm, re-locating turbines, new tracks and cable trench to avoid areas of hydrological sensitivity, incorporating design elements into tracks across marshy areas to ensure free drainage, fencing off of buffer zones around all stream crossing points, instigation of environmentally sound construction working practices, including a full suite of waste management practices, and the implementation of a rapid response plan for any spillages or incidents.

These standard mitigation measures remain identical for the amended layout. A number of general mitigation measures were also proposed, including the micro-siting of turbine bases and associated tracks and trenches prior to construction. The micro-siting exercise is another opportunity, immediately before construction, to minimise potential impacts on peat communities and watercourses. This exercise will also apply to the new layout.

Specific mitigation measures were proposed in the Environmental Statement (November 2004) in relation to (a) construction activities in proximity to streams and stream crossing points, (b) specialist techniques associated with floating tracks across wet peat mires, (c) drainage from access tracks generally, (d) water use for vehicle and equipment washing and (e) protection of private water supplies. All of these mitigation measures will still apply to the new layout. An additional mitigation measure is proposed in this Amendment Report to protect stream water quality and brown trout and salmonid fisheries. This is described in Section 9.11 below.

Mitigation measures proposed in the Environmental Statement (November 2004) for potential hydrological impacts during the operation and decommissioning of the wind farm remain unchanged for the amended layout.

## 9.10 ASSESSMENT OF RESIDUAL IMPACTS

As stated in the Environmental Statement (November 2004), the purpose of inherent and further mitigation measures has been to prevent and minimise each of the identified hydrology impacts discussed in Section 9.3 above. It was also stated that if inherent mitigation, which informed the design of the site layout, and further mitigation measures, as described in detail in the Environmental Statement (November 2004) are implemented correctly, the significance of all identified impacts would be reduced to an 'acceptable' level. All impacts considered to be minor or less are assessed as being acceptable.

Seven types of hydrological impacts were identified in the Environmental Statement (November 2004) during the construction phase. The residual impacts of these are listed below:

1. **Impacts on stream water quantity (and hence freshwater biology and ecology), impacts on amount of ponded water and groundwater table levels.** After mitigation, the residual impacts of construction activities on these receptors is assessed as minor;
2. **Impact on soil moisture storage, water movement in peat and on the integrity of the peatland vegetation community and rushy stream headwater areas.** After mitigation, the residual impacts of construction activities on these receptors is assessed as negligible;
3. **Impact on peatland, resulting in soil and peat erosion.** After mitigation, the residual impacts of construction activities is assessed as negligible;
4. **Impact on wet and deep peat causing peat slides.** After mitigation, the residual impacts of construction activities is assessed as minor;
5. **Impact on the quality of stream water and resultant impacts on freshwater biology and ecology.** After mitigation, the residual impacts of construction activities on these receptors is assessed as negligible to minor;
6. **Impact on the quantity and quality of private domestic water supplies.** After mitigation, the residual impacts of construction activities on these receptors is assessed as negligible to minor;
7. **Impact of accidental spillages on peat and mire vegetation.** After mitigation, the residual impacts of construction activities on plant communities is assessed to be negligible.

These residual impacts are unchanged as a result of the amended wind farm layout.

With the implementation of proposed mitigation measures, the residual impacts during construction and operation of the new wind farm layout are assessed to be minor or less and are thus acceptable for the development.

## 9.11 RE-ASSESSMENT OF POTENTIAL IMPACTS ON FISHERIES

Potential impacts on fisheries, particularly on brown trout spawning and rearing streams, has been assessed in the Environmental Statement (November 2004). Since then, responses have been received from the Awe District Salmon Fishery Board (February, 2005) and from the Scottish Executive (May, 2005).

It has been assessed in 9.3 above that the removal of 5 turbines and associate tracks and cable trenches from the south and south west of the layout will reduce potential impacts on streams and on Loch na Criathraich to the south west of the site. Full mitigation measures to prevent any adverse effects on freshwaters were presented in this Amended Environmental Statement. These remain unchanged in the amended layout. Although the Awe District Salmon Fishery Board already hold limited data on juvenile brown trout and salmon fish populations in the lower reaches of the River Nant system, the Berchan River (Loch Awe) and the Abhainn Fionan sub catchments, no data is held on populations in Loch na Criathraich, Loch Dubha or their tributary systems. For this reason, an additional element of mitigation work is proposed. This will take the form of additional surveys of fish populations in the above stream and loch systems and would be used to describe the baseline fish population conditions prior to construction. This baseline data would then be available for review following construction. A programme will be put in place to monitor water quality and fish population conditions during the construction programme to ensure that any detrimental effects are identified and to permit a rapid response and remediation plan to be instigated.



Although highlighted by the Scottish Executive as a concern in relation to obstructing the passage of migratory fish populations, mention of the term “culverts”, used to construct track crossings of small streams requires explanation. The simplest form of stream crossing on small burns with large seasonal variations in flow is to use a wide diameter drainpipe as the “bridge” over which the track will run. Depending on projected winter and storm flows, these drain or culvert crossing points could range in diameter from 0.5m to 3m. These “culvert” crossing points would not alter the stream gradient and would be inserted beneath existing stream bed materials, such as rocks and gravels to retain natural stream bed conditions for fish migration and for spawning. In addition, all in-stream works would be scheduled to avoid critical spawning hatch periods, times of low flow and times of low oxygen saturation. To accommodate these requirements, construction works associated with stream crossing points will be avoided, if practicable, between the months of October to March. In addition, track drainage will be designed to ensure that no runoff waters drain directly into a watercourse.

To ensure that the mitigation measures proposed in the Environmental Statement (November 2004) are effective in preventing adverse effects on watercourses and associated freshwater biology and fisheries, construction contractors will be required to follow strict on-site working procedures, particularly when working in deep peat and in proximity to watercourses.

## 9.12 CONCLUSIONS

The removal of 5 turbines from the south and south western sections of the amended layout, together with the addition of one new turbine and slight modifications to the location of 12 turbines, will result in the net reduction in length of proposed track and cable trench by approximately 2.94km. This is assessed to reduced the overall hydrological impact, particularly in relation to streams and Loch na Craithraich.

There is no change in the types of potential hydrological impacts predicted. Seven different potential hydrological impacts during construction were identified in the Environmental Statement (November 2004) and are re-assessed in Section 9.3. These relate to: (a) the effects of construction activities, including stream crossing points, on amount of ponded water, groundwater table levels and stream water *quantity* (and hence freshwater biology and ecology), (b) the effects of construction activities on soil moisture storage, water movement in peat and on the integrity of the peatland vegetation community and rushy stream headwater areas, (c) the effects of excavation and construction activities on soil and peat resulting in soil erosion, as well as (d) effects on wet peat on or close to a topographic gradient, causing it to be compressed, lose its strength and cause a peat slide, (e) the effects of excavation and construction activities on the *quality* of stream water and resultant impacts on freshwater ecology, including fisheries, (f) the effects of excavation and construction activities on the *quantity* and *quality* of private domestic water supplies and (g) effects of excavation and construction activities on peatland and mire vegetation communities.

The re-assessment of the significance of these impacts for the new layout has indicated that there is no change to the levels of significance of potential impacts during construction, operation or decommissioning of the proposed wind farm.

This assessment considers that the suite of standard and specific mitigation measures which was proposed in the Environmental Statement (November 2004), together with proposed new survey of fish populations, is sufficient to reduce all of the potential hydrological impacts to a level of minor or less, which is judged to be acceptable for the development.

## REFERENCES

Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report, GreenPower (Carraig Gheal) Ltd.



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# **Landscape and Visual Impact Assessment Amendment**

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## **Summary**

Whilst the conclusions of the ES (November 2004) are still valid, the Carraig Gheal Wind Farm Amendment has slightly reduced the landscape and visual effects and provides some improvements to the composition of views.

The Amendment results in a slight reduction in the predicted landscape effects on the Craggy Uplands landscape character type and there are no predicted significant landscape effects.

Significant visual effects will be limited to recreational users at Loch Nant, and views experienced by people along the B840 at Portsonachan, and between Balliemeanoch and Blarghour (including two residential properties), in locations where loch-side vegetation allows open views. There is a slight improvement to the visual composition as viewed from all of the assessment viewpoints. These visual effects will be partly cumulative as a result of the combined visibility of Carraig Gheal Wind Farm and the existing Beinn Ghlas Wind Farm.

Considering the visual context and the nature of the improvements, which have reduced the overall landscape and visual effects, the Amended Carraig Gheal Wind Farm should be regarded as acceptable.

## **10.1 INTRODUCTION**

This chapter evaluates the Amended Carraig Gheal Wind Farm in relation to its potential landscape and visual effects. It should be read in conjunction with Chapter 10 of the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004).

## **10.2 METHODOLOGY**

### **10.2.1 General Approach**

The methodology for the landscape and visual impact assessment (LVIA) and the cumulative landscape and visual assessment (CLVIA) of the Amendment has been undertaken in accordance with the methodology set out in Section 10.2 of the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004). All of the LVIA & CLVIA assessment work conforms with the 'The Guidelines for Landscape and Visual Impact Assessment, Second Edition (Landscape Institute and IEMA, 2002)' and have been conducted by chartered landscape architects from Entec UK Limited.

### **10.2.2 Consultation and Agreement of the Scope**

Consultation with the relevant planning authorities (in this case Argyll and Bute Council) and Statutory Consultees (SNH) has been on-going post submission of the Carraig Gheal Wind Farm Environmental Statement (November 2004). SNH have noted the assessment of significant visual effects at three viewpoint locations along the B840 and have requested further re-design of the wind farm layout to reduce visual impact by making improvements to the visual composition as viewed from these locations. An amended layout has been developed in response to SNH's and the Council's requests and includes a reduction in turbine numbers (and corresponding access tracks) and turbine height. This amended LVIA and CLVIA provides an update to the original landscape and visual assessment.

### **10.2.3 Definition of the Study Area**

The study area defined in the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004) has been retained for the amended LVIA and CLVIA.

### **10.2.4 Description of the Existing (Baseline) Landscape Resource**

The existing landscape resource is described in section 10.4 of the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004), and for the purposes of this assessment is considered to be unchanged.

## **10.2.5 Amended Visibility Maps**

The visibility maps have been revised to take account of the Amendment and indicate the area of theoretical visibility, subject to the additional screening effect of localised landform, buildings, and trees. The methodology for re-calculating the revised visibility maps is consistent with the assessment work presented in the Carraig Gheal Wind Farm Environmental Statement: Figures (November 2004).

Three Visibility Maps have been prepared to assess the visibility of the Proposed Development:

- To upper blade tip (Visibility Map A1);
- To hub height (Visibility Map A2);
- To upper blade tip with existing forest screening zones removed (Visibility Map A3).

In addition, cumulative visibility maps have been prepared to upper blade tip and do not exclude areas of forestry:

- Definitions of Wind Farms for Cumulative Assessment (Visibility Map CLVIA A1);
- Operational Wind Farms (Visibility Map CLVIA A2);
- Operational and Consented Wind Farms (Visibility Map CLVIA A3);
- Carraig Gheal, Inverliever and Cumulative Baseline (Visibility Map CLVIA A4);
- Total Wind Farms Visible (Visibility Map CLVIA A5).

## **10.2.6 Amended Viewpoint Assessment**

The viewpoint assessment has been conducted from selected viewpoints within the LVIA Study Area, which were agreed through a combination of professional judgement and consultation with Scottish Natural Heritage (SNH) and Argyll and Bute Council and presented in the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004).

Each of the viewpoints has been illustrated in this report with visualisations (photographs, wireframes and in some cases photomontages) capturing a 90° angle of view. The amended viewpoint figures are prefixed with 'A' and are accompanied by an additional figure (suffix 'c') which provides a wireframe comparison of the Proposed Development (November 2004) and the Amended Proposed Development.

The production of the visualisations for the amended layout uses the same methodology and original photography in order that they may be directly comparable with the submitted visualisations within the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004).

## **10.2.7 Cumulative Landscape and Visual Assessment**

The scope of the CLVIA remains the same and although the Inverliever Wind Farm was recently refused by Argyll and Bute Council, the proposal has remained part of the CLVIA for ease of comparison with the original Carraig Gheal Wind Farm Environmental Statement (November 2004).

The production of the visualisations for the amended layout uses the same methodology and original photography in order that they may be directly comparable with the submitted visualisations within the Carraig Gheal Wind Farm Environmental Statement: Figures (November 2004).

## 10.3 MITIGATION INCORPORATED IN THE PROPOSED DEVELOPMENT

### 10.3.1 Amended Wind Farm Design

Part of the amended design has focused on improvements to the visual composition as illustrated by all of the viewpoints and from those located along the B840 in particular. In addition to this, the amended layout has retained the original design objectives stated in Section 10.4 of the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004). These included relating the design to the underlying landscape character of the site area and consideration of the visual composition with the objective of retaining '*simplicity of image*'.

A summary of the changes made to the amended layout compared to the submitted layout is provided in Table 10.1.

**Table 10.1: Summary of the Changes made to the Amended Carraig Gheal Wind Farm**

Wind Farm Component	Proposed Development (Nov 2004)	Amended Proposed Development
<b>Wind Turbines:</b>	Number: 24 Blade Tip: 112m / 127m Hub Height: 70m / 85m	Number: 20 Blade Tip: 110m / 125m Hub Height: 65m / 80m
<b>Access Track:</b>	New access track: 15km	New access track: 13km
<b>Other Components:</b>	Sub station	No change
	1 meteorological mast	2 meteorological masts

### 10.3.2 Turbine Selection

The project has been amended to include up to a maximum of twenty turbines, based on a turbine specification with two different hub heights of up to 65mm (turbine numbers: TA1, TA4, TA5, TA9, TA12, TA17, TA18, TA19 and TA20 as indicated in Figure A2) and a hub height of up to 85m (the remaining eleven turbines). Overall turbine heights to blade tip of up to 110m (nine turbines) and up to 125m (eleven turbines) are proposed.

The amended turbine dimensions would lead to an overall reduction of 2m in the maximum potential height to blade tip. The amended turbine dimensions create a slightly more 'squat' and less elongated proportions, although the changes to the turbine dimensions as observed from the surrounding area will be negligible.

Two turbine heights have been proposed in response to the undulating nature of the Carraig Gheal site, and assist in presenting a more unified appearance and '*simplicity of image*' when viewed from surrounding areas. The use of the selected lower hub heights has led to some slight improvements to the visual compositions recommended by SNH in connection with viewpoint numbers 8 and 14.

### 10.3.3 Turbine Colour

It is considered that a semi-mat, pale grey (as opposed to white or light grey) would provide the lowest levels of contrast between the overall combinations of background sky and landscape, against which the Carraig Gheal Wind Farm may be viewed from various locations.

This is considered to be the traditional colour for turbines and is most likely to match with other existing or proposed wind farms within the area and support the planned strategic approach to wind farm development within this area. The philosophy of '*simplicity of image*' would also be retained with all of the turbines within this area retaining a simple and common appearance, colour, and type.

### 10.3.4 Amended Pattern of Visibility

The general pattern of potential visibility for the Amendment, when compared with the Proposed Development (November 2004) is very similar. The extent of potential visibility, calculated to blade tip, for the Proposed Development covers approximately 25% of the total LVIA study area. This will reduce to approximately 24% of the total study area as a result of the Amendment. Both calculations include visibility over open water in the Firth of Lorn and other areas that would be screened by localised landform, buildings, and trees.

### 10.3.5 Viewpoint Analysis of Amended Layout

Viewpoint analysis has compared the Amendment within the Proposed Development (November 2004) for each of the viewpoints, in order to determine whether there would be an overall improvement to the visual composition and to consider whether this would alter the results of the assessment of visual effects upon the existing view, presented in Appendix 10 of the Environmental Statement (November 2004).

The existing view and the receptor sensitivity have remained unchanged, but the composition of the turbines and the magnitude of change that would affect the views as a result of the Amendment would correspondingly alter. The magnitude of change has been analysed in terms of high, medium, low, and negligible, with high referring to the greatest level or magnitude of change when compared to the existing view.

The amended layout achieves most of the requested recommendations made by SNH during consultation in respect of the composition and the apparent height of the turbines that would be seen from viewpoints 2, 3, 7, 8 and 14. Further recommendations affecting the apparent height of turbines as seen from viewpoints 1 and 12 could not be achieved, although alternative slight improvements to the overall composition, as viewed from these and the remaining viewpoints have been achieved.

There would be a reduction in the potential magnitude of change, affecting Viewpoint 13: Oban Hilltop, reduced from low to negligible. This is likely to have a corresponding reduction in the visual effects experienced from this location.

The results of the viewpoint analysis of the Amendment are provided in Table 10.2 and provide an update of the assessment in Appendix 10 of the Environmental Statement (November 2004).

**Table 10.2: Amended Viewpoints Analysis**

Viewpoint	Change to Proposed Visual Composition Compared to the Submitted Application Layout	Change in turbines visible*		Magnitude of Change (Amendment)
		BT	HH	
<b>1: Loch Nant</b>	The visible change from this viewpoint is a negligible improvement and there would be no change in the assessment of magnitude or type of effect, although there is a slight reduction in the number of turbines visible and a reduction in the potential for these to overlap.	-2	-3	High
<b>2: Balliemanoach</b>	A low level of improvement to the visual composition, resulting from a slight reduction to the extent of view occupied by the wind farm, a reduced number of turbines visible, and a reduced number of overlapping turbines. <i>This amendment achieves the overall requested recommendations made by SNH during consultation.</i>	-4	-5	High
<b>3: Waterfall, Loch Awe</b>	A low level of improvement to the visual composition due to a slight reduction of the visible extent of the Wind Farm, and a reduced number of visible turbines / overlapping turbines. <i>This amendment achieves most of the requested recommendations made by SNH during consultation.</i>	-4	-4	High
<b>4: Annat</b>	A negligible level of improvement to the visual composition although it is likely that the wind farm would be screened by vegetation from this location.	-2 <sup>a</sup>	-1	Negligible
<b>5. Kilchrenan</b>	A negligible level of improvement to the visual composition is	-2 <sup>a</sup>	-1	Low



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Viewpoint	Change to Proposed Visual Composition Compared to the Submitted Application Layout	Change in turbines visible*		Magnitude of Change (Amendment)
		BT	HH	
Footpath	predicted due to a slight reduction in the number of turbines visible.			
6: Portsonachan	There would be a low level of improvement to the visual composition due to a reduced number and more even spread of turbines visible.	-4	-4	Medium
7: Blarghour	There would be a low level of improvement to the visual composition due to a slight reduction of the apparent extent of the Wind Farm, a reduced number of turbines, a reduced number of overlapping turbines and a more even spread of turbines. <i>This amendment achieves the overall requested recommendations made by SNH during consultation.</i>	-4	-4	Medium
8: Ardbrecknish House (road above)	A negligible level of improvement to the visual composition is predicted due to a slight reduction in the number of turbines visible. <i>This amendment achieves the overall requested recommendations made by SNH during consultation.</i>	-4	-4	Medium
9: Eredine	There would be a low level of improvement to the visual composition due to a reduced number of turbines visible.	-6	-5	Low
10: Foxhole Hotel, Kilmore	There would be a negligible change to the view, although there is a slight increase in the number of blade tips that would be visible (the upper parts of up to 3 blade tips would be visible). However, at this distance and considering the scale and nature of the view the magnitude of change would remain negligible.	-1 <sup>a</sup>	-1	Negligible
11. Ben Cruachan	There would be a negligible level of improvement to the visual composition due to a reduced number and a more even spread of those turbines, which would be visible.	-4	-4	Medium
12: Military road above the A85	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-4	-4	Medium
13: Oban Hilltop	There would be a low to medium level of improvement to the visual composition due to a slight reduction of the apparent extent of the wind farm and a reduced number of turbines. When compared to the Proposed Development (November 2004) the apparent extent of the Amendment in the existing view is reduced by at least 1/3.	-5	-4	<b><u>Negligible</u></b>
14: Dalmally Monument	There would be a negligible change to the view, due to slightly reduced number of visible turbines. <i>This amendment achieves the overall requested recommendations made by SNH during consultation.</i>	-4	-4	Low
15: Beinn Bhuidhe	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-4	-4	Low
16: Kilcheran, Lismore	There would be a low level of improvement to the visual composition due to a reduced number of turbines visible and apparent extents of the wind farm.	-4	-2 <sup>a</sup>	Negligible
17: A85 east of Dalmally	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-4	-4	Negligible
18: Duart Castle, Mull	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-6 <sup>a</sup>	-6 <sup>a</sup>	Negligible
19: Beinn Trilleachan	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-4	-4	Negligible
20: Kirkton Sculptured Stones	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-4	-2	Negligible
21: Beinn an Lochain	There would be a negligible change to the view, due to slightly reduced number of visible turbines.	-4	-4	Negligible

\*The numbers in these columns refer to the change in the number of turbine hubs(HH) and upper blade tips (BT) that would potentially be visible from these locations when compared to the Proposed Development (November 2004). Negative

Viewpoint	Change to Proposed Visual Composition Compared to the Submitted Application Layout	Change in turbines visible*		Magnitude of Change (Amendment)
		BT	HH	
figures indicate less turbines are visible for the Amendment compared to the Proposed Development (November 2004). <sup>a</sup> The numbers referred to in the BT and HH columns take account of the erratum in Amendment Appendix A15. Note: Where assessment of the Amendment results in an alteration to the Magnitude of Change predicted in relation to the Proposed Development (November 2004) then it is highlighted in bold and underlined. The type of all visual effects experienced from the viewpoints has been considered as permanent (but reversible) and direct.				

### 10.3.6 Site Tracks within the Site Boundary

The amended layout and reduction in turbine numbers has led to an overall reduction in the length of proposed site access tracks by 2.94km (total length of site access tracks required for the Amendment is 12.995km). Otherwise the detail design of access tracks to a width of 5m, with passing places, and increased in width on corners to allow for turning vehicles, would remain as per the submitted Carraig Gheal Environmental Statement (November 2004).

### 10.3.7 Site Substation and Ancillary Development

Two meteorological masts as illustrated on Figure A2 are proposed and would be of the same height and design as the indicated in the Environmental Statement (November 2004).

There would be no change to the design and location of the proposed substation compound, Contractor's compound, sourcing of road stone, delivery route to site, or the grid connection (subject to any necessary separate consenting procedures) as presented in the submitted Carraig Gheal Environmental Statement (November 2004).

### 10.3.8 Operation and Decommissioning

The details regarding the operational period of the wind farm (25 years) and decommissioning, would remain as per the original application described in the submitted Carraig Gheal Environmental Statement (November 2004).

## 10.4 PREDICTED LANDSCAPE EFFECTS

### 10.4.1 Introduction

Landscape effects include the direct and indirect effect on landscape receptors such as landscape elements and features, as well as the effects upon the general landscape character and its quality or condition and value. The effects of the development may be negative or positive and may vary in their duration from temporary to permanent.

### 10.4.2 Effects on Designated Landscapes

The Amendment does not alter the assessment of Designated Landscapes presented in the ES (November 2004).

There would be no significant landscape effects on designated landscapes including the Loch Lomond and the Trossachs National Park, National Scenic Areas, Historic Gardens and Designed Landscapes, regionally designated AGLV's and ALLI's. Some slight improvements to the visual composition of the wind farm as it would be viewed from the viewpoints, in particular those along the B840 within the Area of Local Landscape Importance (ALLI), have been achieved by the Amendment.

### 10.4.3 Landscape Effects on Craggy Uplands LCT

The Amendment does not alter the assessment of effects on Craggy Uplands Landscape Character Type presented in the ES (November 2004).

The Craggy Uplands Landscape Character Type (LCT) forms an extensive landscape resource (~89,454ha.) of broad and large scale, undulating moorland plateaux that is both remote and generally unpopulated. Large areas of the Craggy Uplands have been man-modified through extensive commercial forestry plantation and the site area is of relatively low landscape sensitivity. The amended Carraig Gheal Wind Farm would cover a reduced area of less than ~1% of the total Craggy Upland LCT. When considered in combination with the existing Beinn Ghlas Wind Farm, the magnitude of change affecting this LCT would be low, during both operation and construction, leading to a low and neutral effect on the landscape character.

#### **10.4.4 Landscape Effects on Carraig Gheal Craggy Uplands LCA**

The Amendment does not alter the assessment of effects on Carraig Gheal Craggy Uplands LCT presented in the ES (November 2004).

The localised landscape character of the Carraig Gheal site is typical of the Craggy Uplands and is located close to areas of commercial forestry and utility development, within an area of low landscape sensitivity.

During both construction and operation, the wind turbines would add a new feature or characteristic element of the existing landscape character for a period of 25 years, the effects of which would be reversible. Although the Amendment will have a smaller overall footprint, avoiding the area around Carn Dearg, the direct magnitude of change on the local Craggy Uplands landscape character of Carraig Gheal would remain high. Nevertheless, the Amended Wind Farm would be comfortably accommodated within the scale and character of the existing landscape, bringing about an acceptable evolution or change, which would not be significant.

Considering the individual landscape elements such as moorland vegetation and crags, the direct impact of access tracks and turbines in the Amendment will affect a small proportion of moorland (less than 1.5% of the total site area). The magnitude of change affecting the moorland vegetation and crags will be low and not result in significant landscape effects.

#### **10.4.5 Predicted Cumulative Landscape Effects**

The assessment (ES November 2004) identified that wind farm development was already likely to become a characteristic element of the Craggy Uplands (Beinn Ghlas Wind Farm exists and An Suidhe Wind Farm is consented).

There is no change to the original cumulative landscape assessment, which concluded that there was a rationale for broad scale landscape management, to cluster the modification of landscape character to those areas that were already modified by a range of previous development and landuse, including wind farm development and commercial forestry. It is considered that the Carraig Gheal Wind Farm would be comfortably accommodated within the scale and character of the existing landscape, bringing about an acceptable evolution, or planned change to the Craggy Uplands LCT.

### **10.5 PREDICTED VISUAL EFFECTS**

#### **10.5.1 Introduction**

The findings from the viewpoint analysis have been used to form a conclusion as to the level of overall visual effect on visual amenity during operation, as viewed by people (receptors) and the significance of these visual effects in EIA terms.

The viewpoint analysis and field surveys indicate that significant visual effects could potentially occur at distances of up to 6 to 7km within the visual envelope, calculated to upper blade tip. The Amendment does not alter this overall analysis.

## 10.5.2 Predicted Visual Effects During Construction

Ground-based construction activity would be substantially screened by surrounding forestry and landform and visibility would be limited to the site area and adjacent high points on the surrounding plateau and Craggy Uplands LCT. These areas are generally of low visual sensitivity with few visual receptors and the overall visual effects are considered to range from slight to negligible and there would be no change to the visual assessment presented in the Environmental Statement (November 2004).

The visual effects associated with the gradual erection of turbines have been assessed under the operational effects as they would occur incrementally over the construction period, but would not exceed the final operational magnitude of effect.

## 10.5.3 Visual Effects on Residents During Operation

There would be no change to the residential assessment as a result of the amended layout, with the exception of Upper Achenna, which would be now be outwith the areas of visibility.

The assessment has identified that two properties (Balliemanoch Farm and Oaklea) that are likely to have direct or partly screened views of the wind farm that would appear in the background view at ~4.7km distance. As a result there could be significant visual effects on some of the views from these properties. However, it is not considered that these would be sufficient to adversely affect the visual amenity and setting of the properties overall. Slight improvements to the visual composition of the wind farm have been made to the view from Balliemanoch and this would be experienced from both of these residences.

## 10.5.4 Visual Effects on Residents in Settlements during Operation

There are predicted to be no significant visual effects experienced from settlements (as defined in the local plan) within the study area in relation to the Amendment. This is the same conclusion as that presented in the Environmental Statement (November 2004).

## 10.5.5 Visual Effects on Road and Rail Users During Operation

There are predicted to be no significant visual effects experienced by road and rail users on routes following the A83, A85, A819, B840, B845, the minor road to the north western side of Loch Awe and the railway line to Oban, within the study area (excepting ~0.6km between Blarghour and Balliemanoch on the B840). This is the same conclusion as that presented in the Environmental Statement (November 2004) although there would be a slight improvement to the potential visual composition as viewed from the B840.

Other routes including the A886, A815, A83 (Loch Fyne), and the A828 would be located outwith the visual envelope calculated to upper blade tip for the Amended Carraig Gheal Wind Farm.

## 10.5.6 Visual Effects on Recreational Receptors During Operation

There would be some locally significant visual effects from a small number of recreational viewpoint locations, notably at Loch Nant, Portsonachan, and Blarghour as follows:

### 10.5.6.1.1 Loch Nant

Fishermen and occasional walkers at Loch Nant would experience the Wind Farm and the visual effects would vary from moderate to negligible depending on location and amount of forestry screening. This is the same conclusion as that presented in the Environmental Statement (November 2004). However, the visual composition and the design as viewed from this area has been slightly improved and should not automatically be perceived as negative.

### 10.5.6.1.2 Loch Awe

Road users, residents, and walkers at Loch Awe would experience the Wind Farm. The magnitude of change, visible from Loch Awe would vary

from high to negligible depending on location and amount of screening. Significant visual effects would be visible from viewpoints along the shoreline at Portsonachan and Blarghour and the jetty and foreshore of Ardbrecknish House.

Considering the composition of the Wind Farm within the landscape setting, the type of effect should not automatically be considered as negative, and includes some positive compositional features. For example at Portsonachan the development would be readily accommodated within the simple landscape and given the scale and visual composition, the Wind Farm would add a new focus or feature to this view, which would not compete with the existing views of Ben Cruachan in the opposite direction. This is the same overall conclusion as that presented in the ES (November04). However, the visual composition as viewed from each of these locations has been slightly improved.

Other recreational locations include Loch Avich, Glen Nant, mountain summits the Loch Lomond and the Trossachs National Park, Kilmartin Glen, the National Cycle Route, the Old Dover's Route, National Scenic Areas, Historic Gardens and Designed Landscapes such as Torosay Castle, and the islands such as Lismore, and Mull. These would not be significantly affected by views of the Amendment.

## **10.6 PREDICTED CUMULATIVE VISUAL EFFECTS**

Cumulative visibility maps and wireframes have been prepared to assist the cumulative assessment, which considers the combined effects of other operating (already assessed as part of the baseline), consented, or proposed wind farms within the area. The assessment has considered both the potential effects of simultaneous visibility from one location and sequential visibility from a route through the landscape.

### **10.6.1 Cumulative Visibility Maps**

A series of revised cumulative visibility maps have been prepared to upper blade tip with no exclusion for the effects of forestry screening as follows:

- Definitions of Wind Farms for Cumulative Assessment (Visibility Map CLVIA A1);
- Operational Wind Farms (Visibility Map CLVIA A2);
- Operational and Consented Wind Farms (Visibility Map CLVIA A3);
- Carraig Gheal, Inverliever and Cumulative Baseline (Visibility Map CLVIA A4);
- Total Wind Farms Visible (Visibility Map CLVIA A5).

In each case, the extent of cumulative visibility indicated is very similar to the cumulative visibility maps within the Carraig Gheal Environmental Statement: Figures (November 2004). The Inverliever proposal has remained as part of the assessment although it has recently been refused by Argyll and Bute Council.

### **10.6.2 Cumulative Viewpoint Analysis**

Most of the cumulative effects have already been assessed (within this document) as these mainly relate to the visual combinations of the existing Beinn Ghlas Wind Farm with the Carraig Gheal Wind Farm.

Revised Cumulative Visualisations have been prepared to illustrate the Amendment from viewpoints 7, 11, 15, and 21 and take account of the existing Beinn Ghlas and Cruach Mhor wind farms, An Suidhe Wind Farm (consented), and the Inverliever Wind Farm (refused), in addition to the Carraig Gheal Wind Farm.

Each of the viewpoints have been re-examined in respect of the Amendment and the potential for cumulative effects. Changes resulting in the amended layout for Carraig Gheal have not affected the conclusions listed in Section 10.10.2 of the Carraig Gheal Environmental Statement: Main Report (November 2004). However, a slight improvement has been identified at all of the viewpoints and in respect of the illustrated cumulative viewpoints as follows:

- Viewpoint 7: Blarghour - The Amendment would lead to a low level improvement in the visual composition of the Wind Farm and achieves the visual improvements requested during consultation (Table 10.2: Amended Viewpoint Analysis). In addition to the Beinn Ghlas and Carraig Gheal Wind Farms (already assessed), the proposed Inverliever Wind Farm (refused) would also be potentially visible at ~8km distance though the wind farm would be partly screened by intervening forest. The additional magnitude of change would be low and not significant;
- Viewpoint 11: Ben Cruachan – The consented but not yet built An Suidhe and Clachan Flats wind farms, existing windfarms and the Inverliever wind farm (refused) are predicted to be visible. The additional magnitude of change contributed by Carraig Gheal in combination with other windfarms visible from this location for recreational receptors is low and not significant;
- Viewpoint 15: Beinn Bhuidhe – The consented but not yet built Clachan Flats Wind Farm would exert the main visual influence at this location. The additional magnitude of change for recreational receptors contributed by Carraig Gheal in combination with other windfarms visible from this location would be negligible and not significant when viewed from this distance;
- Viewpoint 21: Beinn an Lochain - The consented but not yet built Clachan Flats Wind Farm would exert the main visual influence at this location. The additional magnitude of change for recreational receptors contributed by Carraig Gheal in combination with other windfarms visible from this location would be negligible and not significant.

### **10.6.3 Cumulative Visual Effects**

The findings from the analysis of the cumulative visibility maps and cumulative viewpoint assessment have been used to form a conclusion as to the level of overall cumulative visual effects during operation as experienced by various receptors.

#### **10.6.3.1 Residents**

The addition of the Inverliever Wind Farm (refused), to the views of Beinn Ghlas and Carraig Gheal Wind Farms (already assessed), would increase the cumulative visibility of windfarms from residential receptors between Eredine to Balliemanoach on the south eastern side of Loch Awe though often in successive views<sup>1</sup> due to the separation of the sites. These additional cumulative visual effects are considered as of low or negligible magnitude. This is the same conclusion as that presented in the ES (November04).

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- <sup>1</sup> A cumulative sequential view is where more than one wind farm may be visible from different locations along particular routes through the landscape, such as a main road or a popular footpath.
  - A cumulative simultaneous view is where more than one wind farm is viewed in the same “view”, when the viewer is facing on one direction (assuming an approximate 90 degree field of view).
  - A cumulative successive view requires the viewer to turnaround at a viewpoint in order to see different wind farms that would not otherwise be visible when facing in one direction.

### **10.6.3.2 People Undertaking Recreational Activity**

Overall, the visibility maps show that simultaneous visibility of multiple wind farms is generally restricted to higher ground including some popular mountain summits. At these locations Carraig Gheal Wind Farm is generally viewed at distance, and where other wind farm development closer to the viewer is likely to provide the dominant visual influence (e.g. at Beinn Bhuide and Beinn an Lochain where a number of wind farms may be visible).

No significant cumulative visual effects, affecting recreational receptors, have been identified, due to the intervening distance between the wind farm locations and the viewpoint locations such as popular mountain summits or higher levels of vegetation screening. This is the same conclusion as that presented in the ES (November 2004).

### **10.6.3.3 People Travelling Routes**

The cumulative visibility maps show that visibility of wind farm developments from travel routes is relatively restricted with visibility tending to be concentrated on the valley sides and upper slopes and high ground. Some visibility is possible as simultaneous and sequential views of wind farm development. However, no significant cumulative visual effects are predicted overall. This is the same conclusion as that presented in the Environmental Statement (November 2004).

The probability of these cumulative effects occurring is certain in respect of the existing Beinn Ghlas and Cruach Mhor wind farms, and should be regarded as uncertain in respect of the Clachan Flats and An Suidhe wind farms, which are both consented, but not built. The probability of potential cumulative effects in relation to the Inverliever Wind Farm (refused) should be regarded as unlikely or unknown.

## **10.7 CONCLUSIONS**

The summary and conclusions of the LVIA for the Proposed Development (November 2004) and presented in the Environmental Statement (November 2004) are still valid in that the Amendment will not alter the significant visual effects identified in respect of the landscape and visual impact assessment for the Carraig Gheal Wind Farm (November 2004).

The Amendment will however provided some localised mitigation and reduced landscape effects by removing turbines and access tracks from the area around Carn Dearg within the site.

The Amendment will also lead to a slight improvement to the visual composition as experienced from the illustrated viewpoints and as such provides some further mitigation of significant visual effects from particular locations at Loch Nant, and along the B840 at Portsonachan, and the waters edge between Balliemeanoch and Blarghour (including two residential properties at Balliemeanoch Farm and Oaklea). Some of the visual effects identified will be cumulative, although the probability of these is only likely to be certain in respect of the existing wind farms.

Considering the visual context and the improvements, which have slightly reduced the overall landscape and visual effects, it is still considered that the visual effects should be regarded as acceptable.

## **10.8 REFERENCES**

Carraig Gheal Wind Farm Environmental Statement (November 2004).





## **Chapter 11**

# **Archaeology and Cultural Heritage Impact Assessment Amendment**

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## Summary

This assessment of the amended Carraig Gheal Wind Farm layout predicts that no significant adverse impacts will occur in relation to cultural heritage.

### 11.1 INTRODUCTION

This chapter evaluates the amendments to the Proposed Carraig Gheal Wind Farm in relation to their impact on the surveyed cultural heritage. It should be read in conjunction with Chapter 11 of the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004).

### 11.2 COMPANY CAPABILITY

This chapter was prepared by Simon Atkinson, Senior Archaeologist, and reviewed by Robert Johns, Consultant Archaeologist, both of whom are members of the Institute of Field Archaeologists.

Simon is currently working across the UK on a wide range of projects involving the management of archaeological fieldwork in advance of built and other development, including that in the renewable energy sector. He has also provided the desk-based archaeological and Cultural Heritage input to numerous projects. Simon previously worked as a field archaeologist and researcher since graduating in archaeology in 1989.

Robert has broad experience of the assessment of both urban sites and rural landscapes from a Cultural Heritage perspective both as part of Environmental Impact Assessments and for stand-alone reports. The renewable energy sector is one of the key areas of this work and recent projects have included assessments of proposed wind farms from across the UK. Prior to joining Entec, Robert worked as a field archaeologist and researcher. He graduated in archaeology in 1995.

### 11.3 METHODOLOGY

For the purpose of this assessment, the baseline situation is taken as unchanged from that described in Chapter 11 of the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004).

#### 11.3.1 Construction

Direct effects on features of cultural heritage can occur during the construction phase of a project. These are assessed through a comparison of the proposed layout design with the known distribution of features of cultural heritage interest.

A reduction in the number of turbines can be expected to reduce the potential for direct effects during the construction phase, but this will also depend on the location of the proposed turbines.

#### 11.3.2 Operation

Indirect effects on the setting of features of cultural heritage interest may occur during the operational phase of the development.

Indirect effects on features of Cultural Heritage interest can occur as a result of significant adverse changes to the setting of a feature, whether permanent or temporary. Although the setting of a feature can be considered whether or not it is legally protected, setting is most relevant to designated features of national importance, such as Scheduled Monuments (AMAAA, NPPG 5) and Category A Listed Buildings (NPPG 18).

A number of factors can affect whether a development may adversely affect the setting of a feature or monument. It is important to consider the eventual appearance of the development, and how significant or prominent this will be in views from the features being assessed. Relevant factors include:

- The distance between the monument and the development (see below), as well as the presence of any intervening buildings or vegetation, as this will affect the visibility and prominence of the development from the monument;
- The size, nature and layout of the development, or extent of development which will be visible from the feature;
- The extent to which the development reflects or alters the setting of the feature;
- The extent to which the existing environment reflects the original, or an appropriate, setting for the feature;
- The proposed duration of the development or potential effect. For example it may be considered that an adverse effect on setting will only occur during the construction phase of a development, or some developments are intended to be temporary. Effects that will be temporary are likely to be considered as less significant than if they were to be permanent.

## **11.4 ANALYSIS OF AMENDMENT**

The amendment involves a reduction in the number of turbines from 24 to 20, with relatively minor changes to the position of some of the retained turbines. Corresponding changes to the track layout are involved, including an overall reduction in track length.

The principal change involves the removal of turbines from the south-western part of the site, which will result in a smaller development footprint.

The overall effect can be expected to be a reduction of potential direct and indirect effects.

### **11.4.1 Assessment of Impacts**

#### **11.4.1.1 Construction**

The Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004), identified no significant impact during construction of the proposed development

The revised layout involves a reduction in the number of turbines and will result in a smaller development footprint (see Amendment Figure A2). None of the proposed changes in turbine location involve a move to the immediate vicinity of a known archaeological feature or to within an area of known archaeological interest (Amendment Figures A20a). There is also a reduction in the total track length with some new re-alignment of track to reflect the turbine layout changes. No re-aligned track sections are within or closer to known archaeological features.

Therefore, with the same mitigation incorporated (see Section 11.5.1, Environmental Statement (November 2004)) there would be no additional or increased potential effect in the construction phase (see Amendment Figure A20b). The reduced development footprint may result in a slight reduction in the magnitude of any effect.

#### **11.4.1.2 Operation**

Potential effects on the setting of each of the designated features included in the original assessment have been re-assessed in the light of the amended layout. The results are set out in the revised Appendix A11f.

The original assessment identified that any changes to the settings of designated features would be of a low magnitude and therefore of only minor significance. As a result of the reduction in the number of proposed turbines, fewer turbines will be visible from most designated features assessed. Therefore it is expected that overall effects on the setting of designated features may be expected to be reduced and will remain of minor significance only. There are no designated features for which any increased effect on the setting can be expected as a result of the proposed layout changes.

## **11.5 MITIGATION MEASURES**

### **11.5.1 Construction**

It is anticipated that all direct impacts on Cultural Heritage will occur during the construction phase, as that is when the land-take will occur. The site layout has been designed so that turbine locations, new access tracks and other aspects of intrusive development avoid the locations of known features of Cultural Heritage interest.

For archaeological remains of less than national importance, guidance (PAN 45) states that *'care must therefore be taken to ensure that they are not needlessly destroyed'*. It is appropriate for significant effects on such features to be compensated by a programme of archaeological field investigation and preservation by record, if their destruction is unavoidable. Remains of less than national importance have been identified within the site, but development design has avoided all known features. These will also be marked out, in advance of construction, in order that no accidental damage occurs through accidental transgression by machinery or dumping of materials. The movement of machinery will in any case be strictly limited to predefined and marked routes and managed in all areas of the site.

In light of the nature of features identified within the site and the possibility for further archaeological remains that have not previously been identified, some further mitigation of the effects of construction may also be necessary. It is proposed that an archaeologist will monitor intrusive construction works in areas of previously undisturbed ground, down to archaeologically sterile deposits, normally the surface of drift geology. This could be achieved as an archaeological 'watching brief' on construction, although the exact scope required will need to be agreed with the West of Scotland Archaeological Service.

This approach to mitigation is as set out in the Environmental Statement (November 2004).

### **11.5.2 Operation and Decommissioning**

The revised layout involves a reduction in the number of proposed turbines and continues to avoid any significant adverse effect.

No additional mitigation is proposed.

### **11.5.3 Conclusions**

#### **11.5.3.1 Construction**

The revised layout will make no significant changes to the assessment of construction impacts. As a result of the reduced footprint of the development there will be a slightly reduced potential for effects on previously unidentified features of archaeological interest. There are no predicted significant adverse effects.

#### **11.5.3.2 Operation**

The revised layout will result in an overall reduction in the number of turbines and some minor changes in the location of other turbines. Any changes to the settings of designated features will continue to be of a low magnitude at most, and will not result in significant adverse effects.

**11.6 REFERENCES**

Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report, GreenPower (Carraig Gheal) Ltd.

## **Chapter 12**

### **Noise Impact Assessment Amendment**

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## Summary

This assessment of the amended Carraig Gheal Wind Farm layout, incorporating updated data for the proposed turbine model, shows little change in impact at residential properties. Overall, it is predicted that the Amended Proposed Development will have a similar impact to that originally proposed and will meet the ETSU-R-97 simplified noise limit at all locations.

### 12.1 INTRODUCTION

This chapter evaluates the amendments to the Proposed Carraig Gheal Wind Farm in terms of noise impact at residential locations. It should be read in conjunction with the Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004): Chapter 12, November 2004.

#### 12.1.1 Company Capability

This revised assessment was carried out by the Hayes McKenzie Partnership of Salisbury and Machynlleth who were responsible for the previous assessment.

#### 12.1.2 Methodology

This revised assessment has been carried out according to the requirements of ETSU-R-97<sup>2</sup>, *The Assessment and Rating of Noise from Wind Farms*, as referred to in PAN 45<sup>3</sup>, *Renewable Energy Technologies* as relevant guidance on good practice.

Baseline noise measurements were not required as part of the assessment of noise impact for this site as it was established that predicted noise level will be below the simplified criterion of not exceeding 35 dB L<sub>A90</sub> for wind speeds up to 10 m/s as measured at 10 metres height, as referred to in ETSU-R-97.

Noise predictions have been carried out for the Amended Proposed Development turbine locations assuming the use of Vestas V90 3MW turbines as assumed for the original assessment.

The predictions were carried out using the methodology given in ISO9613-2<sup>4</sup>, *Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation*, assuming downwind propagation over hard ground noise, to give worst case predicted noise levels as described in the Environmental Statement (November 2004).

#### 12.1.3 Analysis of Amendment

The revised layout has been assessed in order to evaluate the noise impact at nearby residential locations. The Vestas V90 3MW turbine can be configured to run in different 'modes' designed to give varying levels of trade-off between noise level and power output. The modelling has been carried out based on the turbine configuration designed for maximum power output. Turbine noise levels vary according to hub height. The latest guaranteed source level data from Vestas, as used for these predictions, is given in Table 1.

**Table 1: Assumed Sound Power Levels**

Wind Speed at 10m Height (m/s)	Sound Power Level (dB LAeq) 65m Hub Height	Sound Power Level (dB LAeq) 80m Hub Height
4	96.4	97.0
5	101.5	102.0
6	105.3	105.8
7	107.8	108.2
8	109.1	109.3
9	109.4	109.4
10	108.0	106.7
11	106.1	105.9
12	105.8	105.7

The noise spectrum for this turbine was taken from the results of noise tests carried out to the requirements of IEC61400-11<sup>5</sup>, based on measurements carried out at 8 m/s but normalised to the overall sound power level for the relevant wind speed.

The turbine layout assumed is shown in Amendment Figure A2 and the turbine hub height is 65m or 80m as described in this Amendment: Chapter 3.

#### **12.1.4 Assessment of Impacts**

The highest source noise levels occur at a 10m height wind speed of 9 m/s for hub heights of both 65m and 80m. Noise predictions were therefore carried out for a 9km by 9km grid centred on the site for this wind speed. The results are plotted in the form of noise contours shown in Amendment Figure A21. This contour plot does not include any topographical shielding effects so levels at locations where there is significant shielding will be lower. In addition, it should be noted that where properties are up-wind of the wind turbines, noise levels will be significantly lower and even more so where upwind propagation is combined with shielding effects.

It can be seen that only one residential property, Upper Fernoch to the east of the proposed wind farm, falls within the 35dB  $L_{A90}$  contour. The worst case turbine noise level is predicted to be 35.5 dB. However, no turbines are visible from this location and hence, based on the methodology for the prediction of barrier attenuation given in Section 12.5.6 of the Environmental Statement (November 2004), noise levels can be expected to be 2 dB lower resulting in a noise level at this location of 33.5 dB or less; below the 35 dB limit.

All other properties fall outside the predicted 35 dB  $L_{A90}$  noise contour even without taking barrier attenuation into account.

A warranty agreement will be drawn up with the manufacturer in line with the expected noise levels used as the basis for the assessment. As described in the Environmental Statement (November 2004), the turbines for this site will be warranted not to emit audible tones of a level requiring a correction according to ETSU-R-97. Noise conditions should be based on noise levels at residential locations with respect to the simplified noise limit.

As described in the Environmental Statement (November 2004), levels of infra-sound from wind turbines are significantly below perception thresholds for this kind of noise. There is no reliable evidence of any adverse effects occurring below this threshold.

The assessment of noise at non-residential locations in Carraig Gheal Wind Farm Environmental Statement (November 2004): Main Report, Chapter 12 shows that noise from wind turbines meets Planning Policy noise limits for open spaces used for relaxation to within 100m of an individual turbine.

#### **12.1.5 Mitigation Measures**

No mitigation is required for turbine noise on this site.

#### **12.1.6 Conclusions**

A revised assessment of the likely noise impact of the proposed Carraig Gheal Wind Farm has been carried out. Noise predictions have been produced which show that the ETSU-R-97 simplified noise limit of 35 dB  $L_{A90}$  for 10m height wind speeds up to 10 m/s is met for all residential properties around the site.

A warranty agreement will be drawn up with the manufacturer in line with the expected noise levels used as the basis for the assessment. The turbines for this site will be warranted not to emit audible tones of a level requiring a correction according to ETSU-R-97. Noise conditions should be based on noise levels at residential locations with respect to the simplified noise limit.

As described in Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004), Chapter 12, levels of infra-sound from wind turbines are significantly below perception thresholds for this kind of noise. There is no reliable evidence of any adverse effects occurring below this threshold.

The assessment of noise at non-residential locations in Carraig Gheal Wind Farm Environmental Statement: Main Report (November 2004), Chapter 12, shows that turbine noise would meet Planning Policy noise limits for open spaces used for relaxation to within 100m of an individual turbine.

**12.1.7 References**

- Carraig Gheal Wind Farm Environmental Statement (November 2004) Main Report: GreenPower (Carraig Gheal) Ltd.
- Planning Advice Note 45, Renewable Energy Technologies: Scottish Executive Development Department, 2002
- ETSU-R-97, The Assessment and Rating of Noise from Wind Farms: ETSU for the Department of Trade and Industry, 1996
- ISO 9613-2, Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation: International Organization for Standardization, 1996
- IEC 61400-11, Wind Turbine Generator Systems, Part 11, Acoustic Noise Measurement Techniques: International Electrotechnical Commission, 2002



# **PART IV**

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## **Chapter 13**

### **Infrastructure and Telecommunications**

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### **13.1 INTRODUCTION**

While formal re-consultation will take place as a result of the submission of this amendment, given the physical envelope of development has been reduced and that no objections were raised to the Proposed Development (November 2004), it is not envisaged that the Amended Proposed Development will raise any new objections in relation to infrastructure and telecommunications.



# **Chapter 14**

## **Access**

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## **14.1 INTRODUCTION**

The access impact assessment as presented in Chapter 14 of the Environmental Statement: Main Report (November 2004) stands and as such no amendment to that chapter is proposed here.



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**Emissions Reduction**

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## 15.1 INTRODUCTION

It is predicted that Carraig Gheal Wind Farm will produce up to 170GW.h of electricity per annum.

Given the way in which the electricity grid is operated in Scotland, it is most likely that generation from Carraig Gheal Wind Farm will displace the most expensive marginal fuel on the system. Currently this role is carried out by coal-fired power stations such as Longannet and Cockenzie. Scottish Power's published figures for CO<sub>2</sub> emissions from Longannet equate to emissions of 0.968 tonnes of CO<sub>2</sub> per MWh generated over 2001/2002 and 0.952 for the year 2003<sup>1</sup>. Taking an average of 0.96 tonnes per MWh, Carraig Gheal Wind Farm could displace 160,000 tonnes of CO<sub>2</sub> per annum<sup>2</sup>.

In 2007 the British Electricity Trading and Transmission Arrangements, BETTA, will be introduced. BETTA may influence the way in which generation is scheduled and what power source will be displaced. However statistics do not yet exist to estimate the likely CO<sub>2</sub> displacement post the introduction of BETTA.

## 15.2 PREDICTED ANNUAL GENERATION

Carraig Gheal Wind Farm is predicted to operate at a capacity factor<sup>♦</sup> of between 30% and 35%. At an installed capacity of 60MW, this gives a predicted annual output for Carraig Gheal Wind Farm of between 157.68GW.h and 183.96GW.h. The calculation is detailed below:

Annual Electricity Generation = *Rated Capacity* x Hours in a year x *Capacity Factor*

At 30% capacity factor       = 60 x 8760 x 0.30  
= 157.68GW.h

At 35% capacity factor       = 60 x 8760 x 0.35  
= 183.96GW.h

## 15.3 CALCULATING CO<sub>2</sub> AVOIDANCE

In calculating CO<sub>2</sub> avoidance, it is necessary to consider what generation plant is most likely to be displaced by generation from Carraig Gheal Wind Farm.

The Scottish electricity system consists of a range of generating plant with differing characteristics. Some technologies are considered to provide base load (such as nuclear

<sup>1</sup> While Longannet has in place a programme to reduce NO<sub>x</sub> and meet international standard ISO 14001 no evidence is found to suggest the lower CO<sub>2</sub> rate for 2003 was due to a programme of emissions reduction, so it is fair to take an average.

<sup>2</sup> Cockenzie is configured for use as a marginal station (Scottish Power website, "Cockenzie Power Station: Introduction") and has higher CO<sub>2</sub> emissions per unit (an average of 1.021 tonnes per MWh) than Longannet. The lower figures for Longannet are used here, however, in order to make a conservative prediction.

<sup>♦</sup> Capacity Factor: the capacity factor is a measure that indicates the ratio of the mean actual output of the generating station to its maximum theoretical output (assuming it operated at full rating 24 hours a day, 7 days a week, all year). A capacity factor of 35% indicates that if all the output of the wind farm were averaged over the year it would be equivalent to a power station of 35% the capacity operating at full output all year. For renewable energy sources the capacity factor is a measure of the intermittent nature of the energy source. For a conventional fossil fuel power station it is a measure of the commercial decisions made in operating the station (it may be only operated when energy prices are high or when there is a shortage of power on the system) as well as the reliability of the power station.

power) as they cannot be controlled to meet fluctuations in demand. Other technology such as large hydro power can respond very rapidly to fluctuations in demand - or to changes in the commercial power markets. The decision as to which plant operates is based upon a complex set of decisions based on operating costs, "marginal cost" for generating an "extra" unit of electricity and available fuel (e.g. water levels in a hydro scheme, wind speed at a wind farm). It is therefore extremely difficult to define exactly which plant will be operating at any specific time in the future and even the mix of plant, which can vary from year to year.

The electricity system seeks to operate in the most cost efficient way. That should generally mean that when generation increases from unpredictable sources, such as wind power, the system operator would seek to reduce output from the most expensive marginal station on the system. That is, they consider which plant can respond to the effective reduction in demand and select the most expensive to reduce output.

Currently in the UK and Scotland coal is most expensive marginal power source on the system and is the source most often varied to match fluctuations in effective demand<sup>3</sup>.

Scottish Power have quoted a figure for Longannet of 0.968 tonnes of CO<sub>2</sub> per MWh generated for the period 2001-2002 and 0.952 tonnes of CO<sub>2</sub> per MWh for the year 2003<sup>4</sup>, from which we take an average of 0.96 tonnes per MWh. Based on an equivalent generation as detailed above, Carraig Gheal is predicted to avoid between 151,373 and 176,602 tonnes of CO<sub>2</sub> per year. For ease an average figure of 164,000 tonnes of CO<sub>2</sub> will be used as the estimate. The calculation is detailed below.

Avoided CO<sub>2</sub> = Electricity generated x Conversion Factor

At 30% capacity factor = 157,68 x 0.96  
= 151,373 tonnes CO<sub>2</sub>/year

At 35% capacity factor = 183,96 x 0.96  
= 176,602 tonnes CO<sub>2</sub>/year

## 15.4 CONCLUSION

Carraig Gheal Wind Farm can make a contribution to reducing emissions in the Scottish and UK context. The exact volume of reduction is difficult to determine and depends on a complex set of operating conditions. However it can be estimated that Carraig Gheal will contribute a 164,000 tonne per annum reduction in UK emissions of CO<sub>2</sub>.

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<sup>3</sup> NGC 7-Year Statement 2005

<sup>4</sup> Scottish Power Environmental Performance Report: Appendices. 2003/2004

# **PART V**

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## **Chapter 16**

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## 16.1 INTRODUCTION

This Chapter summarises all assessments and evaluations contained within the Environmental Statement (November 2004) and this Amended Environmental Statement. This Amendment Chapter 16 supersedes Chapter 16 of the Environmental Statement (November 2004).

Reference should be made to Chapter 5, which addresses site selection and design alternatives. Inherent in the final Proposed Development design are numerous mitigation measures reflecting issues raised in relation to the topics considered within this Amended Environmental Statement and the Environmental Statement (November 2004).

## 16.2 SUMMARY OF ENVIRONMENTAL ASSESSMENT CONCLUSIONS

### 16.2.1 Vegetation and Flora Impact Assessment

The impact assessment reported in Chapter 6 was based on field surveys using the National Vegetation Classification and appraised the vegetation communities and flora according to their conservation importance, assessed the potential impacts and defined recommendations for mitigation.

The surveys confirmed the presence within the Study Site of the following vegetation types listed on Annex 1 of the EU Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/EEC):

- Blanket Bog (active only) (NVC communities M15, M17);
- Species-rich *Nardus* grassland in upland areas (NVC community CG10);
- Limestone Pavements (NVC community CG10),
- Dry Heath (NVC communities H10, H21);
- Northern Atlantic Wet Heath with *Erica tetralix* (NVC community M15);
- Alkaline Fen (NVC community M10);
- Oligotrophic waters containing very few minerals of Atlantic sandy plains with amphibious vegetation: *Lobelia*, *Littorella* and *Isoetes* (NVC community A22);
- Dystrophic lakes (NVC communities M1 and M3);
- Old oak woods with *Ilex* and *Blechnum* in the British Isles (NVC community W17).

Based on the quality, extent and condition evaluated during the field surveys it was assessed that no habitats of *International Value* or *National Value* were confirmed within the Study Site. However, the Limestone Pavement (NVC CG10a calcareous grassland) associated with the limestone pavement formation was assessed to be of *Regional Value*. The remaining types listed above are considered to be of *High Local Value*.

The assessment also determined that the Study Site supports a number of plant species that are *Locally Notable*, *Locally Scarce* and *Nationally Scarce*, including: Intermediate Bladderwort *Utricularia intermedia*, Water Lobelia *Lobelia dortmanna*, Melancholy Thistle *Cirsium heterophyllum* (*C. helenoides*), Yellow Water-lily *Nuphar lutea*, Marsh Hawk's-beard *Crepis paludosa*, Marsh Ragwort *Senecio aquaticus*, Oak Fern *Gymnocarpium dryopteris*, Bitter Vetch *Lathyrus montanus*, Alpine Clubmoss *Diphasiastrum alpinum*, *Sphagnum magellanicum*, Lesser Bladderwort *Utricularia minor*, Mountain Everlasting *Antennaria dioica*, Floating Bur-reed *Sparganium angustifolium*, White Water-lily *Nymphaea alba*, Juniper *Juniperus communis*, Marsh Cinquefoil *Potentilla palustris*, Slender Sedge *Carex lasiocarpa*, Stone Bramble *Rubus saxatile*, Yellow Saxifrage *Saxifraga aizoides*, Northern Bedstraw *Galium boreale*, Water Avens *Geum rivale*, Mossy Saxifrage *Saxifraga hypnoides*, Green Spleenwort *Asplenium viride*, Alpine Meadow-rue *Thalictrum alpinum*, Early Purple Orchid *Orchis mascula*, Carnation Sedge *Carex flacca*, Brittle Bladder Fern *Cystopteris fragilis*, Hart's-tongue Fern *Asplenium scolopendrium*, Lesser Twayblade *Listera cordata*, *Sphagnum imbricatum*, Bog Sedge *Carex limosa*, Least Bur-reed *Sparganium minimum*, Great Sundew *Drosera anglica*, Hairy Rock-cress *Arabis hirsuta*, Meadow Oat-grass *Avenula pratensis*, Nodding Melick *Melica nutans* and Bog Orchid *Hammarbya paludosa*.

The assessment determined vegetation types which have a high sensitivity to potential impacts from turbine locations and access tracks, namely: Blanket Bog (active only) (M17), Dystrophic lakes (M1 and M3); Species-rich *Nardus* grassland in upland areas (CG10) and Limestone Pavements (CG10) and Alkaline Fen (M10).

The proposed wind farm could result in the following key impacts:

- Potentially low impacts due to permanent direct loss of habitats to the footprint of the turbines and access tracks;
- Potentially low - moderate impacts due to temporary direct loss of habitats in the construction area beyond the footprint of the turbines and access tracks;
- Potentially moderate impacts due to permanent indirect impacts through alterations to hydrology;
- Potentially moderate impacts due to temporary indirect impacts from construction;
- Potentially moderate impacts on habitats/flora due to decommissioning impacts.

Mitigation measures are recommended to reduce the residual significance to low levels. These are:

- An Environment Management Plan should be implemented to ensure appropriate restoration of habitats affected by construction and enhanced management of existing habitats as compensation;
- An Ecological Watching Brief should be undertaken throughout the construction phase;
- A number of specific mitigation measures should be carried out, as prescribed in Chapter 6 and summarised in Appendix 5b: Schedule of Environmental Commitments.

All residual effects are regarded as not significant.

## 16.2.2 Protected Mammals Impact Assessment

The impact assessment reported in Chapter 7 considered the potential for the Amended Proposed Development to have effects on the following protected mammal species:

- Otter *Lutra lutra*;
- Water Vole *Arvicola terrestris*;
- Badger *Meles meles*;
- Pine Marten *Martes martes*;
- Wildcat *Felis silvestris*;
- Red Squirrel *Sciurus vulgaris*;
- Bats (All species).

The only protected mammal species whose presence was confirmed (from desktop assessment and during field surveys) within the Study Site was Otter. Evidence in the form of two spraints was recorded on the shore of the un-named loch south of Ban Lon (Grid Ref NM 97448 19741), approximately 80m from the nearest proposed turbine. No resting up sites were confirmed in the vicinity of this loch, and significance of impacts on this species are considered to be mostly negligible to low. One moderate impact significance, before mitigation, is predicted in relation to possible pollution to watercourses.

Potentially suitable habitat for Water Vole was confirmed at two watercourse locations, namely the Allt na Maoile and Allt Gleann na h Airigh. However, the presence of this species was not confirmed. A potentially moderate impact significance on the potential loss of habitat has been identified where the access track runs parallel with the Allt na Maoile and Allt Gleann na h Airigh.

A low impact significance is predicted for all other mammals listed above.



The assessment put forward key recommendations to facilitate implementation of mitigation measures. These are:

- An Environment Management Plan should be implemented to create positive habitat enhancement;
- A Site Environmental Management Procedure should be in place during the construction and operational phases;
- An Ecological Watching Brief should be undertaken throughout the construction phase;
- A Pre-Construction Survey should be undertaken for Water Vole in Potentially Sensitive Areas;
- A number of specific mitigation measures should be carried out, as prescribed in Chapter 7 and summarised in Appendix 5b: Schedule of Environmental Commitments;
- Appropriate consideration should be given to protected mammal species during decommissioning of the site or should the turbines be replaced following the end of their operational lifetime.

It is predicted that, after mitigation, the proposed Carraig Gheal Wind Farm will not have any significant effect on protected mammal species.

### **16.2.3 Ornithology Impact Assessment**

The ornithology assessment presented in Chapter 8 considered the potential for the Amended Proposed Development to affect a range of key sensitive bird species and their habitats.

The field surveys and desk-top assessment concluded that the key species for which there was potential for significant effects from the Wind Farm were:

- Merlin;
- Red throated diver;
- Golden eagle; and
- Golden plover.

The assessment considered the range of physical elements of the amended wind farm and activities that take place during construction, operation and decommissioning and evaluated their potential to contribute to:

- Direct loss of habitat (for nesting or for feeding) for example through land take;
- Indirect loss of habitat through disturbance;
- Collision risk, principally with the turbines themselves.

The assessment found that all direct impacts during construction that would result in habitat loss for the key species or to their habitats will be of low or negligible significance.

The assessment determined that the location of turbines and access tracks was very important to avoid the potential for moderate to high magnitude impacts to key species from direct disturbance during construction and operation. The amended layout has accommodated layout changes to reflect these sensitivities.

The assessment determined that impacts from operational activities would potentially be significant for Red-throated Diver and Merlin arising from potential disturbance at certain times of the year, but that these could be addressed through mitigation.

The assessment determined that impacts from operational activities would be not significant for Golden Eagle and Golden Plover.

The operational activities are predicted to have no significant effects on the other bird species present on the site.

The assessment put forward key recommendations for mitigation measures. These include:

- A Site Environmental Management Procedure to be in place during construction and operational phases. The Procedure should include:
- A pre-construction (or early in breeding period if construction already commenced) survey to identify locations of sensitive nesting species;
- A programme of timing of works to ensure nesting species are not disturbed;
- A procedure for site work in the vicinity of active bird nest sites. All works should be excluded in the area and specialist advice sought, to determine suitable set-backs or buffer zones;
- A procedure to ensure all site workers are trained in relation to ecological requirements, that includes the sensitivity to pollution and procedures to avoid these potential effects;
- An Ecological Watching Brief to ensure flexibility and due consideration is given to ecological requirements throughout the construction phase.
- A Land Management Plan should be implemented for the site, the main aim being to create positive habitat enhancement for the bird resource, with particular reference to key species. The Plan should be agreed with SNH and the landowners. This should include:
  - Habitat requirements for all key bird species should be considered with the aim of the enhancement of the structure and the diversity of habitats (e.g. base-rich grassland);
  - Within the moorland areas, a diversity of age classes of heather should be aimed for in order to raise the live prey for raptors;
  - The carrion resource should be managed on and off site for the benefit of Golden Eagles;
  - Areas of native scrub and native woodland should be created;
  - Installation of artificial nest sites for divers should be explored along with predator control around water bodies.

Long term monitoring is also recommended to assess the effectiveness of habitat enhancement on the bird resource and to monitor impacts of the wind farm on birds.

It is suggested a full impact assessment and evaluation be undertaken, in accordance with legislation and best practice guidelines, at the time of decommissioning. The assessment stated it is considered the impact of any turbine removal is unlikely to be significant if suitable mitigation is put in place.

On the assumption that all mitigation measures are followed, the assessment concluded that all residual impacts would be not significant.

#### **16.2.4 Hydrology Impact Assessment**

Amendment Chapter 9 presented a hydrological impact assessment on clear water streams, blanket peat, deep peat and wet peat mires and their associated biology and vegetation communities, for the Amended Proposed Development. Consideration was also made of private water supplies for local properties.

The assessment identified seven types of potential hydrological impacts during the construction phase of the project. These relate to effects on stream water quantity and quality and their freshwater ecology, peat bog/mires and their vegetation communities, the integrity of peat resources and the potential for construction activities to cause peat erosion and peat slides. Private water supplies are not predicted to be affected by the development.

During construction, two types of impacts were assessed as being of potentially major significance and two impacts as of potentially moderate to major significance.

The potentially major impacts were:

- The potential for excavation activities to sever peat hydrological flows, resulting in alterations of the groundwater and stream flows;

- The potential for the generation of sediments or accidental spills of fuels or chemicals to adversely affect stream water quality and hence adversely affect freshwater biology.

The potentially moderate to major impacts were:

- the potential for excavation activities to cause soil and peat erosion; and
- the potential for laydown of construction materials or excavated spoil on wet and deep peat to cause peat slides.

No impacts were considered to be of major significance during the operational phase of the wind farm.

During decommissioning of the wind farm, two impacts are rated as being of “moderate to major” significance. These are the potential for excavation and removal of wind farm components to interrupt hydrological flows in peat and to alter groundwater conditions and stream water flows, as well as the potential for excavation of components to damage peatland and mire vegetation communities directly, possibly causing soil and peat erosion. The removal of stream crossing points, is unlikely to occur since it would be more damaging to remove these structures than to leave them *in situ*.

A series of both generic and specific mitigation measures are prescribed in Section 9.7 of the Environmental Statement (November 2004). These include working methods for carrying out construction works in hydrologically sensitive areas, specialised mitigation techniques such as in-stream sediment trapping and a rapid response plan for handling any adverse impacts to potable water supplies or accidents such as spillages of fuels.

The generic mitigation measures, as described in Section 9.7.1 of the Environmental Statement (November 2004), are:

- **Using the existing forestry track** - to prevent the need for certain sections of access road construction;
- Re-routing of any new track and cable trench to completely avoid the impact;
- **Re-location of turbines** to completely avoid the impact;
- **Choosing all new stream crossing points carefully** to minimise any adverse effects on water quantity or quality;
- **Incorporation of design elements into track construction** in marshy areas to ensure that there is free drainage and hydrological movement either through or beneath the track;
- **Designation and fencing-off of a buffer zone** where tracks cross streams and where there is the need for track/culvert widening or reinforcement;
- **Ensuring the speedy completion of construction** works taking place near hydrologically sensitive areas so that water flows and freshwater biology are affected for the minimum amount of time;
- Ensuring that all materials (especially fuel oils) storage areas on site are adequately bunded and protected so that there can be no spillages or leaks;
- **Ensuring that a rapid response plan** has been devised and will be implemented if there are any incidents such as spillages of contaminating materials.

In addition to the above, a number of specific mitigation measures are described in Sections 9.7.2 to 9.7.8 of the Environmental Statement (November 2004) and summarised in Appendix 5b: Schedule of Environmental Commitments. These relate to specific activities and locations where potentially significant impacts could occur.

The assessment of the Amended Proposed Development concludes that the proposed mitigation measures adequately reduce all identified hydrological impacts in all three phases of the project, to a level of minor or lower, which are therefore considered not to be significant effects as reported in the Amendment Chapter 9: 9.12, Conclusions.

## **16.2.5 Landscape and Visual Impact Assessment**

The assessment established that the Amended Proposed Development would be located within the Craggy Uplands Landscape Character Type (LCT) within an area identified by SNH to be of low sensitivity for wind farm development. The area is also identified as a 'Preferred Area' for wind farm development in Argyll and Bute Council's Approved Structure Plan. The assessment noted the importance of woodland and forestry within the Loch Awe area to the maintenance of landscape capacity for wind farm development.

The assessment identified that landscape and visual effects were considered during project design and that the site layout had been optimised from the assessment viewpoints which included the south eastern shoreline of Loch Awe, mountain summits (e.g. Ben Cruachan) and elevated areas within the Craggy Uplands LCT.

The assessment identified that wind farm development was already likely to become a characteristic element of the Craggy Uplands (Beinn Ghlas Wind Farm exists and An Suidhe Wind Farm is consented). This was predicted to be likely to lead to the sub-division of the LCT into areas of Craggy Upland and areas of Craggy Upland with Wind Farm and Forest. This LCT subdivision was less likely to be reinforced by the Proposed Carraig Gheal site due to its relative proximity to Beinn Ghlas.

The assessment concluded that there was a rationale for broad scale landscape management that sought to cluster or concentrate the modification of landscape character to areas where the semi-natural characteristics had already been diluted by previous development and landuse. The Carraig Gheal Wind Farm could therefore be comfortably accommodated within the scale and character of the existing landscape, bringing about an acceptable evolution or change to the Craggy Uplands LCT and the associated landscape effects would not be significant.

The assessment concluded that there would be no significant landscape effects on designated landscapes including the Loch Lomond and the Trossachs National Park, National Scenic Areas, Historic Gardens and Designed Landscapes, regionally designated AGLV's and ALLI's that were within the LVIA Study Area.

The assessment identified that views of the ground based construction activity would be largely contained by the undulating topography within the Craggy Uplands LCT and that the associated access tracks and site substation (which would be subject to sensitive detail design) would not be widely visible. There would be no view of these activities from the nearest residential properties at Musdale, Lower Fernoch, Upper Achenna, and Inverinan, though from distant views (over 10km) of the site, activity would possibly be discernible from viewpoints such as the Dalmally Monument and Ben Cruachan. Overall due to the distance and the temporary nature of the works, the assessment concluded that there would be no significant visual effects of construction.

The assessment has concluded that there could be significant visual effects on two properties (Balliemanoach Farm and Oaklea both at ~4.7 km distance) though considered that these would not adversely affect the visual amenity of their residents or the setting of these properties overall. The assessment considered that further properties (approx 6 in number) between Balliemanoach, and Blarghour would have an oblique or partly screened view of the development but that this was not a significant visual effect. The significant effects were considered unlikely to be negative and more probably neutral, particularly as the Amendment has enhanced the visual composition of the Wind Farm when viewed as a group and within its landscape setting.

The assessment concluded that there would be no significant visual effects on settlements within the LVIA Study Area as a result of a combination of their distance to the turbines and the extent of the intervening screening provided by landform or vegetation.

The assessment identified that glimpsed and intermittent views of turbines or blade tips may be possible from a number of roads within the LVIA Study Area. The assessment concluded that, with the exception of a short section (~0.6km between Blarghour and Balliemeanoch) along the B840 alongside Loch Awe, there would be no significant visual effect on people (receptors) travelling along road or rail transport routes. The likely views of the wind farm from along the B840 have been subject to further enhancement of the proposed composition (through the design of the Amendment) and were considered unlikely to be negative and more probably neutral.

The assessment identified the potential for the proposed Carraig Gheal Wind Farm to be visible to recreational and tourist receptors at a range of locations but concluded that significant visual effects would be restricted to a small number of viewpoint locations, notably at Loch Nant, Portsonachan and Blarghour. The assessment went on to conclude that considering the scale and visual composition of the wind farm, the type of effect should not automatically be considered as negative, and included some positive compositional features, which would add a new focus or feature to the view, without competing with the existing views.

### **16.2.6 Cumulative Landscape and Visual Impact Assessment**

The cumulative visual assessment within Chapter 10 has identified that visual effects would, or already occur within the area at limited locations arising from other wind farms. These comprise:

- Beinn Ghlas Wind Farm – significant visibility from Loch Nant;
- Carraig Gheal Wind Farm – potentially significant visibility from Loch Nant, Portsonachan Hotel, and intermittent locations along the B840 and waters edge between Balliemeanoch and Blarghour;
- Inverliever Wind Farm - potentially significant visibility from Loch Avich and intermittent locations along the B840 and waters edge between Eredine and Balliemeanoch.

The assessment has identified the potential for cumulative visual effects on residents to be largely restricted to properties along the B840 between Eredine and Balliemeanoch. In most cases the views would be successive rather than simultaneous and the cumulative visual effects were concluded not to be significant.

The assessment identified the potential for sequential cumulative visual effects on the southern shoreline of Loch Awe (affecting ~ 9.8km out of the total ~47km of the combined route of the A819 / B840), though the visibility of wind farms (potentially of Inverliever, Beinn Ghlas and Carraig Gheal) would be reduced due to high levels of tree screening. The assessment concluded that this was not significant and that the potentially significant cumulative visual effects in association with the proposed Carraig Gheal Wind Farm would be absorbed within the wider environs and visual experience of Loch Awe.

The assessment concluded that there would be no significant cumulative visual effects of Carraig Gheal with the An Suidhe and Clachan Flats Wind Farms, with cumulative visibility limited to mountain summits and upper slopes at some distance. It also concluded that there would not be a significant cumulative effect with Carraig Gheal and Cruach Mhor due to very little cumulative visibility.

The assessment concluded that the overall effect in the Craggy Uplands LCT would be a modern landscape with small and medium clusters of wind farm development, generally well sited and located within the landscape setting of the area and as such not exceeding the landscape and visual capacity for wind farm development. It concluded that cumulative visual effects associated with other wind farms would be largely contained within separate Regional Landscape Character Area's and would not be significant. It also concluded that effects on views from popular mountain summits, although potentially including a number of wind farm developments, would not be significant, principally due to the intervening distance.

The assessments concluded overall that the Carraig Gheal Wind Farm would be located within the Craggy Uplands LCT, which has a recognised capacity for wind farm development. The Wind Farm would occupy an undistinguished area of a non-designated landscape character presenting a simple composition, and appearing as a new feature or visual focus, set within a broad and simple landscape. The overall landscape effects were concluded to be acceptable, the Wind Farm would be comfortably accommodated within the scale and character of the existing forest, bringing about an acceptable evolution or change that would be permanent, but ultimately reversible. Significant visual effects would be limited to two properties, but would not adversely affect the visual amenity of their residents or the setting of these properties overall, and to recreational viewpoints at Loch Nant, Portsonachan, Blarghour and intermittent locations along the B840 and waters edge between Balliemeanoch and Blarghour. The significant effects were considered unlikely to be negative and more probably neutral.

### **16.2.7 Archaeology and Cultural Heritage Impact Assessment**

The assessment reported in Amendment Chapter 11 has identified that the design measures incorporated in the Amended Wind Farm layout have minimised any direct effects on features of cultural heritage interest. As a result of this, it is predicted that there will be no direct effects on known features as a result of the Amended Proposed Development.

The assessment concludes that there is some limited potential for the presence of further archaeological remains, not previously identified within the site. However, given the small scale of intrusive works, archaeological monitoring (commonly referred to as an archaeological 'watching brief') would enable identification of archaeological remains and their preservation by record. This would be expected to represent adequate mitigation of any such loss.

The assessment has identified only limited indirect effects on the setting of scheduled monuments within the vicinity of the site. Most of the scheduled monuments from which the site will be visible are alongside Loch Awe, and the settings of these are principally defined by the Loch and its shore. There may be further, minor indirect effects on more distant scheduled monuments though these will be limited by distance, topography and interposing vegetation and are not considered to be significant.

The assessment concludes remaining effects, especially on Scheduled Monuments, should be seen in the context of a landscape that has changed considerably since that contemporary to many of these monuments. The key consideration is that such effects are temporary and reversible, subject to eventual decommissioning of the Wind Farm.

### **16.2.8 Noise Impact Assessment**

The assessment reported in Amendment Chapter 12 compared the predicted turbine noise levels with the 'simplified' criterion of 35 dB LA90 for wind speeds of up to 10 m/s (measured on site at 10 metre height).

This criterion was found not to be exceeded at any existing residential location.

The assessment noted that the manufacturer of any turbines to be installed on the site will be required to guarantee that any tonal components in the noise will be below the level at which a correction or 'penalty' is required under the ETSU-R-97 assessment methodology.

Noise conditions should be based on not exceeding this simplified criterion including any tonal penalty required in practice.

The assessment established that the level of any infra-sonic components in the noise will be significantly below perception thresholds and that there is no reliable evidence of any physiological or psychological effects of infra-sound below this threshold. Overall, therefore, the noise impact assessment concluded that there were predicted to be no significant noise impacts.

## **16.2.9 Infrastructure and Telecommunications**

The evaluation in Chapter 13 (ES - November 2004) states that, as a result of the Proposed Development, there are no predicted significant effects on infrastructure and telecommunications.

The evaluation states that there are no predicted significant effects at any properties due to shadow flicker due to the separation distances between the Proposed Development and the nearest dwellings.

The evaluation of effects on other infrastructure and telecommunications was based on responses to a consultation process. Responses deemed the Proposed Development to be unconstrained with respect to telecommunications and infrastructure.

Overall, therefore, there are predicted to be no significant effects from the Proposed Development on infrastructure and telecommunications and none expected as a result of the Amendment.

### **16.2.10 Access**

Given the low level of Site usage by any receptor group, Chapter 14 (ES - November 2004) concludes there to be no predicted significant effects for these receptor groups. Where access restrictions will be present, mainly during the construction phase of the project, diversions will be put in place and remain for the minimum duration. Information will be made readily available on any access restrictions to reduce disruption to receptor groups. No change is expected as a result of the Amendment.

### **16.2.11 Emissions**

The evaluation stated that the Amended Carraig Gheal Wind Farm can make a contribution to reducing emissions. The evaluation noted that the exact volume of reduction is difficult to determine and depends on a complex set of operating conditions. However the evaluation determined that Carraig Gheal is likely to reduce UK emissions of CO<sub>2</sub> by up to 164,000 tonnes per annum during its operational lifetime.

## **16.3 POTENTIAL AND RESIDUAL EFFECTS AND SUGGESTED MITIGATION**

The table in Appendix 5b summarises, for all assessments and evaluations, the potential effects before mitigation, suggested mitigation measures and residual effects after mitigation is implemented.

It is concluded that the only significant residual effects post-mitigation are visual in nature. Significant visual effects would be limited to two properties (Balliemeanoch Farm and Oaklea ~4.7 km distance), but would not adversely affect the visual amenity of their residents or the setting of these properties overall, and to recreational viewpoints at Loch Nant, Portsonachan, Blarghour and intermittent locations along the B840 and waters edge between Balliemeanoch and Blarghour. The significant effects were considered unlikely to be negative and more probably neutral.





**Chapter 17**  
**Mitigation Measures**

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## **17.1 INTRODUCTION**

This Chapter addresses mitigation in respect of two aspects of the Amended Proposed Development. The first aspect relates to design evolution wherein mitigation is an integral part of the final Amended Proposed Development design. The stages of design evolution that gave rise to the final Amended Proposed Development design are detailed in Chapter 5 of this volume. Mitigation incorporated in the project design is detailed in Appendix A5a.

The second aspect of the Amended Proposed Development for which mitigation is addressed relates to those mitigation measures that are a response to the suggested measures made by each of the environmental consultants in their respective assessments and evaluations within this Environmental Statement. This Chapter summarises these in the form of a Schedule of Environmental Commitments. The Schedule of Environmental Commitments is included in full as Appendix A5b.

There are three types of activity designed to avoid, reduce or offset environmental impacts that are broadly called mitigation. The first, acts through *avoidance* of impacts by, for example, altering project design details in such a way as to avoid sensitive areas. The second, *mitigation*, reduces the level of impacts through procedural or design improvements in such a way as to effectively minimise their level of significance. The third provides *compensation* for and counterbalances potential harm through provision of environmental improvements commensurate to the harm caused.

A special type of environmental improvement - enhancement for its own sake - though not strictly a type of mitigation is nevertheless appropriately addressed at the end of this Chapter.

## **17.2 MITIGATION INHERENT IN PROPOSED DEVELOPMENT DESIGN**

### **17.2.1 Summary of Mitigation Inherent in Proposed Development Design**

The mitigation adopted during the various stages of the design evolution process is described in detail in Chapter 5 of this volume and in Appendix A5a. It may be summarised as follows;

- Preferential route selection for tracks to avoid vegetation and flora and hydrology sensitivities and track design to minimise impacts where sensitivities are encountered;
- Preferential route selection for tracks to avoid mammal, ornithology and archaeology sensitivities;
- Preferential location selection for turbines and other site infrastructure on mammal, vegetation and flora, ornithology, hydrology, and archaeology sensitivities;
- Preferential location selection for turbines to maintain sufficient separation from residences not to produce a noise nuisance;
- Movement back from edge of plateau at north and eastern edges and avoidance of more prominent peaks to reduce visibility to Loch Nant and Loch Awe to minimise visibility from closest residential receptors.
- Movement of individual turbines within the overall wind farm to enhance the visual composition of the wind farm as viewed from the viewpoint locations.

## **17.3 SCHEDULE OF ENVIRONMENTAL COMMITMENTS**

### **17.3.1 Summary Schedule of Environmental Commitments**

The table in Appendix 5b summarises the mitigation measures suggested by the independent consultants in each of the respective assessments and evaluations within this Amended Environmental Statement and the Environmental Statement (November 2004). These measures, with the commitment from GreenPower to their implementation, constitute a Schedule of Environmental Commitments

## **17.3.2 Detailed Schedule of Environmental Commitments**

### **17.3.2.1 Land Management Plan**

With the introduction of the Amended Carraig Gheal Wind Farm into the environment of the Development Site a number of land management challenges arise. It is therefore proposed that, in place of a range of separate but related management plans, an integrated “Land Management Plan” is adopted.

This Land Management Plan will have various functions and objectives. Of primary importance for the successful implementation of the Plan is that it manages the operational needs of the Wind Farm and the landowners in conjunction with managing any environmental needs.

It is proposed that a Land Management Plan will be put in place prior to commencement of the construction of the Wind Farm. The Land Management Plan is intended to integrate the management needs related to:

- Environmental management;
- Pre and post construction ecological monitoring;
- Access and recreational management.

The key land management objectives for the operation of the Wind Farm are:

- Maximising the efficiency of electricity generation, through procuring clean undisturbed air flow to the turbines;
- Meeting the continuing farming needs of the landowner;
- Minimising the construction and operation impacts upon the nature conservation value of the Site;
- Maintaining a positive aesthetic setting for the Wind Farm and its infrastructure;
- An over-riding requirement to maintaining the health and safety of all site personnel, visitors and members of the public at all times.

A number of outline key nature conservation land management objectives have been identified including:

- Maintaining and enhancing the heather moorland as a habitat of conservation value and as a host habitat for species of conservation value;
- Maintaining the habitat of the open water bodies to maintain and enhance their habitat value for breeding and foraging birds of conservation value;
- Ensuring the continued and where possible enhanced breeding success of key bird species.
- Maintaining the habitat of burns and streams draining the site to maintain and enhance their habitat value for brown trout and salmonid populations.

Several of the mitigation measures in Appendix A5b indicate a requirement for inclusion in the Land Management Plan. GreenPower is committed to their inclusion in the Land Management Plan.

### **17.3.2.2 Site Environmental Management Procedures**

The Site Environmental Management Procedures will provide details relating to the construction, operation and decommissioning of the Amended Carraig Gheal Wind Farm. It will incorporate the mitigation to minimise specific impacts identified in the environmental impact assessments and as required by statutory obligations or planning conditions and agreements. GreenPower is committed to incorporating all those mitigation measures indicated in Appendix A5b to its Site Environmental Management Procedures.

### **17.3.2.3 Ecological Watching Brief**

An ecological watching brief will be required during the construction of the Wind Farm. GreenPower is committed to retaining an independent ecologist to ensure that the commitments of GreenPower are met by its staff and contractors whilst constructing the Amended Carraig Gheal Wind Farm.

### **17.3.2.4 Ecology: Specific Mitigations Plans**

A number of mitigation proposals have been put forward by the ecological consultants. In collaboration with the landowner, GreenPower seeks, within the Land Management Plan, to adopt appropriate long term environmental management of the Wind Farm to enhance conservation value. In part this will be achieved through careful design, construction and operation of the wind farm and in part through specific habitat measures.

### **17.3.2.5 Archaeological Watching Brief**

GreenPower is committed to minimising the disturbance to any archaeological resource on the Development Site. In addition to adopting safeguarding plans to identify, demarcate and protect known resource, an archaeological watching brief will be employed to review construction progress and to deal with any archaeological remains identified during construction – either through preservation in situ (re-design of the project) or preservation by record.

### **17.3.2.6 Condition Relating to Noise**

GreenPower is committed to ensuring that the Amended Carraig Gheal Wind Farm does not cause a noise nuisance. In the event that any noise nuisance is identified, GreenPower will work with the Environmental Health Officer to identify and implement measures to mitigate against the noise effects. Such mitigation could include a noise management programme to achieve lower sound levels for certain wind speeds and directions.



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**Conclusions**

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## **18.1 INTRODUCTION**

This Chapter draws together overall conclusions from the results and conclusions of the assessments, evaluations and other considerations contained within the Environmental Statement (November 2004) and this Amendment to the Environmental Statement. This Amendment Chapter 18 supersedes Chapter 18 of the Environmental Statement: Main Report (November 2004).

The Chapter firstly considers the Carraig Gheal Wind Farm Environmental Statement (November 2004 and Amended) in respect of EIA regulatory compliance. The Chapter then considers the mitigation inherent in the Amended Proposed Development design, the potential significant environmental effects that may arise from the Amended Proposed Development, the suggested mitigation measures from the respective assessments and evaluations and the Schedule of Environmental Commitments, which address these suggested mitigation measures. The Chapter then considers the residual environmental effects arising when the Amended Proposed Development is developed in accordance with the Schedule of Environmental Commitments. Finally, the Chapter considers the positive enhancement measures included in the Schedule of Environmental Commitments, the positive environmental effects that will accrue as a result of these and the other benefits that will accrue from the Amended Proposed Development.

## **18.2 REGULATORY COMPLIANCE**

This Environmental Statement (November 2004 and Amended) constitutes a full and comprehensive description of the physical characteristics, size and design of the Amended Proposed Development and the landuse requirements during the construction and operational phases. It provides information on potential emissions and evaluates the potential of the Amended Proposed Development to reduce carbon dioxide harmful to the global environment. Potentially sensitive receptors are identified and a comprehensive and detailed appraisals of likely significant environmental effects described. Mitigation measures are addressed in depth and methodological limitations acknowledged. The results and conclusions are described in a Non-Technical Summary Amendment.

It is concluded that this Environmental Statement (November 2004 and Amended) fully complies with the 2000 Regulations, specifically Regulations 9 and Schedule 4.

## **18.3 MITIGATION INHERENT IN PROPOSED DEVELOPMENT DESIGN**

Chapter 5 of this volume of the Environmental Statement details the design process, reflecting this in four stages. Due to the practical limitations of textual space only a brief indication of the full extent of this complex process has been provided. From the earliest stages of project development the sensitivities identified by the various assessments and evaluations reported within this volume have informed project design. As the design process progressed these sensitivities became increasingly important in defining the overall project layout.

It is concluded that the Amended Proposed Development design has been arrived at with due consideration for potential environmental effects. The final project design embodies a range of measures to avoid or reduce impacts on sensitive receptors. Inherently, it represents a very high standard of development design, and addresses the various environmental sensitivities represented within the Environmental Statement.

## **18.4 POTENTIAL EFFECTS AND SUGGESTED FURTHER MITIGATION**

### **18.4.1 Potential Effects from the Proposed Development**

Chapters 6-15 of this volume of the Environmental Statement detail the various assessments and evaluations of the environmental impacts that may arise from the Amended Proposed Development. These pre-mitigation potential effects are summarised in Chapter 16 of this volume.

#### **18.4.2 Suggested Further Mitigation Measures as Applied to Potential Effects**

In addition to assessing potential effects, the assessments and evaluations of Chapters 6-15 of this volume also put forward various further mitigation measures aiming to mitigate impacts by avoiding, minimising or compensating for them during the course of Amended Proposed Development construction, operation and decommissioning. These suggested mitigation measures are summarised in Chapter 17 of this volume.

#### **18.4.3 Residual Effects**

It is concluded that the only significant residual effects post-mitigation are visual in nature. Significant visual effects would be limited to two properties (Balliemeanoch Farm and Oaklea ~4.7 km distance), but would not adversely affect the visual amenity of their residents or the setting of these properties overall, and to recreational viewpoints at Loch Nant, Portsonachan, Blarghour and intermittent locations along the B840 and waters edge between Balliemeanoch and Blarghour. The significant effects were considered unlikely to be negative and more probably neutral, particularly as the Amendment has enhanced the visual composition of the turbines within the Wind Farm when viewed as a group and the composition of the Wind Farm within its landscape setting.

### **18.5 SCHEDULE OF ENVIRONMENTAL COMMITMENTS**

Chapter 17 of this volume of the Environmental Statement summarises the suggested further mitigation measures from the various assessments and evaluations contained within this volume. This Chapter also provides a summary and more detailed Schedule of Environmental Commitments. This Schedule represents a proactive response to the suggested further mitigation measures.

It is concluded that the Schedule of Environmental Commitments will facilitate the implementation of the suggested further mitigation measures and as a consequence the residual impacts from the Amended Proposed Development will be reduced to the level as indicated in Section 18.4.3 above.

### **18.6 ENVIRONMENTAL ENHANCEMENTS AND OTHER BENEFITS**

#### **18.6.1 Enhancement from a Schedule of Environmental Commitments**

The Schedule of Environmental Commitments in Chapter 17 of this volume of the Environmental Statement also contains a number of environmental enhancements. This represents a further and progressive response to the challenges inherent in delivering good development design. Such challenges are considered in Chapter 4 and the mitigation inherent in the design of the Amended Proposed Development is addressed in Chapter 5 of this volume.

The Schedule of Environmental Commitments goes beyond merely mitigating negative environmental impacts. It represents GreenPower's commitment to achieving positive environmental gain.

It is concluded that implementation of the Schedule of Environmental Commitments will ensure that positive environmental gain is integral to the Proposed Development.

#### **18.6.2 Environmental Gain Through Greenhouse Gas Reduction**

Chapter 15 considers the challenge of mitigating global climate change. The evaluation demonstrates that there will be positive gain through greenhouse gas emission reductions as a result of increasing renewable energy electricity generation.

It is concluded that the Amended Proposed Development will provide positive gain through displacement of greenhouse emissions as a result of its operations.

### 18.6.3 Other Benefits

There are further benefits accruing from the Proposed Development that go beyond the scope of this Environmental Statement. Such benefits are detailed within the Amended Needs and Benefits document.

## 18.7 SUMMARY OF CONCLUSIONS

Presented below is a summary of the overall conclusions of this Environmental Statement:

- It is concluded that the Environmental Statement (November 2004) and this Amended Environmental Statement fully comply with the 2000 Regulations, specifically Regulations 9 and Schedule 4.
- It is concluded that the Amended Proposed Development design has been arrived at with due consideration for potential environmental effects. The final project design embodies a range of measures to avoid or reduce impacts on sensitive receptors. Inherently, it represents a very high standard of development design, and addresses the various environmental sensitivities represented within this Environmental Statement.
- It is concluded that the only significant residual effects post-mitigation are visual in nature. Significant visual effects would be limited to two properties (Balliemeanoch Farm and Oaklea ~4.7 km distance), but would not adversely affect the visual amenity of their residents or the setting of these properties overall, and to recreational viewpoints at Loch Nant, Portsonachan, Blarghour and intermittent locations along the B840 and waters edge between Balliemeanoch and Blarghour. The significant effects were considered unlikely to be negative and more probably neutral, particularly as the Amendment has enhanced the visual composition of the wind farm within its landscape setting.
- It is concluded that the Schedule of Environmental Commitments will facilitate the implementation of the suggested further mitigation measures and as a consequence the residual impacts from the Amended Proposed Development will be reduced to the level as indicated in Section 18.4.3 above.
- It is concluded that implementation of the Schedule of Environmental Commitments will ensure that positive environmental gain is integral to the Amended Proposed Development.
- It is concluded that the Amended Proposed Development will provide positive gain through displacement of greenhouse emissions as a result of its operations.
- It is concluded that benefits will accrue from the Amended Proposed Development through provision of access and other similar provisions formulated within the Land Management Plan. It is concluded that other benefits, which go beyond the scope of this Environmental Statement will accrue from the Amended Proposed Development.



**Amendment**

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**APPENDIX A1: CARRAIG GHEAL LAYOUT COMPARISON**

The table below provides the turbine positions of the Proposed Development (November 2004) and the turbine positions of the Amended Proposed Development, along with turbine dimensions, and illustrates the mapping of turbine numbers between the layouts.

Proposed Development (November 2004)					Amended Proposed Development				
Turbine No	Easting	Northing	Hub Height (m)	Tip Height (m)	Turbine No	Easting	Northing	Hub Height (m)	Tip Height (m)
T1	198406	720490	70	112	TA1	198391	720470	65	110
T2	197984	720249	85	127	TA2	197984	720249	80	125
T3	197487	719969	85	127	TA3	197495	719917	80	125
T4	197005	719627	85	127	TA4	197074	719685	65	110
T5	196611	719682	85	127	Removed				
T6	197103	720081	85	127	TA5	196967	720034	65	110
T7	197536	720376	85	127	TA6	197388	720330	80	125
No previous corresponding turbine location					TA7	197765	720603	80	125
T8	197969	720713	85	127	TA8	198165	720722	80	125
T9	197849	721063	70	112	TA9	197849	721063	65	110
T10	197461	720739	85	127	TA10	197461	720739	80	125
T11	197039	720459	85	127	TA11	196988	720436	80	125
T12	196663	720102	85	127	Removed				
T13	196223	719863	85	127	Removed				
T14	196217	720223	70	112	Removed				
T15	196653	720508	70	112	TA12	196648	720504	65	110
T16	197137	720894	85	127	TA13	197137	720894	80	125
T17	197520	721208	85	127	TA14	197520	721208	80	125
T18	197194	721327	85	127	TA15	197175	721294	80	125
T19	196816	720972	85	127	TA16	196807	720967	80	125
T20	196059	720544	85	127	Removed				
T21	196417	720923	70	112	TA17	196417	720923	65	110
T22	196800	721376	70	112	TA18	196835	721374	65	110
T23	196370	721317	70	112	TA19	196427	721356	65	110
T24	196002	720923	85	127	TA20	196076	720995	65	110



**APPENDIX 5a: MITIGATION INCORPORATED INTO THE PROJECT DESIGN**

Assessment Topic	Project Element Affected	Mitigation Steps	Sensitivity Addressed
<b>VEGETATION</b>	Turbine locations, track routing and positioning of other site infrastructure	Preferential route selection to less sensitive areas (avoidance)	Potential risks to moorland habitat
	Temporary site construction infrastructure (site compound, stone crushing, vehicle movements etc)	Avoidance <sup>1</sup>	Sensitive habitats
<b>MAMMALS</b>	Track	Routing to best achieve crossings over watercourses (minimising impacts)	Mammal habitat in riparian zones
	Temporary site construction infrastructure (site compound, stone crushing, vehicle movements etc)	Avoidance <sup>1</sup>	Sensitive habitats
<b>ORNITHOLOGY</b>	Turbine locations, track routing and positioning of other site infrastructure	Constraint on the extent of the project to the north west	Known sensitive bird nesting site
	Turbine locations, track routing and positioning of other site infrastructure	Constraint on the extent of the project to the north	Bird nesting and flight corridor
	Electrical infrastructure	All conductors to be underground cable, not overhead line	Potential for bird collision risk
	Temporary site construction infrastructure (site compound, stone crushing, vehicle movements etc)	Avoidance <sup>1</sup>	Sensitive habitats or known nest sites of species with enhanced protection
	Turbine locations, track routing and positioning of other site infrastructure	Constraint on the extent of the project to the south west	To achieve set back from nest sites and avoidance of potential habitat displacement
<b>HYDROLOGY</b>	Turbine locations, track routing and positioning of other site infrastructure	Avoidance <sup>1</sup>	Areas of deep peat, wet peat mire, marshy headwaters of small streams
	Turbine locations, track routing and positioning of other site infrastructure	Avoidance <sup>1</sup>	Areas of peat hagsgs and peat erosion
	Temporary site construction infrastructure (site compound, laydown areas, vehicle parking, re-fuelling areas, fuel and chemical storage areas etc)	Avoidance <sup>1</sup>	Marshy headwater areas and area of deep peat.
	Track	Routing around the site to minimize the number of small stream crossings	Hydrologically sensitive watercourses

**APPENDIX 5a: MITIGATION INCORPORATED INTO THE PROJECT DESIGN**

Assessment Topic	Project Element Affected	Mitigation Steps	Sensitivity Addressed
<b>LVIA</b>	Turbine Locations	Movement back from edge of plateau at north and eastern edges and avoidance of more prominent peaks to reduce visibility to Loch Nant and Loch Awe	Views of Project from closest residential receptors and viewpoints.
	Turbine Locations	Movement back from edge of plateau at north and eastern edges and avoidance of more prominent peaks. Movement of turbines to enhance visual composition of the turbines when viewed as a group within the landscape.	Views of Project from closest residential receptors and viewpoints.
	Substation / control building	Situated near to forest edge	Visibility
	Access Tracks	Surfaced with stone won locally	Views from off-site to be in harmony with the landform and landscape fabric.
	On-site electrical infrastructure	Underground cable runs	Views from off-site.
<b>ARCHAEOLOGY</b>	Turbine locations, track routing and positioning of other site infrastructure	Avoidance <sup>1</sup>	Known archaeological resource
	Temporary site construction infrastructure (site compound, stone crushing, vehicle movements etc)	Avoidance <sup>1</sup>	Known archaeological resource
<b>NOISE</b>	Temporary site construction infrastructure (site compound, stone crushing, vehicle movements etc)	Locate facilities to maximise separation distance and exploit natural screening	Potential noise effect on dwellings
<b>INFRASTRUCTURE &amp; TELECOMMS</b>	Turbine locations	Consultation with MOD	Ministry of Defence "Tactical Training" areas for low flying
	Turbine locations and positioning of other site infrastructure	Consultation with stakeholders	Telecommunications fixed links, radio, TV radar installations
<b>ACCESS</b>	Turbine locations, track routing and positioning of other site infrastructure	Selection of Site with low or negligible levels of public access	Public access to the Development Site during its operation

<sup>1</sup> Unless authorised by the Ecological Clerk of Works

**APPENDIX 5a: MITIGATION INCORPORATED INTO THE PROJECT DESIGN**

<b>Assessment Topic</b>	<b>Project Element Affected</b>	<b>Mitigation Steps</b>	<b>Sensitivity Addressed</b>
<b>ACCESS (Cont.)</b>	Temporary site construction infrastructure (site compound, stone crushing, vehicle movements etc)	Selection of Site with low or negligible levels of public access	Public access to the Development Site during its construction or decommissioning



Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
Vegetation	<ul style="list-style-type: none"> <li>Permanent direct and indirect loss of habitats to the footprint of the turbine. (Moderate)</li> </ul>	<p>a) Micro-siting of turbine locations will be undertaken by the Engineer and Ecological Clerk of Works to minimise positioning on sensitive habitats, particularly blanket mire vegetation[SEMP]<sup>Y</sup>;</p> <p>b) Turbine construction activities will create as small a footprint as is practicable, staying within a 50m radius from the centre of the proposed turbine location[SEMP];</p> <p>c) All construction areas will be fenced-off using appropriate fencing to define working areas[SEMP];</p> <p>d) All areas will be subject to habitat restoration measures outlined in the Land Management Plan.</p>	6.2 (ES November 2004)	Low (not significant)
	<ul style="list-style-type: none"> <li>Temporary indirect impacts on habitats during turbine construction (Potentially Moderate)</li> </ul>	<p>a) Reference will be made to Pollution Prevention Guidelines issued by the Scottish Environment Protection Agency (SEPA), particularly the following:</p> <ul style="list-style-type: none"> <li>- PPG1: General guide to the prevention of water pollution[SEMP]</li> <li>- PPG5: Works in, near or liable to affect watercourses[SEMP]</li> </ul> <p>b) Alterations to the hydrological regimes feeding the mire communities will be avoided in order to maintain the integrity of the headwaters of the watercourses running through the site[SEMP].</p>	6.2 (ES November 2004)	Low (not significant)

<sup>Y</sup> [SEMP] indicates mitigation measure to be included in the Site Environmental Management Plan.

<b>Vegetation (Continued)</b>	<ul style="list-style-type: none"> <li>• Temporary direct loss of habitats within the track construction corridor. (Moderate)</li> <li>• Permanent indirect impacts on habitats through alterations to hydrology. (Moderate)</li> </ul>	<p>a) Micro-siting of access tracks will be undertaken by the Engineer and Ecological Clerk of Works to minimise positioning on sensitive habitats, particularly blanket mire vegetation[SEMP];</p> <p>b) Access track construction activities will be undertaken using end-on construction techniques, creating as small a footprint as is practicable:[SEMP];</p> <p>c) Access track design will be used to minimise impact as defined in Appendix 1:[SEMP]</p> <p>d) All construction areas will be fenced-off using appropriate fencing to define working areas:[SEMP]</p> <p>e) All areas will be subject to habitat restoration measures outlined in the Land Management Plan.</p>	6.3 (ES November 2004)	Low (not significant)
	<ul style="list-style-type: none"> <li>• Temporary indirect impacts on habitats during construction. (Potentially Moderate)</li> </ul>	<p>a) Reference will be made to Pollution Prevention Guidelines issued by the Scottish Environment Protection Agency (SEPA), particularly the following:</p> <ul style="list-style-type: none"> <li>- PPG1: General guide to the prevention of water pollution[SEMP]</li> <li>- PPG5: Works in, near or liable to affect watercourses[SEMP]</li> </ul> <p>b) Alterations to the hydrological regimes feeding the mire communities will be avoided in order to maintain the integrity of the headwaters of the watercourses running through the site. [SEMP]</p>	6.3 (ES November 2004)	Low (not significant)
	<ul style="list-style-type: none"> <li>• Possible impacts during operation (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>• All operational procedures should be included within the Site Environmental Management Plan.[SEMP]</li> </ul>	6.5 (ES November 2004)	Low (not significant)
	<ul style="list-style-type: none"> <li>• Potential impacts during decommissioning (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>• Appropriate consideration will be given to vegetation and flora during decommissioning of the site or should the turbines be replaced following the end of their operational lifetime.[SEMP]</li> </ul>	6.6 (ES November 2004)	Low (not significant)



Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Protected Mammals</b>	<ul style="list-style-type: none"> <li>Risk of pollution during construction and operation to watercourses used by otter. (Potentially moderate)</li> </ul>	<ul style="list-style-type: none"> <li>Working practices will be followed to minimise the risk of any pollution incidents. [SEMP]</li> <li>Care will be taken to ensure that sediments are not washed into any watercourses or other water bodies. [SEMP]</li> <li>Machinery will only be re-fuelled in a designated safe area away from any watercourses/waterbodies. [SEMP]</li> <li>Reference will be made to Pollution Prevention Guidelines issued by the Scottish Environmental Protection Agency (SEPA), particularly the following guidelines:                             <ul style="list-style-type: none"> <li>PPG1: General guide to the prevention of water pollution; [SEMP]</li> <li>PPG5: Works in, near or liable to affect watercourses; [SEMP]</li> <li>PPG23: Maintenance of structures over water. [SEMP]</li> </ul> </li> </ul>	7.8.1.3 (ES November 2004)	Low (not significant)
	<ul style="list-style-type: none"> <li>Potential loss of Water Vole habitat. (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>As a precautionary approach, further survey will be undertaken approximately 6 months prior to the start of construction works. [SEMP]</li> <li>Should any evidence of Water Vole be identified during further survey work which will have an adverse impact it is proposed that the location of the track be moved to establish a buffer zone of at least 30m around the sensitive area. If it is not possible to mitigate the impact by alteration of the scheme layout, then a detailed mitigation strategy will be prepared in conjunction with SNH. [SEMP]</li> </ul>	7.8.1.5 (ES November 2004)	Low (not significant)

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Ornithology</b>	<ul style="list-style-type: none"> <li>the potential direct and indirect effects of disturbance on nest sites for Red-throated Diver, for both the construction phase and operation phase</li> </ul>	<ul style="list-style-type: none"> <li>maintenance of a 300m distance to the nearest sections of the development and the scheduling of works outside April to September if within the 300m; [SEMP]</li> <li>provision of information to minimise human disturbance to the sensitive parts of the site during the breeding season; [SEMP]</li> </ul>	8.5.1.1 (ES November 2004)	Not significant
	<ul style="list-style-type: none"> <li>the potential direct and indirect effects of disturbance on nest sites for Merlin, for both the construction phase and operation phase</li> </ul>	<ul style="list-style-type: none"> <li>Mitigated by both a timing constraint and a site design to include a set back distance of 300m. It is recommended to adopt a breeding season timing constraint for the construction phase of the nearest two wind turbines; [SEMP]</li> </ul>	8.5.1.3 (ES November 2004)	Not significant
	<ul style="list-style-type: none"> <li>the potential direct and indirect effects of disturbance on nest sites for Golden Plover, for both the construction phase and operation phase</li> </ul>	<ul style="list-style-type: none"> <li>Mitigated by both a timing constraint and a site design to include a set back distance of 250m. It is recommended to adopt a breeding season timing constraint for the construction phase of the nearest three wind turbines; [SEMP]</li> <li>Final proposed site layout that avoids the most sensitive hydrological features. This has been taken in to account in the final project layout;</li> </ul>	8.5.1.4 (ES November 2004)	Not significant
<b>Ornithology (cont)</b>	<ul style="list-style-type: none"> <li>the potential indirect effect of pollution of water bodies for Red-throated Divers during the construction phase</li> </ul>	<ul style="list-style-type: none"> <li>stipulation of re-fuel locations away from the sensitive water catchments; [SEMP]</li> </ul>	8.5.1.1 (ES November 2004)	Not significant
	<ul style="list-style-type: none"> <li>the potential indirect effect of pollution of water bodies for Golden Plover during the construction phase</li> </ul>	<ul style="list-style-type: none"> <li>stipulation of re-fuel locations away from the sensitive water catchments; [SEMP]</li> </ul>	8.5.1.4 (ES November 2004)	Not significant

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
	<ul style="list-style-type: none"> <li>the potential for a direct effect via bird strike on Red-throated Diver</li> </ul>	<ul style="list-style-type: none"> <li>site design for the wind turbines that accommodates the bird's access to Loch Nant to the north east and to the Sior Lochs to the north west of the study area. In addition, as a precautionary measure this constraint zone should be extended to cover potential flights to and from Loch Awe - the southeast sector. These constraints have already been taken into account in the amended project layout.</li> </ul>	8.5.1.1 (ES November 2004)	Not significant

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Hydrology</b>	<ul style="list-style-type: none"> <li>• Impact of excavation activities on disruption of peat water flows, and altered stream water quantities. (Moderate)</li> <li>• Impact of abstraction of water for vehicle and equipment washing on stream water quantity. (Moderate)</li> <li>• Impact of construction on wet peat and mire vegetation communities. (Major)</li> <li>• Impact of excavation activities (including track construction) on soil and peat erosion. (Moderate to Major)</li> <li>• Impact of dumping spoil or laydown of materials on generating peat slides. (Moderate to Major)</li> <li>• Impact of sedimentation runoff into streams and effects on freshwater ecology, including fisheries. (Major)</li> </ul>	<p>Generic good practice mitigation to protect all hydrology will include:</p> <ul style="list-style-type: none"> <li>• Using the existing forestry track – to <u>prevent</u> the need for certain sections of road construction; [SEMP]</li> <li>• Re-routing of any new track and cable trench to completely <u>avoid</u> the impact; [SEMP]</li> <li>• Re-location of turbines to completely <u>avoid</u> the impact; [SEMP]</li> <li>• Choosing all new stream crossing points carefully to <u>minimise</u> any adverse effects on water quantity or quality; [SEMP]</li> <li>• Incorporation of design elements into track construction in marshy areas to ensure that there is free drainage and hydrological movement either through or beneath the track; [SEMP]</li> <li>• Designation and fencing-off of a buffer zone where tracks cross streams and where there is the need for track/culvert widening or reinforcement; [SEMP]</li> <li>• Ensuring the speedy completion of construction works taking place near hydrologically sensitive areas so that water flows and freshwater biology are affected for the minimum amount of time; [SEMP]</li> <li>• Ensuring that all materials (especially fuel oils) storage areas on site are adequately bunded and protected so that there can be no spillages or leaks; [SEMP]</li> <li>• Ensuring that a rapid response plan has been devised and will be implemented if there are any incidents such as spillages of contaminating materials. [SEMP]</li> </ul>	9.7.1 (ES November 2004)	All impacts: Minor or lower (all not significant)

<p><b>Hydrology (Continued)</b></p>	<ul style="list-style-type: none"> <li>• Impact of excavation activities (including track construction) on soil and peat erosion. (Moderate to Major)</li> <li>• Impact of dumping spoil or laydown of materials on generating peat slides. (Moderate to Major)</li> <li>• Impact of sedimentation runoff into streams and effects on freshwater ecology, including fisheries. (Major)</li> <li>• Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major)</li> </ul>	<p>In proximity to streams:</p> <ul style="list-style-type: none"> <li>• All working practices should conform with the Environment Agency (and SEPA) PPG05: "Works in, near or liable to affect watercourses"; [SEMP]</li> <li>• Designation of an exclusion "buffer zone" along stream banks in the vicinity of any stretches of track or turbine base; fenced off with hazard warning tape; [SEMP]</li> <li>• Where excavations are planned, sediment traps should be installed and regularly inspected and emptied; contents disposed of either off site or carefully on site if sediments are not contaminated. On site disposal should be located far away from any areas of existing peatland, heathland or mire vegetation; [SEMP]</li> <li>• Excavations and work with heavy plant should not take place close to watercourses during wet weather, where there is surface standing water and when the ground conditions are saturated; [SEMP]</li> <li>• All excavated materials should be properly stored, for the very shortest practicable period of time, on geotextile material; [SEMP]</li> <li>• All tracks should be designed to be permeable and to have formal drainage systems; [SEMP]</li> <li>• Appropriately sized culverting should be used for all crossing points; [SEMP]</li> <li>• Where new stream crossing points are required and where existing crossing points are widened, specialised in-channel sediment trapping techniques should be used to maximise the retention of generated sediments near the point of origin; [SEMP]</li> <li>• During all road widening activities and renewal or widening of culverts at stream crossing points, particular attention should be paid to: (a) prevention of soil erosion from stream banks and associated sedimentation into streams, (b) storage of excavated materials away from stream banks, (c) maintenance of stream water flows at all times and (d) restoration of stream banks to their former, vegetated, condition; [SEMP]</li> </ul>	<p>9.7.2 (ES November 2004)</p>	<p>All impacts: Minor or lower (all not significant)</p>
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<p><b>Hydrology (Continued)</b></p>		<ul style="list-style-type: none"> <li>• In-channel engineering works should ideally be undertaken during periods outside the trout migration and spawning season (October to March). However, this needs to be balanced against the fact that impacts from works are likely to be greater during the summer months due to low flows and reduced dissolved oxygen concentrations; [SEMP]</li> <li>• The project hydrologist/ecologist should be involved in final design of construction working practices and the timing of construction activities to ensure that any environmental impacts are prevented or minimised; [SEMP]</li> <li>• The design of working practices should include a detailed rapid response plan to be followed in case of any spillage or leakage of contaminating materials [SEMP].</li> </ul>		
	<ul style="list-style-type: none"> <li>• Impact of abstraction of water for vehicle and equipment washing on stream water quantity and quality. (Moderate)</li> <li>• Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major)</li> </ul>	<p>In relation to water use for vehicle washing:</p> <ul style="list-style-type: none"> <li>• Water abstraction: <ul style="list-style-type: none"> <li>• Water flow in the burn should be gauged and monitored daily (a simple graduated meter rule will suffice); [SEMP]</li> <li>• Water abstraction rate should be low, calculated, according to seasonal water flows in the burn, to be no more than 20% of water flow at any time; [SEMP]</li> <li>• Water should not be abstracted if water flow in the burn (during summer drought conditions and low flow periods) falls below 50% of its annual average discharge rate; [SEMP]</li> <li>• Abstracted water can be stored on site at times of high flow for use at times of low flow. [SEMP]</li> </ul> </li> <li>• Stream water quality: <ul style="list-style-type: none"> <li>• After washing, water should be drained from the compound via an oil interceptor to ensure that fuels, oils and grease cannot enter either of the above streams. The oil interceptor should be part of a regularly inspected, cleaned and maintained drainage system from the site compound; [SEMP]</li> <li>• Washing waters should be drained via a sediment trapping system prior to discharge into either of the above streams. This may be a sediment settling tank to permit settlement of suspended solids, or a</li> </ul> </li> </ul>	<p>9.7.5 (ES November 2004)</p>	<p>All impacts: Minor or lower (all not significant)</p>

<p><b>Hydrology (Continued)</b></p>		<p>filtration system. In either case, the sediment trapping system should be part of a regularly inspected, cleaned and maintained drainage system from the site compound. [SEMP]</p>		
	<p>Excavation of turbine bases, cable trenches and tracks could sever hydrological flows through peat and adversely affect wet peat mire communities (Major)</p> <p>Runoff water from access tracks during rainstorms could erode the track and cause soil and peat erosion, particularly reinstated roadside verges. (Minor to Moderate)</p>	<p>In relation to water draining from access tracks:</p> <ul style="list-style-type: none"> <li>• Suitable armored and designed track drainage systems; [SEMP]</li> <li>• Careful attention should be paid to</li> <li>• Interception between a cut and fill track with a gradient and associated interceptor ditch, and a flat, wet mire:             <ul style="list-style-type: none"> <li>• Interceptor ditch should be routed to a sedimentation basin located at the base of slope where the track crosses the flat mire; [SEMP]</li> </ul> </li> </ul> <p>In relation to floating tracks:</p> <ul style="list-style-type: none"> <li>• Location specific design and cabling buried in trackside batter. [SEMP]</li> </ul> <p>Floating track where it crosses an area of wet mire or deep peat:</p> <ul style="list-style-type: none"> <li>• No interceptor ditch will be cut into the peat alongside floating tracks. Water accumulated on the floating track during heavy rainstorms will either infiltrate directly into the track or will be allowed to flow directly into the track verges, following the road camber; [SEMP]</li> </ul>	<p>9.7.4 (ES November 2004)</p>	<p>Minor (not significant)</p>

<p><b>Hydrology (Continued)</b></p>		<p>Requirements at constraint site A (see Figure 18b)</p> <ul style="list-style-type: none"> <li>• Construction personnel instructed on the sensitivity of the peat mire habitats, the need to maintain their hydrological status and the precautions to be taken and care required when working in deep and wet peat; [SEMP]</li> <li>• Environmental Management Plan to give explicit guidance on the correct handling and laydown of all construction materials, together with correct disposal of construction wastes; [SEMP]</li> <li>• Prior to the start of construction activities on the access track in this area, a working corridor should be demarcated and fenced off along this rocky ridge to confine working activities to the central portion of the ridge; [SEMP]</li> <li>• Care should be taken to ensure that there is no possibility that water flows in this stream could be interrupted during track construction in this area. [SEMP]</li> </ul>	<p>9.7.7 (ES November 2004)</p>	
	<ul style="list-style-type: none"> <li>• Excavation and removal of turbine bases, cable trenches, tracks, hard standings.</li> <li>• Removal of culverts and track crossing points of streams.</li> <li>• Excavation and removal of turbine bases, cable trenches, tracks, hard standings.</li> <li>• Excavation and removal of turbine bases, cable trenches, tracks hard standings, including dumping of materials and spoil.</li> </ul> <p>(All the above Moderate to Major)</p>	<p>At decommissioning:</p> <ul style="list-style-type: none"> <li>• Further scoping and environmental impact assessment is advised prior to the start of decommissioning so that the most appropriate choices of decommissioning techniques can be chosen; [SEMP]</li> <li>• Mitigation measures proposed for construction activities should be implemented to ensure that, as a minimum, the same (high) environmental standards will be applied to decommissioning of the development as is recommended to be applied during its construction. [SEMP]</li> </ul>	<p>9.7.8 (ES November 2004)</p>	<p>Minor (not significant)</p>



Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Landscape and Visual</b>	<ul style="list-style-type: none"> <li>Potentially significant effects on two properties at Balliemeanoch Farm and Oaklea ~ 4.7 km distance.</li> </ul>	<ul style="list-style-type: none"> <li>Mitigation measures have been accommodated through attention to the site layout, number, and proposed size of turbines.</li> <li>Movement of turbines to enhance visual composition of the turbines when viewed as a group within the landscape.</li> </ul>	10.4 (ES November 2004)	Significant effect on two properties at Balliemeanoch Farm and Oaklea ~ 4.7 km distance, but not considered to adversely affect the visual amenity of the residents or setting.
	<ul style="list-style-type: none"> <li>Potentially significant effect to recreational receptors and road users along a short section of the B840 alongside Loch Awe and at viewpoint locations at Loch Nant, Portsonachan and Blarghour.</li> </ul>			Significant effect that adds a new focus or feature to the view. Not necessarily considered adverse as does not compete with the existing view.

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Archaeology</b>	<ul style="list-style-type: none"> <li>Limited potential for unavoidable effects on unidentified archaeological features.</li> </ul>	<ul style="list-style-type: none"> <li>Archaeological monitoring (watching brief) would enable identification of remains and preservation by record. [SEMP]</li> </ul>	11.5.3 (ES November 2004)	Residual effects will be addressed through preservation by record, which is expected to represent adequate mitigation.
<b>Noise</b>	<ul style="list-style-type: none"> <li>No predicted significant effects</li> </ul>	<ul style="list-style-type: none"> <li>None required</li> </ul>		
<b>Infrastructure and Telecommunications</b>	<ul style="list-style-type: none"> <li>No predicted significant effects</li> </ul>	<ul style="list-style-type: none"> <li>None required</li> </ul>		
<b>Access</b>	<ul style="list-style-type: none"> <li>Access restrictions will be temporary and short lived.</li> </ul>	<ul style="list-style-type: none"> <li>Information should be made available to receptor groups. [SEMP]</li> </ul>	14.5 (ES November 2004)	Impacts during construction will not be significant. It is believed that during operation access opportunities will be enhanced.

**APPENDIX A11f: INDIRECT EFFECTS ON THE SETTING OF NATIONALLY DESIGNATED FEATURES**

Status	Grid Ref.	Name/ Description	No of turbines visible <sup>1</sup>	Distance*	Magnitude of Indirect Effect	Mitigating Factors/ Rationale
SM 4197	193800 722000	Musdale, cairn	0	2.5 km	Low	No turbines will be visible from the monument. Some turbines may be visible as a back drop to views of the monument from the north-west. However, as a grassy mound, the monument will not, in any case, be a readily identifiable features in such views.
SM 4047	202300 721000	Upper Achachenna, long cairn	5-8	4.3	Low	Adjacent and intervening forestry would restrict any views between this monument and the turbines, and for the same reason any effect of the turbines in other views of the monument will be low.
SM 4227	201400 716700	Ballimeanoch, chapel & burial ground	17-20	5.9	Low	The monument is on a sheltered west facing shelf and the dominant views to the west will not be affected.
LB C(S)	204200 720570	Campbell of Sonachan burial enclosure, Portsonachan	17-20	6.2	Low	The principal setting of the burial enclosure is confined to the surrounding settlement. Portsonachan is a loch side settlement and so it's setting is defined by the loch shore, which will be unaffected.

<sup>1</sup> Figure given is from the centre of the site, unless otherwise indicated

Status	Grid Ref.	Name/ Description	No of turbines visible <sup>1</sup>	Distance*	Magnitude of Indirect Effect	Mitigating Factors/ Rationale
SM 4033	204900 721800	Barbreck, cairn	17-20	6.9	Low	Adjacent and intervening forestry would restrict any views between this monument and the turbines, and for the same reason any effect of the turbines in views of the monument will be low.
<b>SM 4037</b>	<b>204300 724900</b>	<b>Loch Tromlee, Eilean Tighe Bhain, fortified dwelling</b>	<b>1-4</b>	<b>7.2</b>	<b>Low</b>	<b>The setting of this feature is defined by Loch Tromlee which will be unaffected. At this distance there will be very limited views of the turbines and little effects on views of the monument.</b>
SM 4049	205300 723500	Larach Bhan, cup marked rock	17-20	7.7	Low	This lies within a large area of commercial forestry and there is unlikely to be any effect.
SM 4104	206200 724500	Larach Bhan,	17-20	8.8	Low	As above (SM4049)
SM 4201	206800 721800	Rockhill Farm	17-20	8.8	Low	Turbines will be visible, but over a considerable distance, and will not affect the principal loch shore setting of the monument.
SM 4173	199300 712700	Ardchonnell, long cairn	17-20	8.9	Low	This lies within a large area of commercial forestry and there is unlikely to be any effect.
SM 4105	206700 723500	Larach Bhan, cairn	17-20	9	Low	This lies within a large area of commercial forestry and there is unlikely to be any effect.
LB B	206920 721220	Ardbrecknish House	17-20	9	Low	This building is sheltered by a tree line and there is unlikely to be any effect.

*Cultural Heritage Impact Assessment: Indirect Effects on the Setting of Nationally Designated Features  
(Revised)*

<b>Status</b>	<b>Grid Ref.</b>	<b>Name/ Description</b>	<b>No of turbines visible<sup>1</sup></b>	<b>Distance*</b>	<b>Magnitude of Indirect Effect</b>	<b>Mitigating Factors/ Rationale</b>
SM 4202	207800 722300	Rockhill Farm, crannogs	17-20	9.2	Low	These features lie either side of a prominent piece of shore line, such that the effect on the crannogs 200 m N of Rockhill Farm may be greater. However, these are not prominent features and their setting is largely defined by Loch Awe, therefore the effect in both cases will be low.
SM 4146	197800 712200	Innis Chonnell, crannog	1-4	9.4	Low	Some turbines may be visible, but at this distance will not substantially affect the setting of the crannog, which is principally defined by the shore of Loch Awe.
SM 291	197600 711900	Ardchonnell Castle & Island of Innis Chonnell, Loch Awe	1-4	9.6	Low	Some turbines may be visible, but at this distance will not significantly affect the setting of the monument, which is principally defined by the shore of Loch Awe.
SM 4214	197200 711000	Loch Awe, Innis Errich, chapel & burial ground	1-4	10.6	Low	This feature lies within a wooded setting, principally defined by Loch Awe.
HGDL 95	-	Ardanaiseig	0-20	10.7	Low	There may be some visibility between the southern part of the HGDL and turbines. However, this part is also predominantly wooded and any effect on its setting would be minor.
SM 4186	208900 721300	Keppochan, cup marked stone	17-20	10.8	Low	The magnitude of any effects will be reduced by distance.

Environmental Statement Amendment: Appendices

Status	Grid Ref.	Name/ Description	No of turbines visible <sup>1</sup>	Distance*	Magnitude of Indirect Effect	Mitigating Factors/ Rationale
SM 4198	209000 724100	Loch Awe, Eilean Seileachan, crannog	17-20	11.3	Low	Local screening will further reduce any effect.
SM 4203	186400 720400	Lagganbeg, cairn	5-8	11.7	Low	Unlikely to be any effect owing to local topography.
SM 4137	209500 724400	Inishail, crannog	17-20	11.9	Low	Turbines may be visible, but over the distance will not substantially affect the setting of the monument, which is principally defined by the shore of Loch Awe and adjoining islands.
SM 4184	209800 724400	Inishail, church, cross & burial ground	17-20	12.2	Low	Turbines may be visible, but over the distance will not substantially affect the setting of the monument, which is principally defined by the shore of Loch Awe and adjoining islands.
LB B	186304 724704	Loch Feochan, Dunach	5-8	12.2	Low	Located within forestry, therefore any effect unlikely.
SM 4272	210800 723500	Inistrynich, crannog	17-20	13.1	Low	Turbines may be visible, but at this distance will not substantially affect the setting of the monument, which is principally defined by the shore of Loch Awe and adjoining islands.
SM 4160	185800 726400	Cologin, fort	9-12	13.2	Low	Located at edge of forestry.
SM 4161	186300 727500	Ariogan, cairn	5-8	13.2	Low	Distance between monument and turbines will result in any effect being of low magnitude.
LB B	210950 723330	Inishail Kirk	17-20	13.2	Low	Located within forestry, therefore any effect unlikely.

*Cultural Heritage Impact Assessment: Indirect Effects on the Setting of Nationally Designated Features  
(Revised)*

<b>Status</b>	<b>Grid Ref.</b>	<b>Name/ Description</b>	<b>No of turbines visible<sup>1</sup></b>	<b>Distance*</b>	<b>Magnitude of Indirect Effect</b>	<b>Mitigating Factors/ Rationale</b>
SM 2219	210800 725100	Fraoch Eilean, castle	17-20	13.3	Low	Turbines may be visible, but at this distance will not substantially affect the setting of the monument, which is principally defined by the shore of Loch Awe and adjoining islands.
SM 4204	211500 724700	Achlian, crannog	17-20	14.9	Low	Turbines may be visible, but at this distance will not substantially affect the setting of the monument, which is principally defined by the shore of Loch Awe and adjoining islands.
© Historic Scotland						
Notes:						

\*Distance measured from the centre-point of the site unless otherwise stated

HGDL: Registered Historic Garden or Designed Landscape; LB (B): Listed Building (Category); SM: Scheduled Monument

Compass points shown as N, E, S, W, etc.





**APPENDIX A14: BUTTERFLY REPORT**

**CARRAIG GHEAL WIND FARM**

**Addendum To The Environmental Statement**

**BUTTERFLIES**



March 2005

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## **1 INTRODUCTION**

This report is submitted as an addendum to the Carraig Gheal Wind Farm Environmental Statement following a request from Scottish Natural Heritage (SNH) to consider the potential impacts of the development on the potential suite of butterfly species on the site.

## **2 COMPANY CAPABILITY**

This assessment has been prepared by Heritage Environmental Ltd (HEL), specialists in ecological impact assessment for development projects since 1997. The key to our approach is the provision of independent and objective reporting based upon sound scientific data collection and analysis. HEL has considerable experience of wind farm projects, and specifically has undertaken impact assessments for habitats and vegetation throughout Scotland.

Principal author for this Chapter was Mark A. Bates HND (Conservation management), AIEEM – Principal Ecologist and Ecological Impact Assessment Specialist.

## **3 ASSESSMENT METHODOLOGY**

A desk study was carried out to determine which species of butterfly were likely to occur within the Development Site. Although a specific butterfly survey has not been carried out, it is possible from existing information on butterfly distribution and the NVC survey of the site (see the Vegetation and Flora Impact Assessment detailed in the Environmental Statement) to assess which species are likely to occur in the Proposed Development Site and therefore to identify potential environmental effects arising from the proposed development.

This assessment includes the following:

- A desk study of potential butterfly distributions within the Wind Farm Site, based on distribution and trends of butterfly species and their habitat requirements;
- A description of potential butterfly habitat of the Site based upon the NVC survey described in Carraig Gheal Environmental Statement: Main Report, Chapter 6;
- An impact assessment of the Proposed Development on the potential butterfly habitat;
- Ecological mitigation measures.

Several sources of information were consulted including the Millennium Atlas of Butterflies in Britain and Ireland and the Argyll and Bute Local Biodiversity Action Plan.

## **4 RESULTS**

From the desk study the species listed in Table 1 were considered to have potential to occur (only UKBAP Priority Species and Species of Conservation Concern have been considered). The table also provides information on the conservation status, habitat requirements and distribution and trends of each of the species.

**Table 1.** List of UKBAP Priority and Conservation Concern Species likely to occur within the Carraig Gheal proposed wind farm site with a summary of habitat requirements, distribution and trends.

Species	Conservation status	Habitat	Distribution and Trends
<b>Pearl-bordered Fritillary</b> <b>Boloria euphrosyne</b>	UKBAP Priority Species. Argyll and Bute LBAP species.	Food plant: Common Dog-violet <i>Viola riviniana</i> and Marsh Violet <i>Viola palustris</i> Bracken <i>Pteridium aquilinum</i> and scrub mosaics, woodland edge and open, grazed woodland (young plantations can also be used). In Argyll all known sites are south-facing slopes with bracken. Grazing by deer and/or sheep is favourable for this species as it reduces the density of bracken.	In Scotland is widespread in the west and the Highlands and hasn't suffered the major declines of England and Wales. Found in "around 20" 10km squares in Argyll and Bute region. Appears to be stable in many other European countries but with serious declines in Netherlands, Belgium and Denmark.
<b>Marsh Fritillary</b> <b>Eurodryas aurinia</b>	UKBAP Priority Species. Argyll and Bute LBAP species.	Food plant: Devil's-bit Scabious <i>Succisa pratensis</i> . Acid or neutral grassland that is unimproved, damp and lightly grazed. Sites grazed by sheep usually not conducive to this species due to selective grazing of the food plant.	Confined to Argyll and Lochaber in Scotland where it is found in "about 40 10km squares" and has suffered considerable declines in UK, particularly in England. It is also declining in most European countries
<b>Chequered Skipper</b> <b>Carterocephalus palaemon</b>	UKBAP Priority Species	Food plant: Purple Moor-grass <i>Molinia caerulea</i> . Open damp grassland particularly at woodland edges with scattered Bog Myrtle <i>Myrica gale</i> and birch <i>Betula spp.</i> scrub.	Now restricted to Scotland in the south west Highlands to approximately the border with Argyll. Formerly found in East Midlands of England. Thought to have been more or less stable in Scotland in recent times. The rest of Europe has seen declines in Austria, Luxembourg, Romania, Belgium and Lithuania but little change elsewhere.
<b>Mountain Ringlet</b> <b>Erebia epiphron</b>	UKBAP Species of Conservation Concern	Food Plant: Mat Grass <i>Nardus stricta</i> and Sheep's Fescue <i>Festuca ovina</i> Open mountain grassland 350-900m dominated by Mat Grass and Heath Bedstraw <i>Galium saxatile</i> . Often associated with damper areas and sometimes flushes dominated by sedges but also heath dominated by Blaeberry <i>Vaccinium myrtillus</i> and Wavy Hair-grass <i>Deschampsia flexuosa</i> . Favours south-facing slopes in Scotland.	Found only in the central Lake District in England and central Scotland.. Recorded in 34% more 10k squares in 1995-99 compared to 1970-82. Thought to be stable throughout most of its European range (although under-recorded)
<b>Small Pearl-bordered Fritillary</b> <b>Boloria selene</b>	UKBAP Species of Conservation Concern	Food plants: Common Dog-violet and Marsh Violet. Damp grassland and moorland, grassland with scrub or bracken patches and woodland edges.	Widespread in Scotland and Wales but has suffered dramatic declines in England. Europe wide is more or less stable but with big declines in some countries (Netherlands, Belgium and Luxembourg)
<b>Large Heath</b> <b>Coenonympha tullia</b>	UKBAP Species of Conservation Concern	Food plant: Harestail Cotton-grass <i>Eriophorum vaginatum</i> (and occasionally Common Cotton-grass <i>Eriophorum angustifolium</i> and Jointed Rush <i>Juncus articulatus</i> Bogs (lowland raised and upland blanket), damp acidic moorland usually below 500m. Cross-leaved Heath <i>Erica tetralix</i> is main adult nectar source.	In Ireland, Scotland and northern England this species is widespread and locally common. Losses in Scotland due to drainage and afforestation of moorland. In 1995-99 not recorded in 47% of 10k squares in which it was recorded in 1970-82. Declines in many other parts of Europe.

## 5 EVALUATION

From the habitat requirements summarised in Table 1, it is possible to identify NVC communities that would satisfy the habitat requirements of the UKBAP Priority and Conservation Concern Species likely to occur within the study site. This has allowed areas to be identified within the site that are potentially sensitive and therefore help inform mitigation.

**Pearl-bordered Fritillary.** The NVC communities within the study site that have the potential to support colonies of this species are U20a *Pteridium aquilinum-Galium saxatile* community and W17 *Quercus petraea-Betula pubescens-Dicranum majus* woodland. There is only a small area of these communities within the study site, mostly in the northern corner along the Allt Coire Odhair and tributaries as well as two patches of U20a, one to the west of the access track which is west of Maol Mòr and one on the edge of the study site by the Rudh' Alltan burn. Both these communities often contain the larval food plant Dog-violet. The M6 communities in these areas may also provide the alternative food plant Marsh Violet.

**Marsh Fritillary.** This species may also be able to make use of the U20 community described above, but in addition could potentially be supported by the U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland. These acid grassland communities are scattered throughout the site but particularly concentrated in the eastern and northern corners of the site. They are of two types, U4a and U4e with the former, less abundant type more likely to contain the larval food plant (Devil's-bit Scabious). However, given that the site is grazed and that the NVC survey considered the U4 habitats to be of low naturalness and of negligible or low local conservation value it is considered unlikely that this species will occur here.

**Chequered Skipper.** The typical Purple Moor-grass community, M25 is not found within the Site, however this grass can be very common in M15 and M17 communities, which make up the majority of the habitat of the Site. In addition to this, M15b and M17a can frequently contain Bog Myrtle. It is suggested that the areas where Chequered Skipper is most likely to be found are those where these communities occur in the vicinity of the oak/birch woodland community (W17). This occurs only in the northern corner of the site, which is outwith the areas proposed for turbines, tracks and other site infrastructure.

**Mountain Ringlet.** The *Nardus/Galium* community (U5), which would provide typical habitat for this species, does not occur on the site. However, U4e typically contains some *Nardus* as does M15d along with *V. myrtillus* and *D. flexuosa*. *Vaccinium* is also co-dominant in the H21 heath community and the CG10a grassland community contains *G. saxatile*. From this, the area of most suitable habitat for Mountain Ringlet is likely to be the crags and moorland to the north-west of the access track between the turbine envelope and the site boundary to the north-east where M15d occurs in association with CG10a. In addition, much of this area is south-east facing. There are only small pockets of H21 with no habitat likely to contain the food plant in the vicinity.

**Small Pearl-bordered Fritillary.** This species has similar requirements to Pearl-bordered Fritillary and is therefore likely to be found in similar areas, although it may also be able to make use of the M6 communities where Marsh Violet occurs. These occur frequently along small burns in the site but the only areas where they are in a mosaic with bracken or woodland edges are the areas already mentioned for Pearl-bordered Fritillary.

**Large Heath.** This species has the potential to be very widespread throughout the site as it is found in damp moorland and bog habitats. The main adult nectar source (Cross-leaved Heath) is a major component of the M15 communities and the larval food plant is a major component of the M17 communities. These communities individually and in mosaics with other communities make up most of the habitats of the site.

## 6 ASSESSMENT OF IMPACTS

The impacts have been assessed for each of the above butterfly species considering direct (habitat loss) and indirect (eg changes to hydrology) impacts.

**Pearl-bordered Fritillary.** The areas where this species is likely to be found are outside the areas proposed for turbines, tracks and other site infrastructure. It is therefore considered that the impact of the development on any potential Pearl-bordered Fritillary population will be negligible.

**Marsh Fritillary.** The suitable habitat for this species is mainly outwith areas proposed for turbines, tracks and other site infrastructure. There may be some loss of habitat during the construction of the tracks, however this is considered to be minimal compared to the total available habitat within the Site and therefore the impact on any potential Marsh Fritillary population would be minor.

**Chequered Skipper.** Areas of potential habitat for this species will be lost during the construction of the Wind Farm. However, the Vegetation and Flora Impact Assessment demonstrated that, in comparison to the areas of these communities present within the Site, the areas lost are small and any indirect impacts due to alterations in hydrology are likely to result in only minor changes in vegetation structure and composition. It is therefore considered that the impact of construction on any potential Chequered Skipper population would be minor. However, should a population of this species occur only in one small area within the development site the impact could obviously be greater and mitigation in terms of micro-siting of turbines could be necessary.

**Mountain Ringlet.** The area identified as most likely to contain a population of this species is outside the areas proposed for turbines, tracks and other site infrastructure. It is therefore considered that the impact of construction would be negligible on any potential Mountain Ringlet population.

**Small Pearl-bordered Fritillary.** The most suitable habitat for this species is in areas where there are no predicted impacts from the Proposed Development and therefore populations of this species are likely to be unaffected.

**Large Heath.** Areas of potential habitat for this species will be lost during the construction, both directly and indirectly through hydrology changes. However, habitat loss will be small and any indirect impacts due to alterations in hydrology are likely to result in only minor changes in vegetation structure and composition. Moreover, the extent of suitable habitat within the site is considerable and the impacts on any potential butterfly habitats are likely therefore to be minor. Should the species only occur in one small area of the site, careful micro-siting of turbines and tracks may be necessary to avoid significant impacts on Large Heath.

## 7 MITIGATION MEASURES

Mitigation measures already proposed in the Vegetation and Flora Impact Assessment will ensure that impacts to sensitive habitats are minimised in terms of direct loss and indirect hydrological effects. This will also help to minimise the impacts on the Butterfly community.

A pre-construction butterfly survey should be carried out at an appropriate time of year and during suitable weather conditions to identify those species present and any localised populations that could potentially be impacted upon. This would involve a walkover of suitable habitat within the Development Site on 3 separate occasions; with visit 1 in end-May, visit 2 in June and visit 3 in July.

For most of the butterfly species with potential to occur on the site, mitigation is not necessary due to the location of suitable habitats, but for Chequered Skipper and Large Heath, micro-siting of structures and tracks to avoid the habitat of any localised populations (occurring in one small area of the site) of these species would be undertaken.



**8 CONCLUSION**

Based upon the information presented here, and providing that the suggested mitigation measures are implemented, it is unlikely that any significant impacts on those butterfly species considered will occur. However, it is recommended that a pre construction butterfly survey be undertaken to identify butterfly populations within the Site and guide any mitigation should it be required.

## 9 REFERENCES

**Asher, J., Warren, M., Fox, R., Harding, P., Jeffcoate, G. and Jeffcoate, S. 2001.** *The Millennium Atlas of Butterflies in Britain and Ireland.* Oxford University Press, Oxford.

**Averis, A. M., Birks, H.J.B., Horsfield, D., Thompson, D.B.A. and Yeo, M.J.M. 2004.** *An Illustrated Guide to British Upland Vegetation.* JNCC, Peterborough

**Rodwell, J.S. 1991.** *British Plant Communities Volume 2: Mires and Heaths.* Cambridge University Press, Cambridge

**Rodwell, J.S. 1992.** *British Plant Communities Volume 3: Grasslands and montane communities.* Cambridge University Press, Cambridge.

**Argyll and Bute Biodiversity Action Plan,** Argyll and Bute Local Biodiversity Partnership.

## **APPENDIX A15: ERRATUM TO ENVIRONMENTAL STATEMENT (APRIL 2004)**

This document contains erratum relating to the Carraig Gheal Environmental Statement (November 2004).

It includes corrections to errors made in the original release of the Environmental Statement.

None of the corrections featured in this Erratum have a material effect on the analysis or conclusions of the Environmental Statement (November 2004) nor the subsequent conclusions of the Amendment (October 2005), but are released herewith for the sake of accuracy.

The alterations that have been made are listed below.

### **MAIN REPORT**

**1 Chapter 1: Section 1.1 (Page 1-1)**

Chapter 1 of the Environmental Statement (November 2004) begins with a reference to "This Proposed Development". This should say "This Environmental Statement".

**2 Chapter 6: Section 6.5 (Page 6-14)**

Here, a reference is made to "mitigation recommendations made in Section 6.8". The correct location of the mitigation recommendations is Section 6.6.

**3 Chapter 12: Section 12.7 (Page 12-6)**

In the first paragraph, the reference to the "methodology for the prediction of barrier attenuation" refers to Section 12.4.7. This should refer to Section 12.5.6.

### **FIGURES**

**4 Figure 2**

Turbine T22 should be included as one of the turbines with a 70m hub height.

**5 Figure 13b**

In the Notes box, an Included Angle of 60<sup>0</sup> is stated. In fact the Included Angle for the image should state 30<sup>0</sup>.

**6 Visibility Maps 1-3**

In the Notes boxes, Turbine T22 should be included as one of the turbines with a 70m hub height.

**7 Visualisation 4**

Number of upper blade tips visible should read 8, not 6.

**8 Visualisation 5a and 5b**

Number of upper blade tips visible should read 19, not 20.

**9 Visualisation 10**

Number of upper blade tips visible should read 4, not 2.

**10 Visualisation 16**

Number of hubs visible should read 11, not 12.

**11 Visualisation 18**

Number of upper blade tips visible should read 18, not 17.

Number of hubs visible should read 13, not 8.

**12 Cumulative Visualisation 2**

In the Notes box, the Viewing Distance is stated to be 610mm. The correct Viewing Distance for this photo montage is 300mm as stated in the title box (bottom right corner).

***APPENDICES***

**13 Contents Page**

Appendix 5b is not listed

Appendix 5a is listed as Appendix 5

**14 Appendix 5b**

The "reference" column for Vegetation refers to chapter 8 and should refer to Chapter 6. For Ornithology, the "reference" column refers to Chapter 9 and should refer to Chapter 8.

The sub-heading numbering is correct.

***NEEDS AND BENEFITS***

**15 Part I**

Part I begins with a reference to "This Proposed Development". This should say "This Environmental Statement".

**16 Part I: Section I.5**

There should not be a reference to the Cumulative volume made here.

**17 Part II: Section 2.1.3**

A reference after the sentence "The IPCC, an international panel of non-governmental climatologists and meteorologist, states that "many human systems are sensitive to climate change, and some are vulnerable" is made to reference number <sup>3</sup>. This reference should point to reference number <sup>2</sup>.

***ENVIRONMENTAL STATEMENT ON CD-ROM***

**18 Appendices**

Appendix 5a is listed as Appendix 5

Appendix 5b is not listed in the Contents page and is missing from the document. This Appendix is included in full overleaf.

**APPENDIX 5b**

The following information was omitted in error from the CD-ROM version of the Environmental Statement (November 2004).

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
Vegetation	<ul style="list-style-type: none"> <li>Permanent direct and indirect loss of habitats to the footprint of the turbine. (Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>a) Micro-siting of turbine locations will be undertaken by the Engineer and Ecological Clerk of Works to minimise positioning on sensitive habitats, particularly blanket mire vegetation[SEMP]<sup>Y</sup>;</li> <li>b) Turbine construction activities will create as small a footprint as is practicable, staying within a 50m radius from the centre of the proposed turbine location[SEMP];</li> <li>c) All construction areas will be fenced-off using appropriate fencing to define working areas[SEMP];</li> <li>d) All areas will be subject to habitat restoration measures outlined in the Land Management Plan.</li> </ul>	8.2	Low (not significant)
	<ul style="list-style-type: none"> <li>Temporary indirect impacts on habitats during turbine construction (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>a) Reference will be made to Pollution Prevention Guidelines issued by the Scottish Environment Protection Agency (SEPA), particularly the following:                             <ul style="list-style-type: none"> <li>- PPG1: General guide to the prevention of water pollution[SEMP]</li> <li>- PPG5: Works in, near or liable to affect watercourses[SEMP]</li> </ul> </li> <li>b) Alterations to the hydrological regimes feeding the mire communities will be avoided in order to maintain the integrity of the headwaters of the watercourses running through the site[SEMP].</li> </ul>	8.2	Low (not significant)

APPENDIX 5b: SCHEDULE OF ENVIRONMENTAL COMMITMENTS

<sup>Y</sup> [SEMP] indicates mitigation measure to be included in the Site Environmental Management Plan.

Erratum to Environmental Statement (April 2004)

<p><b>Vegetation (Continued)</b></p> <ul style="list-style-type: none"> <li>• Temporary direct loss of habitats within the track construction corridor. (Moderate)</li> <li>• Permanent indirect impacts on habitats through alterations to hydrology. (Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>a) Micro-siting of access tracks will be undertaken by the Engineer and Ecological Clerk of Works to minimise positioning on sensitive habitats, particularly blanket mire vegetation[SEMP];</li> <li>b) Access track construction activities will be undertaken using end-on construction techniques, creating as small a footprint as is practicable;[SEMP];</li> <li>c) Access track design will be used to minimise impact as defined in Appendix 1;[SEMP]</li> <li>d) All construction areas will be fenced-off using appropriate fencing to define working areas;[SEMP]</li> <li>e) All areas will be subject to habitat restoration measures outlined in the Land Management Plan.</li> </ul>	<p>8.3</p>	<p>Low (not significant)</p>
<ul style="list-style-type: none"> <li>• Temporary indirect impacts on habitats during construction. (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>a) Reference will be made to Pollution Prevention Guidelines issued by the Scottish Environment Protection Agency (SEPA), particularly the following: <ul style="list-style-type: none"> <li>- PPG1: General guide to the prevention of water pollution[SEMP]</li> <li>- PPG5: Works in, near or liable to affect watercourses[SEMP]</li> </ul> </li> <li>b) Alterations to the hydrological regimes feeding the mire communities will be avoided in order to maintain the integrity of the headwaters of the watercourses running through the site. [SEMP]</li> </ul>	<p>8.3</p>	<p>Low (not significant)</p>
<ul style="list-style-type: none"> <li>• Possible impacts during operation (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>• All operational procedures should be included within the Site Environmental Management Plan.[SEMP]</li> </ul>	<p>8.5</p>	<p>Low (not significant)</p>
<ul style="list-style-type: none"> <li>• Potential impacts during decommissioning (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>• Appropriate consideration will be given to vegetation and flora during decommissioning of the site or should the turbines be replaced following the end of their operational lifetime.[SEMP]</li> </ul>	<p>8.6</p>	<p>Low (not significant)</p>

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
Protected Mammals	<ul style="list-style-type: none"> <li>Risk of pollution during construction and operation to watercourses used by otter. (Potentially moderate)</li> </ul>	<ul style="list-style-type: none"> <li>Working practices will be followed to minimise the risk of any pollution incidents. [SEMP]</li> <li>Care will be taken to ensure that sediments are not washed into any watercourses or other water bodies. [SEMP]</li> <li>Machinery will only be re-fuelled in a designated safe area away from any watercourses/waterbodies. [SEMP]</li> <li>Reference will be made to Pollution Prevention Guidelines issued by the Scottish Environmental Protection Agency (SEPA), particularly the following guidelines:                             <ul style="list-style-type: none"> <li>PPG1: General guide to the prevention of water pollution; [SEMP]</li> <li>PPG5: Works in, near or liable to affect watercourses; [SEMP]</li> <li>PPG23: Maintenance of structures over water. [SEMP]</li> </ul> </li> </ul>	7.8.1.3	Low (not significant)
	<ul style="list-style-type: none"> <li>Potential loss of Water Vole habitat. (Potentially Moderate)</li> </ul>	<ul style="list-style-type: none"> <li>As a precautionary approach, further survey will be undertaken approximately 6 months prior to the start of construction works. [SEMP]</li> <li>Should any evidence of Water Vole be identified during further survey work which will have an adverse impact it is proposed that the location of the track be moved to establish a buffer zone of at least 30m around the sensitive area. If it is not possible to mitigate the impact by alteration of the scheme layout, then a detailed mitigation strategy will be prepared in conjunction with SNH. [SEMP]</li> </ul>	7.8.1.5	Low (not significant)

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
Ornithology	<ul style="list-style-type: none"> <li>the potential direct and indirect effects of disturbance on nest sites for Red-throated Diver, for both the construction phase and operation phase</li> </ul>	<ul style="list-style-type: none"> <li>maintenance of a 300m distance to the nearest sections of the development and the scheduling of works outside April to September if within the 300m; [SEMP]</li> <li>provision of information to minimise human disturbance to the sensitive parts of the site during the breeding season; [SEMP]</li> </ul>	9.5.1.1	Not significant
	<ul style="list-style-type: none"> <li>the potential direct and indirect effects of disturbance on nest sites for Merlin, for both the construction phase and operation phase</li> </ul>	<ul style="list-style-type: none"> <li>Mitigated by both a timing constraint and a site design to include a set back distance of 300m. It is recommended to adopt a breeding season timing constraint for the construction phase of the nearest two wind turbines; [SEMP]</li> </ul>	9.5.1.3	Not significant
	<ul style="list-style-type: none"> <li>the potential direct and indirect effects of disturbance on nest sites for Golden Plover, for both the construction phase and operation phase</li> </ul>	<ul style="list-style-type: none"> <li>Mitigated by both a timing constraint and a site design to include a set back distance of 250m. It is recommended to adopt a breeding season timing constraint for the construction phase of the nearest five wind turbines; [SEMP]</li> <li>Final proposed site layout that avoids the most sensitive hydrological features. This has been taken in to account in the final project layout;</li> </ul>	9.5.1.4	Not significant



Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
Ornithology (cont)	<ul style="list-style-type: none"> <li>the potential indirect effect of pollution of water bodies for Red-throated Divers during the construction phase</li> </ul>	<ul style="list-style-type: none"> <li>stipulation of re-fuel locations away from the sensitive water catchments; [SEMP]</li> </ul>	9.5.1.1	Not significant
	<ul style="list-style-type: none"> <li>the potential indirect effect of pollution of water bodies for Golden Plover during the construction phase</li> </ul>	<ul style="list-style-type: none"> <li>stipulation of re-fuel locations away from the sensitive water catchments; [SEMP]</li> </ul>	9.5.1.4	Not significant
	<ul style="list-style-type: none"> <li>the potential for a direct effect via bird strike on Red-throated Diver</li> </ul>	<ul style="list-style-type: none"> <li>site design for the wind turbines that accommodates the bird's access to Loch Nant to the north east and to the Sior Lochs to the north west of the study area. In addition, as a precautionary measure this constraint zone should be extended to cover potential flights to and from Loch Awe - the southeast sector. These constraints have already been taken into account in the final project layout.</li> </ul>	9.5.1.1	Not significant

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Ref	Residual Significance
Hydrology	<ul style="list-style-type: none"> <li>• Impact of excavation activities on disruption of peat water flows, and altered stream water quantities. (Moderate)</li> <li>• Impact of abstraction of water for vehicle and equipment washing on stream water quantity. (Moderate)</li> <li>• Impact of construction on wet peat and mire vegetation communities. (Major)</li> <li>• Impact of excavation activities (including track construction) on soil and peat erosion. (Moderate to Major)</li> <li>• Impact of dumping spoil or laydown of materials on generating peat slides. (Moderate to Major)</li> <li>• Impact of sedimentation runoff into streams and effects on freshwater ecology, including fisheries. (Major)</li> </ul>	<p>Generic good practice mitigation to protect all hydrology will include:</p> <ul style="list-style-type: none"> <li>• Using the existing forestry track – to <u>prevent</u> the need for certain sections of road construction; [SEMP]</li> <li>• Re-routing of any new track and cable trench to completely <u>avoid</u> the impact; [SEMP]</li> <li>• Re-location of turbines to completely <u>avoid</u> the impact; [SEMP]</li> <li>• Choosing all new stream crossing points carefully to <u>minimise</u> any adverse effects on water quantity or quality; [SEMP]</li> <li>• Incorporation of design elements into track construction in marshy areas to ensure that there is free drainage and hydrological movement either through or beneath the track; [SEMP]</li> <li>• Designation and fencing-off of a buffer zone where tracks cross streams and where there is the need for track/culvert widening or reinforcement; [SEMP]</li> <li>• Ensuring the speedy completion of construction works taking place near hydrologically sensitive areas so that water flows and freshwater biology are affected for the minimum amount of time; [SEMP]</li> <li>• Ensuring that all materials (especially fuel oils) storage areas on site are adequately bunded and protected so that there can be no spillages or leaks; [SEMP]</li> <li>• Ensuring that a rapid response plan has been devised and will be implemented if there are any incidents such as spillages of contaminating materials. [SEMP]</li> </ul>	9.7.1	All impacts: Minor or lower (all not significant)

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Ref	Residual Significance
<p><b>Hydrology (Continued)</b></p>	<ul style="list-style-type: none"> <li>Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major)</li> </ul>	<p>In relation to floating tracks:</p> <ul style="list-style-type: none"> <li>Location specific design and cabling buried in trackside batter. [SEMP]</li> </ul>	9.7.3	
		<p>In relation to water draining from access tracks:</p> <ul style="list-style-type: none"> <li>Suitable armored and designed track drainage systems; [SEMP]</li> <li>Careful attention should be paid to</li> <li>Interception between a cut and fill track with a gradient and associated interceptor ditch, and a flat, wet mire:                             <ul style="list-style-type: none"> <li>Interceptor ditch should be routed to a sedimentation basin located at the base of slope where the track crosses the flat mire; [SEMP]</li> </ul> </li> <li>Floating track where it crosses an area of wet mire or deep peat:                             <ul style="list-style-type: none"> <li>No interceptor ditch will be cut into the peat alongside floating tracks. Water accumulated on the floating track during heavy rainstorms will either infiltrate directly into the track or will be allowed to flow directly into the track verges, following the road camber; [SEMP]</li> </ul> </li> </ul>	9.7.4	

<p><b>Hydrology (Continued)</b></p>	<ul style="list-style-type: none"> <li>Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major)</li> </ul>	<p>In proximity to streams</p> <ul style="list-style-type: none"> <li>All working practices should conform with the Environment Agency (and SEPA) PPG05: “Works in, near or liable to affect watercourses”; [SEMP]</li> </ul> <p>Designation of an exclusion “buffer zone” along stream banks in the vicinity of any stretches of track or turbine base; fenced off with hazard warning tape; [SEMP]</p> <p>Where excavations are planned, sediment traps should be installed and regularly inspected and emptied; contents disposed of either off site or carefully on site if sediments are not contaminated. On site disposal should be located far away from any areas of existing peatland, heathland or mire vegetation; [SEMP]</p> <p>Excavations and work with heavy plant should not take place close to watercourses during wet weather, where there is surface standing water and when the ground conditions are saturated; [SEMP]</p> <p>All excavated materials should be properly stored, for the very shortest practicable period of time, on geotextile material; [SEMP]</p> <p>All tracks should be designed to be permeable and to have formal drainage systems; [SEMP]</p> <p>Appropriately sized culverting should be used for all crossing points; [SEMP]</p> <p>Where new stream crossing points are required and where existing crossing points are widened, specialised in-channel sediment trapping techniques should be used to maximise the retention of generated sediments near the point of origin; [SEMP]</p> <p>During all road widening activities and renewal or widening of culverts at stream crossing points, particular attention should be paid to: (a) prevention of soil erosion from stream banks and associated sedimentation into streams, (b) storage of excavated materials away from stream banks, (c) maintenance of stream water flows at all times and (d) restoration of stream banks to their former, vegetated, condition; [SEMP]</p> <p>In-channel engineering works should ideally be undertaken during periods outside the trout migration and spawning season (October to March). However, this needs to be balanced against the fact that impacts from works are likely to be greater during the summer months due to low flows and reduced dissolved oxygen concentrations; [SEMP]</p> <p>The project hydrologist/ecologist should be involved in final design of construction working practices and the timing of construction activities to ensure that any environmental impacts are prevented or minimised; [SEMP]</p> <ul style="list-style-type: none"> <li>The design of working practices should include a detailed rapid response plan to be followed in case of any spillage or leakage of contaminating materials [SEMP].</li> </ul>	<p>9.7.2</p>	<p>All impacts: Minor or lower (all not significant)</p>
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Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<p><b>Hydrology (Continued)</b></p>	<ul style="list-style-type: none"> <li>• Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major)</li> </ul>	<p>In relation to water use for vehicle washing:</p> <ul style="list-style-type: none"> <li>• Water abstraction:                             <ul style="list-style-type: none"> <li>• Water flow in the burn should be gauged and monitored daily (a simple graduated meter rule will suffice); [SEMP]</li> <li>• Water abstraction rate should be low, calculated, according to seasonal water flows in the burn, to be no more than 20% of water flow at any time; [SEMP]</li> <li>• Water should not be abstracted if water flow in the burn (during summer drought conditions and low flow periods) falls below 50% of its annual average discharge rate; [SEMP]</li> <li>• Abstracted water can be stored on site at times of high flow for use at times of low flow. [SEMP]</li> </ul> </li> <li>• Stream water quality:                             <ul style="list-style-type: none"> <li>• After washing, water should be drained from the compound via an oil interceptor to ensure that fuels, oils and grease cannot enter either of the above streams. The oil interceptor should be part of a regularly inspected, cleaned and maintained drainage system from the site compound; [SEMP]</li> <li>• Washing waters should be drained via a sediment trapping system prior to discharge into either of the above streams. This may be a sediment settling tank to permit settlement of suspended solids, or a filtration system. In either case, the sediment trapping system should be part of a regularly inspected, cleaned and maintained drainage system from the site compound. [SEMP]</li> </ul> </li> </ul>	<p>9.7.5</p>	
		<ul style="list-style-type: none"> <li>• To protect private water supplies:                             <ul style="list-style-type: none"> <li>• Survey to identify any currently unknown private water supplies; [SEMP]</li> <li>• Rapid response plan produced. [SEMP]</li> </ul> </li> </ul>	<p>9.7.6</p>	

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Hydrology (Continued)</b>	<ul style="list-style-type: none"> <li>• Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major)</li> </ul>	Requirements at constraint site A (see Figure 18b) <ul style="list-style-type: none"> <li>• Construction personnel instructed on the sensitivity of the peat mire habitats, the need to maintain their hydrological status and the precautions to be taken and care required when working in deep and wet peat; [SEMP]</li> <li>• Environmental Management Plan to give explicit guidance on the correct handling and laydown of all construction materials, together with correct disposal of construction wastes; [SEMP]</li> <li>• Prior to the start of construction activities on the access track in this area, a working corridor should be demarcated and fenced off along this rocky ridge to confine working activities to the central portion of the ridge; [SEMP]</li> <li>• Care should be taken to ensure that there is no possibility that water flows in this stream could be interrupted during track construction in this area. [SEMP]</li> </ul>	9.7.7	
		At decommissioning: <ul style="list-style-type: none"> <li>• Further scoping and environmental impact assessment is advised prior to the start of decommissioning so that the most appropriate choices of decommissioning techniques can be chosen; [SEMP]</li> <li>• Mitigation measures proposed for construction activities should be implemented to ensure that, as a minimum, the same (high) environmental standards will be applied to decommissioning of the development as is recommended to be applied during its construction. [SEMP]</li> </ul>	9.7.8	

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Hydrology (Continued)</b>	<ul style="list-style-type: none"> <li>Impact of accidental spillages of fuels and other chemicals, including concrete or alkaline waters, into streams and effects on freshwater ecology, including fisheries. (Minor to Major) (CONTINUED)</li> </ul>	.. [SEMP] The design of working practices should include a detailed rapid response plan to be followed in case of any spillage or leakage of contaminating materials. [SEMP]	9.7.2	Minor or lower (all not significant)

Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Landscape and Visual</b>	<ul style="list-style-type: none"> <li>Potentially significant effects on two properties at Balliemeanoch Farm and Oaklea ~ 4.7 km distance.</li> </ul>	<ul style="list-style-type: none"> <li>Mitigation measures have been accommodated through attention to the site layout, number and proposed size of turbines.</li> </ul>	10.4	Significant effect on two properties at Balliemeanoch Farm and Oaklea ~ 4.7 km distance, but not considered to adversely affect the visual amenity of the residents or setting.
	<ul style="list-style-type: none"> <li>Potentially significant effect to recreational receptors and road users along a short section of the B840 alongside Loch Awe and at viewpoint locations at Loch Nant, Portsonachan and Blarghour.</li> </ul>			Significant effect that adds a new focus or feature to the view. Not necessarily considered adverse as does not compete with the existing view.



Assessment or Evaluation Topic	Potential Significant (Moderate or High) Effects	Suggested Mitigation Measures	Reference	Residual Significance
<b>Archaeology</b>	<ul style="list-style-type: none"> <li>Limited potential for unavoidable effects on unidentified archaeological features. [didn't think these were moderate or high?]</li> </ul>	<ul style="list-style-type: none"> <li>Archaeological monitoring (watching brief) would enable identification of remains and preservation by record. [SEMP]</li> </ul>	11.5.3	Residual effects will be addressed through preservation by record, which is expected to represent adequate mitigation.
<b>Noise</b>	<ul style="list-style-type: none"> <li>No predicted significant effects</li> </ul>	<ul style="list-style-type: none"> <li>None required</li> </ul>		
<b>Infrastructure and Telecommunications</b>	<ul style="list-style-type: none"> <li>No predicted significant effects</li> </ul>	<ul style="list-style-type: none"> <li>None required</li> </ul>		
<b>Access</b>	<ul style="list-style-type: none"> <li>Access restrictions will be temporary and short lived.</li> </ul>	<ul style="list-style-type: none"> <li>Information should be made available to receptor groups. [SEMP]</li> </ul>	14.5	Impacts during construction will not be significant. It is believed that during operation access opportunities will be enhanced.

