Quantans Hill Wind Farm

Volume 3 - Part 1
Technical Appendices

VATTENFALL

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CONTENTS

PREFACE

An Environmental Impact Assessment Report (EIAR) has been prepared in support of an application submitted by Natural Power Consultants Limited (Natural Power) on behalf of the Applicant (Vattenfall Wind Power Ltd). The application seeks consent under Section 36 of the Electricity Act 1989 and the EIAR has been prepared in accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Amendment Regulations 2017. The application also seeks a direction under Section 57(2) of the Town and Country Planning (Scotland) Act 1997 as amended that planning permission for the development be deemed to be granted. This EIAR contains the information carried out for the Environmental Impact Assessment to develop a wind farm comprising of up to fourteen wind turbines and associated infrastructure (the Proposed Development). The Proposed Development is located in Dumfries & Galloway local authority area.

The Electricity Works (Miscellaneous Temporary Modifications) (Coronavirus) (Scotland) Regulations 2020 ("the Temporary Regs") came into effect on 24 April 2020. These Regulations are temporary and were due to expire on 30 September 2020. However, these safeguards will now continue to be in place for the duration of the extension period, with the expiry date of the Scottish Acts by this Bill, to 30 September 2022.

Copies of the EIAR may also be obtained from Vattenfall Wind Power Ltd at a charge of £1,400 per hard copy. Copies of Non-Technical Summary and USB format of entire application are available free of charge upon request.

- **This is Volume 3 of the EIAR** which presents the Technical Appendices associated with the EIAR Chapters.
- Volume 1 of the EIAR presents the 15 Chapters of the EIAR.
- Volume 2a of the EIAR presents the technical Figures associated with the EIAR Chapters except for Chapter 5 (Landscape & Visual Impact Assessment).
- Volume 2b of the EIAR presents the technical Figures associated with EIAR Chapter 5.
- Volume 2c of the EIAR presents the Visualisations produced for EIAR Chapter 5 and 9 (Landscape & Visual Impact Assessment and Cultural Heritage).
- Volume 4 of the EIAR presents the Non-Technical Summary.

In addition to the EIAR, the application is also supplemented by accompanying documents including:

- Planning, Design & Access Statement,
- Pre-Application Consultation (PAC) Report.

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This is to certify that

Natural Power Consultants Limited

is a member of the

EIA Quality Mark

for the registration period covering

18th April 2022 – 17th April 2023*

*Subject to meeting the requirements of registration

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Appendix 1.1

Scoping Report

Document history

Author	Natural Power	26/06/2020

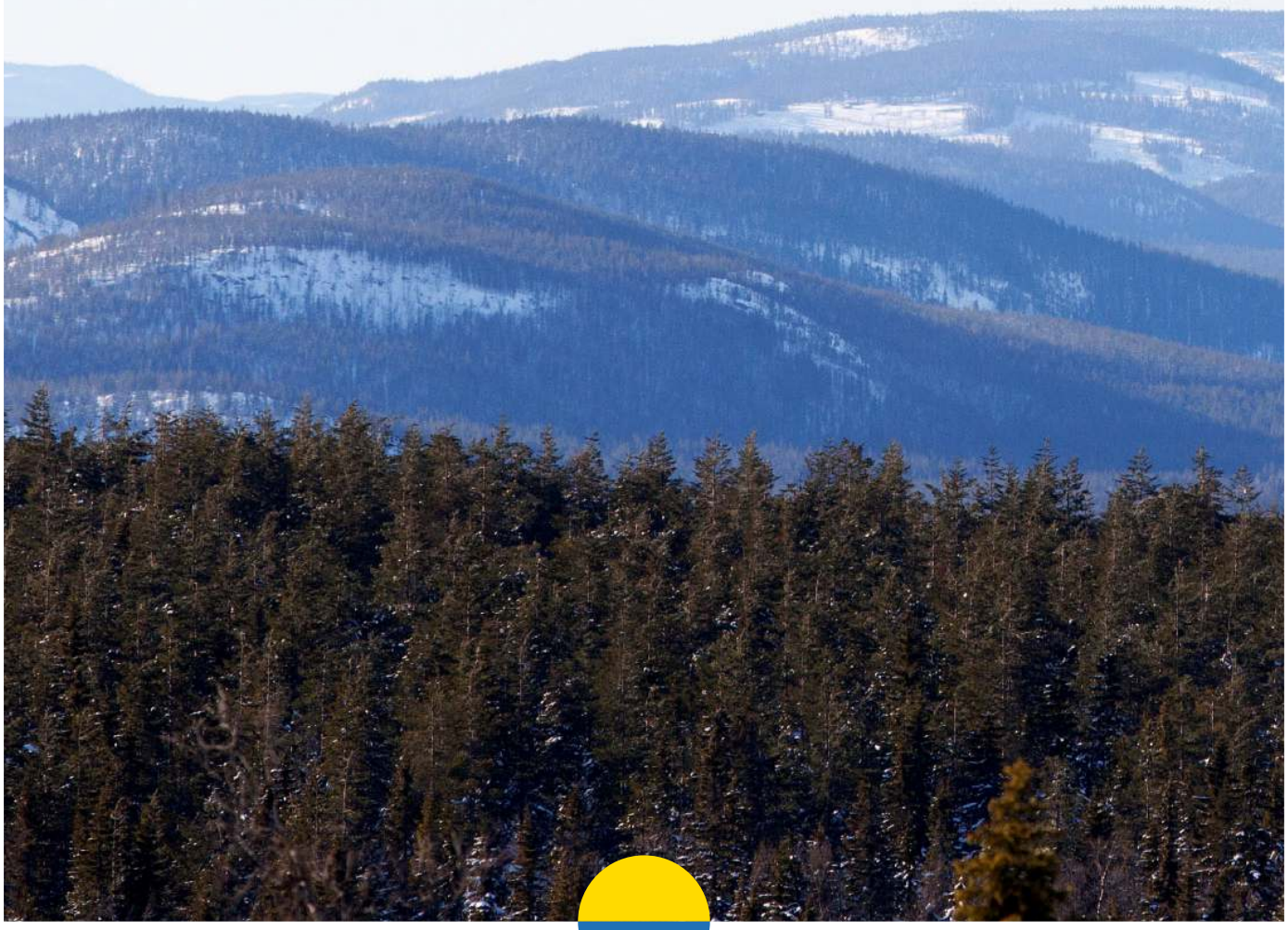
Client Details	
Contact	Matthew Bacon
Client Name	Vattenfall Wind Power Ltd

Issue	Date	Revision Details
A	26/06/2020	Released

Quantans Hill Wind Farm

Scoping Report
Prepared by Natural Power on behalf of
Vattenfall Wind Power Ltd.

Confidentiality class: None (C1)



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Contents

1. Introduction

This Scoping Report has been prepared by Natural Power Consultants Limited (Natural Power) with ornithological input from MBEC environmental consulting (MBEC) on behalf of Vattenfall Wind Power Ltd (Vattenfall). It is provided in anticipation of an application under Section 36 of the Electricity Act 1989 for a wind farm development at Quantans Hill in Dumfries & Galloway.

Under the statutory procedures set out in the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (EIA Regulations) it is proposed that any such application is accompanied by an Environmental Impact Assessment Report (EIAR). Under Regulation 12 of these EIA Regulations, a formal opinion of the information to be supplied in the EIAR is sought from Scottish Ministers.

The purpose of this Scoping Report is to provide information to consultees for determining the scope of the Environmental Impact Assessment (EIA) and EIAR. Consultees will note that the Scoping Report contains a number of questions/comment boxes for which it would be useful to receive feedback. Not all questions will be relevant to all consultees, therefore we request that consultees provide feedback only on those questions appropriate to them. The questions should not be considered an exhaustive list, and consequently consultees are welcome to provide feedback on any issue they consider relevant to Quantans Hill wind farm (herein referred to as the proposed development). If consultees elect not to respond, Vattenfall will assume that consultees are satisfied with the approach adopted/proposed. Further consultation will happen with affected stakeholders throughout the EIA process, including with local communities.

The design of the proposed development to date is a result of maximising the potential wind resource on site whilst recognising site-specific and broader constraints as they are understood now. The layout presented in this Scoping Report is expected to be further refined during the EIA process and through further consultation. Therefore, it should be noted that any amendments to the design are unlikely to increase the likelihood of a significant effect. However, should any changes occur that are likely to result in a significant or unknown effect on an important feature previously scoped out, then this feature will be scoped back in to the EIA process. Changes of this nature will be discussed with the relevant consultees, to ensure that they too are in agreement with Vattenfall's understanding and before altering the inclusion or exclusion of features from the EIA. Further general information about embedded mitigation and layout iterations is provided in Chapter 6.

1.1. The Applicant

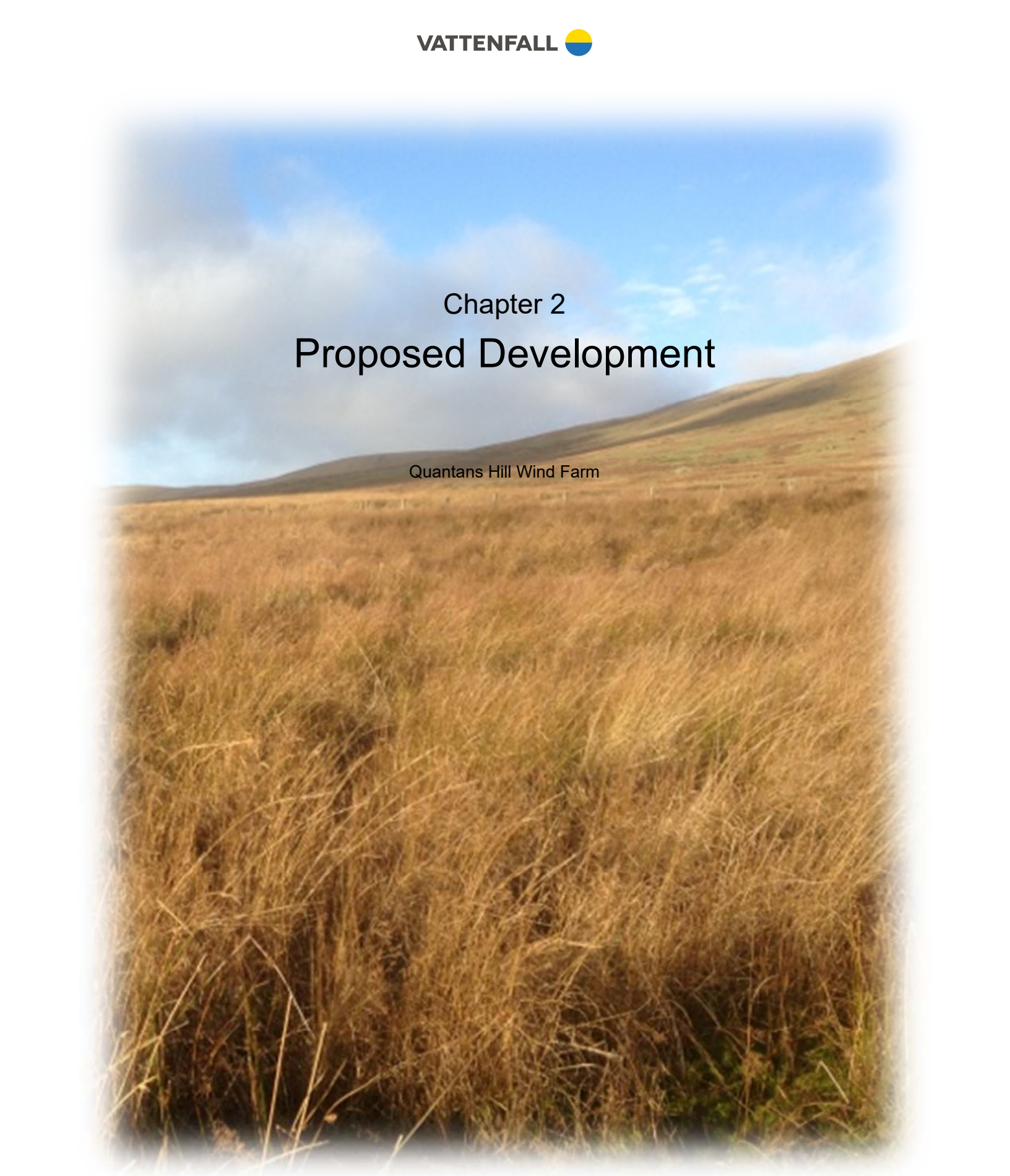
Vattenfall is a leading European energy company with approximately 20,000 employees, owned by the Swedish state. For more than 100 years Vattenfall has powered industries, supplied energy to people's homes and modernised the way its customers live through innovation and cooperation.

Vattenfall aims to make fossil-free living possible within a generation and is leading the transition to a more sustainable energy system through growth in renewables and climate-smart energy solutions for our customers.

Vattenfall has over 50 wind farms, onshore and offshore, across five countries and pioneered co-locating wind with solar and batteries. We have been in the UK since 2008, investing over £3.5 billion in enough wind to power nearly a million British homes. Vattenfall owns the largest onshore wind farm in England and Wales, Pen y Cymoedd, and in Scotland operates wind farms on the Isle of Skye and in Aberdeenshire. At a local level Vattenfall developed the consented South Kyle wind farm, near Dalmellington, lying within both East Ayrshire and Dumfries and Galloway, which is currently under construction and due to begin commercial operation in Q1 2023

1.2. Previous Application

An application was made to the Scottish Government for a development at Quantans Hill in January 2014, known as Quantans Hill wind farm by a different applicant. The proposed development's site boundary is larger but centres around the same area.



Chapter 2
Proposed Development

Quantans Hill Wind Farm

2. Proposed Development

The proposed development is located on Quantans Hill, located in Dumfries and Galloway, northeast of the village of Carsphairn and east of the A713. It covers an area of approximately 1,800 hectares. The maximum topographic height of the site is 797m, although this is not within the technically developable area of the site. Figure 1 illustrates the current proposed turbine layout, which is subject to change on the basis of environmental survey and stakeholder feedback, and location of the site. Figure 2 shows the regional context of the proposed development. Figure 3 presents the site constraints identified to date which will be considered in the design process.

Figure 4 shows the Zone of Theoretical Visibility (to tip height) for the current site layout. The proposed development presented in this Scoping Report is considered by Vattenfall to comprise the largest extent of land and the tallest and greatest number of turbines which is expected to be put forward for permission. It therefore represents what is likely to provide the most benefit in terms of electricity generation, climate mitigation, net biodiversity gain, supply chain, and community benefit, and be the 'greatest extent' with regard to potential adverse environmental effects.

The following key elements are currently being considered for the proposed development:

- Up to 21 wind turbines, tip heights expected to range from 200m to 250m in height to blade tip.
- Turbine foundations
- Crane hardstand and temporary laydown areas
- Upgrading of existing and creation of new access tracks
- Temporary borrow pits
- Underground electricity cables
- Anemometry mast(s)
- External transformer housing
- Signage
- Temporary construction and storage compounds, laydown areas and ancillary infrastructure
- Drainage and drainage attenuation measures (as required)
- Substation, compound and control building
- Battery/energy storage; and
- Hydrogen generation and storage.

The existing B729 road that leads to the site leaves the A713 approximately 0.5km to the east of Carsphairn. These roads will be utilised and upgraded where necessary.

A 30-year operational period may be sought for the proposed development following which decommissioning of this project would be undertaken.

2.1. Wind Turbines

The specific turbine model has not yet been selected but it is expected to be a horizontal axis machine with three rotor blades. Current models have approximately 6MW generating capacity and by the time the project is constructed, such machines may be capable of generating more. Should the candidate turbine require it, external transformers will also be placed adjacent to each turbine.

2.2. Turbine foundations

Reinforced concrete gravity foundations may be used on the proposed development. A typical turbine foundation specification is typically an inverted T shape consisting of a large square pad with protruding upstand left approximately 200mm proud of the finished ground level. Detailed design specifications for each foundation would depend on site-specific factors such as ground conditions, the specific turbine used and various other engineering considerations. Each turbine foundation would comprise of a volume of concrete reinforced with steel bar. Following construction of the foundations, a layer of peat, peat turfs and/or mineral soils that was excavated from the turbine foundation area would be reinstated. Stability for the turbine is provided through the weight of the foundation and the material replaced and compacted over it. Depending on the height of the water table at the foundation location, a drainage system may be installed around the foundation to prevent the build-up of water pressure under the foundation. Alternatively, in locations that were particularly sensitive to hydrological disturbance, it may be possible that a submerged foundation design could be employed which would not require a drainage system around the foundation.

2.3. Crane hardstand and temporary laydown areas

To enable the construction and subsequent maintenance of the proposed wind turbines, crane hard stands and

temporary laydown areas will be required. At this stage in the process the final design, location, and orientation of these has yet to be concluded but will be undertaken in line with the principles identified elsewhere in this report and any potential residual impacts identified in the EIAR. Crane pads would be left in-situ following erection of turbines to allow for maintenance and replacement of parts as necessary during the lifetime of the project.

2.4. Access Tracks

Existing access tracks would be utilised where possible but additional site tracks would be required. The routes for the tracks will be chosen to minimise potential impacts on the environment, while taking account of other site-specific constraints, and the EIAR will include rationale for their location.

The construction of the site tracks fall under two main categories, which can be categorised as follows:

1. 'Cut' track – superficial layers are removed, along with soft subsoils until reaching a competent bearing layer which can be used as a formation level. This construction method will be used on steeper topography where floating track is deemed unacceptable due to ground conditions or slope stability and will generally generate higher volumes of excavated material.

2. 'Floating' track – superficial layers and subsoils are left in-situ with the track built off the existing ground level, utilising geotextiles and geogrids to reinforce the track materials. This technique is generally used where there are deep soft underlying materials e.g. peat or soft clays.

Watercourse crossings will be minimised as far as possible and where these cannot be avoided then indicative water crossings will be identified and assessed.

2.5. Temporary Borrow Pits

Temporary borrow pits on site may be used to reduce the potential effects on the environment and transport network associated with transporting stone to site. Using site won stone is less likely to affect the pH of groundwater systems on site. The EIAR will include search areas of the proposed locations for on-site borrow pits.

The EIAR will present high-level details of the borrow pit designs including indicative borrow pit plans. A detailed working borrow pit scheme and a decommissioning and restoration strategy would be produced pre-construction as part of an appropriately worded suspensive condition.

2.6. Underground Electricity Cables

The transformers may be linked to a substation via high voltage underground cables placed in trenches which would generally follow the route of the on-site tracks. In addition, where appropriate, the transformers would connect to the substation via underground cables across open ground with electrical marker posts used to identify their locations.

2.7. Anemometry Mast(s)

Anemometry masts are used to monitor wind speed and direction across wind farm sites in order to ascertain the available wind resource on any given site. This allows for a greater degree of certainty within the gathered data, overcoming seasonal variations in wind flow and addressing the potential for mechanical or electrical failure. In larger sites, particularly those with a complex wind regime, there is often a need to move masts around the site in order to gain a fuller understanding of wind characteristics across the site.

2.8. External Transformer Housing

The proposed wind turbines would produce electricity at 690 –1,000 Volts. The electricity would then be transformed to 33,000 Volts (33kV) via a transformer located external to the tower of each turbine, depending on the final turbine model used. The transformers are likely to be linked to an on-site substation via the high voltage underground cables.

2.9. Temporary Construction and Storage Compounds, Laydown Areas and Ancillary Infrastructure

To facilitate construction, temporary compounds may need to be developed strategically in the site.

Infrastructure ancillary to the construction and operation of the proposed development will be required. These would be constructed in accordance with best practice and relevant guidelines, and to minimise environmental impact.

2.10. Drainage and Drainage Attenuation Measures (as required)

Drainage design will incorporate sediment management measures to attenuate and treat runoff from wind farm infrastructure.

2.11. Substation, Compound and Control Building

A control building would serve as an operational hub. Its compound would provide for services including waste storage and car parking. A substation will step up the electricity generated on site for connection to the national grid.

2.12. Battery/energy storage and hydrogen generation

A battery energy storage facility primarily consisting of a container/s with some external ancillary may be proposed to store excess electricity generated by the proposed development and export it when required. It is likely to be akin to a shipping container with lithium-ion battery cells inside.

A hydrogen generation and storage facility may also be proposed, which would generate hydrogen electrolysed from water with electricity supplied by the wind farm. This may entail an electrolyser compound comprising electrolyser fuel stacks, a water purification plant, compressors, a water storage tank, and a hydrogen storage tank. Hydrogen produced by such a facility could be used to provide green transport fuel, e.g. bus services.

2.13. Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) would be created and agreed with Dumfries & Galloway Council prior to construction commencing through an appropriately worded suspensive condition in order to ensure the impacts from construction are kept to a practical minimum. The CEMP would set out the method statements for constructing site infrastructure, measures that would be undertaken by contractors to ensure good site practice with regards to construction practices, and environmental management. Such measures would include for the transport and storage of potentially polluting substances such as oils and lubricants as well as waste management for example.

In the past, the use and implementation of a CEMP has ensured that the environment and in particular the integrity of drinking water reservoirs and catchments have not been significantly adversely affected. Should the proposed development be consented similar best practice guidelines and method statements will be adopted to ensure again that the development does not impact negatively on elements of the local environment.

2.14. Forestry

At time of writing there is no commercial forestry within the site boundary of the proposed development.

However, in the event that landowners elect to plant commercial forestry on site, the applicant would consult Forestry and Land Scotland.

2.15. Grid Connection

Connection of the proposed development to the national grid will be subject to a separate application.

2.16. Operational Period

The proposed development would in general operate automatically but would be monitored by an experienced team at a control building onsite and by Vattenfall's remote operations team. Each individual turbine would operate independently from the others. Within the operational wind speed range the pitch angle of the turbine blades of each individual turbine would be automatically adjusted by the control system within the turbine, as appropriate for the measured wind speed.

Should sensors, placed within the nacelle of the turbine, register any instability in the structure or any other malfunction in operation or should wind speeds increase over safe limits, then the turbine would automatically shut

down. If the cause of the shutdown is high wind speeds then the turbine would automatically recommence operation once average wind speeds fell to within the operational range (generally between approximately 4 metres per second (m/s) and 25m/s, i.e. 9 miles per hour (mph) and 56mph, although technological improvements may allow for operation during stronger winds. Under other causes of shutdown the turbine would remain offline and in a safe condition until manually restarted by a member of the operations and maintenance team.

The lifetime of the project is envisaged to be 30 years from commissioning to decommissioning. Turbines are now generally designed with a warranty life in excess of 30 years although advances in technology and understanding of turbine maintenance may prolong this. To ensure that turbines continue to operate with acceptable availability in addition to maintenance in the event of malfunctions, regular pre-planned maintenance and servicing programmes are performed at the site on each turbine. Minor scheduled maintenance checks tend to be carried out every six months with major services being performed annually throughout the lifetime of the turbine.

Each turbine would contain lubricating and hydraulic oils. These are often replaced during regular maintenance operations. In the unlikely event of a lubricant leak the fully sealed tower bottom would act as a bund containing the spillage until it can be appropriately cleaned up. Spill kits would be made readily available on site.

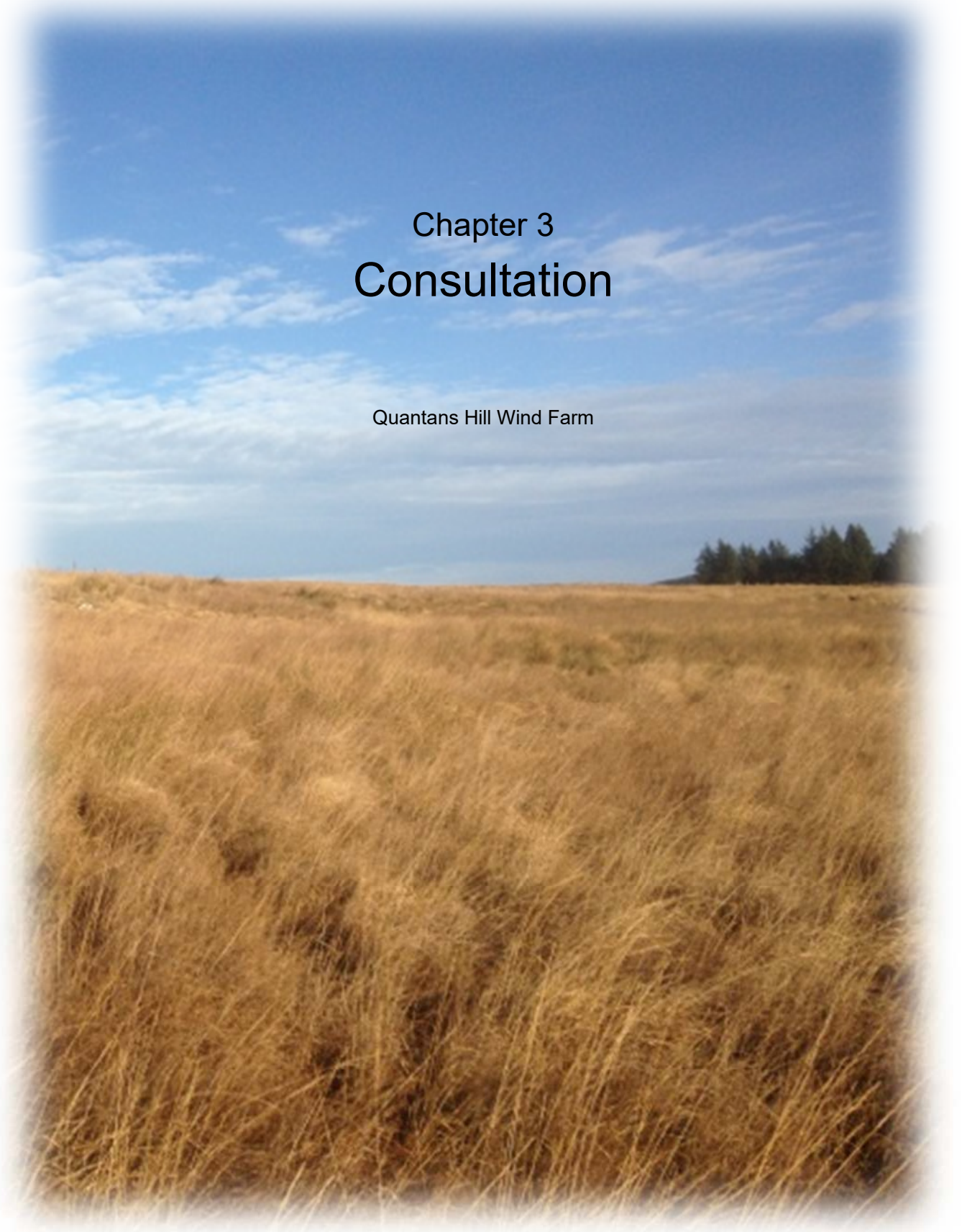
Storage of other potentially polluting substances at the site during the operational period of the wind farm would only take place where agreed with the relevant authorities.

Maintenance and operation staff on site would make use of the control building for work-related activities and welfare.

2.17. Decommissioning

At least six months prior to the decommissioning of the site a Decommissioning Method Statement would be prepared and agreed with the relevant consultees. Best practice guidelines will be utilised at this time. Vattenfall expects a planning condition regarding decommissioning to be attached to the consent. Should the proposed development be consented, its restoration fund may include salvage from turbine components. The provision of the fund should be made so as to not unnecessarily create duplication for the landowner and the planning authority.

If, nearer the time of decommissioning, it is considered by the wind farm operator that the development area may be suitable for re-powering, or if the existing wind farm infrastructure is suitable for a lifetime extension, the applicant may submit a new application to the relevant authority for such development.



Chapter 3
Consultation

Quantans Hill Wind Farm

3. Consultation

3.1. Community Consultation

Vattenfall considers consultation with the community to be a crucial part of the wind farm development process and will engage with the local community throughout the application process. Vattenfall has already engaged a local Regional Liaison Officer to help better understand the local context, seek feedback, and provide information about the project.

A programme of statutory and public consultation will be undertaken to provide information to, and seek feedback from, interested parties. This may include public exhibitions, virtual meetings and webinars, a project website, online consultation, one-to-one meetings with local stakeholders, leaflet drops and an established contact for project information requests.

It is also proposed to establish a Community Liaison Group comprising representatives from relevant community councils in the area and other local representatives. The engagement process will include outlining the findings of the baseline studies and assessment process. These meetings will be designed to provide a medium for two-way communication for the project and address any questions or concerns that representative community groups wish to raise. Public information events may be organised for the local community later in the EIA process, designed to present the concepts of the scheme.[1] These will be followed by further public consultation as the design evolves through the EIA process. Vattenfall proposes to prepare a Pre-Application Consultation (PAC) Report to accompany the Section 36 application, detailing the key outcomes of the consultation process.

Do consultees have any comments in relation to public consultation?

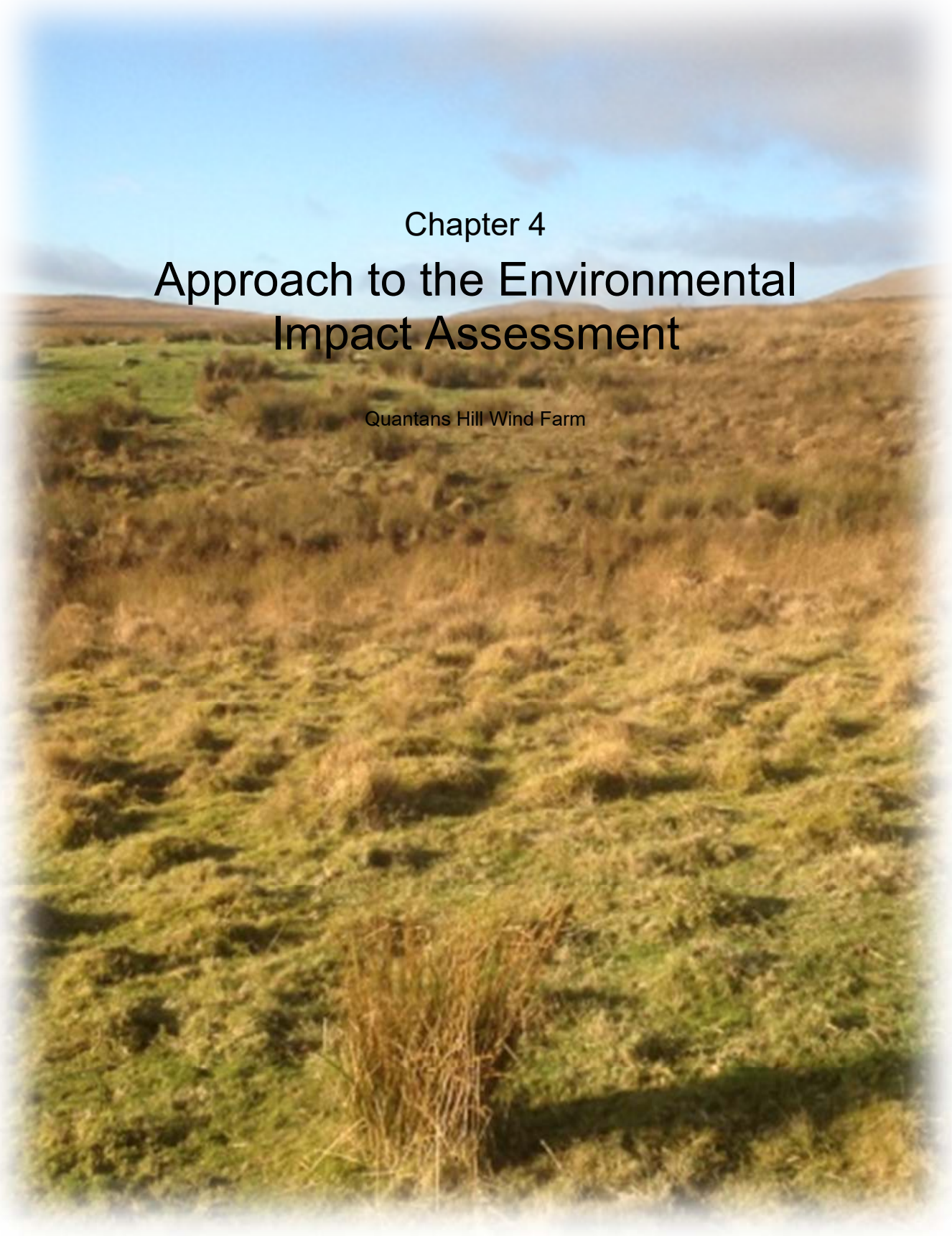
3.2. Stakeholder Consultation

Vattenfall considers consultation with statutory and non-statutory consultees as an integral part of the iterative EIA process and recognises the benefits in carrying out early consultation with all concerned parties.

The consultation will progress with the circulation of this Scoping Report and will continue for the duration of EIA process.

Vattenfall will discuss the Quantans Hill project with a broad range of interested organisations including government bodies and agencies, local businesses, interest groups, and charities.

[1] At the time of writing, Vattenfall is monitoring the threat from Covid-19 and, due to public health risks, public gatherings such as exhibitions are not allowed under UK law for the foreseeable future. Vattenfall is assessing alternative means of communicating project information virtually to comply with these regulations and will try to engage in person at the right time if and when regulations are lifted.



Chapter 4

Approach to the Environmental Impact Assessment

Quantans Hill Wind Farm

4. Approach to the Environmental Impact Assessment

The EIA is a statutory procedure which draws together in a systematic way an assessment of the potential significant environmental effects arising from a proposed development. As the process has numerous steps, it allows for the opportunity to 'design out' adverse environmental effects at an early stage through the design of the project. This of course is generally preferable to mitigation or remedy at a later stage.

An iterative design approach is already underway for this project and will continue throughout the EIA process, which will allow the proposed development to have a design that works well for both the local environment and environmental resources within the area as well as being an economically viable scheme. The steps taken for informing and developing the EIA process are identified in the flow diagram below (Diagram 4.1).

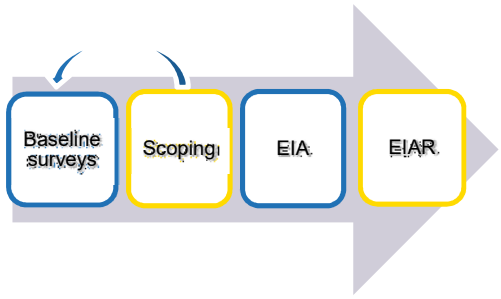


Diagram 4.1:EIA Process

Feasibility studies have been undertaken and some baseline surveys commenced, see Chapter 8 for example.

Consultees are requested to respond where possible to scope in those features and topics that are likely to experience a significant impact, and thus 'scope out' the rest. In doing so the impact assessment will be focussed on those effects that will influence the determination.

The impact assessment will determine for those assessed receptors what the impact may be from the project, either directly or indirectly, by comparing the baseline conditions with the conditions that would prevail should the proposed development be constructed, operated (and decommissioned). The environmental effects of the proposed development will be predicted in relation to environmental receptors (i.e. people), built resources and natural resources.

A distinction will be made in the assessments between impacts and effects, where:

- 'Impacts' mean the predicted change to the baseline environment attributable to the scheme; and
- 'Effects' which are the consequence of impacts on environmental resources or receptors.

4.1. What will the EIA Assess?

The EIA will address the construction phase of the wind farm which may last approximately 12 to 18 months, the operational and maintenance phase which would last approximately 30 years, and the decommissioning phase which is expected to take around two years.

The geographical coverage of the EIA will take account of the following:

- The physical extent of the proposed works;
- The nature of the baseline environment and the manner in which effects are propagated; and the
- Pattern of governmental administrative boundaries which provide the planning and policy context for the scheme.

4.2. Gathering Baseline Information

Baseline data is being collected for this project and the assessment team will ensure that sufficient data is obtained to enable a robust assessment, appropriate to the nature and scale of the proposed development. The extent of the baseline assessment will be determined using both professional judgement and industry and consenting authority best practice. The EIA will also identify areas where the baseline may change, prior to the construction and operational phases of the project from current conditions (for example, maturation of landscaping).

The collection of baseline data will be achieved through desk study, consultation, field survey, and monitoring and will be clearly reported in the subsequent sections, or within the EIAR (should there be an expected significant impact from the development). In line with the regulations, the EIAR will also indicate any difficulties encountered in compiling environmental baseline

conditions; such as access to land to carry out surveys where permission was not granted.

4.3. Prediction and Evaluation of Impacts and Effects

The prediction of impacts examines the change to the baseline environment that could result from the construction and operation of the proposed development. The effects will be classified in to one or more of the following:

- Positive effects that have a beneficial influence, negative effects that have an adverse influence;
- Temporary effects that persist for a limited period only due, for example, to particular construction activities;
- Permanent effects that result from an irreversible change to the baseline environment or which persist for the foreseeable future;
- Direct effects that arise from activities that form an integral part of the project;
- Indirect effects that arise from activities not explicitly forming part of the project;
- Secondary effects that arise as a result of an initial effect of the scheme; and
- Cumulative effects that arise from the combination of different impacts at a specific location, the recurrence of impacts of the same type at different locations, the interaction of different impacts over time, or the interaction of impacts arising from the scheme in conjunction with other development projects.

There is no statutory definition of what constitutes a significant effect. A significant effect may be broadly defined as an effect which, either in isolation or combination with others, should be taken into account in the decision-making process. This general definition will be used as the basis against which the significance criteria for environmental disciplines will be developed. The threshold of significance for predicted effects tends to vary between the environmental topics. The assessment team will ensure that a consistent approach is applied to prevent undue weight being given to a particular discipline to the detriment of another.

4.4. Mitigation of Environmental Effects

Mitigation measures will be considered for each significantly adverse effect. The EIAR will include a description of the measures envisaged to prevent, reduce and, where possible, remedy any significant adverse effects. In line with the regulations, when identifying mitigation measures, the project will take into account the practicability and cost effectiveness of the proposals and their efficiency in reducing environmental impacts. Where practical, mitigation measures will be set out as commitments, which will ensure they are implemented.

Once the final design has been adopted and account has been taken of any mitigation measures, residual adverse effects will be listed. The significance of a residual adverse effect will be determined by correlating the magnitude of the change arising from the scheme with the sensitivity of the particular attribute under consideration. The magnitude of change will be evaluated in accordance with Table 4.1.

High	Total loss or major alteration to key elements/features of the baseline conditions
Medium	Partial loss or alteration to one or more key elements/features of the baseline conditions
Low	Minor shift away from the baseline conditions
Negligible	Very slight change from baseline conditions

Table 4.1: Magnitude of Change

Where applicable in carrying out individual assessments, a scale of increasing sensitivity of the resource or receptor will be defined. This may be defined in terms of quality, value, rarity or importance and can be classed as ‘Low’, ‘Medium’ or ‘High’. For certain assessment areas, guidance will be taken from the value attributed to elements through designation or protection under law. Where assessment of this nature takes place the correlation of magnitude against sensitivity will determine a qualitative expression for the significance of the residual adverse effect. This is demonstrated in the matrix in 4.2 Significance of Effect
4.2 Significance of Effect

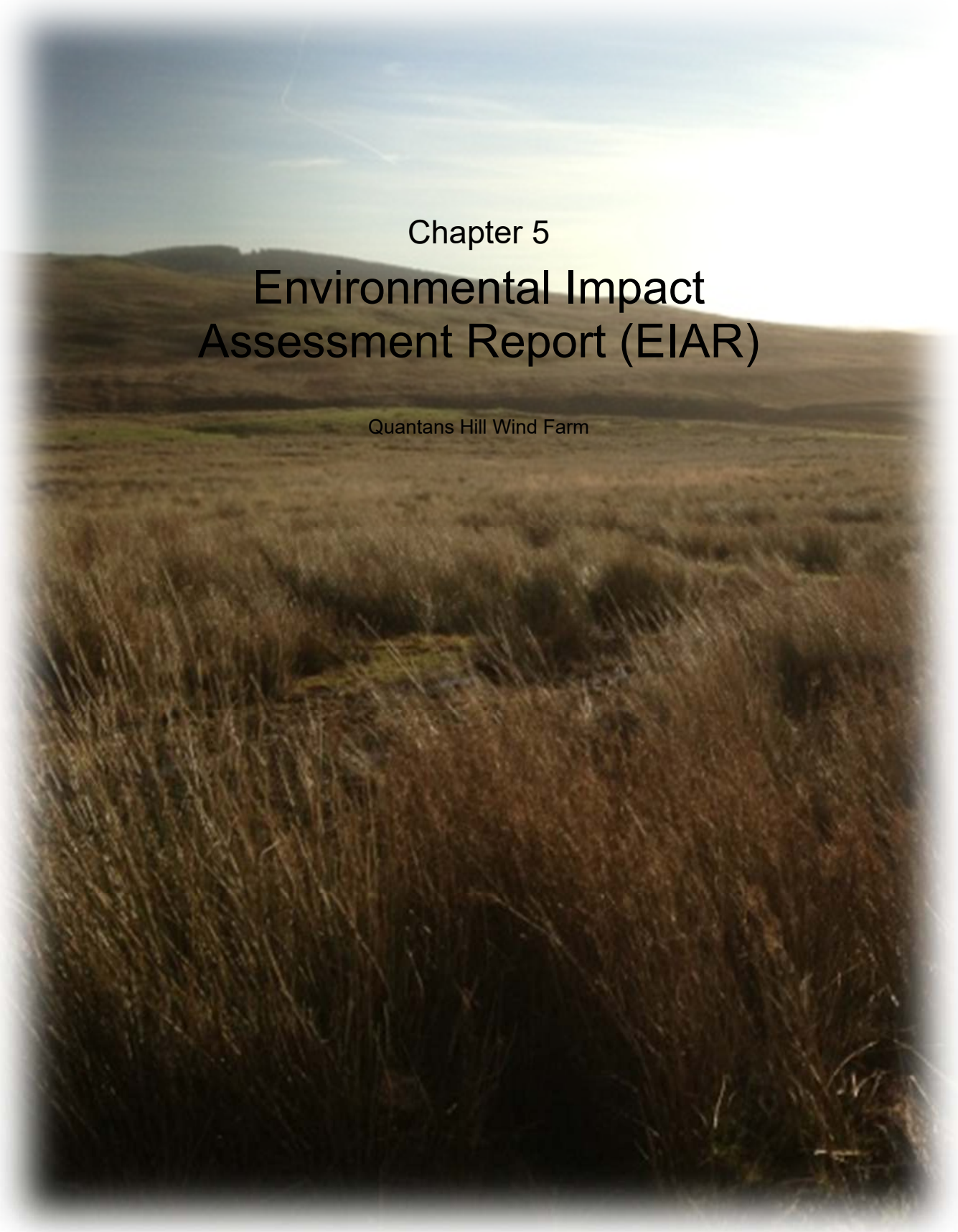
Those residual adverse **effects indicated as Major and Moderate/Major will be regarded as being significant** effects in terms of the relevant legislation. However, other factors may have to be considered including the duration and the reversibility of the effect.

Do consultees have any comments in relation to the approach to the Environmental Impact Assessment?

As per the aim of the Scoping Report, we intend to focus the EIAR on the significant effects and will therefore seek agreement that non-significant effects can be scoped out.

4.5. Securing Commitments and Mitigation through Planning Conditions

Where commitments have been discussed within this Scoping Report they will form part of the EIAR and therefore ensure that they are secured if the proposed development receives consent through specific planning conditions. These conditions may include, for example, requirements for detailed documents including a Construction Environmental Management Plan (CEMP) to be produced prior to construction.



Chapter 5

Environmental Impact Assessment Report (EIAR)

Quantans Hill Wind Farm

5. Environmental Impact Assessment Report (EIAR)

5.1. EIAR Production

The EIA process will result in the production of an Environmental Impact Assessment Report (EIAR). The EIAR will identify those features/receptors that have been agreed with the competent authority and their advisers as those that are likely to have a significant effect from the proposed development and will make an influence on their decision process.

It will focus on each of the broad topics identified within this Scoping Report, plus any others that develop throughout the remainder of the EIA process until submission.

Where features are considered, the assessment methodology, results, effects and mitigation proposed (if any) will be included. This will allow for the residual effect from the proposed development to be identified to allow the competent authority sufficient information to determine the application.

The EIAR will supplement the application and will also be accompanied by a Non-Technical Summary (NTS). A Pre-Application Consultation (PAC) Report and a Planning, Design and Access Statement are likely to also be provided.
The EIAR is likely to follow the structure below:

- Chapter 1: Introduction
- Chapter 2 Approach to EIA
- Chapter 3: Site Selection and Design Evolution
- Chapter 4: Project Description
- Chapter 5: Legal & planning policy and carbon balance context
- Chapter 6: Landscape and Visual Impact Assessment (LVIA)
- Chapter 7: Ecology
- Chapter 8: Ornithology
- Chapter 9: Hydrology, Geology and Hydrogeological
- Chapter 10: Noise
- Chapter 11: Cultural Heritage
- Chapter 12: Traffic and Transport
- Chapter 13: Aviation and Existing Infrastructure
- Chapter 14: Socio-economics
- Chapter 15: Population and Human Health[2]
- Chapter 16 Synergistic Effects, Summary of Mitigation and Residual Effects

Do consultees have any comments in relation to the proposed chapters to be included in the EIAR?

As per Regulation 17 of the EIA Regulations, the EIAR will be submitted to Scottish Ministers. Upon submission of the application, the EIAR will be made available for public inspection at appropriate locations to be agreed with Dumfries and Galloway Council and will be distributed to the relevant consultees. An NTS will be submitted alongside the EIAR, which will provide a summary of the main findings and will be written in a non-technical language for ease of understanding by the general public.

[2] The assessment of population and human health includes consideration of noise, shadow flicker, ice throw, lightning, private water supplies and socio-economics. Such factors are assessed throughout different areas of the EIAR and will be summarised in Chapter 16.

5.2. Legal and Policy Context

The application will conform to the statutory requirements legislated by Section 36 of the Electricity Act 1989 and The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (referred to in this report as the EIA Regulations). Deemed planning permission will be sought by the Scottish Ministers under section 57(2) of the Town and Country Planning (Scotland) Act 1997 as amended.

Planning policy will be covered by an appropriate chapter in the EIAR including carbon balance. In addition to this a Planning Statement is likely to accompany the application for consent. This would assess the proposed development in a legal and policy context against the relevant legislation and planning policies in force. The Planning Statement would assess such documents at international, national, regional and local levels, where applicable, including but not limited to:

- Paris Agreement (effective of November 2016);
- Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, which amends the Climate Change (Scotland) Act 2009;
- Scottish Energy Strategy (2017)
- Onshore Wind Policy Statement (2017)
- National Planning Framework for Scotland 3 (NPF3);
- Scottish Planning Policy 2014 (SPP);
- Draft National Planning Framework for Scotland 4 (NPF4), depending on timescales;
- Dumfries and Galloway Local Development Plan 2 (adopted October 2019).

Chapter 6

Embedded Mitigation and Further Layout Iterations

Quantans Hill Wind Farm

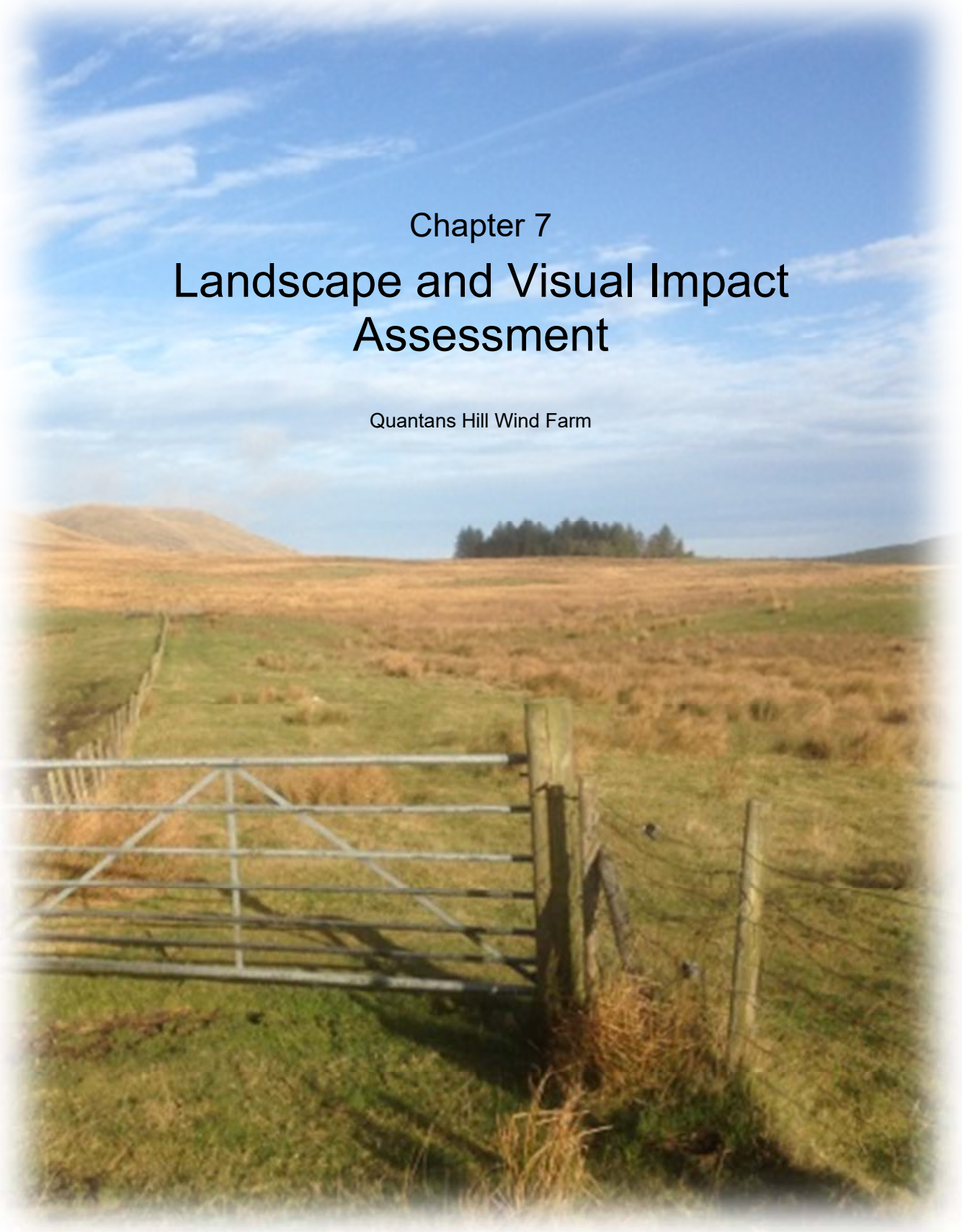
6. Embedded Mitigation and Further Layout Iterations

The design of the proposed development has generally avoided environmental and physical constraints which have been identified during initial feasibility studies (embedded mitigation). These will be refined as the EIA progresses.

Throughout the remainder of the EIA process, until the submission of the EIAR, the layout presented here in the Scoping Report will further develop, especially in light of the Scoping Opinion and public consultations. It should be noted that the layout presented within this Scoping Report represents a 'greatest extent scenario' (i.e. turbines have been presented in the greatest number and tallest envisaged height) and therefore the proposal as identified now will have the greatest environmental impacts and benefits, and generally any amendments to the design will decrease the likelihood of a significant effect.

Should any changes occur that are likely to have a significant effect on the receptor these will be included within the EIAR. If the changes are not likely to have a significant effect, these will first be discussed with the relevant consultees, to ensure that they too are in agreement with Vattenfall's understanding before excluding them from the EIAR.

In the following sections the subject areas to be covered in the Scoping Report and EIAR are provided. Where it is considered that certain subjects or particular aspects within subjects can be scoped out of the EIAR, evidence and a rationale is provided



Chapter 7

Landscape and Visual Impact Assessment

Quantans Hill Wind Farm

7. Landscape and Visual Impact Assessment

7.1. Introduction

EIAR will include a comprehensive but focussed Landscape and Visual Impact Assessment (LVIA) of the likely significant effects of the proposed development on the landscape resource and visual amenity. These assessments will be undertaken by Chartered Landscape Architects.

7.2. Landscape Policy and Guidance

The LVIA would be prepared in accordance with the *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (GLVIA3) (Landscape Institute and the Institute of Environmental Assessment (2013) and *Landscape Character Assessment, Guidance for England and Scotland*, (The Countryside Agency and Scottish Natural Heritage (SNH) (2002 Edition).

In addition to the above, the LVIA will take account of the following guidance documents:

- Topic Paper 6: *Techniques and Criteria for Judging Capacity and Sensitivity* (Scottish Natural Heritage and the Countryside Agency 2004);
- *Landscape Institute GLVIA3 Statement of Clarification 1/13 (2013);*
- *Siting and Designing Windfarms in the Landscape*, Version 3a, (SNH, May 2014);
- *Visual Representation of Windfarms*, Version 2.2, (SNH, Feb 2017);
- Visual Representation of Development Proposals Technical Guidance Note 06/19 (Landscape Institute, 07/2019);
- *Residential Visual Amenity* Assessment (RVAA), Technical Guidance Note 2/19 (Landscape Institute, 2019); and
- *Assessing the Cumulative Impact of Onshore Developments* (SNH, March 2012).

The assessment would also take into consideration relevant national and local landscape planning policy and other such material that may be published during the preparation of the LVIA.

7.3. Methodology

A methodology including detailed criteria for assessing landscape and visual effects will be included as an appendix document to the main LVIA EIAR Chapter. Below is a summary of the intended methodology that has been used for initial assessments to determine the landscape and visual baseline.

7.3.1. Study Area

A Zone of Theoretical Visibility (ZTV) map has been produced to illustrate the potential extent of visibility of the proposed development at tip height (see Figure 4). The ZTV assumes a bare earth surface, i.e. no trees or buildings etc. that might otherwise obscure the view of the turbines, as well as excellent conditions for visibility and therefore is a 'greatest extent' illustration. The ZTV has been produced with an extent of 45km based on SNH guidance for ZTV production in relation to turbines of greater than 150m in height. Following further evaluation of potential effects within this 45km area, it is anticipated that a study area of lesser extent can be focussed on for assessing the potential significance of landscape and visual effects of the proposed development.

7.3.2. Impacts and effects

A distinction will be made in the assessments between impacts and effects:

- Impacts are defined as the predicted change to the landscape and visual baseline as a result of the construction and operation of the proposed scheme; and
- Effects are the consequence of those impacts on landscape resources or visual receptors.

It is a requirement of the EIA Regulations to state whether effects are positive, neutral or adverse. However, as a precautionary approach, effects on landscape character and views will be considered in the LVIA to be adverse, but it should be noted that not all people would experience effects on landscape character, views and visual amenity as adverse, as people's perception of wind turbines varies between negative and positive attitudes. In addition, turbine visibility from a particular location or receptor does not necessarily mean that there will be a significant adverse effect. Rather, it is dependent on the level (or significance) of that effect or change.

7.3.3. Landscape and visual effects
In accordance with GLVIA3 the assessment of Landscape effects and visual effects are considered separately.

Landscape effects are defined as the potential changes as a result of the proposal on the physical landscape resource, including landscape features, which may give rise to changes in its' character, or constituent parts of its' character. This in turn may affect the perceived value ascribed to the landscape. Landscape resources evaluated include whole Landscape Character Types (LCTs), individual elements and features and perceptual aspects and those areas designated for their scenic or landscape qualities at a national, regional or local policy level.

Visual effects consider potential changes as a result of the proposal on population or people. It considers changes to available views as a result of changes to the landscape and people's responses to these changes, otherwise referred to as visual amenity. Changes in views consider the appearance and prominence of the development from key viewpoint locations, settlements, routes and recreational areas. Viewers from such areas are collectively known as visual receptors. Visual effects include issues of intrusion (turbines encroach in the view) or obstruction (turbines intercept or block a view) and whether important opportunities to enjoy views may be improved or reduced as a result of the proposal.

The two principal criteria for determining the significance of both landscape and visual effects are:

- The nature of the location or receptor (sensitivity); and
- The nature of an effect (magnitude).

7.3.3.1. Landscape effects
As guided by GLVIA3, the nature of the landscape receptors (sensitivity) will be assessed in terms of the susceptibility of the receptor to the proposed change and the value of the receptor and will be expressed in terms of High, Medium or Low sensitivity. The nature of the effect (magnitude) on each landscape receptor will be assessed in terms of the size and scale, geographical extent, duration and reversibility of that effect and will be expressed in terms of Substantial, Moderate, Slight and Negligible.

7.3.3.2. Visual Effects
As guided by the GLVIA3, the nature of the visual receptors (sensitivity) will be assessed in terms of the susceptibility of the receptor or viewer (not the view) to the proposed change in views and visual amenity and the value attached to particular views. This will be expressed in terms of High, Medium or Low. The nature of the effect (magnitude) on each visual receptor will be assessed in terms of the size and scale, geographical extent, duration and reversibility of that effect and will be expressed in terms of Substantial, Moderate, Slight and Negligible.

7.3.3.3. Significance of Landscape and Visual Effects
For both landscape and visual effects, an overall judgement is made on the nature of the receptor and the likely change resulting from the proposed development. This judgement is based on evaluations of the individual aspects of value, susceptibility, size and scale, geographical extent, duration and reversibility. Table 7.1 illustrates the four main levels of landscape and visual effects that will be used in this LVIA; Major, Moderate, Minor and Negligible. Three intermediate combinations are also used for determining landscape and visual effects; Major/moderate, Moderate/minor and Minor/negligible. The table is not a prescriptive tool and the evaluation of potential effects makes allowance for the use of professional judgement and experience.

Landscape Institute advice, contained in GLVIA3 statement of clarification 1/13 (June 2013), states that following the determination of magnitude and sensitivity, '*the assessor should then establish (and it is for the assessor to decide and explain) the degree or level of change that is considered to be significant'*. In accordance with this advice, the LVIA will establish at what level in the assessor's opinion, '*significan*t' effects arise, as referred to in the EIA Regulations.

Those effects considered to be Major and Major/moderate effects by virtue of the more sensitive receptors and the greater magnitude of effects, are considered to be Significant Landscape or Visual Effects. Moderate, Moderate/minor, Minor, Minor/negligible and Negligible effects are considered to be Not Significant Landscape or Visual Effects. However, whilst assessments are based on factual and objective data where possible, they involve qualitative considerations, and are therefore essentially and inevitably a matter of professional judgement undertaken on an individual basis. In some instances, Moderate effects may be judged to be Significant by the assessor and equally some Major/moderate effects may be judged to be Not Significant. In these instances, the level of significance of the effect determined by the assessor will be explained in detail.

Examples of significant landscape effects can arise where changes to important key elements or attributes of a Landscape Character Types occur without necessarily

giving rise to a change in character, or where a new landscape type or sub-type and therefore new character type (at various scales) would result from the introduction of the proposed development.

A significant visual effect is considered to be a change in the view that would markedly change the composition of that view.

It should be noted that significant effects need not be unacceptable or necessary adverse and in most cases are reversible.

Table 7.1: Levels of Landscape effects and overall significance

7.3.4. Cumulative Effects

The Cumulative Landscape and Visual Impact Assessment (CLVIA) will be undertaken in a similar process to the LVIA. The aim of the CLVIA is to identify, predict and evaluate potential key effects arising from the addition of the proposed development to a theoretical landscape baseline which includes cumulative sites currently present in the landscape and that may or may not be present in the landscape in the future. Cumulative sites consist of other wind farm developments only. As with the LVIA, the CLVIA deals with the effects on landscape and visual receptors separately.

The difference between LVIA and CLVIA is the different baseline conditions in terms of other wind farm developments that are assumed to be present in the landscape. The LVIA baseline conditions consider the introduction of the proposed development to a landscape with other operational wind farm developments and those under construction. The CLVIA baseline conditions consider the introduction of the proposed development to a landscape with other wind farm developments at more speculative stages of the planning system, such as:

- consented wind farms which have been granted planning consent but are not yet constructed; and
- submitted valid wind farm applications awaiting determination, including those at appeal.

For clarity, the cumulative assessment separates out these different speculative stages of development by identifying different "**cumulative baseline scenarios**".

- The existing scenario of operational wind farms and those under construction is assessed in the LVIA and is referred to as **Scenario 1**. The CLVIA considers the following scenarios;
- **Scenario 2** considers the addition of the proposed development in the context of operational wind farms, those under construction and additionally those developments currently consented. This represents the likely future scenario; and
- **Scenario 3** considers the addition of the proposed development in the context of operational, under construction, consented, undetermined planning applications and wind farm developments currently at appeal i.e. a less certain future scenario.

Scenario 3 represents the most unlikely cumulative baseline as not all planning applications would necessarily be approved. The detailed cumulative assessment will comprise the assessment of the introduction of the proposed scheme into each scenario baseline. Projects which have come forward of relevance at Scoping or pre-application stage would be acknowledged.

In the CLVIA, cumulative effects will be reported as the additional effects of the introduction of the proposed development against different cumulative baseline scenarios. For each receptor, it is clarified as to whether the effect has increased or decreased relative to the LVIA assessment or whether the effects will be the same as in the LVIA assessment.

7.3.4.1. Types of Cumulative Landscape Effects

Cumulative landscape effects are defined as effects on either the physical fabric, aesthetic aspects of the landscape or overall character of the landscape, or any special values attached to it.

Cumulative effects on the physical fabric of the landscape arise when two or more developments affect the landscape components or features such as woodland, dykes or hedgerows.

Cumulative effects on the aesthetic aspects of the landscape arise when two or more developments affect the aesthetic or perceptual components of landscape character including scale, sense of enclosure, diversity, pattern and colour and perceptual or experiential attributes such as naturalness, remoteness, or tranquillity.

Cumulative effects on the landscape character can arise when a new proposal results in a progression from a landscape which contains one development which forms an individual, isolated feature, to a landscape in which two or more developments are evident and may form a significant or dominant characteristic.

7.3.4.2. Types of Cumulative visual effects
Cumulative visual effects are defined as effects that can be caused by combined visibility, which occurs where the observer is able to see two or more developments from one viewpoint or sequential effects which occur when the observer has to move to another viewpoint to see different developments e.g. along linear routes or journeys.

Combined visibility can occur as simultaneous visibility, where more than one development is visible in the same angle of view or successive visibility where two or more developments are present in views from the same viewpoint but cannot be seen at the same time as they are not in the same angle of view e.g. the viewer has to turn their head to see the other developments which become visible in succession.

Sequential visibility occurs where two or more developments are not present in views from the same viewpoint and cannot, therefore, ever be seen at the same time. The observer has to move to another viewpoint to see the other developments so they will then appear in sequence. Sequential effects are most common along linear routes and journeys. Sequential effects range from frequently sequential when the developments keep appearing regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints, to occasionally sequential, where there may be long time lapses between appearances, because the observer is moving slowly and/or there are large distances between the areas of visibility.

7.3.4.3. Assessing Cumulative Landscape and Visual Effects
Assessing the significance of cumulative effects requires:

- The identification of the landscape and visual receptors;
- The consideration of the nature of the receptors (sensitivity) as identified in the LVIA; and
- The determination of the nature of the effect (magnitude) which would be experienced by each receptor as a result of the addition of the proposed development to each baseline scenario.

The landscape and visual receptors to be considered in the CLVIA will consist of all the LCTs, designated landscapes, sequential routes and static locations such as viewpoints or settlements assessed in the LVIA as having more than negligible effects.

The susceptibility of receptors may be affected by the presence of other wind energy developments. Some viewers may consider that susceptibility is reduced because other wind farms are '*already there'*, but for others it may be that sensitivity is increased because more development would be '*too much'*. However, to retain a consistent and objective approach, the susceptibility of receptors used for the cumulative assessment is taken to be the same as that identified in the LVIA. The value of the receptor would also remain the same in the cumulative assessment and therefore the overall sensitivity of the receptor is considered to be the same as will be identified in the LVIA.

As in the LVIA, the nature or magnitude of the cumulative effect on landscape and visual receptors considers the size and scale, geographical extent, duration and reversibility of the change likely to result from the addition of the proposed development to the different baseline scenarios. With particular regard to cumulative visual effects, the following additional factors are also considered in determining the magnitude of cumulative visual change from each visual receptor:

- The number of turbine developments visible;
- The prominence of the developments likely to be seen;
- The amount of available view affected;
- The arrangement of turbine developments e.g. developments seen in one direction or in only part of the view, or seen in all directions;
- The relationship of the scale of the turbine developments including size and number of turbines which may also be expressed as the horizontal and vertical angle occupied by turbines;
- The position of the turbine developments in the view e.g. on the skyline, against the backdrop of land;
- The distances from the viewer and between developments;
- The landscape setting, context and separation (or coalescence) of turbine developments; and
- Potential screening by land cover such as vegetation and local variations in topography.

As in the LVIA, four main levels of cumulative effect will be used in the CLVIA; Major, Moderate, Minor and Negligible. Three intermediate combinations will also be used; Major/moderate, Moderate/minor and Minor/negligible. The evaluation of potential effects

makes allowance for the use of professional judgement and experience.

7.3.4.4. Significance of cumulative effects
SNH guidance considers that the concept of a *'threshold of acceptable change'* beyond which turbine developments in a particular area become unacceptable, is a crucial element in identifying significant adverse cumulative effects. In other words, the effect of the present proposal is limited, but when added to the effect of what has already been permitted, or to new proposals which have been submitted for planning permission, it can become over-dominant in planning terms.

There are varying degrees of cumulative landscape effect. These are as follows:

- Multiple wind farms are seen as separate isolated features within the Landscape Character Type, too infrequent and of insufficient significance to be perceived as a characteristic of the area;
- Multiple wind farms are seen as a key characteristic of the landscape, but not of sufficient dominance to be a defining characteristic of the area;
- Multiple wind farms appear as a dominant characteristic of the area, seeming to define the character type as a *'wind farm landscape'*; and
- Wind farms cross different character types, reducing the distinction between the different types.

The appropriateness of such effects will depend on the value of a landscape, the objectives for change as defined in local capacity studies and scale of that effect, i.e. whether affecting a local character type or occurring at a regional level.

A significant cumulative landscape effect is considered to be a Major or Major/moderate landscape effect likely to be when the combination of the multiple wind farms (following the addition of the proposed development) become a dominant characteristic of the area and/or reduces the distinction between different character types and/or transforms/re-defines local or wider baseline landscape character.

A significant cumulative visual effect is considered to be a Major or Major/moderate visual effect and would result in a view whose composition would be markedly changed.

It should be noted that significant cumulative effects need not be unacceptable or necessarily negative and may be reversible. Each effect is evaluated on its own merit.

Do consultees agree with the LVIA and CLVIA methodologies?

7.4. Landscape Assessment

The assessment of the levels of effect on the landscape resource will be carried out in the detailed LVIA to be contained in the EIA report and will adopt the following general process:

Identify and describe the key landscape characteristics of the development site;

- Describe the LCTs and landscape designations identified in the landscape baseline to represent the wider landscape resource;
- Identify and describe the type of changes which are likely to occur to the development site and wider landscape resource as a result of the construction and operation of the proposed wind farm;
- Describe the extent to which the key characteristics of the development site and the wider landscape resource would be altered in terms of being weakened or strengthened by the introduction of the proposed wind farm; and
- Assess the nature of the effect (magnitude) on the development site and wider landscape resource which are likely to result from the introduction of the proposed wind farm, at construction and operational stages.

7.5. Data Informing Visual Assessment

The assessment of the visual effect of the proposed development considers the effect on visual receptors throughout the study area. These visual receptors comprise the visual baseline.

Visual receptors are people who will be affected by changes in views or visual amenity at different places. They are usually grouped by what they are doing at these places, such as residents. They include people living and working in the area, people who view the proposed development sequentially such as people travelling through the area on road, rail or other forms of transport, people visiting promoted tourist attractions and landscapes and people pursuing other recreational activities.

7.5.1. Zone of Theoretical Visibility Mapping
Computer generated ZTV mapping has been undertaken to assist in determining the likely extent of visibility of the proposed development within the study area and the likely landscape and visual receptors affected by the proposed development. The ZTV (Figure 4) has been undertaken in accordance with the guidance included within '*Visual Representation of Wind farms Good Practice Guidance'* Version 2.2 (SNH, 2017).

7.5.2. Viewpoint Locations
A list of viewpoints is provided in Appendix 7.1 for preliminary assessment and further consultation then approval.

The viewpoints selected represent the views experienced towards the proposed development throughout the study area by various groups of people or receptors. Selected viewpoints include representative, specific, and illustrative views from publicly accessible locations, which are defined as:

- **Representative viewpoints:** selected to represent the experience of different types of visual receptors, where larger number of viewpoints cannot all be included individually and where the significant effects are unlikely to differ. For example, certain points may be chosen to represent the views of users of particular public footpaths and bridleways;
- **Specific viewpoints:** chosen because they are key views and sometimes promoted viewpoints within the landscape, including for example scenic viewpoints from roads, specific local visitor attractions, viewpoints in areas that are particularly noteworthy for visual and/or recreational amenity, such as landscapes with statutory landscape designations, or viewpoints with particular cultural landscape associations; and
- **Illustrative viewpoints:** chosen specifically to demonstrate a particular effect or specific issue.

In accordance with recently revised guidance, 'Visual Representation of Windfarms' Version 2.2, (SNH Feb 2017), '*the aim is to choose a range of viewpoints from where there are likely to be significant effects and those that are representative of views within the study area…It is preferable not to include too many viewpoints as this can distract attention from the key significant effects…We therefore encourage all applicants and consultees to further scrutinise the list of viewpoints selected and reduce these where possible*.' (SNH, 2017 paras. 76 & 85).

Computer generated wire-frame visualisations of the proposed development will then be produced for each selected viewpoint to determine the potential view and suitability for EIA. It is suggested that 25 viewpoints would be an appropriate quantity for the proposed development.

Following a list of final viewpoints being agreed with DGC and SNH, photomontage images will then be produced for the EIA. The photography and visualisation images produced in the EIAR will accord with the guidance included in '*Visual Representation of wind farms' Version 2.2* (SNH, 2017).

7.5.2.1. Aviation Lighting
The proposal for turbines up to 250m to blade tip may require further description and illustration of potential effects of aviation lighting. At time of writing the Civil Aviation Authority (CAA) requires visible red aviation warning lighting at up to 2000 candela for any structure at and greater than 150m in height. For the proposed turbines, a 2000 candela light may be positioned on the nacelle and 32 candela lights on the tower of each turbine. Currently the CAA guidance for lighting onshore wind turbines allows for the lighting intensity to be reduced to 10% in good visibility conditions and, furthermore, that the lighting be omni-directional and therefore dim in intensity outside of a 0° - 3° viewing angle. This results in the light being most visible and seen at its greatest intensity when viewed at eye level such as someone in a low-flying aircraft or atop a similar height hill but will become increasingly dim outside this range, for example for someone standing on the ground looking up. The current guidance is that the lighting would be static and only be operating during hours of darkness. The above methods mitigate the potential effects of the lighting. Vattenfall is aware of proposals accepted by the CAA for other development to install aviation lights on a limited number of turbines to limit visual effects (e.g. the perimeter turbines).

As a precautionary measure, it is proposed a description of any lighting proposals visible from each selected viewpoint will be included in the viewpoint assessment. A limited number of viewpoints may be illustrated in additional photomontages using photographs taken at dusk. These will be agreed during further consultation regarding viewpoints.

Consultees are asked to provide comment on, and review the suggested viewpoint locations detailed in Appendix 7.1, of which some could be considered for night time use. It is suggested that a total of 25 viewpoints maximum are taken forward to EIA.

7.5.3. Residential Receptors

7.5.3.1. Settlements

Receptors within settlements are assumed to be high sensitivity receptors as the majority of receptors from these areas would be residents. Settlements are generally inward-looking with intervening built structures mostly intercepting views any further than settlement boundaries. This premise has led to the approach for the initial assessment, to only consider those settlements within a study area of 20km from the proposed development that are identified in the Development Plan for DGC. Additional smaller settlements/hamlets within a 5km radius of the proposed development will also be considered in the initial assessment.

7.5.3.2. Residential Visual Amenity Assessment (RVAA)

The Residential Visual Amenity Assessment (RVAA) will consist of a detailed study of the visibility from individual properties within a 2km radius of the outer turbine of the proposed development. In the absence of published guidance on the distance from the proposed development that should be adopted for a detailed study of visual amenity from residential properties, a 2km study area is considered appropriate.

This assessment will focus on the effect on the visual component of residential amenity only and does not consider other components such as noise, dust, shadow flicker etc. The assessments of these effects will be contained in other sections of the EIAR.
For properties considered to experience a high or moderate magnitude of visual change, this assessment will evaluate the potential effects on the visual component of residential amenity or '*living conditions'*. The visibility of existing and under construction wind farms considered as Scenario 1 cumulative developments will be taken into account as part of the existing visual baseline.

Do consultees have comment on the acceptability of the proposed RVAA study area of 2km and the general methodology outlined above?

7.5.4. Sequential Receptors

Sequential impacts occur when an observer moves through a landscape along a linear route. This can lead to a series of viewpoints and experiences which may include other developments in addition to the proposed development.

An initial list of routes to be assessed includes the Southern Upland Way (SUW), the A713, B729, and the B700. Core Paths to a radius of 5km from the proposed development will also be included. The aim of the initial assessment will be to ascertain which sequential routes have the potential to experience significant visual effects including significant cumulative sequential effects.

Do consultees agree with the approach to the sequential assessment?

7.6. Data Informing Cumulative Assessment

7.6.1. Cumulative Baseline

As detailed above, the difference between LVIA and CLVIA is the different baseline conditions in terms of other wind farm developments. This cumulative baseline is divided into different scenarios that reflect which groups of wind farm developments are assumed to be present in the landscape.

Quantans Hill wind farm's closest neighbouring development is the proposed Shepherds Rig wind farm. This application was made in December 2018 under Section 36 of the Electricity Act 1989, for a wind farm development to the east of Quantans Hill wind farm in an area of privately owned commercial forestry between Craigengillan Hill and Marscalloch Hill.

Further from Quantans Hill wind farm the operational Brockloch Rig I, Brockloch Rig Wind, Afton, Benbrack, Enoch Hill, Hare Hill, Pencloe, South Kyle, Windy Rig Wind Farms are likely to be the primary developments against which cumulative effects will be most relevant. Cumulative assessment of other projects such as Euchanhead and Brockloch Rig III will be dependent on their progress through the planning system.

These most relevant wind farm developments comprise the cumulative baseline (or Cumulative Study Area). As stated in the SNH guidance 'Assessing the Cumulative Effects of Onshore Wind Energy Developments,' (SNH, 2012) '*the key principle for all cumulative impact assessments is to focus on the likely significant effects and in particular those which are likely to influence the outcome of the consenting process'*. (para 33 SNH 2012).

The cumulative baseline identifies those developments it is considered require further cumulative assessment in the detailed CLVIA. These include all operational, consented and valid planning applications within an approximate 10km radius from the proposed development. Turbines below 50m are only considered

within a 5km radius and are scoped out of the LVIA beyond this distance. Potential sequential cumulative visual effects have been identified relating to the Southern Upland Way (SUW) long distance walking route and potential successive cumulative visibility occurs from points along the Southern Upland Way.

Beyond 30km is considered too distant to present significant cumulative combined and cumulative sequential effects with the proposed development. Such developments are requested to be scoped out of the cumulative baseline.

Do consultees agree with the cumulative baseline?

It should be noted that the cumulative baseline represents the '*maximum development scenario'*. It considers the effects of the proposed development in addition to other developments that do not yet exist in the current landscape, but which may exist in the future. This results in a high level of uncertainty in the cumulative baseline as not all of the other undetermined proposals will necessarily gain planning approval.

Owing to this uncertainty with regard to the maximum development scenario, the cumulative baseline is split into different scenarios with a decreasing likelihood of becoming operational.

The continually evolving nature of the cumulative baseline requires a reasonable end date beyond which any further changes to the baseline would not need to be considered in the CLVIA. It is suggested a '*cut-off*' date of three months prior to the submission of the LVIA and CLVIA be a reasonable timeframe.

Do consultees agree to an end date of three months prior to the submission of the LVIA and CLVIA after which point any additional sites will not be assessed with the application?

7.6.2. Cumulative Assessment

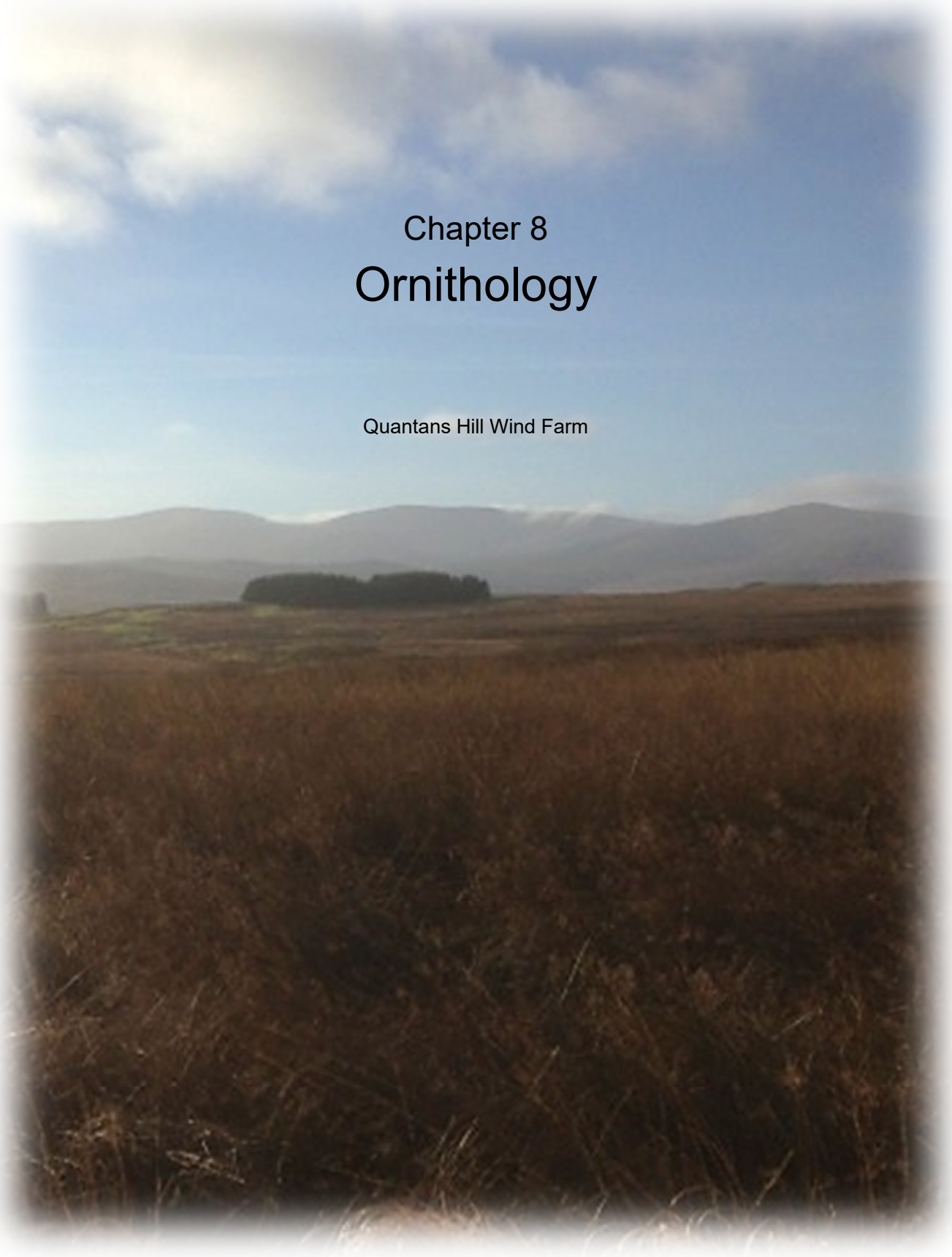
The landscape and visual receptors to be considered in the CLVIA will also consist of relevant Landscape Character Types, designated landscapes, sequential routes and static locations such as viewpoints and settlements.

In the CLVIA, cumulative effects will be reported as the additional effects of the introduction of the proposed development to the different baseline scenarios, over and above the effects identified in the LVIA. For each receptor, it is clarified as to whether the effect has increased or decreased relative to the LVIA assessment or whether the effects will be the same as in the LVIA assessment.

Cumulative wind farms will be shown in the viewpoint visualisations in accordance with SNH good practice guidance (2017). In addition, a ZTV to blade tip height of each wind farm proposal identified in the cumulative baseline will be prepared and then combined with the ZTV of the proposed scheme to create 'paired ZTVs' which illustrate the areas of mutual visibility, i.e. where the proposed scheme and other proposals are both visible from. ZTVs showing the combined visibility of each cumulative baseline scenario will also be prepared to illustrate the total visibility for each scenario.

7.7. Proposed Mitigation

By their nature landscape and visual effects require early consideration of mitigation which is embedded in the design of the proposed development, which has been specifically designed to avoid or to minimise the occurrence of adverse environmental impacts. All effects identified in the final detailed assessment will therefore be 'residual effects'.



Chapter 8
Ornithology

Quantans Hill Wind Farm

8. Ornithology

8.1. Introduction

This chapter of the Scoping Report describes the proposed approach to the assessment of the potential effects from the proposed Quantans Hill wind farm (the 'Proposed Development') on bird populations and their supporting habitats. It includes a summary of the baseline surveys completed to date and the proposed EIA scope and assessment methods.

A chapter of the EIA Report will be devoted to the assessment of the impacts on key ornithological receptors. The chapter will be supported by a number of Technical Appendices, which will provide the full detail of the data used to inform the assessment.

The potential effects on ornithological receptors arising from a proposed development can be summarised as follows:

- Disturbance and/or displacement from supporting habitats during construction works;
- Loss / degradation of habitats through construction works, permanents structures and access tracks;
- Displacement from and disturbance to foraging, nesting and roosting habitat from the operating wind farm, including consideration of potential barrier effects;
- Mortality from collision with turbine blades; but also
- Net biodiversity gain and habitat improvement associated with a wind farm site's Habitat Management Plan

There is also the potential for the above to act cumulatively with the effects of other existing and proposed developments within the wider area. Potentially significant cumulative effects will be fully considered within the assessment following methods set out in current guidance.

8.2. Key Ornithological Receptors

- Particular focus will be given to the assessment of impacts on certain key bird species whose populations are of conservation concern (in a regional, national or international context), that are subject to specific legal protection, and that are considered to be particularly vulnerable to impacts from wind farm development. These include:

- Bird species of conservation concern listed on Annex I of European Council Directive 2009/147/EC on the Conservation of Wild Birds, in particular those that may be associated with populations of species that are qualifying interests of Special Protection Areas in the wider area;
- Bird species listed in Schedule 1 to the Wildlife and Countryside Act 1981 (as amended); and
- Bird species of national or regional conservation concern, not included within the above categories, but that are present within the study area in nationally or regionally important numbers and are considered to be relatively sensitive to the potential impacts of the proposed development.

Table 8.1 provides a provisional list of species to be considered in detail within the assessment (i.e. as key ornithological receptors), based on the results of the surveys carried out in 2018 and 2019. These species have been selected based on the conservation status / relative rarity of their populations, potential sensitivity to the impacts of onshore wind farm development, the suitability of habitats within the study area and their breeding / wintering ranges (i.e. the likelihood of the species being present in the study area). Also included in this table is a summary of the current conservation status, nature conservation policy and legal designations for each species.

Common Name	Scientific Name	Species Designations
Whooper swan	*Cygnus cygnus*	Ann. I[i], Sch. 1[ii], UK Amber List[iii], SBL[v]
Greylag goose	*Anser anser*	UK Amber List[iii]
Black grouse	*Lyrurus tetrix*	UK Red List[iii], UK BAP[iv], SBL[v]
Osprey	*Pandion haliaetus*	Ann. I[i], Sch. 1[ii], UK Amber List[iii], SBL[v]
Goshawk	*Accipiter gentilis*	Sch. 1[ii]
Hen harrier	*Circus cyaneus*	Ann. I[i], Sch. 1[ii], UK Red List[iii], SBL[v]
Red kite	*Milvus milvus*	Ann. I[i], Sch. 1[ii], SBL[v]
Lapwing	*Vanellus vanellus*	UK Red List[iii], UK BAP[iv], SBL[v]
Curlew	Numenius *arquata*	UK Red List[iii], UK BAP[iv], SBL[v]
Barn owl	*Tyto alba*	Sch. 1[ii], SBL[v]
Short-eared owl	*Asio flammeus*	Ann. I[i], UK Amber List[iii], SBL[v]
Merlin	*Falco columbarius*	Ann. I[i], Sch. 1[ii], UK Red List[iii], SBL[v]
Peregrine falcon	*Falco peregrinus*	Ann. I[i], Sch. 1[ii], SBL[v]

Table 8.1: Potential EIA Receptor Species and their Designations

i. Species listed on Annex I of the EC Birds Directive (Directive 2009/147/EC on the conservation of wild birds - the codified version). These species are the subject of special conservation measures concerning their habitat, in order to ensure their survival and reproduction within their area of distribution.

ii. Species listed on Schedule 1 to the Wildlife and Countryside Act 1981 (as amended). All wild birds their nests eggs and dependant young are protected under the Wildlife and Countryside Act. Schedule 1 species receive additional legal protection under the Act.

iii. Birds of Conservation Concern (BoCC) in the UK (Eaton et al. 2015). The population status of birds regularly found in the UK is reviewed every five years to provide an up-to-date assessment of conservation priorities. Quantitative criteria are used to assess the population status of each species and to place it on the Red, Amber or Green list. These are global conservation status, recent decline, historical decline, European conservation status, rare breeders, localised species and international importance.

iv. Priority species in the 2007 UK Biodiversity Action Plan (UK). Local Biodiversity Action Plan species are given in the Dumfries and Galloway LBAP (April 2009). The UK BAP was superseded by the UK Post-2010 Biodiversity Framework (JNCC 2012).

v. Species included on the Scottish Biodiversity List (Scott Wilson 2005), which is part of the Scottish Biodiversity Strategy (published by the Scottish Government in May 2004).

In addition to the species receptors listed in Table 8.1, all relevant statutory designated sites and their cited qualifying interests, such as Sites of Special Scientific Interest (SSSIs) and Special Protection Areas (SPAs) will be considered in the assessment. An overview of statutory designated sites within 20km of the Site is provided in Table 8.2.

8.3. Baseline Conditions

8.3.1. Introduction

The following provides a summary of the baseline conditions relevant to the ornithological assessment. The description of the study area is informed by the results of survey work completed between April 2018 and August 2019.

Ornithological baseline surveys of the proposed Quantans Hill wind farm site were completed between April 2018 and August 2019 (inclusive). The surveys that have been carried to date are as follows:

- Flight Activity Surveys (April 2018 to August 2019);
- Moorland wader and songbird surveys (April to July 2018 and 2019);
- Breeding raptor surveys (April to August 2018 and April to September 2019);
- Black grouse lek survey (April and May 2018 and 2019); and
- Wintering waterfowl surveys (e.g. waterbody and grazing counts) (October 2018 to May 2019).

Further, targeted surveys for black grouse, breeding peregrine falcon and associated flight activity is proposed for March to August 2020 to provide additional data to inform the wind farm design and EIA processes.

The data collected during 2018/19, along with information from other sources (including powerline and wind farm EIA projects in the wider area) are considered to provide a suitably detailed baseline from which to assess the sensitivity of the proposed development area and to inform the design and EIA of the proposed development.

8.3.2. Designated Sites

Statutory sites, designated fully or in part for their ornithological interest within c. 20km of the proposed development are listed in Table 8.2 along with a summary of their cited interest.

Name	Designation	Distance from Site	Summary of Species Interest / Condition
Loch Ken and River Dee Marshes	SPA / Ramsar Site (including Kenmure Holms and River Dee (Parton to Crossmichael) SSSI)	15km South	This SPA is an internationally important site for wintering Greenland white-fronted goose and greylag goose. Important breeding populations of common tern , kingfisher, wigeon, teal, mallard, shoveler, tufted duck, goosander, water rail , coot , oystercatcher, lapwing, redshank, curlew and black-headed gull. The following species of wintering wildfowl are notable: whooper swan; bean goose; wigeon; teal; pintail; goldeneye; smew; and goosander.
Muirkirk and North Lowther Uplands	SPA (various SSSIs)	17.5km north west	This SPA supports populations of European importance: hen harrier; short-eared owl; merlin; peregrine falcon and, golden plover.

Table 8.2: Statutory Designated Sites with Ornithological Interest

8.3.2.1. SPA Connectivity

The SNH document "Assessing Connectivity with Special Protection Areas (SPAs)" (2016) provides guidance on determining if there are likely to be adverse effects on bird populations ranging outside of the SPAs as a result of a proposed development. Included in the document are details of the typical foraging ranges for breeding and wintering populations of species that form the qualifying interests of SPAs.

The reported core ranging distances for all of the qualifying species for Muirkirk and North Lowther Uplands SPA are much shorter than the 17.5km separation distance from the SPA to the proposed development. There is no ecological connectivity to the SPA qualifying interests and the proposed development would not undermine the conservation objectives of the SPA. There is considered to be no Likely Significant Effect from the proposed development, alone or in combination with other plans or projects. Therefore it is proposed that formal consideration of any potential effects on the Muirkirk and North Lowther SPA will be scoped out of the assessment.

The distance from the proposed development to Loch Ken and River Dee Marshes SPA is within the reported ranging distance for wintering greylag goose (estimated to be up to 15-20km from their roosts) but not for Greenland white-fronted goose (core range of 5-8km).

The available data indicates that the proposed development area, and associated buffer zones, do not regularly support appreciable numbers of roosting or feeding migratory Icelandic greylag geese that are part of the Ken and River Dee Marshes SPA population. This is consistent with a study of the feeding distribution of the SPA population (Mitchel 2012[3]). The proposed development is located in an area occasionally used by whooper swan, particularly during migration. The potential effects of the proposed development on the Loch Ken and River Dee Marshes SPA / Ramsar qualifying interests will be fully considered within the assessment.

The primary land use within the site is sheep and cattle grazing, across large tracts of unenclosed moorland, marshy and semi-improved grassland and improved pasture fields at lower elevations. There are several small mixed woodland plantations scattered across the site. The eastern edge of the site borders an extensive area of commercial conifer plantation. The site is intersected by a number of minor watercourses, many of which originate within the site, and flow into the Water of Deugh to the west and south.

8.3.3. Baseline Surveys

8.3.3.1. Introduction

Baseline ornithological surveys were completed between April 2018 and August 2019 (inclusive) to systematically record and assess the use of all habitats within the study area by breeding and non-breeding birds, with a particular focus on species that are potentially sensitive to wind farm development and are also of conservation concern (i.e. species listed on Annex I of the EC Birds Directive, Schedule 1 of the Wildlife and Countryside Act 1981, species on the UK Red List of birds of conservation concern). All surveys have been undertaken by suitably experienced ornithological surveyors trained in the detailed field and recording methods of each of the surveys undertaken.

8.3.3.2. Summary of Completed Surveys

The survey areas referred to within this report are illustrated on Figure 5 and are based on the proposed development boundary. The current site boundary differs in some locations in comparison to the boundary defined at the time the 2018-19 surveys were completed (see Section 8.9.1 for further discussion of this issue).

[3] Mitchell, C. (2012). Mapping the distribution of feeding Pink-footed and Iceland Greylag Geese in Scotland. Wildfowl & Wetlands Trust / Scottish Natural Heritage Report, Slimbridge. 108pp.

The various survey areas were defined as follows:

- 'site area' refers to the area enclosed by the proposed wind farm site boundary;
- 'core survey area' refers to the site area plus an additional 500m wide strip;
- 'black grouse survey area' refers to the site area plus an additional minimum 1.5km wide strip; and
- 'raptor survey area' refers to the site area, plus an additional strip up to 2km wide, depending on the focal species and the presence of contiguous suitable habitat outside of the core survey area.

A suite of ornithological surveys were completed across the study area to inform the design and planning of the proposed development. All surveys follow methods set out in current SNH guidance (*Recommended bird survey methods to inform impact assessment of onshore wind farms*, March 2017). In summary, the following surveys were completed:

- Winter, spring, summer and autumn Flight Activity Surveys, from five strategically located vantage points (see Figure 6), to systematically quantify the use of the site by target species (i.e. species of conservation concern and susceptibility to adverse effects from wind farm development);
- Breeding Bird Surveys: a range of surveys completed to determine the presence and approximate location of breeding territories/sites within the core and wider survey areas, including the following:
  - Moorland and woodland breeding bird surveys of the core survey area in April to July of 2018 and 2019;
  - Breeding raptor surveys, focusing on species listed on Schedule 1 of the Wildlife & Countryside Act 1981, within suitable habitats in the raptor survey area in the Spring/Summer of 2018 and 2019; and
  - Black grouse reconnaissance and lek surveys in spring of 2018 and 2019 within the black grouse survey area.
- Winter waterfowl surveys to assess the use of the core survey area by passage and wintering swans and geese, particularly the carse land along the Water of Deugh. These surveys were carried out from October 2018 to May 2019

8.3.3.3. Flight Activity Surveys

Flight activity surveys were carried out in order to systematically sample, record and quantify the use of the airspace over the survey area by certain key species. Surveyors recorded the proportion of time that these key species spent flying at different elevations relative to the potential turbine blade swept height. The data will be used to identify constraints, such as regularly used flight corridors and areas of concentrated flight activity, which may be taken into consideration in the wind farm design process in order to reduce impacts. The flight activity data will also be used in the assessment of displacement effects and will be input into a standard model of bird collision risk to help inform the assessment of collision mortality impacts on receptor populations.

Flight activity data was collected during timed watches from strategically located Vantage Points (VPs). For this study, a total of five VPs were selected, in order to ensure good visual coverage of the proposed development area and an approximate 500m wide buffer zone. Where possible, the VPs were selected to be outside of the areas where wind turbines might be proposed, in order to minimise observer effort.

The height above ground level of target and secondary species observed in flight was assessed by the observer to be within one of several height bands so that an estimate could be made of flight activity within the zone where turbine blades would be operating. Table 8.3 details the location of each of the VPs selected for the flight activity survey (see Figure 6).

VP Ref.	Location	Easting	Northing
VP1	Willieanna	257724	595687
VP2	Craig of Knockgray	257099	594223
VP3	Marbrack	259199	593813
VP4	The Glenkens (north)	261334	595000
VP5	The Glenkens (south)	261334	595000

Table 8.3: Vantage Point Locations

A minimum of 72 hours of observation were completed at each VP per year (an average of six hours a month), with the surveys spread evenly throughout the survey period. Additional survey effort was made during October-November 2018 and March-May 2019, to coincide with peak passage periods for wildfowl. Table 8.4 provides a summary of the observation effort at each VP per month for the full survey period.

Year	Month	Vantage Point Reference				
		Q1	Q2	Q3	Q4N	Q4S
2018	Apr.	6	6	6	3	3
	May	12	9	9	12	12
	Jun.	6	9	9	9	9
	Jul.	6	6	6	6	6
	Aug.	6	6	6	6	6
	Sep.	9	9	6	9	9
	Oct.	12	16	15	9	9

	Nov.	16	12	12	12	12
	Dec.	6	6	9	12	12
2018 Total		**79**	**79**	**78**	**78**	**78**
2019	Jan.	6	6	6	6	6
	Feb.	6	6	6	6	6
	Mar.	9	9	9	9	9
	Apr.	12	12	18	12	12
	May	15	9	9	9	9
	Jun.	9	15	9	15	15
	Jul.	6	9	9	9	9
	Aug.	9	6	6	6	6
2019 Total		**72**	**72**	**72**	**72**	**72**
Grand Total		***151***	***151***	***150***	***150***	***150***

Table 8.4: Monthly Hours of Observation at Each Vantage Point (April 2018 to August 2019)

VP watches were carried out between sunrise and sunset, with watches timed to achieve an even spread throughout the hours of daylight, by a single observer in conditions of good visibility, avoiding periods of very strong wind speeds when bird flight activity is supressed.

8.3.4. Summary Survey Results

8.3.4.1. Breeding Birds

The surveys completed in 2018 and 2019 confirmed the use of the site by various bird species of conservation concern and susceptibility to the impacts of onshore wind farm development, including raptors such as red kite and peregrine falcon and waders such as curlew.

The surveys confirmed peregrine falcon breeding to the south of the site and a relatively small number of wader territories. There were no records of any raptors of conservation concern breeding within the survey area, with the exception of common kestrel (UK Amber list species).

During spring 2018 there were two male black grouse lekking in the survey area, towards the southern end of the site, to the south of Quantans Hill. There were two other sightings of black grouse during the flight activity surveys in 2018, one of which was of a male in the same location as the lek site. A female was also recorded in May 2018, flushed from the ground within the same area. Surveys in spring 2019 found no evidence of black grouse lekking anywhere within the survey area. One black grouse was recorded in flight during April.

Table 8.5 summarises the results of the breeding bird surveys for 2018 and 2019, with respect to breeding waders.

Species	No. Apparent Territories	
	2018	2019
Curlew	2	3
Common snipe	2	2

Table 8.5: Summarised Results of the Breeding Bird Surveys (Waders only)

Curlew breeding territories were recorded in areas of blanket bog at the base of Craig of Knockgray and to the north-west of Furmiston Craig.

Other species, of national conservation concern, recorded as breeding within the survey area included the following:

- Cuckoo (*Cuculus canorus*), territorial males were recorded in the core survey area, within the coniferous plantation and various smaller woodland blocks.
- Skylark (*Alauda arvensis*) were recorded in all open grassland habits within the core survey area.
- Spotted flycatcher (*Muscicapa striata*), several territories were recorded, associated with small woodland blocks.
- Whinchat (*Saxicola rubetra*) breeding activity was mainly concentrated towards the eastern side of the survey area, towards the base of Knockwhirn hill.

8.3.4.2. Passage / Wintering Birds

Geese were recorded infrequently during the survey, mostly along the Water of Deugh. There were no records of geese roosting or grazing any of the fields within the core survey area.

There was a peak count of 25 greylag geese recorded in February 2019 grazing on carseland along the Water of Deugh. Low numbers (<5) were infrequently recorded during the flight activity surveys.

In March 2018 two skeins of pink-footed geese (one of 15 birds and one of 70) were recorded passing over the site, partly at collision risk height, during the flight activity surveys.

No whooper swans were recorded using the site or surrounding area during the passage / wintering wildfowl surveys. In October 2018, 27 whooper swans were seen flying southeast over North Liggat during the flight activity surveys. In March 2019, 28 were recorded in flight, heading southwest then west over the site.

There was no evidence of the presence of any communal raptor roost sites within the survey area (e.g. red kite or hen harrier).

Dotterel (*Charadrius morinellus*) were recorded on the summit of Cairnsmore of Carsphairn, on the north-eastern edge of the site, in spring of both 2018 and 2019. A single bird in May 2018 and a group of five in May 2019. These sightings were birds on passage, most likely on migration to breeding grounds in the Grampians and Scandinavia. There was no evidence of any breeding occurring in either year, despite the presence of potentially suitable habitat. Dotterel is a species of high conservation concern (UK Red List) due to large population falls and range contractions in recent decades.

8.3.4.3. Flight Activity

Table 8.6 provides an overview of the results of the 2018-19 flight activity surveys. The percentage of birds in flight that were entirely or partly at potential collision risk height are also shown in the table (NB this includes flights recorded between 20 to 250m above ground level and does not reflect actual collision risk which would be modelled during the EIA based on the wind farm layout and the key design parameters of the proposed wind turbine).

Species	Total no. Flights (no. birds)	% Birds at CRH
Whooper swan	2 (55)	50.9
Pink-footed goose	2 (85)	17.7
Greylag goose	4 (11)	81.8
Black grouse	2 (2)	50.0
Golden eagle	1 (1)	100.0
Red kite	95 (108)	93.5
Goshawk	1 (1)	100.0
Osprey	3 (3)	33.3
Curlew	11 (15)	66.7
Common snipe	8 (11)	54.6
Common gull	3 (14)	92.9
Common kestrel	60 (63)	90.5
Merlin	4 (4)	25.0
Peregrine falcon	4 (5)	60.0

Table 8.6: Number of Flights by Target and Secondary Species and the Percentage of Flights at Collision Risk Height (CRH)

In November 2018 an adult golden eagle (probable female) flew southwest across site, mostly below collision risk height, from the direction of Green Hill.

There was no evidence of breeding by red kite within the survey are in 2018 or 2019. However, this was the most frequently recorded target species during the flight activity surveys. Most of this activity related to hunting birds, with a high proportion of flight time within the potential collision risk height band. Flight activity was recorded across most of the survey area, with concentrations in the area of Craig of Knockgray and at the southeast corner of the survey area.

The potential effects on this species from wind turbine collision risk will be a key focus for the assessment. Options to reduce the risk through wind farm design and habitat management are being carefully considered by Vattenfall.

8.4. Relevant Embedded Mitigation and Design Principles

The proposed development will incorporate a number of embedded mitigation measures to achieve the design objectives and avoid, prevent or minimise likely significant adverse environmental effects. At this early stage in the design process, this includes the following relevant design principles which will be incorporated into the final design of the proposed development:

- Key ornithological constraints have been mapped, based on the existing baseline data collected in 2018/19. This information will be used to inform the development of the detailed wind farm layout to help reduce potential impacts on sensitive ornithological receptors; for example, important flight corridors / activity areas, breeding sites of Schedule 1 bird species and important areas for breeding curlew will be identified as a wind farm design constraint with appropriate set-back zones.
- All watercourses and waterbodies will have a minimum 50m wide protection buffer that will be avoided for wind turbine (and other structure) placement. The access track layout will be optimised to ensure the minimum number of necessary watercourse crossings.
- A suitably qualified and experienced Ecological Clerk of Works (ECoW) will be appointed in advance of works commencing on the site. The ECoW will oversee the implementation of the suite of measures proposed to avoid or minimise potential impacts from the construction phase on sensitive habitats and species. The ECoW will have the authority to halt works on site and help ensure that the environmental commitments made within the EIA report are properly implemented.
- A Construction Environmental Management Plan (CEMP) will be developed in advance of works commencing on the site. The CEMP will detail all measures, protocols, method statements and monitoring that will be implemented to protect the environment during the works. For example, implementation of best practice measures to protect

aquatic habitats from siltation and chemical pollution during construction.
- A site restoration plan will be prepared in outline which will set out the proposed site restoration measures following construction.
- Pre-construction surveys for breeding birds will be completed to ensure that current baseline information is available and that proposed works that have the potential to disturb such species, or destroy important habitats or nests sites and proceed lawfully with respect to the legislation protecting the relevant species (e.g. ground-nesting birds, Schedule 1 raptor species).
- A Habitat Management Plan (HMP) will be provided in outline within the EIA report, and will be developed in detail prior to works commencing on the site. The HMP will include measures to alter and improve the quality of upland habitats within/adjacent to the site in order to help offset impacts arising from the construction works and operation of the proposed wind farm (e.g. discouragement of red kite flight activity near to the proposed wind turbines, improvement of habitats away from the wind turbine areas for red kite and black grouse).
- A plan to monitor breeding birds prior to and following wind farm construction and to monitor bird collision rates during wind farm operation will be provided in the EIA report and will follow current best practice methods.

8.5. Potential Effects Proposed to be Scoped Out of Further Assessment

Having regard to the characteristics of the site and the proposed development, key baseline characteristics and proposed embedded mitigation measures, at this stage it is considered that the potential effects listed below have no potential to be significant and can therefore be scoped out of requiring further assessment.

8.5.1. Construction and Decommissioning
Effects on common breeding bird species will not be formally assessed, although measures to help ensure that active nest sites of all breeding birds are protected, as legally required, will be set out in the EIA Report.

8.5.2. Operation
Potential effects on any SPAs with the exception of the Loch Ken River Dee Marshes SPA will be scoped out of the assessment as the proposed development is situated outside of the potential connectivity distances, as defined in the SNH guidance, for all of the relevant species.

The potential effects on birds arising from the connection of the proposed development to the national grid will not be assessed within the EIA report. Such effects (e.g. collision risk with overhead powerlines) will be considered within the planning and assessment process for the grid connection.

8.6. Scope of the Assessment

Having regard to the characteristics of the site and the proposed development, key baseline characteristics and proposed embedded mitigation measures, at this stage it is considered that the following effects on the relevant key receptors are likely to or have some potential to be significant and therefore require further consideration through the EIA process:

8.6.1. Construction and Decommissioning
Likely, adverse effects during construction, which will be considered in detail in the EIA, are as follows:

- Disturbance and displacement to key receptors (breeding and non-breeding) caused by the presence of construction workers, noise, vibration and artificial lighting during construction;
- Loss of degradation of important supporting habitats for key receptors during construction; and
- The potential for cumulative construction related effects with other proposed developments.

8.6.2. Operation
Likely, adverse effects during the operational phase, and which will be considered in detail the EIA, are as follows:

- Mortality from collision with wind turbines and tower for the key receptor species (including consideration of proposed aviation warning lighting and this potential for this to increase bird collision risk);
- Operational displacement from / disturbance to important habitats supporting key receptor populations (e.g. displacement from foraging, nesting, roosting habitats due to the presence of the wind farm including consideration of potential 'barrier effects'); and
- The potential for cumulative operational effects with other existing and proposed developments.

8.7. Assessment Methodology

An assessment of the likely significant effects and impacts associated with the proposed development will

be carried out in accordance with relevant and applicable legislation, policies and technical standards.

The ornithological assessment will be supported by a number of Technical Appendices, which will provide further detail on the baseline survey results and background to some aspects of the assessment. Data from the baseline surveys, along with information from other sources (e.g. local Raptor Study Group, Royal Society for the Protection of Birds, British Trust for Ornithology, Scottish Ornithologists' Club) will be used to inform the evaluations of the relative importance of the proposed development site for key receptor species.

A confidential annex will also be produced which will provide details of the locations of breeding sites of bird species at risk of human persecution (e.g. nest locations of species listed on Schedule 1 to the Wildlife & Countryside Act). These details will not be included in the publicly available EIA documents. The confidential annex will follow current best practice guidance (SNH 2016) and will only be issued to SNH.

8.7.1. Relevant Legislation, Guidance and Technical Standards

The assessment of the likely significant effects will be undertaken in accordance with relevant and applicable legislation, policies and technical standards. In addition to relevant legislation and policy considerations, the assessment will be undertaken in accordance with subject specific legislation and best practice guidance including the following:

8.7.1.1. Legislation

- The Convention for the Conservation of European Wildlife and Natural Habitat (The Bern Convention) 1979;
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive');
- Council Directive 2009/147/EC on the conservation of wild birds (codified version of the 'Birds Directive');
- The Conservation (Natural Habitats, &c) Regulations 1994 (as amended in Scotland);
- Wildlife and Countryside Act 1981 (as amended in Scotland);
- Nature Conservation (Scotland) Act 2004 (as amended); and
- The Wildlife and Natural Environment (WANE) (Scotland) Act 2011.

8.7.1.2. Biodiversity Policy Context

Relevant biodiversity policies were originally based on the UK Biodiversity Action Plan (UKBAP) which listed 65 Priority Habitats and 1150 Priority Species, and created action plans for these priority habitats and species. The UKBAP formally ended in 2010 and was replaced by the UK Post-2010 Biodiversity Framework published in 2012. The UK Post-2010 Biodiversity Framework sets out the priorities for UK-level work to support the Convention on Biological Diversity's (CBD's) Strategic Plan for Biodiversity 2011-2020 as well as its five strategic goals.

The '2020 Challenge for Scotland's Biodiversity: A Strategy for the Conservation and Enhancement of Biodiversity in Scotland' launched in 2013 provides the overview of Scottish biodiversity policies set within the UK framework (Scottish Government 2012). The 2020 Challenge publication is a supplement to the Scottish Biodiversity Strategy (SBS) published in 2004.

The SBS emphasises the need to take account of how ecosystems work, particularly across landscapes. It states that both the broad and local scales need to be considered, that the capacity of ecosystems to respond to impacts is not infinite and that resilience is to be built into ecosystems using an adaptive, integrated approach at the scale of river catchments.

The UK BAP list of priority habitats and species remain integral to the SBS and the Scottish Biodiversity List which is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland.

Originally under the UK BAP, and now under the SBS, local authorities have a responsibility to produce their own list of priority habitats and species and associated actions for conservation. These are called Local Biodiversity Action Plans (LBAP). The LBAP applicable to this site is the Dumfries and Galloway Biodiversity Action Plan (2009). The species and habitats identified as a focus for conservation action in the LBAP will be taken into consideration, where relevant, in the assessments.

8.7.2. Relevant Technical Standards

The following guidance will be referred to and followed as appropriate for the ornithological assessment:

- Chartered Institute of Ecology and Environmental Management (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland;
- SNH (2018). Environmental Impact Assessment Handbook. A Handbook on Environmental Impact Assessment: Guidance for Competent Authorities, Consultation Bodies, and others involved in the Environmental Impact Assessment Process in Scotland. 5th Edition;

- SNH Guidance on the Habitats Regulation Appraisal process (available online);
- Assessing Significance of Impacts from Onshore Wind Farms Outwith Designated Areas (SNH, February 2018);
- Natural Heritage Zones Bird Population Estimates. SWBSG Commissioned Report Number: 1504 (BTO, 2015);
- Guidance on Assessing Connectivity with Special Protection Areas (SNH, June 2016);
- EU Guidance on wind energy development in accordance with the EU nature legislation (Publications Office of the European Union 2011);
- Calculating a theoretical collision risk assuming no avoiding action (SNH, 2000; Band, 2007);
- Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model (SNH, 2018);
- Assessing the cumulative impacts of onshore wind farms on birds (SNH, August 2018);
- A Review of Disturbance Distances in Selected Bird Species (SNH, 2007);
- Environmental Statements and Annexes of Environmentally Sensitive Bird Information (SNH, September 2016); and
- Dealing with construction and birds (SNH, March 2016).

Additional reference materials and guidance which is relevant to the ornithology assessment is referred to within the summary of assessment methods provided below. Consideration will also be given to the potential implications of the proposals for all relevant national and local nature conservation polices and for key species highlighted for conservation action in relevant national and local biodiversity action plans.

8.7.3. Consultations

The assessment will be carried out based on relevant requirements and guidance contained in an EIA Scoping Opinion to be adopted by the Scottish Ministers in response to this EIA Scoping Report. To maximise the value of this EIA scoping process, in accordance with the EIA Regulations, all relevant consultees are requested to consider:

- The proposed scope of assessment as outlined in Section 8.6;
- The assessment methodology as outlined in this section; and,
- The key questions and design considerations set out in Section 8.10.

If required, additional consultation will be undertaken with relevant consultees to clarify aspects of the assessment methodology (e.g. any survey requirements) and address topic-specific issues.

8.7.4. Approach to the Assessment of Effect Level and Significance

The following section sets out the proposed approach to determining the level and significance of likely effects.

The assessment will follow a standard, systematic approach which will be informed by the best available scientific evidence and experienced professional judgement. Where there are uncertainties, reasonable greatest extent assumptions are made to minimise the risk of effects being under-estimated. The assessment methods follow guidance produced by SNH and the Chartered Institute of Ecology and Environmental Management (CIEEM), as detailed above.

8.7.4.1. Defining Receptor Sensitivity

The importance of each receptor (also referred to as 'receptor sensitivity') can involve a wide range of factors (e.g. habitat naturalness, extent, quality, populations that are of conservation importance at various geographical scales, or at the edge of their natural range). In practice, conservation status and rarity are often the most important criteria to consider. Therefore, ecological receptor sensitivity is usually defined by rarity at different geographical scales (e.g. local, regional, national, international). This is also useful in placing the receptor in the context of natural heritage designations which tend to be selected and ranked according to the rarity of the qualifying species or habitats at different geographical scales, e.g. habitats or species that are rare at a global or European level are usually covered by European legislation and protected within designated sites defined by the European legislation, namely Special Protection Areas (SPAs).

Although there are a range of factors to be considered, the evaluation of importance in relation to bird population size is primarily based on the estimated proportion of a population that a site supports. Where 1% of the population, for a given geographical scale, is regularly present within the site, then it is considered to be important for that species at that spatial scale. For example, where more than 1% of the national population of a species is regularly present, the site would be considered to be of national importance. The 1% criterion for importance is well established and can be applied at the regional, sub-regional or local scales, providing there is sufficiently accurate information available on population sizes within these geographical units. Where there is uncertainty about the accuracy of the available information a precautionary approach has been adopted to minimise the risk of under-valuing any receptor.

Breeding population estimates, based on Natural Heritage Zone (NHZ) boundaries which divide Scotland into a number of distinct biogeographical areas, have been published for some key bird species (Wilson *et al*. 2015). The proposed development is located within the 'Western Southern Uplands & Inner Solway' NHZ. Population estimates for the NHZ will be used in this assessment where available to assist in informing judgements on the sensitivity of the populations using the site and their supporting habitats.

Definitions of ornithological receptor sensitivity are outlined in Table 8.7 below.

Receptor Sensitivity	Example Criteria / Definitions
International	Populations of bird species that form part of the cited interest of an internationally protected site or candidate site (e.g. a Special Protection Area, or Ramsar site). Bird species listed on Annex I of the EC Birds Directive if regularly present in qualifying numbers / proportions of the national or international populations.
National (i.e. at the Scottish or UK level)	Habitats or species that form part of the cited interest of a nationally important designated site (e.g. a Site of Special Scientific Interest or a National Nature Reserve). Regularly occurring, but rare bird species (for example, less than 300 breeding pairs in the UK) and/or a species present in nationally important numbers (for example, more than 1% of the UK population). A site that provides critical supporting habitat for any regularly occurring bird population of national importance.
Regional (e.g. Western Southern Uplands & Inner Solway NHZ)	Any regularly occurring population of a nationally important bird species which is threatened or rare in the region (for example, more than 1% of the regional population or NHZ population where reliable estimates are available). Regionally important habitats critical to supporting such populations. In the local authority area context, Local Nature Reserves where bird populations / assemblages are a key component.
Local (High)	Regularly occurring population of bird species and their supporting habitats which are considered to be of conservation importance at a sub-regional / supra-local spatial scale. Sites with an identified ornithological interest meeting the criteria for local authority area designation (e.g. Site of Importance for Nature Conservation).
Local (Medium)	A population of a species or assemblage of species, and their supporting habitats, of sub-regional importance, which are not considered sufficiently notable to qualify for protection under a local authority designation, but which are considered important at a moderately local spatial scale (e.g. approx. radius of 15-20km).
Local (Low)	A population of a species or assemblage of species which are not considered to qualify for local authority non-statutory designation, but which are considered important in the context of the immediate surrounding area (e.g. approx. radius of <10km).
Negligible	A commonplace species / population of little or no conservation importance at a local scale. Habitats of negligible value to any bird population.

Table 8.7: Defining Receptor Sensitivity

8.7.4.2. Effect Characterisation

The overall character of an effect is a function of a wide range of variables acting on the receptor which include the following:

- Direction - whether the effect benefits (positive) or harms (negative) the receptor;
- Extent - the area affected or potentially affected by a particular impact (e.g. distance over which artificial lighting may affect bat behaviour);
- Magnitude - the amount of a habitat or population affected (quantified, where possible, as the proportion of the receptor lost or affected);
- Complexity - relating to whether an effect is direct or indirect, proximal or distal, immediate or delayed;
- Reversibility - can the effect be reversed, within a reasonable timescale and with reasonable expectation of recovery, or is it permanent and irreversible;
- Frequency - is the effect acting constantly or intermittently (e.g. occasional noise disturbance in comparison to a longer-term change to the existing baseline levels of disturbance);
- Timing - is the effect occurring during a more or less sensitive period for the receptor (e.g. relative to the bird breeding season);
- Duration - the length of time that the effect is acting on the receptor, this may be longer than the associated impact is occurring for and may be short, medium, long-term or permanent (indicative periods for these categories are given in Table 8.8 below, in relation to faunal receptors duration may also be defined relative to the lifecycle of the species); and
- Confidence - certain/near certain (95% or greater chance of occurring), probably (50-95%), unlikely (5-49%) or extremely unlikely (<5%).

The overall effect, considering all of the above factors, for each receptor is categorised for each phase of the Proposed Development (i.e. the construction phase, the operational phase and the decommissioning phase). To help illustrate this, summary descriptions of the various effect levels (primarily considering effect magnitude and duration) are provided in Table 8.8 below.

Effect Level	Description of the resultant effect on the ornithological receptor
Total/Near Total	Would cause the loss of a major proportion or whole feature/population, or cause sufficient damage to a feature to immediately affect its viability.
High	Major effects on the feature/population, which would have a sufficient effect to alter the nature of the feature in the short-long term and affect its long-term viability. For example, more than 20% habitat loss or damage.
Medium	Effects that are detectable in short and long-term, but which should not alter the long-term viability of the feature/ population. For example, between 10 - 20% habitat loss or damage.
Low	Minor effects, either of sufficiently small-scale or of short duration to cause no long-term harm to the feature/population. For example, less than 10% habitat loss or damage.
Negligible	Minimal change on a very small scale.
Duration definitions	Long-term (5 - 25 years or longer, and refers to wind farm operation). Short-term (<5 years, and refers to construction or decommissioning).

Table 8.8: Defining Effect Level

8.7.4.3. Effect Significance

Significance is a measure of the importance that should be given to an effect in relation to the consideration of appropriate mitigation and the overall environmental impact of the proposals and the planning process. Effects can be significant at a wide range of geographical scales (i.e. from the local level to effects that are of international importance for the receptor under consideration), but which result in important consequences for the functioning and/or conservation status of the receptor. In general terms, significance is determined through the interaction between receptor sensitivity and the categorised effect level (i.e. taking into account effect extent, duration, reversibility etc.).

Effect significance is reported in categories, from None to Major, through Negligible, Minor and Moderate. For the purposes of the assessments, effects are considered significant (i.e. 'significant' in terms of the relevant EIA Regulations and of key importance in terms of planning consent decision-making) if they are reported as Moderate or above.

The process of determining the significance of an effect can be illustrated by a simple matrix which shows the interaction between receptor sensitivity and the magnitude of effect as illustrated in Table 8.9 below. In practice, the determination of significance involves the careful application of informed professional judgment and consideration of a range of parameters, as outlined above. If the likely effect is assessed as being moderate or above, the effect on the receptor is judged to be 'significant'.

Receptor Sensitivity	Effect Level				
	Total / near total	High	Medium	Low	Negligible
Interna-tional	Major	Major	Major	Major-Moderate	Negligible
National	Major	Major	Major-Moderate	Moderate	
Regional	Major	Major - Moderate	Moderate	Moderate - Minor	
Local (High)	Major-Moderate	Moderate	Moderate -Minor	Minor	
Local (Medium)	Moderate	Moderate - Minor	Minor	Minor	
Local (Low)	Moderate – Minor	Minor	Minor	Minor	
Negligible	Negligible				

Table 8.9: Determining the Significance of Effect on Ornithological Receptors

8.7.5. Collision Risk Assessment

Wind turbine collision risk for key species has been estimated following a method developed by Band *et al*. (2007). In summary, the process involves three stages:

- Stage one is the estimation of the number of transits through the proposed rotor swept volume per year based on observed flight activity data and parameters of the wind farm and wind turbine design.
- Stage two involves the estimation of the predicted proportion of transits through the rotor swept volume that would result in a collision between the bird and a wind turbine blade. All predicted collisions are assumed to be fatal. This provides an estimate of the number of fatalities per year for the wind farm but assumes that no bird takes avoiding action to prevent a collision.
- Finally an assumed rate for collision avoidance is applied to the estimate.

This method is more suitable for some species than others. For example, small and/or fast flying birds such as merlin, golden plover and most songbirds are difficult to detect beyond a distance of a few hundreds of metres and therefore it is rarely possible to generate reliable estimates of flight activity. In the case of these species collision risk is probably best determined through informed reasoning rather than quantitative modelling.

In order to provide a biologically realistic estimate of collision risk it is necessary to assume that birds take action to avoid collision. However, reliable empirical data on which to base estimates for avoidance are often lacking and therefore the collision rates derived from assumed avoidance values should be considered as cautious estimates.

In the assessment, estimates of collision risk/mortality will be calculated for key receptors where there was sufficient data to carry out the analysis. Species that are not included in the collision risk analysis are either not of conservation concern or are at low collision risk due to their flight behaviour, and/or are species which are infrequently present within the study area.

Various adjustments to the collision risk estimates will be made to account for the turbine blade parameters relative to the height bands which were used to record observations of target and secondary species in flight.

The potential collision risk is calculated for each species based on a number of assumptions. For example, it is assumed that there is no influence on collision risk from weather conditions. In the case of diurnal raptors, as visual hunters, the risk of increased collision rates due to poor visibility is lessened by the likely reduction in flight activity during such periods, as hunting efficiency is greatly reduced. Flight speeds and biometrics will be conservatively estimated and will follow current SNH guidance.

8.7.6. Statement of Significance

At the end of the assessment a statement of residual effect levels and associated significance will be provided. This is a summary of the complete assessment for each receptor, taking into consideration any proposed mitigation measures, and reports the significance of the residual effects in compliance with the EIA Regulations.

8.7.7. Cumulative Impact Assessment

The potential for cumulative impacts on ornithological receptors arising from other wind farm proposals within the Western Southern Uplands & Inner Solway NHZ will be assessed following the approach set out in current SNH guidance. This part of the assessment will focus on those sensitive receptors where there is at least the potential for biologically important cumulative effects to occur (i.e. effects that have the potential to act additively and materially affect annual survival or productivity rates at the relevant population level). The assessment will include consideration of operational projects; projects under construction; consented projects which are not yet under construction; and projects for which planning applications have been submitted and for which ornithological impact assessment information is available.

8.8. Identification of Further Mitigation and Enhancement Measures

Where likely or potentially significant adverse effects are identified through the assessment, the design will be reviewed to consider if further mitigation can reasonably be embedded into the proposed development. Alternatively, further mitigation may be proposed in order to reduce effect severity. Such mitigation may include alternative construction methods, the timing of works and effective habitat restoration, enhancement and creation. In some cases, mitigation measures may also be specified where effects are not considered to be significant as part of a best practice approach to development. Following consideration of the proposed mitigation then the residual effect and significance is reported in the assessment.

8.9. Risks, Limitation and Uncertainties

8.9.1. Survey constraints

There are considered to be no significant constraints or gaps in the baseline data that will be used to inform the assessment.

The site boundary illustrated in Figures 5 & 6 differ in some locations in comparison to the boundary defined at the time the 2018-19 surveys were completed. There is a part of the current site, the lower Furmiston area, which lies just outside the 2018-19 core survey area (see Figure 5). However, all of the proposed wind turbine locations are located well within the 2018-19 core survey area (at least 500m). Assuming that access to site will be made on the west of the site, this will also be the case for the proposed access tracks, borrow pits, construction compounds etc. Therefore, this is not considered to be an important constraint as there will be sufficient extent of baseline data to inform the EIA of the proposed development.

8.9.2. Assessment Limitations

Ecological impact assessments are always subject to some degree of uncertainty as to the potential scope, scale, duration and magnitude of effects and the range and sensitivity of receptors affected. Such factors can be accounted for by assuming a reasonable ‘greatest extent scenario’ in relation to the potential effects of construction works, taking into consideration prior experience and what can reasonably be expected of a

prudent construction contractor given the nature of the proposed development.

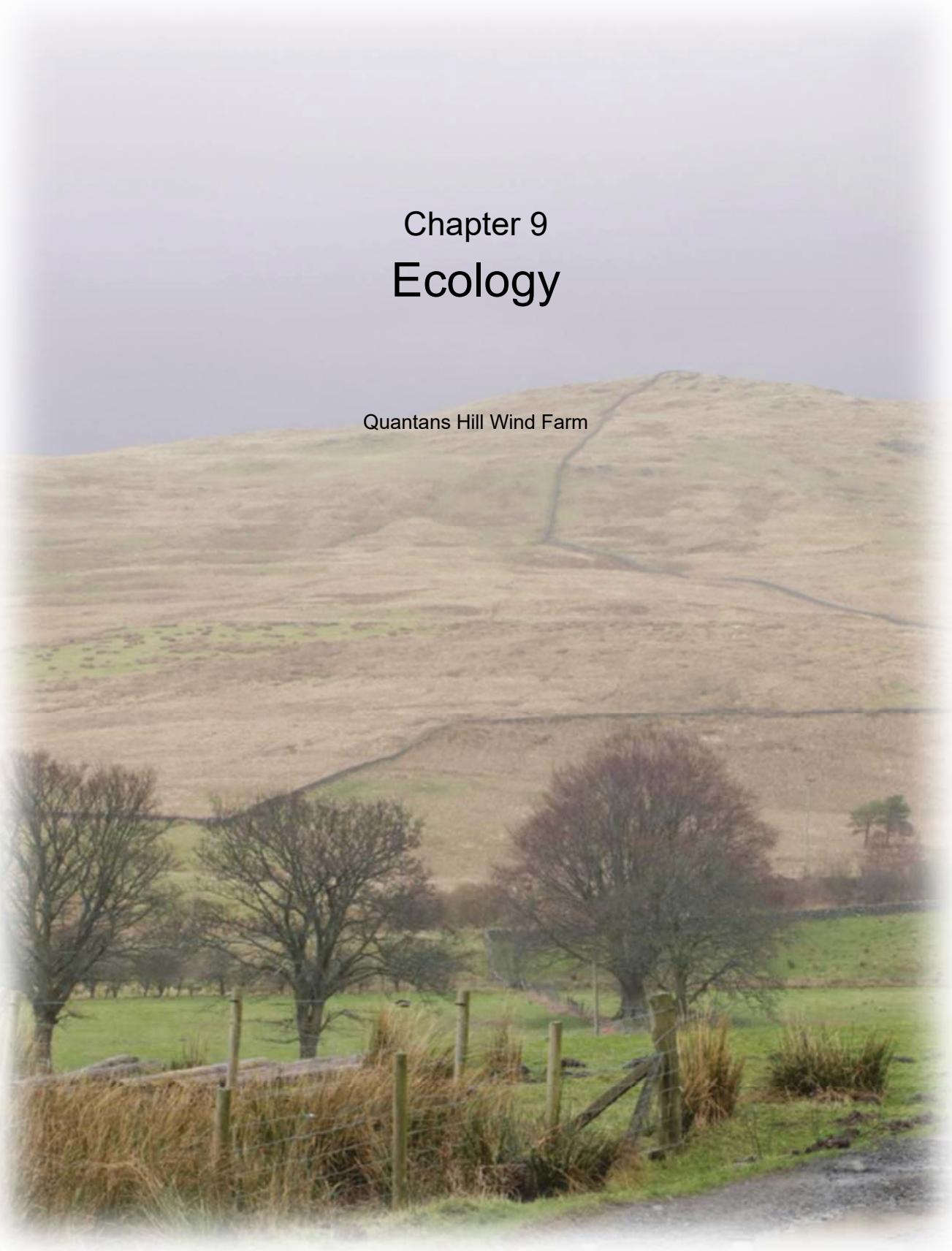
Limitations with respect to bird collision risk modelling methods are well known (Band *et al*. 2007). As discussed above, the method is limited by the current understanding of how bird flight activity and behaviour is affected by wind farms in the long-term and in proximity to individual wind turbines. However, this method includes parameters that can be adjusted to some extent to account for species-specific differences in morphology and flight behaviour and incorporates variables for individual turbine design, wind farm layout and operational regime. A further advantage of the Band Model, which has become widely adopted in wind farm EIA, is that it enables comparison of collision risk between proposals, which also helps to inform cumulative assessment.

8.10. Key Questions

A collaborative design process is being adopted and comments are therefore sought at this stage from consultees regarding both the proposed scope of assessment and the optimum design of the proposed development within the maximum development parameters. Specifically, in responding to this EIA Scoping Report, consultees are asked to consider the following key questions:

Is the proposed scope and extent of the available and proposed baseline data considered to be sufficient to inform a reliable assessment of the potential effects of the proposed development?

Do the consultees agree with the list of key potential receptors for the EIA and with the receptors / issues to be scoped out of the assessment?



Chapter 9
Ecology

Quantans Hill Wind Farm

9. Ecology

9.1. Introduction

The intention of this section of the Scoping Report is to provide the competent authority and its advisers with sufficient information (where it currently exists) on the likely impacts of the proposed development on important ecological features, ornithological features will be covered by a third-party in the subsequent section. This will allow for an EIAR that focusses on features which could be significantly affected, or for which the predicted effects are currently unknown. Baseline survey work on the proposed development to inform the EIA is still to commence, therefore this Scoping Report is based on desk study information on the species and habitats most likely to be present and potentially impacted by this development.

A screening process will be undertaken alongside the EIA to determine whether the predicted impacts of the proposed development will result in a "Likely Significant Effect". The screening process will allow the competent authority to determine whether an Appropriate Assessment (AA) will be required.

9.1.1. Desk Study

A desk-based study will include ecological data for the last five years from within 10km (bat data) or 5km (other ecology data) of the proposed development boundary from local environmental records centres (South West Scotland Environmental Information Centre (SWSEIC) and Glasgow Museums Biological Records Centre (GMBRC)) and EIA Chapters for other developments where available.
Results will be included in the desk-study section of the EIAR Chapter and any implications for the survey programme highlighted for discussion with SNH.

9.1.2. Habitat Surveys

It is proposed that surveyors will work to a minimum polygon size of 10m^2, areas of habitat smaller than this will be recorded as target notes or mosaics - whichever is most appropriate. Where mosaics are recorded, target notes will include a description which will indicate mean habitat patch sizes and integration. Survey work will include:

- Extended Phase 1 and NVC surveys;
- Undertaking habitat loss calculations for the ecology EIAR Chapter;
- Identifying and mapping sensitive areas to avoid e.g. potential Ground Water Dependant Terrestrial Ecosystems (GWDTE) and priority habitats; and
- Identifying less sensitive habitats potentially suitable for development to inform the project design.

Phase 1 and NVC surveys were previously carried out in the southern part of the currently proposed development area (in 2010 and 2013 respectively) in connection with the original Quantans Hill wind farm application. If there have been no significant changes in land management practices, then the existing data could still be applicable and surveys in 2020 would therefore focus on covering the area not already surveyed and ground-truthing the existing data. The site walkover still needs to be repeated to cover the current (larger) extent of the proposed site.

9.1.3. Extended Phase 1 habitat survey

A walkover habitat survey will be undertaken, and habitats present mapped digitally in the field and assigned a Phase 1 habitat code. Target notes will be taken for any other notable observations e.g. signs of protected species or presence of suitable habitat for protected species such as red squirrels and herpetiles, habitat patches that are considered to be botanically rich, and protected or invasive plant species.

9.1.4. National Vegetation Classification survey

National Vegetation Classification (NVC) surveys will be undertaken after Extended Phase 1 habitat surveys have been completed, the results of which will be used to target survey areas to be covered by NVC surveys. The areas to be covered by NVC surveys will be those identified during Phase 1 habitat surveys as potential GWDTEs. GWDTE are protected under the Water Framework Directive. Before the surveys commence, we will seek to have the survey approach agreed by relevant stakeholders and consultees.

NVC habitat polygons will be mapped digitally in the field and identified to sub-community level. As far as practical, the surveyor will avoid recording mosaics that are a mix of potential GWDTE and non-GWDTE habitats, this will aid more accurate mapping of potential GWDTE habitats. Data will be suitable for a hydro-geological GWDTE assessment.

Vegetation surveys are likely to be conducted during the peak/end of the growing season when most plant species are easily detectable (May-August).

9.2. Terrestrial Ecology Surveys

9.2.1. Otter and water vole survey
We anticipate that a survey targeting otter and water vole (mid-May to end June), will be required. These surveys would be completed in all suitable habitat within 250m of proposed infrastructure and will be carried out by two surveyors due to the high health and safety risks posed by working in close proximity to water.

As water vole are a mobile species a single visit can be insufficient to confirm presence/absence, it is therefore possible that a second water vole survey may be required if suitable habitat is present and the results of the initial survey are inconclusive. Alternatively, assessment of impact on water vole could be carried out on a precautionary basis without a second survey.[4] The requirement for further survey would be discussed and agreed with SNH during consultation, based on initial results of survey work and desk study data.

9.2.2. Badger, red squirrel, and pine marten survey
The development area will be surveyed for badger where all signs of presence shall be recorded and mapped. Additionally, during the badger survey, any forested areas that lie within the development area shall be surveyed for signs of squirrel and pine marten presence. It is expected that the surveys will be carried out in late summer (July to September).

9.3. Bat surveys

9.3.1. Bat roost surveys
Farm buildings and mature trees within the site may provide suitable locations for roosting or hibernating bats and these areas will require roost assessment surveys to determine their suitability and any evidence of occupation. Should evidence of bat roosts be recorded, emergence and re-entry surveys will be undertaken to count the species and number of bats involved.

9.3.2. Ground level bat detectors
New guidance (SNH, 2019)[5] has been produced as to the baseline surveys required for bats on a proposed wind farm site. The main requirement will be the deployment of automated full spectrum static detectors. The guidance recommends that bat detectors are sited as close as possible to the location of proposed turbines. The devices need to be deployed for three ten-day (minimum) periods of good weather, over the course of the season: covering spring (April/May), summer (June-early August) and autumn (late August-September). All data is recorded in full spectrum.

Following the new SNH guidance, deployment of static bat detectors at height is not currently required unless there are site-specific reasons for it.

Weather data including wind speed, temperature and rainfall are important for the interpretation of bat activity data and should be recorded nightly.

Bat calls identified in the detectors deployed will be analysed using Kaleidoscope Pro Software. Manual quality assurance will be conducted on a 10% sample of the recorded bat calls.

Current guidance indicates that bat activity levels should be assessed using the online tool Ecobat which compares data entered by the user with bat survey information from similar areas at the same time of year and in similar weather conditions. This requires that the bat data are submitted to Ecobat and form part of the data repository that it uses to make bat activity assessments.

9.4. Fish Surveys

The previous Quantans Hill EIA identified possible adverse effects to brown trout with minor effects to salmon populations further downstream from the development associated with potential pollution incidents during construction. Mitigation proposed included a post-consent fish population monitoring plan including electrofishing surveys to be implemented over a period of at least three years.

Given existing knowledge of the fish population within the local catchments, and considering the use of best-practice mitigation measures which would be employed in the design of watercourse crossings and to protect watercourses during construction and operation, it is not considered that baseline fish surveys will be required. In light of this we would seek to scope out the requirement for baseline fish surveys.

[4] Dean M., Strachan R., Gow D., and Andrews R. 2016. The water vole mitigation handbook (The mammal society mitigation guidance series). Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

[5] SNH. 2019. Bats and onshore wind turbines: survey, assessment and mitigation. Scottish Natural Heritage, Inverness.

Do consultees agree with the scope of survey proposed?

9.5. EIA Assessment

Based on a review of the ecological data available, an assessment of the effects associated with construction, operation, and decommissioning of the project will be undertaken including habitat loss and gain calculations associated with the development.

The assessment will follow CIEEM and other relevant guidelines, and effects will be assessed as being either not significant (for predicted negligible or low impacts) or significant (for predicted moderate or high impacts). Whilst it is intended that much of the non-significant elements can be scoped-out it is important to note that the potential effects can include the following:

- Disturbance and/or displacement of protected species; and
- Damage, destruction or pollution of protected species habitats/other resources.

Any proposed mitigation measures will be developed in conjunction with industry best-practice standards.
In keeping with the principle of proportionate EIA, only summary data and methodologies will be included within Chapters. Other detailed methods and data will be provided in technical appendices or on request as considered appropriate.

Does SNH agree with this approach?

Chapter 10

Hydrology, Geology and Hydrogeology

Quantans Hill Wind Farm

10. Hydrology, Geology and Hydrogeology

10.1. Introduction

As part of the EIAR, a Hydrological, Geological and Hydrogeological Impact Assessment will be undertaken on those receptors that are likely to experience a significant impact from the construction, operation, and decommissioning of the proposed development.

10.2. Embedded Mitigation and Layout Iterations

The design of the proposed development to date has avoided known impacts on hydrological receptors as far as possible through embedded mitigation. Throughout the remainder of the EIAR process and following further survey work and feedback from the consultation process, it may be that the layout presented here in the Scoping Report further develops. Should the layout change from now to the application, it should be noted that the layout presented within this Scoping Report represents a 'greatest extent scenario' and generally any amendments to the design will not increase the likelihood of a significant impact. Should any changes that are likely to have a significant impact on the receptor occur then these will be included within the EIAR. If the changes are not likely to have a significant impact, these will first be discussed with the relevant consultees to ensure that they too are in agreement with the applicant's understanding and before excluding them from the EIAR.

Section 8 contains further general information about embedded mitigation.

10.2.1. Mitigation by Design

A series of buffer distances have been adopted to help reduce effects of the proposed development on the hydrological environment. As the design process evolves, a 50m buffer will be ensured for all identified natural hydrological features. Infrastructure will be located outwith this buffer except where access necessitates.

Watercourse crossings associated with the new access track required as part of the proposed development will be minimised as far as practicable.

10.2.2. Good Practice Mitigation

Mitigation will follow the well-established principles of industry good practice so as to prevent or minimise effects on the surface and groundwater environment. The following good practice principles will be included as part of the embedded mitigation:

- Drainage – all runoff derived from works associated with the proposed development will not be allowed to directly enter the natural drainage network. All runoff will be adequately treated via a suitably designed drainage scheme with appropriate sediment and pollution management measures. The proposed development is situated in an upland hydrological area and it is imperative that the drainage infrastructure is designed to accommodate storm flows based on a 1-in-200 year event + climate change to help maintain the existing hydrological regime.
- Storage – all soil/peat stockpiles as well as equipment, materials and chemicals will be stored well away from any watercourses. Chemical, fuel, and oil stores will be sited on impervious bases with a secured bund. No fuels, chemicals, or oils would be stored in the catchment of the Benloch Burn owing to its status as a Drinking Water Protected Area (DWPA).
- Vehicles and refuelling – standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Where practicable, refuelling of vehicles and machinery will be carried out in designated areas, on an impermeable surface, and well away from any watercourse.
- Maintenance – only emergency maintenance to construction plant will be carried out within the Planning Application Boundary, in designated areas, on an impermeable surface well away from any watercourse or drainage, unless vehicles have broken down necessitating maintenance at the point of breakdown, where special precautions will be taken.
- Welfare facilities – on-site welfare facilities will be adequately designed and maintained to ensure all sewage is disposed of appropriately. This may take the form of a soakaway or tankering and off-site disposal depending on the suitability of the site for a soakaway and only with prior agreement with SEPA.
- Cement and concrete – fresh concrete and cement are alkaline and corrosive and can be lethal to aquatic life. The use of wet concrete in and around watercourses will be avoided and elsewhere carefully controlled.
- Monitoring Plan – all activities undertaken as part of the proposed development will be monitored

throughout the construction phase. Such monitoring will be to ensure environmental compliance.
- Contingency plans – plans will ensure that emergency equipment is available on site i.e. spill kits and absorbent materials, advice on action to be taken and who should be informed in the event of a pollution incident.
- Training – All relevant staff personnel will be trained in both normal operating and emergency procedures and will be made aware of highly sensitive areas on site.

Further details on specific mitigation requirements will be provided as part of the EIAR. This is likely to include the preparation of a site specific Construction Environmental Management Plan (CEMP) as well as associated appendices, including but not limited to, a peat slide risk assessment, a peat management plan, a watercourse crossing assessment and hydrological monitoring plan. Under the Water Environment (Miscellaneous) (Scotland) Regulations 2017, amendments were made to the Controlled Activities Regulations (CAR) and the proposed development will require a construction site licence for water management across the entirety of the wind farm site prior to any construction works taking place, including enabling works. No work will be able to commence on site until a Pollution Prevention Plan (PPP) has been prepared and agreed with Scottish Environment Protection Agency (SEPA).

10.3. Legislation and Guidance

10.3.1. International Legislation and Policy
The assessment takes into account the requirements of the Water Framework Directive (2000/60/EC) (WFD). The WFD aims to protect and enhance the quality of surface freshwater (including lakes, rivers, and streams), groundwater, groundwater dependent terrestrial ecosystems (GWDTE), estuaries, and coastal waters. The key objectives of the WFD relevant to this assessment are:

- To prevent deterioration and enhance aquatic ecosystems; and
- To establish a framework of protection of surface freshwater and groundwater.

The WFD resulted in The Water Environment and Water Services (Scotland) Act 2003, which gave Scottish Ministers powers to introduce regulatory controls over water activities in order to protect, improve and promote sustainable use of Scotland's water environment. These regulatory controls, in the form of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) or CAR, made it an offence to undertake the following activities without a CAR authorisation:

- Discharges to all wetlands, surface waters and groundwaters;
- Disposal to land;
- Abstractions from all wetlands, surface waters and groundwaters;
- Impoundments (dams and weirs) of rivers, lochs, wetlands; and
- Engineering works in inland waters and wetlands.

10.3.2. National & Regional Legislation and Policy
The assessment takes into account the following legislation and policy:

- The Water Environment and Water Services (Scotland) Act 2003;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended);
- Flood Risk Management (Scotland) Act 2009;
- The Water Supply (Water Quality) (Scotland) Regulations 2001;
- Private Water Supplies (Scotland) Regulations 2006;
- Part IIa of the Environment Protection Act 1990;
- Waste Management Licensing Regulations 1994;
- Pollution Prevention and Control Regulations (Scotland 2000); and
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
- Scottish Planning Policy (2014);
- Land Use Planning System (LUPS) Guidance Note 4: Planning Guidance on Onshore Windfarm Developments;
- LUPS Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems; and
- SEPA Policies:
    - No. 19 Groundwater Protection Policy for Scotland;
    - No. 22 Flood Risk Assessment Strategy;
    - No. 41 Development at Risk of Flooding: Advice and Consultation;
    - No. 54 Land Protection Policy; and
    - No. 61 Control of Priority & Dangerous Substances & Specific Pollutants in the Water Environment.

10.3.3. Other Guidance and Best Practice
Table 12.1 lists other key guidance and best practice documentation relevant to assessment.

TOPIC	SOURCE OF INFORMATION
Scottish Government Planning Advice Notes (PAN's)	PAN 50: Controlling the Environmental Effects of Surface Mineral Workings. PAN 51 Planning, Environmental Protection and Regulation. PAN 1/2013 Environmental Impact Assessment. PAN 61 Planning and Sustainable Urban Drainage Systems. PAN 79 Water and Drainage.
SEPA Guidance for Pollution Prevention (GPP's) and Pollution Prevention Guidelines (PPG's)	PPG1 General Guide to the Prevention of Water Pollution. GPP2: Above Ground Oil Storage Tanks. GPP4 Treatment and Disposal of Wastewater Where there is no Connection to the Public Foul Sewer. GPP5: Works and maintenance in or near water. PPG6 Working at Construction and Demolition Sites. PPG 7: Safe Storage - The Safe Operation of Refuelling Facilities; GPP 8: Safe Storage and Disposal of Used Oils GPP 13: Vehicle Washing and Cleaning; GPP 21: Pollution Incident Response Planning; GPP 22: Dealing with Spills; and GPP 26 Safe Storage - Drums and Intermediate Bulk Containers.
SEPA Position Statements (Published)	WAT-PS-06-02 Culverting of Watercourses WAT-PS-07-02 Bank Protection WAT SG- 78 Sediment Management Authorisation
Construction Industry Research and Information Association (CIRIA)	CIRIA C692 Environmental Good Practice on Site (third edition) CIRIA C753 The SuDS Manual CIRIA C532 Control of Water Pollution from Construction Sites CIRIA C648 Control of Water Pollution from Linear Construction Projects CIRIA C689 Culvert Design and Operation Guide
Other Guidelines	Scottish Renewables Joint Publication, (2019) Good Practice During Wind Farm Construction Version 4 FCE, SNH, (2010), Floating Roads on Peat Scottish Renewables, Joint Publication (2012), Development of Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste SEPA, The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), A Practical Guide, Version 8.4, October 2019 River Crossings and Migratory Fish: Design Guidance, A Consultation Paper, The Scottish Executive WAT-SG-23: SEPA (2008), Engineering in the Water Environment, Good Practice Guide - Bank Protection Rivers and Lochs, First Edition WAT-SG-25: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, River Crossings, Second Edition WAT-SG-26: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Sediment Management, First Edition WAT-SG-31: SEPA, (2006) Special Requirements for Civil Engineering Contracts for the Prevention of Pollution, Version 2

Table 10.1: Guidance and Best Practice

Table 10.1: Guidance and Best Practice

10.4. Desk Based Studies

The following sections summarises the work that has been undertaken to inform the details presented in this Scoping Report.

10.4.1. Surface Water Hydrology

The general position of the proposed development means that the site is situated on the localised Water of Deugh hydrological networks and is part of the main Water of Ken and River Dee catchments. There are six main burns which supply these networks situated in and around the proposed development area (Benloch Burn, Knockgray Burn, Furmiston Lane, Rothay Burn, Marbrack Burn and Polshagg Burn).

These catchments along with the additional detail taken from the Flood Estimation Handbook (FEH) web service are summarised below.

Catchment Name	Downstream Network Name	AREA /km²	ALTBAR /mAOD	BFI HOST	SAAR mm yr⁻¹	SPR (%)
Benlock Burn	Water of Deugh	4.16	457	0.353	1808	50.6
Polhay Burn	Water of Deugh	2.13	322	0.348	1680	50.8
Marbrack Burn	Water of Deugh	5.81	349	0.321	1759	53.0

Table 10.2: Summary of catchments within the proposed development. Source: FEH Web Service. ALTBAR – Average Altitude in the catchment, BFI HOST – Base Flow Index (0 [low] to 1[high]), SAAR – Standard Annual Average Rainfall, SPR – Standard Percentage Runoff.

The catchments situated in and around the proposed development are typical of the type of upland watersheds within Southern Uplands, being high in altitude (349 – 457m AOD) with a correspondingly high average rainfall volume (1680 – 1808mm yr^{-1}).

The BFI is a measure of the proportion of a catchment's long-term runoff that derives from stored sources, with the BFI ranging from 0.10 in relatively impermeable clay catchments to 0.99 in highly permeable catchments. The BFI for the site catchments indicates that around a third of the catchments long-term runoff is derived from stored sources. The SPR values represent the percentage of rainfall that is likely to contribute to runoff. The SPR for the site catchments indicates that around a half of the rainfall during an event contributes to runoff. This demonstrates that the site is on moderately impermeable catchments.

10.4.1.1. River Dee Catchments

The main Quantans Hill catchments of Benlock Burn, Polhay Burn and Marbrack Burn drain southwards down the Water of Deugh and through Kendoon Loch becoming the Water of Ken. The Water of Ken flows through Carsfad Loch and Earlstoun Loch before entering Loch Ken and into the River Dee.

The Benloch Burn, located to the west of the proposed development is designated as a Drinking Water Protection Area. This has a catchment area of 4.16km^2, and is designated as a result of an abstraction for Carsphairn Water Treatment Works (WTW) situated at NX 57943 94991.

10.4.1.2. Quantans Hill Catchments

The Quantans Hill catchments drain south down the River Dee discharging into the Solway Firth. Within the proposed development, the watercourses which supply this network are divided into a number of smaller catchments discharging into the Water of Deugh. To the south of the proposed development are the Knockgray Burn (0.62km^2), Furmiston Lane (1.37km^2) and an un-named catchment located between these two burns (0.54km^2) directly south of the confluence of the Polhay and Marbrack Burns, that drains into the Water of Deugh at 259422 591925. The Poldores Burn (3.02km^2) encroaches on the north eastern perimeter but is up catchment from the proposed development and drains east away from the site into the Poliferie Burn, discharging into the Water of Ken.

10.4.2. Water Quality

Several watercourses within the vicinity of the proposed development have been classified under SEPA's River Basin Management Plans (RBMP) (SEPA 2011). The RBMP are one of the requirements of the Water Framework Directive (WFD) (2000/60/EC) and are the plans designed for protecting and improving the water environment. The details of the watercourses within the proposed development that are classified under the RBMP classification scheme are provided below.

Designation	Site name	Qualifying features	Distance to site boundary
Poor ecological potential	Water of Deugh	Heavily modified	0m
Bad ecological potential	Water of Ken	Heavily modified	3km
Poor ecological potential	Poliferie Burn	N/A	1.5km

Table 10.3: RBMP classification of watercourses in the vicinity of the proposed development

10.4.3. Designated Areas

There is one designated Site of Special Scientific Interest (SSSI) within 5km (Cleugh) and a further two SSSI's within 7km of the proposed development's site boundary (Loch Doon and Merrick Kells).

There are no other designated sites within 10km of the site.

10.4.4. Flood Risk

The Flood Risk Management (Scotland) Act 2009 sets in place a statutory framework for delivering a sustainable and risk-based approach to managing flooding.

Flood information provided by SEPA indicates that within the proposed development area there is a risk from flooding in the Water of Deugh, Marbrack Burn and Benloch Burn catchments (less than 1:10 chance of flooding each year). This risk is mainly associated with

fluvial flooding and appears to be most significant on areas of level ground in the riparian zones and in the base of the corries.

A flood risk assessment will be undertaken as part of the planning application. The assessment will be carried out in accordance with Scottish Planning Policy (SPP). The document states that *"Planning authorities must take the probability of flooding from all sources – (coastal, fluvial (watercourse), pluvial (surface water), groundwater, sewers and blocked culverts) and the risks involved into account when preparing development plans and determining planning applications."*

10.4.5. Soils and Peat

Peat is a soft to very soft, highly compressible, highly porous organic material that can consist of up to 90 – 95% water, with 5 – 10% solid material. Unmodified peat consists of two layers; a surface acrotelm which is usually 10cm – 30cm thick, highly permeable and receptive to rainfall. Decomposition of organic matter within the acrotelm occurs aerobically and rapidly. The acrotelm generally has a high proportion of fibrous material and often forms a crust in dry conditions.

A second layer, or catotelm, lies beneath the acrotelm and forms a stable colloidal substance which is generally impermeable. As a result, the catotelm usually remains saturated with little groundwater flow. Peat is thixotropic, meaning that the viscosity of the material decreases when stress is applied. The thixotropic nature of peat may be considered less important where the peat has been modified through artificial drainage or natural erosion and is drier but will be significant when the peat body is saturated.

The distribution of soils across the site is dependent upon land use, geology, topography and hydrological regime of the area. Information on the site soils has been provided by the James Hutton Institute, specifically from its online Soil Information for Scottish Soils (SIFSS) portal.

Soil Association	Parent Material	Component Soils
ETTRICK	Drifts derived from Lower Paleozoic greywackes and shales	Peaty gleyed podzols with peaty gleys and dystrophic peat
ORGANIC SOILS	Organic deposits	Dystrophic blanket peat

Table 10.5: Summary of Soil Types

The above soils information indicates that peat is present in the area occupied by the proposed development. Site survey work would be needed to confirm the presence and depth of peat on site. The completion of such works will support the completion of the EIAR and associated technical appendices including a peat management plan and peat side risk assessment.

10.4.6. Bedrock Geology

According to the 1:50,000 scale British Geological Survey (BGS) Bedrock Geology Sheet, the site is predominantly underlain by a Portpatrick Formation Wacke and Siltstone Turbidite succession, conformably overlying the Hartfell Shale Formation. The central to north-western sections are underlain by a shallow layer of Quartzose Wacke and Conglomorate Turbidite unit (0-500 m) and the western to north-western part of the proposed development is dominated by deeper sequence of Sandstone and Siltstone from the Kirkcolm Formation, which is likely to be ~4500m in vertical thickness.

There are no apparent registered geologically derived Sites of Special Scientific Importance within the site boundary or with a 500m buffer.

10.4.7. Superficial Geology

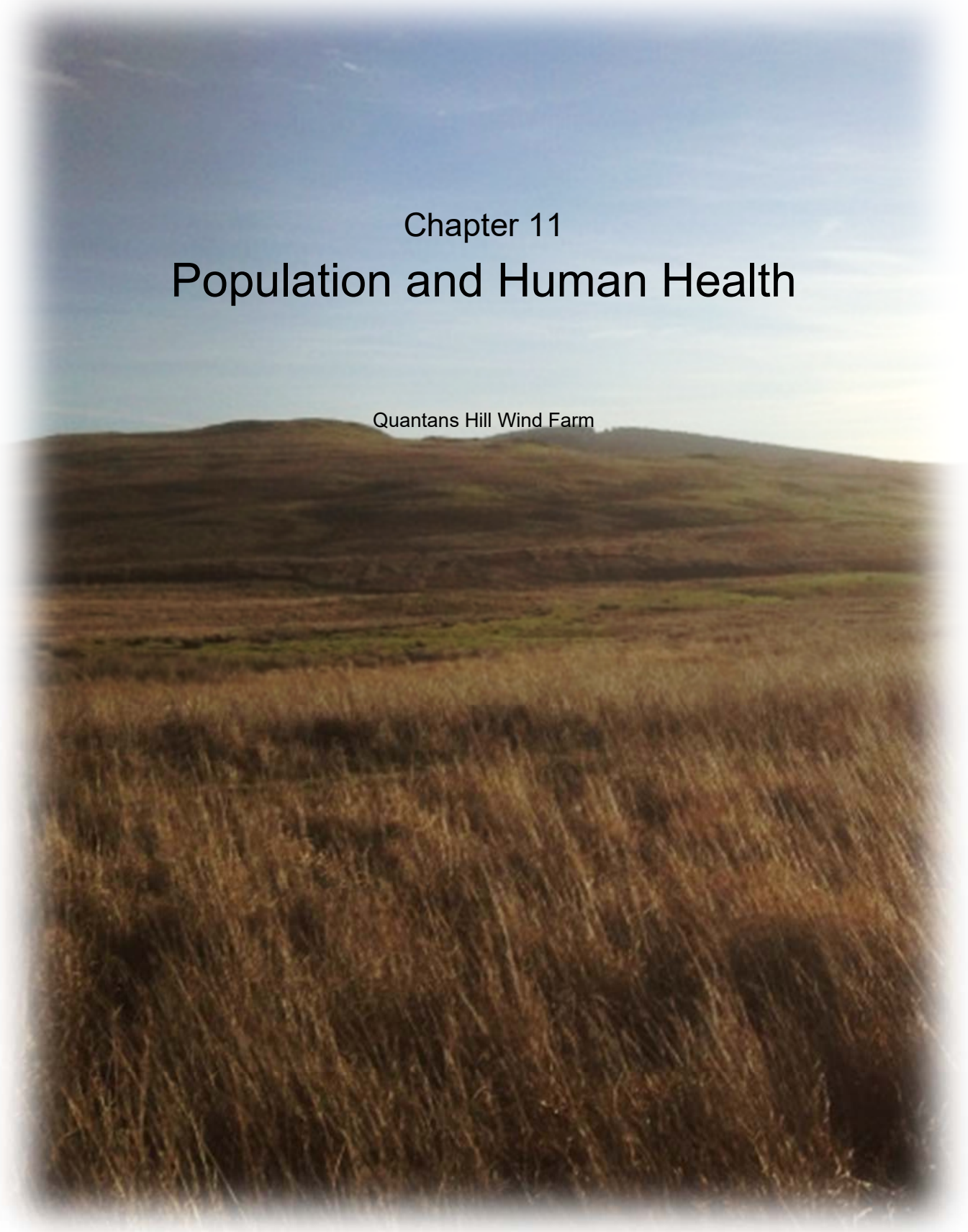
According to the 1:50,000 scale BGS Superficial Drift Sheet the solid bedrock is likely to be overlain by an assemblage or post glacial quaternary deposits comprising of sands, gravels, clays and areas of peat. It appears that most of these deposits are mapped to be within the confines of the valley bottoms and sides with no deposits mapped to be on the hill tops themselves. It is anticipated the general succession of facies is likely to be a layer of peat underlain by alluvial sediments such as sands and gravels, then glacially derived sands and gravels which may also have a clay matrix.

10.5. Hydrogeology

According to the 1:625,000 scale BGS Hydrogeology Sheet the site is underlain by a low productivity aquifer with limited resource potential. This is on account of both the Queensberry Formation and the Gala Unit 4 bedrock being well cemented and highly indurated, being consequently very low in permeability. Notwithstanding, the aquifer underlying most of the site, Upper Clyde, is classified by SEPA as being in 'Poor' condition on account of the historic mining and quarrying of materials in the area. The adjacent Annerdale aquifer is classed as being in 'good' condition. The Annerdale bedrock aquifer is also classified as a Drinking Water Protection Zone.

Given the low porosity of the underlying bedrock, it is possible that groundwater may exist within the weathered zone in fractures, or in superficial sands and gravel deposits. The volume of water corresponding to the aquifer transmissivity will be a primary function of the

effective porosity derived from the content of clays and silts. Since most of these deposits are mapped to be around watercourses it is likely these locations may well support perched aquifers, supplying baseflow to some of the catchments. These may also support species and be considered as groundwater dependant terrestrial ecosystems (GWDTE), which again will require further assessment during the completion of the EIAR.



Chapter 11
Population and Human Health

Quantans Hill Wind Farm

11. Population and Human Health

A requirement of the EIA Regulations is to consider potential effects upon population and human health. These have typically been assessed in the past but under different headings and are now brought together under the same umbrella. Issues considered under this topic include:

- Noise;
- Shadow flicker;
- Ice throw;
- Lightning;
- Private water supplies; and
- Socio-economics

11.1. Noise

As part of the EIA, a noise assessment will be undertaken by a suitably experienced and qualified noise consultant.

Noise and vibration will occur during the construction, operation, and de-commissioning of the proposed development. The extent to which this is significant depends on the noise sources, in each case, and the distance of each of the noise sources to noise sensitive receptors.

Noise sensitive receptors in this case are considered to be residential properties, those identified at this stage are noted on Figure 3 (Site Constraints). During the construction and de-commissioning phases, the effects can be divided into noise and vibration from on-site activities and from construction traffic accessing the site. During operation, noise is generated by the turbines as they rotate with noise output depending on wind speed. Vehicle movements during operation (for maintenance for example) can be considered insignificant in terms of noise impact due to the relatively small number of movements of primarily smaller vehicles. For on-site construction noise and operational noise at different wind speeds, the levels received at residential properties will depend on wind direction.

The site location is rural and remote and residential properties around the site are likely to be free of any noise of human origin except for road noise from the A713 and B729 as well as occasional air traffic and operation of forestry and farm machinery. Any road noise as well as noise relating to forestry is more likely to be significant for properties to the south and west of the proposed development. Such other noise as there is, is likely to be from animals and birds and from wind around trees and foliage, depending on wind speed.

11.1.1. Planning Policy and Guidance on Noise Issues

The principal planning guidance on noise is contained in Planning Advice Note (PAN) 1/2011, Planning and Noise, which contains advice on assessment of noise from new sources as well as the effects of noise on new residential development. For construction noise it refers to the Control of Pollution Act and the Pollution and Prevention Control Act 1999 for relevant installations. The accompanying Technical Advice Note, Assessment of Noise, lists BS 5228, Noise and Vibration Control on Construction and Open Sites as being applicable for Environmental Impact Assessment (EIA) and planning purposes. In respect of operational noise from wind farms, PAN 1/2011 refers to 'web based planning advice' on renewables technologies which in turn refers to ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (ETSU-R-97), as the appropriate method for assessment of operational noise. Additional guidance on assessment of operational noise is contained in the UK Institute of Acoustics (IOA) document Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (GPG) which has been endorsed by the Cabinet Secretary for Finance, Employment and Sustainable Growth of the Scottish Government.

11.1.2. Assessment Methodology

11.1.2.1. Construction Noise

Construction noise is temporary and an assessment of the potential noise associated with construction of the original Quantans Hill wind farm indicated that noise associated with such activity would be limited to acceptable levels. It is considered that potential construction noise effects are not significant and can be scoped out.

Can consultees agree for construction noise to be scoped out of EIA?

11.1.2.2. Operational Noise

Operational noise will be assessed according to the requirements of ETSU-R-97 as clarified and refined by the UK IOA GPG. The ETSU-R-97 methodology sets noise limits for the day and night-time periods by carrying out measurements of baseline/background noise and wind speed and deriving 'prevailing' background noise levels from the results, with limits set at 5dB above this subject to lower limiting values which are different for day and night periods or where properties are deemed to be 'financially involved' with the development. Background noise monitoring was undertaken at 10 residential properties in the vicinity of the site in 2012 as part of the EIA for the original Quantans Hill wind farm. It is proposed to re-analyse that previous baseline data for informing a fresh operational noise assessment.

Can consultees agree that baseline noise monitoring does not need repeated? If there are additional locations considered necessary for recording, please specify.

11.2. Shadow Flicker

It is proposed that shadow flicker can be scoped out if the final layout for proposed turbines are further than 10 rotor diameters from potential receptors. If this situation cannot be avoided, shadow flicker will be calculated using WindFarmer software for a single given turbine layout and set turbine dimensions. Shadow flicker will be calculated assuming:

- There are clear skies every day of the year;
- The turbines are always rotating;
- The sun can be represented as a single point;
- The blades of the turbines are always perpendicular to the direction of the line of sight from the specified location to the sun.

Do consultees agree with the proposed scope for shadow flicker?

11.3. Ice Throw

Ice throw is the process of ice falling or being launched from the blades of a turbine. As imbedded mitigation, the turbines will have sensors on them to detect the build-up of ice and automatically prevent the turbines spinning when ice has developed on them, thus preventing the ice being thrown. Scottish Government's Onshore Wind Farm Advice Sheet states that danger to human or animal life from falling parts or ice is rare. Ice throw will not be assessed in the EIA.

11.4. Lightning

As stated in Scottish Government's Onshore Wind Farm Advice Sheet, the danger to human or animal life from lightning strike via a turbine is rare since lightning is directed down the turbine to the earth; the turbine itself being earthed. Maintenance of the turbines would not be undertaken during high lightning risk weather conditions. Lightning will not be assessed in the EIA.

11.5. Water Supply

The Hydrology chapter of the EIAR will present the relevant hydrological assessment. It will inform a brief assessment upon human health in the Population and Human Health chapter of the EIAR.

11.5.1. Private Water Supplies

The EIA for the original Quantans Hill wind farm identified 84 registered private water supplies (PWS) within 5km of the site and none within. Increased sediment erosion as a result of wind farm construction and decommissioning can have significant impacts on the quality, quantity and continuity of water supply to the properties. Dumfries and Galloway Council is requested to provide a fresh list of PWS to allow a gap analysis of the potential effects on PWS by the proposed development. Potential effects will be assessed in the EIAR and appropriate mitigation would be proposed.

11.5.2. Public Water Supplies

The EIA for the original Quantans Hill wind farm identified one public water supply; the Scottish Water Carsphairn Water Supply. The EIA predicted there would be no significant adverse effects upon this asset. The applicant would consult with Scottish Water during the EIA process to ensure this asset remains safeguarded.

11.6. Socio-Economic Assessment

11.6.1. Introduction

Consideration of sustainable economic development has become a cornerstone of government policy and a key driver of the planning system in recent years. The underlying socio-economic wellbeing of an area is also itself a driver in terms of population change. The EIA will therefore include a socio-economic assessment to ensure the balance between economic, social and environmental effects can be properly assessed.

A report issued by BiGGAR Economics in 2016 concludes that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level nor in the areas immediately surrounding wind farm development. The EIA for the original Quantans Hill wind farm did not report any significant effects upon tourism and it is intended to scope out any specific assessment of tourism from the EIA.

11.6.2. Methodology

Instead we propose that the socio-economic assessment would be based upon 3 economic boundaries (local, regional and national economy) will include the following:

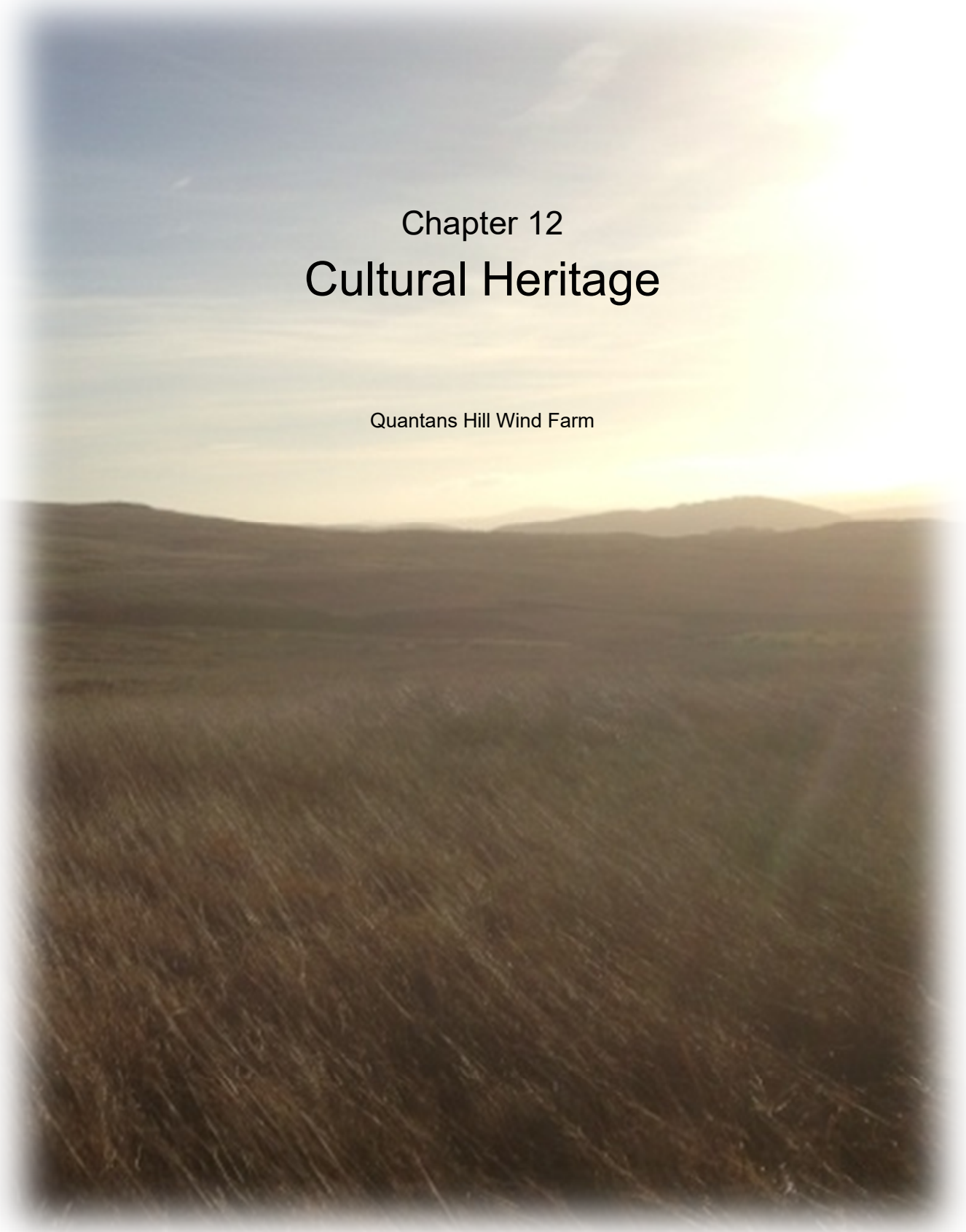
- assess the existing economic environment using official data on population, industrial structure, unemployment and economic activity levels, income and earnings;
- assess the potential economic effects during the development and construction phase of the project including direct employment, supplier effects and income effects;
- assess the potential economic effects during the operation of the wind farm including direct employment, supplier effects and income effects;
- assess the economic affects arising from infrastructure improvements, payment of business rates, and potential community benefits; and
- consider and report on mitigation and management measures which could be employed to minimise any negative impacts and maximise potential positive impacts.

11.6.3. Analysis

As part of the proposed socio-economic assessment, the social and economic effects associated with the proposed development will be identified. Information potentially contained in this section may include the following:

- Direct and supply chain impacts;
- The total amounts predicted to be spent in terms of construction and operation;
- Predicted numbers of jobs supported in the operational phase;
- Predicted spending on accommodation & local businesses – details of accommodation stayed in by construction workers;
- Environmental benefits - electricity generated annually (MWh);
- Case studies of particular businesses – details of Scottish based Tier 1 suppliers; and
- Investment in transport infrastructure – details of any investments that have been made.

This analysis will help inform the prediction of the likely social and economic effects associated with the proposed development.



Chapter 12
Cultural Heritage

Quantans Hill Wind Farm

12. Cultural Heritage

12.1. Introduction

As part of the EIA, a Cultural Heritage Assessment will be undertaken by a suitable qualified consultant. The assessment will be conducted with reference to the relevant statutory and planning frameworks for cultural heritage. Legislation includes:

- The Ancient Monuments and Archaeological Areas Act 1979;
- The Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997;
- The Town and Country Planning (General Development Procedure) (Scotland) Order 1992; and,
- The Electricity Act 1989 (Schedule 9).

The primary planning policy and guidance comprises: Historic Environment Scotland Policy Statement (HESPS), Scottish Planning Policy (SPP) and PAN 2/2011 at the national level; and the Dumfries and Galloway Council Development Plan at the local level.

The Environmental Statement for the original Quantans Wind Farm found no designated cultural heritage assets are located within the Inner Study Area (within the site boundary). A total of 15 cultural heritage assets were found to be located within the Inner Study Area. Six of these assets were recorded in the Dumfries and Galloway Historic Environment Record (HER), with an additional nine assets have been recorded through the examination of maps or during the walkover survey. These consisted of clearance cairns, dykes, mounds, sheep folds and other examples of features and enclosures.

There were eight scheduled monuments located within the Middle Study Area (the middle study area being 5km from the original Quantans site boundary). These include five prehistoric sites, comprising three prehistoric burial cairns, a standing stone and stone circle and a hill fort. There are two scheduled cross slabs dating back to the medieval period. The early industrial remains of the lead mines and smelter at Woodhead are also scheduled.

The outer study area was based on the Zone of Theoretical Visibility (ZTV), as defined in Section 6 of the original Quantans Wind Farm ES Landscape and Visual Impact Assessment, within which cultural heritage assets were highlighted.

Here cultural heritage assets highlighted specifically by consultees or identified as being at risk of significant effects upon setting were considered.

12.2. Scope of Works

When preparing an Environmental Impact Assessment Report (EIAR) chapter which will address the potential cultural heritage impacts resulting from the proposed development the scope of work is proposed to include:

- Desk-based research which will draw upon information held by Historic Environment Scotland (HES), the National Library of Scotland (NLS) and the Dumfries and Galloway Historic Environment Record (HER).
- Carrying out a detailed walkover survey of the site where previously not surveyed, undertaken by two archaeological surveyors.
- Undertaking site visits to assess the potential for impacts upon the settings of both designated heritage assets and nationally important non-designated assets.
- Undertaking pre-application consultation with HES and The Dumfries and Galloway Council Archaeology Service (DGCAS). The scope of these consultations would include identifying required visualisations and discussing mitigation options.

The proposed development lies within an area of known archaeological remains dating from the prehistoric period to the Second World War, including six Scheduled Monuments which lie within 2.5km; Craigengillan Cairn (SM2238); Stroanfreggan Craig Fort (SM1095), Cairn Avel (SM1006), the Braidenoch Hill Cross Slabs (SM1105), the Holm of Daltallochan, Stone Circle and Standing Stone (SM1029) and Cross Slab (SM1106). A selection of non-designated assets, a number of which are considered by DGCAS to be nationally important, are also located within the vicinity of the site and will require consideration.

12.3. Proposed Methodology

Archaeological assessment will comply with both national and local planning policy and guidance as well as the professional standards of the Chartered Institute for Archaeologists.

12.3.1. Baseline Methodology

A desk-based assessment would be undertaken in order to identify any previously unrecorded remains through

map regression and examination of vertical aerial photographs held by the National Collection of Aerial Photographs as well as readily available online satellite digital imagery (Google Earth, ESRI mapping).

A walkover survey will be undertaken by archaeologists walking in transects across new areas of the site where previously not surveyed. The aim of the survey will be to assess the significance and extent of remains identified through desk-based assessment and to identify any hitherto unrecorded remains that might be present within the proposed development footprint.

The extent of previously known or newly recorded heritage assets encountered during the survey will be recorded on site using a handheld GPS/iGIS or ArcGIS Collector as appropriate. Photographs will be taken of any such assets identified, and sketch plans will be produced if appropriate. A written description of the assets including information about their extent, significance and character will also be completed.

The Setting Assessment will include identification of all designated heritage assets within 5km of the site boundary and Nationally Important designated assets (as recorded by HES) within 10km of the site boundary. Site visits will be undertaken to assets which would potentially be impacted (as per the sites identified and ZTV mapping supplied by the client). Dumfries and Galloway Council locally designated Archaeological Sensitive Areas will also be considered. Any non-designated assets, such as those which DGCAS consider to be non-statutory assets of national importance, which require assessment or any designated assets beyond 10km, that require assessment will be agreed via scoping or in consultation with HES and DGCAS.

The setting assessment will be undertaken with reference to Historic Environment Scotland's setting guidance (2016) and will aim to establish the current setting of the identified heritage assets, how that setting contributes to the understanding, appreciation and experience of those assets and how the proposed development could impact upon this.

The following information sources will be consulted:

- The Dumfries and Galloway Historic Environment Record (Dumfries and Galloway Council)
- The National Record of the Historic Environment (Historic Environment Scotland (HES))
- Designated asset downloads (HES)
- The National Collection of Aerial Photography (HES)
- The National Library of Scotland (for historic mapping, including superseded Ordnance Survey editions).
- Available LiDAR data

The cultural heritage assessment will also draw upon the results of previous work on the site, by other consultants as well as work on other proposed sites situated nearby.

12.3.2. Assessment Methodology

In undertaking the impact assessment the following assessment method to establish the sensitivity of heritage receptors, the magnitude of impact and the significance of effect.

• Cultural Heritage Value – the method of classifying cultural heritage value will be guided by the classification criteria used nationally by Historic Environment Scotland in designating Scheduled Monuments, Listed Buildings and Inventory sites. This will involve consideration of the asset's cultural heritage value and will include consideration of factors such as their type, age, rarity, group value, site context, historical associations (i.e. with well-known persons or historical events), quality, character and style of construction and condition.

• Magnitude of Impact - the classification of the magnitude of impact on cultural heritage assets will be rigorous and based on consistent criteria. This will take account of such factors as the physical scale and type of disturbance to them and whether features or evidence would be lost that is fundamental to their historic character and integrity.

• Level of Effect – the method for rating the level of effect on each cultural heritage asset will be based on a matrix that is a function of the cultural heritage value and/or relative sensitivity to changes to setting and magnitude of impact for each site. Classifications of significance of impact follow EIA regulations and generally include None, Neutral, Negligible, Minor, Minor-Moderate, Moderate, Moderate-Major, and Major.

A cumulative impact assessment will be included in the assessment.

12.4. Key Planning Policy and Guidance

Legislation concerning the protection and conservation of cultural heritage assets includes:

- Ancient Monuments and Archaeological Areas Act[6];
- Town and Country Planning (Scotland) Act, as amended in the Planning (Listed Buildings and Conservation Areas) (Scotland) Act and as modified by the Historic Environment (Amendment) (Scotland) Act, [7;] and
- Historic Environment Scotland Act 2014.[8]

Relevant planning policy and guidance concerning cultural heritage matters includes:

- The National Planning Framework for Scotland (NPF3); [9]
- Scottish Planning Policy (SPP); [10]
- Historic Environment Policy for Scotland (HEPS); [11]
- Planning Advice Note 2/2011(PAN 2); [12]
- Chartered Institute for Archaeologists (CIfA) Standards and Guidance for commissioning work and providing consultancy advice on archaeology and the historic environment;[13] and Standards and Guidance for historic environment desk-based assessment;[14]
- The Dumfries and Galloway Local Plan 2 (LDP2); [15] and
- Change in the Historic Environment: Setting.[16]

12.5. Mitigation

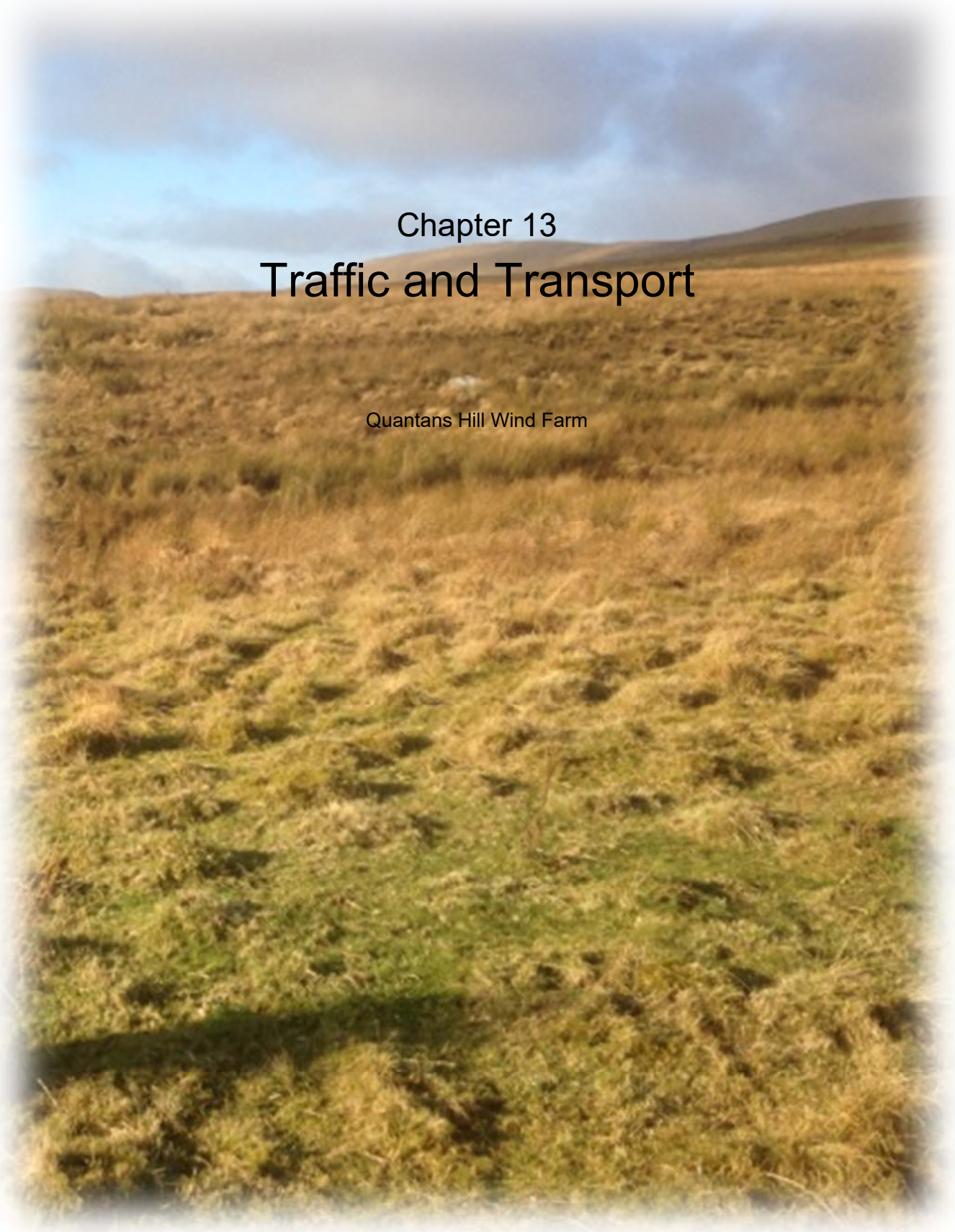
As previously mentioned the undertaking of pre-application consultation with HES and The Dumfries and Galloway Council Archaeology Service (DGCAS) will work to identify required visualisations and discuss mitigation options. Work will also be undertaken to identify any direct or setting effects that could potentially result from the proposed development and developing a proposed mitigation strategy as required.

The proposed development will seek to avoid direct impacts upon any known heritage assets during construction through careful siting of infrastructure and, where appropriate, fencing off known heritage assets. The finalised turbine array and access track layout will be informed by the results of the archaeological walkover survey and wherever possible direct impacts upon heritage assets will be avoided or minimised during the iterative design process. This could include rerouting and micrositing so as to avoid direct impacts upon identified archaeological assets.

Where impacts cannot be entirely avoided, or where the potential for previously unrecorded buried remains cannot be excluded then a programme of archaeological work is likely to be required and the proposed archaeology and cultural heritage chapter include a detailed mitigation strategy developed in consultation with the Council Archaeologist at Dumfries and Galloway Council and, if their input is required, Historic Environment Scotland. The overall objective would be to develop appropriate design responses or mitigation measures required to avoid, minimise or offset significant effects.

Full assessment of the potential for indirect impacts will only be undertaken in cases where ZTV analysis suggests either that the proposed development could be visible from the asset or that it could appear in key views which include the asset. It is not possible to assess indirect impacts in detail prior to the finalising of the design of the proposed development and the preparation of the ZTV. It would be advised that all assets within the ZTV are subject to site visits, to better inform the assessment of the indirect impact of the proposed development.

[6] UK Government, 1979
[7] UK Government, 1997
[8] Scottish Government, 2014
[9] Scottish Government, 2014
[10] Scottish Government, 2014
[11] Historic Environment Scotland (HES). (2019a). Historic Environment Policy for Scotland (HESP). https://www.historicenvironment.scot/advice-Chartered Insitutte for Archaeologists (CIfA) (2014). Available at: https://www.archaeologists.net/codes/cifa (03/02/2020)and-support/planning-and-guidance/historic-environment-policy-for-scotland-heps/ (03/02/2020)
[12] Scottish Government, 2011
[13] Chartered Insitutte for Archaeologists (CIfA) (2014). Available at: https://www.archaeologists.net/codes/cifa (03/02/2020)
[14] Chartered Insitutte for Archaeologists (CIfA) (2017). Available at: https://www.archaeologists.net/codes/cifa (03/02/2020)
[15] Dumfries and Galloway (2019) Local Development Plan 2. Available at: https://www.dumgal.gov.uk/ldp2 (03/02/2020)
[16] Historic Environment. https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=80b7c0a0-584b-4625-b1fd-a60b009c2549 (03/02/2020)



Chapter 13
Traffic and Transport

Quantans Hill Wind Farm

13. Traffic and Transport

13.1. Objective

The objective of the Traffic and Transport Assessment is to assess the impact associated with Quantans Hill wind farm on the public road network, including physical constraints, through an Access Route Assessment; impact on existing traffic levels through a Traffic Impact Assessment (TIA), and management of construction phase traffic through a preliminary Traffic Management Plan (TMP).

The proposed access route for the Quantans Hill wind farm development, as identified previously and used for other wind farm developments in the area, would be via the A713. It is expected that the A713 would be reached via the A77(M), with the port of entry being either Ayr or Kind George V docks in Glasgow. This route is the same abnormal load route to site as proposed in the neighbouring Shepherds Rig application. The difference being that the Quantans Hill wind farm proposal does not require use of the B729 for as great a distance from leaving the A713.

13.2. Access Route Assessment Scope

Assessments for inclusion within the planning submission will be undertaken to determine suitable routes for abnormal load access and general HGV construction traffic. These assessments will include the following:

- Abnormal load access assessment from potential ports of entry to the site access point, to determine potential constraints along entirety of proposed access route. This will include:
    - Identification of port options;
    - Identification of abnormal access route;
    - Swept Path Analysis to determine extent of constraints identified;
    - Consultation with the local roads authority to establish weight restrictions on identified structures.
- Identification of construction material sources (e.g. quarries) and possible routes to site for HGVs, for use in the Traffic Impact Assessment.

13.3. Traffic Impact Assessment Scope

An assessment of the traffic impact will be undertaken for the proposed scheme using the relevant project specific information. The methodology for the assessment would comply with all latest guidance, as relevant, including the Guidelines for the Environmental Assessment of Road Traffic (IEMA 1993) and Transport Scotland Guidance on Transport Assessment.

The methodology used for the assessment will be as follows:

- The geographic extent of the study will be confirmed in consultation with the relevant roads and highways authorities and will generally consist of the local road network where sensitive receptors are evident.
- Baseline traffic data will be used to measure the impact on existing traffic levels, considering the increase in HGVs and LGVs during construction and operation for the proposed scheme which will be derived from detailed project information and professional judgement. Acquisition of traffic count data will be done either by use of the Department for Transport Traffic Count Database, consultation with the local roads authority or commissioning of traffic counts depending on the level of existing information available.
- The assessment of traffic against baseline data will determine the likely impact of project traffic against the criteria set out in IEA Guidance Note 1 and Transport Scotland guidance. If any traffic impact criteria is exceeded, the assessment will recommend suitable mitigation measures. The assessment would consider:
    - Delay effects on other road users (by consideration of percentage changes in traffic composition and volume),
    - Road infrastructure (dilapidation)
    - Safety effects on other road users and adjacent properties, and
    - Safety effects on pedestrians and cyclists (e.g. on routes passing through towns).

The study would consider effects during construction, operation and decommissioning.

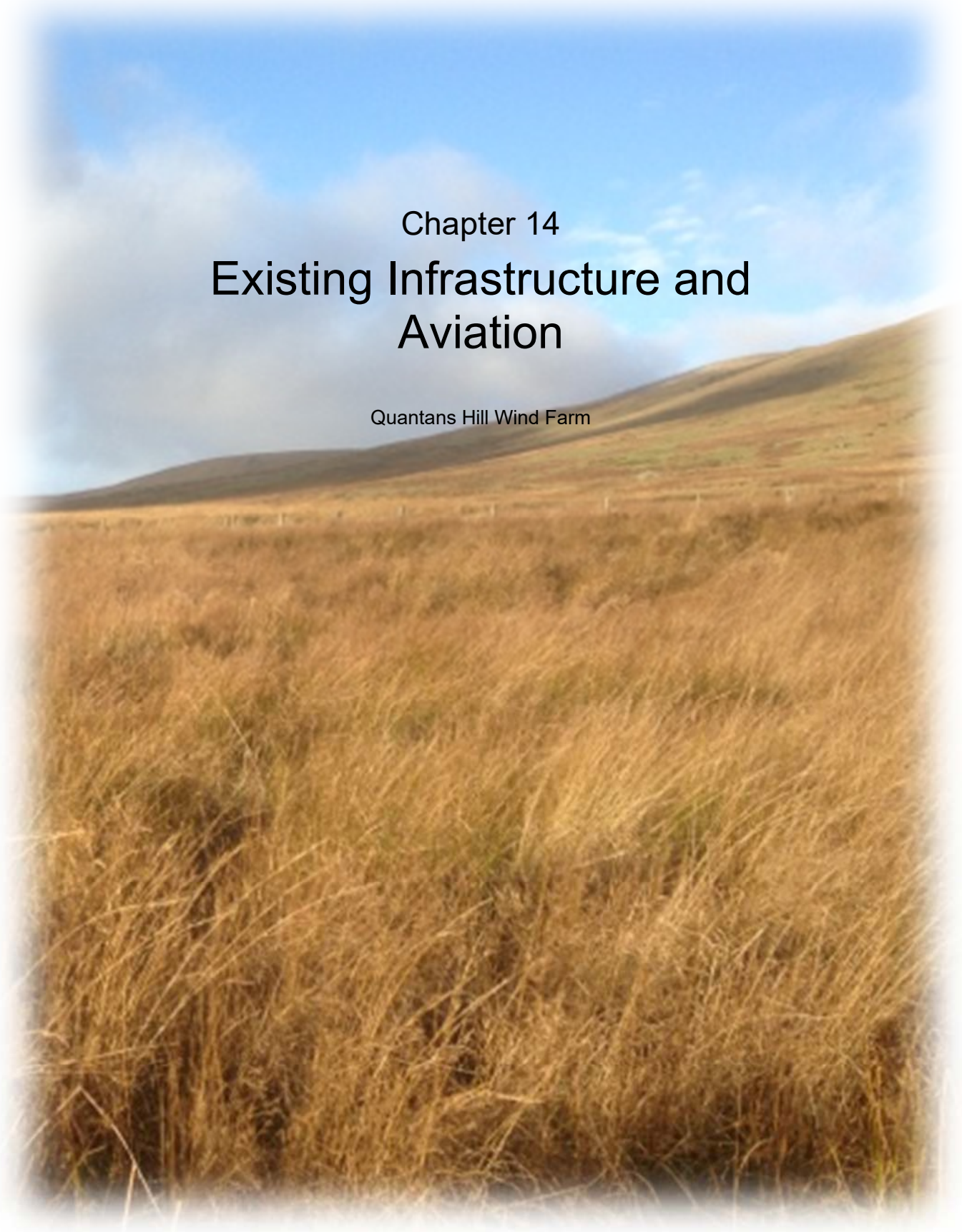
13.4. Preliminary Traffic Management Plan

As part of the Traffic and Transport assessment, and in line with any pre-application requirements, a Preliminary Traffic Management Plan will be produced for inclusion in the application. The Traffic Management Plan will generally outline the detail of the works and the associated traffic. It will include aspects such as the standard industry mitigation measures considered for impacts associated with the works, and typical traffic management measures employed for control of traffic on the public road to ensure there are no safety issues or impediments on the public highway.

13.5. Traffic and Transport Chapter

A Traffic and Transport EIAR chapter will be produced as part of the EIA and include the following information:

- Traffic Impact Assessment;
- Access Route Report including Swept Path Analysis;
- Preliminary Traffic Management Plan .



Chapter 14
Existing Infrastructure and Aviation

Quantans Hill Wind Farm

14. Existing Infrastructure and Aviation

This section of the EIAR will assess the potential impact on any existing infrastructure in the vicinity of the proposed development. The approach to the assessment will be to consult with statutory undertakers and other relevant organisations to ascertain if the proposed development will have an impact on their services and if so, what mitigation if any will be necessary. In this respect, the EIA will consider:

- Civil aviation.
- Military interests including aviation.
- Water, gas and power.
- Existing footpaths including Public Rights of Way and Southern Upland Way.
- Microwave fixed links.
- Telecoms.

14.1. Public access

The locations of all footpaths will be considered during the iterative design process. Scoping responses from the local planning authorities and ScotWays will be considered during the final design work to ensure balance between wind optimisation and potential effects on access are addressed. There is a Public Right of Way that traverses the site but does not appear to physically exist on site. Nonetheless, a safe passage across the site will be maintained.

14.2. Defence interests

The Ministry of Defence (MoD)/Defence Infrastructure Organisation (DIO) had no objection to the original application for Quantans Hill wind farm. However, that application was for 19 turbines at 130 metres to blade tip. The applicant is engaging with the MoD over the proposed development.

14.3. Civil aviation

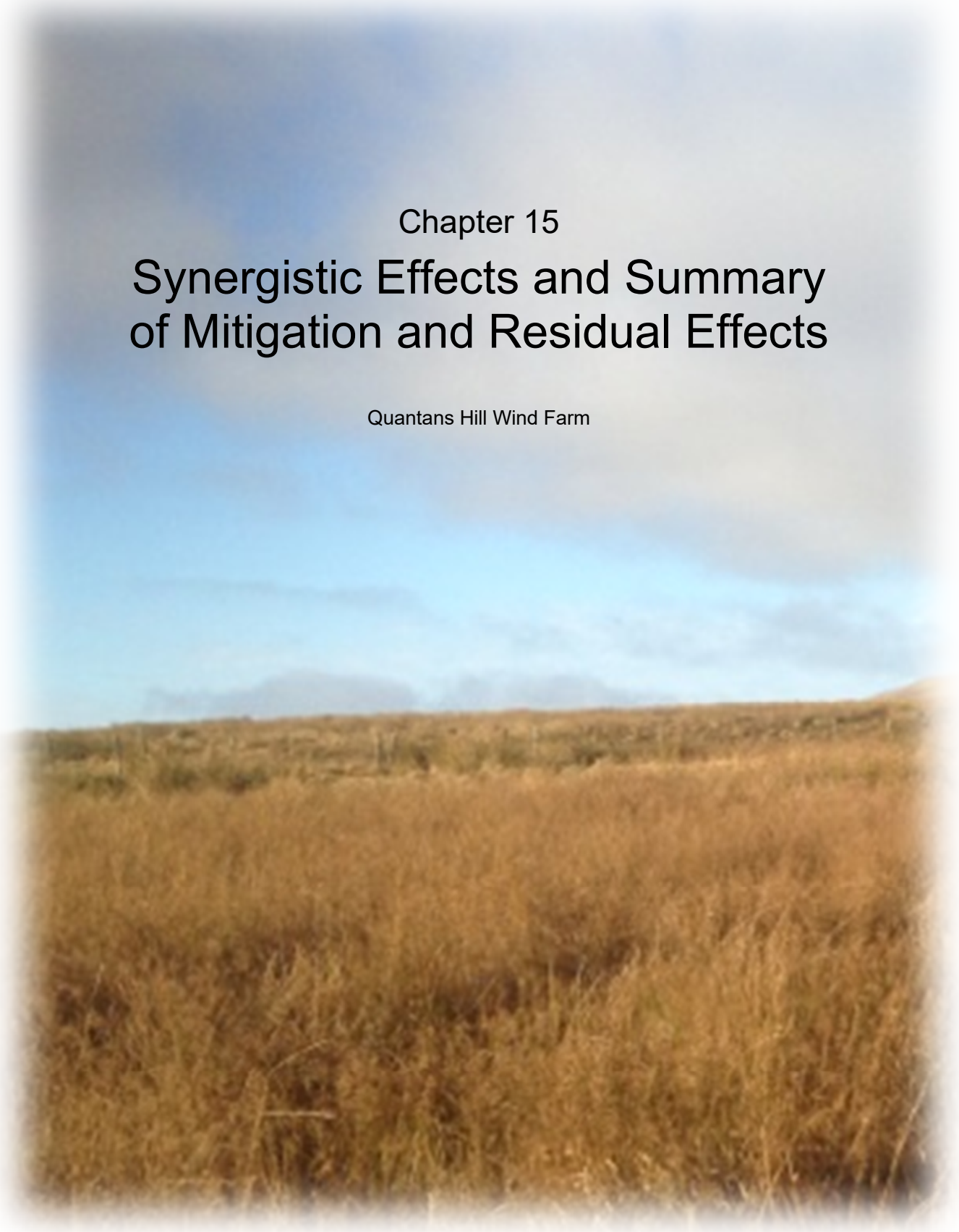
Both Glasgow Prestwick Airport and NATS stated they would have no objection to the original Quantans Hill wind farm application. However, it is appreciated that stance may change with the proposed development and its increase in size. The applicant is in consultation with NATS.

14.4. Telecoms and radiocommunications

Our records indicate a micropath crosses the site although this appears to be at the southwestern end of the site well clear of any potential turbines. Stakeholders responded to the original Quantans Hill with no objection on telecoms grounds. An update to this position will be indicated in the Scoping Opinion. A relevant assessment will be included in the EIAR.
Fixed microwave and scanning telemetry link radio facilities with the potential to be affected by the proposed development will be identified through consultation with Ofcom.
Determination of the impact of the proposed wind turbine on any potentially affected telecommunications facilities will be conducted principally through consultation with the operators of the facilities.

14.5. Utilities

Potential utilities including gas and electricity will be investigated and assessed during the EIA with the final layout designed to avoid potential direct effects



Chapter 15

Synergistic Effects and Summary of Mitigation and Residual Effects

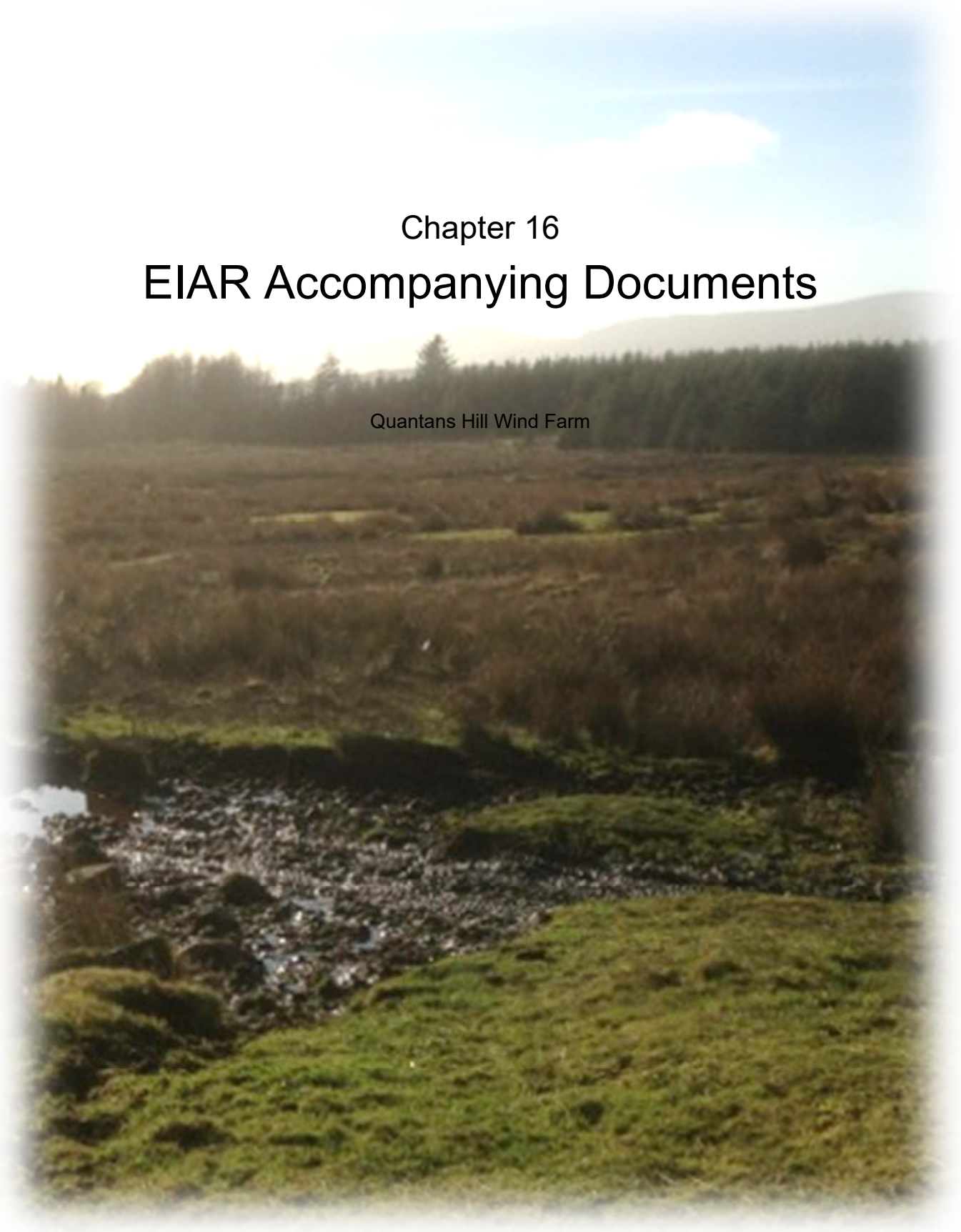
Quantans Hill Wind Farm

15. Synergistic Effects and Summary of Mitigation and Residual Effects

A concluding chapter will present the key findings from each EIAR chapter and any required mitigation. In line with the EIA Regulations (2017) it will then assess the potential synergistic effects that may occur in combination. This will include an assessment of potential effects on human health caused by the proposed development and will be covered by assessments provided throughout chapters in the EIAR (e.g. Noise, Access, Traffic and Transport, Shadow Flicker, Residential Amenity).

The chapter will identify all mitigation, including the mitigation by design that will be undertaken to reduce any adverse effects and summarise the residual effects regarding all of the proposed work in relation to the construction, operation and decommissioning of the proposed development.

Chapter 16
EIAR Accompanying Documents



16. EIAR Accompanying Documents

16.1. Non-Technical Summary (NTS)

The NTS details the main components of the proposed development and summarises the main findings of the environmental studies carried out to build and operate the proposed development. It is designed to be an easily readable document that will communicate the main elements of the EIA to any interested party without the need for the reader to have specialist background knowledge. It will also contain maps that show the extent and geographical location of the development.

16.2. Planning, Design & Access Statement (PDAS)

A PDAS may be produced and would seek to highlight the design principles and concepts behind the proposed development. It would detail how the developer has applied these principles to the proposed development in tandem with input from consultation activities and would review how successful the proposed development has been in realising the design strategy.

The PDAS will also provide a commentary of the EIA findings and assess the proposed development accounting for residual effects (both positive and negative) against national policy and legislation, the Development Plan and other material planning considerations relevant to the proposed development.

16.3. Pre-Application Consultation (PAC) Report

Although not a statutory requirement for applications submitted under Section 36 of the Electricity Act 1989, the applicant intends to submit a PAC Report to accompany the application.

It is proposed that the legislation and best practice guidance in relation to public consultation for Major Developments will be broadly followed as contained in PAN 3/2010 - Community Engagement - Planning with People.

The PAC report would:

- outline the scope of the consultation programme including when and who has been consulted;
- confirm how the consultation programme meets the best practice standards;
- set out how the applicant has responded to the comments made, including whether and the extent to which the proposals have changed as a result of PAC;
- provide documentary evidence that the planned consultation programme has taken place e.g. copies of advertisements of the public events and reference to display materials and records of response from such events;
- demonstrate that steps were taken to explain the nature of PAC i.e. that it does not replace the application process whereby representations can be made to the planning authority; and
- make an assessment of the success of the Pre-application Consultation activities.

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Chapter 17

Responding to this Scoping Report

Quantans Hill Wind Farm

17. Responding to this Scoping Report

Consultee responses to this report should be directed to the Energy Consents Unit which will form a Scoping Opinion. The ECU can be contacted via email:

Econsents_Admin@gov.scot

The Applicant will welcome such responses to inform the scope of EIA to be undertaken for the proposed development and further consultation to be undertaken with each consultee as the EIA progresses.

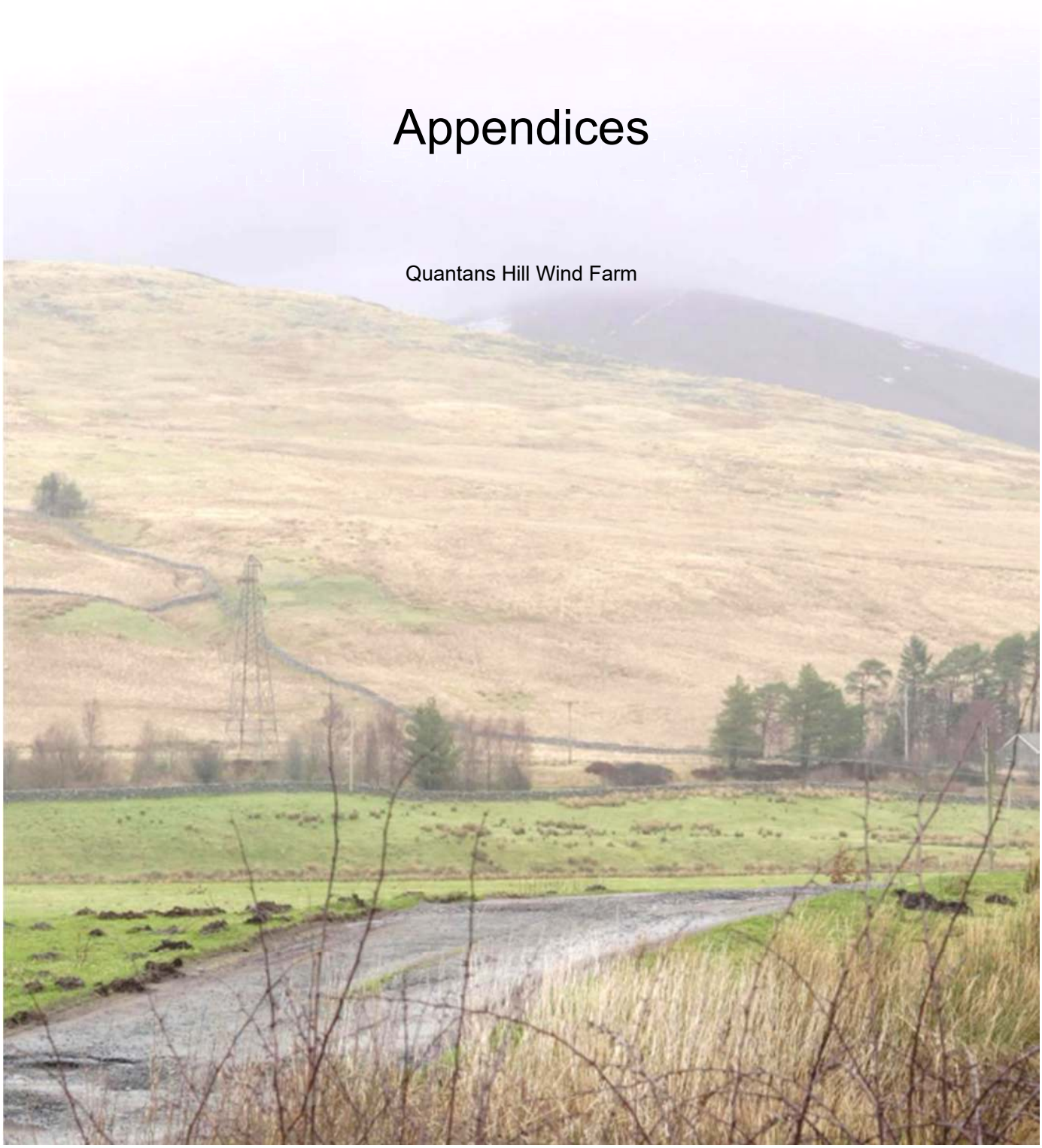
17.1. Consultation Questions

Summary of consultation questions as proposed throughout this Scoping Report. Please see previous chapters where relevant for further context.

- Do consultees have any comments in relation to public consultation?
- Do consultees have any comments in relation to the approach to the Environmental Impact Assessment?
- Do consultees have any comments in relation to the proposed chapters to be included in the EIAR?
- Do consultees agree with the LVIA and CLVIA methodologies?
- Do consultees have comment on the acceptability of the proposed RVAA study area of 2km and the general methodology outlined above?
- Do consultees agree with the approach to the sequential assessment (LVIA)?
- Do consultees agree with the cumulative baseline (LVIA)?
- Do consultees agree to an end date of three months prior to the submission of the LVIA and CLVIA after which point any additional sites will not be assessed with the application?
- Is the proposed scope and extent of the available and proposed baseline data considered to be sufficient to inform a reliable assessment of the potential effects of the proposed development?
- Do the consultees agree with the list of key potential receptors for the EIA and with the receptors / issues to be scoped out of the assessment?
- Do consultees agree with the scope of survey proposed (Ecology)?
- Can SNH agree with this approach (Ecology as outlined at the end of chapter 9)?
- Can consultees agree for construction noise to be scoped out of EIA?
- Can consultees agree that baseline noise monitoring does not need repeated? If there are additional locations considered necessary for recording, please specify
- Do consultees agree with the proposed scope for shadow flicker?

Appendices

Quantans Hill Wind Farm



Appendix 1

Figure List

- Figure 1 – Site Layout and Location (1218656B)
- Figure 2 – Regional Context (1218660B)
- Figure 3 – Site Constraints (1218657B)
- Figure 4 – ZTV to Tip Height (1218658B)
- Figure 5 – Othnothological Survey Areas (1219506A)
- Figure 6 – Vantage Point Locations and Viewsheds (1219508A)

Appendix 7.1

Table A7.1: Viewpoint Locations

VP No.	Location	Easting	Northing	Receptor		Visualisation Type	
				Landscape Character Type (LCT) / Landscape Designation	Visual Receptor	Wireline	Photomontage
1	Carsphairn War Memorial	256863	593088	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Visitors	•	•
2	Carsphairn Community Garden	256293	593223	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Visitors	•	•
3	Cairnsmore of Carspahirn	259619	597613	Southern Uplands – Dumfries & Galloway Galloway Hills RSA	Walkers	•	•
4	Beninner	260413	596549	Southern Uplands – Dumfries & Galloway Galloway Hills RSA	Walkers	•	
5	Alhang	264228	601021	Southern Uplands with Forest – Dumfries & Galloway	Walkers	•	
6	Benbrack	268025	597029	Southern Uplands with Forest	Walkers	•	•
7	Southern Upland Way, north-east of Stroanfreggan	264836	592777	Southern Uplands with Forest	Walkers	•	•
8	B729 south-east of Carsphairn	259465	591935	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Road users	•	
9	Minor road between A713 and B729	260405	590759	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Road users	•	
10	Cairn Avel	255943	592456	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Walkers	•	•
11	Corserine	250356	587173	Rugged Uplands – Dumfries & Galloway Galloway Hills RSA	Walkers	•	•
12	Meikle Millyea	251842	582897	Rugged Uplands – Dumfries & Galloway Galloway Hills RSA	Walkers	•	•
13	Dundeugh	260977	589734	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Walkers	•	
14	Stroanfreggan Cairn	264010	591408	Narrow Wooded River Valley – Dumfries & Galloway	Walkers	•	•
15	B7000 south of High Bridge of Ken	261847	589303	Upper Dale – Dumfries & Galloway	Road users	•	
16	Black Hill	268849	598725	Southern Uplands with Forest	Walkers	•	
17	A762 north of New Galloway	263093	578938	Flooded Valley Galloway Hills RSA	Road users	•	

VP No.	Location	Easting	Northing	Receptor		Visualisation Type	
				Landscape Character Type (LCT) / Landscape Designation	Visual Receptor	Wireline	Photomontage
18	A713 south of Carsphairn	257975	591434	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Road users	•	
19	A713 north of Carsphairn	255442	594671	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Road users	•	
20	Black Shoulder	259235	596735	Southern Uplands – Dumfries & Galloway Galloway Hills RSA	Walkers	•	•
21	Manquhill Hill	266164	594663	Southern Uplands with Forest	Walkers	•	
22	B729 west of Stronefreggan Bridge	263659	591735	Narrow Wooded River Valley – Dumfries & Galloway	Road users	•	
23	B729 Burnfoot Bridge	259053	592278	Upper Dale – Dumfries & Galloway Galloway Hills RSA	Road users	•	
24	Culmark Hill	264447	589673	Foothills with Forest – Dumfries & Galloway	Walkers	•	•
25	Coran of Portmark	250933	593667	Rugged Uplands – Dumfries & Galloway Galloway Hills RSA	Walkers	•	•

Appendix 1.2

Scoping Opinion

Document history

Author	Natural Power	October 2020

Client Details	
Contact	Matthew Bacon
Client Name	Vattenfall Wind Power Ltd

Issue	Date	Revision Details
A	October 2020	Released

Scottish Government

Energy Consents Unit

Scoping opinion of behalf of the Scottish Ministers under Part 4 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Issued to:

Vattenfall Wind Power Ltd in respect of the Quantans Hill Wind Farm proposal

14 October 2020

CONTENTS

1. Introduction

1.1 This scoping opinion is issued by the Scottish Government Energy Consents Unit ("the ECU") on behalf of the Scottish Ministers to Vattenfall Wind Power Ltd ("the Applicant"), a company incorporated under the Companies Acts with company number 06205750 and having its registered office at First Floor, 1 Tudor Street, London, EC4Y 0AH. This is in response to a request for a scoping opinion made in a scoping report relating to the Quantans Hill Wind Farm ("the proposed Development") prepared by Natural Power on behalf of the Applicant and submitted to the ECU on 26 June 2020.

1.2 Regulation 12 of the Electricity Works (Environmental Impact Assessment)(Scotland) Regulations 2017 is applicable to this scoping opinion.

1.3 The proposed Development is located on Quantans Hill, approximately 2 kilometres north east of the village of Carsphairn in Dumfries and Galloway. It solely with the planning authority of Dumfries & Galloway Council.

1.4 The existing B729 road that leads to the site of the proposed Development leaves the A713 approximately 0.5 kilometres to the east of Carsphairn. These roads will be utilised and upgraded where necessary.

1.5. There are three designated sites within 10 kilometres of the site of the proposed Development:

- Cleugh Site of Special Scientific Interest (within 5 kilometres);
- Loch Doon Site of Special Scientific Interest (within 7 kilometres);
- Merrick Site of Special Scientific Interest (within 7 kilometres).

1.6 At this time, the proposed Development will consist of up to 21 wind turbines, the blade tip heights of which will range from 200 metres up to 250 metres.

1.7 In addition to the wind turbines, there will also be ancillary infrastructure including:

- Turbine Foundations;
- Crane Hardstand and Temporary laydown areas;
- Upgrading of existing and creation of new access tracks;
- Temporary borrow pits;
- Underground electricity cables;
- Anemometry mast(s);
- External transformer housing;
- Signage;
- Temporary construction and storage compounds, laydown areas, and ancillary infrastructure;
- Drainage and drainage attenuation measures (as required)
- Substation, compound, and control building; and
- Battery/energy storage.

1.8 There is also the possibility that a battery storage facility will be included.

1.9 The total generation capacity of the proposed Development will be in excess of 50 megawatts.

1.10 The Applicant has indicated in the scoping report that the duration of the consent under section 36 of the Electricity Act 1989 to be applied for could be for a period of 30 years.

1.11 The Applicant also indicates that if, nearer the time of decommissioning, it is considered by the wind farm operator that the development area may be suitable for re-powering, or if the existing wind farm infrastructure is suitable for a lifetime extension, a new application may be submitted to the relevant planning authority for such development.

2. Consultation

2.1 Following a request for a scoping opinion, the Scottish Ministers are required to carry out a consultation, the purpose of which is to obtain scoping advice on environmental matters within their remit from a range of consultees including internal Scottish Government advisors.

2.2 A list of those to be consulted in relation to the proposed Development was agreed between the Applicant and the ECU and is set out in Annex A to this scoping opinion.

2.3 The Scottish Ministers subsequently undertook a consultation on the Quantans Hill Wind Farm proposal scoping report. It commenced on 30 June 2020. The initial deadline to the consultation was 21 July 2020. This deadline was extended to accommodate extension requests from a number of consultees, one of which was the planning authority, Dumfries & Galloway Council. A part response to the scoping consultation was submitted by Dumfries & Galloway Council. A response from the Council's Landscape Architect and a response from and the Council's Archaeologist were not submitted. If a response is subsequently received from the Council's Landscape Architect and/or the Council's Archaeologist it will be published on the ECU website as an addendum to this scoping opinion.

2.4 Marine Scotland, an internal Scottish Government advisor, no longer submit a response to individual scoping consultations. Prior to this consultation, Marine Scotland submitted 'standing advice' appropriate to all scoping consultations to the ECU which is to be issued instead.

2.5 A total of 22 responses to the scoping consultation were received, all of which are in Annex B (Consultation responses) to this scoping opinion. The 'standing advice' from Marine Scotland is also included in Annex B.

2.6 As well as Dumfries & Galloway Council, the following consultees did not submit a response:

- Civil Aviation Authority – Airspace;
- Dee District Salmon Fisheries Board;
- Fisheries Management Scotland;
- John Muir Trust

- Scottish Wildlife Trust;
- Carsphairn Community Council;
- Dalmellington Community Council;
- Dalry Community Council;
- Glencairn Community Council;
- New Cumnock Community Council;
- Penpont Community Council;
- Royal Borough of New Galloway & Kells Community Council;
- Royal Burgh of Sanquhar & District Community Council.

2.7 With regard to those consultees who did not respond, it is assumed that they have no comment to make on the scoping report. However, in the event that an application for section 36 consent is submitted, each will be consulted again..

2.8 The Scottish Ministers are satisfied that the requirements for consultation set out in Regulation 12(4) of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 have been met.

3. The Scoping Opinion

3.1 This scoping opinion had been adopted following consultation with Dumfries and Galloway Council, within whose area the proposed Development will be situated. Historic Environment Scotland ("HES"), NatureScot (formerly Scottish Natural Heritage) and Scottish Environment Protection Agency ("SEPA") were also consulted as statutory consultation bodies, as were other bodies, which the Scottish Ministers considered likely to have an interest in the proposed Development by reason of their specific environmental responsibilities or local and regional competencies.

3.2 The Scottish Ministers are satisfied with the scope of the proposed environmental impact assessment as set out in the scoping report.

3.3 The Scottish Ministers adopt this scoping opinion having taken into account the information provided by the Applicant in the scoping report submitted to the ECU on 26 June 2020 and responses received to the consultation subsequently undertaken. In providing this scoping opinion, the Scottish Ministers have had regard to current knowledge and methods of assessment, have taken into account the specific characteristics of the proposed Development, the specific characteristics of that type of Development and the environmental features likely to be affected.

3.4 A copy of this scoping opinion has been sent to Dumfries & Galloway Council for publication on their website. It has also been published on the Scottish Government energy consents website at www.energyconsents.scot.

3.5 The Scottish Ministers expect the EIA report which will accompany the application for the proposed development to consider any advice given and comply with all particular information requirements set out within the consultation responses attached in Annex B.

3.6 In addition to the advice and guidance provided in the consultation responses, the Scottish Ministers wish to provide the following comments with regards to the scope of the EIA report. The Applicant should note and address each matter:

Aviation - the Lowther Radar and the Great Dunn Fell Radar

It is recommended by the Scottish Minsters that the Applicant has discussions with NATS Safeguarding to agree mitigation schemes to overcome the interference the turbines of the proposed Development will have on the Lowther Radar and the Great Dunn Fell Radar. Discussions at the earliest stage will assist in early resolution being negotiated.

Aviation – Lighting

It is recommended by the Scottish Ministers that with regards to impacts of night time aviation lighting the Applicant should discuss and agree with Dumfries & Galloway Council and NatureScot the range (in kilometres from the proposed Development) for night time assessments of the impacts of night-time aviation lighting and receptors therein to be assessed. As well as the scope, methodology, findings and recommendations of such assessments, full details of all mitigation of aviation lighting impacts subsequently identified should be provided in the EIA Report.

It is also recommended by the Scottish Ministers that the Impacts of nigh time aviation lighting on the Galloway Forest Dark Sky Park and the Merrick Wild Land Area be fully assessed and the outcome and findings of which, along with appropriate visualisations, be presented in the EIA report. The Applicant should discuss and agree the finalised content and style of the visualisations with NatureScot.

Battery Storage

In section 2.12 Battery Energy Storage (page 7/76) of the scoping report reference is made to there possibly being battery storage. In the event that battery storage is to be included in the proposed Development, full details of what it will entail (scale, dimensions etc), its location in the site, minimum and maximum export capacity of megawatts and megawatt hours of electricity and a full assessment of its impacts and effects and all proposed mitigation should be included in the EIA report.

Bird assessments/surveys

It is recommended by the Scottish Ministers that the Applicant discuss with RSPB Scotland the need for targeted flight activity surveys relating to migrating Swans and Geese as stated in their response to the scoping consultation.

It is recommended by the Scottish Ministers that the Applicant discuss with RSPB Scotland appropriate assessment and mitigation in respect of Black Grouse and Red Kite.

Borrow Pits

The Scottish Ministers recommend that the Applicant take cognisance of the advice and guidance in respect of borrow pits stated in SEPA's response to the scoping consultation.

Designated areas

Due to the proposed Development's close proximity to three designated areas (see paragraph 1.5 above) assessment of impacts on each will be required. Scope and methodology of said assessments should be decided following discussions between the Applicant and NatureScot.

Fisheries

The Scottish Ministers recommend that the Applicant discuss and agree baseline fish surveys with the Galloways Fisheries Trust and the Kirkcudbrightshire Dee District Salmon Fishery Board. The Scottish Ministers also recommend that the Applicant discuss and agree mitigation in respect of fish populations and fish habitat especially (but not limited to) in relation to the named water courses cited in the consultation response from the Galloway Fisheries Trust.

Freshwater Pearl Mussel

The Scottish Ministers recommend that a Freshwater Pearl Mussel survey be carried out as requested by NatrureScot in their response to the scoping consultation.

Viewpoints & Visualisations

It is recommended by the Scottish Ministers that the final list of viewpoints and visualisations should be agreed following discussion between the Applicant, Dumfries & Galloway Council, Historic Environment Scotland, Mountaineering Scotland and NatureScot,

Receptors – noise assessment

It is recommended by the Scottish Ministers that the final list of receptors in respect of noise assessment should be agreed following discussion between the Applicant and Dumfries & Galloway Council

Peat Management Plan

The Peat Management Plan to be included in the Construction Environmental Management Plan ("CEMP") should be formulated and finalised following discussions between the Applicant and SEPA.

Construction noise

Construction noise will **not** be scoped out

The noise assessment should be carried out in line with relevant legislation and standards. The noise assessment report should be formatted as per Table 6.1 of the Institute of Acoustics "*A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*". The Scottish Ministers note that that the Applicant wants construction noise to be scoped out of the environmental impact assessment. However the Scottish Ministers do not agree to it being scoped out and consequently require the EIA report to contain information on the relevant likely significant effects and mitigation.

Cumulative assessment – other Developments

It is recommended by the Scottish Ministers that the assessment range (in kilometres) and other Developments to be included in cumulative assessments should be discussed and agreed with Dumfries & Galloway Council.

Peat landslide hazard and risk assessment

The Scottish Ministers consider that where there is a demonstrable requirement for peat landslide hazard and risk assessment, the assessment should be undertaken as part of the EIA process to provide the Scottish Ministers with a clear understanding of whether the risks are acceptable and capable of being controlled by mitigation measures.

The Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition), published at http://www.gov.scot/Publications/2017/04/8868 should be followed in the preparation of the EIA report, which should contain such an assessment and details of mitigation measures.

It should be noted by the Applicant that the Scottish Ministers engage the services of appropriate specialists to assess Peat Landslide Hazard and Risk Assessments submitted with an EIA report.

Private Water Supplies

The Scottish Ministers advise that the Applicant should investigate the presence of any private water supplies which may be impacted by the proposed Development. The EIA report should include details of any supplies identified by this investigation, and if any supplies are identified, the Applicant should provide an assessment of the potential impacts, risks, and any mitigation which would be provided.

Socio-Economic, Recreation and Tourism

The Scottish Ministers recommend that there should be a stand-alone chapter in the EIA report specifically dealing with Socio Economics and that it should include Recreation and Tourism.

Matters to be scoped Out

With regards to matters to be scoped out of the EIA report, the Scottish Ministers advise the Applicant to take cognisance of statements made in the consultation responses from RSPB Scotland, Transport Scotland and Tynron Community Council.

3.7 The Scottish Ministers are aware that further engagement is required between parties regarding the refinement of the design of the proposed Development especially, but not limited to, surveys, management plans, peat, finalisation of viewpoints, transport routes, cultural heritage, designated sites and cumulative assessments and they request that they are kept informed of relevant discussions.

4. Mitigation Measures

The Scottish Ministers are required to make a reasoned conclusion on the significant effects of the proposed Development on the environment as identified in the environmental impact assessment. The mitigation measures suggested for any significant environmental impacts identified should be presented as a conclusion to each chapter. Applicants are also asked to provide a consolidated schedule, in tabular form, of all mitigation measures proposed in the environmental assessment, where that mitigation is relied upon in relation to reported conclusions of likelihood or significant of impacts.

5. Conclusion

5.1 This scoping opinion is based on information contained in the Applicant's scoping report and advice and guidance subsequently received from consultees in response to the consultation undertaken by the Scottish Ministers. The adoption of this scoping opinion by the Scottish Ministers does not preclude the Scottish Ministers from requiring of the Applicant information in connection with an EIA report submitted in connection with any other application for section 36 consent for the proposed Development.

5.2 This scoping opinion will not prevent the Scottish Ministers from seeking additional information at application stage, for example, to include cumulative impacts of additional developments which enter the planning process after the date of this opinion.

5.3 It is acknowledged that the environmental impact assessment process is iterative and should inform the final layout and design of proposed developments. The Scottish Ministers note further engagement between relevant parties in relation to the refinement of the design of the proposed Development will be required and would request that they are kept informed of on-going discussions in relation to this.

5.4 Applicants considering submitting applications for section 36 consent are encouraged to engage with officials at the Scottish Governments ECU at the pre-application stage and before proposals reach the design freeze.

5.5 Applicants considering submitting applications for section 36 consent are reminded that there will be limited opportunity to materially vary the form and consent of the proposed Development once an application is submitted.

5.6 When Finalising the EIA report, Applicants are asked to provide a summary in tabular form of where within the EIA report each of the specific matters raised in this scoping opinion has been addressed.

5.7 It should be noted that to facilitate uploading to the Energy Consents portal, the EIA report and its associated documentation should be divided into appropriately named separate files of size no more than 10 megabytes (MB). In addition, a separate disc containing the EIA report and its associated documentation in electronic format will be required. This should be discussed fully with the ECU at an appropriate stage in the process.

Stephen McFadden
Energy Consents Unit
14 October 2020

ANNEX A LIST OF CONSULTEES

Statutory Consultees

Dumfries & Galloway Council;
Historic Environment Scotland;
NatureScot (formerly Scottish Natural Heritage – SNH);
Scottish Environment Protection Agency.

Scottish Government Advisors

Marine Scotland;
Scottish Forestry;
Transport Scotland.

Non-statutory consultees

British Horse Society;
BT;
Carsphairn Community Council;
Civil Aviation Authority – Airspace;
Crown Estate Scotland;
Dalmellington Community Council;
Dalry Community Council;
Dee District Salmon Fisheries Board;
Defence Infrastructure Organisation;
Fisheries Management Scotland;
Galloway and Southern Ayrshire Biosphere;
Galloway Fisheries Trust;
Glasgow Airport;
Glasgow Prestwick Airport;
Glencairn Community Council;
Highlands and Islands Airport;
John Muir Trust;
Joint Radio Company;
Mountaineering Scotland;
NATS Safeguarding;
New Cumnock Community Council;
Penpont Community Council;
Royal Burgh of New Galloway & Kells Community Council;
Royal Burgh of Sanquhar & District;
RSPB Scotland;
Scottish Rights of Way and Access Society (ScotWays);
Scottish Water;
Scottish Wildlife Trust;
Tyrnon Community Council.

ANNEX B CONSULTATION RESPONSES

A1

Proposal: CONSULTATION FROM SCOTTISH MINISTERS IN RESPECT OF SCOPING OPINION REQUEST FOR PROPOSED SECTION 36 APPLICATION FOR PROPOSED WIND FARM CONSISTING OF UP TO 21 WIND TURBINES (EACH UP TO 200M BASE TO TIP) AND ANCILLARY DEVELOPMENT

Location: Quantans Hill Wind Farm Proposal Site, Approximately 2KM North-East of Carsphairn

Application Type: Scoping Opinion

Ref. No.: 20/0977/ENQ

1. This scoping request from the Scottish Government Energy Consents Unit relates to a proposal to construct and operate a wind farm on land approximately 2 kilometres from the village of Carsphairn, Dumfries and Galloway. The applicant, Vattenfall Wind Power Ltd, seeks consent for the erection of up to 21 wind turbines up to between 200 metres (minimum) and 250 metres to tip height for an operational period of 30 years. In addition to this, the applicant seeks consent for formation of turbine foundations, crane hardstanding and laydown areas, upgraded and new access tracks, temporary borrow pits, electricity cabling, anemometry mast/s, transformer housing, substation, compound and control buildings, battery/energy storage as well as associated temporary construction infrastructure. The application site lies within the Dumfries and Galloway Council area, and as the expected output of the wind farm will be in excess of 50 MW, the proposed works will be sought under Section 36 of the Electricity Act 1989, with the application being made to the Scottish Government energy Consents Unit.

2. The Planning Service consulted the following Departments of Dumfries and Galloway Council: Council Archaeologist, Access Officer, Environmental Health Officer, Council Roads Officer, Flood Risk Management Team and Landscape Architect.

To date responses have been received from the following:

3 **Council Access Officer**

3.1 The proposed site of the Windfarm is affected by right of way DS15, which runs across the site in a Northeast Southwest direction. This route is highlights in the scoping report.

3.2 The site is also affected by a Core Path recorded in the Dumfries and Galloway Core Paths Plan. Core Path 182 runs from the B729 and enters the site just North of Knockgray. It then runs up on to Quantans Hill.

The routes are shown on the attached plan.

3.3 Access to both the Right of Way and Core Path should remain possible during the development of the site.

The above noted plan is included as Annex I to this scoping response

A2

4 Council Roads Team Leader

4.1 This request for scoping opinion is for the proposed erection of up to 21 no. wind turbines of up to 250m high at the tip, associated infrastructure, battery storage and associated works at land north east of Carsphairn.

4.2 It is noted from the 'Scoping Report' that: -

- The proposal is for 21 wind turbines, with a height of up to 250m (blade tip);
- An energy storage facility will be included as part of the proposed development;
- Access is likely to be via the A77(M), A713 and B729 (it should be clarified if this is for all traffic including AIL's);
- The expected duration of the project construction phase is suggested to be 12 – 18 months;
- No details have yet been provided in respect of the trip generation by construction traffic or predicted number of AIL's;
- The anticipated operational life of the wind farm is expected to be 30 years
- A Preliminary Traffic Management Plan will be submitted with any future application

4.3 Whilst I have no objections in principle to the proposal and have no issues with the proposed assessment scope or methodology outlined in the Scoping Report, I would offer the following observations that should be considered and addressed by any future submission/ES:-

- It would be appropriate that Transport Scotland be consulted with regard to any access utilising the Trunk Road network;
- No details have yet been provided in respect of the anticipated trip generation by construction traffic or predicted number of AIL's and these details will be required in full in order to assist assessment. It is acknowledged that on minor roads the short term impact of temporary construction traffic will be significant;
- Confirmation of access route arrangements and detailed proposals for any site accesses will require to be submitted as part of any future application. In the vicinity of the proposed wind farm there are a number of minor roads that may be affected by this proposal. Many of these will be weak and restricted in terms of geometry and width with soft verges and few passing opportunities;
- As the access route(s) has not been finalised yet, I am unable to offer route specific advice; however, it should be noted that most routes leading to the site cross a number of bridges/structures, many of which may be unsuitable for heavy HGVs and larger AILs, and that have limitations on safe axle loadings;
- Where a proposed access route crosses bridges and culverts, the applicant will require to get approvals and safe axle loadings (in respect of those structures) from the Council's Engineering Services (Bridges and Structures) unit. A number of structures in the general area of this proposed development are known to have limitations in respect of safe axle loadings;
- The Council's Bridges and Structures unit have advised that Abnormal Loads require to be assessed on an individual basis, proposed axle load

configurations should be supplied and agreed at earliest opportunity. Any proposal or requirement to carry out amendments to any bridge or culvert will require to be addressed via an AIP process;

- It would be appropriate that any future application confirm the access route(s) and identify the full extent of proposed off-site road accommodation and mitigation works including passing place provision, carriageway strengthening, widening and alterations to road boundaries all along any proposed access route(s) necessary to permit construction traffic and the passage of component delivery vehicles (this may require land outwith the public road boundary and a separate planning consent may be required in respect of these works) and the potential impacts on utility services lying within the public road boundary;
- Proposals for access routes, site access and all accommodation works must be supported by swept path tracks;
- All accommodation works must be designed and constructed to the satisfaction of the Planning Authority in consultation with the Roads Authority and will require appropriate permits and consents to have been issued;
- Where public road boundaries are to be altered either for the formation of temporary accesses or for accommodation works, these should be reinstated in their original position at the conclusion of construction works (unless prior agreements have been secured with the Planning and Road Authorities);
- It would be appropriate that any future submission/Environmental Statement include reference to a construction phase Traffic Management Plan covering all access via public road networks (to be agreed in writing with the Police and the Roads Authority prior to any works commencing on site) that should include a programme of projected traffic movements associated with the project by programme month and vehicle type, details of all proposed mitigation measures, agreed and excluded access routes, enforcement measures (driver code of conduct and disciplinary action) and details of measures that will be implemented to ensure that no stacking of delivery vehicles occur on any part of the public road network;
- Whilst it is accepted that the intention is that normal and abnormal loads will take access and egress via an ‘agreed’ route, there is likely to be some increase in traffic using other minor roads. There is also the possibility of other unrelated windfarm projects being constructed in the vicinity concurrently with this project. Therefore, it would be appropriate that the TMP acknowledge that co-ordination phasing may be required to mitigate against the cumulative traffic impact;
- In the event that suitable and sufficient aggregate not be available from on-site Borrow Pits, any future submission/ES should also identify worse case scenario that 100% of the aggregate required for construction shall be imported to site and identify the potential number of movements in that event so that the potential impact of importing aggregate from elsewhere via the public road network be assessed;
- It would be appropriate that there should be consultation with nearby forest managers and timber hauliers through the office of the South of Scotland Timber Transport Officer to co-ordinate timber haulage operations that may use the access route(s) during the construction period to minimise the cumulative impact on communities and road users;

- The developer will be held responsible for the immediate execution of any repairs and will be required to meet the cost of above average maintenance to the public road network arising from the concentration of heavy traffic associated with this development. This to be secured by legal agreement (Section 96);
- The installation of the grid connection will have an impact upon public roads where the route follows a road, crosses a road or crosses a bridge on the road.

5 **Council Flood Risk Management Team**

5.1 With reference to planning application 20/0977/ENQ, the Flood Risk Management Team (FRMT) have no objection after reviewing the information provided and held.

5.2 As an internal consultee, this is a response to assist the Planning Authority's decision in this application. All queries from the applicant regarding information supplied by the FRMT should, in the first instance, be directed to the appropriate Planning Officer.

6 **Outstanding Responses**

6.1 There is still an outstanding response from the Council's Landscape Architect and Archaeologist which will be forwarded on to the applicant once it has been received by the Planning Service.

7 **Landscape and Visual Impacts**

7.1 As noted above, the internal consultation response from the Council's landscape architect is still outstanding. Due to ongoing pressures on landscape resources and workload, landscape advice is prioritised in the order in which work is submitted to the Council, however the full consultation response will be provided in due course.

7.2 Landscape and visual impact forms one of the development management considerations within LDP2 Policy IN2. In particular: -

- the extent to which the proposal addresses the guidance contained within the Dumfries & Galloway Windfarm Landscape Capacity Study (DGWLCS);
- the extent to which the landscape is capable of accommodating the development without significant detrimental impact on landscape character or visual amenity;
- that the design and scale of the proposal is appropriate to the scale and character of its setting, respecting the main features of the site and the wider environment and that it fully addresses the potential for mitigation.

7.3 IN2 also sets out that for all wind farm proposals, the extent of any detrimental landscape or visual impact from two or more wind energy developments (i.e. cumulative impact), and the potential for mitigation, also requires to be assessed. The Supplementary Guidance (SG) Wind Energy Development: Development Management Considerations corresponds with, and gives more detail on how cumulative impacts on landscape and visual amenity are assessed at Part B. In addition, the DGWLCS (as Appendix C to the SG) assesses the individual landscape area to accommodate wind energy development. It includes an appraisal of the cumulative landscape and visual effects of existing and consented wind energy

developments and an assessment of where ultimate landscape capacity is close to be being reached.

7.4 In terms of the DGWLCS, the proposed turbines are located within the Carsphairn unit of the Southern Uplands Landscape Character Type (LCT19); at a height to blade tip of 200 to 250 metres, they fall into the "Very Large" typology of wind turbine.

7.5 The Carsphairn unit (LCT19), is described as "*These uplands have a generally consistent and homogenous character within Dumfries and Galloway, forming high hills with an often dramatic sculptural landform. While the expansive scale of these uplands could relate to larger typologies, their distinctive landform, where hills are pronounced and often form steep, rugged edges to adjacent dales and upland glens, is a key constraint to development. The sparsely settled nature and simple land cover pattern reduces sensitivity although, conversely, these uplands are particularly valuable because of their openness and absence of built development and large-scale forestry.*"

7.6 The DGWLCS gives this LCT an overall **High** sensitivity to Large typology turbine types (>150m), for both landscape and visual sensitivity. Sensitivity in terms of landscape values are considered to be **High-Medium** for all typology turbines due to the Regional Scenic Areas that cover much of this character type.

7.7 Key cumulative effects that could occur if additional development were located in the Carsphairn Uplands include:

"*The operational Windy Standard wind farm and its consented extension extend into the Carsphairn unit in the Southern Uplands with Forest (19a). Other than this, none of these character areas accommodates operational, under-constructed or consented wind farms although a number of developments lie close-by these uplands. Other wind farms are/will also be visible from the landmark hill of Cairnsmore of Carsphairn within this character area including Whiteside, Afton and Hare Hill. Any additional wind farm development in this and the adjacent Southern Uplands with Forest (19a) could have significant cumulative effects on this landmark hill*".

7.8 The key **constraints** to wind farm development within this LCT generally are:

- An often dramatic landform where high and shapely peaks, steep scarp slopes, crags and deeply incised valleys are interspersed with smoother rolling upland plateaux;
- The backdrop and distinctive skyline provided by these uplands to adjoining settled areas such as the upland glens of Moffat and Langholm, plus the broader dales of Nithsdale, the Glenkens and Annandale which have increased visibility;
- Extensive forestry within adjacent upland areas in Dumfries and Galloway which increases the value of these open, less modified hills and increases the sense of naturalness experienced;
- The important contribution that these sculptural and open uplands make to wider scenic quality, particularly forming dramatic backdrops to well-settled

dales, as recognised in the RSA designations that cover the majority of these uplands.

7.9 The DGWLS lists the **opportunities** as:

- Lower, less complex hill slopes where the small typology (turbines <20m) could be associated with existing settlement on the fringes of the uplands.

7.10 The DGWLCS guidance for development within this landscape states that:

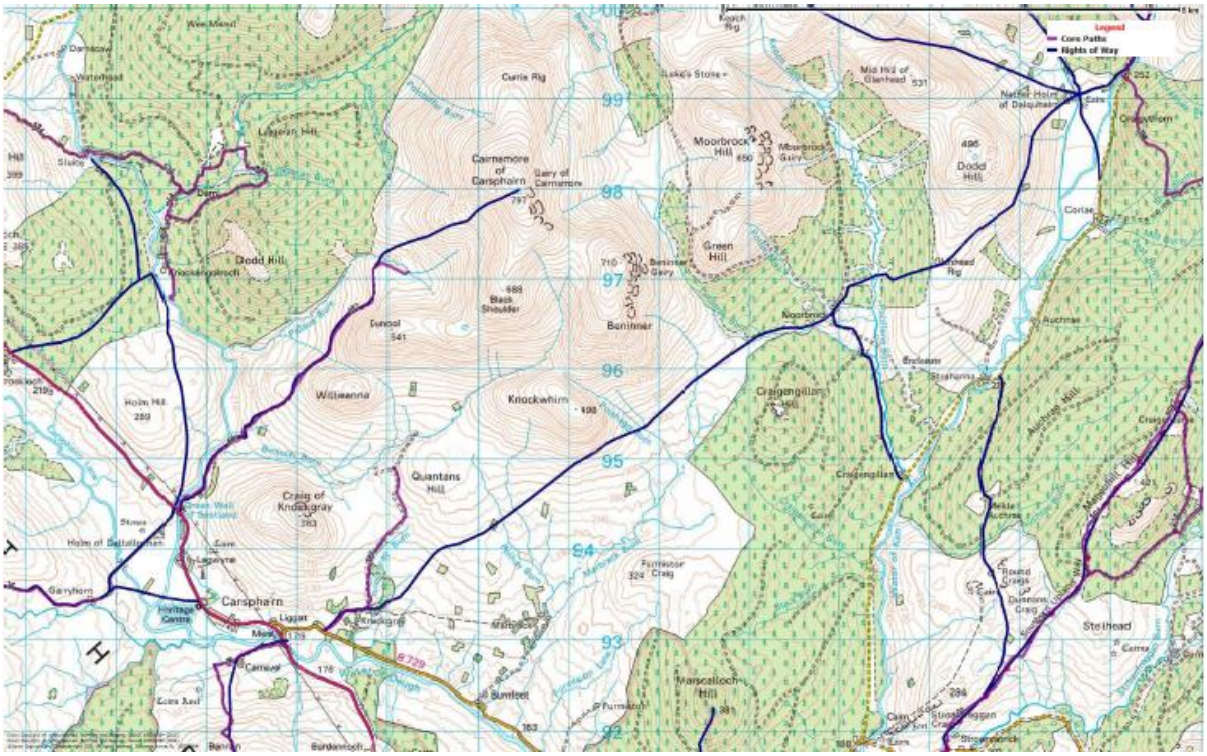
"***There is no scope for the larger development typologies*** *(turbines >50m) to be sited within this character type without incurring significant impacts on a number of key characteristics*".

8 Other Matters

8.1 The Council considers that the structure of the scoping report is clear and sets out a prudent approach to the topics that may give rise to significant effects and should be fully examined in the forthcoming EIA Report. Additionally, the topics listed in the report are acceptable to the Council and should be fully assessed within the EIA Report.

A7

Appendix I



A8

EQUESTRIAN ACCESS THROUGH WIND FARMS IN SCOTLAND

Wind farms are an important part of strategies to achieve the Scottish Government's target of producing 20% of Scotland's energy from renewables by 2020. As an organisation, British Horse Society restricts its involvement and comments (both those made by BHS at national level and those made by local BHS representatives) to those most relevant from an equestrian perspective, including safety and the potential economic impact on equestrian access or local equestrian businesses. Individual BHS members may choose to take other factors into account in supporting or objecting to wind farm development proposals.

BHS Scotland has produced this information sheet to provide guidance to horse riders and carriage drivers on access through wind farms, and to ensure that equestrian access is taken into account in design and determination of planning applications for wind farms.

Riding and carriage driving through wind farms

Many horse riders and carriage drivers are apprehensive about taking their horses near wind turbines. Some horses may initially react negatively to the sight or sound of turbines, as they would to any new experience, while others are totally unperturbed. Don't assume that wind turbines will necessarily have a negative effect on your horse, or on equestrian access. Horses are very adaptable. BHS has received many more reports of horses being unphased by wind turbines than of adverse reactions, and very few where the horse's response has not eased with familiarity and sensitive handling. In some parts of the country, wind farms provide welcome new opportunities for off-road riding and carriage driving.

Legal context for access through wind farms in Scotland

- The Land Reform (Scotland) Act 2003 provides a right of access for all non-motorised recreational users to most land, provided these rights are exercised responsibly. This includes wind farms (other than during the construction phase – see below).
- The network of tracks built during wind farm construction often provides good opportunities for year-round multi-use access, but does not always link into other routes off the site. There may be maps at the entrance to wind farms, or accessible via the internet, identifying recommended routes. Inevitably some turbines will be located close to tracks because of the economic incentive to minimise the distance between main tracks and individual turbines.
- Access rights also apply to the land between turbines, although most wind farms are built on exposed sites, often on boggy ground which may not support equestrian access. Look at the vegetation and weigh up the ground conditions carefully before you wander off the track.
- Access rights are suspended on land where building or civil engineering work is being carried out, other than on core paths or rights of way. During construction access to live working areas may be restricted under Construction (Design and Management) Regulations 2007 on the grounds of public safety. The Scottish Outdoor Access Code clarifies that restrictions should be kept to the minimum area, and for the minimum duration, reasonably and practicably possible. Access to the remainder of the site should not be affected, even during construction. Existing rights of way, core paths and other promoted routes should remain open even in live working areas, other than where pre-agreed signed diversions have been put in place to maintain access. If you find this is not the case, consult your local access authority.

Remember access rights in Scotland come with responsibilities. You are responsible for your own horse, your own safety, and deciding for yourself whether you feel the risks involved in riding or carriage driving mitigate against using certain routes. You are also responsible for ensuring your actions do not put anyone else at risk.

How do horses react to turbines?

Like humans, all horses are individual. They each react to circumstances and structures in different ways. Some will take turbines easily in their stride, others may show some initial apprehension.

Generally, horses are more likely to react to unusual noises and sudden movement than the rhythmic rotation of turbine blades. Blades which start to turn while in a horse's sight may provoke more of a reaction than those already in motion as you ride towards them, but start-up movement is usually slow and gradual, so will not frighten most horses. Horses' vision allows them to see to a certain extent behind them, so they may be frightened by something you have not noticed. Smaller turbines, particularly those with a tail fin, tend to adjust to changes in wind speed and direction more quickly than larger turbines, and the sound may change as the turbine moves. Although sudden changes in sound and movement are more likely to startle a horse, they are not dissimilar to many other hazards in windy conditions, such as loose, flapping plastic.

Some horses may react to the moving shadows cast by turbine blades, particularly if these flicker across their path, but as shifting shadows are commonplace, most horses quickly get used to this. Shadows are longest early in the day and during the evening when the sun is at its lowest.

Familiarising your horse

Riding and carriage driving are inherently risk sports. Some relish the thrill of increased risk through challenges such as cross country courses, others prefer a quiet life. When it comes to wind turbines, it's your choice how you perceive and opt to manage the risk. On the basis of experience, BHS believes that most (but not all) horses which are familiarised with wind farms in a gradual and sympathetic way will happily ride or drive past turbines.

Your own reaction will greatly influence that of your horse. By keeping calm and confident and quietly reassuring your horse, you can help minimise their reaction, just as you would in any other situation. Many riders comment how ethereal and peaceful they find the regular swoosh of turbine blades.

Horses are flight animals. When startled, their first instinct is to flee, then to turn around and look at whatever frightened them. Horses are also naturally herd animals, finding safety in numbers. You can use this to your advantage in familiarising your horse with wind turbines. The same principles apply as introducing young horses to traffic: do it gradually, ideally in the company of an experienced horse.

Before you set off

- If visiting a wind farm for the first time, you might want to have a look round on foot first, so you can plan your route in advance and just concentrate on riding or driving when you get there with your horse.
- Check the weather and do your own risk assessment. Many horses are more sensitive when it is very windy, and the stronger the wind, the louder the noise from the turbines is likely to be. During winter there may be risk of ice or snow falling off the blades,

particularly if the sun comes out and prompts a sudden thaw. It is common sense to avoid wind farms, or to stay clear of individual turbines, during thunderstorms when there may be risk of lightning strike. Some wind farms, such as Whitelee near East Kilbride, have their own rangers or website offering up to date weather forecasts specific to the site, or a contact number you can call if in doubt about risks associated with adverse weather.

- Plan in advance where you are going to park to avoid interference with works traffic or other visitors. If possible, park and unload where your horse can see the turbines and then hack towards them to give your horse change to acclimatise to something new from a distance.
- Remember to take hi-viz gear (and wear it when you are riding or driving through the wind farm) so that you are readily visible to site traffic and other recreational users.

Think, look, listen

- Expect the unexpected. Squeaks and clunks as turbines stop and start, or swivel to face the wind, are more likely to cause your horse to react than the rhythmical movement of the blades. Keep calm, and carry on.

- Turbines require maintenance, so bear in mind that there may be vehicles, and people, around. A friendly greeting will help alert your horse to someone they may not have seen working overhead, and help reduce any risk of it taking fright unnecessarily.

- Be aware that some wind farms are used by sled-dog teams for training and exercise. Keep your eyes open, and be willing to step out of the way: your brakes are likely to be better than theirs!

BHS Scotland has run several training days at Whitelee Wind Farm near East Kilbride offering riders opportunity to familiarise their horse with turbines under the expert guidance of Rhoda McVey, a highly experienced qualified BHS instructor. You can watch a DVD of the event at http://www.youtube.com/watch?v=b0O1hZdaihI.

Guidance for developers and planning authorities

The notes which follow offer guidance on how any potential negative impacts or wind farm development or operation can be minimised, and highlights opportunities to maximise the benefits of wind farm development for equestrian access. Chapter 7 of Good Practice During Wind Farm Construction (http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1618) offers more general guidance on access and recreation in relation to wind farm design, construction and operation.

Key issues for horses

The main concerns about turbines from an equestrian perspective are:

- blade movement, particularly when blades start to turn within a horse's sight line, or blades which come into view at eye level;
- moving shadows cast by blades, which some horses may perceive as a threat to their safety, exacerbated by the fact that the object casting the shadow may not be obvious to the horse. Blade shadows are not a problem if the turbine is north of the track or path;
- sun or light flicker off blades;
- noise from turbines, particularly erratic noise during start-up or deceleration;

- risk of snow and ice shedding off blades;
- risk of electrocution (particularly during lightning strike);
- risk of injury or fright resulting from structural failure, breakage or collapse of the tower, blades or other constituent parts of turbines.

Site assessment

BHS recommends that no anemometer should be situated closer than fall over distance plus 10% from any track used, or likely to be used, by horse riders or carriage drivers, and that no associated cables should be situated any closer than 30m from an equestrian route, as the cables may be difficult to see, especially by a startled horse.

Design

BHS expects turbine siting and wind farm development plans to respect all existing equestrian access, and to consider opportunities for development of further access wherever possible. This includes access within, across, through and adjacent to sites. Scope to use new tracks constructed to enable turbine erection to link other routes outwith the site is encouraged. BHS Scotland and local riders will be happy to help identify existing riding routes, and to offer suggestions for how access could be improved as an integral part of wind farm development.

- **BHS' standard guidance is that there should be a separation distance of at least four times the overall height of turbines (i.e. to tip of blade) for core paths, nationally promoted routes such as Scotland's Great Trails and other promoted riding routes**, as these are most likely to be used by equestrians unfamiliar with turbines.
- **BHS recommends a target of three times overall height between turbines and all other routes** which pre-date wind farm development or turbine erection, including roads.
- **BHS recommends a minimum separation distance of 200 m between turbines and core paths, rights of way or promoted riding routes.**

Where recommended separation distances cannot be achieved, BHS will expect developers to demonstrate how safety issues can be addressed, including development and signage of alternative routes of comparable length, gradient and appeal to horse riders and carriage drivers to cater for those who prefer not to take their horses so close to turbines. From an equine perspective, turbines which suddenly come into view at close range without any warning are likely to cause the greatest risk of horses reacting.

Traffic during and after development

- Drivers of all vehicles visiting the site should be alerted to where they are most likely to meet horses.
- All vehicles should be required to slow down or stop when meeting walkers, cyclists, and particularly horses.
- Where construction traffic has to cross an equestrian route, this should be at right angles to the path or track, with warning notices for both vehicle drivers and horse riders/carriage drivers. Construction traffic should give way to recreational users.
- A Temporary Traffic Regulation Order should be in place before closure of any core path or promoted route which may be necessary during transportation of large components.
- Traffic movement which may impact on equestrian access should be planned to allow horse riders and carriage drivers to continue to ride safely in the early morning, evening, at the weekend and on bank holidays.

- All drivers of large vehicles should follow BHS' guidance to minimise risk to horse riders and carriage drivers (http://www.bhsscotland.org.uk/resources-for-developers.html).
- Where there is no alternative to using the line of a core path or promoted route as an access track during the construction phase, the route should be widened, and a fence erected to segregate vehicles from horses using the route.

Surfacing

BHS recognises that from a developer's perspective, the first priority in constructing tracks providing access to turbines is capacity to support required vehicular access, which usually involves stone surfacing, whereas the ideal surface for horses is firm, well drained turf.

Stoned tracks may increase opportunities for year-round riding, particularly over boggy or waterlogged ground, but sharp stone, particularly if unconsolidated, can quickly lame horses, and will usually restrict pace to walk. Horse riders and carriage drivers understandably feel aggrieved when paths and tracks along which they have previously enjoyed scope to trot, canter or gallop are stone surfaced as part of wind farm development, resulting in loss of amenity for equestrian users.

As a matter of policy:

- Where wind farm development or turbine erection results in loss of previously unsurfaced, firm beaten earth tracks enjoyed by horse riders and carriage drivers, BHS expects developers to provide substitute routes of similar length, gradient and character.
- BHS encourages developers to identify in their proposals what, if any action, is proposed to ameliorate the surface of construction tracks on completion of construction. Where traffic movement and natural consolidation with earth or mud is insufficient to blind sharp stone, dressing with whin dust or similar material may be necessary.
- BHS does not expect paths or tracks with a past history of multi-use, or intended for future multi-use to be surfaced with tarmac, but accepts that developers may agree to bound surfacing of specific routes for the benefit of walkers and cyclists in some instances.

Further guidance on the general principles of equestrian access can be found at http://www.bhsscotland.org.uk/resources-for-developers.htmlt.

Access controls

All access controls should ensure that horse riders and carriage drivers, as well as other non-motorised users, are able to exercise their legal access rights. In order to ensure this, and in accordance with national guidance, BHS expects developers and planners to ensure that:

- In keeping with best practice and the Equalities Act, the least restrictive option is used to provide access for all legitimate recreational users. This is usually a gap.
- Where it is necessary to erect or lock gates across a track to restrict illegal vehicular access, a suitable gap, bridlegate or horse stile should be maintained alongside. Guidance on appropriate widths and designs can be downloaded from the BHS Scotland website. Sites likely to be used for carriage driving should incorporate facility such as the Kent Gap design.

Further details and specifications for gaps, gates and other access infrastructure are provided in the Outdoor Access Design Guide https://www.pathsforall.org.uk/pfa/creating-paths/outdoor-access-design-guide.html. BHS Scotland is happy to provide further guidance and advice where required tel. 01764 656334.

Other facilities

Incorporation within site design of areas with sufficient space for horse boxes and trailers to park, turn and unload easily will be much appreciated by horse riders and carriage drivers. Parking areas should not be close to any turbines to allow horses unfamiliar with turbines to be safely unloaded and opportunity to acclimatise. Corals, tying rails and mounting blocks are valuable additional features.

Maintenance and safety tests

The increased noise during over-speed and similar safety tests which involve rotors being sped up to capacity can be very frightening for horses, even those which are used to turbines. BHS urges all turbine owners and wind farm operators to alert horse riders and carriage drivers in advance of and during scheduled safety tests by erection of suitably placed signs on-site, on websites etc. confirming time and date to enable those concerned about their horses' reaction to avoid the turbines at relevant times. BHS also recommends that planners make it a condition of planning permission that those responsible for turbines are obliged to notify local horse owners of scheduled test dates at least five days in advance.

Guidance for riders and carriage drivers in responding to wind farm development proposals

How BHS responds to development proposals

BHS is a statutory consultee for all major wind farm development proposals in Scotland. It is not generally consulted at national level regarding erection of individual turbines, or small groups of turbines for domestic or commercial use.

For each wind farm application received, BHS consults with local riders and equestrian businesses to identify:

- existing equestrian use of the proposed site (who uses the site, how and when)
- existing equestrian use of adjacent or nearby tracks or roads
- level and frequency of existing use
- how existing use might be affected by proposals
- anticipated changes in future use
- potential for increased equestrian access through site development
- how the proposed development might impact on other equestrian interests.

In some cases BHS responds direct at national level, and in others delegates responsibility to a local Equestrian Access Group or BHS regional access representative.

Key issues to be taken into consideration in responding to development proposals

The main concerns about turbines from an equestrian perspective, which might be referred to in responding to development proposals, are summarised above.

When considering the impact of development proposals, planning authorities are likely to take account of the existing environment (i.e. what the site is like at present) and associated risks. Horse riders and carriage drivers using roads shared by motorists and other users are already in an environment characterised by noise and movement. Consequently objection to development proposals on the basis of horses being unable to cope with noise or movement is unlikely to be taken seriously. This applies to forest roads used by timber wagons as much as to public roads. Similarly objections based on increased risk of horses meeting other recreational users are unlikely to be taken into account in relation to existing multi-use paths where horses may already routinely encounter cyclists and walkers.

Bear in mind that over-exaggerating the fact that horses are inherently unpredictable flight animals may later be used in evidence against you. Planners who have read riders' comments about horses' propensity to spook every time they meet a bike or vehicle of any kind are unlikely to respond positively to future complaints about routes being developed or managed which exclude equestrian use on the grounds of safety risks to other users. Similarly wind farm developers are unlikely to be willing to consider requests for developing additional new multi-use routes through wind farms if you have already protested that you would never go within five miles of a turbine.

It's also worth avoiding the risk of throwing the baby out with the bath water. No matter how strongly opposed you may be to a proposed development, consider carefully whether it is worth commenting on how any potentially negative effects from an equestrian perspective could be minimised, or flagging up opportunities for development of valuable new equestrian facilities or routes linked to development.

Design considerations

The location of individual turbines can have a major impact on horses' response. The following points are worth bearing in mind when considering the equestrian impacts of proposed developments:

- Horses are generally less concerned by turbines if they are able to acclimatise to the noise and sound as they approach. Turbines in close proximity to a path or track which suddenly come into view without any warning may pose more of a problem.
- Blade shadows are not a problem if the turbine is north of the track or path.

Equestrian access

In assessing the effects of proposed development on equestrian access, BHS recommend that you take account of the following:

- Which turbines are the most critical in terms of any potential adverse impact from an equestrian perspective? Identifying which you feel are totally unacceptable, and why, will help developers tailor their proposals to minimise the adverse impacts. Take into consideration not only how close turbines are to existing tracks, but also how readily visible they are: will they suddenly come into view as you round a corner from dense forestry? How far is the closest turbine from any parking area(s), or where you would enter the site? Most horses unaccustomed to turbines are unlikely to take kindly to being unloaded where turbine blades are swooping overhead, but have no problem if they have time to acclimatise from a distance.
- How will site construction or development, particularly construction of stone access tracks, affect the nature of routes currently used for riding?
- What scope is there to make proposed tracks or access roads more useful or acceptable from an equestrian perspective?
- What alternative routes are currently available, or could be developed to avoid the turbines or to substitute for sharp stoned access roads?
- What scope is there for extension or further development of the wind farm access track network to link with other routes outwith the site?

Submitting your comments

- Research your facts carefully. Details of the number and proximity of horses which might be affected by the proposed development, or the number currently making use of the proposed site, or a particular route, will help back up your case.
- State the basis or justification for your comments as clearly as possible.
- Work with others. Submissions that have the support of walkers and cyclists are stronger.
- Remember the significance of numbers, and that each letter counts as one objection. Letters from 10 individual members of a local riding club or riders access group will therefore have far more impact than a single letter from a group which purports to represent 50 members.
- If you decide to object, make sure you include the critical phase "I/we object to...." within your submission, and state your reasons for objecting.
- Substantiate your comments or objections wherever possible by reference to relevant local planning policies, BHS guidance re. separation distances between turbines and riding routes etc.
- Providing a template or summary of points which you wish to encourage others to submit in response to wind farm applications can drum up more support, but planners are likely to take individual letters much more seriously than mass produced identical letters, even if individually signed.

Case study – Grimes Wind Farm, Cumbria

Considerable weight was attached to the potential significant adverse impact on three equestrian businesses in refusing planning permission for this wind farm. In each case, the highly volatile nature of visiting young horses and breeding mares, particularly bloodstock and those in race training, was influential in justifying the impact of turbine development. Use of bridleways by local horses which would have opportunity to become accustomed to the turbines was largely discounted as an objection.

Case Study - an example of refusal of planning permission

Proposals were submitted to Aberdeenshire Council for erection of two 800 kw wind turbines (hub height 55 m, total height 79 m) and associated infrastructure at Newton of Flouzie, in Banffshire. Balhagan Equestrian Services objected to the proposal on the basis of the potential impact of the proposed turbines on the riding stables, which is located approximately 500 m north of the nearest turbine. The business specialises in training and schooling of young horses as well as offering riding, stable management and a range of livery services. Balhagan commissioned an expert witness who undertook a risk assessment of the impact of the two proposed turbines on the business and its users, which concluded that the proposed turbines would have an extremely detrimental impact on any horse on or near the property, that the turbines would increase the risks to training and working horses at the stables, and to their riders, and consequently horse owners would seek other more suitable training facilities elsewhere, resulting in loss of business. BHS supported the objection on the basis that the construction of the turbine in such close proximity to the arena would force Balhagan out of business. The reporter appointed by the Scottish Ministers noted that "it would be naive to think that the proposed turbines would have no effect on the behaviour of some horses at the stables, and on adjoining roads (<100m from the turbines) well within the BHS guideline distance...(particularly given the age of the horses). Nevertheless I remain to be persuaded that the increased risk to the welfare and safety of horses or the persons handling them would be of such a scale as to lead to horse owners withdrawing their horses and taking their business elsewhere in sufficient numbers to lead to the demise of the business." Taking account of the conflicting evidence submitted by the appellant regarding livery yards operating in close proximity to turbines elsewhere in the country and to the provision of bridleways as an integral part of some wind farms where horse riding is actively encouraged and promoted, the reporter concluded "I am not in a position to be certain that the proposal would have a significant adverse impact on the viability and future of the equine business." The proposal was, however, deemed unacceptable on the grounds of landscape and visual impact, and consequently the equestrian issues were not further pursued.

If you need further advice on equestrian access in Scotland, contact your local BHS access representative (see www.bhsscotland.org.uk for contact details) or Helene Mauchlen, national manager for BHS Scotland Tel. 01764 656334 or email Helene.Mauchlen@bhs.org.uk.

For guidance on equestrian access in England and Wales, contact Access and Rights of Way Department, The British Horse Society, Abbey Park, Stareton Lane, Kenilworth, Warwickshire CV8 2XZ. Telephone 02476 840581. Email access@bhs.org.uk.

VWG
Updated March 2018

A17

From: Lisa Smith
Sent: 07 July 2020 14:12
To: Brown C (Carolanne); Econsents Admin
Cc: radionetworkprotection@bt.com
Subject: RE: Quantans Hill Wind Farm proposal - scoping consultation - WID11255

OUR REF; WID11255

Dear Sir/Madam

Thank you for your email dated 30/06/2020.

We have studied this Windfarm proposal with respect to EMC and related problems to BT point-to-point microwave radio links.

The conclusion is that, the Project indicated should not cause interference to BT's current and presently planned radio network.

Please direct all queries to radionetworkprotection@bt.com

Regards
Lisa Smith
Engineering Services Radio Planning
Tel: REDACTED

A18

From: McGrogan, Joan REDACTED
Sent: 29 July 2020 07:59
To: Brown C (Carolanne); Econsents Admin
Subject: 20200729 - Quantans Hill Wind Farm proposal - scoping consultation - CES interests not affected - reply to Scotgov

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Carolanne

I write to confirm that the assets of Crown Estate Scotland are not affected by this proposal and we therefore have no comments to make.

Kind regards

Joan.

Joan McGrogan
Portfolio Co-ordinator
Crown Estate Scotland
REDACTED
6 Bell's Brae, Edinburgh, EH4 3BJ
Tel: +44 (0) 131 260 6070
www.crownestatescotland.com
@crownestatescot

A19

Defence Infrastructure Organisation

Jill Roberts
Assistant Safeguarding Officer
Ministry of Defence
Safeguarding – Wind Energy
Kingston Road
Sutton Coldfield
West Midlands B75 7RL
United Kingdom

REDACTED

Ms Carolanne Brown
Scottish Government
Energy Consents Unit
Scottish Government
4th Floor
5 Atlantic Quay
150 Broomielaw
Scotland
G2 8LU

05 August 2020

Dear Carolanne

Please quote in any correspondence: DIO10048548

Site Name: Quantans Hill Wind Farm

Proposal: Scoping Opinion for proposed Section 36 application for Quantans Hill Wind Farm

Planning Application Number: ECU00002097

Site Address: 2km north-east of Carsphairn, Dumfries and Galloway

Thank you for consulting the Ministry of Defence (MOD) on the above Section 36 Scoping Opinion for the proposed construction and operation of Quantans Hill wind farm.

I am writing to tell you that, subject to the provision of appropriate lighting the MOD has no concerns in relation to the proposal.

The application is for 21 turbines at 250.00 metres to blade tip above ground level (AGL). This has been assessed using the grid references below as submitted in the planning application or in the developers' or your pro-forma

Turbine	Easting	Northing
1	258,417	595,831
2	258,518	594,948
3	258,996	595,423
4	257,550	594,857

5	257,958	595,373
6	259,468	594,766
7	258,701	594,431
8	258,214	593,989
9	259,083	593,911
10	259,732	594,257
11	260,573	594,397
12	260,744	594,915
13	260,906	593,898
14	261,445	594,582
15	261,752	594,025
16	261,459	593,477
17	261,095	595,397
18	261,730	595,782
19	261,540	596,298
20	260,586	593,403
21	260,402	592,885

The principal safeguarding concern of the MOD with respect to the development of wind turbines relates to their potential to create a physical obstruction to air traffic movements and cause interference to Air Traffic Control and Air Defence radar installations.

The proposed development falls within an area used for military low flying training, and where the introduction of structures has the potential to compromise aviation safety. As such, it will be necessary for structures to be fitted with appropriate aviation lighting to maintain the safety of military aircraft.

Specifically, those wind turbines that will be installed with a total height (to blade tip) of 150 metres or more, should be fitted with aviation warning lighting in accordance with the requirements of the Air Navigation Order (2016).

It is noted that the proposal will involve permanent anemometry masts. No details are available at this stage but the MOD would like to review the details once available to verify if the masts will impact military low flying training conducted in the area.

If this development proceeds and planning permission is granted, we would request information relating to the construction dates, construction equipment and turbine latitude and longitudes is provided to us for charting purposes.

Defence Infrastructure Organisation Safeguarding wishes to be consulted and notified of the progression of planning applications and submissions relating to this proposal to verify that it will not adversely affect defence interests.

I trust this adequately explains our position on the matter. If you require further information or would like to discuss this matter further, please do not hesitate to contact me.

Further information about the effects of wind turbines on MOD interests can be obtained from the following websites:

***MOD*:** https://www.gov.uk/government/publications/wind-farms-ministry-of-defence-safeguarding

Yours sincerely

REDACTED

Jill Roberts
Assistant Safeguarding Officer

A22

From: Safe Guarding <safeguarding@edinburghairport.com>
Sent: 17 July 2020 11:33
To: Econsents Admin
Cc: Safe Guarding
Subject: Quantans ECU00002097

Good morning,

In respect of the above, I can confirm the location of this development falls out with our Aerodrome Safeguarding zone therefore Edinburgh Airport have no objection/comment on this proposal.

With best regards,
RED
ACT

Claire Brown | Safeguarding & Compliance Officer

Edinburgh Airport
Where Scotland meets the world

Edge | Empower | Expertise | Energy | Execute | External focus

Edinburgh Airport Limited
Airside Operations
Edinburgh
EH12 9DN Scotland

t: REDACTED f: REDACTED m: REDACTED
w: edinburghairport.com t: twitter.com/edi_airport

A23

Windfarm Position Statement

The Galloway and Southern Ayrshire Biosphere has no planning remit or regulatory function. However it does represent a broad partnership of public, private and community interests focused on supporting sustainable development that benefits local communities and the natural environment.

The Galloway and Southern Ayrshire Biosphere recognises and supports the Scottish Governments ambitious targets on energy production through renewable technologies, and acknowledges that an integrated energy production framework is essential in achieving Scotland's ambitions.

Windfarms both onshore and offshore play a role within the energy generation framework and the South of Scotland has seen in recent times a proliferation of windfarm developments to support the national objective.

The Galloway and Southern Ayrshire Biosphere supports a balanced approach to development locally ensuring that developments are sustainable and suitable for the local environment and communities. It also recognises that the Biosphere area has assets within it which require significant protection from the impacts of wind farm development these include, wild land, carbon rich soils, Natura sites/SSSI's, designed landscapes/historic battlefields.

It is the view of Galloway and Southern Ayrshire Partnership that any wind farm developments within the Core and Buffer zone of the Biosphere would not be suitable or supported due to their adverse impact on the regions natural environment and rural economy.

However it is the view of the Partnership that wind farm developments within the Biosphere could be acceptable in the transition zone, where substantial community engagement has demonstrated that the majority of communities are supportive of the proposed development and it can be shown that the environmental impact of the development is minimal and effective mitigation can be achieved.

Joan Mitchell

Chair of the Biosphere Partnership Board

December 2016

A24

Carolanne Brown
Energy Consents Unit
Scottish Government
4th Floor
5 Atlantic Quay
150 Broomielaw
Glasgow
G2 8LU

17th July 2020

Dear Carolanne

Quantans Hill Wind Farm Proposal – ECU00002097 Request for Scoping Opinion

Thank you for providing the Galloway Fisheries Trust (GFT) with the opportunity to submit a response to this proposal.

The Galloway Fisheries Trust (GFT) is a charitable organisation which was formed in 1988, by a number of neighbouring District Salmon Fishery Boards in Dumfries and Galloway. The aim of the GFT is to undertake research, provide advice and complete practical works to protect and enhance aquatic biodiversity, particularly fish species, living in the freshwaters and river catchments across Dumfries and Galloway (including the Kirkcudbrightshire Dee).

GFT is also commenting in this instance on behalf of the Kirkcudbrighshire Dee District Salmon Fishery Board, within whose jurisdictional area this proposed development lies.

Having read the documentation we have the following comments to make:

- We consider the proposed development area as being sensitive with regards to fish populations. The development area all drains into the Water of Deugh catchment (which is part of the Kirkcudbrightshire Dee catchment).

- There are a number of named water courses flowing through the site which will have turbines constructed close to them. In addition, many of these water courses will require upgrading or new water course crossing points constructed. These water courses, including Benloch Burn, Knockgray Burn, Marbrack Burn, Polhay Burn and Furmiston Burn could all support important trout populations which could be impacted by the proposed development and should be considered fully in the EIA.

- The document refers to the need to collect sufficient baseline data to enable a robust assessment (section 4.2), which we fully agree with.

- In section 9.4 it mentions that the previous EIA 'identified possible adverse effects on Brown trout with minor effects to salmon populations further downstream from the development…'. We agree this is an accurate statement. For this reason we feel it is important to undertake fish surveys as part of the baseline surveys to ensure the Trout populations can be considered accurately during the design and planning of the wind farm. We do not agree with the suggestion on pages 45/46 that no baseline fish surveys are required. It is not known what fish populations are present in the burns within the development boundary.

REDACTED REDACTED REDACTED

- We agree that a post consent fish population monitoring plan covering three years is required. This monitoring should be guided by the findings of a baseline fish survey.

- On page 48, we are pleased to see that watercourse crossings will be minimised. We also are supportive of the aim that runoff water will be treated and that the use of wet concrete will be avoided around water courses.

- Wind farm developments often consider opportunities for habitat enhancement as part of their overall project. We would be very keen to have an opportunity at an early stage to input to any proposed Habitat Management Plan as we believe there would opportunities to improve burn habitats which would help to protect and improve aquatic ecology including fish populations.

In general, the following have the potential to impact fish species and their habitats. These points/potential issues are of concern and interest to GFT and the Kirkcudbrightshire Dee District Salmon Fishery Board:

- Access track layout in relation to the proximity to sensitive fish habitat (e.g. spawning habitat);
- The number of watercourse crossings (new and upgraded);
- The location of new and upgraded watercourse crossings;
- New and upgraded watercourse crossing type, design, and structure, including information relating to the installation of each crossing point (e.g. maintaining the existing gradient, maintaining fish access at all water heights etc.);
- Construction information for new tracks (including layby locations), trackside drainage plans and designs especially in relation to increased run off rates;
- Turbine base locations;
- Turbine base excavation and associated run off from loose ground;
- Peat depth information in relation to water quality, peat slides or ground slips;
- Borrow pit locations;
- Changes to instream hydrological conditions and flush zones;
- Exacerbated erosion and/or elevated levels of suspended silt to watercourses during construction activities;
- Water quality monitoring information;
- Pollution to watercourses in the form of silt pollution;
- Pollution to watercourses in the form of chemical pollution;
- Reduction in quantity and quality of instream habitat;
- Adverse changes to instream morphology;
- Direct mortality of fish species;
- Mitigation measures to protect fish population and their habitats from the impact from all of the above;
- Timings of specific works such as new track building, new watercourse crossing installation, upgrading of existing watercourse crossings;
- Mitigation measures to protect watercourses, fish and their habitats – that which is built in to the design of the development and any additional mitigation measures which will be employed if required.

If you have any queries or would like clarification on any of the points raised above, please do not hesitate to contact me.

Yours sincerely

Jamie Ribbens
Senior Fisheries Biologist

Cc Jamie Ingall, Chairman Kirkcudbrighshire Dee District Salmon Fishery Board

A26

From: #GLA Safeguarding <GLASafeguard@glasgowairport.com>
Sent: 07 July 2020 10:54
To: Brown C (Carolanne)
Subject: RE: Quantans Hill Wind Farm proposal - scoping consultation

This proposal is located outwith the consultation zone for Glasgow Airport. As such we have no comment to make and need not be consulted further.

Kind regards

Kirsteen

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

#GLA Safeguarding
#GLA Safeguarding

REDACT
glasafeguard@glasgowairport.com
www.glasgowairport.com

Glasgow Airport, Erskine Court, St Andrews Drive, Paisley, PA3 2TJ

CURRENT HOLDER OF FOLLOWING AWARDS
- Scottish Airport of the Year 2019
- Excellence in Transport Accessibility 2019

From: Steve Thomson
Sent: 24 July 2020 09:41
To: Brown C (Carolanne); Econsents Admin
Cc: Safeguarding; Windfarm
Subject: RE: Quantans Hill Wind Farm proposal - scoping consultation - response from Glasgow Prestwick Airport Ltd

Carolanne

We have reviewed the documents issued under the scoping consultation – and make the following observations based purely on aviation issues.

1. It is likely that all proposed turbines will be terrain shielded from our primary radars – so Glasgow Prestwick Airport (GPA) ltd is unlikely to object from any concerns of turbine generated radar display clutter. However we would like to be given the opportunity to be consulted again once a formal planning application is submitted – to allow more detailed Line of sight (LOS) analysis to be done once turbine locations and heights have been fully determined.

2. GPA may require an assessment to be undertaken by the Developer of the proposed windfarm against our published Instrument Flight Procedures (IFP's) (both conventional and RNAV) – to satisfy ourselves that the turbine tip heights have no impact on our existing published IFP's.

3. GPA request to be consulted should this proposed development reach formal planning application stage.

With Kind Regards

Steve Thomson

Steve Thomson
Manager Air Traffic Services
Glasgow Prestwick Airport Ltd.

T: REDACTED

www.glasgowprestwick.com

Glasgow Prestwick Airport Ltd.
Aviation House
Prestwick
KA9 2PL
Scotland
United Kingdom

A28

By email to: econsents_admin@gov.scot

Energy Consents Unit
4th Floor, 5 Atlantic Quay
150 Broomielaw
Glasgow
G2 8LU

Longmore House
Salisbury Place
Edinburgh
EH9 1SH

Enquiry Line: 0131-668-8716
HMConsultations@hes.scot

Our case ID: 300045435
Your ref: ECU00002097

24 July 2020

Dear Sir/Madam,

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
Quantans Hill Wind Farm, Dumfries and Galloway
EIA Scoping Report

Thank you for your consultation which we received on 30 June 2020 about the above scoping report. We have reviewed the details in terms of our historic environment interests. This covers world heritage sites, scheduled monuments and their settings, category A-listed buildings and their settings, inventory gardens and designed landscapes, inventory battlefields and historic marine protected areas (HMPAs).

Dumfries and Galloway Council's archaeological and cultural heritage advisors will also be able to offer advice on the scope of the cultural heritage assessment. This may include heritage assets not covered by our interests, such as unscheduled archaeology, and category B- and C-listed buildings.

Proposed Development
I understand that the proposals comprise the development of up to 21 wind turbines, varying between 200m and 250m in height, and associated infrastructure on Quantans Hill near Carsphairn in Dumfries and Galloway.

Scope of assessment
While we note that no heritage assets in our remit are located within the development site boundary, there are a number of such heritage assets located in the vicinity of the proposals which may be subject to setting impacts. This is especially the case given the prominent topographical location of the site at the confluence of the Waters of Ken and Deugh. We therefore consider that any Environmental Impact Assessment (EIA) undertaken for the proposals should include a detailed assessment of impacts on the Cultural Heritage topic area. We recommend that this assessment is undertaken by a suitably qualified professional and meets the requirements of Scottish Planning Policy (SPP, 2014), the Historic Environment Policy for Scotland (HEPS, 2019) and associated

Managing Change Guidance Notes. Further guidance can also be found in the Cultural Heritage Appendix to the EIA Handbook (SNH, HES, 2018).

We note from Chapter 12 (Cultural Heritage) of the EIA Scoping Report that it is proposed to assess impacts on the setting of nationally important heritage assets located within 10km of the proposals. While we are broadly content with this, we recommend that consideration should also be given to potential impacts on the setting of the *Craigengillen Inventory Designed Landscape* (GDL111) which is located beyond the 10km study area. In each case, we could expect an assessment to include a full appreciation of the setting individual heritage assets, recognising that impacts may occur on views from, towards or across them. An assessment should also clearly demonstrate where potential impacts have been reduced or avoided and, also, consider where any residual effects may occur.

We recommend that impacts on the setting of heritage assets should be assessed using photomontage and wireframe visualisations where impacts are likely to be highest. We note that the EIA Scoping Report does not identify any cultural heritage assessment viewpoints. We would recommend further engagement on this as the assessment is progressed and more detailed ZTV information becomes available.

Finally, we note the potential for cumulative impacts on the setting of heritage assets caused by the proposed development in combination with other existing, proposed and consented wind farms in the surrounding area. We would therefore recommend that cumulative impacts are assessed and examined through the use of cumulative visualisations.

EIA Scoping Report (June 2020)

We have reviewed the EIA Scoping Report and, subject to our comments above, are broadly content with the approach to assessing impacts on our interests included at Chapter 12 (Cultural Heritage).

Further information

A new Historic Environment Policy for Scotland (HEPS, 2019) was adopted on the 1st May 2019, which replaces the Historic Environment Scotland Policy Statement (HESPS, 2016). The new Historic Environment Policy for Scotland is a strategic policy document for the whole of the historic environment and is underpinned by detailed policy and guidance. This includes our Managing Change in the Historic Environment Guidance Notes. All of these documents are available online at www.historicenvironment.scot/heps.

Practical guidance and information about the EIA process can also be found in the EIA Handbook (2018). This is available online at

https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=6ed33b65-9df1-4a2f-acbb-a8e800a592c0

We hope this is helpful. Please contact us if you have any questions about this response. The officer managing this case is Alison Baisden REDACTED REDACTED

Yours faithfully,

Historic Environment Scotland

A31

From: Safeguarding <Safeguarding@hial.co.uk>
Sent: 13 July 2020 16:21
To: Brown C (Carolanne); Econsents Admin
Subject: RE: Quantans Hill Wind Farm proposal - scoping consultation

Your Ref: ECU00002097
HIAL Ref: 2020/0131/CAL

Dear Sir/Madam,

PROPOSAL: SCOPING OPINION REQUEST– QUANTANS HILL WIND FARM PROPOSAL
LOCATION: 2km north-east of Carsphairn

With reference to the above proposed development, it is confirmed that our calculations show that, at the given position and height, this development would not impact the safeguarding criteria for any of the Highlands and Islands Airports Limited (HIAL) Airports.

Therefore, HIAL would have no objections to the proposal.

Regards,

Safeguarding Team
Highlands and Islands Airports Limited
Head Office, Inverness Airport, Inverness IV2 7JB
✉ safeguarding@hial.co.uk 🌎 www.hial.co.uk

A32

From: JRC Windfarm Coordinations <windfarms@jrc.co.uk>
Sent: 10 July 2020 10:43
To: Brown C (Carolanne)
Subject: Quantans Hill - Turbine locations.xlsx [WF328877]

Dear carolanne,

A Windfarms Team member has replied to your coordination request, reference **WF328877** with the following response:

Dear Carolanne,

***Name/Location**: Quantans Hill*

***Site Centre/Turbine at NGR/IGR**:*

1	258417.5	595831
2	258518	594948.1
3	258996	595423.4
4	257550.8	594857.7
5	257958.5	595373.3
6	259468.6	594766.6
7	258701.8	594431.4
8	258214.9	593989.2
9	259083.7	593911.4
10	259732.3	594257.6
11	260573.7	594397.9
12	260744.7	594915
13	260906.8	593898.3
14	261445.9	594582
15	261752.7	594025.4
16	261459	593477.5
17	261095.3	595397.1
18	261730.7	595782.8
19	261540.4	596298.5
20	260586.9	593403
21	260402.8	592885.9

***Development Radius**: 0.1KM*

***Hub Height**: Either 115m or 165m m **Rotor Radius**: 83.5m*

*This proposal **cleared** with respect to radio link infrastructure operated by:*

Scottish Power and Scotia Gas Networks

A33

JRC analyses proposals for wind farms on behalf of the UK Fuel & Power Industry. This is to assess their potential to interfere with radio systems operated by utility companies in support of their regulatory operational requirements.

In the case of this proposed wind energy development, JRC does not foresee any potential problems based on known interference scenarios and the data you have provided. However,if any details of the wind farm change, particularly the disposition or scale of any turbine(s), it will be necessary to re-evaluate the proposal.

In making this judgement, JRC has used its best endeavours with the available data, although we recognise that there may be effects which are as yet unknown or inadequately predicted. JRC cannot therefore be held liable if subsequently problems arise that we have not predicted.

It should be noted that this clearance pertains only to the date of its issue. As the use of the spectrum is dynamic, the use of the band is changing on an ongoing basis and consequently,developers are advised to seek re-coordination prior to considering any design changes.

Regards

Wind Farm Team

The Joint Radio Company Limited
Delta House
175-177 Borough High Street
LONDON
SE1 1HR
United Kingdom

Office: 020 7706 5199

JRC Ltd. is a Joint Venture between the Energy Networks Association (on behalf of the UK Energy Industries) and National Grid.
Registered in England & Wales: 2990041
http://www.jrc.co.uk/about-us

JRC is working towards GDPR compliance. We maintain your personal contact details in accordance with GDPR requirements for the purpose of "Legitimate Interest" for communication with you. However you have the right to be removed from our contact database. If you would like to be removed, please contact anita.lad@jrc.co.uk.

We hope this response has sufficiently answered your query.
If not, please **do not send another email** as you will go back to the end of the mail queue, which is not what you or we need. Instead, **reply to this email keeping the subject line intact or login to your account** for access to your coordination requests and responses.

https://breeze.jrc.co.uk/tickets/view.php?auth=o1x2idqaagnjyaaa75C76F1pAK0x%2Fg%3D%3D

A34

The Granary | West Mill Street | Perth | PH1 5QP
T: REDACTED E: info@mountaineering.scot
www.mountaineering.scot

By email to: Econsents_Admin@gov.scot

Energy Consents Unit
Directorate for Energy and Climate Change
5 Atlantic Quay
150 Broomielaw
Glasgow
G2 8LU

15 July 2020

Dear Sir/Madam

Quantans Wind Farm: Environmental Impact Assessment Scoping Report

Reference: ECU00002097

Background and Context

1. Vattenfall has submitted a scoping report for a wind farm of up to 21 turbines of up to 250m BTH on the southwestern slopes of Cairnsmore of Carsphairn. It is largely the same location as a previous application for 19 turbines of 130m BTH made by EON in 2014 and withdrawn in 2016 prior to determination.

2. Mountaineering Scotland is a membership organisation with over 14,000 members and is the only recognised representative organisation for hill walkers, climbers, mountaineers and ski-tourers who live in Scotland or who enjoy Scotland's mountains, and acts to represent, support and promote Scottish mountaineering. Mountaineering Scotland also acts on behalf of the 85,000 members of the British Mountaineering Council (BMC) on matters related to landscape and access in Scotland, and provides training and information to mountain users to promote safety, self-reliance and the enjoyment of our mountain environment.

3. The impact of concern to mountaineering interests is on the reciprocal views between Cairnsmore of Carsphairn and the Rhinns of Kells. Any wind farm immediately south of Cairnsmore of Carsphairn would interrupt these views and visually separate Cairnsmore of Carsphairn from the main part of the Galloway highlands. Protecting these views has been the approach taken consistently by Mountaineering Scotland when considering applications in this area.

Assessment

4. Mountaineering Scotland is in general content with the proposed methodology in the Scoping Report. It has two observations which are set out below.

5. We have no adverse comments on the viewpoints proposed. We particularly support viewpoints 3, 4, and 20 representing the Cairnsmore of Carsphairn massif; viewpoints 11, 12 and 25 representing

the Rhinns of Kells; 6, 7 and 21 representing the Southern Upland Way rising to Benbrack (viewpoint 16 feels redundant); and viewpoint 5 representing the Donalds (hills >610m) northeast of Cairnsmore of Carsphairn. We would note that on flat summits walkers will often sit immediately above a break of slope rather than at the summit itself since this offers a better view. Precise siting of the viewpoints on the Cairnsmore of Carsphairn massif should take this into account.

6. The Report proposes to scope out any consideration of tourism (para 11.6.1). This is unacceptable since reanalysis of Biggar Economics data shows wind farms located in local scenic designations have had an adverse effect on tourism-related employment. We recommend specific analysis of the effect of wind turbines on outdoor recreational interests as the proposed site is located within the Galloway Hills Regional Scenic Area.

Yours sincerely

REDACTED

Davie Black
Access & Conservation Officer
Mountaineering Scotland

T: REDACTED

E: access@mountaineering.scot

Marine Scotland Science advice on freshwater and diadromous fish and fisheries in relation to onshore wind farm developments.

July 2020

Marine Scotland Science (MSS) provides internal, non-statutory, advice in relation to freshwater and diadromous fish and fisheries to the Scottish Government's Energy Consents Unit (ECU) for onshore wind farm developments in Scotland.

Atlantic salmon (*Salmo salar*), sea trout and brown trout (*Salmo trutta*) are of high economic value and conservation interest in Scotland and for which MSS has in-house expertise. Onshore wind farms are often located in upland areas where salmon and trout spawning and rearing grounds may also be found. MSS aims, through our provision of advice to ECU, to ensure that the construction and operation of these onshore developments do not have a detrimental impact on the freshwater life stages of these fish populations.

The Electricity Works (Environmental Impact Assessment) (EIA) (Scotland) Regulations (2017) state that the EIA must assess the direct and indirect significant effects of the proposed development on water and biodiversity, and in particular species (such as Atlantic salmon) and habitats protected under the EU Habitats Directive. Salmon and trout are listed as priority species of high conservation interest in the Scottish Biodiversity Index and support valuable recreational fisheries.

A good working relationship has been developed over the years between ECU and MSS, which ensures that these fish species are considered by ECU during all stages of the application process of onshore wind farm developments and are similarly considered during the construction and operation of future onshore wind farms. It is important that matters relating to freshwater and diadromous fish and fisheries, particularly salmon and trout, continue to be considered during the construction and operation of future onshore wind farms.

In the current document, MSS sets out a revised, more efficient approach to the provision of our advice, which utilises our generic scoping and monitoring programme guidelines (https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Research/onshoreren). This standing advice provides regulators (e.g. ECU, local planning authorities), developers and consultants with the information required at all stages of the application process for onshore wind farm developments, such that matters relating to freshwater and diadromous fish and fisheries are addressed in the same rigorous manner as is currently being carried out and continue to be fully in line with EIA regulations. At the request of ECU, MSS will still be able to provide further and/or bespoke advice relevant to freshwater and diadromous fish and fisheries e.g. site specific advice, at any stage of the application process for a proposed development, particularly where a development may be considered sensitive or contentious in nature.

MSS will continue undertaking research, identifying additional research requirements, and keep up to date with the latest published knowledge relating to the impacts of onshore wind farms on freshwater and diadromous fish populations. This

will be used to ensure that our guidelines and standing advice are based on the best available evidence and also to continue the publication of the relevant findings and knowledge to all stakeholders including regulators, developers and consultants.

MSS provision of advice to ECU

- MSS should not be asked for advice on pre application and application consultations (including screening, scoping, gate checks and EIA applications). Instead, the MSS scoping guidelines and standing advice (outlined below) should be provided to the developer as they set out what information should be included in the EIA report;
- if new issues arise which are not dealt with in our guidance or in our previous responses relating to respective developments, MSS can be asked to provide advice in relation to proposed mitigation measures and monitoring programmes which should be outlined in the EIA Report (further details below);
- if new issues arise which are not dealt with in our guidance or in our previous responses, MSS can be asked to provide advice on suitable wording, within a planning condition, to secure proposed monitoring programmes, should the development be granted consent;
- MSS cannot provide advice to developers or consultants, our advice is to ECU and/or other regulatory bodies.
- if ECU has identified specific issues during any part of the application process that the standing advice does not address, MSS should be contacted.

MSS Standing Advice for each stage of the EIA process

Scoping

MSS issued generic scoping guidelines (https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Research/onshoreren) which outline how fish populations can be impacted during the construction, operation and decommissioning of a wind farm development and informs developers as to what should be considered, in relation to freshwater and diadromous fish and fisheries, during the EIA process.

In addition to identifying the main watercourses and waterbodies within and downstream of the proposed development area, developers should identify and consider, at this early stage, any areas of Special Areas of Conservation where fish are a qualifying feature and proposed felling operations particularly in acid sensitive areas.

If a developer identifies new issues or has a technical query in respect of MSS generic scoping guidelines then ECU should be informed who will then co-ordinate a response from MSS.

Gate check

The detail within the generic scoping guidelines already provides sufficient information relating to water quality and salmon and trout populations for developers at this stage of the application.

Developers will be required to provide a gate check checklist (annex 1) in advance of their application submission which should signpost ECU to where all matters relevant to freshwater and diadromous fish and fisheries have been presented in the EIA report. Where matters have not been addressed or a different approach, to that specified in the advice, has been adopted the developer will be required to set out why.

EIA Report

MSS will focus on those developments which may be more sensitive and/or where there are known existing pressures on fish populations (https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/fishreform/licence/status/Pressures). The generic scoping guidelines should ensure that the developer has addressed all matters relevant to freshwater and diadromous fish and fisheries and presented them in the appropriate chapters of the EIA report. Use of the gate check checklist should ensure that the EIA report contains the required information; the absence of such information may necessitate requesting additional information which may delay the process:

Developers should specifically discuss and assess potential impacts and appropriate mitigation measures associated with the following:

- any designated area, for which fish is a qualifying feature, within and/or downstream of the proposed development area;
- the presence of a large density of watercourses;
- the presence of large areas of deep peat deposits;
- known acidification problems and/or other existing pressures on fish populations in the area; and
- proposed felling operations.

Post-Consent Monitoring

MSS recommends that a water quality and fish population monitoring programme is carried out to ensure that the proposed mitigation measures are effective. A robust, strategically designed and site specific monitoring programme conducted before, during and after construction can help to identify any changes, should they occur, and assist in implementing rapid remediation before long term ecological impacts occur.

MSS has published guidance on survey/monitoring programmes associated with onshore wind farm developments (https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Research/onshoreren) which developers should follow when drawing up survey and/or monitoring programmes.

If a developer considers that such a monitoring programme is not required then a clear justification should be provided.

Planning Conditions

MSS advises that planning conditions are drawn up to ensure appropriate provision for mitigation measures and monitoring programmes, should the development be given consent. We recommend, where required, that a Water Quality Monitoring Programme, Fisheries Monitoring Programme and the appointment of an Ecological Clerk of Works, specifically in overseeing the above monitoring programmes, is outlined within these conditions and that MSS is consulted on these programmes.

Wording suggested by MSS in relation to water quality, fish populations and fisheries for incorporation into planning consents:

1. No development shall commence unless a Water Quality and Fish Monitoring Plan (WQFMP) has been submitted to and approved in writing by the Planning Authority in consultation with Marine Scotland Science and any such other advisors or organisations.

2. The WQFMP must take account of the Scottish Government's Marine Scotland Science's guidelines and standing advice and shall include:

    a. water quality sampling should be carried out at least 12 months prior to construction commencing, during construction and for at least 12 months after construction is complete. The water quality monitoring plan should include key hydrochemical parameters, turbidity, and flow data, the identification of sampling locations (including control sites), frequency of sampling, sampling methodology, data analysis and reporting etc.;
    b. the fish monitoring plan should include fully quantitative electrofishing surveys at sites potentially impacted and at control sites for at least 12 months before construction commences, during construction and for at least 12 months after construction is completed to detect any changes in fish populations; and
    c. appropriate site specific mitigation measures detailed in the Environmental Impact Assessment and in agreement with the Planning Authority and Marine Scotland Science.

3. Thereafter, the WQFMP shall be implemented within the timescales set out to the satisfaction of the Planning Authority in consultation with Marine Scotland Science and the results of such monitoring shall be submitted to the Planning Authority on a 6 monthly basis or on request.

Reason: To ensure no deterioration of water quality and to protect fish populations within and downstream of the development area.

Sources of further information

Scottish Natural Heritage (SNH) guidance on wind farm developments - https://www.nature.scot/professional-advice/planning-and-development/advice-planners-and-developers/renewable-energy-development/onshore-wind-energy/advice-wind-farm

Scottish Environment Protection Agency (SEPA) guidance on wind farm developments – https://www.sepa.org.uk/environment/energy/renewable/#wind

A joint publication by Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, Historic Environment Scotland, MSS and Association of Environmental and Ecological Clerks of Works (2019) Good Practice during Wind Farm Construction - https://www.nature.scot/guidance-good-practice-during-wind-farm-construction.

A41

From: NATS Safeguarding <NATSSafeguarding@nats.co.uk>
Sent: 10 July 2020 09:02
To: Brown C (Carolanne) <Carolanne.Brown@gov.scot>
Cc: NATS Safeguarding <NATSSafeguarding@nats.co.uk>; Econsents Admin <Econsents_Admin@gov.scot>
Subject: RE: Quantans Hill Wind Farm proposal - scoping consultation (SG18627) OBJECTION

Dear Carolanne

We refer to the application above. The proposed development has been examined by our technical safeguarding teams and conflicts with our safeguarding criteria.

Accordingly, NATS (En Route) plc objects to the proposal. The reasons for NATS's objection are outlined in the attached report TOPA SG18627 Issue 2.

We would like to take this opportunity to draw your attention to the legal obligation of local authorities to consult NATS before granting planning permission for a wind farm. The obligation to consult arises in respect of certain applications that would affect a technical site operated by or on behalf of NATS (such sites being identified by safeguarding plans that are issued to local planning authorities).

In the event that any recommendations made by NATS are not accepted, local authorities are obliged to follow the relevant directions within Planning Circular 2 2003 - Scottish Planning Series: Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) (Scotland) Direction 2003 or Annex 1 - The Town And Country Planning (Safeguarded Aerodromes, Technical Sites And Military Explosives Storage Areas) Direction 2002.

These directions require that the planning authority notify both NATS and the Civil Aviation Authority ("CAA") of their intention. As this further notification is intended to allow the CAA to consider whether further scrutiny is required, the notification should be provided prior to any granting of permission.

It should also be noted that the failure to consult NATS, or to take into account NATS's comments when determining a planning application, could cause serious safety risks for air traffic.

Should you have any queries please contact us using the details below.

Yours faithfully

NATS

NATS Safeguarding

E: natssafeguarding@nats.co.uk

4000 Parkway, Whiteley,
Fareham, Hants PO15 7FL
www.nats.co.uk

A42

Prepared by:
NATS Safeguarding Office

Unmarked

Technical and Operational Assessment (TOPA)

For Quantans Hill

Windfarm Development

NATS ref: SG18627

LPA ref: ECU00002097

Issue 2

A43

Contents

A44

Notice

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Publication History

Issue	Month/Year	Change Requests and summary
1	December 2019	Pre-planning application
1.1	January 2020	Updated to include 3 turbine heights
2	July 2020	Scoping request received from Scottish Government

Document Use

External use: Yes

Referenced Documents

1. Background

1.1. En-route Consultation

NATS en-route plc is responsible for the safe and expeditious movement in the en-route phase of flight for aircraft operating in controlled airspace in the UK. To undertake this responsibility it has a comprehensive infrastructure of RADAR's, communication systems and navigational aids throughout the UK, all of which could be compromised by the establishment of a wind farm.

In this respect NATS is responsible for safeguarding this infrastructure to ensure its integrity to provide the required services to Air Traffic Control (ATC).

In order to discharge this responsibility NATS is a statutory consultee for all wind farm applications, and as such assesses the potential impact of every proposed development in the UK.

The technical assessment sections of this document define the assessments carried out against the development proposed in section 3.

2. Scope

This report provides NATS En-Route plc's view on the proposed application in respect of the impact upon its own operations and in respect of the application details contained within this report.

Where an impact is also anticipated on users of a shared asset (e.g. a NATS RADAR used by airports or other customers), additional relevant information may be included for information only. While an endeavour is made to give an insight in respect of any impact on other aviation stakeholders, it should be noted that this is outside of NATS' statutory obligations and that any engagement in respect of planning objections or mitigation should be had with the relevant stakeholder, although NATS as the asset owner may assist where possible.

3. Application Details

The Scottish Government submitted a request for a NATS technical and operational assessment (TOPA) for the development at Quantans Hill Windfarm. An indicative layout as detailed in table 1 was used with turbines assumed to be 250m in height.

Turbine	Easting	Northing
1	258417	595831
2	258518	594948
3	258996	595423
4	257551	594858
5	257959	595373
6	259469	594767
7	258702	594431
8	258215	593989
9	259084	593911
10	259732	594258
11	260574	594398
12	260745	594915
13	260907	593898
14	261446	594582
15	261753	594025
16	261459	593478
17	261095	595397
18	261731	595783
19	261540	596299
20	260587	593403
21	260403	592886

Table 1 – Turbine Details

4. Assessments Required

The proposed development falls within the assessment area of the following systems:

RADAR	Lat	Long	nm	km	Az (deg)	Type
Clee Hill Radar	52.3983	-2.5975	178.8	331.1	342.0	CMB
Great Dun Fell Radar	54.6841	-2.4509	68.3	126.4	298.9	CMB
Lowther Hill Radar	55.3778	-3.7530	17.6	32.6	240.3	CMB
Perwinnes Radar	57.2123	-2.1309	137.6	254.9	211.2	CMB
Tiree Radar	56.4556	-6.9230	116.9	216.6	127.7	CMB
Nav	**Lat**	**Long**	**nm**	**km**	**Az (deg)**	**Type**
New Galloway	55.1774	-4.1686	2.7	4.9	332.7	NDB
AGA	**Lat**	**Long**	**nm**	**km**	**Az (deg)**	**Type**
None						

Table 2 – Impacted Infrastructure

A47

4.1. En-route RADAR Technical Assessment

4.1.1. Predicted Impact on Great Dun Fell RADAR

Using the theory as described in Appendix A and development specific propagation profile it has been determined that the terrain screening available will not adequately attenuate the signal, and therefore this development is likely to cause false primary plots to be generated. A reduction in the RADAR's probability of detection, for real aircraft, is also anticipated. All three turbine heights were assessed as being visible to Great Dun Fell.

4.1.2. Predicted Impact on Lowther RADAR

Using the theory as described in Appendix A and development specific propagation profile it has been determined that the terrain screening available will not adequately attenuate the signal, and therefore this development is likely to cause false primary plots to be generated. A reduction in the RADAR's probability of detection, for real aircraft, is also anticipated. All three turbine heights were assessed as being visible to Lowther.

4.1.3. En-route operational assessment of RADAR impact

Where an assessment reveals a technical impact on a specific NATS' RADAR, the users of that RADAR are consulted to ascertain whether the anticipated impact is acceptable to their operations or not.

Unit or role	Comment
Engineering	Unacceptable
Prestwick ATC	Unacceptable

Note: The technical impact, as detailed above, has also been passed to non-NATS users of the affected RADAR, this may have included other planning consultees such as the MOD or other airports. Should these users consider the impact to be unacceptable it is expected that they will contact the planning authority directly to raise their concerns.

4.2. En-route Navigational Aid Assessment

4.2.1. Predicted Impact on Navigation Aids

No impact is anticipated on NATS' navigation aids.

4.3. En-route Radio Communication Assessment

4.3.1. Predicted Impact on the Radio Communications Infrastructure

No impact is anticipated on en-route radio communication aids.

5. Conclusions

5.1. En-route Consultation

The proposed development has been examined by technical and operational safeguarding teams. A technical impact is anticipated, this has been deemed to be unacceptable for the three proposed heights.

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Appendix A – Background RADAR Theory

Primary RADAR False Plots

When RADAR transmits a pulse of energy with a power of P_t the power density, P, at a range of r is given by the equation:

$$P = \frac{G_t P_t}{4\pi r^2}$$

Where G_t is the gain of the RADAR's antenna in the direction in question.

If an object at this point in space has a RADAR cross section of σ, this can be treated as if the object re-radiates the pulse with a gain of σ and therefore the power density of the reflected signal at the RADAR is given by the equation:

$$P_a = \frac{\sigma P}{4\pi r^2} = \frac{\sigma G_t P_t}{(4\pi)^2 r^4}$$

The RADAR's ability to collect this power and feed it to its receiver is a function of its antenna's effective area, A_e, and is given by the equation:

$$P_r = P_a A_e = \frac{P_a G_r \lambda^2}{4\pi} = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r^4}$$

Where G_t is the RADAR antenna's receive gain in the direction of the object and λ is the RADAR's wavelength.

In a real world environment this equation must be augmented to include losses due to a variety of factors both internal to the RADAR system as well as external losses due to terrain and atmospheric absorption.

For simplicity these losses are generally combined in a single variable L.

$$P_r = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r^4 L}$$

Secondary RADAR Reflections

When modelling the impact on SSR the probability that an indirect signal reflected from a wind turbine has the signal strength to be confused for a real interrogation or reply can determined from a similar equation:

$$P_r = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r_t^2 r_r^2 L}$$

Where r_t and r_r are the range from RADAR-to-turbine and turbine-to-aircraft respectively. This equation can be rearranged to give the radius from the turbine within which an aircraft must be for reflections to become a problem.

$$r_r = \sqrt{\frac{\lambda^2}{(4\pi)^3}} \sqrt{\frac{\sigma G_t G_r P_t}{r_t^2 P_r L}}$$

Shadowing

When turbines lie directly between a RADAR and an aircraft not only do they have the potential to absorb or deflect, enough power such that the signal is of insufficient level to be detected on arrival.

It is also possible that azimuth determination, whether this done via sliding window or monopulse, can be distorted giving rise to inaccurate position reporting.

Terrain and Propagation Modelling

All terrain and propagation modelling is carried out by a software tool called ICS Telecom (version 11.1.7). All calculations of propagation losses are carried out with ICS Telecom configured to use the ITU-R 526 propagation model.

Appendix B – Diagrams

Figure 1: Proposed development location shown on an airways chart

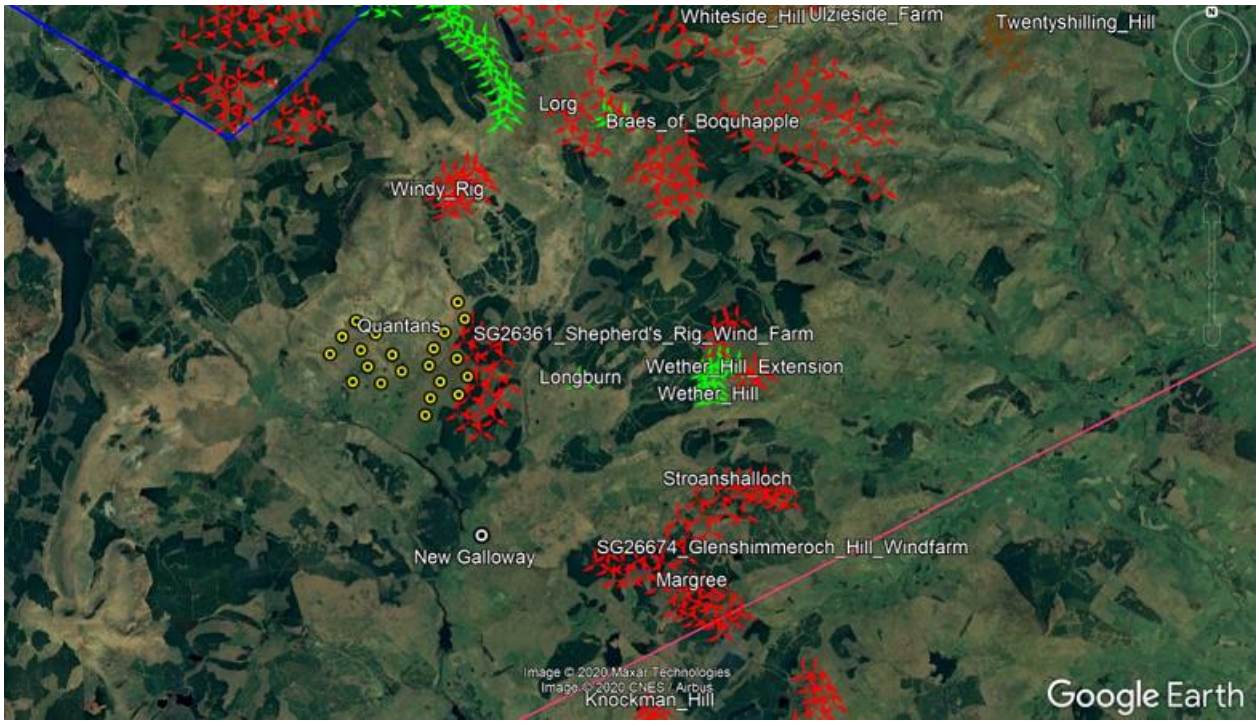

Figure 2: Proposed development location

consented/built
impact –accepted
impact –objection
mitigated
mitigation –proposed
no impact
refused/withdrawn

A52

Energy Consents
Directorate for Energy and Climate Change
Scottish Government
4th Floor
5 Atlantic Quay
150 Broomielaw
Glasgow
G2 8LU

14/07/2020

Dear Carolanne,

Scoping Opinion Request – Quantans Hill Wind Farm
ECU00002097

Thank you for consulting RSPB Scotland on the above-referenced wind farm scoping. We include our comments and answers to the questions posed in chapter 8 of the scoping report in the attached annex 1. If there is anything you wish to discuss further regarding our comments, please don't hesitate to get in touch.

Yours faithfully,

REDACT
Conservation Officer – Scottish Lowlands and Southern Uplands
REDACTED

REDACTE

Annex 1

1. Is the proposed scope and extent of the available and proposed baseline data considered to be sufficient to inform a reliable assessment of the potential effects of the proposed development?

We welcome the fact that two years' worth of ornithological data has been gathered and we broadly agree that it is enough to inform a reliable assessment of the potential effects of the proposed development. However, we would have liked to have seen targeted flight activity surveys with an emphasis on dawn and dusk for migrating swans and geese during spring and autumn passage. In addition, we would recommend consulting the Wildfowl and Wetlands Trust (WWT) for data on migrating geese and swans.

Also, of concern is the presence of a black grouse lek and the high flight activity recorded for red kite, and we would expect to see detail of assessment of impact to these species and the appropriate level of mitigation measures outlined in the environmental impact assessment. This should include assessment of cumulative impact from other developments in combination with this project.

2. Do the consultees agree with the list of key potential receptors for the EIA and with the issues to be scoped out of the assessment?

We agree with the issues to be scoped out of the assessment. We are happy with the assessment process and agree with the list of key potential receptors. We welcome the proposal to assess these receptors in the context of key biodiversity policy, including the 2020 Challenge for Scotland's Biodiversity.

Furthermore, we note that there is peat present on the development site (Chapter 10 of the scoping report) and we would wish to see every effort made to avoid any form of construction on deep peat or soils supporting annex 1 habitats.

A54

REDACTED

14 July 2020

Carolanne Brown
Energy Consent Unit
Scottish Government
by email

Dear Ms Brown

THE ELECTRICITY ACT 1989 THE ELECTRICITY WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017

SCOPING OPINION REQUEST– QUANTANS HILL WIND FARM PROPOSAL, DUMFRIES & GALLOWAY

Thank you for consulting Scottish Forestry on the on Scoping Report for the proposed Quantans Hill Wind Farm (proposed development).

Scottish Forestry is the Scottish Government agency responsible for policy, support and regulation of the forestry sector in Scotland. As such Scottish Forestry comments on the potential impact of development proposals on forests and woodlands and not Forestry and Land Scotland (FLS), as described in section 2.14 of the Scoping Report.

FLS are a separate executive agency of Scottish Government, responsible for the management of Scotland's national forests and land.

The applicant should note there is a requirement to consult Scottish Forestry on development proposals that may have an impact on any type of woodland and not just commercial forestry, as described in section 2.14 of the Scoping Report.

There are several small blocks of existing woodland located within the site boundary. The indicative location of turbines presented in Figure 1: Site Layout would currently suggest there would be no potential impact on these as a result of the proposed development.

Should the location of the turbines change which would require any of these woodlands to be felled for the purposes of the development then this will need to be considered in relation to the requirements of the Scottish Government's Control of Woodland Removal Policy and other relevant guidance. https://forestry.gov.scot/publications/349-scottish-government-s-policy-on-control-of-woodland-removal-implementation-guidance/viewdocument

Scottish Forestry have received an application for 50 hectares of woodland creation under our Forestry Grant Scheme within the proposed site boundary, between the Polhay and Marbrack Burns including the indicative location of Turbine 6 . Application reference: 20FGS49683 is still under consideration and is currently on our public register for comment. Further detail can be obtained by entering the aforementioned reference at https://casebook.forestry.scot/w/webpage/prhome or by contacting South Scotland Conservancy office directly on the email address provided above.

Should there be a requirement to undertake any felling, restocking or compensatory planting proposals as a result of the development then these must be compliant with the UK Forestry Standard, the reference standard for sustainable forest management in the UK.
https://forestry.gov.scot/sustainable-forestry/ukfs-scotland

Please don't hesitate to contact me if you have any question regarding Scottish Forestry's response.

Kind regards

REDACTED

Martin MacKinnon

A56

Wednesday, 08 July 2020

Local Planner
Energy Consents Unit
5 Atlantic Quay
Glasgow
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Development Operations
The Bridge
Buchanan Gate Business Park
Cumbernauld Road
Stepps
Glasgow
G33 6FB

Development Operations
Freephone Number - 0800 3890379
E-Mail - DevelopmentOperations@scottishwater.co.uk
www.scottishwater.co.uk

Dear Sir/Madam

SITE: Quantans Hill Wind Farm, , Quantans Hill, DG7 3TF
PLANNING REF: ECU00002097
OUR REF: DSCAS-0017306-9MD
PROPOSAL: Wind Farm (Generating station of >100 <200 MW Capacity)

Please quote our reference in all future correspondence

Audit of Proposal

Scottish Water has no objection to this planning application; however, the applicant should be aware that this does not confirm that the proposed development can currently be serviced and would advise the following:

Water Capacity Assessment

Scottish Water has carried out a Capacity review and we can confirm the following:

- There is currently sufficient capacity in the CARSPHAIRN Water Treatment Works to service your development. However, please note that further investigations may be required to be carried out once a formal application has been submitted to us.

Waste Water Capacity Assessment

- Unfortunately, according to our records there is no public Scottish Water, Waste Water infrastructure within the vicinity of this proposed development therefore we would advise applicant to investigate private treatment options.

Please Note

- The applicant should be aware that we are unable to reserve capacity at our water and/or waste water treatment works for their proposed development. Once a formal connection application is submitted to Scottish Water after full planning permission has been granted, we will review the availability of capacity at that time and advise the applicant accordingly.

Asset Impact Assessment

According to our records, the development proposals impact on existing Scottish Water assets.

The applicant must identify any potential conflicts with Scottish Water assets and contact our Asset Impact Team via our Customer Portal to apply for a diversion.

The applicant should be aware that any conflict with assets identified may be subject to restrictions on proximity of construction. Please note the disclaimer at the end of this response.

Drinking Water Protected Areas

A review of our records indicates that the proposed activity falls within a drinking water catchment where a Scottish Water abstraction is located. Scottish Water abstractions are designated as Drinking Water Protected Areas (DWPA) under Article 7 of the Water Framework Directive. The Carsfad catchment supplies Lochinvar Water Treatment Works (WTW) and it is essential that water quality and water quantity in the area are protected. In the event of an incident occurring that could affect Scottish Water we should be notified without delay using the Customer Helpline number 0800 0778 778.

The site lies close to the raw water intake for Carsphairn fed by Benloch Burn so travel times of any pollution event will be short, with no large body of water to dilute potential contaminants. There is also potential for changes to the drainage patterns of the catchment reducing the yield of the source in the long term, the entire catchment is within the works area which risks disruption.

Scottish Water would deem this development to have a high risk to water quality and quantity with 5 of the 21 turbines being particularly close to the raw water intake. It would be our preference for the number of turbines to be reduced within the catchment and as many situated out with the catchment as possible.

Scottish Water have produced a list of precautions for a range of activities. This details protection measures to be taken within a DWPA, the wider drinking water catchment and if there are assets in the area. Please note that site specific risks and mitigation measures will require to be assessed and implemented. These documents and other supporting information can be found on the activities within our catchments page of our website at www.scottishwater.co.uk/slm.

We would welcome reference is made to the Scottish Water drinking water catchment and the fact that this area is located within a drinking water catchment should be noted in all future documentation. Also anyone working on site should be made aware of this during site inductions.

We would request further involvement at the more detailed design stages, if changes to the turbine layout cannot be altered we need to determine the most appropriate proposals and mitigation within the catchment to protect water quality and quantity.

In particular we would want sight of a more detailed access track and drainage layout design plan.

We would also like to take the opportunity, to request that 3 months in advance of any works commencing on site, Scottish Water is notified at protectdwsources@scottishwater.co.uk. This will enable us to be aware of activities in the catchment and to determine if a site meeting would be appropriate and beneficial.

A contingency fund may also need to be agreed in advance of any works commencing on site to protect Scottish Water and our customers.

Surface Water

For reasons of sustainability and to protect our customers from potential future sewer flooding, Scottish Water will not accept any surface water connections into our combined sewer system.

There may be limited exceptional circumstances where we would allow such a connection for brownfield sites only, however this will require significant justification from the customer taking account of various factors including legal, physical, and technical challenges.

In order to avoid costs and delays where a surface water discharge to our combined sewer system is anticipated, the developer should contact Scottish Water at the earliest opportunity with strong evidence to support the intended drainage plan prior to making a connection request. We will assess this evidence in a robust manner and provide a decision that reflects the best option from environmental and customer perspectives.

General notes:

- Scottish Water asset plans can be obtained from our appointed asset plan providers:
    - Site Investigation Services (UK) Ltd
    - Tel: 0333 123 1223
    - Email: sw@sisplan.co.uk
    - www.sisplan.co.uk
- Scottish Water's current minimum level of service for water pressure is 1.0 bar or 10m head at the customer's boundary internal outlet. Any property which cannot be adequately serviced from the available pressure may require private pumping arrangements to be installed, subject to compliance with Water Byelaws. If the developer wishes to enquire about Scottish Water's procedure for checking the water pressure in the area, then they should write to the Customer Connections department at the above address.
- If the connection to the public sewer and/or water main requires to be laid through land out-with public ownership, the developer must provide evidence of formal approval from the affected landowner(s) by way of a deed of servitude.

- Scottish Water may only vest new water or waste water infrastructure which is to be laid through land out with public ownership where a Deed of Servitude has been obtained in our favour by the developer.

- The developer should also be aware that Scottish Water requires land title to the area of land where a pumping station and/or SUDS proposed to vest in Scottish Water is constructed.

- Please find information on how to submit application to Scottish Water at our Customer Portal.

Next Steps:

All Proposed Developments

All proposed developments require to submit a Pre-Development Enquiry (PDE) Form to be submitted directly to Scottish Water via our Customer Portal prior to any formal Technical Application being submitted. This will allow us to fully appraise the proposals.

Where it is confirmed through the PDE process that mitigation works are necessary to support a development, the cost of these works is to be met by the developer, which Scottish Water can contribute towards through Reasonable Cost Contribution regulations.

Non Domestic/Commercial Property:

Since the introduction of the Water Services (Scotland) Act 2005 in April 2008 the water industry in Scotland has opened to market competition for non-domestic customers. All Non-domestic Household customers now require a Licensed Provider to act on their behalf for new water and waste water connections. Further details can be obtained at www.scotlandontap.gov.uk

Trade Effluent Discharge from Non Dom Property:

- Certain discharges from non-domestic premises may constitute a trade effluent in terms of the Sewerage (Scotland) Act 1968. Trade effluent arises from activities including; manufacturing, production and engineering; vehicle, plant and equipment washing, waste and leachate management. It covers both large and small premises, including activities such as car washing and launderettes. Activities not covered include hotels, caravan sites or restaurants.
- If you are in any doubt as to whether the discharge from your premises is likely to be trade effluent, please contact us on 0800 778 0778 or email TEQ@scottishwater.co.uk using the subject “Is this Trade Effluent?". Discharges that are deemed to be trade effluent need to apply separately for permission to discharge to the sewerage system. The forms and application guidance notes can be found here.
- Trade effluent must never be discharged into surface water drainage systems as these are solely for draining rainfall run off.

A60

- For food services establishments, Scottish Water recommends a suitably sized grease trap is fitted within the food preparation areas, so the development complies with Standard 3.7 a) of the Building Standards Technical Handbook and for best management and housekeeping practices to be followed which prevent food waste, fat oil and grease from being disposed into sinks and drains.
- The Waste (Scotland) Regulations which require all non-rural food businesses, producing more than 50kg of food waste per week, to segregate that waste for separate collection. The regulations also ban the use of food waste disposal units that dispose of food waste to the public sewer. Further information can be found at www.resourceefficientscotland.com

I trust the above is acceptable however if you require any further information regarding this matter please contact me REDACTED via the e-mail address below or at planningconsultations@scottishwater.co.uk.

Yours sincerely,

Pamela Strachan
Development Operations Analyst
developmentoperations@scottishwater.co.uk

Scottish Water Disclaimer:

"It is important to note that the information on any such plan provided on Scottish Water's infrastructure, is for indicative purposes only and its accuracy cannot be relied upon. When the exact location and the nature of the infrastructure on the plan is a material requirement then you should undertake an appropriate site investigation to confirm its actual position in the ground and to determine if it is suitable for its intended purpose. By using the plan you agree that Scottish Water will not be liable for any loss, damage or costs caused by relying upon it or from carrying out any such site investigation."

A61

ScotWays
Upholding public access

Econsents_Admin@gov.scot

Carolanne Brown
Energy Consents
Directorate for Energy and Climate Change
The Scottish Government

05/08/2020

Dear Ms Brown,

THE ELECTRICITY ACT 1989
THE ELECTRICITY WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017

SCOPING OPINION REQUEST– QUANTANS HILL WIND FARM PROPOSAL, DUMFRIES & GALLOWAY

Thank you for your email of 30 June 2020 requesting a scoping response for the above proposed wind energy development. We gratefully acknowledge the additional time allowed for this response. Here, we have focussed on the immediate area of the proposed application.

The National Catalogue of Rights of Way shows that right of way DS15 is affected by the area shown outlined in red on *Figure 1: Site layout*. The enclosed RoW map shows the recorded line of DS15. As there is no definitive record of rights of way in Scotland, there may be other routes that meet the criteria to be rights of way but have not been recorded as they have not yet come to our notice.

Although not directly affected by the application site '*other route'* DS8 terminates on the application site boundary. This route is shown on the enclosed *Enquiries map_Other*.

There are routes which are promoted by the *Heritage Paths* project and routes described in our popular book *Scottish Hill Tracks* in the wider vicinity.

If required to inform the Environmental Impact Assessment (EIA), maps of a wider search area are available from the Society.

You will no doubt be aware that there may now be general access rights over any area of land under the terms of the Land Reform (Scotland) Act 2003. We note that the Core Paths Plan, prepared by Dumfries and Galloway Council as part of their duties under this Act has been consulted.

ScotWays is concerned with wind farm impacts on public recreational access. In addressing public access *14.1* the applicant states '*The locations of all footpaths will be considered during the iterative design process'* and illustrates the routes on *Figure 3: Site Constraints*. This figure shows a core path in addition to the right of way. In the text *14.1* the applicant uses the term *footpath* in relation to the routes identified: they should be aware that core paths are available to all non-motorised users and as such may be used by cyclists and equestrians in addition to those on foot.

With reference to right of way DS15 *14.1* goes on to state that it *'does not appear to physically exist on site'*. Our records indicate that, although it is possible to walk right of way DS15, there is no trace of a 'physical' path. Regarding this point, it is important to note that a right of way does not need to follow a definite path or track as opposed to a more or less consistent and generally defined line. For example, across moorland there may be many different lines, dependent upon the weather and the state of the ground. However, in this case, although it appears likely that right of way DS15 is an indicative line, we are aware that historic maps show a similar line to that recorded as the right of way.

The applicant closes para *14.1* '*Nonetheless, a safe passage across the site will be maintained'.* We are pleased to note this and would anticipate that measures be put in place to ensure continued public access across the site particularly along the right of way.

Within the scoping documentation there is no indication of the siting of the internal wind farm access tracks. Given that DS15 crosses the site, and that there are indicative turbine locations on both sides of the route, it is likely that it will be affected by any new access tracks. The impact of the proposed development on public recreational access needs to be fully considered. We would anticipate that an Access Management Plan be drawn up in consultation with the access team at Dumfries and Galloway Council, in order to ensure continued public recreational access at all stages of the proposed development.

Although we understand that there is very little guidance regarding the siting of turbines in relation to established paths and rights of way, we would like to draw your attention to the following:

Extract from the Welsh Assembly Government's Technical Advice Note on Renewable Energy (TAN 8)

Proximity to Highways and Railways

2.25 It is advisable to set back all wind turbines a minimum distance, equivalent to the height of the blade tip, from the edge of any public highway (road or other public right of way) or railway line.

The application site is crossed by right of way DS15: in light of the above guidance note we would seek clarification on the minimum separation distances between this route and the turbines as it appears that the proposal is to site at least one turbine in close proximity to DS15.

As well as direct impacts on public access, impacts on recreational amenity are of interest to the Society. We are concerned about the impact the proposed wind farm development will have on the amenity of the *Southern Upland Way (*SUW*).* As we are aware of a large number of wind farm applications along this nationally important route the Society anticipates that the cumulative impact on the length of the SUW, designated as one of *Scotland's Great Trails* by *Scottish Natural Heritage*, will be taken into account.

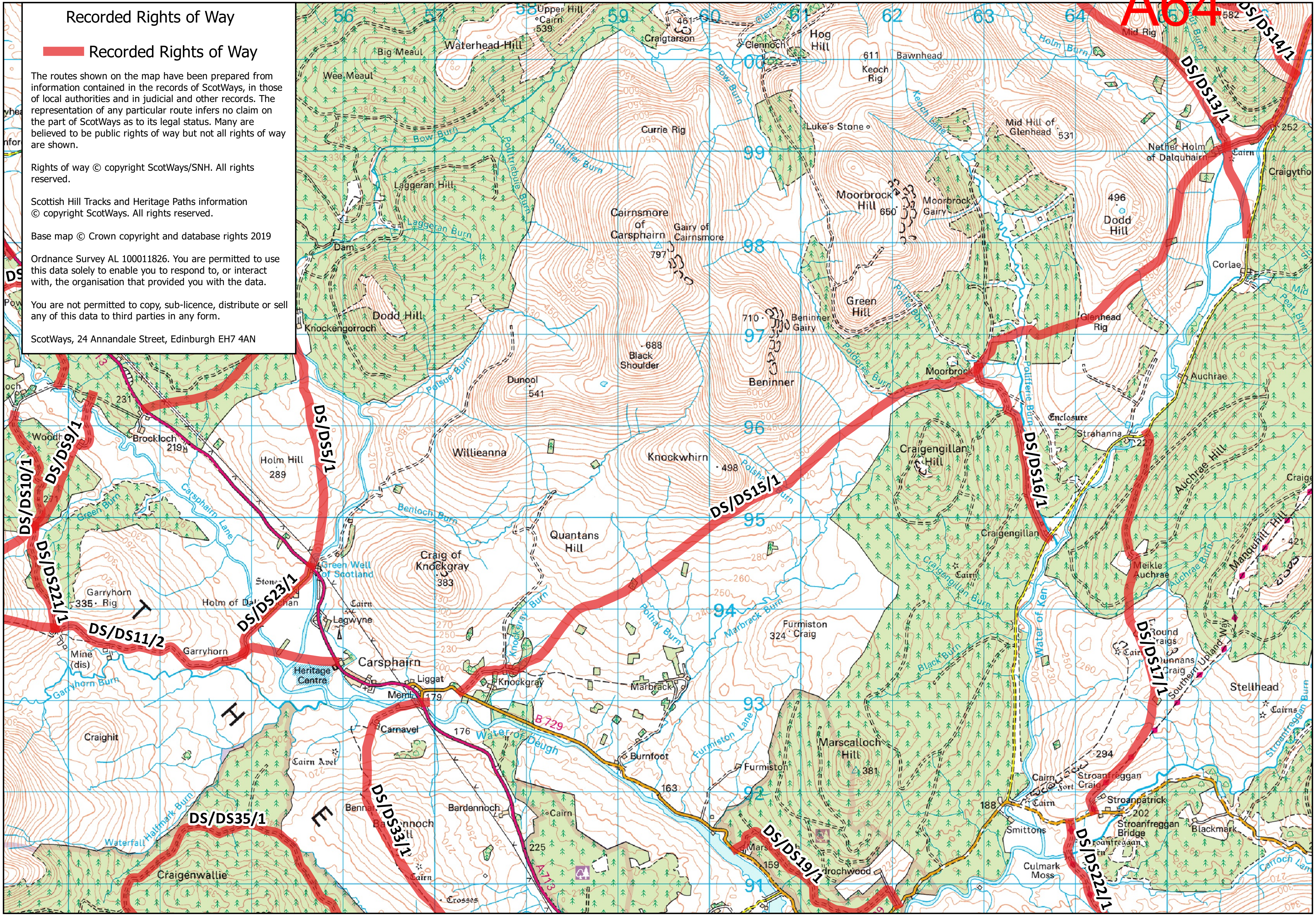
I hope the information above is useful to you. Please do not hesitate to contact me if you need more detail or have any further queries.

Yours sincerely,

REDACTED

Lynda L Grant
Access Officer

Cc Matthew Bacon Vattenfall Wind Power Ltd



Recorded Rights of Way
Recorded Rights of Way
The routes shown on the map have been prepared from information contained in the records of ScotWays, in those of local authorities and in judicial and other records. The representation of any particular route infers no claim on the part of ScotWays as to its legal status. Many are believed to be public rights of way but not all rights of way are shown.
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ScotWays, 24 Annandale Street, Edinburgh EH7 4AN
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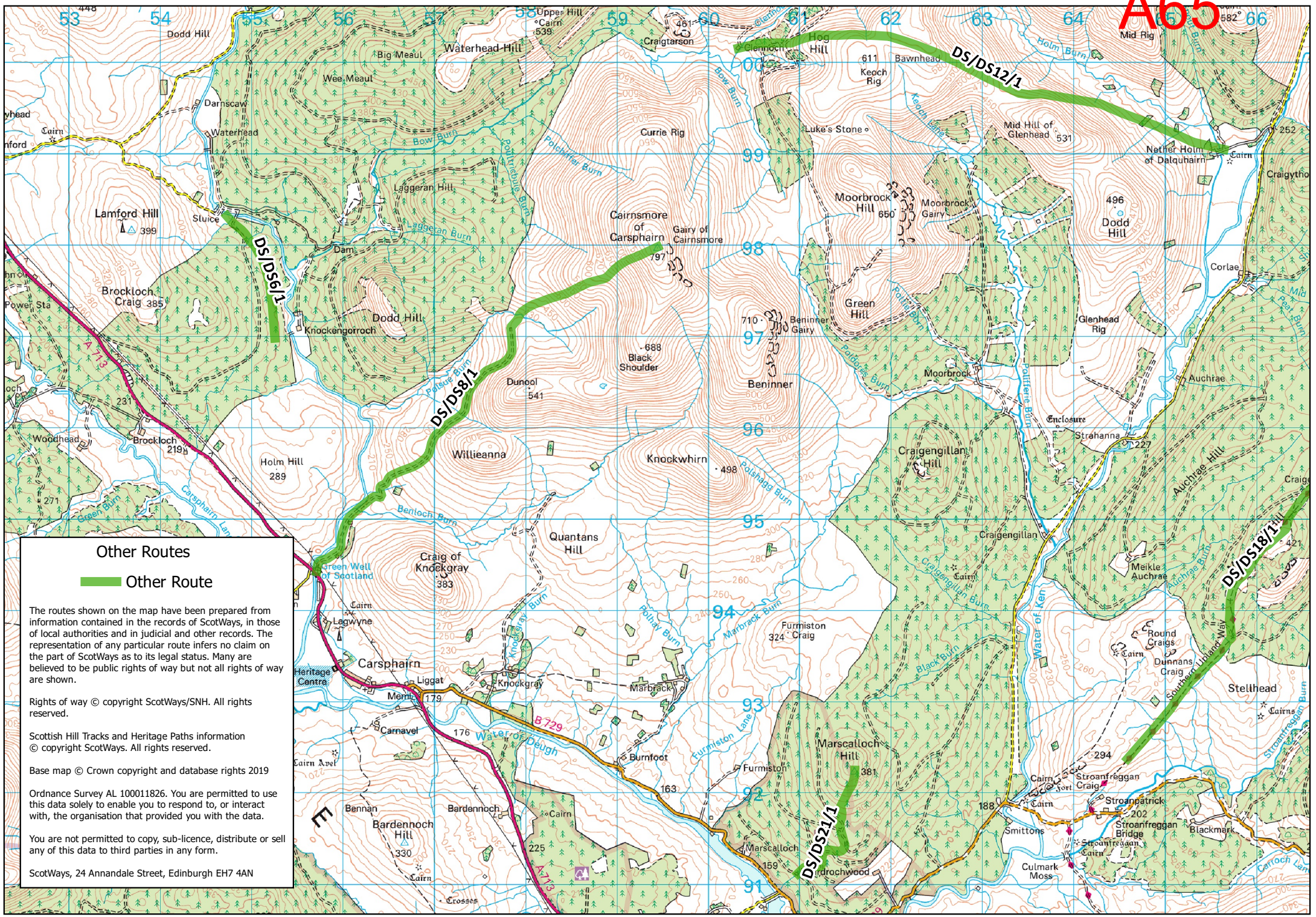
DS/DS14/1
DS/DS13/1
DS/DS16/1
DS/DS15/1
DS/DS17/1
DS/DS5/1
DS/DS9/1
DS/DS10/1
DS/DS221/1
DS/DS11/2
DS/DS23/1
DS/DS33/1
DS/DS35/1
DS/DS19/1
DS/DS22/1
Cairnsmore of Carsphairn
Carsphairn
Heritage Centre
Green Well of Scotland
Knockgray
Marbrack
Craig of Knockgray
Quantans Hill
Knockwhirn
Willieanna
Dunool
Black Shoulder
Beninner
Moorbrock Hill
Moorbrock
Green Hill
Dodd Hill
Craigengillan Hill
Craigengillan
Auchrae
Strahanna
Marscalloch Hill
Furmiston
Bardennoch
Carnavel
Craigenwallie
Garryhorn
Brockloch
Holm Hill
Lagwyne
Water of Deugh
Water of Ken
Southern Upland Way
Stellhead
Corlae
Craigtarson
Clennoch
Hog Hill
Keoch Rig
Bawnhead
Currie Rig
Laggeran Hill
Big Meaul
Wee Meaul
Waterhead Hill
Knockengorroch
Craighit
Smittons
Culmark Moss
Blackmark
Stroanpatrick
Stroanfreggan Bridge


A65
DS/DS12/1
DS/DS6/1
DS/DS8/1
DS/DS18/1
DS/DS21/1
Other Routes
Other Route
The routes shown on the map have been prepared from information contained in the records of ScotWays, in those of local authorities and in judicial and other records. The representation of any particular route infers no claim on the part of ScotWays as to its legal status. Many are believed to be public rights of way but not all rights of way are shown.
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ScotWays, 24 Annandale Street, Edinburgh EH7 4AN

A66

Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Our ref: PCS/172013
Your ref: ECU00002097

If emailing, please mark
FAO Graham Andrews

Carolanne Brown
Scottish Government
4th Floor
5 Atlantic Quay
150 Broomielaw
Glasgow
G2 8LU

13 August 2020

By email only to: Econsents_Admin@gov.scot

Dear Ms Brown

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000
The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
SCOPING OPINION REQUEST QUANTANS HILL WIND FARM PROPOSAL DUMFRIES & GALLOWAY

Thank you for consulting SEPA on the scoping opinion for the above development proposal by your email received on 01 July 2020. We would welcome engagement with the applicant at an early stage to discuss any of the issues raised in this letter.

Advice to the planning authority

To streamline planning, please note in accordance with Table 1 of Planning Advice Note 1/2013 we need only be consulted at the screening stage in exceptional circumstances. Based on the information submitted to us we consider that, with respect to interests relevant to our remit, the proposed development will be **likely to have a significant effect** (in the context of the Regulations) on the water environment, flood risk and ecology and therefore Environmental Impact Assessment (EIA) is required. To **avoid delay and potential objection,** the information outlined below and in the attached appendix must be submitted in support of the application. In summary this must include:

We consider that the following key issues must be addressed in the Environmental Impact Assessment process. To **avoid delay and potential objection,** the information outlined below and in the attached appendix must be submitted in support of the application.

a) Map and assessment of all engineering activities in or impacting on the water environment including proposed buffers, details of any flood risk assessment and details of any related CAR applications.

b) Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers.

c) Map and assessment of impacts upon groundwater abstractions and buffers.

d) Peat depth survey and table detailing re-use proposals.

e) Map and table detailing forest removal.

f) Map and site layout of borrow pits.

g) Schedule of mitigation including pollution prevention measures.

h) Borrow Pit Site Management Plan of pollution prevention measures.

i) Map of proposed water abstractions including details of the proposed operating regime.

j) Decommissioning statement.

Further details on these information requirements and the form in which they must be submitted can be found in the attached appendix. We also provide site specific comments in the following section which can help the developer focus the scope of the assessment.

1. Site specific comments

- In this case, where much of the site is on peat, we expect the application to be supported by a comprehensive site specific Peat Management Plan.

- Given the location of the construction, the applicant is required to produce a biosecurity plan. The site will require a 'complex' Construction Site Licence (CSL).

- We have identified that there are potentially sensitive flood risk receptors which could be affected by the proposals, namely the settlement of Carsphain which has a history of flood events. You should therefore seek input from flood risk professionals in designing the scheme to deal with these issues. A Flood Risk Assessment (FRA) must be produced which should demonstrate that construction will have a neutral impact.

- In terms of ecology, extensive comments were made in the previous SEPA response (ref: PCS/145603) sent on 11 March 2016.

- The scoping does not include any reference to American Signal Crayfish or discuss potential mitigation (i.e. biosecurity measures). This invasive species is present in the Loch Ken catchment and there is a risk that it might be present in the upper catchment. This needs to be ruled out by surveying for the species.

Regulatory advice for the applicant

2. Regulatory requirements

2.1 Authorisation is required under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) to carry out engineering works in or in the vicinity of inland surface waters (other than groundwater) or wetlands. Inland water means all standing or flowing water on the surface of the land (e.g. rivers, lochs, canals, reservoirs).

2.2 Management of surplus peat or soils may require an exemption under The Waste Management Licensing (Scotland) Regulations 2011. Proposed crushing or screening will require a permit under The Pollution Prevention and Control (Scotland) Regulations 2012. Consider if other environmental licences may be required for any installations or processes.

2.3 A Controlled Activities Regulations (CAR) construction site licence will be required for management of surface water run-off from a construction site, including access tracks, which:

- is more than 4 hectares,
- is in excess of 5km, or
- includes an area of more than 1 hectare or length of more than 500m on ground with a slope in excess of 25˚

See SEPA's Sector Specific Guidance: Construction Sites (WAT-SG-75) for details. Site design may be affected by pollution prevention requirements and hence we strongly encourage the applicant to engage in pre-CAR application discussions with a member of the regulatory services team in your local SEPA office.

2.4 Below these thresholds you will need to comply with CAR General Binding Rule 10 which requires, amongst other things, that all reasonable steps must be taken to ensure that the discharge does not result in pollution of the water environment. The detail of how this is achieved may be required through a planning condition.

2.5 Details of regulatory requirements and good practice advice for the applicant can be found on the Regulations section of our website or by contacting waterpermitting@sepa.org.uk or wastepermitting@sepa.org.uk.

If you have queries relating to this letter, please contact me by e-mail at planning.sw@sepa.org.uk.

Yours sincerely

Graham Andrews
Planning Officer
Planning Service

Disclaimer
This advice is given without prejudice to any decision made on elements of the proposal regulated by us, as such a decision may take into account factors not considered at this time. We prefer all the technical information required for any SEPA consents to be submitted at the same time as the planning or similar application. However, we consider it to be at the applicant's commercial risk if any significant changes required during the regulatory stage necessitate a further planning application or similar application and/or neighbour notification or advertising. We have relied on the accuracy and completeness of the information supplied to us in providing the above advice and can take no responsibility for incorrect data or interpretation, or omissions, in such information. If we have not referred to a particular issue in our response, it should not be assumed that there is no impact associated with that issue. For planning applications if you did not specifically request advice on flood risk, then advice will not have been provided on this issue. Further information on our consultation arrangements generally can be found on our website planning pages.

Appendix 1: Detailed scoping requirements

This appendix sets out our scoping information requirements. There may be opportunities to scope out some of the issues below depending on the site. Evidence must be provided in the submission to support why an issue is not relevant for this site in order **to avoid delay and potential objection**.

If there is a delay between scoping and the submission of the application then please refer to our website for our latest information requirements as they are regularly updated; current best practice must be followed.

We would welcome the opportunity to comment on the draft submission. As we can process files of a maximum size of only 25MB the submission must be divided into appropriately named sections of less than 25MB each.

1. Site layout

1.1 All maps must be based on an adequate scale with which to assess the information. This could range from OS 1: 10,000 to a more detailed scale in more sensitive locations. Each of the maps below must detail all proposed upgraded, temporary and permanent site infrastructure. This includes all tracks, excavations, buildings, borrow pits, pipelines, cabling, site compounds, laydown areas, storage areas and any other built elements. Existing built infrastructure must be re-used or upgraded wherever possible. The layout should be designed to minimise the extent of new works on previously undisturbed ground. For example, a layout which makes use of lots of spurs or loops is unlikely to be acceptable. Cabling must be laid in ground already disturbed such as verges. A comparison of the environmental effects of alternative locations of infrastructure elements, such as tracks, may be required.

2. Engineering activities which may have adverse effects on the water environment

2.1 The site layout must be designed to avoid impacts upon the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided then the submission must include justification of this and a map showing:

a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses.

b) A minimum buffer of 50m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works.

c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.

2.2 If water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.

2.3 Further advice and our best practice guidance are available within the water engineering section of our website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide.

2.4 Refer to Appendix 2 of our Standing Advice for advice on flood risk. Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment. Please also refer to Controlled Activities Regulations (CAR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities.

3. Disturbance and re-use of excavated peat and other carbon rich soils

3.1 Scottish Planning Policy states (Paragraph 205) that "Where peat and other carbon rich soils are present, applicants must assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO_2 to the atmosphere. Developments must aim to minimise this release."

3.2 The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat. There is often less environmental impact from localised temporary storage and reuse rather than movement to large central peat storage areas.

3.3 The submission must include:

a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems.

b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.

3.4 To avoid delay and potential objection proposals must be in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and our Developments on Peat and Off-Site uses of Waste Peat.

3.5 Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation.

3.6 Please note we do not validate carbon balance assessments except where requested to by Scottish Government in exceptional circumstances. Our advice on the minimisation of peat disturbance and peatland restoration may need to be taken into account when you consider such assessments.

4. Disruption to Groundwater Dependent Terrestrial Ecosystems (GWDTE)

4.1 GWDTE are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. The following information must be included in the submission:

a) A map demonstrating that all GWDTE are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it.

b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.

4.2 Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice and the minimum information we require to be submitted.

5. Existing groundwater abstractions

5.1 Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. The submission must include:

a) A map demonstrating that all existing groundwater abstractions are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it.

b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected.

5.2 Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice on the minimum information we require to be submitted.

6. Forest removal and forest waste

6.1 Key holing must be used wherever possible as large scale felling can result in large amounts of waste material and in a peak release of nutrients which can affect local water quality. The supporting information should refer to the current Forest Plan if one exists and measures should comply with the Plan where possible.

6.2 Clear felling may be acceptable only in cases where planting took place on deep peat and it is proposed through a Habitat Management Plan to reinstate peat-forming habitats. The submission must include:

a) A map demarcating the areas to be subject to different felling techniques.

b) Photography of general timber condition in each of these areas.

c) A table of approximate volumes of timber which will be removed from site and volumes, sizes of chips or brash and depths that will be re-used on site.

d) A plan showing how and where any timber residues will be re-used for ecological benefit within that area, supported by a Habitat Management Plan. Further guidance on this can be found in Use of Trees Cleared to Facilitate Development on Afforested Land – Joint Guidance from SEPA, SNH and FCS.

7. Borrow pits

7.1 Scottish Planning Policy states (Paragraph 243) that "Borrow pits should only be permitted if there are significant environmental or economic benefits compared to obtaining material from local quarries, they are time-limited; tied to a particular project and appropriate reclamation measures are in place." The submission must provide sufficient information to address this policy statement.

7.2 In accordance with Paragraphs 52 to 57 of Planning Advice Note 50 Controlling the Environmental Effects of Surface Mineral Workings (PAN 50) a Site Management Plan should be submitted in support of any application. The following information should also be submitted for each borrow pit:

a) A map showing the location, size, depths and dimensions.

b) A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 metres. You need to demonstrate that a site specific proportionate buffer can be achieved. On this map, a site-specific buffer must be drawn around each loch or watercourse proportionate to the depth of excavations and at least 10m from access tracks. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works.

c) You need to provide a justification for the proposed location of borrow pits and evidence of the suitability of the material to be excavated for the proposed use, including any risk of pollution caused by degradation of the rock.

d) A ground investigation report giving existing seasonally highest water table including sections showing the maximum area, depth and profile of working in relation to the water table.

e) A site map showing cut-off drains, silt management devices and settlement lagoons to manage surface water and dewatering discharge. Cut-off drains must be installed to maximise diversion of water from entering quarry works.

f) A site map showing proposed water abstractions with details of the volumes and timings of abstractions.

g) A site map showing the location of pollution prevention measures such as spill kits, oil interceptors, drainage associated with welfare facilities, recycling and bin storage and vehicle washing areas. The drawing notes should include a commitment to check these daily.

h) A site map showing where soils and overburden will be stored including details of the heights and dimensions of each store, how long the material will be stored for and how soils will be kept fit for restoration purposes. Where the development will result in the disturbance of peat or other carbon rich soils then the submission must also include a detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements and excavation areas overlain so it can clearly be seen how the development minimises disturbance of peat and the consequential release of CO_2.

i) Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths and types of material to be used.

j) Details of how the rock will be processed in order to produce a grade of rock that will not cause siltation problems during its end use on tracks, trenches and other hardstanding.

8. Pollution prevention and environmental management

8.1 One of our key interests in relation to developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition and restoration. A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of ECOWs, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to Guidance for Pollution Prevention (GPPs).

9. Life extension, repowering and decommissioning

9.1 Proposals for life extension, repowering and/or decommissioning must demonstrate accordance with SEPA Guidance on the life extension and decommissioning of onshore wind farms. Table 1 of the guidance provides a hierarchical framework of environmental impact based upon the principles of sustainable resource use, effective mitigation of environmental risk (including climate change) and optimisation of long term ecological restoration. The submission must demonstrate how the hierarchy of environmental impact has been applied, within the context of latest knowledge and best practice, including justification for not selecting lower impact options when life extension is not proposed.

9.2 The submission needs to demonstrate that there will be no discarding of materials that are likely to be classified as waste as any such proposals would be unacceptable under waste management licensing. Further guidance on this may be found in the document is it waste - Understanding the definition of waste.

Carolanne Brown
Energy Consents Unit
Directorate for Energy and Climate Change
Scottish Government
4th Floor
5 Atlantic Quay
150 Broomielaw
Glasgow
G2 8LU

Email: Econsents_Admin@gov.scot

Date: 7 August 2020

Your ref: ECU00002097
Our ref: CEA159992

Dear Carolanne

Scoping consultation on Environmental Impact Assessment (EIA) for Quantans Hill wind farm

Thank you for consulting Scottish Natural Heritage in relation to EIA scoping for the Quantans Hill wind farm proposal.

The proposed development is for up to 21 wind turbines, tip heights expected to range from 200m to 250m, located on Quantans Hill, northeast of the village of Carsphairn in Dumfries and Galloway.

1. Background

We provided consultation advice to Energy Consents on 7 April 2014 in relation to a section 36 application for a Quantans Hill proposal comprising 19 turbines of 130m to blade tip. We also provided 'informal scoping advice' to Natural Power on 22 March 2016 in relation to a Quantans Hill proposal comprising 12 turbines of 130m to blade tip.

2. Scoping advice

Landscape

Reflecting our earlier responses, we advise that the applicant should carefully consider the following:

- Impacts on the nearby Cairnsmore of Carsphairn and its associated hills/massif;

- Increased influence of wind farm development on the character of the open parts of the Southern Uplands; and
- Impacts on the Galloway Hills Regional Scenic Area (RSA).

The cumulative situation around the Corbett, Cairnsmore of Carsphairn, has intensified since 2016, so this remains a key issue, and something that we would like to see carefully considered.

Compared with previous iterations for Quantans Hill, given the almost doubling of the height of the proposed height of the turbines (to possibly 250m), the related increased zone of visibility, and the need for turbine lighting, we also advise that the applicant assesses the potential for adverse impacts on the wild land qualities of the Merrick Wild Land Area (WLA). The assessment should follow our draft guidance at https://www.nature.scot/professional-advice/landscape-change/landscape-policy-and-guidance/landscape-policy-wild-land/wild-land-area-descriptions-and-technical-guidance

The scoping report does not mention the WLA, but the nearest turbines would be 13km away from the boundary. We advise the addition of another viewpoint at the Merrick summit which lies approximately 17.5km from the nearest turbine.

It is not possible to tell from the ZTV whether lighting will be visible from the WLA; a hub-height ZTV rather than blade tip ZTV would provide that information. But the WLA assessment should be informed by an assessment of the effects of its turbine lighting, if visible. Our experience is that even reduced intensity 200 candela turbine lighting can be clearly visible and draw the eye within an unlit context at a distance of 20km.

The applicant should consider also consider the potential for adverse impacts on views from and within the core area of the Galloway Forest Dark Sky Park, an area valued for its dark skies.

We therefore advise that a night-time photomontage is provided from the summit of the Merrick to illustrate the effects of turbine lights on the WLA and dark sky park. This should also illustrate the cumulative effects of other wind farms proposed with visible lighting in the vicinity, such as Arecleoch, Killgallioch Extension and Clauchrie.

More generally, the related landscape and visual assessment of turbine lighting should be informed by the scoping advice at Annex 2 of our recently updated 'general scoping and pre-application advice' document at https://www.nature.scot/general-pre-application-and-scoping-advice-onshore-wind-farms

Ecology

The scoping report says there would be a part-year bat survey which started in June this year due to Covid 19 restrictions. As noted at https://www.nature.scot/coronavirus/planning-development-services we appreciate the effect the restrictions have had on the completion of site surveys, and the potential gaps in survey and assessment information that may occur as a result. We will accommodate this as far as possible.

In relation to section 9.4 of the scoping report concerning fish survey, and as was also discussed in our afore-mentioned March 2016 advice to Natural Power. Whilst acknowledging the relatively low risks involved, we would still encourage that a freshwater habitat survey should be carried out, as per our 'general scoping and pre-application' guidance. In keeping with that guidance, where there is suitable habitat for freshwater pearl mussel we would also encourage a freshwater pearl mussel survey to be carried out. Freshwater survey should help determine actual habitat suitability for mussels which have sometimes been found unexpectedly as a result of wind farm surveys, and in watercourses inaccessible to salmon (assuming that at least brown trout are present). However, given the relatively low risks involved, and the potential to mitigate impacts, Energy Consents Unit may agree that such surveys could occur prior to construction, should the proposal gain consent,

rather than prior to determination. We note that section 9.4 discusses post-consent plan for monitoring of fish populations.

In relation to bird survey we welcome that section 8.7.7 of the scoping report recognises the need for cumulative assessment at the level of the Natural Heritage Zone (NHZ). As noted in the scoping report the relevant NHZ here is NHZ 19 'Western Southern Uplands & Inner Solway'. We point to our guidance on this at both https://www.nature.scot/guidance-assessing-significance-impacts-bird-populations-onshore-wind-farms-do-not-affect-protected and https://www.nature.scot/guidance-assessing-cumulative-impacts-onshore-wind-farms-birds. The second of these guidance documents discusses (on p6) the onus being on the developer to source data for their cumulative assessment but, should the applicant wish, we may be able to direct them to sources where other developers have previously collated such information for NHZ 19. The applicant could potentially draw upon that information, updating it to take account of any more recent proposals. Our advice on previous schemes within the NHZ suggests that the focus of such cumulative assessment might be particularly concerned with wider countryside impacts on curlew, hen harrier and golden plover.

We welcome (noting section 8.3.2.1) that the potential effects of the proposed development on the Loch Ken and River Dee Marshes SPA qualifying interests will be fully considered.

3. Concluding remarks

More generally, we reiterate the need for the applicant to check the recently updated version of our general scoping and pre-application guidance at https://www.nature.scot/general-pre-application-and-scoping-advice-onshore-wind-farms.

Our advice is given without prejudice to a full and detailed consideration of the impacts of the proposal if it is submitted as a formal application.

If you have any comments or questions regarding the above, please do not hesitate to contact me REDACTED

Yours sincerely

[By email]

Amee Hood
Operation Officer
Southern Scotland

A77

Development Management and Strategic Road Safety
Roads Directorate

Buchanan House, 58 Port Dundas Road, Glasgow G4 0HF
Direct Line: REDACTED Fax: REDACTED
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TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

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carolanne.brown@gov.scot

Your ref:
ECU00002097

Our ref:
GB01T19K05

Date:
15/07/2020

Dear Sirs,

THE ELECTRICITY ACT 1989

THE ELECTRICITY WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017

SCOPING OPINION REQUEST – QUANTANS HILL WIND FARM PROPOSAL, DUMFRIES & GALLOWAY

With reference to your recent correspondence on the above development, we acknowledge receipt of the Scoping Report (SR) prepared by Natural Power in support of the above development.

This information has been passed to SYSTRA Limited for review in their capacity as Term Consultants to Transport Scotland – Roads Directorate. Based on the review undertaken, we would provide the following comments.

Proposed Development

Vattenfall Wind Power Ltd are seeking consent to construct up to 21 wind turbines with blade tip heights ranging from 200m to 250m at a site adjacent to Carsphairn and the A713 in Dumfries and Galloway. The nearest trunk road to the site is the A76(T) which lies approximately 12km to the north of the site, while the A77(T) lies approximately 28km to the west and the A77(T) approximately 32km to the south.

Assessment of Environmental Impacts

Chapter 13 of the SR deals with Traffic and Transport, in which it is stated that the forthcoming Environmental Impact Assessment Report (EIAR) will be prepared in accordance with the Guidelines for the Environmental Assessment of Road Traffic (IEMA 1993) and Transport Scotland Guidance on Transport Assessment.

Transport Scotland is satisfied with this approach, but would add that potential trunk road related environmental impacts such as driver delay, pedestrian amenity, severance, safety etc will require to be considered and assessed where appropriate (i.e. where IEMA thresholds for further assessment are breached). These specify that road links should be taken forward for assessment if:

- Traffic flows will increase by more than 30%, or
- The number of HGVs will increase by more than 30%, or
- Traffic flows will increase by 10% or more in sensitive areas.

In the case of the EIAR, the methods adopted to assess the likely traffic and transportation impacts on traffic flows and transportation infrastructure should comprise:

- Determination of the baseline traffic and transportation conditions, and the sensitivity of the site and existence of any receptors likely to be affected in proximity of the trunk road network;
- Review of the development proposals to determine the predicted construction and operational requirements; and
- Assessment of the significance of predicted impacts from these transport requirements, taking into account impact magnitude (before and after mitigation) and baseline environmental sensitivity.

It is noted that any impacts associated with the operational phase of the development are to be scoped out of the EIAR. We would consider this to be acceptable in this instance.

Abnormal Load Assessment

The SR states that assessment will be undertaken to determine suitable routes for abnormal load access and general HGV construction traffic, including potential ports of entry, identification of the abnormal access route and a Swept Path Analysis.

Transport Scotland will require to be satisfied that the size of turbines proposed can negotiate the selected route and that their transportation will not have any detrimental effect on structures within the trunk road route path.

An Abnormal Loads Assessment report should be prepared and submitted with the EIA as a technical appendix. The report should identify key pinch points on the trunk road network and swept path analysis should be undertaken at these pinch points. The report should include details with regard to any required changes to street furniture or structures along the route.

I trust that the above is satisfactory and should you wish to discuss any issues raised in greater detail, please do not hesitate to contact Alan DeVenny at SYSTRA's Glasgow Office on REDACTED .

Yours faithfully
REDACTED

John McDonald

Transport Scotland
Roads Directorate

cc Alan DeVenny – SYSTRA Ltd.

A80

From: Tynron CC <tynroncc@tynron.org.uk>
Sent: 21 July 2020 14:39
To: Econsents Admin
Subject: SCOPING OPINION REQUEST– QUANTANS HILL WIND FARM PROPOSAL, DUMFRIES & GALLOWAY ECU00002097

Follow Up Flag: Follow up
Flag Status: Flagged

Please find below the response of Tynron Community Council regarding the scoping document for Quantans Hill Wind Farm ECU00002097

Kind regards
Susan Hall, Secretary, Tynron Community Council

Dear Ms Brown
Tynron Community Council would like to make the following comments re the proposed Quantans Hill Wind Farm ECU00002097

Do consultees have any comments in relation to public consultation?
We are concerned regarding Vatenfall's statement that
" At the time of writing, Vattenfall is monitoring the threat from Covid-19 and, due to public health risks, public gatherings such as exhibitions are not allowed under UK law for the foreseeable future. Vattenfall is assessing alternative means of communicating project information EIA process and recognises the benefits in carrying out early consultation with all concerned parties. The consultation will progress with the circulation of this Scoping Report and will continue for the duration of EIA process. ***Vattenfall will discuss the Quantans Hill project with a broad range of interested organisations including government bodies and agencies, local businesses, interest groups, and charities. virtually to comply with these regulations and will try to engage in person at the right time if and when regulations are lifted.***" (Our italics and bold format.)

Given the regulations due to Covid-19 currently in operation, we are concerned that the virtual and 'alternative means' of communication proposed by Vatenfall, the poor/limited/inadequate internet availability in rural areas, the closure of libraries and other areas of information dissemination, the lack of opportunities for site visits, and the lack of opportunities for Community Councils to consult in the best way possible for our communities, we would like to raise our concerns that this scoping document may not be reaching people most impacted by the proposed wind farm,

and that the wide scope of consultation required by this project will not be attained.

Do consultees have any comments in relation to the approach to the Environmental Impact Assessment?
Much emphasis is placed on the use of desk top surveys. Whilst this information is invaluable, this is not a substitute for thorough and exhaustive manual surveys.

Do consultees have any comments in relation to the proposed chapters to be included in the EIAR?
A chapter on the impact on the wind farm on tourism in the area should be included, in line with VisitScotland's recommendations of a separate impact assessment on tourism for each windfarm application. We are concerned that in an area where tourism is a large part of our economy, much emphasis is placed on the findings of an outdated report (BIGGAR 2016). This report was written at a time when there were fewer wind farms with turbines of much lower heights. Figure 6.1 of the BIGGAR report shows that just one of the windfarms used in the analysis of the impact of windfarms on tourism was in Dumfries and Galloway, and not even in the area currently designated for Quantans Hill Wind Farm.
We are also concerned about the impacts of Aircraft Warning Lights and their flicker on local homes and the Galloway Dark Sky Park and we believe this should be an additional chapter in the EIAR

Do consultees agree to an end date of three months prior to the submission of the LVIA and CLVIA after which point any additional sites will not be assessed with the application?
No – given the exponential increase in the number of wind farm planning applications, the increasing heights of turbines and the adverse cumulative impacts on our communities on visual and residential amenity, noise, and disturbance we believe this is unacceptable.

Do the consultees agree with the list of key potential receptors for the EIA and with the receptors / issues to be scoped out of the assessment?
We are unable to comment on this given the restrictions on travel during the Covid-19 lockdown

Can consultees agree for construction noise to be scoped out of EIA?
No. We are concerned about the increasing acceptability of the incursion of wind turbines to people's homes. Quantans Hills windfarm would have (possibly) 225 metre high turbines within half a mile of the settlements of Marbrack and Knockgray, with the potential for significant construction noise and nuisance from quarrying, traffic, turbine erection, and track construction.

Additionally we are concerned about the seemingly exponentially increasing number of wind farm applications in this area and massive increase in turbine heights, and the resultant impacts on communities; fragile rural infrastructure, in particular our roads and traffic; loss of local jobs and employment opportunities; loss of biodiversity and

habitat; impacts on ecology and ornithology; and the apparent change of a predominantly rural region into seemingly one continuous windfarm development.

We would like to see a thorough investigation into the loss and displacement of long term permanent existing jobs (eg farming, farm support, tourism) and families moving away, and their 'replacement' with minimal long term jobs, considering the amount of investment. The specific long-term jobs should be described.

We would like to see further expansion of the battery storage facility at Quantans Hill Wind farm, specifically the capacity and potential benefits to the National Grid.

Tynron Community Council fully support the urgent need for non-fossil fuel energy sources. However we would like to mention the increasing pressure these applications are placing on Community Councils, in responding to the applications, consulting with their communities, keeping up to date with local and government policy, attending multiple meetings, and liaising between multiple agencies. Community Councillors are all unpaid volunteers.

VATTENFALL

Document history

Author	Graeme Glencorse	22/06/2022
Checked	Lesley Cartwright	18/07/2022
Approved	Emily Galloway	18/07/2022

Client Details	
Contact	Matthew Bacon
Client Name	Vattenfall Wind Power Ltd

Issue	Date	Revision Details
A	17/09/2021	Issued for client review
B	23/11/2021	Updated
C	10/01/2022	Released
D	22/06/2022	Updated cumulative baseline
E	27/01/2023	Updated cumulative baseline
F	27/01/2023	Released

Appendix 5.1

Landscape & Visual Impact Assessment (LVIA) Methodology

Contents

Glossary

Term	Definition
Baseline studies	*'Work done to determine and describe the environmental conditions against which future changes can be measured or predicted and assessed.'**
Characteristics	*'Elements or combinations of elements, which make a contribution to distinctive landscape character.'**
Compensation	*'Measures devised to offset or compensate for residual adverse effects which cannot be prevented/avoided or further reduced.'**
Cumulative Landscape & Visual Impact Assessment (CLVIA)	To identify, predict and evaluate potential key effects arising from the addition of the Proposed Development to a theoretical baseline which includes the existing baseline situation of operational wind farms, those under construction, consented schemes and additionally wind farms currently being considered within the planning system that may or may not be present in the landscape in the future.
Direct effect	*'An effect that is directly attributable to the proposed development.'**
'Do nothing' situation	*'Continued change or evolution in the landscape in the absence of the proposed development.'**
Enhancement	'*Proposals that seek to improve the landscape resource and the visual amenity of the proposed development site and its wider setting, over and above it's baseline condition.'**
Environmental Impact Assessment (EIA)	*'The process of gathering environmental information; describing a development ; identifying and describing the likely significant environmental effects of the project; defining ways of preventing/avoiding, reducing, or offsetting or compensating for any adverse effects; consulting the general public and specific bodies with responsibilities for the environment; and presenting the results to the competent authority to inform the decision on whether the project should proceed.'**
Environmental Impact Assessment Report (EIAR)	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations.
Geographical Information System (GIS)	*'A system that captures, stores, analyses, manages and presents data linked to location. It links spatial information to a digital database.'**
Indirect effects	*'Indirect effects that result indirectly from the proposed project as a consequence of the direct effects., often occurring away from the site, or as a result of a sequence of interrelationships or a complex pathway. They may be separated by distance or in time from the source of the effects.'**
Iterative design process	*'The process by which project design is amended and improved by successive stages of refinement which respond to growing understanding of environmental issues'**
Key characteristics	*'Those combinations of elements which are particularly important to the current character of the landscape and help to give an area its particularly distinctive sense of place'**
Landcover	*' The surface cover of the land, usually expressed in terms of vegetation cover or lack of it. Related to but not the same as land use.'**
Land Use	*'What land is used for, based on broad categories of functional land cover, such as urban and industrial use and the different types of agriculture and forestry.'**
Landform	*'The shape and form of the land surface which has resulted from combinations of geology, geomorphology, slope, elevation and physical processes.'**
Landscape	*'An area, as perceived by people, the character of which is the result of the action and interaction of natural and/or human factors.'**
Landscape & Visual Impact Assessment (LVIA)	*'A tool used to identify and assess the likely significance of the effects of change resulting from development both on the landscape as an environmental resource in its own right and on people's views and visual amenity.'**
Landscape character	*'A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.'**
Landscape Character Areas (LCAs)	*'A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.'**
Landscape Character Assessment (LCA)	*'The process of identifying and describing variation in the character of the landscape, and using this information to assist in managing change in the landscape. It seeks to identify and explain the unique combination of elements and features that make landscape distinctive. The process results in the production of a Landscape Character Assessment.'**
Landscape Character Types	*'These are distinct types of landscape that are relatively homogeneous in character. They are generic in nature in that they may occur in different areas in different parts of the country, but wherever they occur they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern, and perceptual and aesthetic attributes.'**
Landscape effects	*'Effects on the landscape as a resource in its own right.'**
Landscape quality (condition)	*'A measure of the physical state of the landscape. It may include the extent to which typical character is represented in individual areas, the intactness of the landscape and the condition of individual elements.'**
Landscape receptors	*'Defined aspects of the landscape resource that have the potential to be affected by a proposal'**
Landscape value	*'The relative value that is attached to different landscapes by society. A landscape may be valued by different stakeholders for a whole variety of reasons.'**
Magnitude (of effect)	*'A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is reversible or irreversible and whether it is short or long term in duration.'**
Panorama	*'An image covering a horizontal field of view wider than a single 50mm frame. Wirelines and photomontages may also be produced as panoramas.'***
Perception	*'Combines the sensory (that we receive through our senses) with the cognitive (our knowledge and understanding gained from many sources an experiences).'**
Photomontage	*'A visualisation which superimposes an image of a proposed development upon a photograph or series of photographs'**
Protected and designated landscapes	*'Areas of landscape identified as being of importance at international, national or local levels, either defined by statute or identified in development plans or other documents.'**
Receptors	*'See Landscape receptors and Visual receptors.'**
Scoping	*'The process of identifying the issues to be addressed by an EIA. It is a method of ensuring that an EIA focuses on the important issues and avoids those that are considered to be less significant.'**
Sensitivity	*'A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor.'**
Significance	*'A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to environmental topic'**
Susceptibility	*'The ability of a defined landscape or visual receptor to accommodate the specific proposed development without undue negative consequences.'**
The Applicant	Vattenfall Wind Power Ltd
The Proposed Development	The Quantans Hill Wind Farm Project
The Proposed Development Area	The area within which the Proposed Development will be located.
Developer	In the event of the Proposed Development being granted Section 36 Consent, this is the Company developing the Project.

Term	Definition
Tranquility	*'A state of calm and quietude associated with peace, considered to be a significant asset of landscape.'**
Visual amenity	*'The overall pleasantness of the views people enjoy of their surroundings, which provides an attractive visual setting or backdrop for the enjoyment of activities of the people living, working, recreating, visiting or travelling through an area.'**
Visual effects	*'Effects on specific views and on the general visual amenity experienced by people.'**
Visual receptors	*Individuals and/or defined groups of people who have the potential to be affected by a proposal.'**
Visualisation	*'A computer simulation, photomontage or other technique illustrating the predicted appearance of a development.'**
Wirelines	*These are also known as wireframes and computer generated line drawings. These are line diagrams that are based on DTM data and illustrate the three-dimensional shape of the landscape in combination with additional elements such as the components of a proposed wind farm.'***
Zone of Theoretical Visibility (ZTV)	*'A map, usually digitally produced, showing areas of land within which, a development is theoretically visible.'**

*Taken from *Guidelines for Landscape and Visual Impact Assessment, Third Edition*. 2013.

** Taken from *Visual Representation of Wind Farms, Guidance.* 2017

List of Abbreviations

List and describe your abbreviations here.

Abbreviation	Description
AGL	Above Ground Level
CLVIA	Cumulative Landscape & Visual Impact Assessment
CPRE	Campaign to Protect Rural England
DSLR	Digital Single Lens Reflex
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ELC	European Landscape Convention
EOS	Electro-Optical System
GLVIA3	Guidelines for Landscape and Visual Impact Assessment, Third Edition
HES	Historic Environment Scotland
km	Kilometre
LCA	Landscape Character Area
LCT	Landscape Character Type
LVIA	Landscape & Visual Impact Assessment
m	Metre
OS	Ordnance Survey
PLI	Public Local Inquiry
SNH	Scottish Natural Heritage (now NatureScot)
ZTV	Zone of Theoretical Visibility

A5.1 INTRODUCTION

A5.1.1 This Appendix sets out in detail the methodology that has been applied to undertake the Landscape and Visual Impact Assessment (LVIA). The aim of this LVIA is to identify, predict and evaluate potential effects arising from the addition of Quantans Hill Wind Farm (the Proposed Development) on landscape and visual amenity. The *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (GLVIA3) describes LVIA as:

'Landscape and Visual Impact Assessment is a tool used to identify and assess the significance of and the effects of change resulting from development on both the landscape as an environmental resource in its own right and people's views and visual amenity.' (GLVIA3, paragraph 1.1).

Definition of Landscape & Visual Amenity

A5.1.2 Although closely related, landscape and visual amenity are considered separately in this LVIA in accordance with best practice[1] and are distinguished as follows:

- **Landscape**: Is defined by the European Landscape Convention (ELC) as "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*".[2] Factors contributing to landscape character include the interaction of both natural (geology, soils, climate, flora and fauna) and cultural (historical and current impacts of land use, settlement, enclosure and other human interventions), which are perceived by people; and
- **Visual Amenity**: Relates to the views people have, and their visual amenity *'meaning the overall pleasantness of the views they enjoy of their surroundings.'* (GLVIA3, Para 2.20) .

Key Stages of the LVIA

A5.1.3 GLVIA3 sets out the steps for undertaking the assessing of landscape effects (GLVIA3, Figure 5.1) and visual effects (GLVIA3, Figure 6.1) as follows:

Diagram A5.1: Assessment of landscapes

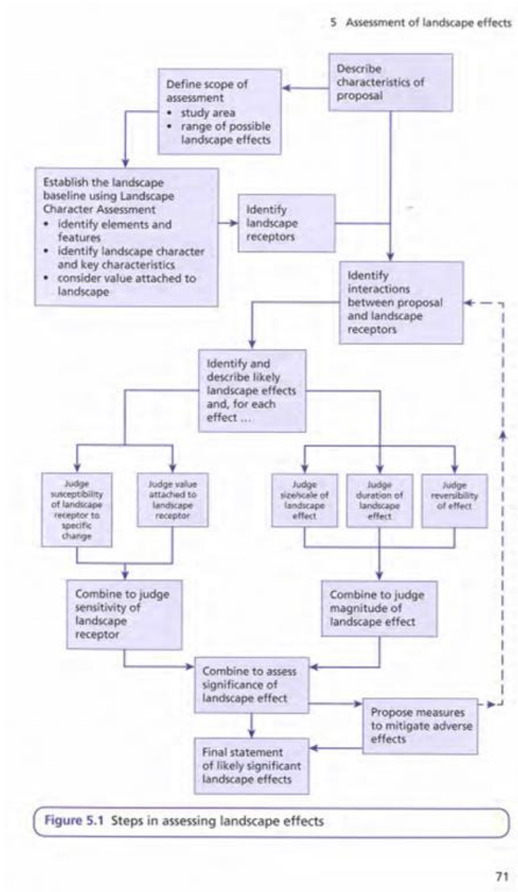
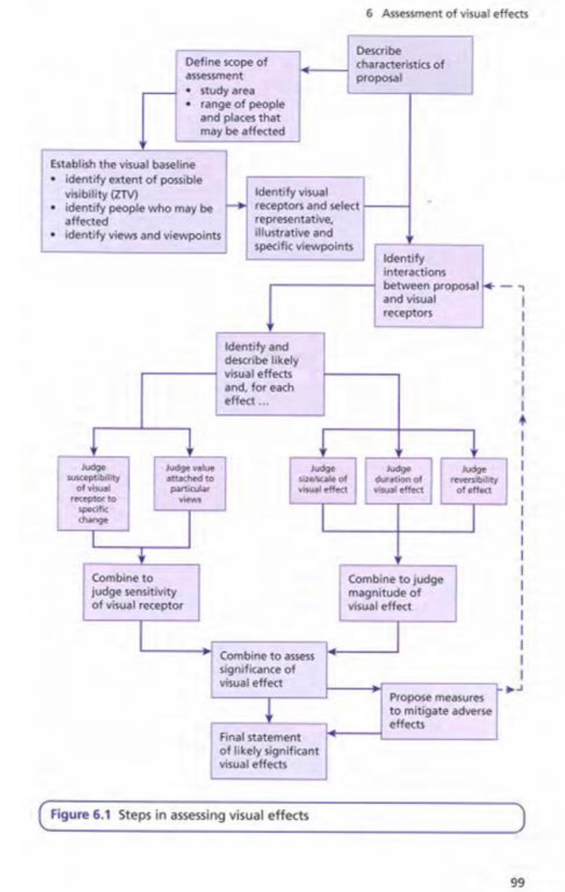


Diagram A5.2: Assessment of visual effects



A5.1.4 Each of the above steps is interchangeable throughout the assessment process as the design of the Proposed Development evolves and further information becomes available during the Environmental Impact Assessment (EIA).

A5.2 ASSESSMENT GUIDANCE

A5.2.1 This LVIA has been prepared in accordance with the principles set out in GLVIA3. In addition to this, the LVIA takes account of the following guidance documents:

- *GLVIA3 Statement of Clarification 1/13 10-06-13* (Landscape Institute, 2013);[3]

[1] Landscape Institute, Institute of Environmental Management. (2013) *Guidelines for Landscape and Visual Impact Assessment, Third Edition*. Abingdon. Routledge.

[2] Council of Europe. Council of Europe Landscape Convention (2000) *European Landscape Convention*. Strasbourg: Council of Europe.

[3] Landscape Institute (2013) GLVIA3 Statement of Clarification 1/13 10-06-13 [Online] Available from https://www.landscapeinstitute.org/technical/glvia3-panel/glvia3-clarifications/ (Accessed November 2022)

- *Siting and Designing Wind Farms in the Landscape, Guidance, Version 3a* (SNH, August 2017);[4]
- *Environmental Impact Assessment Handbook: Guidance for competent authorities, consultation bodies, and others involved in the Environmental Impact Assessment process in Scotland*. (SNH, Historic Environment Scotland, April 2018);[5]
- General pre-application and scoping advice for onshore wind farms, Guidance (NatureScot, August 2022);[6]
- *Landscape Character Assessment, Guidance for England and Scotland*, (The Countryside Agency and Scottish Natural Heritage (SNH) 2002 Edition)[7];[8]
- *Landscape Sensitivity Assessment – Guidance for Scotland,* (NatureScot, April 2022);[9]
- *Technical Guidance Note 02/21, Assessing landscape value outside national designations* (Landscape Institute, February 2021);[10]
- *Technical Information Note 01/2017 (Revised), Tranquillity – An overview (Landscape Institute, 2017);*[11]
- *Assessing impacts on Wild Land Areas – Technical Guidance* (NatureScot, Sep 2020);[12]
- *Assessing the Cumulative Impact of Onshore Developments* (SNH, 2012);[13]
- *Guidance on Undertaking Environmental Lighting Impact Assessments* (Institution of Lighting Professionals, 2013);[14]
- *Guidance Note 01/20 Guidance note for the reduction of obtrusive light* (Institution of Lighting Professionals, 2020);[15]
- *Technical Guidance Note 2/19, Residential Visual Amenity Assessment (RVAA)* (Landscape Institute, 2019);[16]
- *Visual Representation of Wind Farms, Version 2.2,* (SNH, February 2017);[17] and
- *Technical Guidance Note 06/19, Visual Representation of Development Proposals (*Landscape Institute, 2019);[18]

A5.3 STUDY AREA & IDENTIFICATION OF RECEPTORS

LVIA Study Area

A5.3.1 The first step of the LVIA is to establish the extent of study area. NatureScot guidance (2017),[19] advises for turbines in excess of 150 m in tip height, a 45 km study area is recommended. This has been offset from the outermost turbines of the Proposed Development.

A5.3.2 It should be noted that the study areas applied in this LVIA have been determined as areas where potential significant landscape and visual effects are likely to occur and is not the limit of potential visibility of the Proposed Development.

Cumulative Study Area

A5.3.3 For the cumulative assessment, an initial study area of 60 km is identified in accordance with the relevant guidance (SNH, 2012). Following a review, this is refined to 45 km from the outermost turbines and data collected for sites currently in operation/under construction, consented and submitted applications which would likely be experienced in conjunction with the Proposed Development.

Identification of Landscape and Visual Receptors

A5.3.4 Once the study area has been defined, the next step is to establish how the Proposed Development may give rise to landscape and visual effects. This is established through an understanding of the project components proposed, their layout and evolution through construction, operational and decommissioning phases. This forms the basis of the assessment and aids the identification of the landscape and visual baseline likely to be affected, referred to as landscape and visual receptors.

A5.3.5 These were identified through analysis of Zone of Theoretical Visibility (ZTV) mapping (described in Section A5.8), desk-study and field work.

[4] Scottish Natural Heritage (2017) Siting and Designing Wind Farms in the Landscape, Guidance. [Online] https://www.nature.scot/sites/default/files/2017-11/Siting%20and%20designing%20windfarms%20in%20the%20landscape%20-%20version%203a.pdf (Accessed November 2022)

[5] Scottish Natural Heritage., Historic Environment Scotland (2018) Environmental Impact Assessment Handbook [Online] https://www.nature.scot/sites/default/files/2018-05/Publication%202018%20-%20Environmental%20Impact%20Assessment%20Handbook%20V5.pdf (Accessed November 2022)

[6] Scottish Natural Heritage (2022) General pre-application and scoping advice for onshore wind farms [Online] https://www.nature.scot/doc/general-pre-application-and-scoping-advice-onshore-wind-farms (Accessed November 2022)

[7] Land Use Consultants., Swanwick. C. (2002) Landscape Character Assessment Guidance for England and Scotland. The Countryside Agency, Scottish Natural Heritage. Cheltenham.

[8] This document is superseded in England but still applies in Scotland, see https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/what-landscape-character-assessment.

[9] NatureScot (2022) Landscape Sensitivity Assessment Guidance [Online] https://www.nature.scot/doc/landscape-sensitivity-assessment-guidance-methodology (Accessed November 2022)

[10] Landscape Institute (2021) Technical Guidance Note 02/21 Assessing landscape value outside national designations. [Online] https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2021/05/tgn-02-21-assessing-landscape-value-outside-national-designations.pdf (Accessed November 2022)

[11] Landscape Institute (2017) Technical Information Note 01/2017 (Revised) Tranquillity – An overview. [Online] https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2017/02/Tranquillity-An-Overview-1-DH.pdf (Accessed November 2022)

[12] NatureScot (2020) Assessing impacts on Wild Land Areas – technical guidance [Online] https://www.nature.scot/doc/assessing-impacts-wild-land-areas-technical-guidance (Accessed November 2022)

[13] Scottish Natural Heritage (2012) Assessing the Cumulative Impact of Onshore Developments [Online] https://www.nature.scot/doc/assessing-impacts-wild-land-areas-technical-guidance (Accessed August 2021)

[14] Institution of Lighting Professionals (2013) Professional Lighting Guide 04: Guidance on undertaking Environmental Lighting Impact Assessments. Institution of Lighting Professionals. Rugby.

[15] Institution of Lighting Professionals (2021) Guidance Note GN01/21 The Reduction of Obtrusive Light. Institution of Lighting Professionals. Rugby.

[16] Landscape Institute (2019) Residential Visual Amenity Assessment (RVAA) [Online] https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/03/tgn-02-2019-rvaa.pdf (Accessed November 2022)

[17] Scottish Natural Heritage (2017) Visual Representation of Wind Farms, Guidance. [Online] https://www.nature.scot/sites/default/files/2019-09/Guidance%20-%20Visual%20representation%20of%20wind%20farms%20-%20Feb%202017.pdf (Accessed November 2022)

[18] Landscape Institute (2019) Technical Guidance Note 06/19 Visual Representation of Development Proposals [Online] https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/09/LI_TGN-06-19_Visual_Representation.pdf (Accessed November 2022)

[19] Paragraph 48, Visual Representation of Wind Farms, Version 2.2, (SNH, February 2017)

A5.4 LANDSCAPE & VISUAL AMENITY BASELINE

Landscape Baseline

A5.4.1 Landscape is defined by the relationship between people and place and how different components of the natural environment such as geology, soils, climate, flora and fauna; interact and are perceived alongside cultural and social components of historical and cultural land use, settlement, enclosure and other human interventions.

A5.4.2 Landscape is made up of individual features which, can be defined at a broad scale, as a distinct, recognisable, and consistent pattern of elements that makes one landscape different from another. In relation to this LVIA, these are recognised as Landscape Character Types (LCTs), which comprise geographical areas of particular combinations of landform, landcover and pattern conveying a sense of place defined at a scale of 1:50,000 and include a list of key characteristics.

A5.4.3 Designated landscapes at national and local level are also included as broad-scale landscape receptors and include the special qualities which contributed to their reasons for designation.

A5.4.4 The landscape receptors have been identified through review of the following information:

- Landscape Character Types and Map Descriptions (SNH, 2019)[20];
- Landscape Character Assessment: Dumfries and Galloway – Landscape Evolution and Influences (NatureScot, 2019);[21]
- Dumfries and Galloway landscape assessment (SNH, 1998)[22];
- Ayrshire landscape assessment (SNH, 1998)[23];
- Glasgow and the Clyde Valley landscape assessment (SNH, 1999)[24];
- Supplementary Guidance Wind Energy Development Management Considerations and Landscape Capacity Study (Dumfries and Galloway Council, 2020)[25];
- The special qualities of the National Scenic Areas (SNH, 2010)[26];
- Inventory of Gardens and Designed Landscapes (Historic Environment Scotland)[27];
- Wild Land Area Descriptions and Maps (SNH, 2017)[28];
- Regional Scenic Areas Technical Paper (Dumfries & Galloway Council, 2018)[29]
- East Ayrshire Local Development Plan, Background Paper: Sensitive Landscape Areas (East Ayrshire Council, 2015)[30];
- South Ayrshire Local Development Plan (South Ayrshire Council, 2014)[31]; and
- South Lanarkshire Validating Local Landscape Designations (South Lanarkshire Council, 2010)[32].

A5.4.5 Legislation, policy, and guidance relevant to landscape and visual amenity are set out in Chapter 4: Climate Change, Legislative and Policy Context.

Visual Amenity Baseline

A5.4.6 Visual amenity relates to people's views from static locations or when moving through the landscape and are usually grouped by what they are doing such as residents, walkers, visitors, and workers etc. They include people living and working in the area, people travelling through the area on foot, road, rail or other forms of transport, people visiting promoted tourist attractions and landscapes, and people pursuing other recreational activities.

A5.4.7 The following have been considered in the visual baseline:

- Residential properties within 2 km of the Proposed Development;
- Settlements;
- Roads including A, B, and minor roads;
- Walking routes including the long-distance routes, Scottish Hill Tracks, and Public Rights of Way/Core Paths within 5 km of the Proposed Development;
- Selected hill tops; and
- Promoted visitor attractions.

Viewpoints

A5.4.8 A selection of viewpoints has been chosen in consultation with Energy Consents Unit (ECU) and NatureScot to represent the views experienced towards the Proposed Development within the study area by various groups of people and include a selection of viewpoints representing the effects from aviation lighting during night-time and periods of poor visibility. No response on viewpoint locations was provided by Dumfries & Galloway Council during scoping or follow-up consultation.

A5.4.9 Selected viewpoints include representative, specific, and illustrative views from publicly accessible locations, which are defined in GLVIA3 (paragraph 6.19) as:

- ***Representative viewpoints****: selected to represent the experience of different types of visual receptors, where larger number of viewpoints cannot all be included individually and where the significant effects are unlikely to differ. For example, certain points may be chosen to represent the views of users of public footpaths and bridleways;*
- ***Specific viewpoints****: chosen because they are key views and sometimes promoted viewpoints within the landscape, including for example scenic viewpoints from roads, specific local visitor attractions, viewpoints in areas that are particular noteworthy for visual and/or recreational amenity, such as landscapes with statutory landscape designations, or viewpoints with particular cultural landscape associations; and*

[20] NatureScot (2021) Scottish Landscape Character Types Map and Descriptions [Online] Available from https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions [Accessed November 2022]

[21] NatureScot (2019) Landscape Character Assessment: Dumfries and Galloway - Landscape Evolution and Influences [Online] https://www.nature.scot/doc/landscape-character-assessment-dumfries-and-galloway-landscape-evolution-and-influences (Accessed November 2022)

[22] Land Use Consultants. (1998) *Dumfries & Galloway landscape assessment*. Scottish Natural Heritage Review No.94.

[23] Land Use Consultants. (1998) *Ayrshire landscape assessment*. Scottish Natural Heritage Review No. 111.

[24] Land Use Consultants. (1999) *Glasgow and the Clyde Valley landscape assessment*. Scottish Natural Heritage Review No. 116.

[25] Dumfries and Galloway Council (2020) *Local Development Plan 2, Part 1 Wind Energy Development: Development Management Considerations Appendix 'C' Dumfries & Galloway Wind Farm Landscape Capacity Study, Supplementary Guidance*.

[26] Scottish Natural Heritage (2010) *The special qualities of the National Scenic Areas*. Scottish Natural Heritage Commissioned Report No. 374 (iBids and Projectn. 648).

[27] Historic Environment Scotland (2021) Designations Map Search. [Online] Available from https://hesportal.maps.arcgis.com/apps/Viewer/index.html?appid=18d2608ac1284066ba3927312710d16d [Accessed November 2022]

[28] NatureScot (2021) Wild Land Areas map and descriptions 2014[Online] Available from https://www.nature.scot/doc/wild-land-areas-map-and-descriptions-2014 [Accessed November 2022]

[29] Dumfries and Galloway Council. (2018). *Local Development Plan 2, Regional Scenic Areas Technical Paper* (Dumfries & Galloway Council, 2018)

[30] East Ayrshire Council (2015) *East Ayrshire Council Local Development Plan, Background Paper: Sensitive Landscape Areas.* East Ayrshire Council.

[31] South Ayrshire Council (2014) *South Ayrshire Local Development Plan*. South Ayrshire Council.

[32] South Lanarkshire Council (2010) *South Lanarkshire Validating Local Landscape Designations*. South Lanarkshire Council.

- ***Illustrative viewpoints****: chosen specifically to demonstrate a particular effect or specific issue, which might be the restricted visibility at certain locations.*

A5.4.10 Viewpoints are selected to take account of the viewing experience (such as static views from settlements and sequential views from routes), cumulative views of other developments and as far as possible are representative of the range of key visual receptors and view types (including panoramas, vistas, glimpsed views), as well as being located at varying distances, elevations, and orientations from the Proposed Development.

Night-time Baseline

A5.4.11 Night-time baseline lighting has been informed by England's Light Pollution and Dark Skies Interactive Map produced by the Campaign to Protect Rural England (CPRE) which also covers Scotland, and fieldwork from a number of landscape and visual receptor locations.

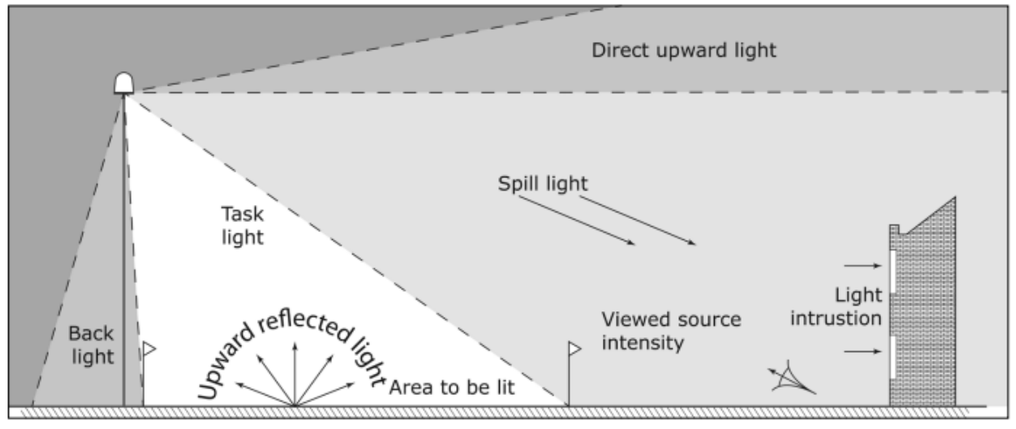
A5.4.12 Guidance published by the Institute of Lighting Professionals (ILP) has also been considered in this assessment, in particular, two documents:

- *Guidance on Undertaking Environmental Lighting Impact Assessments* (Institution of Lighting Professionals, 2013); and
- *Guidance Note 01/21 The Reduction of Obtrusive Light* (Institution of Lighting Professionals, 2021).

A5.4.13 These documents provide useful guidance in the undertaking of night-time assessment as well as providing some context of the different types of light pollution encountered as follows:

- '***Obtrusive light****, whether it keeps you awake through a bedroom window, impedes your view of the night sky or adversely affects the performance of an adjacent lighting installation, is a form of pollution. It may also be a nuisance in law and can be substantially mitigated without detriment to the requirements of the task.*
- ***Skyglow****, the brightening of the sky, Glare, the uncomfortable brightness of a light source when viewed against a darker background,* ***Light spill*** *the spilling of light beyond the boundary of the area being lit and* ***Light intrusion ('Nuisance')*** *are all forms of obtrusive light which may cause nuisance to others, or adversely affect fauna & flora as well as waste money and energy.*' (ILI, 2021)3

Diagram A5.3: Types of obtrusive light (Figure 1 from IL, 2021)



A5.5 FIELD SURVEY

A5.5.1 Site visits were undertaken periodically between January 2019 and December 2021 during periods of good visibility and included the Proposed Development Area, from publicly accessible locations within the wider 45 km study area, viewpoint locations (including those selected for night-time assessment) and residential properties within 2 km of the Proposed Development in order to aid the assessment.

A5.5.2 Day and night time viewpoint photography was undertaken by a professional photographer between November 2020 and January 2022 during periods of good visibility and is detailed further in Section A5.8 of this Appendix.

A5.6 LANDSCAPE AND VISUAL EFFECTS

A5.6.1 The terms 'impact' and 'effect' are distinguished in GLVIA3 (para, 1.15) as follows:

'impact', defined as the action being taken, and 'effect', defined as the change resulting from that action, and recommends that the terms should be used consistently in this way'

A5.6.2 Landscape effects are defined in GLVIA3 as '***An assessment of landscape effects deals with the effects of change and development on landscape as a resource.*** *The concern here is with how the proposal will affect the elements that make up the landscape and its distinctiveness character* (GLVIA3, Para 5.1).

A5.6.3 Visual effects are defined in GLVIA3 *as '****An assessment of visual effects deals with the effects of change and development on the views available to people and their visual amenity****. The concern here is with assessing how the surroundings of individuals or groups of people may specifically be affected by the changes in the content and character of views as a result of the change or loss of existing elements of the landscape and/or introduction of new elements.'* (GLVIA3, Para 6.1).

A5.6.4 In addition, this LVIA also considers the cumulative effect of the Proposed Development on the landscape and visual resource. In this LVIA, cumulative effects are defined as:

'the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together.' (Scottish Natural Heritage (SNH), 2012)

A5.6.5 The SNH guidance also defines the difference between landscape and visual cumulative effects as follows:

- Cumulative landscape effects: '*can impact on either the physical fabric or character of the landscape, or any special values attached to it'* (SNH, 2012); and
- Cumulative visual effects: '*occurs where the observer is able to see two or more developments from one viewpoint' resulting in combined visibility or 'occur when the observer has to move to another viewpoint to see different developments*' (SNH, 20212: 11).

A5.6.6 In this LVIA, potential effects are classified into one or more of the following:

- **Direct effects** to the physical landscape and restricted within the Proposed Development site boundary that arise from activities that from an integral part of the project. For example, the effects upon landform and vegetation that may be physically altered by the Proposed Development;
- **Indirect** or **Secondary** effects that arise from activities not explicitly forming part of the project or which arise subsequently as a result of an initial effect of the scheme. For example, effects on landscape character from the introduction of new elements that alter the recognisable pattern of elements that occurs consistently in a particular type of landscape;
- **Temporary effects** that persist for a limited period only, due for example to particular construction activities;

- **Medium** to **Long-term** effects which would persist for the foreseeable future, or which would give rise to an irreversible change to the baseline environment;
- **Residual effects** resulting from the scheme once the final design has been adopted and mitigation measures have been considered; and
- **Cumulative effects** associated with consented sites and those currently within the planning system.

A5.6.7 As a precautionary approach, effects on landscape character and visual amenity are considered in this LVIA to be adverse but it should be noted that not all people would experience effects on landscape character, views and visual amenity as adverse, as people's perception of wind turbines vary between negative and positive attitudes. An additional point is that simply because wind turbines are visible from a particular location or receptor, this does not mean that the effect is significant. In some instances, there may be likely significant effects on the landscape resource, but the Proposed Development may be in a location that does not affect visual amenity in a significant way. It is also possible that there may be likely significant effects on visual amenity without effects on the landscape resource.

Landscape Effects

A5.6.8 Assessing landscape effects of the Proposed Development on the landscape requires a number of steps broadly summarised as identifying sensitivity of the landscape receptor, establishing the magnitude or scale of the change likely as a result of the Proposed Development and ultimately forming a judgement with respect to the significance of the effect in the context of the EIA (Scotland) Regulations (2017). The identification of significant effects is important because those are the effects that are likely to carry more weight in the decision making (or often referred to as the planning balance). This does not however mean that non-significant effects are not considered.

Sensitivity of Landscape Receptors

A5.6.9 GLVIA3 states that sensitivity of the landscape should be defined by analysing the susceptibility of the landscape receptor to the proposed change (the Proposed Development) and the value of the landscape receptor.

Landscape Value

A5.6.10 Landscape value can be indicated by designation with reference to their importance (International, National, Local level), or with reference to a specific feature or element of the landscape. Landscape value may also be expressed by other factors described in Box 5.1 (GLVIA3, page 84) which can aid the identification of valued landscapes as follows:

- *'**Landscape quality (condition)**: A measure of the physical state of the landscape. It may include the extent to which typical character is represented in individual areas, intactness of the landscape and the condition of individual elements;*
- ***Scenic quality**: The term used to describe landscapes that appeal primarily to the senses (primarily but not wholly the visual senses);*
- ***Rarity**: The presence of rare elements or features in the landscape or the presence of a rare Landscape Character Type;*
- ***Representativeness**: Whether the landscape contains a particular character, and/or features or elements which are considered particularly important examples;*
- ***Conservation interests**: The presence of features of wildlife, earth science or archaeological or historical and cultural interest can add to the value of the landscape as well as having value in their own right;*
- ***Recreation value**: Evidence that the landscape is valued for recreational activity where experience of the landscape is important;*
- ***Perceptual aspects**: A landscape may be valued for its perceptual qualities, notably wildness and/or tranquillity; and*
- ***Associations**: Some landscapes are associated with particular people, such as artists or writers, or events in history that contribute to perceptions of the natural beauty of the area.(Based on Swanwick and Land Use Consultants (2002)'*

A5.6.11 Non designated landscapes or elements and features still have value but this will be given less weight.

A5.6.12 With regard to the value of dark skies, landscapes can be recognised as places of exceptionally dark night skies where people have committed to keep skies dark through the control of light pollution. Similar to landscape designations, this can be recognised through designation at international level such as Dark Sky Parks, or at a local level through the special qualities of a national or local landscape designation. Similarly, some landscapes may not be formally designated for their dark skies but may be promoted as tourist destinations based on their dark sky attributes or through community led projects.

A5.6.13 Definitions of Very High, High, Medium, Low and Very Low are used in this LVIA to evaluate landscape value as follows:

Table A5.1: Definitions of landscape value

Value	Definition of Landscape Value
Very High	Areas that exhibit a very strong, positive character and which are in excellent or very good condition with valued features that combine to give an experience of unity, richness, and harmony. As a result, these landscapes may also demonstrate a high scenic quality also. These are landscapes that may be considered to be of particular importance to conserve and which may be particularly sensitive to change if inappropriately dealt with. Smaller areas of especially high quality/value or landscapes which, by virtue of the extent of their positive attributes, may also be described as exceptional. This is likely to apply to International and National designations such as World Heritage Sites, National Parks, National Scenic Areas, Wild Land Areas and Inventoried Historic Gardens and Designed Landscapes.
High	Areas that exhibit positive character and are considered to be in good condition with some valued features, but which may have evidence of alteration to/ degradation/erosion of features resulting in areas of more mixed character. Scenic quality and attractiveness are recognised at a local level. Change may not necessarily be detrimental nor require special attention to detail. These areas may be valued at the local authority level such as Special Landscape Areas, Non-Inventoried Designed Landscapes
Medium	Areas that exhibit positive character and are considered to be in relatively good condition with average valued features and scenic quality, Change may not necessarily be detrimental nor require special attention to detail.
Low	Areas generally negative in character, in average to poor condition with a weak landscape structure and few valued features. Some scope for positive enhancement.
Very Low	Areas generally negative in character, in very poor condition with a weak landscape structure and very few valued features. Scope for positive enhancement.

Landscape Susceptibility to Change

A5.6.14 Landscape susceptibility is defined in GLVIA3 as *'the ability of the landscape receptor (whether it be the overall character or quality/condition of a particular landscape type or area, or an individual element and/or feature, or a particular aesthetic and perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policies and strategies.'* (GLVIA3, para 5.41).

A5.6.15 Indicators that influence the susceptibility of landscape receptors to different types of development being proposed are as follows and include examples that generally indicate a lower susceptibility to wind farm development:

- **Landscape scale and geographical extent**: Large-scale landscapes generally indicate a lower susceptibility to wind farm development;
- **Landform**: Flat plateau/gently undulating land without distinctive topographical features;
- **Skylines**: Screened or less prominent skylines punctuated by modern man-made features;
- **Landscape pattern and complexity**: Landscapes with a simple and regular pattern;
- **Settlement and man-made influences**: Presence of modern, man-made structures such as infrastructural/ industrial features;
- **Inter-visibility with adjacent landscapes and key vistas**: inward looking areas with no strong vistas or interconnectivity with adjacent landscapes; and
- **Perceptual aspects**: Non remote areas, close to human activity or development (including light pollution).

A5.6.16 The following examples generally indicate a higher susceptibility to wind farm development:

- **Landscape scale**: small scale landscapes generally indicate a higher susceptibility to wind farm development;
- **Landform**: Variations in topography with distinctive or iconic topographical features;
- **Skylines**: highly visible, generally undeveloped skylines often punctuated by important landmarks;
- **Landscape pattern and complexity**: Landscapes with a complex, rugged and irregular pattern;
- **Settlement and man-made influences**: Presence of small-scale features, historic/vernacular settlement and lack of modern development;
- **Inter-visibility with adjacent landscapes**: Landscapes which are integral to the character of adjacent landscapes and feature strongly in views from sensitive landscapes and/or have strong vistas and principal directions of view; and
- **Perceptual aspects**: Remote areas with no visual or audible signs of human activity, development or light pollution.

A5.6.17 Definitions of Very High, High, Medium, Low and Very Low are used in this LVIA to evaluate landscape susceptibility as follows:

Table A5.2: Definitions of Landscape Susceptibility

Value	Definition of Landscape Susceptibility
Very High	The landscape receptor is highly susceptible to the change proposed by the development. Landscape characteristics have very limited ability to accommodate the development without undue adverse effects.
High	The landscape receptor has some susceptibility to the change proposed by the development. Landscape characteristics have some ability to accommodate certain elements of the development without undue adverse effects
Medium	The landscape receptor has moderate susceptibility to the change proposed by the development. Landscape characteristics are able to accommodate certain elements of the development without undue adverse effects
Low	The landscape receptor has low susceptibility to the change proposed by the development. Landscape characteristics are able to accommodate certain elements of the development without undue adverse effects
Very Low	The landscape receptor has very low susceptibility to the change proposed by the development. Landscape characteristics are able to accommodate the development without undue adverse effects

A5.6.18 GLVIA3 advises that an individual assessment of the susceptibility of receptors to the specific development proposal is a key process and should not be replaced by existing landscape sensitivity and capacity studies. However, such studies have been reviewed to provide a useful guide to inform the evaluation of susceptibility of landscape receptors.

Determination of Landscape Sensitivity

A5.6.19 Both Landscape value and susceptibility are identified as Very High, High, Medium, Low and Very Low. Professional judgement is used to evaluate this complex relationship between value and susceptibility to determine the overall sensitivity of the landscape receptor to the Proposed Development. For example, where susceptibility to landscape change may be High but value is considered to be Low, overall landscape sensitivity to wind farm development would generally be expected to be Medium. However, in some cases, landscapes generally attributed the highest value such as international or national landscape designations do not necessarily have a Very High susceptibility to all types of change. Full justification for the assessment of the sensitivity of a particular receptor is included in the LVIA. The following table is used as a guide only.

Table A5.3: Levels of sensitivity on landscape receptors defined by value and susceptibility

Landscape Susceptibility	Landscape Value: Very High	High	Medium	Low	Very Low
Very High	Very High				
High		High			
Medium			Medium		
Low				Low	
Very Low					Very Low

Landscape Magnitude of Effect

A5.6.20 Judgements of magnitude of effect are assessed in terms of the size and scale, geographical extent, duration, and reversibility of the change likely to result from the Proposed Development.

Size & Scale

A5.6.21 The size and scale of the proposed change can refer to both whole Landscape Character Areas/Types and to individual elements and features. For Landscape Character Areas/Types, the size and scale of the change refers to the degree to which the key characteristics of the landscape are changed as a result of the addition of the Proposed Development. For landscape elements and features the size and scale of the change refers to the extent of existing landscape elements (including aesthetic and perceptual elements) that will be lost or changed and the proportion this represents of the total extent within the landscape. It also considers the contribution of the affected element to the overall character of the landscape.

A5.6.22 Existing wind farms also form part of the landscape baseline, and the size and scale of change also considers the relationship between the Proposed Development and the other wind farms. This considers issues such as the arrangement of wind farms in the landscape (clustering or dispersal), the relationship between the scale and situation (different landscapes) of the different wind farms, distances between wind farms and ultimately whether the Proposed Development fits comfortably with the overall existing pattern of wind farm development or whether it intensifies the presence of wind farms creating a ‘wind farm landscape’.

A5.6.23 The size and scale of change is determined as major, moderate, minor, or negligible and could be either adverse or beneficial.

Geographical Extent

A5.6.24 This refers to the geographical extent over which the landscape change will occur. It is described as being limited at site level, to the immediate site setting (or local area) and to the wider area, across some or all of the Landscape Character Areas/Types or landscape designation affected.

Duration & Reversibility

A5.6.25 The duration of landscape changes are classified as permanent, temporary or reversible. This can be described as long term (generally lasting over 15 years, including effects that will persist for up to 35-year operational lifespan of the wind farm), medium term (generally lasting 5-15 years) and short term (generally lasting 0-5 years).

A5.6.26 Reversibility is related to whether the change can be reversed at the end of the development's lifecycle (including the end of construction or decommissioning which would be short term reversible). For example, operational effects related to the presence of turbines are considered to be reversible as they will be removed during decommissioning at the end of the operational lifespan.

A5.6.27 The duration and reversibility of landscape change is determined as Permanent/irreversible, Long term/reversible, Medium term/reversible or Short term/reversible.

Determination of Magnitude of Landscape Effect

A5.6.28 The relationship between all three of the above factors is assessed to determine the overall nature of the change resulting from the introduction of the Proposed Development. This results in four levels of magnitude. Substantial, Moderate, Slight and Negligible which is outlined in Table A5.4.

A5.6.29 In general, a major level of change in terms of size and scale, across a large geographical extent with Long term reversible/permanent, irreversible effects would result in an overall Substantial magnitude of effect. However, this is a complex relationship between the different factors of magnitude, and various combinations are possible. Each effect is judged on its own merit and the following table is used as a guide only.

Table A5.4: Levels of Landscape Magnitude of Effect

Level of Magnitude	Definition of Magnitude
Substantial	Total loss or major alteration to key elements, features, or perceptual characteristics of the baseline landscape over a large area including the possible introduction of major new and uncharacteristic elements. The post development character and composition of the baseline landscape resource will be fundamentally changed for some distance from the site. Changes would also be deemed permanent and irreversible.
Moderate	Partial loss or alteration to one or more key elements, features, or perceptual characteristics of the baseline landscape over a moderate area, including the possible introduction of moderate new and uncharacteristic elements. The post development character and composition of the baseline landscape resource will be partially, but noticeably changed at a medium distance from the site, including the immediate setting and the landscape character area in which it lies. Changes would be long term, between 10 and 25 years but theoretically reversible.
Slight	Minor loss of or alteration to one or more key elements, features, or perceptual characteristics of the baseline landscape over a small area, including the possible introduction of minor new and uncharacteristic elements. The post development character and composition of the baseline landscape resource will be noticeably changed but the underlying character of the baseline landscape will be similar to the pre-development character. The change would occur only within the site itself or within the immediate vicinity of the development proposal. Changes would be wholly or partially reversible and would be medium term, lasting for up to ten years.
Negligible	Very limited or imperceptible loss or alteration to one or more key elements, features, or perceptual characteristics of the baseline landscape over a negligible area, including negligible effects from the introduction of minor new and uncharacteristic elements. Change to the landscape character will be barely discernible with very limited influence on the landscape character within the site or immediate vicinity of the development proposal. Changes would be reversible, deemed temporary and would last between 0 and 5 years.

A5.6.30 The determination of the magnitude of effect on the designated landscape resource additionally considers the distance from the site at its closest point, potential changes to principal views from within and towards the designated landscape and potential effects on the integrity of the designated landscape, including the extent to which it could affect the for the special qualities/attributes of the designation.

Assessing Visual Effects

A5.6.31 Assessing the significance of visual effects of the Proposed Development requires several steps including identifying the sensitivity of the visual receptor, identifying the magnitude or scale of the change to the receptors view, prior to forming a judgement with respect to the significance of the effect in the context of the EIA (Scotland) Regulations 2017.

Sensitivity of Visual Receptors

A5.6.32 The sensitivity or nature of visual receptors is defined by the professional judgement of the interaction between the value of the view experienced by the visual receptor and the susceptibility of the visual receptor (or viewer not the view) to the particular form of change likely to result from the Proposed Development.

Value of View

A5.6.33 Different groups of people attach different levels of value to particular views. Determining the value of a view therefore takes account of the following factors:

- Recognition of the view through the presence of planning designations;
- Importance in relation to heritage assets (such as designed views);
- Popularity of the viewpoint; and
- Indicators of the value attached to views by visitors through appearances in promotional tourist literature and the provision of tourist facilities.

A5.6.34 Value can also be attributed to the numbers of people using a route receptor or visiting an attraction. For example, a popular attraction is often considered more sensitive than a less visited attraction. However, there are exceptions to this such as motorways and railways which have a higher number of people but are considered to be of lower value; or more remote locations with fewer people visiting but are considered to be of higher sensitivity.

A5.6.35 Views from individual private residential properties are considered to be highly valued by residents (and discussed separately in Volume 3: Appendix 5.5.

A5.6.36 With regard to aviation lighting, the value of views at night-time differs from daytime, an example being viewpoints located within a Dark Sky Park where the value is considered to be high on account of the low levels of light pollution to enable observation of the night sky. However, in other situations the value of views may decrease at night where the elements that add value to the view are not discernible. Furthermore, the popularity, reason for use and level of use of a viewpoint during the day may be completely different to its use at night, or vice versa. These differences are set out for each visual receptor assessed.

A5.6.37 Definitions of Very High, High, Medium, Low, and Very Low are used in this LVIA to evaluate the value of view as follows:

Table A5.5: Defining the value of the view

Visual Value	Definition of Visual Value
Very High	Views from nationally/internationally known viewpoints which may be covered by a landscape/planning/heritage designation, have important cultural associations, be a popular visitor attraction that is well promoted by tourist literature and where the view forms a key part of the visitor experience.
High	Views of regional and local importance which may be covered by a local landscape/planning designation, be a locally popular visitor attraction that is promoted in locally distributed visitor literature and where the view forms a key part of the visitor experience.
Medium	Views with no designation or cultural association. Not a promoted area but may still be valued by the local community.
Low	Views with no designation, cultural association or a promoted area with little value by the local community.
Very Low	Views with no designation or cultural association. Not a promoted area with no value by the local community.

Susceptibility of Visual Receptors to Change

A5.6.38 This aspect of the nature of the receptor refers to the susceptibility of the viewer to the proposed change, not the view. The susceptibility of visual receptors to changes in views is a function of the occupation or activity of people experiencing the view and the extent to which their attention is focused on views.

A5.6.39 Viewers of higher susceptibility to changes in views are generally those whose attention or interest is focused on their surroundings, including residents, walkers, and visitors to attractions.

A5.6.40 Viewers of lower susceptibility to changes in views include people travelling on non-scenic routes and people at their place of work whose attention is not on their surroundings and where setting is not important to their quality of working life.

A5.6.41 The susceptibility of people experiencing night-time outdoors will depend on the degree to which their perception is affected by existing baseline lighting. In brightly lit areas, or when travelling on roads from where sequential experience of lighting may be experienced, the susceptibility of receptors is likely to be lower than from within areas where the baseline contains no or limited existing artificial lighting.

A5.6.42 The following table provides a guide to the susceptibility of different viewer groups.

Table A5.6: Susceptibility of different groups of visual receptors

Value	Definition of Landscape Susceptibility
Very High	• A viewpoint of international or national importance;
High	• Residents; • People participating in landscape dependent outdoor recreation where their attention is focussed on the landscape and particular views; • Visitors to attractions and heritage assets where views are integral to the visitor experience; • Communities where views contribute to the landscape setting; • Travellers on road, rail and other transport routes where their attention is generally less focussed on the landscape and particular views;
Medium	• People participating in outdoor sport and recreation where the landscape or views make some contribution to the activity; • Travellers where the view where the landscape and views make some contribution to the journey.
Low	• People participating in outdoor sport and recreation which has limited importance to the landscape or views; • People at their place of work where the landscape setting has limited importance to the quality of their working life; • Travellers where the view has limited importance to the journey.
Very Low	• People participating in outdoor sport and recreation which does not involve the landscape or views; • People at their place of work where the landscape setting is not important to the quality of their working life; • Travellers where the view is not important to the journey.

Determination of Visual Sensitivity

A5.6.43 The sensitivity of visual receptors is defined by the relationship between the value of views and the susceptibility of different types of viewer to the proposed change. Both value and susceptibility are identified as Very High, High, Medium, Low and Very Low. Professional judgement is used to evaluate this complex relationship between value and susceptibility to determine the overall sensitivity of the visual receptor to the Proposed Development. In general terms, where the value of the view is High and the susceptibility of the viewer to change is Low, the overall sensitivity of the visual receptor would be expected to be Medium. However, this is not formulaic and can be a complex relationship with different combinations possible. The following table is used as a guide only.

Table A5.7: Levels of sensitivity on visual receptors defined by value and susceptibility

Visual Susceptibility ↓ / Visual Value →	Very High	High	Medium	Low	Very Low
Very High	Very High				
High		High			
Medium			Medium		
Low				Low	
Very Low					Very Low

Magnitude of Visual Effect

A5.6.44 The nature or magnitude of the effect on visual receptors considers the size and scale, geographical extent, duration, and reversibility of the change likely to result from the Proposed Development.

A5.6.45 The worst-case scenario is considered during the assessment of the nature (magnitude) of all visual effects. All changes to views are considered as they would occur in winter conditions with minimal screening by vegetation and deciduous trees. Changes occurring at night-time assume clear moonlit or summer nights when the levels of darkness are at the lightest. ZTVs and wireframes are similarly displayed on the basis of bare ground and therefore demonstrate the maximum extent of theoretical visibility possible, in the absence of buildings, modified landform or vegetation.

Size & Scale

A5.6.46 The size and scale of a visual change refers to the amount of change that is likely to occur as a result of the Proposed Development and depends on the following factors:

- The scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the Proposed Development;
- Distance of the view;
- The degree of contrast or integration of any new features or changes in the view with the existing elements in the view and their characteristics in terms of form, scale and mass, line, height, colour and texture;
- The nature of the view of the Proposed Development, in terms of how long the view of the proposal would last along sequential routes and whether views will be full, partial or glimpses; and
- The angle of view of the Proposed Development, either direct view or oblique view including the horizontal field of view and movement.

A5.6.47 Existing wind farms form part of the existing view and the size and scale of change also considers the relationship between the Proposed Development and these other wind farms. This considers issues such as the arrangement of wind farms in the view e.g. developments seen in one direction or part of the view (combined views), or seen in different directions (successive views in which the viewer must turn) or developments seen sequentially along a route; the relationship between the scale of the different wind farms in terms of turbine height and number; the position of the wind farms (e.g. on the skyline); distances between wind farms and from the viewer; and ultimately whether the Proposed Development fits comfortably with the overall existing pattern of wind farm development or whether it intensifies the presence of wind farms by 'infilling' a gap and leading to a greater combined effect.

A5.6.48 Visual receptors which experience no change to the view as a result of the Proposed Development are not assessed in this LVIA.

Geographical extent

A5.6.49 This refers to the geographical extent over which the visual changes will be visible and whether these are unique views allowing only glimpsed views of the Proposed Development, or whether it is a typical example of a widespread view such as a representative viewpoint.

A5.6.50 For specific, promoted viewpoints, geographical extent may be assessed either as the proportion of a specific area from where a change in view is possible; for example, a small part of a historic designed landscape or as the extent of change within the overall view; for example, the change occurs in a narrow vista rather than across the full panorama or the extent of a route receptor such as a footpath affected.

A5.6.51 The geographical extent of change is determined as Large, Medium, Small or Negligible.

Duration and Reversibility

A5.6.52 The duration of changes to views are classified as permanent, temporary or reversible. This can be described as long term (generally lasting over 15 years, including effects that will persist for the 30 year operational lifespan of the wind farm), medium term (generally lasting 5-15 years) and short term (generally lasting 0-5 years, e.g. limited to during construction).

A5.6.53 Reversibility is related to the duration of the change and whether the change can be reversed at the end of the development (including the end of construction which would be short term reversible or the end of decommissioning which would be long term reversible.) For example, operational visual effects related to the presence of turbines are considered to be reversible as they will be removed during decommissioning, but permanent visual effects are identified after decommissioning owing to continued views of retained tracks.

Determination of Magnitude of Visual Effect

A5.6.54 The relationship between all three of the above factors is assessed to determine the overall nature of the visual change resulting from the introduction of the Proposed Development. This results in four levels of magnitude: Substantial, Moderate, Slight and Negligible, which is outlined in the table below. In general, a Major visual change in terms of size and scale, seen from many locations with long term reversible or permanent, irreversible effects would result in an overall Substantial magnitude of visual change. However, this is a complex relationship between the different factors of magnitude, and various combinations are possible. Each effect is judged on its own merit and the following table is used as a guide only.

Table A5.8: Levels of visual magnitude of potential effect defined by size and scale, geographical extent and duration and reversibility

Level of Magnitude	Definition of Magnitude
Substantial	Major visual change which causes a complete or substantial change in the view as a result of loss of important features or the addition of significant new ones, to the extent that the composition of the view is substantially altered. The change is experienced from many locations across the study area, from the majority of a linear route or from most areas within a specific location and/or by a large number of viewers. Changes would last for 30 years or more and are deemed permanent or irreversible.
Moderate	Moderate visual change which causes a noticeable change in the view as a result of the loss of features or the addition of new ones, to the extent that the composition of the view is altered to a moderate degree. The change is experienced from a moderate number of locations across the study area, from a moderate part of a linear route or from a moderate proportion of an area within a specific location and/or by a moderate number of viewers. Changes would be long term, between 10 and 30 years but theoretically reversible.
Slight	Minor visual change which causes a perceptible change in the view as a result of the loss of features or the addition of new ones, to the extent that this partially alters the composition of the view. The change is experienced from a small number of locations across the study area, from only limited sections of a linear route or from a small proportion of an area within a specific location and/or by a small number of viewers. Changes would be wholly or partially reversible and would be medium term, lasting for up to 10 years.
Negligible	Negligible visual change which causes a barely perceptible change in the view as a result of the loss of features or the addition of new ones, to the extent that this barely alters the composition of the view. The change is either not visible or seen by viewers from only one or two locations across the study area, from very limited sections of a linear route or from hardly any locations within a specific area and/or by only a very small number of viewers. Changes would be reversible, deemed temporary and would last between 0 and 5 years.

Judging the Levels of Significance of Effects

A5.6.55 An overall judgement is made on the nature of the receptor and the likely change resulting from the Proposed Development. This judgement is based on evaluations of the individual aspects of value, susceptibility, size and scale, geographical extent, duration, and reversibility. The table below illustrates the four main levels of visual effect that are used in this LVIA; Major, Moderate, Minor and Negligible. Three intermediate combinations are also used for determining landscape effects; Major/moderate, Moderate/minor, and Minor/negligible. The table is not a prescriptive tool, and the evaluation of potential effects makes allowance for the use of professional judgement and experience.

Table A5.9: Levels of landscape & visual effects and overall significance

Nature of Effect (Magnitude)	Nature of Receptor (Sensitivity)				
	Very High	High	Medium	Low	Very Low
Substantial	Major				
Moderate			Moderate		
Slight				Minor	
Negligible					Negligible

A5.6.56 Landscape Institute advice, contained in GLVIA3 statement of clarification 1/13 (June 2013), states that following the determination of magnitude and sensitivity, '*the assessor should then establish (and it is for the assessor to decide and explain) the degree or level of change that is considered to be significant*'. In accordance with this advice, this LVIA establishes at what level in the assessor's opinion, 'significant' effects arise.

A5.6.57 Those effects considered to be **Major**, **Major/moderate** and some **Moderate** effects by virtue of the more sensitive receptors and the greater magnitude of effects, are considered to be **Significant Visual Effects**. Some **Moderate**, and all **Moderate/minor**, **Minor**, **Minor/negligible** and **Negligible** effects are considered to be not significant visual effects.

A5.6.58 A significant visual effect is considered to be a change in the view that would markedly change the composition and geographical extent of that view.

A5.6.59 It should be noted that significant effects need not be unacceptable or necessarily negative and may be reversible.

A5.7 CUMULATIVE METHODOLOGY

A5.7.1 The aim of the CLVIA is to identify, predict and evaluate potential key effects arising from the addition of the Proposed Development to a theoretical baseline which includes the existing baseline situation of operational wind farms, those under construction and additionally wind farms currently being considered within the planning system that may or may not be present in the landscape in the future.

A5.7.2 The methodology for CLVIA follows good practice guidance as set out in the GLVIA3 and *Assessing the Cumulative Effects of Onshore Wind Energy Developments* (SNH, 2012).

Differences between LVIA and CLVIA

A5.7.3 SNH guidance defines cumulative effects as '*the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together*.' This highlights the two possible ways of reporting cumulative effects. The first is to consider only the additional effect that would occur in the cumulative baseline, meaning those effects over and above the effects identified in the LVIA assessment. The second is to redo the LVIA assessment but using the theoretical cumulative baseline, so a combined effect is determined.

A6.7.4 This CLVIA takes the first approach resulting in a stand-alone assessment which identifies the effects of introducing the Proposed Development into the cumulative baseline. It is clearly set out whether the effect has increased or decreased relative to the LVIA assessment or whether the effects will be the same as in the LVIA assessment.

Types of Cumulative Effect

A5.7.5 As with the LVIA, the CLVIA deals with the effects on landscape and visual receptors separately.

Cumulative landscape effects

A5.7.6 Cumulative landscape effects are defined as effects on either the physical fabric, aesthetic aspects of the landscape or overall character of the landscape, or any special values attached to it as follows:

- Cumulative effects on the physical fabric of the landscape arise when two or more developments affect the landscape components or features such as woodland, dykes or hedgerows;
- Cumulative effects on the aesthetic aspects of the landscape arise when two or more developments affect the aesthetic or perceptual components of landscape character including scale, sense of enclosure, diversity, pattern and colour and perceptual or experiential attributes such as naturalness, remoteness or tranquillity; and
- Cumulative effects on the landscape character can arise when a new proposal results in a progression from a landscape which contains one development which forms an individual, isolated feature, to a landscape in which two or more developments are evident and may form a significant or dominant characteristic. Cumulative visual effects.

Cumulative Visual Effects

A5.7.7 Cumulative visual effects are defined as effects that can be caused by combined visibility, which occurs where the observer is able to see two or more developments from one viewpoint or sequential effects which occur when the observer has to move to another viewpoint to see different developments. (i.e., along linear routes or journeys)

- Combined visibility: can occur as simultaneous visibility, where more than one development is visible in the same angle of view or successive visibility where two or more developments are present in views from the same viewpoint but cannot be seen at the same time as they are not in the same angle of view. (i.e. the viewer has to turn their head to see the other developments which become visible in succession.); and
- Sequential visibility: occurs where two or more developments are not present in views from the same viewpoint and cannot, therefore, ever be seen at the same time. The observer has to move to another viewpoint to see the other developments so they will then appear in sequence. Sequential effects are most common along linear routes and journeys. Sequential effects range from frequently sequential when the developments keep appearing regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints, to occasionally sequential, where there may be long time lapses between appearances, because the observer is moving very slowly and/or there are large distances between the areas of visibility.

Significance of Cumulative Effects

A5.7.8 SNH guidance considers that the concept of a 'threshold of acceptable change' beyond which turbine developments in a particular area become unacceptable, is a crucial element in identifying significance adverse cumulative effects. In other words, the effect of the present proposal is limited, but when added to the effect of what has already been permitted, or to new proposals which have been submitted for planning permission, it can become over-dominant in planning terms.

Cumulative Sites

A5.7.9 For the purposes of this CLVIA, cumulative sites consist of other wind farm developments only. These are listed in Volume 3: Appendix 5.2.

A5.7.10 An initial cumulative search area of 60 km from the proposed scheme was delineated and a list was prepared including all operational, those schemes under construction, consented schemes, those schemes in the planning system as valid applications and those at the scoping stage within this search area. Recently withdrawn sites have not been included and those sites registered with a Pre-Application Notice (PAN), are not finalised applications and have therefore not been included as a valid application but have been included as a pre-application/scoping scheme.

A5.7.11 The windfarm developments identified in the initial Cumulative Search Area are mapped in the Cumulative Search Area map, Volume 2b: Figure 5.11 and are up to date as of 24th January 2023.

A5.7.12 Using this initial Search Area list of developments, an initial cumulative desktop and site assessment was carried out by a CMLI to identify a suitable cumulative baseline (or Cumulative Study Area). In accordance with SNH guidance (2012), the initial Search Area list was therefore refined to establish which turbine developments were of most relevance to the cumulative assessment for the proposal. As the guidance states '*the key principle for all cumulative impact assessments is to focus on the likely significant effects and in particular those which are likely to influence the outcome of the consenting process'*. (para 33 SNH 2012).

A5.7.13 The Cumulative Study Area or cumulative baseline for windfarms was therefore defined to include those developments it was considered required further cumulative assessment. These included all operational, consented, and valid planning applications within an approximate 20 km radius from the proposed site with additional developments to reflect potential sequential and cumulative viewpoints.

A5.7.14 It should be noted that the cumulative baseline represents the 'maximum development scenario.' It considers the effects of the proposal in addition to other developments that do not yet exist in the current landscape, but which may exist in the future. This results in a high level of uncertainty in the cumulative baseline as not all of the other undetermined proposals will necessarily gain planning approval.

A5.7.15 Owing to this uncertainty with regard to the maximum development scenario, the cumulative baseline is split into different scenarios with a decreasing likelihood of becoming operational.

Cumulative baseline

A5.7.16 The cumulative baseline is divided into different scenarios which reflect which groups of wind farm developments are assumed to be present in the landscape. The existing scenario of operational wind farms and those under construction is assessed in the LVIA and is referred to as **Scenario 1**. The CLVIA considers the following scenarios:

- **Scenario 2**: considers the addition of the Proposed Development in the context of operational wind farms, those under construction and additionally those developments currently consented. This represents the likely future scenario; and
- **Scenario 3**: the addition of the Proposed Development in the context of operational, under construction, consented, undetermined planning applications i.e. a less certain future scenario.

A5.7.17 Known scoping sites have been included on the wirelines for context but have not been assessed as not all scoping developments would reach planning application stage.

Assessing Cumulative Effects

A5.7.18 The methodology for the CLVIA follows that of the LVIA as set out in Sections A5.1 – A5.5 of this Appendix. The key additional steps in the CLVIA are as follows:

- Preparation of ZTV maps for each of the other existing or proposed wind farms and combining them to inform the assessment of scenarios and relationships; and
- Particular attention to the relationships between wind farms in the baseline for each scenario, and how those relationships will change with the addition of the Proposed Development.

A5.7.19 The susceptibility of receptors may be affected by the presence of other wind energy developments. Some viewers may consider that susceptibility is reduced because other wind farms are '*already there'*, but for others it may be that sensitivity is increased because more development would be '*too much'*. However, to retain a consistent and objective approach, the susceptibility of receptors used for the cumulative assessment is taken to be the same as that identified in the LVIA. The value of the receptor would also remain the same in the cumulative assessment and therefore the overall sensitivity of the receptor is considered to be the same as judged in the LVIA.

A5.7.20 In this CLVIA, cumulative effects are reported as the additional effects of the introduction of the Proposed Development, should other cumulative schemes be present in the different baseline scenarios, over and above the effects identified in the LVIA (Scenario 1). For each receptor, it is clarified as to whether the effect has increased or decreased relative to the LVIA assessment, and where necessary the CLVIA states where there will be no cumulative effects over and above those identified in the LVIA assessment.

Assessing Cumulative Landscape Effects

A5.7.21 Assessing the significance of cumulative landscape effects requires the identification of the landscape receptors, the consideration of the nature of the landscape receptors (sensitivity) as identified in the LVIA and the determination of the nature of the effect (magnitude) which would be experienced by each landscape receptor as a result of the addition of the Proposed Development to each baseline scenario.

Landscape Receptors of Cumulative Effects

A5.7.22 The cumulative landscape assessment considers all the LCTs, and designated landscapes assessed in the LVIA.

Overall Significance of Cumulative Landscape Effects

A5.7.23 An overall judgement is made on the nature of the receptor and the likely change resulting from the addition of the Proposed Development. This judgement is based on evaluations of the individual aspects of value and susceptibility of the receptor as identified in the LVIA and the size and scale, geographical extent, duration, and reversibility of the cumulative change. Four main levels of cumulative landscape effect are used in this CLVIA; Major, Moderate, Minor and Negligible. Three intermediate combinations are also used; Major/moderate, Moderate/minor and Minor/negligible. The evaluation of potential effects makes allowance for the use of professional judgement and experience.

A5.7.24 There are varying degrees of cumulative landscape effect. These are as follows:

- Multiple wind farms are viewed as separate isolated features within the LCT/LCA, too infrequent and of insufficient significance to be perceived as a characteristic of the area;
- Multiple wind farms are viewed as a key characteristic of the landscape, but not of sufficient dominance to be a defining characteristic of the area;
- Multiple windfarms appear as a dominant characteristic of the area, seeming to define the character type as a '*wind farm landscape character area'*; and
- Wind farms cross different character types, reducing the distinction between the different types.

A5.7.25 The appropriateness of such effects will depend on the value of a landscape, the objectives for change as defined in local capacity studies and scale of that effect, i.e. whether affecting local character or occurring at a regional level.

A5.7.69 A significant cumulative landscape effect is considered to be a **Major** or **Major/moderate** and **some Moderate** landscape effects. Some Moderate, and all Moderate/minor, Minor, Minor/negligible and Negligible effects are considered to be not significant cumulative visual effects.

A5.7.27 It should be noted that significant cumulative landscape effects need not be unacceptable or necessarily negative and may be reversible. Each effect is evaluated on its own merit.

Assessing Cumulative Visual Effects

A5.7.28 Assessing the significance of cumulative visual effects requires the identification of the visual receptors, the consideration of the nature of the visual receptors (sensitivity) as identified in the LVIA and the determination of the nature of the effect (magnitude) which would be experienced by each visual receptor as a result of the addition of the Proposed Development to each baseline scenario.

Visual receptors of cumulative effects

A5.7.29 The cumulative visual assessment considers all the sequential routes and static locations such as viewpoints or settlements that have theoretical visibility (as shown in the ZTVs) of cumulative wind farm developments and were considered in the LVIA.

A5.7.30 Cumulative wind farms are shown in the visualisations as required by SNH good practice guidance.[33] In addition, a ZTV to blade tip height of each wind farm proposal has been prepared and then combined with the ZTV of the Proposed Development to create 'paired ZTVs' which illustrate the areas of mutual visibility, i.e., where the Proposed Development and other proposals are both visible from. ZTVs showing the combined visibility of each cumulative baseline scenario have also been prepared to illustrate the total visibility for each scenario.

Magnitude of Cumulative Visual Effect

A5.7.31 The nature or magnitude of the cumulative effect on visual receptors as with the LVIA considers the size and scale, geographical extent, duration and reversibility of the change likely to result from the addition of the Proposed Development to the different baseline scenarios. With particular regard to cumulative effects, the following factors are also considered in determining the magnitude of cumulative visual change from each visual receptor:

- The number of wind energy developments visible;
- The prominence of the developments likely to be seen;
- The arrangement of wind energy developments e.g., developments seen in one direction or in only part of the view, or seen in all directions;
- The relationship of the scale of the wind energy developments including size and number of turbines which may also be expressed as the horizontal and vertical angle occupied by turbines;
- The position of the turbine developments in the view e.g., on the skyline, against the backdrop of land;
- The distances from the viewer and between developments;
- The landscape setting, context and separation or coalescence / overlapping of wind energy developments; and
- Potential screening by landcover such as vegetation and local variations in topography.

Overall Significance of Cumulative Visual Effects

A5.7.32 An overall judgement is made on the nature of the receptor and the likely change resulting from the addition of the Proposed Development. This judgement is based on evaluations of the individual aspects of value and susceptibility of the receptor as identified in the LVIA and the size and scale, geographical extent, duration, and reversibility of the cumulative change. Four main levels of cumulative visual effect are used in this CLVIA; Major, Moderate, Minor and Negligible. Three intermediate combinations are also used; Major/moderate, Moderate/minor and Minor/negligible. The evaluation of potential effects makes allowance for the use of professional judgement and experience.

[33] SNH (2017) *Visual Representation of Wind Farms, Version 2.2*. SNH. Battleby.

A5.8 SUPPORTING FIGURES & VISUALISATIONS

Zone of Theoretical Visibility

A5.8.1 ZTVs have been generated to aid the understanding of the extent of theoretical visibility of the Proposed Development. ZTVs have been used through the different stages of the Proposed Development from the initial feasibility study, through the evolution of the layout design, and have informed the extent of the study area and identification of landscape and visual receptors that are likely to be affected.

A5.8.2 ZTVs takes no account of the potential screening effects of intervening factors such as forestry/woodland, vegetation, buildings, recent modifications to landforms, or weather conditions. Therefore, ZTVs represent the 'worst case scenario' and over represent the extent of visibility of the Proposed Development. It is important to note, NatureScot guidance states: 'ZTVs indicate areas from where a wind farm is theoretically visible within the study area, but they cannot show what it would look like, nor indicate the nature or magnitude of landscape or visual impacts'.

A5.8.3 ZTV maps have been created using QGIS 3.4.4 Software and Ordnance Survey (OS) Square Grid Terrain 50 m Digital Terrain Model (DTM) by experienced GIS Analysts. In accordance with best practice, the viewer height of the ZTV has been set at 2 m Above Ground Level (AGL) and the tool outputs were coloured in transparent bands to represent the number of turbines visible at tip and hub heights, aviation lighting intensity and interaction with operational/under construction and cumulative developments.

A5.8.4 A series of ZTVs have been produced to provide an illustration of potential light intensities from the aviation lights, both as an overview, and individually for each lit turbine.

Assumptions

A5.8.5 ZTVs have the following assumptions and limitations:

- The DTM data from which the ZTV has been calculated from is Ordnance Survey Terrain 50 (12/02/2020) 50 m resolution and has not been down sampled;
- No non-bare-ground ZTVs have been used in this LVIA;
- The viewer height has been set at 2 m Above Ground Level (AGL);
- Earth curvature correction parameters have been applied with a light refractivity coefficient of 0.13;
- The ZTV has been created to an extent of 45 km from the outermost turbines with 10 km distance rings;
- Turbine heights were based on the candidate turbine described in Chapter 4: Project Description;
- The software used to create the ZTV does not use mathematically approximate methods;
- A ZTV is only accurate as the data on which it is based, and the algorithm used in its calculation;
- A ZTV alone cannot indicate the potential visual impacts of a development, nor show the likely significance of impacts, therefore it shows theoretical visibility only;
- It is not easy to test the accuracy of a ZTV in the field, although some verification will occur during the assessment from viewpoints; and
- The accuracy of most DTMs is limited and they do not include accurate representation of minor topographic features and may not represent areas of recent topographic change, such as opencast coal mines, spoil heaps and road cuttings.

A5.8.6 Analysis of the ZTV identified areas where the proposed turbines would be theoretically visible within the 45 km study area. This process also identified those areas where there would be limited or no visibility of the Proposed Development, which allowed some landscape and visual receptors to be scoped out of the assessment.

Supporting Figures

A5.8.7 Supporting figures have been produced to show LCTs, protected and designated landscapes, visual receptors and cumulative developments located within the study area. The data for these figures has been obtained from publicly accessible websites, fieldwork and a desk review of relevant literature and guidance concerning the identified landscape and visual receptors likely to be affected by the Proposed Development.

Photography

A5.8.8 Baseline photography has been undertaken by a professional photographer for viewpoint locations used in the LVIA and Cultural Heritage assessments, and for the Residential Visual Amenity Assessment.

A5.8.9 Photography was undertaken using a Canon EOS 1ds MkIII full frame sensor, Digital Single Lens Reflex (DSLR) camera with a 50mm f1.4 lens mounted on a Calumet CK8157 tripod with Manfrotto 303 Plus. Grid coordinates and elevation were recorded on a Garmin Etrex GPS. Camera settings were RAW -ISO 400 except for low-light conditions with minimal adjustment.

A5.8.10 A 360-degree panorama was undertaken at 1.5 m AGL ensuring a 50% overlap between photographs to minimise distortion when stitching the photographs together. Photographs are taken in landscape format unless locations are close where photographs are then taken in portrait format to enable the vertical extent of the turbines to be included in the photograph.

A5.8.11 At night-time, baseline photography is recorded at either dawn (approximately 30 minutes prior to sunrise) or dusk (approximately 30 minutes after sunset). The objective for night-time viewpoint photography is to represent, as far as is practical, the baseline lighting levels as they would be perceived by the human eye. To achieve this, camera settings are used to meet this requirement, and settings which artificially brighten the image are not used.

A5.8.12 During the visit to each viewpoint, the grid reference was recorded, ground level and camera viewing height along with a brief description of the nature of the view, weather conditions and visibility. Details of the time and date, camera make and model, lens focal length, shutter speed, f-number and ISO speed rating are recorded as metadata in each photograph file. Additionally, a photograph of the tripod position was also taken at each location.

Wirelines

A5.8.13 Wirelines have been created using ReSoft Windfarm Software and 50 m plus – or 1 m Terrain DTM data for all viewpoints in the LVIA and Cultural Heritage assessment (see Chapter 10: Cultural Heritage). Turbine data is based on the candidate turbine described in Chapter 4: Project Description and data gathered for the cumulative assessment for cumulative Scenarios 1, 2 and 3. Using this information, the software then generated a horizontal view wireline of the Proposed Development from viewpoints. These were exported as images at viewcone angles of 90° and 53.5° for the best representation of what a person will see. Turbines shown on the wirelines are shown to face the viewer with the highest turbine blade pointing directly vertical. It should be noted that similar to ZTVs, wirelines are based on bare ground and do not consider the effects from intervening screening such as vegetation, trees, woodland/forestry, buildings, or minor variations in topography.

Visualisation Production

A5.8.14 Photomontages have been generated for the same viewpoint locations and comply with the NatureScot guidance. Visualisations have been produced to illustrate a 53.5° horizontal Field of View (FoV) and a vertical field of view of 18.2 degrees to capture the Proposed Development and sufficient landscape and visual context.

A5.8.15 Viewpoint photography was stitched together using Microsoft ICE software and imported and lined up to match the viewcone defined for the wireline. Once the photos are aligned, the proposed turbines were rendered onto the photo using paint.net and exported as images. Similar to the wirelines, the proposed turbines are shown to face the viewer but with random rotations to provide a greater sense of realism.

A5.8.16 NatureScot guidance recognise that the production of night-time visualisations to accurately represent aviation lighting is difficult to achieve and is an emerging area of study. This is due to the limitations in in being able to model the light intensity over distance whilst considering variable lighting conditions and atmospheric conditions. The rendering or visual representation of the proposed aviation lights has been achieved using paint.net and a comparative study of photography of actual turbine lighting in similar lighting conditions and viewing distances.

Viewing Instructions

A5.8.17 NatureScots guidance (2017) states:

*'**Visualisations, whether they are hand drawn sketches, photographs or photomontages can never exactly match what is experienced in reality**. They should, however, provide a representation of the proposal that is accurate enough for the potential impacts to be fully understood.*

The assessor, consultees, decision-makers and any interested parties or members of the public should ideally visit the viewpoint(s) where visualisations can be compared to the 'real life' view. It is acknowledged this is not always possible – time, weather and accessibility will restrict the number of viewpoints which can be visited.

Interpretation of visualisations must take account of additional information specific to the proposal, viewpoint and landscape which cannot be shown on a single 2-dimensional image. Factors include variable lighting, movement of turbine blades, seasonal differences and movement of the viewer through the landscape. Visualisations in themselves can never provide the full picture in terms of potential impacts; they only inform the assessment process by which judgements are made.'

A5.8.18 The guidance goes on to provide specific guidance to be undertaken when viewing visualisations as follows:

'it is recommended that photomontages are simply viewed at a comfortable arm's length. This will vary depending on the length of the viewer's arms and their eyesight. However, the difference in viewing distance which results will have little impact on the impression of scale / depth in the image due to the increased size of the images. An instruction to view images at a 'comfortable arm's length' should be included on all visualisations produced. They should also be viewed flat as they are in planar projection.

Planar projection has been chosen for the photomontages as it is easier to use both in print and on screen (a computer screen cannot be curved to view a cylindrical image). Both planar and cylindrical projections have limitations. The main limitation of planar projection is that, if viewed incorrectly, it can slightly increase the scale of turbines at the edge of the image. Ideally the viewer should view the image with their eyes in the centre – however, in practice the difference in scale in most images will be difficult to perceive.'

Appendix 5.2

Cumulative Sites

Document history

Author	Shona Macleod	23/11/2021
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Approved	Emily Galloway	23/11/2021

Client Details	
Contact	Matthew Bacon
Client Name	Vattenfall Wind Power Ltd

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D	17/01/2023	Updated and released

Table A.5.2.1: Cumulative Sites within 45km of Proposed Development

Site Name	Number of Turbines	Max Tip Height (m)	Status
Scenario 1 - Operational/ Under Construction			
Afton	25	118	Operational
Airies	14	126.5	Operational
Andershaw	14	125	Operational
Assel Valley	10	110	Operational
Arecleoch	60	118	Operational
Bankend rig	11	100	Operational
Blackcraig	23	110	Operational
Clyde	206	180	Operational
Dalswinton	15	120	Operational
Dersalloch	23	125	Operational
Dungavel	13	120	Operational
Galawhistle	22	121	Operational
Hadyard Hill	51	111	Operational
Hagshaw Hill	46	57	Operational
Hare Hill I	20	63.5	Operational
Hare Hill II	35	91	Operational
Harestanes	68	120	Operational
Kilgalloch	96	180	Operational
Kype Muir	26	132	Operational
Mark Hill	28	110	Operational
Middle Muir	15	149.9	Operational
Minnygap	10	125	Operational
Nutberry	6	125	Operational
Sandy Knowe	24	125	Operational
Sanquhar	9	130	Operational
South Kyle	50	149.5	Operational
Sunnyside	2	62	Operational
Twentyshilling Hill	9	125	Operational
Wether Hill	14	91	Operational
Whiteside Hill	10	130	Operational
Windy Rig	16	125	Operational
Windy Standard I	36	53.5	Operational
Windy Standard II	30	119.5	Operational
Scenario 2 – Consented Turbine			
Benbrack	18	149.9	Consented
Chirmorie	21	146.5	Consented
Cornharrow	8	149.9	Consented
Crookedstane	4	127	Consented
Dalquhandy	10	149.9	Consented
Enoch Hill	16	130	Consented
Glenmuckloch	8	133.5	Consented
Glenshimmeroch	10	149.9	Consented
Greenburn	16	149.9	Consented
Hagshaw Hill Repower	14	200	Consented
Kirk Hill	8	115.5	Consented
Knockman Hill	5	81	Consented
Lethans	22	220	Consented
Linburn Farm	2	67	Consented
Lion Hill	4	70	Consented
Lorg	9	149.9	Consented
Margree	9	200	Consented
Mochrum Fell	8	1265	Consented
North Kyle	54	149.9	Consented
Overhill	11	149.9	Consented
Penbreck	9	220	Consented
Pencloe Variation	19	149.5	Consented
Polquhairn	9	100	Consented
Sanquhar Six	6	130	Consented
Torrs Hill	2	100	Consented
Troston Loch	14	149.9	Consented
Windy Standard III	20	177.5	Consented
Scenario 3 – Application			
Arecleoch II	13	200	Application
Artfield Forest	15	180	Application
Bankend Rig 2	3	126.5	Application
Clauchrie	18	200	Application
Craiginmoddie	14	200	Application
Cumberhead	21	200	Application
Daer	17	180	Application
Douglas West II	13	200	Application
Enoch Hill Variation	16	149.9	Application
Euchanhead	21	230	Application
Fell	9	200	Application
Glentaggart	7	250	Application
Greenburn	16	149.9	Application
Kilgallioch II	9	180	Application

Site Name	Number of Turbines	Max Tip Height (m)	Status
Knockcronal	9	200	Application
Knockkippen	12	180	Application
Overhill Variation	11	180	Application
Sanquhar 2	50	200	Application
Sclenteuch	9	200	Application
Shepherd's Rig	17	149.9	Application
Windy Standard I Repower	8	200	Application
		Scoping	
Appin	25	230	Scoping
Cloud Hill	14	180	Scoping
Divot Hill	9	200	Scoping
Lorg Rescoping	12	200	Scoping
Manquhill	8	200	Scoping
South Kyle II	8	200	Scoping

VATTENFALL

Document history

Author	Graeme Glencorse	13/10/2021
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A	09/11/2021	draft for client review
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Appendix 5.3

Landscape Character Review

Contents

Term	Definition
Landform	*'The shape and form of the land surface which has resulted from combinations of geology, geomorphology, slope, elevation and physical processes.'**
Landscape	*'An area, as perceived by people, the character of which is the result of the action and interaction of natural and/or human factors.'**
Landscape & Visual Impact Assessment (LVIA)	*'A tool used to identify and assess the likely significance of the effects of change resulting from development both on the landscape as an environmental resource in its own right and on people's views and visual amenity.'**
Landscape character	*'A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.'**
Landscape Character Assessment (LCA)	*'The process of identifying and describing variation in the character of the landscape, and using this information to assist in managing change in the landscape. It seeks to identify and explain the unique combination of elements and features that make landscape distinctive. The process results in the production of a Landscape Character Assessment.'**
Landscape Character Types	*'These are distinct types of landscape that are relatively homogeneous in character. They are generic in nature in that they may occur in different areas in different parts of the country, but wherever they occur they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern, and perceptual and aesthetic attributes.'**
Landscape effects	*'Effects on the landscape as a resource in its own right.'**
Landscape quality (condition)	*'A measure of the physical state of the landscape. It may include the extent to which typical character is represented in individual areas, the intactness of the landscape and the condition of individual elements.'**
Landscape receptors	*'Defined aspects of the landscape resource that have the potential to be affected by a proposal'**
Landscape value	*'The relative value that is attached to different landscapes by society. A landscape may be valued by different stakeholders for a whole variety of reasons.'**
Magnitude (of effect)	*'A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is reversible or irreversible and whether it is short or long term in duration.'**

Term	Definition
The Applicant	Vattenfall Wind Power Ltd
The Proposed Development	The Quantans Hill Wind Farm Project
The Proposed Development Area	The area within which the Proposed Development will be located.
Developer	In the event of the Proposed Development being granted Section 36 Consent, this is the Company developing the Project.
Zone of Theoretical Visibility (ZTV)	*'A map, usually digitally produced, showing areas of land within which a development is theoretically visible.'**

*Taken from *Guidelines for Landscape and Visual Impact Assessment, Third Edition*. 2013.

** Taken from *Visual Representation of Wind Farms, Guidance.* 2017

List of Abbreviations

List and describe your abbreviations here.

Abbreviation	Description
LCT	Landscape Character Type
LVIA	Landscape & Visual Impact Assessment
km	Kilometre
m	Metre
ZTV	Zone of Theoretical Visibility

A5.3.1 INTRODUCTION

A5.3.1.1 This Appendix of the Environmental Impact Assessment Report (EIAR) identifies and assesses the potential effect of the Proposed Development on Landscape Character Types (LCTs) within the 45 km study area.

A5.3.1.2 Analysis of the Zone of Theoretical Visibility (ZTV) maps established which of the LCTs within 45 km of the Proposed Development would potentially be affected and takes cognisance of the methodology detailed in Appendix 5.1: LVIA Methodology.

A5.3.1.3 This Appendix should be read in conjunction with the following appendices and figures:

- Appendix 5.1: LVIA Methodology;
- Figure 1.1: Site Layout and Location;
- Figure 5.2a: Zone of Theoretical Visibility - Tip Height (A3 Size);
- Figure 5.2b: Zone of Theoretical Visibility - Tip Height (A0 Size);
- Figure 5.3: Zone of Theoretical Visibility - Hub Height (A3 Size);
- Figure 5.4: Zone of Theoretical Visibility – Aviation Lighting (Reduced Lighting Scheme);
- Figure 5.5: Landscape Character Types;

A5.3.2 LANDSCAPE CHARACTER TYPES REVIEW

A5.3.2.1 LCTs have been identified following a review of NatureScot's Landscape Character database (2019)[1]. Table A5.2.1 provides an overview of the extent of theoretical visibility within each LCT and justification for being scoped in or out of the Landscape and Visual Impact Assessment (LVIA).

Table A5.2.1: Theoretically Visibility Predicted Within Landscape Character Types

Landscape Character Type	Extent of Theoretical Visibility	Inclusion in the Assessment
LCT 59: Raised Beach Coast and Cliffs – Ayrshire	The ZTV indicates that all three units of the LCT would not receive theoretical visibility of the Proposed Development.	No
LCT 60: Low-Lying Coast – Ayrshire	The ZTV predicts no theoretical visibility.	No
LCT 62: Coastal Headlands – Ayrshire	Located 31.2 km to the north west of the Proposed Development in South Ayrshire. Theoretical visibility of 1 – 12 turbines is predicted on the upper slopes extending from Newark Hill in the north, to Knoweside Hill in the south.	No – due to distance from the Proposed Development.
LCT 63: Coastal Valley with Policies – Ayrshire	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 64: Coastal Farmland and Policies – Ayrshire	No theoretical visibility is predicted by the ZTV within this LCT.	No
LCT 66: Agricultural Lowlands - Ayrshire	No theoretical visibility is predicted by the ZTV within this LCT.	No
LCT 68: Lowland River Valleys - Ayrshire	The ZTV predicts no theoretical visibility within this LCT.	No

[1] NatureScot (2021) Scottish Landscape Character Types Map and Descriptions [Online] Available from https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions (Accessed August 2021)

Landscape Character Type	Extent of Theoretical Visibility	Inclusion in the Assessment
LCT 69: Upland River Valleys – Ayrshire	Located in five separate locations in East Ayrshire covering the rivers Irvine, Ayr, Bellow and Glenmuir Waters, Nith and the Doon. The River Doon unit is predicted to receive limited theoretical visibility of the Proposed Development on high ground to the east and west of the river near Patna, Waterside and Dalmellington. From here, 1-9 turbines are predicted to be theoretically visible at distances between 13.1 – 23.7 km to the north west of the Proposed Development. None of the other four units of this LCT are predicted to receive theoretical visibility.	No – due to the limited extent of the Proposed Development theoretically visible experienced from a small area.
LCT 70: Lower Dale – Ayrshire	No theoretical visibility predicted within this LCT.	No
LCT 71: Middle Dale – Ayrshire	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 72: Pastoral Valleys – Ayrshire	Located in two locations covering the Water of Girvan and River Stinchar. The ZTV predicts that the Water of Girvan unit of this LCT would receive very limited theoretical visibility of 1-14 turbines covering high ground on either side of the river at Craig Hill, the lower slopes of Big Hill of the Baing, and Fence of Knockdon. This would occur at distances of 14.4 – 21.3 km to the north west of the Proposed Development.	No – due to distance and the limited extent of the Proposed Development theoretically visible experienced from a small area.
LCT 73: Upland Glen – Ayrshire	No theoretical visibility predicted within this LCT.	No
LCT 74: Upland Basin – Ayrshire	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 75: Lowland Hills – Ayrshire	No theoretical visibility predicted within this LCT.	No
LCT 76: Foothills – Ayrshire	Located in two areas covering high ground extending from the Upper Nith Basin in the east, to the Stinchar Valley in the west. Both units of this LCT are predicted to receive theoretical visibility of the Proposed Development. Theoretical visibility in the unit north of Dalmelington would be very limited to an elevated area above Waterside where 1-6 turbines would theoretically be visible at 19.4 km to the north west. The second unit abuts the administrative boundary with Dumfries & Galloway 8.2 km to the north west of the Proposed Development and is predicted to receive theoretical visibility of 1-14 turbines on high ground including Big Hill of Glenmount and Dersalloch Hill; thereafter, limited to the north west and west extending to 27.2 km from the Proposed Development.	**Yes** – due to proximity to the Proposed Development and extent of theoretical visibility within 15 km from the outermost turbines.
LCT 160: Narrow Wooded River Valley – Dumfries and Galloway	Six units of this LCT are located within the study area covering the Cree, Palnure, Moneypool, Fleet, Urr and Ken. The ZTV predicts theoretical visibility within the Ken unit which lies 1.6 km to the east of the Proposed Development. Within this unit, 1-14 turbines are predicted to be theoretically visible.	**Yes** – due to the extent of theoretical visibility predicted within the Ken unit, and proximity to the Proposed Development.
LCT 165: Upper Dale – Dumfries and Galloway	Turbine 7 is located within the Upper Glen Kens unit of this LCT. Theoretical visibility is predicted to be widespread within this unit comprising 1-14 turbines.	**Yes** – due to proximity to the Proposed Development and widespread theoretical visibility predicted.
LCT 176: Foothills with Forest – Dumfries and Galloway	Five units of this LCT are located within the study area, Cullendoch, Cairnsmore, Rhinns of Kells, Stroan and Lauriston. Theoretical visibility of 12 – 14 turbines is predicted from high ground within the Rhinns of Kells and Stroan units, reducing in extent within the other three units.	**Yes** – the Rhinns of Kells and Stroan units are included due to their proximity and extent of theoretical visibility predicted.

Landscape Character Type	Extent of Theoretical Visibility	Inclusion in the Assessment
LCT 177: Southern Uplands – Dumfries and Galloway	The Proposed Development is located within the Carsphairn unit of this LCT which is predicted to receive widespread theoretical visibility within the southern half of the unit.	**Yes** – due to the Proposed Development being located within the LCT.
LCT 178: Southern Uplands with Forest – Dumfries and Galloway	Both the Carsphairn and Ken units of this LCT are located within the study area situated 1.3 km to the north and 500 m to the east. Theoretical visibility of 1-14 turbines is predicted in both units.	**Yes** – the Carsphairn and Ken units of the LCT are included due to proximity to the Proposed Development and extent of theoretical visibility predicted.
LCT 180: Rugged Uplands – Dumfries and Galloway	Three units of this LCT are located to the west and south of the Proposed Development covering the Rhinns of Kells, Merrick and Fell of Fleet. Widespread theoretical visibility is predicted in the Rhinns of Kells unit 3 km to the west; very limited within the Merrick unit covering the summits of Kirriereoch Hill, and the Merrick; and the north facing slopes of 1-14 turbines in the Fell of Fleet unit.	**Yes** – the Rhinns of Kells unit is included due to the proximity to the Proposed Development and extent of theoretical visibility.
LCT 156: Peninsula – Dumfries and Galloway	The Dundrennan unit of this LCT is located 39.4 km to the south of the Proposed Development. The ZTV indicates scattered theoretical visibility comprising 1-14 turbines in elevated areas to the east of Kirkcudbright.	No – due to the distance of the Proposed Development from the LCT.
LCT 157: Peninsula with Gorsey Knolls – Dumfries and Galloway	Located in two locations within the study area, the Borgue and Rockcliffe units lie to the south and south east of the Proposed Development. The ZTV predicts that there would be very limited theoretical visibility in the Rockcliffe unit of 1-3 turbines at 44.2 km to the south east.	No – due to the very small extent of the Proposed Development predicted to be theoretically visibility within the Rockcliffe unit and distances involved.
LCT 158: Coastal Flats – Dumfries and Galloway	No theoretical visibility predicted within this LCT.	No
LCT 161: Pastoral Valley – Dumfries and Galloway	The Cairn unit of this LCT is located 17.5 km to the south east of the Proposed Development. The ZTV predicts 1-3 turbines would be theoretically visible from a small area on the periphery of the unit where 1-3 turbines are predicted to be theoretically visible.	No – due to the very small extent of the Proposed Development predicted to be theoretically visibility and distance from the Proposed Development.
LCT 162: Lower Dale – Dumfries and Galloway	No theoretical visibility predicted within this LCT.	No
LCT 163: Middle Dale – Dumfries and Galloway	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 164: Flooded Valley – Dumfries and Galloway	The Ken Valley unit of this LCT lies 11.9 km to the south east of the Proposed Development. Theoretical visibility of 1-14 turbines would be scattered throughout the unit.	No – following a field trip to the LCT which established limited visibility due to intervening screening by broadleaf woodland.
LCT 166: Upland Glens – Dumfries and Galloway	Six units of this LCT are located to the north east, east and south east of the Proposed Development, namely Scar, Shinnel, Dalwhat, Castlefairn, Mennock and Dalveen units. The ZTV predicts theoretical visibility of 1-3 turbines within the Mennock unit although this would be limited to the western slopes of East Mount Lowther and summit of Threehope Height.	No – due to the very small extent of the Proposed Development predicted to be theoretically visibility and distance involved.
LCT 167: Moss and Forest Lowland – Dumfries and Galloway	No theoretical visibility predicted within this LCT.	No

Landscape Character Type	Extent of Theoretical Visibility	Inclusion in the Assessment
LCT 168: Drumlin Pasture in Moss and Moor Lowland – Dumfries and Galloway	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 169: Drumlin Pastures – Dumfries and Galloway	Three units of this LCT are located to the south east and south west of the Proposed Development, namely Machars, Deeside and Milton. Theoretical visibility is predicted within the Milton unit on Blairshinnoch Hill and Killymingan Hill of 1-6 turbines at 35.0 km. Within the Deeside unit, theoretical visibility would be widespread of 1-14 turbines covering areas to the west of Loch Ken, south of Castle Douglas and scattered elevated areas elsewhere at distances between 13.6 – 38.6 km away. No theoretical visibility is predicted within the Machars unit.	No – due to the distances involved between the Proposed Development and the LCT units.
LCT 172: Upland Fringe – Dumfries and Galloway	Six units of this LCT are located within the southern part of the study area, Glentrool, Cairnharrow, Corsock, Dunscore, Cairn and Ae/Torthwold. The ZTV predicts that theoretical visibility would occur within the Corsock, Dunscore, Cairn and Ae/Torthwold units but would be very limited to a few small areas of high ground comprising 1-6 turbines at distances between 22 – 45 km.	No – due to the very small extent of the Proposed Development predicted to be theoretically visibility and distances involved.
LCT 173: Plateau Moorland – Dumfries and Galloway	No theoretical visibility predicted within this LCT.	No
LCT 174: Plateau Moorland and Forest – Dumfries and Galloway	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 175: Foothills – Dumfries and Galloway	Seven units of this LCT are located to the east and south of the Proposed Development. The ZTV predicts four of the units as receiving theoretical visibility, Keit, Dalmacallan, Fleet and Cairharrow of 1-14 turbines in elevated areas ranging between 12 – 39.3 km.	No – due to the limited extent of theoretical visibility within each of the units of the LCT combined with distance.
LCT 179: Coastal Uplands – Dumfries and Galloway	Three units of this LCT are located in the study area covering Cairnsmore, Benggirn and Dalbeattie. All three units are predicted to receive some theoretical visibility on north facing slopes and summits of 1-14 turbines at distances of 21.3 – 45 km.	No – due to the distance between the Proposed Development and units of the LCT.
LCT 181: Rugged Uplands with Forest – Dumfries and Galloway	Two units covering the Merrick and Cairn Edward are located within the study area to the west of the Proposed Development. The ZTV predicts very limited theoretical visibility within the Merrick unit occurring at Milldown of 1-14 turbines at 12.6 km.	No – due to the very limited theoretical visibility predicted.
LCT 201: Plateau Farmland – Glasgow and Clyde Valley	No theoretical visibility predicted within the LCT.	No
LCT 207: Upland River Valley – Glasgow and Clyde Valley	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 208: Broad Valley Upland – Glasgow and Clyde Valley	No theoretical visibility predicted within the LCT.	No
LCT 209: Upland Glen – Glasgow and Clyde Valley	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 213: Plateau Moorlands – Glasgow and Clyde Valley	No theoretical visibility predicted within the LCT.	No
LCT 214: Plateau Moorland with Windfarms – Glasgow and Clyde Valley	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 77: Low Hills – Ayrshire	Located 23.8 km to the north west, this LCT covers the elevated ground on either side of the A77 road including the town of Maybole and village of Kirkoswald. The ZTV predicts theoretical visibility would be very limited to elevated areas to the west and south of Maybole comprising 1-12 turbines.	No - due to distance and the limited theoretical visibility predicted.
LCT 78: Plateau Moorland – Ayrshire	No theoretical visibility predicted.	No
LCT 79: Plateau Moorland with Windfarms – Ayrshire	The ZTV predicts no theoretical visibility within this LCT.	No
LCT 81: Southern Uplands – Ayrshire	Located in three locations covering Benty Cowan Hill to the north, Black Craig Hill and Hare Hill to the north east, and an area of high ground between the Carrick Forest and Changue Plantation to the west. Theoretical visibility of 1-3 turbines is predicted on high ground in very limited areas within the north eastern and western units of the LCT.	No - due to the very small extent of the Proposed Development predicted to be theoretically visible from very limited areas.
LCT 82: Southern Uplands with Forest – Ayrshire	This LCT is in two locations within the study area covering the northern part of Carsphairn Forest and part of Carrick Forest. Theoretical visibility is predicted to occur in the Carsphairn unit of the LCT on south facing slopes where 1—9 turbines would be visible at 8.0 km. However, much of the area is covered by coniferous forestry which would significantly reduce the extent of the Proposed Development visible.	No - due to the very small extent of the Proposed Development predicted to be theoretically visible from forested areas.
LCT 83: Rugged upland – Ayrshire	Located to the west of the Proposed Development, theoretical visibility would be limited to summits and east facing slopes where 12-14 turbines would potentially be visible on Craiglee; thereafter, reducing to 1- 6 on scattered hill tops at distances between 9.0 – 18.2 km.	No - due to the very small extent of the Proposed Development predicted to be theoretically visible from very limited areas.
LCT 217: Southern Uplands – Glasgow and Clyde Valley	This LCT covers the hills surrounding Leadhills within South Lanarkshire. Theoretical visibility is predicted from summits within this group of hills including Dun Law, Green Lowther and Lowther Hill of 1-6 turbines. This would be between 32 – 39.4 km to the north east of the Proposed Development.	No – due to distance between the LCT and Proposed Development.

Source: Figure 5.5: Landscape Character Types

A.5.3.3 LANDSCAPE CHARACTER ASSESSMENT

A5.3.3.1 The following LCTs have been scoped into the assessment and are assessed in detail in Chapter 5.:

- LCT 76: Foothills – Ayrshire;
- LCT 160: Narrow Wooded River Valley – Dumfries and Galloway;
- LCT 165: Upper Dale – Dumfries and Galloway;
- LCT 176: Foothills with Forest – Dumfries and Galloway;
- LCT 177: Southern Uplands – Dumfries and Galloway;

- LCT 178: Southern Uplands with Forest – Dumfries and Galloway; and
- LCT 180: Rugged Uplands – Dumfries and Galloway.

VATTENFALL

Document history

Author	Graeme Glencorse	09/11/2021
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Client Details	
Contact	Matthew Bacon
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Appendix 5.4

Protected & Designated Landscapes Review

Contents

Term	Definition
Landscape & Visual Impact Assessment (LVIA)	*'A tool used to identify and assess the likely significance of the effects of change resulting from development both on the landscape as an environmental resource in its own right and on people's views and visual amenity.'**
Protected and designated landscapes	*'Areas of landscape identified as being of importance at international, national or local levels, either defined by statute or identified in development plans or other documents.'**
The Applicant	Vattenfall Wind Power Ltd
The Proposed Development	The Quantans Hill Wind Farm Project
The Proposed Development Area	The area within which the Proposed Development will be located.
Developer	In the event of the Proposed Development being granted Section 36 Consent, this is the Company developing the Project.
Zone of Theoretical Visibility (ZTV)	*'A map, usually digitally produced, showing areas of land within which a development is theoretically visible.'**

*Taken from *Guidelines for Landscape and Visual Impact Assessment, Third Edition*. 2013.

List of Abbreviations

List and describe your abbreviations here.

Abbreviation	Description
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
GDL	Garden & Designed Landscape
GLVIA3	Guidelines for Landscape and Visual Impact Assessment, Third Edition
km	Kilometre
LVIA	Landscape & Visual Impact Assessment
m	Metre
NSA	National Scenic Area
RSA	Regional Scenic Area
SA	Scenic Area

Abbreviation	Description
SLA	Special Landscape Area
SLCA	Sensitive Landscape Character Area
WLA	Wild Land Area
ZTV	Zone of Theoretical Visibility

A5.4.1. INTRODUCTION

A5.4.1.1. This Appendix of the Environmental Impact Assessment Report (EIAR) identifies and assesses the potential effect of the Proposed Development on protected and designated landscapes within the 45 km study area.

A5.4.1.2. Analysis of the Zone of Theoretical Visibility (ZTV) maps established which of the protected and designated landscapes within 45 km of the Proposed Development would potentially be affected and takes cognisance of the methodology detailed in Appendix 5.1: LVIA Methodology.

A5.4.1.3. This Appendix should be read in conjunction with the following appendices and figures:

- Appendix 5.1: LVIA Methodology;
- Figure 1.1: Site Layout and Location;
- Figure 5.2a: Zone of Theoretical Visibility - Tip Height (A3 Size);
- Figure 5.2b: Zone of Theoretical Visibility - Tip Height (A0 Size);
- Figure 5.3: Zone of Theoretical Visibility - Hub Height (A3 Size);
- Figure 5.4: Zone of Theoretical Visibility – Aviation Lighting (Reduced Lighting Scheme);
- Figure 5.6a: Protected & Designated Landscapes;
- Figure 5.10: Cumulative Sites considered within Cumulative Assessment;
- Figure 5.11a: Cumulative 45km ZTV - Scenario 1: Quantans Hill & Operational / Under Construction Sites;
- Figure 5.11b: Cumulative 25km ZTV - Scenario 1: Quantans Hill & Operational / Under Construction Sites;
- Figure 5.13a: Cumulative 45km ZTV – Scenario 3: Quantans Hill & Operational / Constructed / Consented / Application;
- Figure 5.13b: Cumulative 25km ZTV – Scenario 3: Quantans Hill & Operational / Constructed / Consented / Application; and
- Figures 5.14a – 5.38g: Visualisations

A5.4.2. PROTECTED & DESIGNATED LANDSCAPES REVIEW

A5.4.2.1. Protected and designated landscapes have been identified following a review of designation data available from NatureScot, Dumfries & Galloway Council, East Ayrshire Council, South Ayrshire Council, and South Lanarkshire Council. Table A5.3.1 provides an overview of the extent of theoretical visibility within each designation and justification for being scoped in or out of the LVIA.

A5.4.2.2. The following landscape designations have been reviewed:

- National Scenic Areas (NSA);
- Garden & Designed Landscapes (GDL);
- Wild Land Areas (WLA);
- Regional Scenic Areas (RSA);
- Sensitive Landscape Character Areas (SLCA);
- Scenic Areas (SA); and
- Special Landscape Areas (SLA).

Table 3.1: Theoretically Visibility within Protected & Designated Landscapes

Protected & Designated Landscapes	Extent of Theoretical Visibility	Included in the Assessment
National Scenic Areas		
East Stewartry Coast	Located approximately 40.1 km to the south east of the Proposed Development on the Solway Coast. The ZTV predicts that theoretical visibility would be very limited and confined to the north western edge of the NSA covering Mid Hill, Bengairn and Potterland Hill comprising 13-14 turbines.	No – due to distance and limited theoretical visibility predicted.
Fleet Valley	Situated 29.8 km to the south of the Proposed Development, no theoretical visibility is predicted by the ZTV.	No
Nith Estuary	This NSA is located 29.7 km to the south east of the Proposed Development on the Solway coast. The ZTV predicts very limited theoretical visibility of 1-3 turbines on the forested covered Glen Craig.	No – Due to the very limited and distant theoretical visibility predicted.
Gardens & Designed Landscapes		
Auchincruive	No theoretical visibility predicted.	No
Bargany	No theoretical visibility predicted.	No
Blairquhan	No theoretical visibility predicted.	No
Broughton House	No theoretical visibility predicted.	No
Cally	No theoretical visibility predicted.	No
Caprington Castle	No theoretical visibility predicted.	No
Carnell	No theoretical visibility predicted.	No
Cowhill Tower	No theoretical visibility predicted.	No
Craigengillan	This GDL is located 11.6 km to the north west of the Proposed Development. The ZTV predicts scattered theoretical visibility of 1-12 turbines occurring on high ground within the policies including Carwaur, Shear Hill, Knocktrail and Auchenroy Hill, the latter being covered in broadleaf woodland.	No – due to a combination of distance and limited extent of theoretical visibility experienced within the policies.
Culzean Castle	No theoretical visibility predicted.	No
Dalswinton	No theoretical visibility predicted.	No
Drumlanrig Castle	No theoretical visibility predicted.	No
Dumfries House	No theoretical visibility predicted.	No
Kilkerran	No theoretical visibility predicted.	No
Lanfine	No theoretical visibility predicted.	No
Loudoun Castle	No theoretical visibility predicted.	No
Maxwelton (Glencairn Castle)	No theoretical visibility predicted.	No
Rozelle (La Rochelle)	No theoretical visibility predicted.	No
Scot's Mining Company House	No theoretical visibility predicted.	No
Skeldon House	No theoretical visibility predicted.	No
Threave Gardens	This GDL is located 35.3 km to the south east of the Proposed Development. The ZTV predicts widespread theoretical visibility within the range of 1-14 turbines. However, the presence of mixed woodland along the northern boundary and covering the western side of the GDL would reduce the extent of visibility of the Proposed Development experienced in conjunction with intervening screening.	No – due to a combination of distance from the Proposed Development and screening by woodland.
Local Landscape Designations		

Protected & Designated Landscapes	Extent of Theoretical Visibility	Included in the Assessment
Galloway Hills RSA	This RSA covers a large part of the Southern Uplands in Dumfries & Galloway. The Proposed Development is located within this local designation and is likely to experience direct and indirect effects as a consequence.	**Yes** – due to the Proposed Development being located within the designation.
Solway Coast RSA	Located 38.2 km to the south of the Proposed Development. The ZTV predicts theoretical visibility on high ground to the south of Castle Douglas, and to the north east and east of Kirkcudbright ranging between 1-14 turbines.	No – due to a combination of distance and limited extent of theoretical visibility predicted within the designation.
Terregles Ridge RSA	Located 26.4 km to the south east of the Proposed Development. The ZTV indicates very limited theoretical visibility of the Proposed Development occurring on the summits of the Cairn, Glenkiln Hill, Mallabay Hill, See Morrish Hill, and Woodhead Hill.	No – due to a combination of distance and limited extent of theoretical visibility predicted within the designation.
Thornhill Uplands RSA	This RSA extends eastwards between 9.0 – 40.0 km in Dumfries & Galloway. The ZTV predicts theoretical visibility of 12-14 turbines from Big Morton Hill, thereafter, reducing to a few scattered hill tops where 1-12 turbines would theoretically be visible.	No – due to the very small extent of theoretical visibility predicted.
Torthorwald Ridge RSA	This RSA is located 40.4 km to the south east of the Proposed Development. The ZTV predicts limited theoretical visibility of 1-12 turbines from the north and west facing slopes of Hightown Hill, Bow Hill and Back Hill.	No – due to a combination of distance and limited extent of theoretical visibility predicted within the designation.
Doon Valley SLCA	This SLCA is located 7.8 km to the north west of the Proposed Development in East Ayrshire. The ZTV indicates that theoretical visibility of the Proposed Development would be limited and scattered on the more elevated areas to the north west and west of Loch Doon where 1-14 turbines would be theoretically visible depending on elevation.	**Yes** – due to the proximity of the SLCA.
Southern Uplands SLCA	The Southern Uplands SLCA lies 6.6 km to the north east of the Proposed Development in East Ayrshire. Theoretical visibility is predicted to be very limited in the ZTV and confined to Cannock Hill, Black Craig Hill, High Chang Hill and Enoch Hill where 1-3 turbines are predicted to be visible.	No – due to the very limited theoretical visibility predicted and the small extent of the Proposed Development likely to be visible.
River Ayr SLCA	This SLCA is located 22.6 km to the north of the Proposed Development in East Ayrshire. The ZTV predicts no theoretical visibility within the designation.	No – due to no theoretical visibility being predicted.
South Ayrshire SA	This designation covers the Heads of Ayr, the Carrick Hills, upland areas of South Carrick and the southern coastal strip in South Ayrshire 12.4 km to the west of the Proposed Development. The ZTV predicts theoretical visibility occurring on high ground between the B741 road and Loch Bradan between 12.4 – 20 km. At approximately 22.5 km the ZTV predicts the summits of Black Hill of Knockgardner, and Back Hill would receive theoretical visibility of 1-14 turbines; thereafter, theoretical visibility is predicted to become more sporadic and confined to a few hill summits within Carrick where 1-3 turbines are predicted to be visible.	No – due to a combination of distance and limited extent of theoretical visibility predicted.
Douglas Valley SLA	ZTV predicts no theoretical visibility.	No
Leadhills / Lowther Hills SLA	This SLA is located 32.0 km to the north east of the Proposed Development. The ZTV predicts very limited theoretical visibility of 1-6 turbines on hill tops and west facing upper slopes of the tallest summits within the designation.	No – due to the limited extent of theoretical visibility predicted combined with distance and number of turbines predicted to theoretically be visible.
Upper Clyde Valley SLA	Only a very small part of this SLA is located within the 45 km study area to the north east of the Proposed Development. The ZTV predicts no theoretical visibility.	No

Source: Figure 5.6a: Protected & Designated Landscapes

A5.4.3. PROTECTED & DESIGNATED LANDSCAPES ASSESSMENT

A5.4.3.1. The following landscape designations have been scoped into the LVIA and assessed in detail in Chapter 5.

- Galloway Hills RSA; and
- Loch Doon SLCA.

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Author	Graeme Glencorse	11/07/2022
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A	23/11/2021	Issued for Review
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Appendix 5.5

Residential Visual Amenity Assessment

Contents

List of Abbreviations

List and describe your abbreviations here.

Abbreviation	Description
AOD	Above Ordnance Datum
LVIA	Landscape & Visual Impact Assessment
NATS	National Air Traffic Services
ZTV	Zone of Theoretical Visibility

A5.5 INTRODUCTION

A5.5.1 The Residential Visual Amenity Assessment (RVAA) focusses on the visual amenity of views from residential property. It is intended to assist the decision maker in a judgement as to the overall effect of the Proposed Development in the planning balance i.e., '*is the effect of the development on Residential Visual Amenity of such nature and / or magnitude that it potentially affects 'living conditions' or Residential Amenity.*'[1]

A5.5.2 Residential amenity comprises a range of sensory components which can be affected by development such as noise, air quality, dust, vibration, traffic, low light levels, shadow flicker and visual amenity, often referred to as 'living conditions'. This RVAA does not consider or provide information on the other components of residential amenity but concentrates on the potential effects of the visual component of 'residential amenity' or 'living conditions'. It is for the decision makers to weigh all the components and assessments relating to residential amenity in determining the acceptability of the Proposed Development.

A5.5.3 The assessment comprises the following main activities:

- identification of properties to be considered for detailed visual amenity assessment;
- description and evaluation of existing visual amenity (and views) as experienced by people in and around their properties included in the RVAA;
- identification and description of components of the Proposed Development that could have potential effects on visual amenity at the property, including aviation lighting;
- evaluation of the nature, magnitude of change and overall effect on views and visual amenity at the property; and
- provide a reasoned judgement with regard to the effect of the Proposed Development on visual amenity at the property.

A5.5.4 This Appendix is supported by the following appendices and figures (Appendices and Figures can be found in Volume 3, 2b and 2c respectively):

- Appendix 5.1: LVIA Methodology;
- Figure 5.2a: ZTV to Tip Height (A3);
- Figure 5.2b: ZTV to Tip Height (A0);
- Figure 5.3: ZTV to Hub Height A3); and
- Figures A5.1.1 – A5.1.18: Residential Visualisations.

A5.6 METHODOLOGY

A5.6.1 The *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (GLVIA3)[2] defines people's visual amenity as follows:

'the overall pleasantness of the views they enjoy of their surroundings'

A5.6.2 The approach to the RVAA accords with the principles and processes of GLVIA3 as follows:

'An assessment of visual effects deals with the effects of change on views available to people and their visual amenity. The concern here is with assessing how the surroundings of individuals or groups of people may specifically affected by changes in the content and character of views as a result of the change or loss of existing elements of the landscape and/or introduction of new elements.'

A5.6.3 GLVIA3 recognises that RVAA is a stage beyond and is distinct from LVIA, the latter focusing on public amenity and views, whereas the RVAA focuses on private visual amenity at individual properties exclusively. Paragraph 6.17 of GLVIA3 states:

'Effects of development on private property are frequently dealt with mainly through 'residential amenity assessments'. These are separate from LVIA although visual effects assessment may sometimes be carried out as part of a residential amenity assessment, in which case this will supplement and form part of the normal LVIA for a project. Some of the principles set out here for dealing with visual effects may help in such assessments but there are specific requirements in residential amenity assessment.'

A5.6.4 There is no published formal or statutory guidance available as to how to assess the visual component of living conditions. However, in response the Landscape Institute has published *Technical Guidance Note 2/19: Residential Visual Amenity Assessment* (2019)[3] to assist landscape professionals undertaking RVAAs.

A5.6.5 The Technical Guidance Note (TGN) defines RVAA as:

'the overall quality, experience and nature of views and outlook available to occupants of residential properties, including views from gardens and domestic curtilage'

A5.6.6 This guidance draws on several previous planning decisions which have become the basis for how decision makers throughout the UK have handled residential visual amenity. The TGN sets out a 4-step process based on the principles and processes established in GLVIA3 as follows:

1. *'Definition of study area and scope of the assessment – informed by the description of the proposed development, defining the study area extent and scope of the assessment with respect to the properties to be included.*
2. *Evaluation of baseline visual amenity at properties to be included having regard to the landscape and visual context and the development proposed.*
3. *Assessment of likely change to visual amenity of included properties in accordance with GLVIA3 principles and processes.*
4. *Further assessment of predicted change to visual amenity of properties to be included forming a judgement with respect of the Residential Visual Amenity Threshold.'*

Step 1 – Definition of the study area and scope of the assessment

A5.6.7 There is currently no published guidance available on the distance from the Proposed Development that should be adopted for a detailed study of visual amenity from residential properties. Scottish Planning Policy (SPP) notes that 2 km from a wind farm development is generally considered appropriate. For the purposes of this assessment, a 2 km study area from the outermost turbines of the Proposed Development has been agreed.

Step 2 – Evaluation of the Baseline Visual Amenity

A5.6.8 The TGN sets out the following considerations when evaluating baseline:

- *'the nature and extent of all potentially available existing views from the property, and its garden / domestic curtilage, including the proximity and relationship of the property to surrounding landform, landcover and visual foci. This may include primary / peripheral views; and*

[1] Landscape Institute (2019) Residential Visual Amenity Assessment (RVAA) Technical Guidance Note 2/19 [Online] Available from https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/03/tgn-02-2019-rvaa.pdf (Accessed August 2021)

[2] Landscape Institute, Institute of Environmental Management and Assessment.(2013) Guidelines for Landscape and Visual Impact Assessment. Third Edition. Routledge. London.

[3] Landscape Institute (2019) Residential Visual Amenity Assessment (RVAA) Technical Guidance Note 2/19 [Online] Available from https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/03/tgn-02-2019-rvaa.pdf (Accessed August 2021)

- *views as experienced when arriving at or leaving the property, for example from private driveways / access tracks.'*

A5.6.9 For the purpose of this assessment, all residential receptors are considered to be of **High** sensitivity to change in their view. This takes into account that people at their home attach high value to their existing view and visual amenity and are more susceptible to being affected by changes in their visual amenity.

Step 3 – Assessment of likely change to visual amenity of properties

A5.6.10 Step 3 of the assessment follows the principles and processes set out in GLVIA3 in considering the 'nature of the receptor' (overall sensitivity, comprising value and susceptibility) with the '*nature of effect*'. The aim being to identify properties that require further assessment to establish the Residential Visual Amenity Threshold.

A5.6.11 To understand the effects of changes in views, it is necessary to understand the components of the Proposed Development which could have potential effects on views need to be understood. These are set out in Chapter 3: Project Description.

Description and Evaluation of Effect

A5.6.12 The TGN sets out a framework for describing and evaluating the predicted magnitude of change and visual effects as follows:

- *'Distance of property from the proposed development having regard to its size / scale and location relative to the property (e.g., on higher or lower ground);*
- *Type and nature of the available views (e.g., panoramic, open, framed, enclosed, focussed, etc.) and how they may be affected, having regard to seasonal and diurnal variations);*
- *Direction of view / aspect of property affected, having regard to both the main / primary and peripheral / secondary views from the property;*
- *Extent to which development / landscape changes would be visible from the property (or parts of) having regard to views from principal rooms, the domestic curtilage (i.e. garden) and the private access route, taking into account seasonal and diurnal variations;*
- *Scale of change in views having regard to such factors as the loss or addition of features and compositional changes including the proportion of view occupied by the development, taking account of seasonal and diurnal variations;*
- *Degree of contrast or integration of new features or changes in the landscape compared to the existing situation in terms of form, scale and mass, line, height, colour and texture, having regard to seasonal and diurnal variations;*
- *Duration and nature of the changes, whether temporary or permanent, intermittent or continuous, reversible or irreversible etc.; and*
- *Mitigation opportunities – consider implications of both embedded and potential further mitigation.'*

A5.6.13 Step 3 states the likely magnitude of change which is informed by the duration of the effect and reversibility in addition to the size and scale. The nature of existing and predicted views (open, enclosed, panoramic, focused, framed etc.) will affect the magnitude of change. Definitions of **Substantial**, **Moderate**, **Slight** and **Negligible** are used to evaluate the magnitude of change.

A5.6.14 The assessment concludes with a judgement of significance of visual effects using the LVIA methodology detailed in Appendix 5.1: Landscape & Visual Impact Methodology. Four main levels of visual effect are used: **Major**, **Moderate**, **Minor** and **Negligible**. The evaluation of potential effects makes allowance for the use of professional judgement and experience.

A5.6.15 Those effects considered to be **Major** and **some Moderate** effects, by virtue of the more sensitive receptors and the greater magnitude of effects, are considered to be **significant** visual effects. Some Moderate, and all Minor, Minor and Negligible effects are considered to be not significant visual effects.

A5.6.16 In order to provide a focussed assessment, only those properties that are predicted to experience a significant change in view are considered in Step 4.

A5.6.17 As with the LVIA, the RVAA is based on professional judgements made by Chartered Members of the Landscape Institute (CMLI).

Step 4 – Forming the RVAA Judgement

A5.6.18 Step 4 considers properties identified in Step 3 as receiving a significant effect and forms a judgement regarding the effects of the predicted changes on the visual amenity component of residential amenity to inform the decision maker. The TGN defines this as:

'whether the predicted effects on visual amenity and views at the property are such that it has reached the Residential Visual Amenity Threshold, therefore potentially becoming a matter of Residential Amenity.'

Supporting Information

Field Surveys

A5.6.19 Field surveys from each of the properties were undertaken in August - September 2021. This identified the following:

- the orientation, composition and type of view obtained from each property (including main aspect and direction of windows);
- layout and orientation of the external spaces and gardens associated with the property curtilage;
- views from access leading to and from the property; and
- the likely change to the existing view from each property.

A5.6.20 The field surveys were supported by Zone of Theoretical Visibility (ZTV) mapping and wirelines and considered local variations in landform, tree cover and vegetation, and potential screening by adjacent buildings. The assessments were undertaken from the closest publicly accessible points to the properties or from within the grounds of the property where access was granted by the resident. No properties were inspected internally.

Wirelines

A5.6.21 Ordnance Survey (OS) mapping and online aerial images were used for both the desktop research and to assist with fieldwork. Wireframe visualisations have been prepared for each of the properties using OS grid references selected from OS map data and checked during fieldwork (see Figures A5.1.1 – A5.1.18, Volume X).

A5.6.22 Wireframe visualisations were generated using Resoft Wind Farm - Release 4, using a 1.5 metre viewing height and illustrate a bare ground situation which does not consider vegetation, buildings, or variation in local topography. From each property, a 90° (degree) cylindrical projection was produced focused on the Proposed Development and turbines numbered. No operational wind farms were visible from the properties identified.

A5.7 ASSESSMENT OF EFFECTS

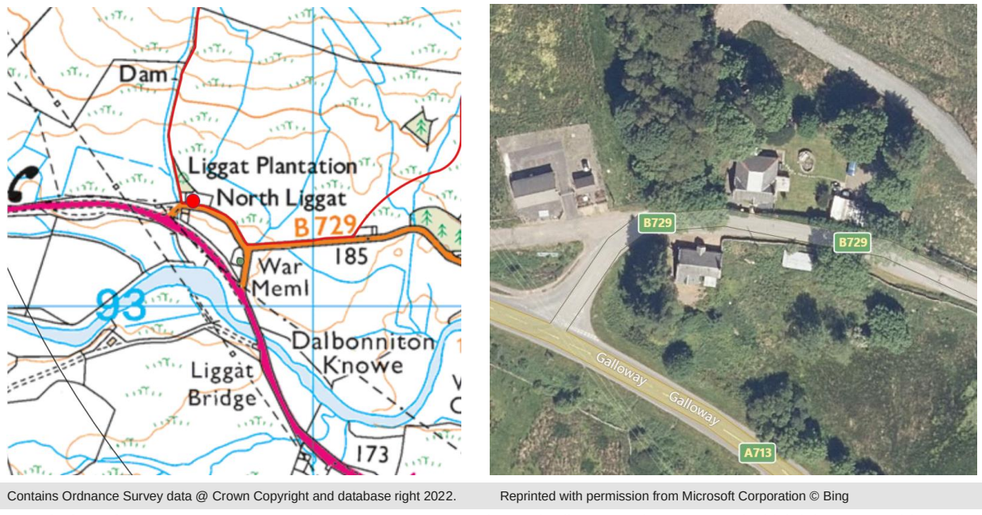
A5.7.1 Eighteen individual properties/groups were identified as being within 2 km of the turbines of the Proposed Development. Properties are listed in Table A5.5.1 and assessed below:

Table A5.5.1: Properties included in the RVAA

Property No.	Name	Easting	Northing
1	North Liggate	256766	593209
2	South Liggate	256747	5931189
3	Knockgray Cottage	257650	593153
4	Stables Cottage	257622	593186
5	Knockgray Farm	257846	593372
6	Marbrae Farm	258306	592824
7	Old Burnfoot Cottage	259009	592300
8	Burnfoot	259207	592296
9	Burniston	259094	592391
10	Marbrack & Marbrack Cottage	259636	593216
11	Polwhirn	259349	592144
12	Kensglen	259670	591855
13	Netherloskie	260241	591723
14	Furmiston	260303	592280
15	Marscalloch Cottage	260378	591364
16	Property near Liggat Bridge	256601	592931
17	White Crook	257453	592577
18	Cumnock Knowes	257756	592567

Table A5.5.2: Property 1: North Liggate RVAA

Property 1: North Liggate			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	256766, 593209	**Primary outlook:**	South
Distance to nearest Turbine:	1.6 km	**Direction of view to turbines:**	North east
Potential No. of turbines visible:	13	**Potential Number of aviation lights directly visible:**	3



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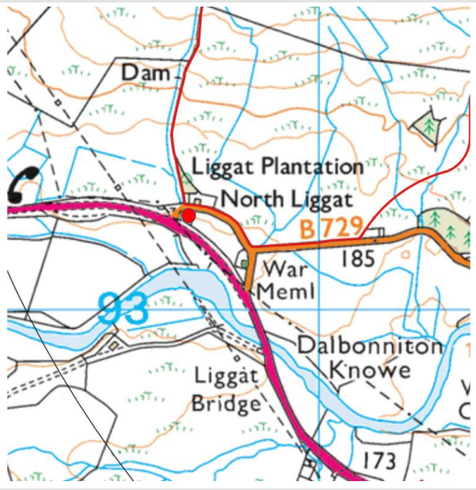
Description of Property, Location and Context:	Comprises a 1 storey cottage located adjacent to the B729 road which it is accessed from close to the junction with the A713 road. The property sits at approximately 180 m Above Ordnance Datum (AOD) and is orientated in a north to south direction. The front elevation faces south onto the foreground road and includes close oblique of the property at South Liggate. The property is situated on the lower slopes of Craig of Knockgray with the surrounding landscape being predominantly open moorland. There are a number of semi-mature trees and boundary hedges in the vicinity providing shelter.
Description of Existing Views from the Property:	Views from the property and its garden are heavily filtered by boundary planting comprising conifer, and broadleaf trees as well as dry stone walls. To the north, semi-open views onto the southern slopes of Craig of Knockgray can be obtained.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north east and east of the property and would generally affect views from the eastern aspect of the house and garden. Views would be partially screened by a combination of the lower slopes of Craig of Knockgray and Quantans Hill, as well as foreground boundary trees. The closest turbines T5, T7, T10 and T11 would be the most prominent in views as a result of their proximity with the vertical extent being reduced by the foreground landform. Three aviation lights would potentially be directly visible from the property at a light intensity of 4 candela (ca) (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 20 – 30 hours per year. Beyond the forestry on Marscalloch Hill, the tips of Shepherd's Rig would be visible if consented. This would become less visible as new forestry within the application site establishes.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be considerable in views from the eastern side of the property and garden rather than the front of the property, albeit partially filtered by boundary trees. A combination of proximity to the Proposed Development, screening by landform and

Property 1: North Liggate	
	intervening trees reduces the vertical extent of the turbines within the view. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantia**l.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to a combination of distance between the property and proposed turbines, the aspect of the view, and reduction in vertical extent of the turbines as a result of foreground landform and trees..

Table A5.5.3: Property 2: South Liggate

Property 2: South Liggate			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	256747, 5931189	**Primary outlook:**	North
Distance to nearest Turbine:	1.6 km	**Direction of view to turbines:**	North east
Potential No. of turbines visible:	13	**Potential Number of aviation lights directly visible:**	3



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Description of Property, Location and Context:	South Liggate is a 1 storey cottage located adjacent to the B729 road close to the junction with the A713 road. The property sits at approximately 180 m AOD and is orientated in a north to south direction. The front elevation faces north onto the B729 road and boundary hedge surrounding North Liggate. The property is situated on the lower slopes of Craig of Knockgray with the surrounding landscape being predominantly open moorland. There are a number of semi-mature trees and boundary hedges in the vicinity as well as planting within the western and southern side of the property grounds.
Description of Existing Views from the Property:	Views from the property and its garden are restricted by boundary planting, conifer and broadleaf trees to the north and north east around North Liggate with open views occurring from the eastern part of the house and garden..
Description of Likely Views of the Proposed	The Proposed Development would be located to the north east and east of the property and would occupy oblique views from the front of the property and the eastern aspect of the house

Property 2: South Liggate	
Development from the Property:	and garden. Views would be partially screened by a combination of the lower slopes of Craig of Knockgray and Quantans Hill, as well as foreground boundary trees. The closest turbines T5, T7, T10 and T11 would be the most prominent in views as a result of their proximity with the vertical extent being reduced by the foreground landform. Three aviation lights would potentially be directly visible from the property at a light intensity of 4 candela (ca) (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 20 – 30 hours per year. Beyond the forestry on Marscalloch Hill, the tips of Shepherd's Rig would be visible if consented. This would become less visible as new forestry within the application site establishes.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be considerable in views from the eastern side of the property and garden and partially occupy oblique views from the front of the property, albeit partially filtered by boundary trees to the east. A combination of proximity to the Proposed Development, screening by landform and intervening trees reduces the vertical extent of the turbines within the view. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to a combination of distance between the property and proposed turbines, the aspect of the view, and reduction in vertical extent of the turbines as a result of foreground landform and trees..

Table A5.5.4: Property 3: Knockgray Cottage RVAA

Property 3: Knockgray Cottage			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	257650, 593153	**Primary outlook:**	South
Distance to nearest Turbine:	935 m	**Direction of view to turbines:**	North east
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	3

Property 3: Knockgray Cottage

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Description of Property, Location and Context:	A 1.5 storey house and cottage accessed from an access track heading north from the B729 road. The property sits at approximately 185 m AOD and is orientated in a north east to south west direction. To the north west is another property on the western side of the access track (Property 4: Stables Cottage).
Description of Existing Views from the Property:	From the access track leading to the property, boundary trees restrict views. Views from the property and its garden are also restricted by boundary planting to the east, south and west and rising landform to the north. Nevertheless, beyond the foreground trees, partial views onto open fields can be experienced from the property and its garden.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north east and would be partially screened from view by foreground trees around the property and by intervening woodland to the north, being more visible during winter months when broadleaf trees are leafless. 3 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility) as a result of the horizontal angle. Figure 13.1 indicates that shadow flicker would be experienced between 20 – 30 hours per year. Beyond the forestry on Marscalloch Hill, the tips of Shepherd's Rig would be visible if consented. This would become less visible as new forestry within the application site establishes.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be considerable in views from the property and garden although this would be heavily filtered and screened by surrounding trees. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to screening from nearby trees.

Table A5.5.5: Property 4: Stables Cottage RVAA

Property 4: Stables Cottage

OS Grid Ref	257622, 593186	**Primary outlook:**	South east
Step 2: Evaluation of the Baseline Visual Amenity			
Distance to nearest Turbine:	927 m	**Direction of view to turbines:**	North east
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	3

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Description of Property, Location and Context:	A 1.5 storey house accessed from an access track heading north from the B729 road. The property sits at approximately 185 m AOD and is orientated in a north to south direction. To the south east is another property on the eastern side of the access track (Property 3: Knockgray Cottage).
Description of Existing Views from the Property:	From the access track leading to the property, boundary trees restrict views. Views from the property and its garden are also restricted by boundary planting to the north east, east, south and west and rising landform to the north. Nevertheless, beyond the foreground trees, views onto open fields and moorland can be experienced from both the property and its garden.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north east and would be partially screened from view by foreground trees around the property and by intervening woodland to the north east limiting views to the upper sections of the proposed turbines. 3 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility) as a result of the horizontal angle. Figure 13.1 indicates that shadow flicker would be experienced between 10 – 20 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be limited in views from the property and garden due to being heavily filtered and screened by trees. The change in view would be long term and reversible. Magnitude of change is considered to be **Moderate**.
Effect:	**Major-moderate (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to screening from foreground woodland.

Table A5.5.6: Property 5: Knockgray Farm RVAA

Property 5: Knockgray Farm			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	257846, 593372	**Primary outlook:**	South east
Distance to nearest Turbine:	642 m	**Direction of view to turbines:**	North east
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	3

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Description of Property, Location and Context:	A 1.5 storey house accessed from an access track heading north from the B729 road. The property sits at approximately 200 m AOD and is orientated in a north west to south east direction. To the south east are farm outbuildings.
Description of Existing Views from the Property:	From the access track leading to the property, boundary trees restrict views. Views from the property and its garden are also restricted by boundary planting to the east, south and west and rising landform to the north. Beyond the foreground trees to the north, open views can be experienced from the property and its garden.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north east and would be partially screened from view by foreground trees to the east of the property. Turbine 10 would be the closest of the turbines to the north east and would be prominent above the tops of trees. 3 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility), two of which would be filtered by nearby trees. Figure 13.1 indicates that shadow flicker would be experienced between 10 – 20 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be limited in views from the property and garden due to being heavily filtered by trees to the east and would apply mainly to Turbine 10. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to screening from foreground woodland.

Table A5.5.7: Property 6: Marbrae Farm RVAA

Property 6: Marbrae Farm				
Step 2: Evaluation of the Baseline Visual Amenity				
OS Grid Ref	258306	592824	**Primary outlook:**	South east
Distance to nearest Turbine:	1.0 km		**Direction of view to turbines:**	North
Potential No. of turbines visible:	14		**Potential Number of aviation lights directly visible:**	None

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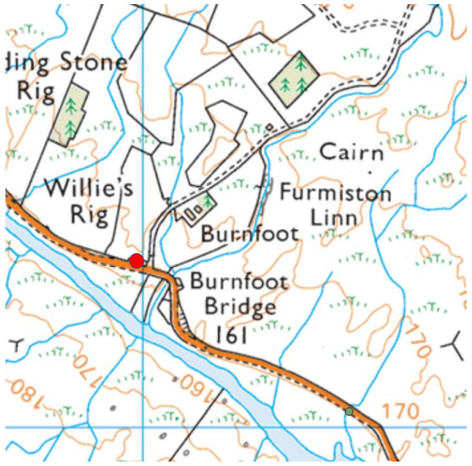
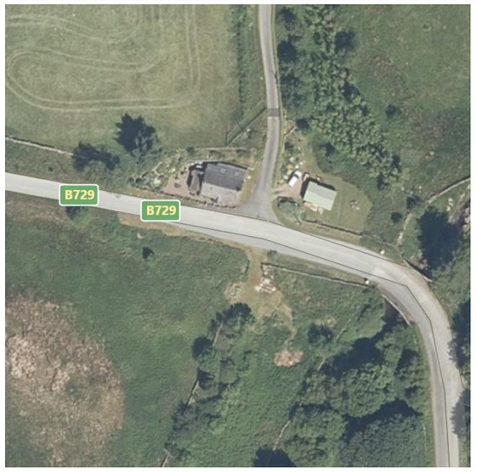
Description of Property, Location and Context:	A 1 storey house accessed from an access track heading north from the B729 road. The property sits at approximately 180 m AOD and is orientated in a south east direction. To the west are farm outbuildings.
Description of Existing Views from the Property:	From the access track leading to the property, open views of the surrounding fields can be obtained with the distance of view influenced by rising landform to the north. Views from the property and its garden are open, and the house has been orientated to the south east to take advantage of the views.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north east and would be partially screened by intervening landform rom view by foreground trees to the east of the property. Turbines 7, 8 and 11 would be the closest of the turbines and prominent on the skyline. The aviation lights mounted on top of the hubs would not be directly visible from this property due to the horizontal viewing angle. However, receptors would experience a slight reflection along the base of the turbine blade each time a blade passes the vertical position. Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be considerable in views to the north and mainly experienced from the garden, outside area and side of the property rather than the main view to the south east. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	

Property 6: Marbrae Farm	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to partial screening from landform which reduces the extent of the vertical extent of the closest turbines.

Table A5.5.8: Property 7: Old Burnfoot Cottage RVAA

Property 7: Old Burnfoot Cottage			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	259009 592300	**Primary outlook:**	South west
Distance to nearest Turbine:	1.5 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	None





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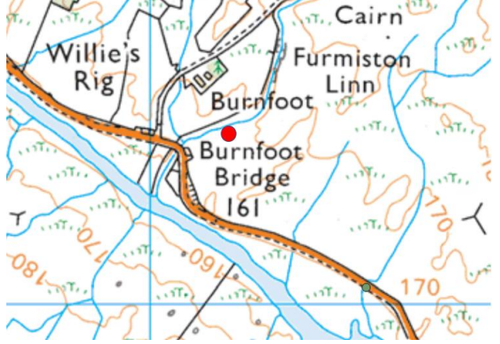
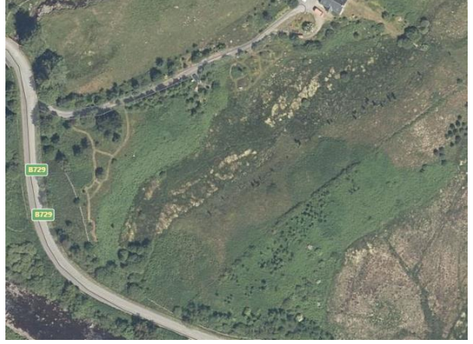
Description of Property, Location and Context:	A 1.5 storey cottage located adjacent to the B729 road which it is accessed from. The property sits at approximately 160 m AOD and is orientated in a north east to south west direction with the main view being to the south across the road onto fields. To the east on the opposite side of an access track is a small outbuilding.
Description of Existing Views from the Property:	Views from the property and its garden are partially restricted by roadside planting and landform rising to the north.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the rear of the property and from the garden area. The aviation lights mounted on top of the hubs would not be directly visible from this property due to the horizontal viewing angle. However, receptors would experience a slight reflection along the base of the turbine blade each time a blade passes the vertical position. Figure 13.1 indicates that shadow flicker would be experienced between 10 – 20 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be considerable in views to the north and mainly experienced from the garden, and rear of the property rather than the main view to the south. The change in view would be long term and reversible. Magnitude of change is **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	

Property 7: Old Burnfoot Cottage	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to partial screening from landform which reduces the extent of the vertical extent of the closest turbines.

Table A5.5.9: Property 8: Burnfoot RVAA

Property 8: Burnfoot			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	259207, 592296	**Primary outlook:**	South west
Distance to nearest Turbine:	1.3 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	None





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Description of Property, Location and Context:	1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 170 m AOD and is orientated in a north east to south west direction with the main view being to the south west across fields and woodland. To the west of the property is an outbuilding.
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by roadside trees and shrubs onto adjacent fields. Views from the property and its garden are partially restricted by foreground woodland to the south and landform rising to the north.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the rear of the property and from the garden area. The aviation lights mounted on top of the hubs would not be directly visible from this property due to the horizontal viewing angle. However, receptors would experience a slight reflection along the base of the turbine blade each time a blade passes the vertical position. Figure 13.1 indicates that shadow flicker would be experienced between 30 – 100 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	

Property 8: Burnfoot	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, and rear of the property rather than the main view to the south west. The change in view would be long term and reversible. Magnitude of change is **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.

Table A5.5.10: Property 9: Burniston

Property 9: Burniston			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	259094, 592391	**Primary outlook:**	South west
Distance to nearest Turbine:	1.4 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	None

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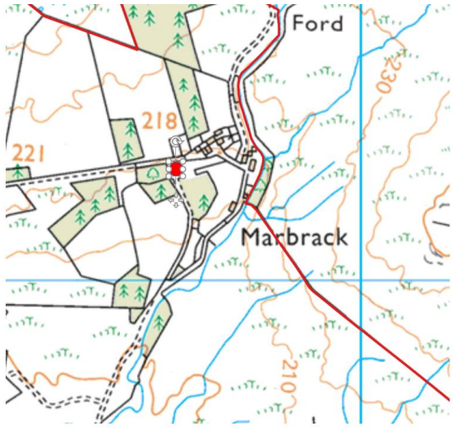
Description of Property, Location and Context:	A 1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 170 m AOD and is orientated in a north east to south west direction with the main view being to the south west onto fields and woodland. To the north of the property are some outbuildings.
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by roadside trees and shrubs onto adjacent fields. Views from the property and its garden are partially restricted by foreground woodland to the north, east, south and west with landform rising to the north.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be partially visible through the foreground trees, especially during winter months when the trees are leafless. This would be experienced from the rear of the property and from the garden area.

Property 9: Burniston	
	The aviation lights mounted on top of the hubs would not be directly visible from this property due to the horizontal viewing angle. However, receptors would experience a slight reflection along the base of the turbine blade each time a blade passes the vertical position, albeit filtered by trees. Figure 13.1 indicates that shadow flicker would be experienced between 30 – 100 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, and upper windows of the property rather than the main view to the south west. The change in view would be long term and reversible. Magnitude of change is **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to screening from foreground woodland.

Table A5.5.11: Property 10: Marbrack & Marbrack Cottage

Property 10: Marbrack & Marbrack Cottage			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	259636, 593216	**Primary outlook:**	South east
Distance to nearest Turbine:	806 m	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	None



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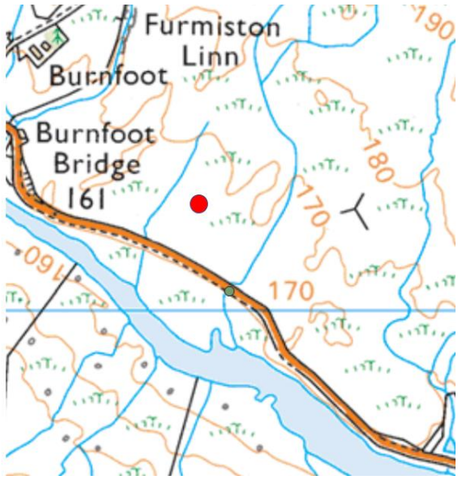
Description of Property, Location and Context:	A 1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 200 m AOD and is orientated in a north west to south east direction with the main view being to the south onto fields. Woodland is located to the north, east, south and west of the property. To the north east of the property are some outbuildings.
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by roadside trees and shrubs onto adjacent fields. Views from the property and its garden are partially restricted by foreground woodland to the north, east, south, and west with landform rising to the north.

Property 10: Marbrack & Marbrack Cottage	
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be partially visible through the foreground trees, especially during winter months when the trees are leafless. This would be experienced from the rear of the property and from the garden area. The aviation lights mounted on top of the hubs would not be directly visible from this property due to the horizontal viewing angle. However, receptors would experience a slight reflection along the base of the turbine blade each time a blade passes the vertical position, albeit filtered by trees. Figure 13.1 indicates that shadow flicker would be experienced between 30 – 100 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, and upper windows of the property rather than the main view to the south east. The change in view would be long term and reversible. Magnitude of change is **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to screening from foreground woodland.

Table A5.5.12: Property 11: Polwhirn RVAA

Property 11: Polwhirn			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	259349, 592144	**Primary outlook:**	South
Distance to nearest Turbine:	1.3 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	None



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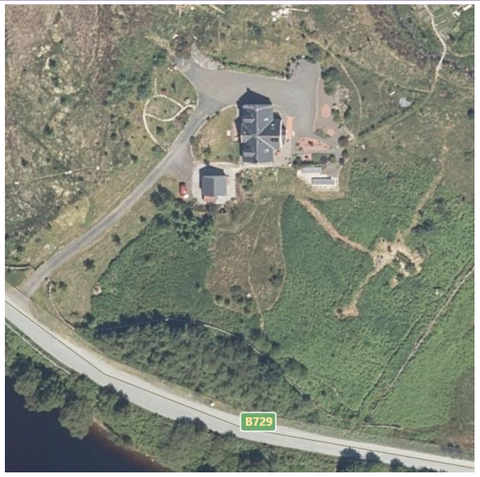
Description of Property, Location and Context:	A 1.5 storey cottage (currently under construction) located to the north of the B729 road which it is accessed from.

Property 11: Polwhirn	
	The property sits at approximately 170 m AOD and is orientated in a north to south direction with the main view being to the south onto fields and the B729 road. To the north west of the property are some outbuildings.
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by rising landform to the north. Views from the property and its garden are also partially restricted by foreground landform to the north.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the rear of the property and from the garden area. The aviation lights mounted on top of the hubs would not be directly visible from this property due to the horizontal viewing angle. However, receptors would experience a slight reflection along the base of the turbine blade each time a blade passes the vertical position. Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, outside area and side of the property rather than the main view to the south. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.

Table A5.5.13: Property 12: Kensglen

Property 12: Kensglen			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	259670, 591855	**Primary outlook:**	East - west
Distance to nearest Turbine:	1.3 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	2

Property 12: Kensglen			
			
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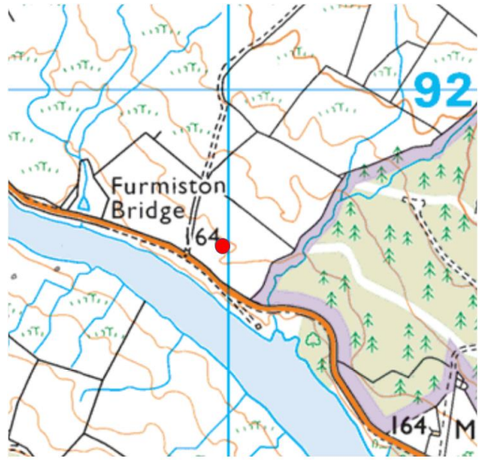
Description of Property, Location and Context:	1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 170 m AOD and is orientated in an east to west direction with the main view being to the west onto fields with views along Glenkens. To the south east and south west of the property are some outbuildings.		
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by rising landform to the north. Views from the property and its garden are also partially restricted by foreground landform to the north although extensive views west along Glenkens can be obtained.		
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the side of the property and from the garden area in views towards the north. 2 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.		
Step 3: Assessment of likely change to visual amenity of properties			
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, outside area and the side of the property rather than the main views to the east and west. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.		
Effect:	**Major (significant)**		
Step 4: Forming the RVAA Judgement			
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.		

Table A5.5.14: Property 13: Netherloskie

Property 13: Netherloskie			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	260241, 591723	**Primary outlook:**	South east
Distance to nearest Turbine:	1.2 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	2
			
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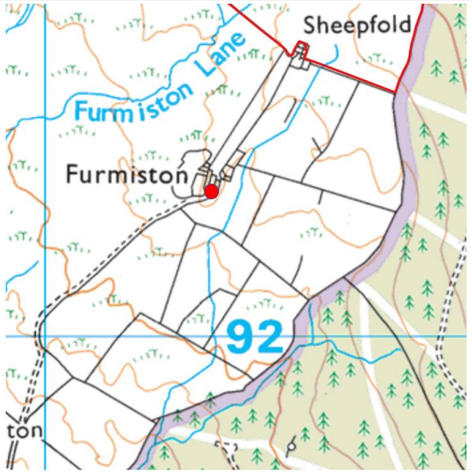
Description of Property, Location and Context:	A 1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 160 m AOD and is orientated in north west to south east direction with the main view being to the south east onto fields, the river and nearby woodland.		
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by rising landform and roadside trees to the north. Views from the property and its garden are also partially restricted by foreground landform to the north.		
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the rear of the property and from the garden area in views towards the north. 2 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.		
Step 3: Assessment of likely change to visual amenity of properties			
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, outside area and side of the property rather than the main view to the south east. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.		
Effect:	**Major (significant)**		
Step 4: Forming the RVAA Judgement			
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.		

Table A5.5.15: Property 14: Furmiston

Property 14: Furmiston
Step 2: Evaluation of the Baseline Visual Amenity

Property 14: Furmiston			
OS Grid Ref	260303, 592280	**Primary outlook:**	South west
Distance to nearest Turbine:	684 m	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	2



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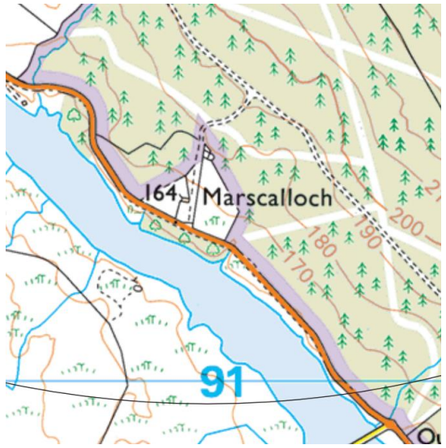
Description of Property, Location and Context:	A 1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 215 m AOD and is orientated in a north east to south west direction. To the north are some outbuildings and woodland to the west.
Description of Existing Views from the Property:	Views from the access track leading to the property are partially restricted by rising landform to the north. Views from the property and its garden are also partially restricted by foreground landform and outbuildings to the north and woodland to the west.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the rear of the property and from the garden area in views towards the north and partially screened by landform. 2 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, outside area and rear of the property rather than the main view to the south west. Over time this would gradually reduce as nearby forestry establishes and screens the view towards the Proposed Development. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back and partially screened by landform reducing their vertical extent within views.

Table A5.5.16: Property 15: Marscalloch Cottage

Property 15: Marscalloch Cottage			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	260378, 591364	**Primary outlook:**	South
Distance to nearest Turbine:	1.5 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	13	**Potential Number of aviation lights directly visible:**	None



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Description of Property, Location and Context:	A 1.5 storey cottage located to the north of the B729 road which it is accessed from. The property sits at approximately 165 m AOD and is orientated in a north to south direction with the main view being to the south onto the B729 road and fields. To the north are outbuildings and forestry to the north and west.
Description of Existing Views from the Property:	Views from the property and its garden are restricted by forestry and mainly focussed to the south and east onto surrounding fields.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be screened by forestry whilst the tree crop is present.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	Magnitude of change is considered to be **Negligible** whilst forestry is located to the north and west.(If the forestry was felled during the lifecycle of the wind farm potential effects would increase to Substantial.)
Effect:	Negligible (not significant)
Step 4: Forming the RVAA Judgement	
RVAA Judgement	N/a

Table A5.5.17: Property 16: Property near Liggat Bridge

Property 16: Property near Liggat Bridge
Step 2: Evaluation of the Baseline Visual Amenity

Property 16: Property near Liggat Bridge			
OS Grid Ref	256601, 592931	**Primary outlook:**	South east
Distance to nearest Turbine:	1.8 km	**Direction of view to turbines:**	North east
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	3

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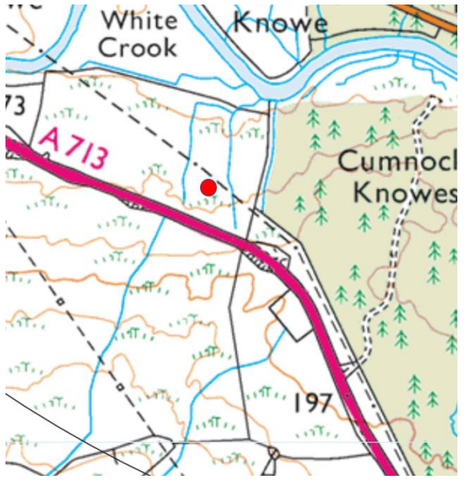
Description of Property, Location and Context:	1 storey cottage located to the south of the A713 road which it is accessed from. The property sits at approximately 190 m AOD and is orientated in a north west to south east direction south east. To the north west are trees close to the property and roadside trees to the east.
Description of Existing Views from the Property:	Views from the property and generally open onto the nearby river and surrounding fields.
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north east and be visible in views from the front and eastern side of the property along with the garden. Some partial screening would occur from roadside trees, nevertheless, the majority of the proposed turbines would be visible. 3 aviation lights would potentially be visible from the property at light intensities of 4 ca (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the front of the property and garden. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.

Table A5.5.18: Property 17: White Crook

Property 17: White Crook			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	257453, 592577	**Primary outlook:**	North west – south-east
Distance to nearest Turbine:	1.5 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	4



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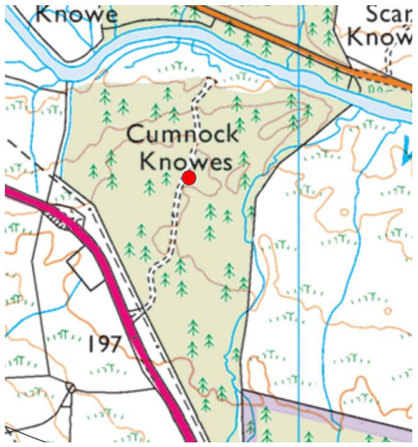
Description of Property, Location and Context:	New building (currently under construction) located to the north of the A713 road which it is accessed from. The property sits at approximately 190 m AOD and is orientated in a north west to south east direction with the main view being to the north west onto fields with views along Glenkens.
Description of Existing Views from the Property:	Open views are obtained from this property of the surrounding hills and fields within Glenkens..
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible above the foreground ridgeline. This would be experienced from the northern side of the property, the garden and track from the A713 road. 4 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, outside area and side of the property rather than the main view to the west. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.

Table A5.5.19: Property 18: Cumnock Knowes

Property 18: Cumnock Knowes			
Step 2: Evaluation of the Baseline Visual Amenity			
OS Grid Ref	257756, 592567	**Primary outlook:**	All directions
Distance to nearest Turbine:	1.4 km	**Direction of view to turbines:**	North
Potential No. of turbines visible:	14	**Potential Number of aviation lights directly visible:**	4



Description of Property, Location and Context:	Large turreted property located to the north of the A713 road which it is accessed from. The property sits at approximately 190 m AOD.
Description of Existing Views from the Property:	Obtains open views in all directions including extensive views to the north west along Upper Glenkens
Description of Likely Views of the Proposed Development from the Property:	The Proposed Development would be located to the north and be visible from north facing windows, the garden and drive leading up to the property from the A713 road. 4 aviation lights would potentially be visible from the property at light intensities of 1 ca (clear visibility). Figure 13.1 indicates that shadow flicker would be experienced between 0 – 10 hours per year.
Step 3: Assessment of likely change to visual amenity of properties	
Magnitude of Change:	The size and scale of the change would be large and mainly experienced from the garden, outside area and side of the property rather than the main view to the west. The change in view would be long term and reversible. Magnitude of change is considered to be **Substantial**.
Effect:	**Major (significant)**
Step 4: Forming the RVAA Judgement	
RVAA Judgement	Although there would be a significant effect on views from the property and garden, it is not considered that living standards of the property would be affected overall or render it an unattractive place to live due to the proposed turbines being set back reducing their vertical extent within views.

VATTENFALL

Document history

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Client Details	
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Appendix 6.1

Botanical / Habitat Desk Study & Survey Results

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.1.1 INTRODUCTION

Purpose of this Document

A6.1.1.1 This is a Technical Appendix to Chapter 6: Ecology & Biodiversity of the Environmental Impact Assessment Report (EIAR) for the proposed Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with that Chapter.

A6.1.1.2 This document provides the results of a desk study, Phase 1 habitat and National Vegetation Classification (NVC) surveys completed in September 2020 and July/August 2021.

Background

A6.1.1.3 MBEC was appointed by Vattenfall Wind Power Ltd (Vattenfall) to carry out baseline Phase 1 habitat and targeted NVC surveys for the Proposed Development Area.

A6.1.1.4 The initial survey area (2020) is shown on Figure 6.1. This was based on a previous version of the Site boundary and the indicative wind farm layout included with EIA Scoping Report. The results from the initial habitat surveys informed the design process for the Proposed Development. During summer 2021, once the emerging layout of the Proposed Development (i.e. including all elements of required infrastructure, temporary compounds, works areas, borrow pits) was more clearly defined, the 2020 surveys were updated, as necessary, to ensure that appropriately detailed survey data was available to inform the impact assessment. Habitat and survey areas were defined by precautionary zones of potential effect relative to the Proposed Development, following current NatureScot and SEPA guidance.

A6.1.1.5 Consultation with NatureScot was undertaken during the EIA Scoping process to confirm the approach to the EIA, including baseline habitat survey methods.

Site Description

A6.1.1.6 The ‘Site’ (as defined in Chapter 2: Site Description) is in Dumfries & Galloway, located to northeast of the village of Carsphairn. The west is defined by the hills Dunool, Willieanna and Craig of Knockgray, with Cairnsmore of Carsphairn at the northern end of the Site, and is bordered to the east by commercial conifer plantation. Elevation within Site ranges from approximately 180 m to 797 m (at the summit of Cairnsmore of Carsphairn) above sea level. Most of the Site is located within the catchment of the Water of Deugh. Habitats primarily comprise a mixture of unenclosed mire, wet heath, and marshy grassland with semi-improved acid grasslands on the steeper slopes. The Site also includes a number of small plantation woodlands that primarily serve as shelter for livestock. The dominant land use is low-density mixed livestock grazing.

A6.1.2 METHODS

Desk Study

A6.1.2.1 The desk study and survey areas adopted for the assessment are defined by the potential 'zone of influence' of the Proposed Development (i.e. the area over which the ecological receptors could be adversely affected). This area can vary considerably depending on which potential effects and receptors are being considered. For example, effects on acid grassland, as a habitat receptor, can be highly localised to the areas of construction which are physically disturbed by the works. At the other end of the scale, there is the potential for impacts on surface water quality to affect aquatic habitat receptors some distance from construction locations, therefore requiring consideration in the assessment at the appropriate scale. Consequently, the boundaries of the desk study and survey areas reflect this variation in the extent of potential effects from the Proposed Development.

A6.1.2.2 The desk study extended to an area up to c. 5 km from the Site boundary, as illustrated on Figure 6.3. The main aim of the desk study was to obtain information regarding statutory and non-statutory natural heritage

designations, from various online sources, as well as to request any records of notable flora and fauna from a range of data holders.

A6.1.2.3 Details of international and national designated sites, such as Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs), were obtained through NatureScot's Sitelink website [www.sitelink.nature.scot] and associated GIS (Geographic Information System) data made publicly available by NatureScot.

A6.1.2.4 The websites of Dumfries & Galloway Council [https://www.dumgal.gov.uk] and Scottish Wildlife Trust [www.scottishwildlifetrust.org.uk] were searched for details of any Wildlife Sites, Local Biodiversity Sites, Local Nature Conservation Sites, Local Nature Reserves etc. within the wider desk study area.

A6.1.2.5 The SNH Ancient Woodland Inventory (Edition 3) was searched, using publicly available GIS data, to identify areas identified as ancient woodland, both semi-natural and those of plantation origin (areas that have been under continuous woodland cover since about 1750). Data from the Native Woodland Survey of Scotland, provided by Scottish Forestry, were also searched for any information relevant to the study area.

A6.1.2.6 Records of notable plant species were requested from the following organisations:

- The Botanical Society of the British Isles (BSBI); and
- South-West Scotland Environmental Information Centre.

A6.1.2.7 In addition, the National Biodiversity Network (NBN) Atlas online database [https://nbnatlas.org/] was also searched for records of rare or notable species within the desk survey area (NB only those records which were listed as open access for commercial use, or with permission of the original data provider, were downloaded from the NBN Atlas website).

Survey Methods

A6.1.2.8 This section provides a summary of the survey methods used to record, map and characterise the habitats and vegetation communities present in the survey area. All fieldwork was completed by suitably experienced surveyors. Global Positioning System (GPS) were used to accurately record the locations of any important features and field signs to an accuracy of ±6 m.

A6.1.2.9 The main survey area (i.e. for Phase 1 habitats and protected species) is defined by a potential development area within the red-line boundary (as shown on Figure 6.1). More detailed survey and mapping of vegetation communities, following the NVC methodology, was completed within a buffer zone of c. 250 m around each deep excavation (e.g. turbine bases, borrow pits) and c. 100 m of all proposed access tracks, in compliance with Scottish Environment Protection Agency (SEPA) guidance with respect to the identification and assessment of potential Groundwater Dependent Terrestrial Ecosystems (GWDTEs[1]).

A6.1.2.10 For all botanical surveys, the common and scientific names used for vascular plants follow those provided in Stace (2019)[2] and for non-vascular plants (mosses and liverworts) they follow Atherton *et al*. (2010)[3] and Smith (2004)[4].

[1] SEPA (2017). Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. Land Use Planning System SEPA Guidance Note 31 (LUPS GU31).

[2] Stace, C.A. (2010). New Flora of the British Isles (3rd Edition). Cambridge University Press, Cambridge.

[3] Atherton I., Bosanquet, S.D.S. & Lawley, M. (eds.) (2010). Mosses and Liverworts of Britain and Ireland: A Field Guide. British Bryological Society, Plymouth.

[4] Smith, A. J. E. (2004). The Moss Flora of Britain and Ireland. (2nd Edition). Cambridge University Press, Cambridge.

Phase 1 Habitat Survey

A6.1.2.11 The purpose of the Phase 1 habitat survey was to describe the type, extent and sensitivity of all habitats present in the proposed development area, in order to inform the wind farm layout design process. The Phase 1 habitat types were mapped and categorised according to the method and definitions outlined in the JNCC Handbook for Phase 1 Habitat Survey (JNCC 2010)[5].

A6.1.2.12 Target notes were recorded at the time of the Phase 1 survey, and these provide additional detail on habitat condition, vegetation composition and diversity, management impacts, and the location of species and notable habitats that were too small to map.

A6.1.2.13 Any highly invasive non-native plant species, such as giant hogweed (*Heracleum mantegazzianum*) or Japanese knotweed (*Fallopia japonica*) were also recorded where present.

NVC Survey

A6.1.2.14 The aim of the NVC survey was to describe in further detail the type and distribution of all vegetation communities identified during the Phase 1 habitat survey which might be affected by the Proposed Development, and to identify sensitive habitats of nature conservation interest, including those considered to be Groundwater Dependent Terrestrial Ecosystems (GWDTEs). GWDTEs are habitats that are considered particularly sensitive to changes in groundwater flow and quality, particularly in response to earthworks associated with construction sites and which might affect the hydrology within these communities.

A6.1.2.15 The NVC survey included all accessible areas within the proposed development area, as defined in 2019. Depending on the size of the habitat areas that were considered and also the uniformity of the vegetation composition within each given habitat area, at least two quadrats were completed for each type of homogenous and representative vegetation stand. All quadrats were 2m x 2m in size, as this is considered to be the most appropriate scale to sample the various habitats that were the focus of the survey. Within each quadrat, all higher and lower plant species were identified and a total percentage cover for each was estimated, following the Domin scale of cover/abundance (following the method described in Rodwell 2006)[6]. Using field notes and quadrat data the closest matching NVC community was assigned, using professional judgement and with reference to the descriptions provided in Rodwell (e.g. 1991[7], 1992[8], 1995[9]) and the keys provided in Averis *et al*. (2004)[10].

A6.1.3 RESULTS

Survey Limitations

A6.1.3.1 Due to the COVID-19 pandemic there was inevitably some impact on fieldwork during 2020, particularly during April. However, working safely and lawfully within the Scottish Government restrictions and guidance, it was possible to achieve sufficient survey effort during 2020 without significantly affecting on the accuracy of the survey results.

A6.1.3.2 The vegetation surveys were carried out during the main growing season for most flowering plants. However, due to the differences in flowering times between species, it is possible that some species may have been

[5] JNCC (2010). Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit. Joint Nature Conservation Committee, Peterborough.

[6] Rodwell, J.S. (2006). National Vegetation Classification: Users' handbook. Joint Nature Conservation Committee, Peterborough.

[7] Rodwell, J.S. (ed.) (1991). British Plant Communities, Vol. 2: mires and heaths. Cambridge University Press, Cambridge.

[8] Rodwell, J S (ed.) (1992). British Plant Communities, Vol. 3: grasslands and montane communities. Cambridge University Press, Cambridge.

[9] Rodwell, J S (ed.) (1995). British Plant Communities, Vol. 4: aquatic communities, swamps and tall-herb fens. Cambridge University Press, Cambridge.

[10] Averis, A., Averis, B., Birks, J., Horsfield, D., Thompson, D. & Yeo, M. (2004). An Illustrated Guide to British Upland Vegetation. Joint Nature Conservation Committee, Peterborough.

under-recorded. It is important to note that the surveys are not intended to provide an exhaustive list of all plant species present within the survey area. However, the baseline data collated to inform the assessment are considered to accurately represent the key habitats and species and is sufficiently detailed and concurrent to allow a realistic assessments of feature sensitivity for the EIA. Where there is uncertainty, a precautionary approach has been taken in order to avoid under-estimating sensitivity or potential effects from the Proposed Development.

Desk Study

Designated sites

A6.1.3.3 The locations of natural heritage designated sites are shown on Figure 6.2.

A6.1.3.4 There are no statutory designated sites (e.g. Special Protection Areas, Special Areas of Conservation, Sites of Special Scientific Interest) within the Site or adjacent to it.

A6.1.3.5 The closest statutory designated site is Cleugh SSSI, located approximately 4.5 km to the south of the Site boundary. This SSSI extends to 54.83 hectares and is designated for its unimproved grassland habitats, for which it is recognised as the best example in Dumfries & Galloway. It is primarily a neutral grassland, with both base-rich and acidic areas, and supports a number of rare or notable plants including field gentian (*Gentianella campestris*), frog orchid (*Dactylorhiza viridis*), greater butterfly-orchid (*Platanthera chlorantha*) and spignel (*Meum athamanticum*).

A6.1.3.6 Loch Doon SSSI is located approximately 7 km to the west of the Site. This waterbody covered an area of 821.89 ha and receives its designation for its population of Arctic char (*Salvelinus alpinus*). This is the last naturally-occurring population in south-west Scotland.

A6.1.3.7 Hannaston Wood SSSI is located approximately 10 km to the south of the Site boundary. This upland oak woodland is important for its lichen assemblages, including the nationally rare species *Ledidea sanguineoatra*, and also for an area of neutral grassland that supports a range of uncommon species, including orchids and globeflower (*Trollius europaeus*).

A6.1.3.8 There are no non-statutory designated site (i.e. local nature reserves) within the Site boundary. There are a small number within the wider area, including the Dumfries & Galloway Local Wildlife Sites of Polmaddy, located approximately 5 km to the south, and the Island Block Oak Woodland, approximately 3.6 km to the south, and the Afton Woodlands, an Ayrshire Provisional Wildlife Site, which is located approximately 4.6 km to the north.

Ancient woodlands

A6.1.3.9 A search of the Ancient Woodland Inventory revealed that there are no ancient or long-established woodlands within the Site boundary. However, there are a small number within the wider study area. This included small areas to the south, south of Kendoon Loch, one area to the south of Carsphairn, and one at Lamloch. Within 5-10 km of the Site boundary, there is one are at Craigdarroch, to the north of the Site with within the area of the Afton Uplands Provisional Wildlife Site, and several areas in a line between Earlston and Forrest Lodge, to the south of the Site.

Notable plant species records

A6.1.3.10 The desk study did not reveal records of any notable (e.g. nationally rare or scarce) plant species within the Site. There was a BSBI field record of spignel (*Meum athamanticum*) for the Burnfoot area from 2013, which is c. 1 km outside of the Site boundary. Spignel is a nationally scarce plant with a restricted distribution which is also a local priority species in the Dumfries & Galloway BAP.

Phase 1 Habitat & NVC Surveys

A6.1.3.11 Phase 1 habitat and targeted NVC surveys (focusing on the proposed wind turbine areas, based on the Scoping Report layout) were completed in September 2020, with further surveys carried out in August/September 2021, to ensure that there was sufficient data coverage to inform the emerging wind farm design and subsequent EIA process. The mapped results of the Phase 1 habitat survey are shown on Figures 6.4a-c, with target note descriptions provided in Appendix 1 at the end of this Technical Appendix.

A6.1.3.12 The NVC communities that comprise the various Phase 1 habitat types are described where applicable (due to the land use across the survey area and subsequent changes to ground conditions, it was not always possible to assign a NVC type) are shown on Figures 6.5-b. The results from the representative 2 x 2 m quadrats used to help determine the NVC communities that most closely aligned with the habitats surveyed are included in Appendix 2 of this Technical Appendix, and a full list of higher and lower plant species recorded during the surveys is included in Appendix 3.

A6.1.3.13 The following section provides an overview of the habitat types and plant communities present within the survey area. A description of potential GWDTEs is also provided.

Description of Habitat Types

A6.1.3.14 The Site extends over a total area of c. 1095 hectares and varies in elevation from 180 m to 797 m (the summit of Cairnsmore of Carsphairn) above sea level. The dominant land use in the area is low-density mixed livestock grazing. The Site primarily comprises unenclosed moorland and grassland habitats, with a mixture of mire and heathland, marshy grassland and semi-improved grasslands. The site also includes a number of small plantation woodlands that primarily serve as shelter for livestock, and some stands of bracken (*Pteridium aquilinum*). Most of the Site is located within the catchment of the Water of Deugh. All watercourses within the site flow into the Water of Deugh, which is situated to the south of Carsphairn and flows southeast.

A6.1.3.15 Broad habitat types found within the Site include modified and unmodified bog, wet heath and marshy grassland, interspersed with semi-improved grasslands and small pockets of coniferous plantation woodland. The moorland habitats have become modified to some extent, mainly through grazing management, which has included drainage and burning.

A6.1.3.16 The majority of the Site comprises open unenclosed moorland (primarily wet heath and wet modified bog), the majority of which is modified to some extent, as is evident by the encroachment of purple moor-grass (*Molinia caerulea*) and marshy grassland communities into areas of blanket bog. Preferential grazing has also led to the establishment of patches of semi-improved grassland, both acidic and neutral, on some of the areas of raised ground where the soils are shallower and more freely draining. Marshy grassland covers a significant portion of the Site, with purple moor-grass or rush-dominated habitats covering often extensive areas, as well as lining watercourses and drainage features. Stands of continuous and scattered bracken were present, particularly on some of the steeper slopes adjacent to some of the larger watercourses. There are also a small number of woodland blocks, particularly toward the south of the site, and these are likely to be associated with shelter for livestock.

A6.1.3.17 Numerous watercourses originate within the Site, all of which flow ultimately into the Water of Deugh, to the south and southwest of the Site area. Most of the watercourses within the site are narrow channels; the largest is the Benloch Burn, located towards the western edge of the Site. Other named watercourses within the site, from west to east, include the Knockgray Burn, Polhay Burn, Marbrack Burn, Polshagg Burn and Furmison Lane, all of which drain into the Water of Deugh to the south of the Site.

A6.1.3.18 The habitat types recorded within the Phase 1 habitat survey area (see Figure 6.1), and their estimated total extent within the survey area, are listed in Table 6.1.1 and the mapped results are provided on Figures 6.4a-c.

Table 6.1.1: Phase 1 habitat types within the survey area

Phase 1 code/title		Area (ha)	% Cover
B5	Marshy grassland	434.98	39.73
E17	Wet modified bog	283.03	25.85
B12	Semi-improved acid grassland	133.69	12.21

Phase 1 code/title		Area (ha)	% Cover
E161	Blanket bog	113.81	10.40
D2	Wet dwarf shrub heath	59.54	5.44
C11	Continuous bracken	27.06	2.47
B22	Semi-improved neutral grassland	24.15	2.21
E21	Acid flush	3.57	0.33
D6	Wet heath/acid grassland mosaic	3.40	0.31
C12	Scattered bracken	1.87	0.17
A132	Mixed plantation woodland	1.75	0.16
A112	Broad-leaved plantation woodland	1.26	0.12
G2	Running water	0.33	0.03
E22	Basic flush	0.03	0.00

A6.1.3.19 Table 6.1.2 lists the NVC communities that were identified within the NVC survey area (see Figure 6.1), along with all sub-communities identified, their extent in hectares and total percentage cover. Vegetation communities not covered by the NVC system (for example, non-native commercial conifer plantation) are also included. The mapped results of the NVC surveys are shown on Figures 6.4a-b.

Table 6.1.2: NVC communities / sub-communities identified within the survey area

NVC code	NVC Title	Area (ha)	% Cover
M10	***Carex dioica-Pinguicula vulgaris* mire**	**0.03**	**0.0**
M10a	*Carex viridula* ssp. *oedocarpa-Juncus bulbosus* sub-community		
M15	***Scirpus cespitosus-Erica tetralix* wet heath**	**53.97**	**8.53**
M15a	*Carex panicea* sub-community		
M15b	typical sub-community		
M15/U5	**Wet heath / acid grassland mosaic**	**2.75**	**0.43**
M17	**Scirpus cespitosus-Eriophorum vaginatum blanket mire**	**24.93**	**3.94**
M17a	*Drosera rotundifolia-Sphagnum* species sub-community		
M17c	*Juncus squarrosus-Rhytidiadelphus loreus* sub-community		
M18	***Erica tetralix-Sphagnum papillosum* raised and blanket mire**		
M18b	*Empetrum nigrum* ssp. *nigrum-Cladonia* spp. sub-community		
M19	***Calluna vulgaris-Eriophorum vaginatum* blanket mire**	**6.88**	**1.09**
M19a	*Erica tetralix* sub-community		
M20	***Eriophorum vaginatum* blanket and raised mire**	**0.07**	**0.01**
M20b	*Calluna vulgaris-Cladonia* spp. sub-community		
M23	***Juncus effusus/acutiflorus-Galium palustre* rush pasture**	**164.83**	**26.06**
M23a	*Juncus acutiflorus* sub-community		
M23b	*Juncus effusus* sub-community		
M25	***Molinia caerulea-Potentilla erecta* mire**	**228.27**	**36.09**
M25a	*Erica tetralix* sub-community		
M25b	*Molinia caerulea-Potentilla erecta* mire, *Anthoxanthum odoratum* sub-community		
M29	***Hypericum elodes-Potamogeton polygonifolius* soakway**	**0.08**	**0.01**
M6	***Carex echinata-Sphagnum recurvum/auriculatum mire***	**3.05**	**0.48**
M6c	Juncus effusus sub-community		
M6d	*Juncus acutiflorus* sub-community		
MG10	***Holcus lanatus-Juncus effusus* rush-pasture**	**4.25**	**0.67**
MG10a	typical sub-community		
MG6	***Lolium perenne-Cynosurus cristatus* grassland**	**13.12**	**2.07**
MG6b	*Anthoxanthum odoratum* sub-community		
U20	***Pteridium aquilinum-Galium saxatile* community**	**16.58**	**2.62**
U20a	Anthoxanthum odoratum sub-community		
U4	***Festuca ovina-Agrostis capillaris-Galium saxatile* grassland**	**77.18**	**12.20**
U4a	typical sub-community		
U4b	*Holcus lanatus-trifolium repens* sub-community		
U4e	*Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Vaccinium myrtillus-Deschampsia flexuosa* sub-community		
U5	***Nardus stricta-Galium saxatile* grassland**	**28.75**	**4.55**
U5a	species-poor sub-community		
U5d	*Nardus stricta-Galium saxatile* grassland, *Calluna vulgaris-Danthonia decumbens* sub-community		
U6	***Juncus squarrosus-Festuca ovina* grassland**	**1.49**	**0.24**
U6d	*Agrostis capillaris-Luzula multiflora* sub-community		
	Non-NVC communities	**6.22**	**0.98**
Total		**632.45**	**100.00**

A6.1.3.20 Descriptions of each of the Phase 1 habitats recorded within the survey area are provided below. Details of the NVC communities applicable to each habitat type are also included under each relevant Phase 1 habitat heading.

Marshy grassland

A6.1.3.21 Areas of marshy grassland (predominantly rush pasture NVC communities) were extensive within the survey area, particularly within the central part of the site, associated with natural surface water drainage features but also indicative of the effects of long-term livestock grazing and artificial drainage in this area. This Phase I habitat type was recorded within 39.73 % of the survey area (434.98 ha in total). These habitats typically occur on areas of neutral poorly draining soils and were often associated with surface water drainage features.

A6.1.3.22 Where rushes dominated, the community was a good fit to the M23 *Juncus effusus / acutiflorus-Galium palustre* rush-pasture community, with M23a (*J. acutiflorus* sub-community) and M23b (*J. effusus* sub-community) indicating a dominance of either sharp-flowered rush or soft-rush respectively. Of these, M23a was most abundant across the site, with large areas covered with a dense growth of sharp-flowered rush and other species being suppressed. The M23b community was less extensive and was often associated with linear features such as old muirgrips, as well as being present in some of the more well-grazed areas of the site.

A6.1.3.23 Due to the effects of sheep and cattle grazing much of this vegetation type was relatively species-poor in terms of associated higher plant species. Typically dominated by purple moor-grass, sharp-flowered rush or soft-rush, in the case of the less frequently occurring M23b sub-community. M23a/b often occurred in a complex mosaic with some of the blanket bog communities, particularly M25 in the central and some western parts of the survey area.

A6.1.3.24 Associated forbs typically included marsh thistle (*Cirsium palustre*), marsh violet (*Viola palustris*), meadow buttercup (*Ranunculus acris*) and marsh willowherb (*Epilobium palustre*). Bog myrtle (*Myrica gale*) was also present in a small number of areas, where it was co-dominant with sharp-flowered rush. Some localised areas were comparatively species-rich and included additional species such as bog asphodel, cross-leaved heath, heath spotted-orchid, marsh thistle and purple moor-grass (transitional to M25 areas).

A6.1.3.25 However, there were some locations, particularly along some of the minor watercourses, where there was a relatively high diversity of flowering plants intermixed within the rushes. In a few locations the M23a community supported a wider array of forbs including ragged robin (*Lychnis flos-cuculi*), marsh marigold (*Caltha palustris*) and water mint (*Mentha aquatica*). Notably, whorled caraway (*Carum verticillatum*), a species that in the UK is largely confined to western Scotland and southwest Wales, was also recorded within this habitat type in some localised areas of the western part of the Site.

A6.1.3.26 Where purple moor-grass was the dominant species, the community also included species such as common bent (*Agrostis capillaris*), cross-leaved heath (*Erica tetralix*), crowberry (*Empetrum nigrum*), deergrass (*Trichophorum germanicum*) and wavy hair-grass (*Deschampsia flexuosa*), with more occasional soft-rush, star sedge (*Carex echinata*) and tormentil. This habitat often covered extensive areas of the site and was the most widely recorded of the marshy grassland communities. Sharp-flowered rush-dominated areas supported a range of species including common marsh-bedstraw (*Galium palustre*), creeping buttercup (*Ranunculus repens*), marsh thistle (*Cirsium palustre*), marsh willowherb (*Epilobium palustre*) and sweet vernal-grass (*Anthoxanthum odoratum*), with whorled caraway (*Carum verticillatum*) a rarely-occurring species. Bog myrtle (*Myrica gale*) was present in a small number of areas, where it was co-dominant with sharp-flowered rush. These areas were quite species-rich and included additional species such as bog asphodel (*Narthecium ossifragum*), cross-leaved heath, heath spotted-orchid (*Dactylorhiza maculata*), marsh thistle and purple moor-grass. Soft-rush-dominated habitats were the most infrequently recorded marshy grassland communities and had a similar underlying species composition to areas dominated by sharp-flowered rush.

A6.1.3.27 A high proportion of the marshy grassland within the survey was classified as the NVC community M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community. This was characterised by the high dominance of purple moor-grass with dwarf shrub species and grasses, several of which were also presence within mire habitats present on deeper peat. The marshy grassland classified as M25 was all present on peat less than 0.5 m deep and was defined according to the Phase 1 habitat survey methodology.

A6.1.3.28 Other areas dominated by rushes which were generally mossier and with a lower diversity of additional species were the M6 *Carex echinata-Sphagnum recurvum/auriculatum* mires, with M6c *Juncus effusus* sub-community and M6d *J. articulatus* sub-community both being represented. These communities were generally smaller and more waterlogged than the other rush-dominated marshy grasslands and were usually found alongside watercourses and ditches and were characterised by a dominance of either soft-rush or sharp-flowered rush respectively were otherwise generally quite species-poor.

Semi-improved acid grassland

A6.1.3.29 Semi-improved acid grassland occurred, typically in small patches, across the survey area. Particularly on raised and freely draining areas of ground, often with areas of exposed rock, that were also preferentially grazed. This habitat was most extensive on the summit and slopes of Furmiston Craig in the eastern survey area. Acid grassland was recorded within 12.21 % of the survey area (133.69 ha in total). These habitats typically included a range of characteristic grass and sedge species that varied in relative abundance depending on grazing pressure and soil conditions, including sweet vernal grass (*Anthoxanthum odoratum*), common bent (*Agrostis capillaris*), mat-grass (*Nardus stricta*), sheep's-fescue (*Festuca ovina*), Yorkshire-fog (*Holcus lanatus*), crested dog's-tail (*Cynosurus cristatus*) and carnation sedge (*Carex panicea*). The associated forbs typically included common clover (*Trifolium* sp.) and creeping buttercup (*Ranunculus repens*), ribwort plantain (*Plantago lanceolata*), with harebell (*Campanula rotundifolia*), heath milkwort (*Polygala serpyllifolia*), lousewort (*Pedicularis sylvatica*) and tormentil (*Potentilla erecta*) also occurring. Where areas of exposed rock were present some bilberry (*Vaccinium myrtillus*) and stonecrop (*Sedum anglicum*) were also occasionally present.

A6.1.3.30 In terms of the NVC, the acid grassland communities within the survey area comprised primarily of U4 *Festuca ovina - Agrostris capillaris - Galium saxatile* grassland and less commonly U5 *Nardus stricta - Galium saxatile* grassland. Scattered bracken (*Pteridium aquilinum*) is also abundant in some of these grassland areas, particularly on the western and southern slopes of Furmiston Craig and the south-facing slopes of Knockwhirn.

A6.1.3.31 The majority of the acid grassland areas were a best fit to U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-trifolium repens* sub-community. These areas had the appearance of grassland that was clearly neutralising as a result of grazing pressures, but still supported acidophilous species such as heath bedstraw (*Galium saxatile*), sheep's-fescue (*Festuca ovina*) and tormentil, as well as species more typically associated with mesotrophic conditions including common mouse-ear, perennial rye-grass (*Lolium perenne*) and white clover (*Trifolium repens*). Where the grassland was less neutralised, the percentage cover of heath bedstraw and sheep's-fescue was higher, along with species green-ribbed sedge, heath-rush (*Juncus squarrosus*), wavy hair-grass and additional species more typically associated with heathland habitat, such as bilberry and heather. These areas are a closer fit to U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community. The grasses common bent, sweet vernal-grass and Yorkshire-fog were common throughout all of the U4 communities recorded.

A6.1.3.32 A smaller percentage of the acid grassland communities corresponded to U5 *Nardus stricta-Galium saxatile* grassland, with the species-poor sub-community U5a and the more diverse and heathier U5d *Calluna vulgaris-Danthonia decumbens* sub-community both recorded. These communities were characterised by the abundance of mat-grass alongside other species such as creeping bent (*Agrostis stolonifera*), green-ribbed sedge, heath bedstraw, tormentil and wavy hair-grass.

A6.1.3.33 There were also a small number of areas that were a close fit to the U6d *Juncus squarrosus-Festuca ovina* grassland, *Agrostis capillaris-Luzula multiflora* sub-community, such as on part of Quantans Hill. This community had an overall abundance of heath rush with a range of other grass species including sweet vernal-grass and wavy hair-grass and can occur in areas where the original peatland habitat has been lost to burning and/or over-grazing.

Blanket bog & Associated Habitats

A6.1.3.34 Various plant communities associated with blanket bog (also known as blanket mire) occur across the survey area. Most of the bog vegetation is highly modified by sheep and cattle grazing, trampling and also by artificial drainage, although in many locations the cover of peat-forming sphagnum mosses remains relatively high. There are several areas where the underlying peat deposits are deeper and less well drained than most of the bog habitat within the Site and these areas are defined as 'unmodified' in terms of the Phase 1 habitat mapping (see Figures 6.4a-c). All areas of blanket bog are ombrogenous (i.e. rain-fed) and are not considered to be groundwater dependent. Within the blanket bog habitats there are also extensive areas of soligenous mire communities, associated with surface water flow, where sphagnum mosses can form dense carpets under a cover of rushes. There are also more discrete linear acid flush habitats within and on the periphery of these areas of modified and unmodified blanket bog.

A6.1.3.35 Areas of wetter blanket bog habitat, associated with flatter topography where a deeper layer of peat has accumulated, were considered to be comparatively less modified (i.e. evidence of the impacts of artificial drainage, livestock grazing and trampling were less prevalent in these areas but were still present). There were two main locations where this habitat was recorded, a flat area at the western end of the Site, to the east of Craig of Knockgray, and another area located towards the eastern boundary of the Site, to the north of Furmiston Craig and south and west of the extensive conifer plantation that lies to the east. These habitats often had a similar plant species composition to the wet modified bog, but with a tendency for a higher percentage

cover of species such as deer-grass, hare's-tail cotton-grass, cross-leaved heath and low growing heather, round-leaved sundew with occasional cranberry, and with a more complete coverage of bog mosses including *Sphagnum cuspidatum* and *S. capillifolium* ssp. *rubellum*, indicative of the wetter conditions. This habitat is most closely aligned to the NVC community M17 *Scirpus cespitosus - Eriophorum vaginatum* blanket mire. In some locations there were low peat hags and evidence of active peat erosion, particularly towards the western end of the survey area. Towards the eastern end of the Site, there was less evidence of peat erosion and there were also small examples of bog pool and sedge mire NVC communities (e.g. M2 *Sphagnum cuspidatum/recurvum* bog pool, M4 *Carex rostrata – Sphagnum recurvum* mire) associated with seepages from the surrounding areas of bog. Most of the drainage ditches within these areas were found to be actively infilling with peat-forming sphagnum species.

A6.1.3.36 Some relatively small areas of blanket bog, on the shallow sloping hill tops, primarily in the Quantans Hill area, were not a particularly good fit to any NVC community. They have been mapped as M19 *Calluna vulgaris-Eriophorum vaginatum* blanket mire but, despite occurring on deep peat, due to the effects of grazing have some similarities to M15 *Scirpus cespitosus – Erica tetralix* wet heath. This community is characterised by the presence of deergrass, hare's-tail cottongrass, cross-leaved heath and heather (always low growing due to livestock grazing).

A6.1.3.37 Some of the mire areas were also a close fit to M15 *Scirpus cespitosus-Erica tetralix* wet heath, characterised by being drier than the M19 areas and having a significantly lower percentage of hare's-tail cottongrass. However, most areas supporting this community were classed as wet dwarf shrub heath. The majority of the modified blanket bog communities present within the survey area were characterised by the presence of extensive tussocky purple moor-grass with frequent bog asphodel, cross-leaved heath, tormentil and wavy hair-grass, with occasional common cotton-grass. This habitat was mostly closely aligned to the NVC community M25 *Molinia caerulea - Potentilla erecta* mire. Small patches of bog myrtle were also present in some of the wetter areas, whereas drier areas supported a higher frequency of grasses, including wavy hair-grass and Yorkshire-fog. This community was recorded across the survey area but was more extensive within in the western part of the survey area but was also recorded in the central area where it formed a complex mosaic with M23 rush pasture communities. The M25 community is highly variable with the extent to which purple moor-grass dominates strongly influenced by grazing and other land management practices. If not grazed sufficiently then it can result in very species-poor habitat that is dominated by purple moor-grass to the exclusion of most other higher plants, although tormentil (*Potentilla erecta*) often will occur. Where there is moderate grazing and comparatively drier conditions then cross-leaved heath and heather can be present, indicating the potential for recovery back to wet dwarf-shrub heath. Wetter examples of M25 that are moderately grazed can appear similar M15 *Scirpus cespitosus – Erica tetralix* wet heath and may include sphagnum cover and species such as bog asphodel.

Wet heath

A6.1.3.38 Most of the habitat classified as wet heath most closely corresponding to the NVC community M15 *Trichophorum cespitosum-Erica tetralix* wet heath, with both the *Carex panicea* sub-community M15a and the M15b typical sub-community represented. These areas were characterised by an abundance of deergrass, and a much lower percentage of hare's-tail cottongrass overall. Bog asphodel, cross-leaved heath, heather and purple moor-grass were all typically occurring species that were distinctive components of this community. This habitat occurred in areas where the long-term effects of livestock grazing and trampling had modified either bog or wet heath communities which, under a lighter grazing regime, would have a more evident dwarf-shrub component. These areas were generally quite variable, with typically occurring species including deer-grass, bilberry, bog asphodel, heather, purple moor-grass and wavy hair-grass, with more occasional cross-leaved heath, mat-grass (*Nardus stricta*), star sedge (*Carex echinata*) and tormentil and with a patchy moss layer including *Sphagnum capillifolium* and *Sphagnum papillosum*.

A6.1.3.39 Dry dwarf-shrub heath was not recorded to any significant extent with the survey area. The grazing intensity by livestock across the Site has supressed this habitat type where it might be expected to occur given the soil conditions. However, some species indicative of the potential, former presence of this habitat was recorded in some locations. For example, species such as heather, bell heather (*Erica cinerea*), green-ribbed sedge and heath grass were found in small areas where grazing pressure was apparently lower, including some parts of Furmiston Craig and on some steeper slopes adjacent to the Benloch Burn.

Continuous/scattered bracken

A6.1.3.40 Continuous and scattered bracken was recorded across 2.64 % of the survey area (28.93 ha in total). Stands of bracken were typically present on some of the drier slopes across the Site. In particular, extensive areas occurred on the slopes down to the Marbrack Burn and the Benloch Burn. Along the Benloch Burn, where the coverage of bracken was less dense and there were some areas where it had a more scattered distribution, the underlying habitat was semi-improved neutral grassland, which had established on free-draining ground.

A6.1.3.41 The continuous bracken stands within the survey area mostly correspond to NVC community U20a *Pteridium aquilinum-Galium saxatile*, the *Anthoxanthum odoratum* sub-community. These are dry, bracken-dominated areas with an understorey comprising grasses similar to those found within adjacent habitats, in particular sweet vernal-grass.

Semi-improved neutral grassland

A6.1.3.42 Improved/Semi-improved pasture comprised 2.21 % of the survey area (24.15 ha in total). Semi-improved grassland occurred in areas that were preferentially grazed by livestock (cattle and sheep). These areas are likely to have once been acidic in nature, but the high intensity of grazing have led to the soils becoming neutralised over time. These areas typically supported common bent, perennial rye-grass, white clover and Yorkshire-fog, with additional species including common mouse-ear, common sorrel (*Rumex acetosa*), creeping buttercup, crested dog's-tail (*Cynosurus cristatus*), selfheal (*Prunella vulgaris*) and sweet vernal-grass. In some areas there was still a slightly acidic influence, with species such as creeping thistle (*Cirsium arvense*), mat-grass and tormentil occasionally present. Some of the damper areas included very occasional purple moor-grass and sharp-flowered rush were very occasional species in some of the damper areas.

A6.1.3.43 The areas of semi-improved neutral grassland were all a close fit to the NVC community MG6b *Lolium perenne-Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community. This community was characterised by the presence of common bent, crested dog's-tail and perennial rye-grass.

A6.1.3.44 These areas typically supported common bent, perennial rye-grass, white clover and Yorkshire-fog, with varying degrees of additional species depending on grazing intensity, including common mouse-ear, common sorrel, creeping buttercup, crested dog's-tail, selfheal and sweet vernal-grass. In some areas there was still a slightly acidic influence, with species such as mat-grass and tormentil occasionally present. Some of the damper areas included very occasional purple moor-grass and sharp-flowered rush. Areas of semi-improved neutral grassland all closely fitted the NVC community MG6 *Lolium perenne-Cynosurus cristatus* grassland.

A6.1.3.45 At lower elevations to the south of the Proposed Development, there are also enclosed fields of species-poor improved pastures.

Coniferous plantation woodland

A6.1.3.46 There were a small number of coniferous plantation shelterbelts and blocks, established in the 1980s, throughout the survey area, some of which were quite isolated. These small plantations comprised 0.51 % of the survey area (5.59 ha in total). They were dominated by even-aged non-native conifers, primarily Sitka spruce (*Picea sitchensis*), with some being damaged by windthrow. Most of the plantations were being regularly used by livestock and as such the ground flora was affected by trampling and grazing and there was generally little vegetation cover or, where present, it was species-poor.

A6.1.3.47 There was also small long-established copse (shown on OS maps from the late 19th Century) of mature mixed broadleaved and conifer trees located in the eastern part of the Site on the south-facing slope of Furmiston Craig.

A6.1.3.48 A new area (c. 58 ha) of, predominantly, commercial conifer plantation was established on Marbrack (central part of the Site) in 2021. This area is not shown as a plantation on the Phase 1 habitat map (see Figure 6.4) as

the very young trees occupied only a small proportion of the area at the time of the survey. A second, much larger, area of planting is proposed in 2022 for the Furmiston Craig area (c. 306 ha). A large proportion of the planting plans for both areas is of non-native conifers (Marbrack 68 %, Furmiston 58 %). The remaining areas are comprised of mixed / native broadleaved trees and open ground. The planting plans and boundaries of these areas are shown on Figure 12.3 and their species composition is detailed in Technical Appendix 12.1 (of Chapter 12 Forestry).

Acid flush

A6.1.3.49 Soligenous flush type vegetation was recorded at various locations scattered across the survey area. These habitats were generally relatively small linear features with an abundance of sedges, in particular carnation sedge, common sedge and common yellow-sedge, with other graminoid species including bulbous rush, sharp-flowered rush and star sedge and species including bog asphodel, marsh willowherb and marsh violet.

A6.1.3.50 As well as forming more discrete linear acid flush features, similar vegetation was also found to occur over larger areas of diffuse surface drainage, often occurring in a mosaic with rush pasture communities (i.e. various sub-communities of M23 *Juncus effusus/acutiflorus - Galium palustre* rush-pasture).

A6.1.3.51 The flushes recorded generally had a good coverage of mosses, primarily *Sphagnum papillosum* but also with *Sphagnum capillifolium, S. cuspidatum* and *S. fallax*, with some flush areas having a complete coverage. Herbaceous species included bog asphodel, lesser spearwort (*Ranunculus flammula*), marsh willowherb and marsh violet (*Viola palustris*), and more occasionally bog pondweed (*Potamogeton polygonifolius*), marsh lousewort (*Pedicularis palustris*) and round-leaved sundew, which generally occurred at the margins. Water forget-me-not (*Myosotis scorpioides*) and whorled caraway were also recorded rarely.

A6.1.3.52 Most of the acidic flushes within the survey area were considered to have a best fit to the NVC community M6a *Carex echinata-Sphagnum fallax/denticulatum mire, Carex echinata* sub-community. This community is characterised by high levels of *Sphagnum* growth and an abundance of rushes (primarily *J. effusus* and *J. acutiflorus*). and sedge species, in particular carnation sedge and star sedge, with a relatively low diversity and cover of herbs. Much of this habitat was relatively species-poor in terms of the associated flora.

A6.1.3.53 The M6 NVC community is considered to be potentially highly groundwater dependent. However, in many cases within the survey area, particularly where this habitat was found in a mosaic with M23 communities, this habitat appeared to be closely associated clearly defined and diffuse surface water drainage features and with areas that had been heavily modified by livestock grazing and artificial drainage ditches. Indicating that this was a vegetation community arising, at least in part, from the history of land management on the Site.

Wet heath / acid grassland mosaic

A6.1.3.54 Wet heath / acid grassland mosaic habitat was recorded only occasionally and was generally present where acid grassland habitats occurred on damper ground. This Phase 1 habitat comprised 0.31 % of the survey area (3.40 ha in total). These habitats supported abundant common bent and wavy hair-grass, with frequent purple moor-grass and occasional heather, heath rush and the mosses *Polytrichum commune* and *Rhytidiadelphus squarrosus*. These areas were grazed in preference to the surrounding wetter heath, mire and rush pasture communities.

Running Water

A6.1.3.55 Several watercourses and associated minor tributaries occur within the survey area. There are also many artificial drainage ditches with running water. Associated plant species include common water starwort, floating sweet-grass, lesser spearwort, common water-crowfoot, and water forget-me-not.

A6.1.3.56 Heavily sheep and cattle poached areas occur at various locations along all the watercourses but are generally limited in extent. The majority of the watercourses had vegetated banks, with species generally typical of the adjacent habitats but also with additional species such as lesser spearwort, marsh thistle and soft-rush, and there were some sections where the channel was not visible due to overhanging vegetation. In more open areas, there were a small number of aquatic plant species including common water starwort (*Callitriche stagnalis*), floating sweet-grass (*Glyceria fluitans*) and water forget-me-not. Generally, the water had a good clarity, although a few of the smaller tributaries were peaty, and at least one was showing evidence of iron-rich ochre.

A6.1.3.57 The steeper banks of the Benloch Burn were well-vegetated, primarily with either bracken, rush-dominated marshy grassland or semi-improved neutral grassland. There is some evidence of bank erosion in places, which may be partly exacerbated by livestock trampling / grazing and the lack of any appreciable riparian tree cover. Some of the steeper banks are less accessible to grazing stock and, consequently, are more botanically diverse than the surrounding, more heavily grazed, habitats. There are a few scattered rowan trees present on some of the steeper banks of both watercourses within the Site

A6.1.3.58 Furmiston Lane is located on the eastern side of the study area, east of Marbrack. This is a narrow watercourse with high banks, and the channel was obscured by vegetation in some places. The water flowed over pebbles and cobbles, with some peaty sections, and there were some exposed rocks.

A6.1.3.59 Marbrack Burn is situated on the eastern side of the study area, to the north and west of Furmiston Lane. This had a substrate comprising cobbles and boulders, with some exposed bedrock in areas. The channel was open, with marginal vegetation including grasses and bracken. This burn has a small number of tributaries that were narrow and shallow, with a similar marginal vegetation composition.

A6.1.3.60 Other watercourses included the Knockgray Burn to the south of Quantans Hill, part of which flowed through an area of deciduous woodland and had an apparently high iron content, and the Polhay Burn to the east of Quantans Hill, which was primarily a narrow channel with sections that were hidden beneath overgrowing vegetation.

Basic flush

A6.1.3.61 A small number of flushes within the survey area were in areas where there were exposed rock or shallow soils that provided more base-rich conditions. These flushed habitats included species such as butterwort, carnation sedge, common yellow-sedge and dioecious sedge (*Carex dioica*), with additional species including common sedge, round-leaved sundew and *Sphagnum* spp. These habitats corresponded to the M10a *Carex dioica-Pinguicula vulgaris* mire, *Carex viridula* ssp. *oedocarpa-Juncus bulbosus* sub-community.

Boundary Features

A6.1.3.62 Most of the boundaries within the survey area were either post-and-wire fences (some of which are electrified to protect them from cattle) or dry-stone dykes. There were no hedges present.

Notable plants

A6.1.3.63 Whorled caraway was recorded in a small number of locations including one of the acid flushes. Whorled caraway is listed as a local priority species in the Dumfries & Galloway Local Biodiversity Action Plan (2009) and is, within Great Britain, largely confined to western Scotland and southwest Wales.

A6.1.3.64 Harebell, heather, rowan and thistle spp. are included on the social criterion list of the Scottish Biodiversity List and were all recorded within the survey area.

Invasive non-native plants

A6.1.3.65 No non-native highly invasive plant species were recorded during any of the habitat or botanical surveys. Non-native plant species were only recorded in association with the coniferous plantation woodlands, which were dominated by Sitka spruce.

Groundwater Dependent Terrestrial Ecosystems

A6.1.3.66 The majority of the NVC communities found within the survey area are not classed as GWDTEs. This includes the bog, wet heath communities and the areas of acid grassland. Further discussion and assessment of the extent to which these habitats are supported by groundwater, given the geological, hydrological and land

management context of the Site, is provided in Chapter 6 (Ecology & Biodiversity) and Chapter 8 (Hydrology, Geology & Hydrogeology).

A6.1.3.67 In summary, the four communities that are considered to be potentially highly groundwater dependent are as follows:

- M6 *Carex echinata-Sphagnum fallax/denticulatum* mire - this relates to several acidic flushes that were recorded in various locations across the survey area. These often linear habitats occurred where there was slow surface water movement visible, or where there were small areas of surface water and bare peat;
- M10 *Carex dioica-Pinguicula vulgaris* mire - this relates to a small number of small base-rich flushed features where the peat is shallow, there is surface water movement and the underlying rock is exposed;
- M23 *Juncus effusus/acutiflorus-Galium palustre* rush pasture - the majority of examples of this community across the survey area have arisen as a result of surface water movement, and occur on sloping ground where there is a limited dependency on groundwater. In many instances this community has developed where the long-term effects of grazing and trampling has caused localised changes to ground conditions and rushes were able to encroach and dominate; and
- M29 *Hypericum elodes-Potamogeton polygonifolius* soakway – these were generally small features with a small number recorded within the survey area.

A6.1.3.68 The four communities considered to be potentially moderately groundwater dependent are as follows:

- M15 *Scirpus cespitosus-Erica tetralix* wet heath – this community covered extensive areas, typically in level or gently sloping ground and at the base of slopes, and as such it is likely that there is some water movement though some of these areas. As with other areas of the site, this community has been subjected to the long-term effects of grazing over time and as such has become modified, with many areas supporting a high percentage of grasses and species more consistent with drier habitats.
- M25 *Molinia caerulea-Potentilla erecta* mire - this community occurred extensively across the survey area, often in level or gently sloping areas, where tussocky purple moor-grass and other typical species of the community had become established due to long-term effects of land management (chiefly grazing, trampling). In such areas, there is a limited dependency on groundwater. It is therefore likely that some of the areas dominated by M25 communities are not groundwater dependent.
- MG10 *Holcus lanatus-Juncus effusus rush-pasture* – this community was distributed across the survey area, which it was often present alongside watercourses, in which case it would not be considered to be particularly groundwater dependent, whereas areas that are more level or associated with flushes are more likely to be groundwater dependent.
- U6 *Juncus squarrosus-Festuca ovina* grassland – there were a small number of examples of this community within the survey area, all related to relatively dry habitats affected by grazing and trampling impact. These areas were not considered to be particularly groundwater dependent in this context.

APPENDIX 1: TARGET NOTES FROM THE PHASE 1 HABITAT SURVEY

A6.1.3.69 This appendix provides the target notes recorded during the Phase 1 habitat survey. The mapped results of the Phase 1 habitat survey are provided on Figures 6.4a-c of the EIAR and the target note locations are also shown on these figures. A list of higher and lower plant species recorded during the survey is included in Appendix 4 of this document.

Table A1.1: Phase 1 habitat survey target notes

TN ref	Easting	Northing	Habitat type	Location	Description
1	257151	593338	Semi-improved acid grassland	Site access track	Sloping area of damp acid grassland with whorled caraway (*Carum verticillatum*) plants throughout.
2	257438	595028	Marshy grassland	T4	Area approximately 4 x 8 m. Wet underfoot. With frequent common sorrel (*Rumex acetosa*), creeping buttercup (*Ranunculus repens*), marsh thistle (*Cirsium palustre*), marsh willowherb (*Epilobium palustre*), tormentil (*Potentilla erecta*), Yorkshire-fog (*Holcus lanatus*) and the moss *Pleurozium schreberi*.
3	257440	594933	Running water	T4	Narrow channel with a fast flow. Shallow, less than 10 cm and 50 cm wide, over rocks. Banks are vegetated as the surrounding community, with some *Sphagnum* spp., hard-fern (*Blechnum spicant*) and marsh violet (*Viola palustris*) at the edges.
4	257441	594917	Marshy grassland	T4	Area approximately 3 x 10 m with bog-myrtle (*Myrica gale*), purple moor-grass (*Molinia caerulea*) and sharp-flowered rush (*Juncus acutiflorus*).
5	257535	595038	Acid flush	T4	Area approximately 2 x 5 m. With abundant carnation sedge (*Carex panicea*), frequent bog asphodel (*Narthecium ossifragum*), and occasional bulbous rush (*Juncus bulbosus*), common bent (*Agrostis capillaris*), heath rush (*Juncus squarrosus*), *Sphagnum papillosum*, and a small amount of star sedge (*Carex echinata*) at the edges. Also some areas of bare peat.
6	257555	595028	Running water	T4	Narrow, fast-flowing channel, shallow, over rocks. With occasional patches of soft-rush (*Juncus effusus*) but no other associated vegetation.
7	257570	595015	Semi-improved acid grassland	T4	Very variable; neutralising due to grazing pressures. With patches of mat-grass (*Nardus stricta*) and purple moor-grass. Tormentil is occasional throughout. Also includes common bent, Yorkshire-fog and white clover (*Trifolium repens*), with a few small patches of carnation sedge at the northern end.
8	257599	594823	Acid flush	T4	Flush dominated by *Sphagnum papillosum* with abundant sharp-flowered rush, frequent marsh willowherb and star sedge, and occasional bog asphodel, cranberry (*Vaccinium oxycoccos*), lesser spearwort (*Ranunculus flammula*) and lousewort (*Pedicularis sylvatica*), and patches of *Rhytidiadelphus squarrosus*, Covers an area of approximately 1.5 x 8 m. Surrounded by a marshy grassland community dominated by purple moor-grass.
9	257656	595057	Acid flush	T4	Very damp flush area approximately 3 x 6 m. With abundant carnation sedge, frequent devil's-bit scabious (*Succisa pratensis*), purple moor-grass and tormentil, occasional heath rush, lousewort and star sedge, some *Sphagnum papillosum* and bog asphodel occurring rarely. *Hylocomium splendens* was present throughout. A very wet area of ground approximately 1 m to the north supported lesser spearwort.
10	257669	594866	Marshy grassland	T4	Area dominated by bog myrtle and sharp-flowered rush. With abundant purple moor-grass, frequent cross-leaved heath (*Erica tetralix*) and marsh willowherb, locally frequent heath spotted-orchid (*Dactylorhiza maculata*) and tormentil, and occasional bog asphodel, common bent, deergrass (*Trichophorum germanicum*), heather (*Calluna vulgaris*), marsh thistle and purple moor-grass. Yorkshire-fog is a very occasional species, and sweet vernal-grass (*Anthoxanthum odoratum*) occurs rarely. The moss layer includes *Hypnum* sp. and *Sphagnum fallax*.
11	257674	594925	Semi-improved neutral grassland	T4	Preferentially grazed area. Abundant common bent, creeping buttercup and sweet vernal-grass, locally frequent selfheal (*Prunella vulgaris*), frequent Autumn hawkbit (*Scorzoneroides autumnalis*), common mouse-ear

TN ref	Easting	Northing	Habitat type	Location	Description
					(*Cerastium fontanum*), common sorrel and white clover, and occasional crested dog's-tail (*Cynosurus cristatus*), marsh thistle, perennial rye-grass (*Lolium perenne*) and purple moor-grass. There are also some patches of soft-rush encroachment.
12	257788	595366	Acid flush	T5	An area of approximately 3 x 5 m dominated by *Sphagnum cuspidatum* with frequent carnation sedge and heath rush, occasional bulbous rush, eyebright (*Euphrasia* sp.) and mat-grass, and with very occasional bog asphodel and heather occurring rarely at the edges. Carnation sedge is abundant in the grassland to the north.
13	257810	595400	Acid flush	T5	Dominated by carnation sedge, with occasional bulbous rush and star sedge in wetter areas. Bog asphodel occurs rarely, and mat-grass is occasional at the edges. Covers an area of approximately 2 x 5 m. A similar area occurs 3 m to the east but is drier with a higher percentage of mat-grass.
14	257830	595222	Acid flush	T5	0.5 x 5 m. As TN14 but with some exposed rock and one water forget-me-not (*Myosotis scorpioides*).
15	257837	595215	Acid flush	T5	Approximately 0.5 x 2 m. With some standing water and bare peat. Abundant bulbous rush, common yellow-sedge (*Carex demissa*) and lesser spearwort, occasional cuckooflower (*Cardamine pratensis*), marsh thistle, marsh willowherb and tormentil, and very occasional carnation sedge.
16	257845	595189	Marshy grassland	T5	Damp grassland area, over an area of approximately 4-5 m diameter, with abundant carnation sedge, frequent whorled caraway and occasional devil's-bit scabious.
17	257852	595460	Semi-improved acid grassland	T5	With frequent mat-grass and tormentil, and occasional common bent, green-ribbed sedge (*Carex binervis*), heath bedstraw (*Galium saxatile*) and sweet vernal-grass, locally frequent carnation sedge and occasional heath-grass (*Danthonia decumbens*), heath milkwort (*Polygala serpyllifolia*) and lousewort.

TN ref	Easting	Northing	Habitat type	Location	Description
					Occasional rocky areas support bilberry (*Vaccinium myrtillus*), and harebell (*Campanula rotundifolia*) is a rare species.
18	257854	595182	Acid flush	T5	Dominated by carnation sedge with frequent bulbous rush, and occasional bog asphodel. Up to 1 m wide and 6 m long, grading into the surrounding vegetation.
19	257856	595196	Acid flush	T5	Approximately 1 x 5 m. Abundant carnation sedge, frequent lesser spearwort, marsh lousewort (*Pedicularis palustris*) at the edges, occasional common yellow-sedge, marsh willowherb and marsh violet, rare mat-grass and one whorled caraway plant. Occasional small patches of *Polytrichum commune* and some standing water.
20	257993	593917	Marshy grassland	T8	In a small depression - likely to be a GWDTE. Dominated by soft-rush with frequent purple moor-grass, with frequent common sorrel and marsh willowherb, occasional tormentil, sweet vernal-grass and Yorkshire-fog, and occasional patches of soft-rush.
21	257995	595247	Semi-improved neutral grassland	T5	Approximately 6 m diameter. With common bent, creeping buttercup, white clover and Yorkshire-fog, and occasional purple moor-grass. Marsh thistle, sharp-flowered rush and tormentil occur at the edges.
22	258043	594124	Marshy grassland	T8	Dominated by sharp-flowered rush. With frequent common bent, creeping buttercup, sweet vernal-grass, Yorkshire-fog, *Polytrichum commune* and *Sphagnum papillosum*. Other more occasional species include marsh thistle, marsh willowherb, tormentil and whorled caraway. Fast-flowing channel cutting through, with no associated vegetation.
23	258119	594082	Acid flush	T8	*Sphagnum papillosum*-dominated flush covering an area of approximately 2 x 8 m with frequent lesser spearwort, soft-rush, occasional bog asphodel and bog pondweed (*Potamogeton polygonifolius*), and with lousewort and round-leaved sundew (*Drosera rotundifolia*) occurring rarely. Soft-rush is encroaching into the

TN ref	Easting	Northing	Habitat type	Location	Description
					surrounding mire.
24	258162	594135	Plant record		Small colony of whorled caraway.
25	258424	594011	Marshy grassland	T8	With fast flowing water through and areas of standing water. Supports common marsh-bedstraw (*Galium palustre*), common sorrel, marsh willowherb, water forget-me-not and wavy bitter-cress (*Cardamine flexuosa*). Soft-rush is dominant along the line of the channel, being replaced by sharp-flowered rush further out.
26	258865	593820	Marshy grassland	T9	Mostly dominated by soft-rush with locally frequent purple moor-grass and sharp-flowered rush at the uphill end. Marsh thistle is occasional. Water has a moderate water flow through this area. A further patch of marshy grassland to the west is dominated by purple moor-grass with frequent sharp-flowered rush and occasional soft-rush.
27	259274	593759	Acid flush	T9	An area of approximately 4 m diameter with a full coverage of mosses, dominated by *Polytrichum commune* and *Sphagnum papillosum*, with *Sphagnum fallax* and *Sphagnum capillifolium* also present, and with *Rhytidiadelphus squarrosus* at the edges. Herbaceous species include occasional star sedge and tormentil.
28	260300	593023	Swamp	T14	Area of swamp dominated by bottle sedge with common sorrel, marsh horsetail (*Equisetum palustre*), marsh thistle, marsh thistle, star sedge and water forget-me-not.
30	260762	593713	Acid flush	T13	Damper area with frequent star sedge and patches of soft-rush and *Sphagnum fallax*, and occasional heath rush at the edges. Covers an area of approximately 2 x 6 m.
31	260775	593288	Acid flush		Flush area with a variety of sedges: common sedge, common yellow-sedge, flea sedge (*Carex pulicaris*) and star sedge, with carnation sedge occurring in areas with shallower soils. Other species in this habitat include bog asphodel, cross-leaved heath, jointed rush (*Juncus articulatus*), marsh lousewort and round-leaved sundew, with mat-grass occurring close to exposed rocks.
32	260816	594041	Acid flush	T13	Flush, 3 x 3 m at the widest, with standing water and slight, audible water movement. With frequent carnation sedge and common yellow-sedge, and occasional devil's-bit scabious and star sedge.
33	260818	594037	Acid flush	T13	Very small flush approximately 1 x 3 m, with abundant carnation sedge, frequent flea sedge, and occasional common sedge (*Carex nigra*), eyebright, heath-grass, mat-grass and star sedge. A further area 1 m downslope is of a similar composition but with frequent common yellow-sedge.
34	260855	593700	Semi-improved acid grassland	T13	Acid grassland on area of exposed rock. With frequent mat-grass and sheep's-fescue (*Festuca ovina*), occasional heath-grass, green-ribbed sedge, and *Polytrichum commune*, with *Racomitrium lanuginosum* occurring rarely and numerous other mosses, with occasional patches of tufted hair-grass. English stonecrop (*Sedum anglicum*) occurs locally frequently on exposed rocks.
35	260929	593707	Wet heath	T13	Covers an area or approximately 6 x 15 m. Flushed, with a small patch of standing water approximately 1.5 m across, dominated by bulbous rush with a patch of heath rush. Area also supports frequent heather and wavy hair-grass, locally frequent deer-grass and large patches of *Sphagnum capillifolium* and *Sphagnum papillosum*.
36	261020	593722	Seepage	T13	Very slow-flowing seepage area with devil's-bit scabious, bog pondweed, lousewort, lesser spearwort, *Sphagnum papillosum*, cuckooflower, carnation sedge, marsh willowherb and frequent star sedge.
37	261273	593373	Seepage	T16	Seepage / old drainage line filled with *Sphagnum* sp.
38	261414	593420	Seepage	T16	An area up to 0.5 m wide, dominated by *Polytrichum commune* and *Sphagnum papillosum* and with occasional heath rush. Roughly follows edge of an area of wet modified bog.

TN ref	Easting	Northing	Habitat type	Location	Description
39	260555	593204	Acid flush		Acid flush where slope with bracken meets bog. Numerous heath spotted-orchids.
40	260552	593395	Basic flush		Stony basic flush (with butterwort) extends 20 m uphill from this point. Indicative of M10 NVC community
41	260578	593559	Spring		Spring. Water exits out of sharp-flowered rush marshy grassland to stony slow flowing flush.
43	260829	593490	Basic flush		Small runnel feature, flowing N-S, stony and sparsely vegetated with short sedges, including *Carex panicea*, also Pinguicula vulgaris, indicative of basic flush, indicative of M10 NVC community
44	257704	595181	Plant record		Small area of heath spotted-orchid plants.
45	257708	595229	Plant record		Several stands of heath spotted-orchid in this area.
46	257341	595138	Plant record		Several stands of heath spotted-orchid in this area.
47	261076	594638	Plant record		*Lysimachia nemorum* (yellow pimpernel) plant on edge of riverbank.
48	260206	594552	Plant record		Small area of heath spotted-orchid plants.
49	260957	595025	Marshy grassland		*Juncus acutiflorus* dominated vegetation following a natural drainage line, relatively diverse in comparison with similar habitat in surrounding area, forbs including ragged robin, meadowsweet, marsh thistle, creeping buttercup, lesser stitchwort, marsh bedstraw, marsh hawksbeard, water forget-me-not, marsh violet, marsh willowherb, angelica, sheep's sorrel.
50	260092	594651	Plant record		Small area of heath spotted-orchid plants.
51	257341	594761	Heath		Banks of the Benloch burn, small areas of dry heath vegetation on steeper slopes where grazing pressure is reduced, and dwarf shrubs are more prevalent than in the surrounding area. Calluna is dominant in places, with bell heather and blaeberry also present. Bank side vegetation is also relatively diverse, includes scattered rowan trees, and a range of forbs including marsh hawk's-beard, birds-foot trefoil, slender St John's-wort, meadow vetchling, pig nut.
52	257765	593900	Plant record		Whorled caraway plants are frequent in this area, within a field dominated by rush pasture / rush mire communities

APPENDIX 2: NVC QUADRAT DATA

A6.1.3.70 This appendix provides the quadrat data obtained during the National Vegetation Classification (NVC) survey, carried out to inform the determination of NVC community types within the survey area in combination with professional judgement and reference to various NVC guidance documents (as cited in the methods section of this Technical Appendix).

A6.1.3.71 Species lists, and estimated cover scores, from the representative quadrats established during the NVC survey are provided below. These are assigned to the most closely corresponding NVC community. Numbers alongside each plant species name refer to the extent of each species within the quadrat following the Domin scale of cover/abundance, with the highest number indicating the greatest cover, with the exception of the number '11' which indicates species that were found outside the quadrat. The percentage cover and the Domin Value are shown in Table A2.1.

A6.1.3.72 The full list of NVC communities identified during the surveys is provided in Table 6.1.2. For each of these NVC communities, the data from sample quadrats used to determine the community type are provided in Tables A2.3 to A3.12. The location of each of the sample quadrats is provided in Table A2.2.

Table A2.1: The Domin number and associated percentage cover

Domin value	% cover
11	Absent from the quadrat, but present in the surrounding area
10	91-100
9	76-90
8	51-75
7	34-50
6	26-33
5	11-25
4	4-10
3	<4, with many individuals
2	<4, with several individuals
1	<4, with few individuals

A6.1.3.73 Table A2.2 lists all quadrat locations at which representative communities were sampled, and provides the applicable NVC codes at each quadrat location.

Table A2.2: Quadrat locations

Quadrat ref	NVC Code	Easting	Northing
1	M25a	257550	594855
2	M25a	258161	595456
3	M25a	258209	593986
4	M19a	258675	595135
5	M17c	259306	593802
6	M17a	259597	594076
7	U5a	261368	594023
8	M15b	558444	295085
9	M19a	558848	295232
10	M25a	559110	295481
11	M15a	559279	295634
12	M15a	561169	294617
13	M15a	561205	294392
14	M17a	561315	293769

A6.4.1.1 The following tables (A2.3 to A2.9) provide the results of the NVC quadrat surveys, carried out to determine the NVC categories of the habitats present within the Proposed Development area. The quadrat data have been separated into tables for each of the distinct NVC communities.

Table A2.3: M15a *Scirpus cespitosus-Erica tetralix* wet heath, *Carex panicea* sub-community

	Quadrat 11	Quadrat 12	Quadrat 13
Agrostis capillaris	4		
Calluna vulgaris		11	4
Deschampsia flexuosa	6	5	5
Drosera rotundifolia			1
Erica tetralix	4	2	5
Eriophorum vaginatum		4	2
Galium saxatile		4	
Molinia caerulea	5	5	5
Narthecium ossifragum	4	3	5
Potentilla erecta	3	5	
Rhytidiadelphus squarrosus		2	
Sphagnum capillifolium	8	6	5
Sphagnum papillosum			4
Trichophorum germanicum	7	8	7
Vaccinium myrtillus	7		4

Table A2.4: M15b *Scirpus cespitosus-Erica tetralix* wet heath, typical sub-community

	Quadrat 8
Calluna vulgaris	4
Erica tetralix	3
Eriophorum vaginatum	5
Galium saxatile	4
Hylocomium splendens	5
Molinia caerulea	5
Narthecium ossifragum	1
Pleurozium schreberi	5
Sphagnum capillifolium	5
Trichophorum germanicum	5
Vaccinium myrtillus	5

Table A2.5: M17a *Scirpus cespitosus-Eriophorum vaginatum* blanket mire, *Drosera rotundifolia-Sphagnum* species sub-community

	Quadrat 6	Quadrat 14
Calluna vulgaris	7	4
Carex rostrata		11
Drosera rotundifolia	2	
Erica tetralix	4	7
Eriophorum vaginatum	4	3
Molinia caerulea		11
Narthecium ossifragum	5	7
Sphagnum capillifolium	8	7
Sphagnum papillosum		5
Trichophorum germanicum	8	8
Vaccinium myrtillus	2	

Table A2.6: M17c *Scirpus cespitosus-Eriophorum vaginatum* blanket mire, *Juncus squarrosus-Rhytidiadelphus loreus* sub-community

	Quadrat 5
Calluna vulgaris	4
Deschampsia flexuosa	2
Erica tetralix	4
Eriophorum vaginatum	4
Juncus squarrosus	2
Molinia caerulea	7
Narthecium ossifragum	3
Sphagnum capillifolium	8
Sphagnum papillosum	5
Trichophorum germanicum	7
Vaccinium oxycoccos	2

Table A2.7: M19a *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Erica tetralix* sub-community

	Quadrat 4	Quadrat 9
Anthoxanthum odoratum	4	
Calluna vulgaris	7	7
Cladonia sp.	4	
Deschampsia flexuosa	5	5
Erica tetralix	4	3
Eriophorum angustifolium		2
Eriophorum vaginatum	6	5
Juncus squarrosus		4
Molinia caerulea	5	
Narthecium ossifragum		3
Pleurozium schreberi	5	
Potentilla erecta		2
Sphagnum capillifolium	8	7
Sphagnum papillosum	11	
Trichophorum germanicum	4	
Vaccinium myrtillus	5	7

Table A2.8: M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 10
Agrostis capillaris	1	4		5
Anthoxanthum odoratum	1			4
Calluna vulgaris	3		3	
Carex echinata	2			
Deschampsia flexuosa	4	5	1	3
Empetrum nigrum	3			
Erica tetralix	2		3	4
Eriophorum vaginatum	1			5
Holcus lanatus	11			
Juncus effusus		2		
Juncus squarrosus	2	2		4
Molinia caerulea	8	7	9	6
Myrica gale			11	
Narthecium ossifragum	2		3	
Pleurozium schreberi	7			
Potentilla erecta	5	5	4	4
Sphagnum capillifolium		5		
Sphagnum papillosum			5	
Trichophorum germanicum		5		
Vaccinium myrtillus		4		

Table A2.9: U5a *Nardus stricta-Galium saxatile* grassland, species-poor sub-community

	Quadrat 7
Agrostis stolonifera	5
Anthoxanthum odoratum	6
Carex binervis	3
Carex nigra	2

	Quadrat 7
Deschampsia flexuosa	4
Festuca ovina	4
Galium saxatile	5
Juncus squarrosus	1
Nardus stricta	4
Potentilla erecta	4

APPENDIX 3: PLANT SPECIES LIST

A6.1.3.74 Tables A3.1 and A3.2 provides a list of higher and lower plants recorded during the habitat and botanical surveys within the survey area for the Proposed Development, along with their national and local status.

Table A3.1: Higher plants recorded within the survey area

Common name	Scientific name	BAP	SBL	Status[i]
Alder	*Alnus glutinosa*			
Annual meadow-grass	*Poa annua*			
Ash	*Fraxinus excelsior*			
Autumn hawkbit	*Scorzoneroides autumnalis*			
Bell heather	*Erica cinerea*			
Bilberry	*Vaccinium myrtillus*			
Bird’s-foot trefoil	*Lotus corniculatus*			
Blinks	*Montia fontana*			
Bog asphodel	*Narthecium ossifragum*			
Bog pondweed	*Potamogeton polygonifolius*			
Bog-myrtle	*Myrica gale*			
Bog Stitchwort	*Stellaria alsine*			
Bottle sedge	*Carex rostrata*			
Bracken	*Pteridium aquilinum*			
Bulbous rush	*Juncus bulbosus*			
Carnation sedge	*Carex panicea*			
Cat's-ear	*Hypochaeris radicata*			
Cock's-foot	*Dactylis glomerata*			
Colt's-foot	*Tussilago farfara*			
Common bent	*Agrostis capillaris*			
Common butterwort	*Pinguicula vulgaris*			
Common chickweed	*Stellaria media*			
Common cottongrass	*Eriophorum angustifolium*			
Common dog-violet	*Viola riviniana*			
Common knapweed	*Centaurea nigra*			
Common marsh-bedstraw	*Galium palustre*			
Common mouse-ear	*Cerastium fontanum*			
Common nettle	*Urtica dioica*			
Common sedge	*Carex nigra*			
Common sorrel	*Rumex acetosa*			
Common valerian	*Valeriana officinalis*			
Common yellow-sedge	*Carex demissa*			
Compact rush	*Juncus conglomeratus*			
Cow Parsley	*Anthriscus sylvestris*			
Cranberry	*Vaccinium oxycoccos*			
Creeping buttercup	*Ranunculus repens*			
Creeping thistle	*Cirsium arvense*			
Crested dog's-tail	*Cynosurus cristatus*			
Cross-leaved heath	*Erica tetralix*			
Crowberry	*Empetrum nigrum*			
Cuckooflower	*Cardamine pratensis*			
Daisy	*Bellis perennis*			
Deergrass	*Trichophorum germanicum*			
Devil's-bit scabious	*Succisa pratensis*			
Dioecious sedge	*Carex dioica*			
English stonecrop	*Sedum anglicum*			
European larch	*Larix decidua*			
Eyebright	*Euphrasia officinalis*			
Field wood-rush	*Luzula campestris*			
Flea sedge	*Carex pulicaris*			
Floating sweet-grass	*Glyceria fluitans*			
Foxglove	*Digitalis purpurea*			
Great wood-rush	*Luzula sylvatica*			
Green-ribbed sedge	*Carex binervis*			
Hard-fern	*Blechnum spicant*			
Harebell	*Campanula rotundifolia*			
Hare's-tail cottongrass	*Eriophorum vaginatum*			
Heath bedstraw	*Galium saxatile*			
Heath milkwort	*Polygala serpyllifolia*			
Heath rush	*Juncus squarrosus*			
Heath spotted-orchid	*Dactylorhiza maculata*			
Heath wood-rush	*Luzula multiflora*			
Heather	*Calluna vulgaris*			
Heath-grass	*Danthonia decumbens*			
Jointed rush	*Juncus articulatus*			
Knotgrass	*Polygonum aviculare*			

Common name	Scientific name	BAP	SBL	Status[i]
Lemon-scented fern	*Oreopteris limbosperma*			
Lesser spearwort	*Ranunculus flammula*			
Lesser stitchwort	*Stellaria graminea*			
Lousewort	*Pedicularis sylvatica*			
Male-fern	*Dryopteris filix-mas*			
Marsh arrowgrass	*Triglochin palustris*			
Marsh foxtail	*Alopecurus geniculatus*			
Marsh hawk's-beard	*Crepis paludosa*			
Marsh horsetail	*Equisetum palustre*			
Marsh lousewort	*Pedicularis palustris*			
Marsh-marigold	*Caltha palustris*			
Marsh thistle	*Cirsium palustre*			
Marsh violet	*Viola palustris*			
Marsh willowherb	*Epilobium palustre*			
Marsh woundwort	*Stachys palustris*			
Mat-grass	*Nardus stricta*			
Meadow foxtail	*Alopecurus arvensis*			
Meadow Vetchling	*Lathyrus pratensis*			
Meadowsweet	*Filipendula ulmaria*			
Oval sedge	*Carex leporina*			
Pignut	*Conopodium majus*			
Pill sedge	*Carex pilulifera*			
Primrose	*Primula vulgaris*			
Purple moor-grass	*Molinia caerulea*			
Ragged-robin	*Lychnis flos-cuculi*			
Red fescue	*Festuca rubra*			
Ribwort plantain	*Plantago lanceolata*			
Rough meadow-grass	*Poa trivialis*			
Round-leaved sundew	*Drosera rotundifolia*			
Rowan	*Sorbus aucuparia*			
Scots pine	*Pinus sylvestris*		✓	
Selfheal	*Prunella vulgaris*			
Sharp-flowered rush	*Juncus acutiflorus*			
Sheep's Fescue	*Festuca ovina*			
Sheep's sorrel	*Rumex acetosella*			
Sitka spruce	*Picea sitchensis*			
Slender St John's-wort	*Hypericum pulchrum*			
Sneezewort	*Achillea ptarmica*			
Soft-rush	*Juncus effusus*			
Star sedge	*Carex echinata*			
Sweet vernal-grass	*Anthoxanthum odoratum*			
Tormentil	*Potentilla erecta*			
Tufted hair-grass	*Deschampsia cespitosa*			
Tufted Vetch	*Vicia cracca*			
Viviparous sheep's-fescue	*Festuca vivipara*			
Water forget-me-not	*Myosotis scorpioides*			
Wavy bitter-cress	*Cardamine flexuosa*			
Wavy hair-grass	*Deschampsia flexuosa*			
White clover	*Trifolium repens*			
Whorled caraway	*Carum verticillatum*	LBAP		
Wild angelica	*Angelica sylvestris*			
Wild thyme	*Thymus polytrichus*			
Wild pansy	*Viola tricolor*		✓	
Yarrow	*Achillea millefolium*			
Yellow pimpernel	*Lysimachia nemorum*			
Yorkshire-fog	*Holcus lanatus*			

i – Source: conservation designations for UK taxa, JNCC (July 2021):
Critically endangered (CR)
Endangered (EN)
Vulnerable (VU)
Data Deficient (DD)
Near Threatened (NT)
Nationally Rare (NR)
Nationally Scarce (NS)
Least Concern (LC)
Status not available (-)

Table A3.2: List of lower plants recorded in the survey area

Scientific name	Common name
Dicranum scoparium	Broom forkmoss
Hylocomium splendens	Glittering wood-moss
Hypnum jutlandicum	Heath plait-moss
Pleurozium schreberi	Red-stemmed feather-moss
Plagiothecium undulatum	Waved Silk-moss
Polytrichum commune	Common haircap
Racomitrium lanuginosum	Woolly fringe-moss
Rhytidiadelphus loreus	Little Shaggy-moss
Rhytidiadelphus squarrosus	Springy turf-moss
Sphagnum capillifolium	Red bog-moss
Sphagnum cuspidatum	Feathery Bog-moss
Sphagnum denticulatum	Cow-horn bog-moss
Sphagnum fallax	Flat-topped bog-moss
Sphagnum palustre	Blunt-leaved Bog-moss
Sphagnum papillosum	Papillose bog-moss

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A1	17/11/2021	Issued for review
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Appendix 6.2

Protected Species Survey Results

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.2.1 INTRODUCTION

Purpose of this Document

A6.2.1.1 This is a Technical Appendix to Chapter 6: Ecology & Biodiversity of the Environmental Impact Assessment Report (EIAR) for the proposed Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with that Chapter.

A6.2.1.2 This Technical Appendix provides further background information on the desk study and various protected species surveys completed by MBEC and Galloway Fisheries Trust (GFT) between September 2020 and September 2021.

A6.2.1.3 The results of these surveys have been fully considered within the assessment of effects on protected species and the proposed mitigation and monitoring measures to protect these species during the construction and operation and decommissioning phases of the Proposed Development.

Background

A6.2.1.4 MBEC was appointed by Vattenfall in 2020 to carry out various baseline ecological surveys for the Proposed Development.

A6.2.1.5 Consultation with NatureScot was undertaken during the EIA Scoping process to confirm the approach to the EIA, including baseline protected species survey methods.

A6.2.1.6 The initial survey area (2020) is shown on Figure 6.1. This was based on a previous version of the Proposed Development boundary and the indicative wind farm layout included with EIA Scoping Report. The results from the initial protected species surveys informed the design process for the Proposed Development. During summer 2021, once the emerging layout of the Proposed Development (i.e. including all elements of required infrastructure, temporary compounds, works areas, borrow pits) was more clearly defined, the 2020 surveys were updated, as necessary, to ensure that appropriately detailed survey data was available to inform the impact assessment.

A6.2.1.7 Baseline surveys for the following species were completed between June 2020 to September 2021:

- Badger (*Meles meles*);
- Bats (all relevant species);
- Otter (*Lutra lutra*);
- Red squirrel (*Sciurus vulgaris*);
- Water vole (*Arvicola amphibius*);
- Great crested newt (*Triturus cristatus*); and
- Freshwater pearl mussel (*Margaritifera margaritifera*).

A6.2.1.8 Salmonid fish species population surveys and an assessment of habitat suitability for fish species of conservation concern was completed for the main watercourses draining the Proposed Development. The results of these surveys are provided in Technical Appendix 6.4.

A6.2.1.9 Site-wide bat activity surveys were also completed in 2020 and 2021. The methods and results of the bat activity surveys are reported in Technical Appendix 6.3.

Site Description

A6.2.1.10 The Proposed Development is located in Dumfries & Galloway, towards the northern end of the historic county of Kirkcudbrightshire, to the northeast of the settlement of Carsphairn, on the eastern side of a wide glen that forms part of the northern end of The Glenkens. This is the valley of the Water of Ken, Loch Ken and the River Dee, an extensive topographical feature that passes in an approximate northwest-southeast orientation through a large section of the western Southern Uplands.

A6.2.1.11 The Proposed Development would be located on the predominantly southwest-facing slopes of hills at the southern base of Cairnsmore of Carsphairn (797m) such as Willieanna (431m) and Knockwhirn (498m). Quantans Hill (338m) and Furmiston Craig (324m) are the main tops situated within the Proposed Development area. Elevation within the Proposed Development area ranges from c. 185 m to 350 m above sea-level.

A6.2.1.12 The Proposed Development is located to the north and east of the Water of Deugh, which is part of the Water of Ken / River Dee catchment. There are several tributaries of the Water of Deugh that rise within the Proposed Development, including the Benloch Burn, which flows south-west, the Knockgray, Polhay/Marbrack and Furmiston Burns flowing generally south through the Proposed Development towards the Water of Deugh which is located just outside of the Proposed Development, to the south of the B729.

A6.2.1.13 The dominant land use within the Proposed Development is mixed livestock farming. The Proposed Development is mostly located in unenclosed areas where sheep and cattle are allowed to wander and freely graze. Stocking levels and grazing management varies between the three landholdings that the Proposed Development Area is located within. The western area (Knockgray) is primarily used for year-round extensive sheep grazing. The central area (Marbrack) is grazed by sheep year-round and cattle during the summer months. The eastern area (Furmiston) is grazed by sheep year-round.

A6.2.1.14 Sheep and cattle grazing, along with artificial drainage and burning, have significantly influenced the vegetation present over many decades. Habitats with the proposed Development Area are primarily comprised of rush pasture, semi-improved neutral and acid grasslands, a range of modified blanket bog and wet heath communities of varying degrees of grazing / management impact.

A6.2.1.15 There are also several small spruce-dominated plantations used as shelter for stock, located across the Proposed Development Area, and a much older copse of mature conifer and broadleaved species at the eastern edge of the Proposed Development Area. The eastern edge of the Proposed Development Area borders an extensive area of commercial conifer plantation.

Summary of Relevant Legislation

A6.2.1.16 Table 6.2.1 provides a summary of the legislation protecting the various species considered in this assessment. Further detail is provided in Technical Appendix 6.5 (Outline Species Protection Plans).

A6.2.1.17 The information provided here is primarily derived from the SNH website [www.nature.scot]. The original legislation should be referred to for definitive guidance.

Table 6.2.1: Summary of the Conservation Status of Protected Species relevant to the Proposed Development Area and Current Status at the Site-level

Species / Taxon	Key Legislation	Summary of Relevant Protections
Badger	Protection of Badgers Act (1992)[i]	Badgers and their setts are fully protected.
Bats (all native species)	Habitats Regulations 1994, Schedule 2 (as amended)[ii]	All wild native bat species and their roosts are fully protected.
Otter	Habitats Regulations 1994, Schedule 2 (as amended)[ii]	Otters and their breeding sties and resting places are fully protected.
Pine marten	Wildlife and Countryside 1981, as amended (Schedule 5)[iii]	Pine martens and any structure or place which they use for shelter or protection are legally protected.

Species / Taxon	Key Legislation	Summary of Relevant Protections
Red squirrel	Wildlife and Countryside 1981, as amended (Schedule 5)[iii]	Red squirrels and any structure or place which they use for shelter or protection are legally protected.
Water vole	Wildlife and Countryside 1981, as amended (Schedule 5)[iii]	Water vole is partially protected in Scotland. Water vole burrows are protected from damage, destruction, obstruction and disturbance when a water vole is occupying a burrow.
Great crested newt	Habitats Regulations 1994, Schedule 2 (as amended)[ii]	Great crested newts and their supporting habitats, including resting places and breeding ponds are protected.
Freshwater pearl mussel	Wildlife and Countryside 1981, as amended (Schedule 5)[iii]	Freshwater pearl mussels are protected as is their habitat.

i. The Protection of Badgers Act 1992 protects badgers from taking, injuring, killing, cruel treatment, selling, possessing, marking and having their setts interfered with, subject to certain exceptions.

ii. The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Schedule 2 - European protected species (EPS) of animals. It is an offence to capture, injure, kill an EPS, harass or disturb an EPS while occupying a structure or place used for shelter or protection, disturb while it is rearing or otherwise caring for its young, obstruct access to a breeding site or resting place, or otherwise deny and EPS or group of EPS use of a breeding site or resting place.

iii. The Wildlife & Countryside Act 1981 (as amended in Scotland). Specially protected bird species listed on Schedule 1, non-avian fauna on Schedules 5 and 6 and flora on Schedule 8.

International & National Conservation Status

A6.2.1.18 Table 6.2.2 provides a summary of the conservation designations and the national population status applicable to each of the protected species considered in this study. Further information and discussion on local status and the potential effects of the proposed development are provided in Chapter 6.

Table 6.2.2: Summary of the Conservation Status of Protected Species Relevant to the Proposed Development Area

Species / Taxon	International Conservation Designations	National Conservation Status & Designations
Badger	• Bern Convention Appendix 3[i]	• IUCN Red List criteria 'Least Concern', Scotland [ii] • Not currently of conservation concern but remain vulnerable to human persecution and cruelty.
Bats (all native species)	• EC Habitats Directive Annex IV [iii] • Bern Convention Appendices 2 & 3[i] • Convention on Migratory Species Appendix 2 & EUROBATS Annex I [iv]	• Current UK assessment – 'Favourable' (applies to all established species in Scotland with the exception of Nathusius' pipistrelle which is 'Unknown')[v] o IUCN Red List status for Scotland [ii] : o Daubenton's bat - 'Least Concern' o Natterer's bat - 'Least Concern' o Leisler's bat - 'Near Threatened' o Noctule - 'Least Concern' o Common pipistrelle - 'Least Concern' o Soprano pipistrelle - 'Least Concern' o Nathusius' pipistrelle - 'Vulnerable' o Brown long-eared bat - 'Least Concern' • UK BAP Priority Species [vi] • Scottish Biodiversity List [vii]
Otter	• EC Habitats Directive Annex II & IV [iii] • Bern Convention Appendix 2[i]	• Conservation Status, Scotland: 'Favourable' [v] • IUCN Red List criteria 'Least Concern', Scotland ii • UK BAP Priority Species [vi] • Scottish Biodiversity List [vii] • Following major declines between the 1950s and the 1970s and the species has recovered across Scotland.
Pine marten	• EC Habitats Directive Annex V [iii] • Bern Convention Appendix 3[i]	• IUCN Red List criteria 'Least Concern', Scotland ii • Conservation Status, Scotland: 'Favourable' [v] • UK BAP Priority Species [vi] • Scottish Biodiversity List [vii] • Was once found throughout Britain, suffered dramatic declines during 19th century. Since legal protection came into force in the 1980s the population has made a significant recovery with an expansion south and eastwards from the core areas in the northwest Highlands.
Red squirrel	• Bern Convention Appendix 3[iii]	• IUCN Red List criteria 'Near Threatened', Scotland [ii] • UK BAP Priority Species [vi] • Scottish Biodiversity List [vii] • Long-term decline in population size and range in the UK, strongholds
Water vole	• n/a	• Current UK-wide assessment - Not assessed [v] • IUCN Red List status - 'Near Threatened' (Scotland) [ii] • Very large declines in population size and in distribution in the UK and Scotland in the 1980s and 1990s, without recovery. Due to habitat loss/change and predation by American mink (*Neovison vison*).
Great crested newt	• Habitats Directive Annex IV [iii]	• UK BAP Priority Species [vi] • Scottish Biodiversity List [vii] • The species has suffered significant declines and is under threat in several European countries.
Freshwater pearl mussel	• EC Habitats Directive Annex V [iii]	• UK BAP Priority Species [vi] • Scottish Biodiversity List [vii] • Critically Endangered in Europe • Scotland supports internationally important populations, however, there have been dramatic declines due to a combination of human

Species / Taxon	International Conservation Designations	National Conservation Status & Designations
		exploitation, habitat damage and poor water quality.

i. *The Bern Convention on the Conservation of European Wildlife and Natural Habitats (or Bern Convention), is a binding international legal instrument in Europe. The Convention came into force on 1 June 1982. Appendix II - Strictly protected fauna species. Appendix III - Protected fauna species. Appendix IV - Prohibited means and methods of killing, capture and other forms of exploitation.*

ii. International Union for Conservation of Nature (2001). IUCN Red List Categories and Criteria: Version 3.1. IUCN, Gland and Cambridge: IUCN Species Survival Commission, As reported in: Mathews, F., Kubasiewicz, L.M., Gurnell, J., Harrower, C.A., McDonald, R.A., Shore, R.F. (2018). A Review of the Population and Conservation Status of British Mammals. A report by the Mammal Society under contract to Natural England, Natural Resources Wales and Scottish Natural Heritage. Natural England, Peterborough. ISBN 978-1-78354-494-3.

iii. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Adopted in 1992. Annex II species: core areas of their habitat are designated as sites of Community importance and included in the Natura 2000 network. Annex IV species: a strict protection regime must be applied across their entire natural range within the EU, both within and outside Natura 2000 sites. Annex V species: Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favourable conservation status.

iv. The Convention on the Conservation of Migratory Species of Wild Animals, also known as the Convention on Migratory Species (CMS) or the Bonn Convention, is an international agreement that aims to conserve migratory species within their migratory ranges. The Agreement was signed in 1979 in Bonn, Germany. The Agreement on the Conservation of Populations of European Bats (EUROBATS) was established under the CMS and came into force in 1994.

v. UK Conservation Status is derived from the 3rd UK Habitats Directive Report (JNCC, 2013). This report considered the conservation status of all terrestrial and marine species listed under Annexes II, IV and V of the EC Habitats Directive present within the UK.

vi. The UK List of Priority Species and Habitats was published in 2007 after adoption by the Governments of all four UK administrations as part of the UK contribution to the Convention on Biological Diversity (1992). The 'UK Post-2010 Biodiversity Framework' succeeded the UK BAP in 2012 and set out the strategy for England, Wales, Scotland and Northern Ireland, and the UK as a whole, to meet internationally agreed biodiversity targets. However, the 2007 UK BAP priority species and habitats remain relevant in the nature conservation / biodiversity policies.

vii. The Scottish Biodiversity List is a list of flora, fauna and habitats considered by the Scottish Ministers to be of principal importance for biodiversity conservation. The publication of the Scottish Biodiversity List satisfies the requirements of Section 2(4) of The Nature Conservation (Scotland) Act 2004.

A6.2.2 METHODS

Desk Study

A6.2.2.1 The desk study extended to an area up to c. 5 km from the Proposed Development Area boundary, as illustrated on Figure 6.3. The main aim of the desk study was to obtain information regarding statutory and non-statutory natural heritage designations, from various online sources, as well request details of any existing records of protected and notable fauna from a range of sources. An initial desk study was carried out in 2020 and this was updated in August 2021.

A6.2.2.2 Details of international and national designated sites, such as Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs), were obtained through SNH's Sitelink website [www.gateway.snh.gov.uk/] and associated GIS (Geographic Information System) data made publicly available by NatureScot.

A6.2.2.3 The websites of Dumfries & Galloway Council [https://www.dumgal.gov.uk] and Scottish Wildlife Trust [www.scottishwildlifetrust.org.uk] were searched for details of any Wildlife Sites, Local Biodiversity Sites, Local Nature Conservation Sites, Local Nature Reserves etc. within the wider desk study area.

A6.2.2.4 Records of protected and notable fauna were requested from the following organisations:

- Scottish Badgers; and
- South-West Scotland Environmental Information Centre (collate information from a wide range of recorders).

A6.2.2.5 In addition, the National Biodiversity Network (NBN) Atlas online database [https://nbnatlas.org/] was also searched for records of notable species within the desk survey area (NB only those records which were listed as open access for commercial use, or where there was permission from the original data provider, were downloaded from the NBN Atlas website).

Survey Scope

A6.2.2.6 The baseline surveys encompassed all of the Proposed Development Area (i.e. including all proposed wind turbines, borrow pits, access tracks and associated temporary and permanent works) and appropriate buffer zones. The protected species survey covered all suitable habitats within at least 250 m of the Proposed Development, as shown on Figure 6.1.

A6.2.2.7 Surveys for key protected fauna considered likely to occur within the survey area, based on current distribution in Scotland and the presence of suitable habitat, were carried out in September 2020, with update surveys between May to September 2021.

A6.2.2.8 Surveys were completed for badger, bats, otter, red squirrel and water vole, with a habitat suitability survey for great crested newt carried out at all waterbodies within the survey area. Specific surveys for reptiles were not carried out, although any observations relevant to the species were recorded during other surveys. A survey for freshwater pearl mussel was completed by GFT. All fieldwork was completed by suitably experienced surveyors, working under protected species survey licences from NatureScot as required.

A6.2.2.9 Handheld Global Positioning Systems (GPS) were used to record the locations of important features, such as animal shelters, field signs or sightings. The accuracy of the GPS recordings was approximately +/-6 m, although this would be compromised under closed plantation canopy.

A6.2.2.10 The survey methodology for each species or taxonomic group is summarised below.

Badger

A6.2.2.11 All suitable habitats for badger, where accessible, within the survey area were searched for evidence of the presence of this species. Optimal habitat includes a mixture of mature deciduous or mixed woodland or scrub near to pasture or arable fields with the presence of well-drained easily dug soil for sett excavation.

A6.2.2.12 Field signs of badger are described in Harris *et al*. (1989)[1], Neal & Cheeseman (1996)[2] and Bang & Dahlstrøm (2001)[3]. Field signs include hair caught on barbed wire fences, conspicuous trails, footprints, small pits or latrines in which droppings are deposited, scratch marks on trees and snuffle holes (scrapes where badgers have searched for insects, plant tubers etc.), bedding and setts. All field signs encountered were carefully mapped and described. On the basis of the evidence, a description and assessment of the current use of the area by badgers was made and, if possible the type of setts found were provisionally categorised using standardised criteria.

A6.2.2.13 Setts were assessed for the current level of use and the number of entrance holes recorded, as well as the number of active holes. Where possible, each sett was provisionally classified into one of four types: main, annex, subsidiary and outlier, following the general definitions outlined below:

[1] Harris, S., and Yalden, D. W. (eds.) (2008). *Mammals of the British Isles: Handbook, 4th Edition*. The Mammal Society, Southampton.

[2] Neal, E. & Cheeseman, C. (1996). *Badgers.* T & A D Poyser Ltd, London.

[3] Bang, P. and Dahlstrom, P. (2001). *Animal Tracks and Signs*. Oxford University Press, Oxford.

- **Main**: These are large, well-established setts, normally in continuous use, multiple entrances often linked by clear paths (NB in parts of Scotland main setts can have single holes). Each social group will use only one main sett and this will form the most likely location for the raising of cubs;
- **Annex**: These setts are usually found in close association with a main sett (i.e. within 50 m), have several entrances, occupied for most / all of the year, also used for breeding often connected to the main sett by a well-worn path;
- **Subsidiary**: Subsidiary setts will usually have no more than five holes, although not all of these will be in continuous use, may be used for breeding, and are located further from the main sett than an annex and paths between the subsidiary and main sett may be less distinct; and
- **Outlier**: These setts are used on an occasional basis by a single badger as a temporary refuge, and will usually consist of a single hole.

A6.2.2.14 Factors such as the distance between adjacent setts, any connectivity between setts such as obvious pathways, the number of holes in adjacent setts and also the levels of activity were all considered and used to classify the setts, following the guidelines set out by Andrews (2013)[4]. However, it is important to recognise that there are limitations to sett classification based on walkover survey results alone. In some cases, it may be necessary to carry out more detailed surveys in order to more reliably establish the current status of any particular sett.

Bats

A6.2.2.15 All potentially suitable trees and structures within the survey area, where safely accessible, were assessed for their potential to support roosting bats, broadly following methodologies and rating systems described in Hundt (2012)[5], Collins (2016)[6] and the JNCC Bat Workers' Manual (Mitchell-Jones & McLeish 2004)[7].

A6.2.2.16 Individual trees, or groups of trees, with features that were considered to provide opportunities for roosting bats were systematically graded for their suitability, following the qualitative ratings set out in Table 6.2.1. The grading of trees was undertaken conservatively, noting any constraints to the survey which may prevent full inspection or assessment of the tree, such as the presence of dense foliage obscuring visibility to high branches and upper sections of the trunk. This cautious approach minimises the risk of potentially suitable trees being dismissed as having low suitability or no potential for bats.

Table 6.2.1: Stage 1 Bat Roost Assessment Categories for Trees

Category	Description
Confirmed or suspected roost	Tree supporting or suspected of supporting a bat roost. Identified through sighting / hearing bats, presence of fresh droppings / staining, scratch marks, bat fly pupae.
High	Trees with multiple, highly suitable features capable of supporting larger roosts.
Moderate	Trees with definite bat potential, supporting fewer features than High category trees or with potential for use by low numbers of bats.
Low	Tree with no obvious potential, although the tree size is of age that elevated surveys may result in cracks and crevices being found; or the tree supports some features which may have limited potential to support single bats.
No potential	Tree with no potential to support bats.

A6.2.2.17 Any trees that were considered to have a moderate or greater roost potential were inspected in detail for any evidence of use by bats. This includes the presence of droppings, staining and scratch marks at roost entrances. Bats may also be heard within occupied roosts, particularly during warm summer days. Depending on the outcome of the inspection then follow-up surveys to confirm the presence of bats (or their likely absence) and if present to characterise the roost site in terms of the species present, number, location of access points and type of roost (e.g. transitional roost, maternity roost, night roost) may be completed. Such surveys followed the methods detailed in Collins (2016)[6] and involve monitoring the tree or structure at dusk and pre-dawn periods, at the appropriate time of year, to record bats exiting or entering.

Otter

A6.2.2.18 All accessible watercourses within the survey area were searched for evidence of the presence of otter. Signs indicating presence of otter are described in Bang and Dahlstrøm (2001)[3] and Sargent & Morris (2003)[8]. Otter field signs include spraints, footprints, feeding remains, holts and couches. Spraints tend to be found secreted on rocks, protruding above the water level, within a river. Footprints are generally found on the bank, in soft mud/sand. Holts tend to be in the bank (or on islands) hidden by dense cover or underground, these can sometimes be identified by the presence of spraints, trails and slides towards the water. As they are often located in dense cover or inaccessible locations and not occupied year-round, underground holts can be difficult to locate. Otter couches are generally more frequently encountered within an occupied otter territory than underground holt sites, although they may be more transitory.

A6.2.2.19 The survey methodology used involved walking banksides (where safe to do so) both up and down stream (on both sides) within the survey area, recording any signs of otter encountered, taking a GPS reading, photographs and marking the location of any signs on a map. Any locations which had the potential to be used as a resting site (e.g. couch, lie-up or holt) were carefully inspected and recorded and any evidence of use recorded.

Pine marten

A6.2.2.20 A general assessment of habitat quality of the survey area was completed, along with a search for evidence of the presence of pine marten and potentially suitable den sites.

A6.2.2.21 Useful field signs for pine marten are prints and scats. The number of scats recorded is not a reliable indicator of the number of pine martens present in the area but does give an indication of relative levels of activity. Certain feeding remains may also be a good indicator of pine marten presence. Good quality prints can be identified as pine marten, although partial or indistinct prints cannot be relied upon. As scats are very variable in colour, size and shape it can be difficult to accurately assign them to species without taking samples and carrying out DNA analysis (i.e. there is potential for confusion with scats from other similarly-sized mammalian carnivores).

A6.2.2.22 It is also important to recognise that depending on a number of factors (e.g. time of year, density of the population) pine marten may not leave scats in obvious locations as territorial markers. Consequently, the absence of such evidence, in areas with suitable habitat and within the distributional range of the species, should not be ruled out as being used by pine marten on that basis alone.

Red Squirrel

A6.2.2.23 Suitable habitat for red squirrel includes mature woodland with pine (*Pinus* sp.) and spruce (*Picea* sp.) trees as well as deciduous species such as alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*), birch (*Betula* sp.), rowan (*Sorbus aucuparia*) and willow (*Salix* sp.) which have small seeds that provide a suitable food supply for red squirrel.

[4] Andrews, R. (2013). The Classification of Badger Meles meles Setts in the UK: a Review in Guidance for Surveyors. Chartered Institute of Ecology and Environmental Management (CIEEM) In Practice magazine, December 2013.

[5] Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines* (2nd Edition). Bat Conservation Trust, London.

[6] Collins, J. (ed.) (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn).* The Bat Conservation Trust, London.

[7] Mitchell-Jones, A.J, & McLeish, A.P. (ed.) (2004). *3rd Edition Bat Workers' Manual*, JNCC, Peterborough.

[8] Sargent, G. and Morris, P. (2003). How to Find and Identify Mammals. The Mammal Society, London.

A6.2.2.24 The survey methodology for red squirrel followed that outlined by Gurnell *et al.* (2009)[9]. Areas of woodland were classified according to the tree species, composition, age class and aspect. All signs of red squirrel presence, such as animal sightings, feeding remains and drey sites were searched for and recorded (Bang & Dahlstrøm 2001)[3]. Signs of the presence of red squirrel include dreys in trees, particularly conifers, as well as feeding remains (e.g. stripped conifer tree cones) under trees.

A6.2.2.25 It is not possible to reliably distinguish between field signs of the native red squirrel and invasive non-native grey squirrel (*Sciurus carolinensis*). Both species are known to be present in the study area. Therefore, on a precautionary basis, any dreys or feeding remains in suitable habitat were assumed to be evidence of the presence of red squirrels and were recorded as such.

Water Vole

A6.2.2.26 A water vole survey was carried out following the method detailed in Strachan *et al.* (2011)[10]. This involved a thorough inspection of all watercourses and other suitable habitats, such as rush-dominated flushes and areas of wet grassland, for water vole field signs such as burrows, feeding areas, latrines, prints and runways through the vegetation within the survey area.

A6.2.2.27 All signs of water vole presence were recorded. These include:

- Faeces: typically 8-12 cm long, cylindrical in cross-section, colour may vary from green to brown, soft when fresh, hard with concentric rings when dry;
- Latrines: piles of faeces at discrete locations, established and maintained from February to November;
- Feeding stations: food is consumed at favoured locations along runs on bank edge, food remains are left as neat pile of vegetation in sections approximately 10 cm long;
- Burrows: typically located in bank sides, entrance approximately 4-8 cm wide;
- Lawns: grazed areas located round burrow entrances, often created by nursing females;
- Nests: cylindrical nest woven into the base or rushes or sedges, can be as large as a rugby ball;
- Footprints: four toes in star arrangement with outer toes splayed, hind foot between 26-34 mm; and
- Runways: found within 2 m of water edge, pathway 5-9 cm wide, leading to water's edge, burrow or feeding area.

A6.2.2.28 A hand-held GPS was used to accurately record the location of each water vole feature or the limits of field evidence where there were extensive signs.

Great Crested Newt

A6.2.2.29 Great crested newts favour medium-sized ponds (50-250 m^2) for breeding, particularly those without fish and with a mosaic of dense aquatic vegetation for egg laying and more open, non-vegetated areas where courtship can take place. They do not necessarily require permanent ponds. The species is more likely to be present in areas of suitable terrestrial habitat that is well connected to several suitable ponds.

A6.2.2.30 A great crested newt Habitat Suitability Index (HSI) assessment (following the method detailed in Oldham *et al*. 2000[11] and ARG 2010[12]) was undertaken for each waterbody within the survey area. This assessment was carried out to determine the likelihood of great crested newt populations being present and using the waterbody as a breeding site. For the HSI assessment, ten parameters, including location, waterbody area, suitability and extent of aquatic / marginal vegetation, water quality etc. are determined (ARG 2010)[12]. The various scores for each parameter are combined to give an overall suitability index or rating. The index ranges between <0.5 (poor) to >0.8 (excellent). For all ponds rated greater than 'poor', water samples were taken in the spring for environmental DNA analysis following the methods set out in Biggs *et al*. 2014[13].

Freshwater Pearl Mussel

A6.2.2.31 The Freshwater pearl mussel (FWPM) survey targeted suitable habitat within the study area (e.g. clean, coarse sand, usually found in pockets behind stable cobbles or boulders) and involved the use of bathyscopes to search for the presence of FWPM following the methods described by Young *et al.* (2003)[14]. NatureScot, who issue FWPM licenses to trained and approved surveyors, recommend this method in Scotland. The surveys were completed by two experienced surveyors working under GFTs' FWPM survey license.

A6.2.3 RESULTS

Study Limitations

A6.2.3.1 Due to the COVID-19 pandemic there was inevitably some impact on fieldwork during 2020, particularly during April. However, working safely and lawfully within the Scottish Government restrictions and guidance, it was possible to achieve sufficient survey effort during 2020 without significantly affecting on the accuracy of the survey results.

A6.2.3.2 The baseline data collated to inform the assessment are considered to accurately represent the key habitats and species and is sufficiently detailed and concurrent to allow a realistic assessments of feature sensitivity for the EIA. Where there is uncertainty, a precautionary approach has been taken in order to avoid under-estimating feature sensitivity or potential effects from the Proposed Development.

Desk Study Records

A6.2.3.3 Records of protected and/or notable species within and up to 5 km from the Proposed Development Area boundary were requested from various data providers. Records with location details at a spatial resolution greater than hectad scale (i.e. <10 x 10 km square on GB OS Grid) the relevant locations are shown on Figure 6.3.

A6.2.3.4 It is important to note that the absence of records of any species from a study area does not mean that the species is not present. Many species of conservation concern are under-recorded and not systematically monitored across the country. If there is suitable habitat present and the site is within the geographic distribution of the species it should be assumed likely to be present unless sufficient survey effort has been expended to conclude otherwise.

A6.2.3.5 A summary of the desk study findings with respect to protected species is provided in Table 6.2.2 below with the locations of non-confidential records shown on Figure 6.3, further details are provided in Appendix 1 to this document. Sensitive records relating to species that are at risk from human disturbance, persecution or exploitation have been fully considered in this assessment and are detailed in a separate Confidential Annex to this Chapter.

[9] Gurnell, J., Lurz, P. W. W., McDonald, R. and, Pepper, H., (2009). Practical techniques for surveying and monitoring squirrels. Forestry Commission Technical Note, FCPN011.

[10] Strachan, R., Moorhouse, T. and Gelling, M. (2011). Water Vole Conservation Handbook. Wildlife Conservation Research Unit, University of Oxford, Oxford.

[11] Oldham R. S., Keeble, J., Swan, M. J. S. and Jeffcote, M. (2000). Evaluating the suitability of habitat for the great crested newt (Triturus cristatus). Herpetological Journal 10(4), 143-155.

[12] Amphibian and Reptile Groups of the United Kingdom Advice Note 5: Great Crested Newt Habitat Suitability Index (May 2010).

[13] Biggs, J., Ewald, N., Valentini, A., Gaboriaud, C., Griffiths, R.A., Foster, J., Wilkinson, J., Arnett, A., Williams, P. & Dunn, F. (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. Defra Project WC1067. Freshwater Habitats Trust: Oxford.

[14] Young, M. R., Hastie, L. C., & Cooksley, S. L. (2003). Monitoring the freshwater pearl mussel: Margaritifera margaritifera. English Nature.

Table 6.2.2: Protected Species Records within Desk Study Area (source: SWSEIC)

Ref.	Record	Years	Location	Location Relative to the Proposed Development
1-57	Various records from bat detector surveys including Bat species (1); Myotis species (13); Leisler's bat (9); Noctule (3); Pipistrelle species (9); Common pipistrelle (11); Soprano pipistrelle (11);	2016-18	Along the minor road to the east of Marscalloch Hill	c. 1-2 km east of the Proposed Development
58-59	Badger: road casualty and sighting of an individual	2006, 2018	West of Carsphairn along the A713	c. 1 km west of the Proposed Development
60-62	Adder (*Vipera berus*): three sightings of individuals	2005	Carsphairn, Bridge at Carminnows; Kendoon Loch, by Deugh Dam	1-5 km west and south of the Proposed Development

A6.2.3.6 The 'Saving Scotland's Red Squirrels' website, most recently checked in August 2021, had no records of red squirrel within the Proposed Development area, however the are several records along the corridor of the B729. There are very few records of grey squirrel for this general area.

A6.2.3.7 Searches of the NBN Atlas (www.nbnatlas.org[15]), most recently completed in August 2021, revealed no recent records for the Proposed Development (i.e. within the past 25 years) of any nationally notable flora or fauna (i.e. species whose populations, under a range of definitions, are considered to be of conservation concern at a national or international level and/or species that for various reasons receive special legal protection).

A6.2.3.8 It is important to note that the absence of such records does not mean that a species is not present. Where there is suitable habitat, and the Proposed Development is located within its distributional range, the absence of observations may simply be due to under-recording. Additionally, the location details for some records are only reported at the hectad scale (i.e. 10x10km square, based on the OS National Grid system) and therefore could potentially apply to the Proposed Development.

A6.2.3.9 During baseline surveys for the original Quantans Hill wind farm evidence of the presence of several protected species was recorded. The survey area for that proposal included most of the area of the current Proposed Development. The key findings, with respect to protected species, are summarised below.

- Otter and water vole surveys were completed during September/October 2010[16] and again in October 2013[17]. These surveys failed to find any confirmed otter laying-up sites although signs otter presence were found (e.g. fresh spraints and prints) on the Benloch Burn, Polhay Burn and Marbrack Burn as well as some tributary burns. No signs of water vole were recorded within the survey area although it was noted that the site offers potentially suitable habitat for this species.
- A badger survey was completed in April 2010[16]. No signs of badger activity were recorded, and the majority of the site was considered to be unsuitable for badger to construct setts (i.e. too waterlogged). Some potentially suitable habitat was identified associated with the areas of plantation woodland, however no evidence of badger was found in these areas.
- Bat activity surveys were completed by Entec between May and September 2010 using a combination of transects and static automated monitoring[18]. No confirmed bat roosts were identified within the site, however, soprano and common pipistrelle roosts, including a soprano pipistrelle maternity roost, were identified at the Marbrack Farm buildings, located close to the southern Proposed Development boundary. The surveys recorded generally low levels of foraging and commuting activity, primarily by soprano pipistrelle and common pipistrelle. A smaller number of passes by Myotis species and noctule were also recorded. Entec concluded that only low numbers of noctule, which is at relatively high risk of mortality from wind farms, are using the site as an occasional feeding area or commuting route to more productive feeding areas elsewhere.
- Further bat activity surveys were completed from two meteorological masts between 2011 and 2013[19]. Two met masts were erected at Quantans Hill in October 2011 and a bat detector was deployed on each one. A microphone was placed at 75 m above ground level and one at ground level. Data was collected from October 2011 to April 2013. Five taxa of bats were recorded at the met masts: noctule, common pipistrelle, soprano pipistrelle, *Myotis* spp. and brown long-eared bat. Noctule was the only 'high-risk species' recorded and only on two occasions. The passes were not close to sunset and it was therefore considered unlikely that the activity was related to noctule bats that may be roosting in the near-by area. Bat activity was only recorded at the west met mast in three of the months that were surveyed and bat activity in those months was low. There was more activity at the East met mast, but the level of activity was still considered to be low. At both masts there were records of common and soprano pipistrelle close to sunset suggesting a roost site close to the Proposed Development.
- A specific survey for red squirrel and pine marten was not undertaken as part of the baseline ecology surveys for the previous Quantans Hill wind farm proposal. However, it was noted in the 2011 report[16] that the conifer plantations within the Proposed Development are very small and isolated and therefore provide poor habitat for red squirrel. No evidence of the presence of pine marten was noted and no potentially suitable denning habitat was recorded.
- No reptiles were seen during the 2010 protected species and habitat surveys[16]. Suitable reptile habitat was noted to be present across most of the Proposed Development in the form of purple moor-grass vegetation, which is tussock forming, providing suitable habitat for common lizard (*Zootoca vivipara*).
- A survey of habitat suitability and presence/absence of great crested newt was completed in 2012 as part of the baseline surveys to inform the assessment of the original Quantans Hill wind farm proposal. A number of potentially suitable ponds were identified but there was no evidence of the presence of a great crested newt population at any of these locations[20].

A6.2.3.10 The baseline ecology survey for the previous wind farm proposal also identified the presence of suitable habitat for salmonid fish species along the Marbrack and Benloch Burns, including potentially suitable spawning gravels[16]. The tributaries of these watercourses were considered to be generally unsuitable being too shallow or with stagnant water or having long sections that were overgrown by bankside grasses.

A6.2.3.11 No information was obtained through the desk studies or through the EIA scoping process to indicate that there were populations of freshwater pearl mussel (*Margaritifera margaritifera*) in watercourses within or adjacent to the Proposed Development that could be affected by the Proposed Development. FWPM is a protected and critically endangered species due to the rapid decline within, and extirpations from, various catchments in recent decades primarily because of commercial exploitation. FWPM colonies are also particularly vulnerable to the effects of water pollution, including siltation arising from construction works. They are also sensitive to declines in salmonid

[15] Only those records which were listed as open access for commercial use, or where there was permission from the original data provider, were downloaded from the NBN Atlas website and considered in this study.

[16] Entec (2011). Quantans Hill Wind Farm Baseline Ecology Survey Report

[17] Amec (2013). Quantans Hill Wind Farm Otter and Water Vole Survey Report.

[18] Entec (2011). Quantans Hill Wind Farm Bat Survey Report.

[19] Amec (2013). Quantans Hill Wind Farm Bat Surveys at the Met Masts – Survey Report.

[20] Amec (2012). Quantans Hill Proposed Wind Farm – Habitat Suitability Index and Great Crested Newt Survey.

populations, which are their preferred larval-stage host. A survey for this species was completed in June 2021 the results of which are discussed below.

A6.2.3.12 Scottish Badgers provided records one outlier sett and two setts of unknown status within the study area, as well as records of five road casualties. None of these locations were within or near to the Proposed Development boundary. The desk study records relating to badger is included in a Confidential Annex to Chapter 6.

Survey Results

A6.2.3.13 Protected species surveys were initially undertaken in September 2020 and updated between May to September 2021 to ensure that the baseline data was current and that there was sufficient coverage of the Proposed Development following the completion of most of the design process. The non-confidential results of the protected species surveys are outlined below, with key locations shown on Figure 6.6. Records from the survey relating to badger are provided in a separate Confidential Annex to this Chapter.

Badger

A6.2.3.14 Evidence of badger activity was recorded in two locations within the survey area which are outside of the Proposed Development Area. Most habitats within the Proposed Development area are sub-optimal for this species and not suitable for sett excavation. Due to the risk of human persecution to this species the results of the badger survey are provided in a separate Confidential Annex to Chapter 6.

Bats

A6.2.3.15 The exposed upland parts of the survey area are considered to be of low overall habitat quality for bats in comparison to the lower-lying areas of sheltered mature woodland, riparian habitats and farmland to the south of the Proposed Development Area. However, some areas and features within the Proposed Development Area were considered likely to provide comparatively good foraging habitat and suitable commuting routes for a range of bat species. This included the conifer plantation edges, the main watercourses / riparian zones and areas of sheltered damp marshy grassland.

A6.2.3.16 Most of the small, isolated conifer-dominated woodlands offered poor roosting habitat for bats. The trees were of a uniform height and age and were generally lacking in suitable features that could support a bat roost. However, a small copse located on the south-facing slope of Furmiston Craig, which is a mixed, long-established, plantation, did have some standing deadwood and live trees with potentially suitable roost features (e.g. woodpecker holes, bark slabs, knot holes, splits and crevices associated with old tear-outs). This copse is located c. 200 m east from the proposed location of turbine 14 (see Figure 6.6). The results from automated monitoring of bat activity in 2020 and 2021 near to this location indicated that a bat roost may be present in the general area (which can be inferred by comparing the timing of bat activity relative to sun-set and the peak roost emergence times of different bat species). Monitoring of bat activity within the copse during 2020 showed a concentration of activity by common pipistrelle (*Pipistrellus pipistrellus*) before the peak dusk emergence period indicating that there may be a roost close by.

A6.2.3.17 The various farm buildings and private houses near to the southern end of the Proposed Development have the potential to provide a wide range of potential roosting opportunities for pipistrelle bats. The farm buildings at Marbrack were confirmed to support roosting pipistrelle bats during surveys in 2010. These buildings were not inspected or assessed in any detail for potential bat roost features as they were sufficiently separate to the proposed wind turbine locations that the risk of appreciable impact on any roosts associated with these buildings would be negligible.

Otter

A6.2.3.18 There is suitable habitat for otter within the survey area, particularly along sections of the Benloch Burn and Marbrack Burn, including several potentially suitable resting site features (i.e. bankside lie-ups). No evidence of recent otter activity was noted during surveys completed in 2020 and 2021. However, old spraints were found, particularly along the banks of the Marbrack Burn. There were records of five possible resting sites, along the Marbrack Burn on the eastern side of the survey area (see Figure 6.6). Three of these related to the undercut banks of the watercourse, with two further features relating to voids created by boulders situated close to the bank. Additionally, there were eight records of old spraints relating to this burn.

A6.2.3.19 There are brown trout populations present, in most of the larger watercourses draining the Proposed Development, which can provide an attractive prey source for otter. Otters may also move across dry land and hunt away from watercourses, for example, when foraging for amphibians at small pools in moorland areas during the spring. It is possible that the larger watercourses are located within the wider territory of one or two otters that forage within the Proposed Development only occasionally.

Pine Marten

A6.2.3.20 No evidence of pine marten or any potentially suitable denning opportunities were recorded during baseline surveys or the desk study. The even-aged, densely planted small Sitka spruce dominated blocks that would be affected by the Proposed Development lack suitable denning opportunities. Overall habitat suitability is poor for this species. The more extensive conifer plantations in the wider area (to the east) may provide more suitable habitat for this species.

Red Squirrel

A6.2.3.21 No evidence of the presence of red squirrel was found within any of the small woodland areas in the main survey area. Overall habitat suitability within the survey area was relatively poor for red squirrel. The conifer plantation areas are small, isolated and consisted primarily of uniform stands of even-aged, thicket and pole-stage Sitka spruce trees. Habitat quality was therefore relatively poor in terms its extent, tree species and canopy diversity.

Water Vole

A6.2.3.22 Despite the presence of extensive suitable habitat, no evidence of the presence of water vole was recorded within the survey area. A number of burns and channels appear to provide good quality habitat for the species, in terms of burrowing opportunities, food availability and shelter. However, the levels of poaching by livestock have potentially reduced the likelihood of the species being present and there are no known populations present in the wider area that could recolonise the Proposed Development.

Other Mammals

A6.2.3.23 Brown hare (*Lepus europaeus*) were observed within the survey area on several occasions. Roe deer are also present within the general area, particularly associated with the conifer plantation area to the east and mixed woodland to the south of the Proposed Development area. There was evidence of fox (*Vulpes vulpes*) across much of the Proposed Development, particularly on the open moorland and beside forest edges to the east, where several individuals were seen on several occasions apparently hunting for small mammals and ground-nesting birds.

A6.2.3.24 In the central part of the Proposed Development, on semi-improved pasture near to the course of the Marbrack Burn, there was evidence of foraging by wild boar (*Sus scrofa*). There is a population present in the area, associated with the extensive conifer planation to the east of the Proposed Development, one of two known feral breeding populations in Dumfries and Galloway. The native wild boar became extinct in Great Britain in the 17th century. However, feral breeding populations have become established following the escape of captive animals from wild boar farms and wildlife parks.

A6.2.3.25 Evidence of the presence of short-tailed field vole (*Microtus agrestis*) and possibly also bank vole (*Myodes glareolus*) populations within the marshy grassland areas was found during the water vole survey, with runs, burrows and droppings all recorded.

Great Crested Newt

A6.2.3.26 There are several small ponds within the Proposed Development, none of which would be at risk of any direct impact from the Proposed Development. Outside of the breeding season GCN occupy suitable terrestrial habitats away from their breeding ponds and are at risk from construction works affecting those habitats. Each of the ponds were assessed for their potential to support breeding GCN. One pond was considered to have moderate suitability (see TN 18, Figure 6.6), the other ponds within the survey area were assessed as being poor/unsuitable for this species. This was primarily due to the low presence, or absence. of suitable aquatic macrophytes for egg laying, absence of standing water or the marginal / aquatic plant species indicating acidic conditions. Water samples from the one pond with moderate suitability, taken in May 2021, were tested for GCN environmental DNA (eDNA) and returned a negative result.

Reptiles

A6.2.3.27 A formal survey for reptiles was not undertaken. The Proposed Development is within the distributional range of adder, common lizard and slow worm and there is some suitable habitat for all three species present. There were four common lizard sightings within the survey area, with records spread across the open moorland parts of the Proposed Development. There was also a single record of an adder, with an individual observed by derelict dry-stone wall to the west of Big Loskie.

A6.2.3.28 Several potential reptile refugia / hibernacula features were also recorded in suitable habitat (see Figure 6.6), these included drystone walls, various old sheep stells and cairns.

Freshwater Pearl Mussel

A6.2.3.29 The freshwater pearl mussel is an endangered bivalve mollusc that has been in decline for the last century due to a combination of human exploitation and water pollution, particularly sediment accumulation in river-bed gravels, reducing oxygen supply to juvenile mussels. It is a very long-lived species, with a generation period of 30 years, and many remaining colonies are non-recruiting with no juvenile mussels entering the adult breeding population[21].

A6.2.3.30 FWPM act as an indicator species and have an important role in ecosystems, including particle processing, nutrient release, and sediment mixing. However, this important species is on the brink of extinction, with Scotland being one of the last remaining European strongholds.

A6.2.3.31 The FWPM surveys were undertaken by GFT in June 2021 with survey locations selected based on an assessment of habitat suitability during previous electrofishing and fish habitat surveys. Presence/absence surveys for FWPM were undertaken to determine sensitivity of the surveyed sites to construction works.

A6.2.3.32 A total of six sites were surveyed. Within the Proposed Development area, the Benloch Burn and Marbrack Burn had the most suitable habitat to support FWPM populations. No FWPM were found at the time of survey for any of the six sites surveyed, including the Benloch Burn and Marbrack Burn (the full report is provided as Appendix 3 to this document).

[21] Moorkens, E., Cordeiro, J., Seddon, M.B., von Proschwitz, T. & Woolnough, D. (2017). Margaritifera margaritifera (errata version published in 2018). The IUCN Red List of Threatened Species 2017. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T12799A508865.en.

APPENDIX 1: DESK STUDY RECORDS

A6.2.3.33 This appendix provides details of non-confidential notable and/or protected fauna records collated during the desk study.

A6.2.3.34 Details of any sensitive records, relating to species at risk due to their rarity and/or a history of human persecution / exploitation (including records that the rights holder has provided on condition that the information is only included in a Confidential Annex) are provided in a separate Confidential Annex to Chapter 6 of the EIAR.

Table A1.1: Non-confidential protected species records provided by SWSEIC for the study area (locations are shown on Figure 6.3)

ID	Scientific Name	Common Name	Date	Location	Grid Reference	Type	Source
1	Chiroptera	Bats	24/10/2018	Craigengillan South	NX63659465	None	Biological Records Centre
2	Myotis	Unidentified Bat	11/08/2016	NX6290	NX6208990283	detector	BTO
3	Myotis	Unidentified Bat	09/08/2016	NX6495	NX6435195623	detector	BTO
4	Myotis	Unidentified Bat	09/08/2016	NX6496	NX6452096374	detector	BTO
5	Myotis	Unidentified Bat	12/08/2016	NX6592	NX6555292174	detector	BTO
6	Myotis mystacinus/ brandtii	Whiskered/ Brandt's Bat	09/08/2016	NX6396	NX6359496009	detector	BTO
7	Myotis mystacinus/ brandtii	Whiskered/ Brandt's Bat	11/08/2016	NX6290	NX6208990283	detector	BTO
8	Myotis mystacinus/ brandtii	Whiskered/ Brandt's Bat	09/08/2016	NX6495	NX6435195623	detector	BTO
9	Myotis daubentonii	Daubenton's Bat	14/08/2016	NX5987	NX5902987453	detector	BTO
10	Myotis nattereri	Natterer's Bat	09/08/2016	NX6392	NX6312992463	detector	BTO
11	Myotis nattereri	Natterer's Bat	11/08/2016	NX6393	NX6320593669	detector	BTO
12	Myotis nattereri	Natterer's Bat	09/08/2016	NX6396	NX6359496009	detector	BTO
13	Myotis nattereri	Natterer's Bat	11/08/2016	NX6597	NX6541997347	detector	BTO
14	Myotis nattereri	Natterer's Bat	11/08/2016	NX6290	NX6208990283	detector	BTO
15	Nyctalus leisleri	Lesser Noctule	22/07/2016	NS6307	NS6326907299	detector	BTO
16	Nyctalus leisleri	Lesser Noctule	19/07/2016	NS6306	NS6326806415	detector	BTO
17	Nyctalus leisleri	Lesser Noctule	20/07/2016	NS6306	NS6326406369	detector	BTO
18	Nyctalus leisleri	Lesser Noctule	14/08/2016	NX5884	NX5886984556	detector	BTO
19	Nyctalus leisleri	Lesser Noctule	14/08/2016	NX5486	NX5483386364	detector	BTO
20	Nyctalus leisleri	Lesser Noctule	14/08/2016	NX5987	NX5902987453	detector	BTO
21	Nyctalus leisleri	Lesser Noctule	14/08/2016	NX6083	NX6089183614	detector	BTO
22	Nyctalus leisleri	Lesser Noctule	13/08/2016	NX6485	NX6436085589	detector	BTO
23	Nyctalus leisleri	Lesser Noctule	11/08/2016	NX6597	NX6541997347	detector	BTO
24	Nyctalus noctula	Noctule Bat	14/08/2016	NX5884	NX5886984556	detector	BTO
25	Nyctalus noctula	Noctule Bat	09/08/2016	NX6496	NX6452096374	detector	BTO
26	Nyctalus noctula	Noctule Bat	14/08/2016	NX6083	NX6089183614	detector	BTO
27	Pipistrellus	Pipistrelle Bat species	11/08/2016	NX6597	NX6541997347	detector	BTO
28	Pipistrellus	Pipistrelle Bat species	09/08/2016	NX6495	NX6435195623	detector	BTO
29	Pipistrellus	Pipistrelle Bat species	09/08/2016	NX6496	NX6452096374	detector	BTO
30	Pipistrellus	Pipistrelle Bat species	11/08/2016	NX6393	NX6320593669	detector	BTO
31	Pipistrellus	Pipistrelle Bat species	11/08/2016	NX6290	NX6208990283	detector	BTO
32	Pipistrellus	Pipistrelle Bat species	12/08/2016	NX6592	NX6555292174	detector	BTO
33	Pipistrellus	Pipistrelle Bat species	09/08/2016	NX6396	NX6359496009	detector	BTO
34	Pipistrellus	Pipistrelle Bat species	11/08/2016	NX6291	NX6257691195	detector	BTO
35	Pipistrellus	Pipistrelle Bat species	09/08/2016	NX6392	NX6312992463	detector	BTO
36	Pipistrellus pipistrellus	Common Pipistrelle	15/08/2016	NX5888	NX5824788107	detector	BTO
37	Pipistrellus pipistrellus	Common Pipistrelle	14/08/2016	NX5987	NX5902987453	detector	BTO
38	Pipistrellus pipistrellus	Common Pipistrelle	09/08/2016	NX6392	NX6312992463	detector	BTO
39	Pipistrellus pipistrellus	Common Pipistrelle	11/08/2016	NX6290	NX6208990283	detector	BTO
40	Pipistrellus pipistrellus	Common Pipistrelle	11/08/2016	NX6393	NX6320593669	detector	BTO
41	Pipistrellus pipistrellus	Common Pipistrelle	09/08/2016	NX6396	NX6359496009	detector	BTO
42	Pipistrellus pipistrellus	Common Pipistrelle	09/08/2016	NX6495	NX6435195623	detector	BTO
43	Pipistrellus pipistrellus	Common Pipistrelle	09/08/2016	NX6496	NX6452096374	detector	BTO
44	Pipistrellus pipistrellus	Common Pipistrelle	11/08/2016	NX6291	NX6257691195	detector	BTO
45	Pipistrellus pipistrellus	Common Pipistrelle	11/08/2016	NX6597	NX6541997347	detector	BTO
46	Pipistrellus pipistrellus	Common Pipistrelle	23/04/2019	Sensitive. Lat long is approximate.	NX5987	N/A	Biological Records Centre
47	Pipistrellus pygmaeus	Soprano Pipistrelle	27/07/2016	Kendoon, St John's Town of Dalry	NX6049387638	Roost	SNH
48	Pipistrellus pygmaeus	Soprano Pipistrelle	11/08/2016	NX6291	NX6257691195	detector	BTO
49	Pipistrellus pygmaeus	Soprano Pipistrelle	11/08/2016	NX6597	NX6541997347	detector	BTO
50	Pipistrellus pygmaeus	Soprano Pipistrelle	11/08/2016	NX6290	NX6208990283	detector	BTO
51	Pipistrellus pygmaeus	Soprano Pipistrelle	15/08/2016	NX5888	NX5824788107	detector	BTO
52	Pipistrellus pygmaeus	Soprano Pipistrelle	14/08/2016	NX5987	NX5902987453	detector	BTO
53	Pipistrellus pygmaeus	Soprano Pipistrelle	11/08/2016	NX6393	NX6320593669	detector	BTO
54	Pipistrellus pygmaeus	Soprano Pipistrelle	09/08/2016	NX6396	NX6359496009	detector	BTO
55	Pipistrellus pygmaeus	Soprano Pipistrelle	09/08/2016	NX6495	NX6435195623	detector	BTO
56	Pipistrellus pygmaeus	Soprano Pipistrelle	12/08/2016	NX6592	NX6555292174	detector	BTO
57	Pipistrellus pygmaeus	Soprano Pipistrelle	09/08/2016	NX6496	NX6452096374	detector	BTO
58	Meles meles	Eurasian Badger	28/03/2006	Carsphairn	NX573926	N/A	SWSEIC
59	Meles meles	Eurasian Badger	21/05/2018	Sensitive. Lat long is approximate.	NX5594	N/A	Biological Records Centre
60	Vipera berus	Adder	2005	Carsphairn.	NX561932	N/A	SWSEIC
61	Vipera berus	Adder	July 2005	Kendoon Loch. Bridge at Carminnows	NX608909	dead on road	SWSEIC
62	Vipera berus	Adder	July 2005	Kendoon Loch. By Deugh Dam	NX605907	N/A	SWSEIC

Table A1.2: Bat records from the NBN Atlas (produced in compliance with the relevant Data Licence)

Rights holder [i]	Scientific Name	Common Name	Date	OSGR	Lat.	Lon.	Individual count
SNH	Chiroptera	Bat	21/11/1997	NX5693	55.21	-4.26	
BCT	*Pipistrellus pipistrellus*	Common pipistrelle	23/04/2019	NX5987	55.16181	-4.20694	
SNH	*Pipistrellus*	Pipistrelle sp.	30/07/1996	NX6087	55.16	-4.19	
SNH	*Pipistrellus pygmaeus*	Soprano pipistrelle	27/07/2016	NX6087	55.16	-4.19	630+

i. SNH = Scottish Natural Heritage (now NatureScot); BCT = Bat Conservation Trust

Table A1.3: Non-confidential notable fauna records provided by SWSEIC

Scientific Name	Common Name	Date	Location	Grid Ref.	Provider / Rights Holder [i]	Status [ii]
Hilaira nubigena	Spider (Araneae)	07/06/2019	Moorbrock Hill, The Glenkens: summit plateau	NX619980	SWSEIC	RLGB.VU
Ellescus bipunctatus	Insect - beetle (Coleoptera)	23/05/1989	Near Carsphairn	NX584926	SNH (Newton Stewart)	Nb
Hydroporus longulus	Insect - beetle (Coleoptera)	07/06/2019	Moorbrock Hill, The Glenkens: pool 1.	NX617977	SWSEIC	
Prolita sexpunctella	Six-spot Groundling	17/06/2014	Cairnsmore of Carsphairn	NX594976	County Moth Recorder	Nb
Boloria selene	Small Pearl-bordered Fritillary	25/07/1985	South of Carsphain, Carminnows Bridge	NX608918	Butterfly Conservation	RLGB.Lr(NT)
Boloria selene	Small Pearl-bordered Fritillary	25/07/1985	South of Carsphain	NX601916	Butterfly Conservation	RLGB.Lr(NT)
Boloria selene	Small Pearl-bordered Fritillary	28/06/1986	Carminnows Bridge, Carsphain	NX608918	Butterfly Conservation	RLGB.Lr(NT)
Catoptria furcatellus	Northern Grass-veneer	17/06/2014	Cairnsmore of Carsphairn	NX594977	County Moth Recorder	Nb
Catoptria furcatellus	Northern Grass-veneer	17/06/2014	Beninner, Carsphairn	NX604969	County Moth Recorder	Nb
Catoptria furcatellus	Northern Grass-veneer	17/06/2014	Beninner, Carsphairn	NX606971	County Moth Recorder	Nb
Zootoca vivipara	Common Lizard	04/08/2014	Cairnsmore of Carsphairn.	NX591977	SWSEIC	
Vipera berus	Adder	2005	Carsphairn.	NX561932	SWSEIC	
Vipera berus	Adder	July 2005	Kendoon Loch. Bridge at Carminnows	NX608909	SWSEIC	
Vipera berus	Adder	July 2005	Kendoon Loch. By Deugh Dam	NX605907	SWSEIC	
Erinaceus europaeus	West European Hedgehog	18/08/2006	Carsphairn	NX562932	SWSEIC	RLGB.VU
Erinaceus europaeus	West European Hedgehog	11/08/2014	A712	NX5693	SWSEIC	RLGB.VU
Sciurus carolinensis	Eastern Grey Squirrel	01/09/2009	Carsphairn	NX568930	SWT	
Sciurus carolinensis	Eastern Grey Squirrel	13/07/2015	Carsphairn DG73TF, United Kingdom	NX568932	SWT	
Sciurus carolinensis	Eastern Grey Squirrel	28/08/2015	Carsphairn, United Kingdom	NX563932	SWT	
Sciurus carolinensis	Eastern Grey Squirrel	07/06/2016	Carsphairn, Castle Douglas, Dumfries and Galloway DG7 3TE, UK	NX594922	SWT	
Sciurus carolinensis	Eastern Grey Squirrel	07/06/2016	Carsphairn, Castle Douglas, Dumfries and Galloway DG7 3TE, UK	NX594922	SWT	
Sciurus vulgaris	Eurasian Red Squirrel	03/06/2008	Moorbrock Hill, The Glenkens: summit plateau	NX565935	SWT	RLGB.EN
Sciurus vulgaris	Eurasian Red Squirrel	19/10/2013	Near Carsphairn	NX601917	SWSEIC	RLGB.EN
Sciurus vulgaris	Eurasian Red Squirrel	24/09/2014	Moorbrock Hill, The Glenkens: pool 1.	NX601915	SWT	RLGB.EN
Sciurus vulgaris	Eurasian Red Squirrel	04/09/2017	Cairnsmore of Carsphairn	NX563932	SWT	RLGB.EN
Sciurus vulgaris	Eurasian Red Squirrel	24/09/2017	South of Carsphain, Carminnows Bridge	NX562933	SWT	RLGB.EN
Lepus europaeus	Brown Hare	06/05/2014	Cairnsmore of Carsphairn	NX6090	BTO	

i. SWSEIC = South-West Scotland Environmental Information Centre; SNH Scottish Natural Heritage (now known as NatureScot); SWT = Scottish Wildlife Trust; BTO = British Trust for Ornithology

ii. ***N*** *= Nationally Notable Species which are estimated to occur within the range of 16 to 100 10km squares (subdivision into Notable A and Notable B is not always possible because there may be insufficient information available). Superseded by Nationally Scarce, and therefore no longer in use.*
Na *= Nationally Notable A Taxa which do not fall within RDB categories but which are none-the-less uncommon in Great Britain and thought to occur in 30 or fewer 10km squares of the National Grid or, for less well-recorded groups, within seven or fewer vice-counties. Superseded by Nationally Scarce, and therefore no longer in use.*
Nb *= Nationally Notable B Taxa which do not fall within RDB categories but which are none-the-less uncommon in Great Britain and thought to occur in between 31 and 100 10km squares of the National Grid or, for less-well recorded groups between eight and twenty vice-counties. Superseded by Nationally Scarce, and therefore no longer in use.*
NR-excludes *= Nationally Rare. Excludes Red Listed taxa Nationally Rare - Occurring in 15 or fewer hectads in Great Britain. Excludes rare species qualifying under the main IUCN criteria.*
NS-excludes *= Nationally Scarce. Excludes Red Listed taxa Nationally Scarce - Occurring in 16-100 hectads in Great Britain. Excludes rare species qualifying under the main IUCN criteria.*
RLGB.Lr(NT) *= IUCN (2001) - Lower risk - near threatened Taxa which do not qualify for Lower Risk (conservation dependent), but which are close to qualifying for Vulnerable. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable.*

APPENDIX 2: TARGET NOTES FROM THE PROTECTED SPECIES SURVEYS

A6.2.3.35 This appendix provides the non-confidential records from the protected species surveys completed between September 2020 and September 2021. The relevant locations are shown on Figure 6.6.

A6.2.3.36 Details of badger sett locations recorded during the surveys are provided in a separate Confidential Annex to Chapter 6 of the EIAR.

Table A2.1: Protected species target notes

TN Ref.	Easting	Northing	Date	Species / Taxa	Sign / Feature	Notes
1	258434	594898	10/08/20	Reptile	Common lizard	Common lizard sighting.
2	258764	594677	10/08/20	Reptile	Common lizard	Common lizard sighting.
3	258615	594079	11/08/20	Mammal	Fox sighting	Fox seen running towards small forestry block.
4	260715	594708	12/08/20	Mammal	Fox sighting	Fox on north side of T-shaped forestry block.
5	260628	593035	13/08/20	Bat	Potential roost (tree)	Small copse of mature trees (mixed broadleaved and coniferous) east of Little Loskie. Some standing deadwood and trees with cracks and broken limbs with bat roost potential.
6	260406	593271	14/08/20	Reptile	Adder sighting	Adder sighting on edge of bog habitat next to ruined stone wall west of Big Loskie.
7	260057	594192	11/08/20	Reptile	Common lizard	Common lizard sighting.
8			11/08/20	Badger	Latrine	Fresh badger latrine in woodland.
9			11/08/20	Badger	Main sett - active	Badger sett comprising six active holes.
10	260181	594099	12/08/20	Mammal	Digging	Wild boar rooting in grassland.
11	260203	593997	12/08/20	Mammal	Digging	Wild boar rooting in grassland adjacent to river.
12	260221	593972	12/08/20	Mammal	Digging	Wild boar rooting in grassland adjacent to river.
13	261409	594762	13/08/20	Reptile	Common lizard sighting	Common lizard.
14	261614	594677	13/08/20	Mammal	Fox sighting	Fox sighted on edge of plantation.
15	259309	595349	19/09/20	Mammal	Holes	Large mammal hole, possibly fox; no sign of badger.
16	259550	592854	06/08/20	Mammal	Brown hare	Sighting.
17	257998	594924	08/06/21	Great crested newt	Unsuitable pond	Small pond, c. 12 x 5m, isolated, lacking aquatic macrophytes, *Juncus* sp. at margins, *Sphagnum* cover indicates acidic conditions. Poor suitability for GCN, eDNA water sample not taken.
18	257876	594353	08/06/21	Great crested newt	Suitable pond	Medium sized pond, c. 35 x 15m, on edge of large area of blanket peat, dominant aquatic plants are horsetail sp., water appears dark and peaty. Moderate suitability for CGN. Precautionary sample taken for eDNA analysis.
19	258158	594286	08/06/21	Great crested newt	Unsuitable pond	Small seasonal pond, c. 5 x 10m, mud only, no open water at time of the survey, surrounded by pole stage conifers in shelterbelt planting. Not suitable for CGN, no sample taken.
20	261092	593990	13/06/21	Great crested newt	Unsuitable pond	Small, isolated, seasonally inundated area, dry at the time of survey. Not suitable.
21	260506	594821	13/06/21	Reptile	Potential hibernacula	Old sheiling, located in suitable habitat, potential reptile refugia / hibernacula.
22	257729	595450	15/07/21	Reptile	Potential hibernacula	Old sheep stell, located in suitable habitat, potential reptile refugia / hibernacula.
23			08/06/21	Badger	Sett - active	Possible outlier, single hole.
24	261011	593918	21/07/21	Mammal	Holes	Single hole, possibly a fox earth; no evidence of use by badger.
25	260602	594120	12/07/21	Otter	Spraint	Old sprainting site, scattered sun-bleached fish bones on large boulder in stream.
26	260756	594146	12/07/21	Otter	Spraint	Old sprainting site, sun bleached, fish bones on large boulder in stream.
27	260997	594494	12/07/21	Otter	Spraint	Old spraint on boulder in stream.
28	260999	594496	12/07/21	Otter	Resting site - potential	Potential lie-up, undercut bank behind boulder pile at stream edge. No evidence of recent use.
29	261026	594579	12/07/21	Otter	Spraint	Old spraint, scattered fish bones on large boulder in stream.
30	261096	594684	12/07/21	Otter	Spraint	Old spraint on small boulder at stream edge.
31	261105	594691	12/07/21	Otter	Spraint	Old spraint on small boulder at stream edge.
32	261123	594705	12/07/2021	Otter	Spraint	Old spraint on small boulder at stream edge.
33	261174	594771	12/07/21	Otter	Spraint	Old spraint, scattered fish bones on large boulder in stream.

TN Ref.	Easting	Northing	Date	Species / Taxa	Sign / Feature	Notes
34	261209	594802	12/07/21	Otter	Resting site - potential	Potential lie-up, undercut bank at stream edge. No evidence of recent use.
35	260876	593673	06/08/21	Mammal	Fox sighting	
36	258672	595355	16/07/21	Otter	Resting site - potential	Potential holt, large boulder on stream edge creating a potentially suitable void with the bank. No evidence of current use.
37	258222	595212	16/07/21	Otter	Resting site - potential	Potential lie-up, undercut bank behind rowan tree. No evidence of current use.
38	257284	594781	16/07/21	Otter	Resting site - potential	Potential lie-up, small void behind large boulder embedded in stream bank.
39	260837	593658	07/09/21	Great crested newt	Unsuitable pond	Small, isolated, seasonally inundated area, dominated by common spike rush (*Eleocharis palustris*), dry at the time of survey. Not suitable.

APPENDIX 3: FRESHWATER PEARL MUSSEL SURVEY

A Scottish Registered Charity
No. SC 020751

Commissioned Report No. – SBAD260821

Freshwater Pearl mussel survey for Quantans Wind Farm

For further information on this report please contact:

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This report should be quoted as:

Galloway Fisheries Trust. August 2021. Freshwater Pearl mussel survey for Quantans Wind Farm.
Galloway Fisheries Trust Report No. – SBAD260821

Summary

Freshwater Pearl mussel survey for Quantans Wind Farm

Commissioned Report No.: Report No. – SBAD260821
Contractor: MBEC
Year of publication: August 2021

Keywords

Margaritifera margaritifera; endangered; freshwater bivalve molluscs; Freshwater Pearl mussel.

Background

The Galloway Fisheries Trust (GFT) was commissioned by MBEC to carry out Freshwater Pearl mussel (*Margaritifera margaritifera*) surveys for the proposed Quantans Wind Farm (herein referred to as the 'Development'), which will lie within the Kirkcudbrightshire Dee catchment in Dumfries and Galloway.

Freshwater Pearl mussels (FWPM) are one of the most endangered bivalve molluscs worldwide. They act as an indicator species and have an important role in ecosystems, including particle processing, nutrient release, and sediment mixing. However, this important species is on the brink of extinction, with Scotland being one of the last remaining European strongholds.

The FWPM surveys were undertaken on 17th and 18th June 2021 in the Dee catchment and were selected based on previous electrofishing survey sites combined with proposed crossing points for the Development. Presence/absence surveys for FWPM were undertaken to determine sensitivity of sites to construction works.

Main findings

- A total of six sites were surveyed.
- Within the Development, the Benloch Burn and Marbrack Burn had the most suitable good quality habitat to support FWPM populations.
- No FWPM were found at the time of survey for any of the six sites surveyed, including the Benloch Burn and Marbrack Burn.

For further information on this project contact:
Name of Project Manager – S V Beck
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Table of Contents **Page**

1 INTRODUCTION

Galloway Fisheries Trust (GFT) was commissioned by MBEC to carry out Freshwater Pearl mussel (FWPM) surveys for the proposed Quantans Wind Farm. The Development is within the River Dee catchment in the South West of Scotland, which is managed by the Kirkcudbrightshire Dee District Salmon Fisheries Board (KDDSFB) and is covered by GFT.

FWPM are becoming increasingly rare, with Scotland being one of the last remaining strongholds of this iconic species. Larval FWPM, glochidia, attach to the gills of salmonids before dropping off into riverbeds to settle in sandy substrates, often between boulders and pebbles where there is clean, well-oxygenated water. As well as the decline of their host salmonid species, other factors including poor water quality, acidification, siltation, and pearl fishing contribute to their increasing rarity. Although populations still occur throughout their range, the lack of juveniles suggest such populations are no longer viable. FWPM can live up to 140 years old and have been found to mature from at least 12-13 years old (Scotland; Young & Williams, 1984). Considering such long life-history characteristics is important when assessing population viability, with presence of juveniles being an indicator of the long-term sustainability of FWPM populations as it demonstrates recent recruitment.

FWPM are filter feeders and are therefore particularly sensitive to deteriorating water quality, a factor that is often influenced by construction works through the release of siltation from ground disturbance, accelerated or exacerbated erosion of watercourse banksides, hydrological changes to watercourses and surface water run-off, pollution of watercourses, and the blocking or hindering of the upstream/downstream migration of host salmonid species. Impacts from construction works may result in death, injury or disturbance to FWPMs, as well as potentially damage, destroy or obstruct access to riverbeds supporting FWPM, all of which are considered an offence when conducted recklessly or intentionally as they are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and are listed on the EU Habitats and Species Directive (Annexes II and V) and Appendix III of the Bern Convention 1979. They are included on the IUCN Invertebrate Red List, where their status is described as Endangered. FWPM are also classified as a priority species in the UK Biodiversity Action Plan.

The FWPM surveys conducted here were undertaken in the upper Dee catchment in watercourses that drain into the Water of Deugh. The surveys were undertaken on sunny days during low water levels to ensure maximum visibility. A total of six sites were chosen based on previous electrofishing surveys as well as proposed crossing points for the Development.

2 AIMS

The aims of this work were as follows:

2.1 To undertake FWPM surveys at six sites within the boundary of the Quantans Wind Farm Development on the Kirkcudbrightshire Dee catchment.

2.2 To analyse and present results from the surveys in report form, reporting presence/absence of FWPM.

3 METHODOLOGY

3.1 Data recording

A total of six FWPM surveys were undertaken on 17th and 18th June 2021 to determine presence/absence of FWPM in sites chosen from a combination of previous electrofishing surveys (Galloway Fisheries Trust, 2021) and proposed crossing points (Figure 1). The total surveyed area was 600 m (100 m upstream and 500 m downstream) for all sites where habitats were deemed suitable to support FWPM. In habitats that were less suitable for FWPM, surveyed area was reduced to 150 m (50 m upstream and 100 m downstream). Two control sites were included to match previous electrofishing surveys (C.1 and C.2 in Figure 1), as well as to determine the presence of FWPM further downstream where barriers do not impede salmonid migration and where FWPM would likely be found if they occurred in this region of the Dee catchment (site C.2 in Figure 1).

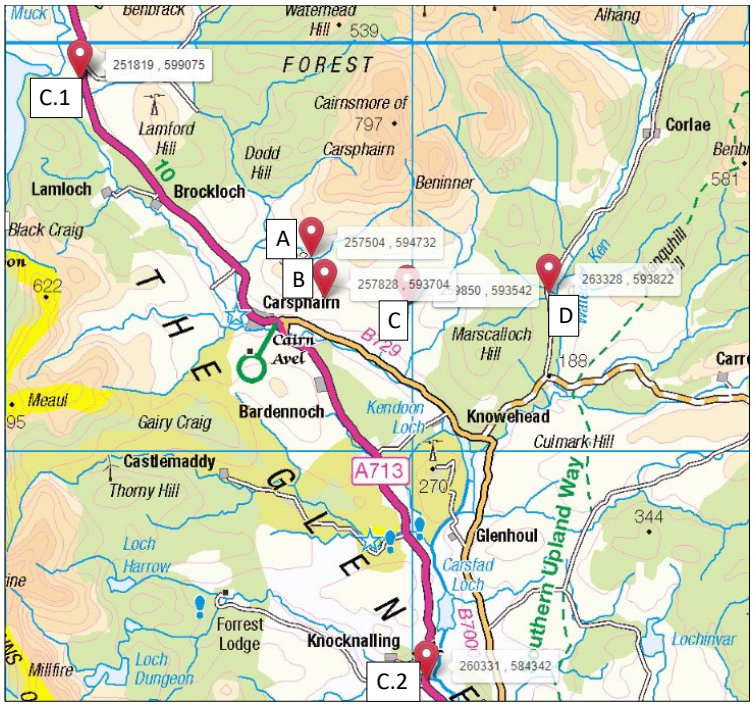

Figure 1: Six FWPM survey sites: two sites acted as controls (C.1, C.2) whilst the remaining four sites (A:D) lie within Quantans Wind Farm Development. Grid references are also shown for each site.

The surveys looked for the presence of FWPM as described by Young *et al.,* (2003). NatureScot, who issue FWPM licenses to trained and approved surveyors, recommend this method of surveying for FWPM in Scotland. The surveys were completed by two trained GFT surveyors under GFTs' FWPM license. Bathyscopes were used to target suitable habitats, e.g. clean, coarse sand, usually found in pockets behind stable cobbles or boulders (Figure 2).

Figure 2: GFT staff surveying for FWPM using a bathyscope

4 RESULTS

4.1 FWPM surveys

Three of six survey sites were deemed less suitable for FWPM and therefore the surveyed area was reduced to 50 m upstream and 100 m downstream. Details of each site and associated photos can be found below.

4.1.1 A: Benloch Burn

A total of 600 m was surveyed for this burn: 500 m downstream of NX 57330 94744 and 100 m upstream. No FWPM were found (Figure 3).

Figure 3: Site photos for Benloch Burn (site A)

4.1.2 B: Knockgray Burn

A total of 150 m was surveyed for FWPM at this site: 100 m downstream of NX 57828 593704 and 50 m upstream. No FWPM were present at this site (Figure 4).

Figure 4: Site photos for Knockgray Burn (site B)

4.1.3 C: Marbrack Burn

A total of 600 m was surveyed for this burn: 500 m downstream of NX 59850 93542 (just upstream of the confluence between Marbrack Burn and Polhay Burn) and 100 m upstream. No FWPM were found (Figure 5).

Figure 5: Site photos for Marbrack Burn (site C)

4.1.4 D: Craigengillan Burn

This burn was surveyed 100 m upstream of NX 63328 93822 and ~200 m downstream to where the Craigengillan Burn joins the Water of Ken. No FWPM were found at this site (Figure 6).

Figure 6: Site photos for Craigengillan Burn (site D)

4.1.5 C.1: Polharrow Burn

The survey started at NX 60324 84358 and continued 600 m upstream as site was not accessible downstream where it joins the Water of Ken. Although suitable habitat was present for FWPM, no FWPM were found (Figure 7).

Figure 7: Site photos for control site C.1 on the Polharrow Burn

4.1.6 C.2: Meadowhead Burn

A total of 150 m was surveyed for FWPM at this site: 100 m downstream of NX 51916 99139 and 50 m upstream (through the culvert). No FWPM were present at this site (Figure 8).

Figure 8: Site photos for control site C.2 on the Meadowhead Burn

5 DISCUSSION

A total of six sites were surveyed for freshwater pearl mussels (FWPM) on the proposed Quantans Wind Farm Development in the upper Kirkcudbrightshire River Dee catchment area. The Marbrack Burn and Benloch Burn had suitable good quality habitat to support FWPM populations but none were found. No FWPM or evidence of FWPM (e.g. shells) were found during these surveys.

6 REFERENCES

Baglinière, J.-L., Marchand, F., & Vauclin, V. (2005). Interannual changes in recruitment of the Atlantic salmon (*Salmo salar*) population in the River Oir (Lower Normandy, France): Relationships with spawners and in-stream habitat. *ICES Journal of Marine Science*, *62*(4), 695–707.

Galloway Fisheries Trust (2021). *Fisheries electrofishing survey for Quantans Wind Farm* (No. SBAD191120).

Young, M. R., Hastie, L. C., & Cooksley, S. L. (2003). *Monitoring the freshwater pearl mussel: Margaritifera margaritifera*. English Nature.

Young, M., & Williams, J. (1984). The reproductive biology of the freshwater pearl mussel *Margaritifera margaritifera* (Linn.) in Scotland. I: Field studies. *Archive Für Hydrobiologie*, *99*(4), 405–422.

VATTENFALL

Document history

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Contact	Matt Bacon
Client Name	Vattenfall Wind Power Ltd

Issue	Date	Revision Details
A1	16/11/2021	Issued for review
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Appendix 6.3

Bat Activity Survey Results

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.3.1 INTRODUCTION

Purpose of this Document

A6.3.1.1 This is a technical appendix to Chapter 6 (Ecology & Biodiversity) of the Quantans Hill Wind Farm (the 'Proposed Development') Environmental Impact Assessment Report (EIAR).

A6.3.1.2 This document provides the results of the bat activity surveys completed by MBEC between June 2020 and October 2021. These results have been fully considered within the assessment as detailed within Chapter 6 of the EIAR.

Background

A6.3.1.3 MBEC was appointed by Vattenfall in 2020 to carry out a suite of ecological surveys to inform the design and impact assessment of the Proposed Development. The surveys were to include sampling of bat activity, recorded from static detectors, following guidance on baseline bat activity surveys for onshore wind farm EIA (e.g. Hundt *et al*. 2012, NatureScot *et al*. 2019).

A6.3.1.4 The purpose of the surveys was to determine species present within the proposed wind farm area, the extent and level of activity and habitat associations. This information was to inform the wind farm design process and to provide the baseline data to assess the potential impact of the proposed wind farm on bat populations (e.g. the risk of mortality from the operating wind turbines[1], habitat loss and fragmentation effects) and the need for appropriate mitigation.

A6.3.1.5 Desk study results confirmed that the following bat species were likely to be present in the region and could exploit suitable habitats within the study area:

- Common pipistrelle (*Pipistrellus pipistrellus*);
- Soprano pipistrelle (*P. pygmaeus*);
- Nathusius' pipistrelle (*P. nathusii*);
- Brown long-eared bat (*Plecotus auritus*);
- Natterer's bat (*Myotis nattereri*);
- Daubenton's bat (*M. daubentonii*);
- Whiskered bat (*M. mystacinus*);
- Leisler's bat (*Nyctalus leisleri*); and
- Noctule (*N. noctula*)

A6.3.1.6 Bat species adapted to fly in open, less cluttered air-space (i.e. away from vegetation) are considered to be most vulnerable to wind turbine mortality. Of the species listed above, noctule, Leisler's bat and Nathusius' pipistrelle are considered at high risk from wind turbine collisions and the bat populations of these species are vulnerable to the effects of additional mortality from wind turbines (NatureScot *et al*. 2019). Common and soprano pipistrelle also are considered to be at high risk from wind turbine mortality due to their behaviour and flight capabilities (i.e. being able to exploit open habitats and potentially hunting for insects within the height band that wind turbines could be operating within), see Table 6.3.1.

Table 6.3.1 Level of potential vulnerability of populations of Scottish bat species (adapted from Wray *et al*. 2010)

	Collision Risk		
	Low collision risk	**Medium collision risk**	**High collision risk**
Common species			Common pipistrelle Soprano pipistrelle
Rarer species	Brown long-eared bat Daubenton's bat Natterer's bat		
Rarest species	Whiskered bat Brandt's bat		Nathusius' pipistrelle Noctule bat Leisler's bat

No border = Low population vulnerability; narrow border = medium population vulnerability; heavy border = high population vulnerability

A6.3.1.7 The Proposed Development is located within a region of Scotland where all the species listed in the High collision risk category in Table 6.3.1 are known to occur.

A6.3.1.8 Common and soprano pipistrelle are relatively common and widespread resident species in mainland Scotland. Leisler's bat is a relatively rare species in Scotland, the current range is restricted to the south-west of the country (Newson *et al*. 2017). Leisler's bat is adapted to fast, direct flight in open environments. It is thought to fly at lower heights than the closely related noctule. The noctule is believed to have a wider distribution in Scotland than Leisler's bat but is restricted to areas south of the Central Belt. Both species are considered to be at high risk of wind turbine mortality (NatureScot *et al*. 2019). Nathusius' pipistrelle is a rare species in Scotland with the nearest known maternity roost sites located in Northern Ireland. This species is migratory in Europe and has been recorded making long-distance movements between breeding and wintering areas. In the UK most records of the species are from bat detector surveys in the late summer / autumn migratory period, indicating migration to and from Europe.

A6.3.1.9 An extensive survey of bat activity across Southern Scotland by species considered to be at high risk of impacts from onshore wind farm development (i.e. noctule, Leisler's bat and Nathusius' pipistrelle) was completed in 2016 (Newson *et al*. 2017). Based on the data collected, spatial modelling analysis, at the 1 km^2 scale, was completed to assist decision making for future wind farm development. Newson *et al*. produced maps showing the most potentially sensitive areas (the top 1%, 5% and 10% 1km squares for each species). The Proposed Development is not located within the areas identified by that study to be highly sensitive for these species.

Site Description and Habitat Quality

A6.3.1.10 The Site is in Dumfries & Galloway, towards the northern end of the historic county of Kirkcudbrightshire, to the northeast of the settlement of Carsphairn, on the eastern side of a wide glen that forms part of the northern end of The Glenkens. This is the valley of the Water of Ken, Loch Ken and the River Dee, an extensive topographical feature that passes in an approximate northwest-southeast orientation through a large section of the western Southern Uplands.

A6.3.1.11 Generally, the exposed upland parts of the survey area are considered to be of low overall habitat quality for bats in comparison to the lower-lying areas of sheltered mature woodland, riparian habitats and farmland to the south of the Proposed Development area. However, some areas and features within the Proposed Development area were considered likely to provide comparatively good foraging habitat and suitable commuting routes for a range of bat species. This included the conifer plantation edges, the main watercourses / riparian zones and areas of sheltered damp marshy grassland.

A6.3.1.12 Most of the small, isolated conifer-dominated woodlands offered poor roosting habitat for bats. The trees were of a uniform height and age and were generally lacking in suitable features that could support a bat roost. However, a small copse located on the south-facing slope of Furmiston Craig, which is a mixed, long-established, plantation, did have some standing deadwood and live trees with potentially suitable roost features (e.g. woodpecker holes, bark slabs, knot holes, splits and crevices associated with old tear-outs). This copse is located c. 200 m east from the proposed location of turbine 14 (see Figure 6.6). The results from automated monitoring of bat activity in 2020 and 2021 near to this location indicated that a bat roost may be present in the general area (which can be inferred

[1] Direct trauma from blade strike during flight is the main cause of wind farm bat mortality, however there is also the potential of death as a result of barotrauma (i.e. vortices near to turbine blades causing rapid pressure fluctuations rupturing internal structures in the body).

by comparing the timing of bat activity relative to sun-set and the peak roost emergence times of different bat species). Monitoring of bat activity within the copse during 2020 showed a concentration of activity by common and soprano pipistrelles at or before the peak dusk emergence period indicating that there may be a roost close by.

A6.3.1.13 The various farm buildings and private houses near to the southern end of the Site have the potential to provide a wide range of potential roosting opportunities for pipistrelle bats. These buildings were not inspected or assessed in any detail for potential bat roost features as they were sufficiently separate to the proposed wind turbine locations that the risk of appreciable impact on any roosts associated with these buildings would be negligible.

A6.3.1.14 In conclusion, there was no evidence from the bat surveys to indicate that the Proposed Development (i.e. the wind turbine positions) are located close to any bat roosts. However, based on the timing of bat passes relative to the peak emergence times, there may be common and/or soprano pipistrelle roosts present in the local area, potentially associated with the various buildings near to the Site or a small, isolated copse c. 200 m east of T14, which has some trees with potentially suitable roost features (see Figure 6.6).

A6.3.2 METHODS

Introduction

A6.3.2.1 A survey plan was developed in spring 2020 to systematically monitor bat activity across the proposed wind farm (based on the layout included with the EIA Scoping Report), including all representative habitat types within the proposed wind farm development area and following relevant guidance available at the time (e.g. Wray *et al*. 2010, Hundt *et al*. 2012, Natural England 2014, NatureScot *et al*. 2019).

A6.3.2.2 The objectives of the survey were to complete sufficient monitoring to determine the species using the Site (and component habitat types) during the main active period and to allow comparisons to be made between levels of bat activity in different parts of the Site and with representative data from other activity surveys completed in the wider region. Finally, to provide sufficient data to inform an assessment of risk to bat species from wind turbine mortality and the need for mitigation measures to address the potential impacts on the bat populations affected.

Automated Bat Detector Surveys

A6.3.2.3 The automated bat detector survey focused on areas within the Site where wind turbines were most likely to be located. Following current guidance, a minimum of 11 detector locations is recommended for a development of 14 wind turbines (NatureScot *et al*. 2019). Automated bat detectors (Wildlife Acoustics' SongMeter SM4-bat, referred to as 'SM4s') were deployed at 14 locations across the Site during 2020 and 4 locations during 2021 (addressing issues with equipment failure and restricted survey periods during 2020).

A6.3.2.4 The survey was designed to capture sufficient number of nights with appropriate weather conditions for bat activity (i.e. temperatures of 8°C and above at dusk, maximum ground level wind speed of 5 m/s and no, or very light rainfall). Automated detectors operated all night, commencing at least half an hour before sunset and finishing at least half an hour after sunset to ensure that bat species that emerge early and return to roosts late were recorded.

A6.3.2.5 A seasonal survey programme (i.e. that involved sampling bat activity during spring, summer and autumn) was considered to be appropriate for the Site with the potential to increase survey effort (e.g. monthly sampling) should the results indicate that the Site is of greater sensitivity that was anticipated based on the desk study and initial assessments of habitat quality. Ideally, there should be a minimum of 10 nights of survey across the survey periods (e.g. early, mid and late), i.e. 30 nights in total. However, due to Covid-19 related travel restrictions the spring period 2020 was not included in the survey. This was not considered to be a significant constraint on the validity of the data to inform the impact assessment as levels of bat activity during the spring at exposed upland sites tends to be low in comparison to the summer and early autumn periods. There is evidence from surveys in Southern Scotland that mid-August to mid-September often corresponds with a substantial seasonal peak in bat activity (NatureScot 2021), the survey effort at the Site included this period during both 2020 and 2021.

A6.3.2.6 The detectors were deployed at ground level with the ultrasonic microphones (SMX-U1 model) attached to 2m long poles in order to maximise the probability of recording bat calls and reducing the likelihood of interference (e.g. high frequency noise from insects, small mammals and from wind-blown low-lying vegetation). Monitoring at height was not included in the survey effort. There was no meteorological mast deployed at the Site to facilitate acoustic monitoring closer to turbine blade swept airspace. Monitoring at height can provide useful additional information on bat activity but it is unlikely to detect the presence of any species not already recorded using detectors at ground level except in woodland. The Proposed Development is in mostly located in open moorland habitats, although new tree plantations were established near to some of the proposed wind turbines in 2020-21. The potential implications for the tree planting to influence the use of the Site by bats in the future has been taken into consideration in the impact assessment.

A6.3.2.7 The bat activity survey effort during 2020 and 2021 is summarised in Table 6.3.2.

Table 6.3.2: Summary of Bat Activity Data (2020/2021)

Ref	Habitat	Total Detector Nights (Year)	Detector nights			
			Early Summer (Jun/Jul)	Summer (Jul/Aug)	Late Summer (Aug/Sep)	Autumn (Sep/Oct)
Q01[i]	Rush pasture, edge of conifer plantation	13 (2020)	13		0	
Q02	Blanket mire	36 (2020)	13		23	
Q03	Rough grass / heath	38 (2020)	23		15	
Q04	Rough grass / degraded mire	36 (2020)	13		23	
Q06	Rush pasture	31 (2020)	16		15	
Q08	Rough grass / rush pasture	36 (2020)	13		23	
Q09	Rush pasture, conifer copse	31 (2020)	16		15	
Q10[ii]	Rush pasture, conifer copse	16 (2020)	16		0	
		99 (2021)	18		53	28
Q11	Rush pasture, small stream	31 (2020)	16		15	
Q13a	Acid grassland, mire edge	35 (2020)		35		
Q13b[iii]	Acid grassland, mire edge	72 (2021)	20		52	0
Q14[iv]	Blanket mire / acid flush	100 (2021)	20		52	28
Q15	Blanket mire / acid flush	35 (2020)		35		
Q17	Molinia mire	35 (2020)		35		
Q19	Molinia mire	35 (2020)		35		
Q21[v]	Bracken, mire, rush pasture	35 (2020)		35		
		100 (2021)	20		52	28

i. Equipment failed; not re-surveyed in 2021 as the location was no longer relevant to the emerging wind farm layout.
ii. Equipment failed for part of the survey period; re-surveyed in 2021.
iii. Q13b is in similar location to Q13a but closer to the nearest proposed wind turbine (T12). Equipment failed for part of the survey period in 2021, although sufficient data already collected.
iv. Q14 is at the location of proposed wind turbine T13 (located between Q13b and Q21)
v. Q21 is close to the position of proposed wind turbine T14. This location was re-surveyed in 2021 due to proximity to a woodland copse with several trees that have potential bat roost features (located c. 200 m east of T14).

A6.3.2.8 The total Site-wide sampling effort was 443 detector nights in 2020 and 367 detector nights in 2021.

A6.3.2.9 Bat call sequences (also referred to as 'bat passes') were recorded by the SM4 for later computer analysis. A bat pass was defined as a sequence of echolocation calls separated from the next sequence by a minimum one second gap. Call sequences were automatically assigned to species, genus, unknown or noise files by Kaleidoscope Pro software (version 5.4.2, auto ID Bats of Europe 5.4.0). The validity of the automated species identifications was checked by manually verifying, using Bat Explorer software (version 2.1.9.1), a proportion of the common species recordings (e.g. common and soprano pipistrelle), and reviewing all of the recordings assigned to less commonly occurring species (e.g. Myotis and Nyctalus species). This process was based on professional judgement assisted by review of reference recordings and guidance on bat call identification provided in Russ (2012) and Barataud (2015).

A6.3.2.10 Nyctalus species (i.e. noctule and Leisler's bat) frequency modulated calls may show a large overlap in the key diagnostic call parameters. Although all Nyctalus passes were assigned to either noctule or Leisler's bat it is possible that some of the passes that fall within this zone of overlap were assigned to the incorrect species. Similarly, it is sometimes difficult to distinguish between the pipistrelle species calls and where this is the case some pipistrelle passes may have been misassigned. There can be a high degree of overlap in the call parameters of Myotis bats making it difficult to reliably distinguish between species so these have all been categorised as Myotis sp.

A6.3.2.11 The results of the 2020 and 2021 bat activity surveys were processed using the Ecobat online tool (www.ecobat.org.uk), which was developed by the University of Exeter (Lintott *et al*. 2019) and is run by the Mammal Society. This gives access to comparative database of bat activity survey results collected from similar areas (within 100 km of the Site) and at the same time of year (within 30 days). Ecobat generates a percentile rank (and associated confidence limits) for each night where bat activity was recorded against a reference range. Bat activity levels are divided into categories using the percentiles as follows:

- 0 – 20th percentile = low;
- 21st – 40th percentile = low to moderate;
- 41st – 60th percentile = moderate;
- 61st – 80th percentile = moderate to high; and
- 81st – 100th percentile = high

A6.3.2.12 Ecobat uses all bat records for the analysis, so does not consider "no bat nights", i.e. nights where the detectors are deployed but no bats are recorded. This reduces the potential influence of poor weather conditions on the comparative analysis. Ecobat provides a numerical way of interpreting the levels of bat activity and is currently the most objective method of assessing bat activity and relative risk to bats from wind farm development (NatureScot *et al*. 2019).

A6.3.2.13 An additional automated bat detector (Q22) was deployed at Furmiston Copse (NX 60629 93060) to monitor bat activity in relation to potential tree roosts. The copse is an isolated woodland of mixed mature trees approximately 230 m northeast of Turbine 14. The detector was deployed for 21 nights between 13/08/20 and 03/09/20. The data from this detector was not included in the general site-wide bat activity analysis which was designed to focus on the proposed wind turbine locations. For information, where indicated, the summary plots in Appendix 2 include Q22.

A6.3.2.14 An automated portable weather station was deployed on the western side of Quantans Hill (at NGR NX 58126 94969) to provide temperature, wind speed and rainfall data for the survey periods, to assist with the bat activity data interpretation.

A6.3.3 RESULTS

Study Limitations

A6.3.3.1 It is important to note the generic limitations of bat activity monitoring, particularly with respect to determining risk to bat populations from a proposed wind farm development.

A6.3.3.2 In relation to the bat detector surveys, there are limitations on the data that these types of surveys provide. For example, automated bat detectors, do not provide information on the number of bats present. It is not possible to determine if a relatively large number of separate bat passes were made by the same individual circling the detector location or by a number of bats flying past. The data they generate gives an estimate of the level of activity only. Also, there can be a wide variation in the detection rates for different species and between different detectors and microphone models.

A6.3.3.3 Data from pre-construction monitoring of bat activity at proposed wind farm sites are often relatively poor at predicting the post-construction risk to bats (Hein *et al*. 2013, Lintott *et al*. 2016, Mathews *et al*. 2016). Although this may be related to survey effort and ensuring that sufficient baseline monitoring has been carried out to accurately encompass the full range of temporal and spatial variability in bat activity through the main active period.

A6.3.3.4 Bat mortality at turbines does not appear to be the result of chance events, however, the key factors that result in wind farms and individual wind turbines posing a relatively high risk to bats are still not fully understood. Additionally, reliable information on bat population sizes is often lacking, particularly at the scale at which effects from individual wind farms need to be considered.

A6.3.3.5 It is therefore important that the interpretation of pre-construction data and in the assessment of potential impacts there is recognition of the limitations of preconstruction monitoring studies and the uncertainties about the risk to bats from individual wind farm developments.

A6.3.3.6 The Scottish Government measures to control the Covid-19 pandemic constrained travel for fieldwork during 2020, particularly during the spring/summer. This affected the number and timing of survey visits. For example, the number of data collection periods for the bat activity survey was reduced to one or two rather than three sampling periods as would ordinarily be appropriate for this Site. However, additional survey effort was completed in summer 2021 to account for this.

A6.3.3.7 The guidance applicable at the time of survey (NatureScot *et al*. 2019) recommends a minimum of 10 consecutive sampling nights per season for three seasons. At least 30 nights of survey were achieved at each location through 2020, although due to travel restrictions, these were not spread evenly across the three seasons. With the addition of 2021 survey effort, every detector location close to a proposed turbine location achieved over 30 days survey spread across at least two seasons, including early summer and late summer periods. (Note, locations Q01, Q15, Q17 and Q19 were no longer close to proposed turbine locations in 2021).

A6.3.3.8 Equipment failed at two survey locations in 2020, however the additional survey in 2021 accounts for this, where relevant to the Proposed Development layout.

A6.3.3.9 The amount of survey effort overall is considered to be sufficient to accurately determine species presence and to classify the relative levels of bat activity within the Proposed Development Are and the broad habitat types present (see Richardson *et al*. 2019).

A6.3.3.10 Low sunset temperatures (<8°C) are considered to have had a negligible influence on the quality of the data collected. There were two nights with low sunset temperatures during the 2020 and none during the 2021 survey periods.

A6.3.3.11 The Ecobat analysis compares the survey data to a reference dataset. A reference range (number of nights for each species that the data is compared to) of >200 is recommended to be confident in the Ecobat relative activity level category. For Nathusius' pipistrelle and brown long-eared bat this recommendation wasn't reached in 2020 and for Nathusius' pipistrelle in 2021. However, for species of high collision risk concern at this site (*Nyctalus* species, and common and soprano pipistrelle) the reference ranges all exceeded the 200 threshold.

Automated Bat Detector Surveys

A6.3.3.12 The results of the automated bat detector surveys are summarised in Chapter 6 of the EIAR and further detail is provided below. The full results are provided in tables within Appendix 1 to this report, with plots and charts summarising the key metrics in Appendix 2. The ECOBAT outputs are provided in Appendix 3.

A6.3.3.13 Table 6.3.3 provides a summary of the 2020 and 2021 bat activity survey results for each survey.

Table 6.3.3: Summary of Bat Activity Data (2020/2021)

Ref	Habitat	Mean bat passes/night (max passes/night) [i]						
		MYOSP	NYCLEI	NYCNOC	PIPNAT	PIPPIP	PIPPYG	PLEAUR
Q01[ii]	Rush pasture, edge of conifer plantation	2.6 (12)	1.8 (23)	1.2 (14)		48.0 (206)	20.2 (92)	0.0 (0)
Q02	Blanket mire	0.2 (1)	0.7 (6)	0.3 (3)		0.6 (5)	1.2 (8)	0.0 (0)
Q03	Rough grass / heath	0.2 (2)	0.3 (6)	0.2 (2)		1.6 (29)	1.3 (12)	0.1 (1)
Q04	Rough grass / degraded mire	0.3 (2)	1.4 (10)	0.6 (3)		2.2 (20)	3.1 (25)	0.0 (1)
Q06	Rush pasture	0.6 (4)	0.6 (6)	0.2 (2)		4.8 (47)	5.1 (54)	0.1 (2)
Q08	Rough grass / rush pasture	0.4 (3)	0.7 (6)	0.3 (2)		3.9 (26)	4.8 (40)	0.2 (1)
Q09	Rush pasture, conifer copse	0.4 (2)	2.9 (19)	0.7 (7)	0.0 (1)	7.6 (71)	11.8 (66)	0.2 (3)
Q10[iii]	Rush pasture, conifer copse	0.3 (1)	4.2 (20)	0.4 (2)	0.1 (1)	5.8 (18)	3.4 (11)	0.2 (1)
		0.9 (4)	3.5 (64)	1.4 (32)	0.0 (1)	5.6 (21)	6.2 (54)	0.4 (5)
Q11	Rush pasture, small stream	0.4 (4)	1.8 (19)	0.1 (2)	0.1 (1)	7.7 (44)	4.6 (19)	0.2 (2)
Q13a	Acid grassland, mire edge	0.0 (0)	0.4 (4)	0.4 (4)		0.7 (8)	0.6 (8)	0.0 (0)
Q13b[iv]	Acid grassland, mire edge	0.2 (3)	0.8 (8)	0.6 (4)		1.2 (11)	2.4 (25)	0.1 (3)
Q14[v]	Blanket mire / acid flush	0.9 (8)	0.5 (5)	0.6 (5)	0.0 (1)	1.3 (11)	2.8 (31)	0.1 (2)
Q15	Blanket mire / acid flush	0.0 (0)	0.4 (3)	0.2 (2)		0.7 (4)	0.7 (7)	0.0 (0)
Q17	Molinia mire	0.2 (2)	0.5 (6)	0.3 (2)		1.3 (8)	0.4 (4)	0.0 (1)
Q19	Molinia mire	0.1 (1)	0.3 (4)	0.3 (2)		0.8 (12)	0.2 (3)	0.0 (0)
Q21[vi]	Bracken, mire, rush pasture	0.3 (3)	1.4 (11)	0.2 (2)	0.0 (1)	5.5 (31)	3.1 (13)	0.1 (1)
		0.6 (4)	0.9 (14)	2.2 (55)	0.0 (1)	3.7 (29)	6.0 (34)	0.2 (2)

i. MYOSP (*Myotis* species); NYCLEI (Leisler's bat); NYCNOC (Noctule); PIPNAT (Nathusius' pipistrelle), PIPPIP (Common pipistrelle); PIPPYG (Soprano pipistrelle); PLEAUR (Brown long-eared bat).

ii. Equipment failed; not re-surveyed in 2021 as the location was no longer relevant to the emerging wind farm layout.
iii. Equipment failed for part of the survey period; re-surveyed in 2021.
iv. Q13b is in similar location to Q13a but closer to the nearest proposed wind turbine (T12).
v. Q14 is at the location of proposed wind turbine T13 (located between Q13b and Q21)
vi. Q21 is close to the position of proposed wind turbine T14. This location was re-surveyed in 2021 due to proximity to a woodland copse with several trees that have potential bat roost features (located c. 200 m east of T14).

A6.3.3.14 As anticipated, the levels of bat activity were generally comparatively lower in the more exposed open areas (such as Q02, Q03 and Q17), compared to locations near to watercourses and plantation edges/blocks. For example, activity levels were comparatively high for most taxa at Q01 in 2020 (the detector was deployed at the corner of a conifer plantation block) despite this being one of the more elevated locations within the survey area (c. 370 m AOD). Also, at sampling locations Q09, Q10 and Q11, which were also near to a small conifer plantation and/or minor watercourses.

Bat Species Recorded

A6.3.3.15 Analysis of the automated bat detector recordings indicated the presence of at least seven bat taxa in both 2020 and 2021. In order of frequency of occurrence across the 2020 data: common pipistrelle (45.6% of bat passes); soprano pipistrelle (35.9%); Leisler's bat (10.9%); Noctule (3.5%); Myotis bats (mostly likely to be Daubenton's, *Myotis daubentonii*, or Natterer's bats, *M. nattereri*) (3.4%), a small number of passes identified as brown long-eared bat (0.7%), a species that is generally under-recorded in bat detector surveys due to its low amplitude echolocation calls) and 0.1% of passes were attributed to Nathusius' pipistrelle (*P. nathusii*).

A6.3.3.16 Leisler's bat is a relatively rare species in Scotland, its conservation status is assessed as 'Near Threatened' (Mathews *et al*. 2018). The current range is restricted to the south-west of the country (Newson *et al*. 2017). The British population has been estimated at 24,000 to 40,000 and with only 250 in Scotland (Harris *et al*. 1995, JNCC 2013). However, for various reasons, there are considerable uncertainties about the accuracy of this estimate and the actual population present in Scotland is likely to be much higher, in the thousands (Newson *et al*. 2017). Leisler's bat is adapted to fast, direct flight in open environments. It is thought to fly at lower heights than the closely related noctule. The noctule is believed to have a wider distribution in Scotland than Leisler's bat but is restricted to areas south of the Central Belt. The reported Scottish population estimates for this species are the same as Leisler's bat and are also considered to be unreliable, for similar reasons to Leisler's bat (Mathews *et al*. 2018). Both species are considered to be at high risk of wind turbine mortality (NatureScot *et al*. 2019).

A6.3.3.17 Nathusius' pipistrelle is a rare species in the UK with only a handful of maternity colonies recorded to date, none of which are in Scotland, with the nearest known sites located in Northern Ireland. The species has a conservation status of Vulnerable in Scotland (Mathews *et al*. 2018). Nathusius' pipistrelle is migratory in Europe and has been recorded making long-distance movements between breeding and wintering areas. In the UK the vast majority of records of the species are from bat detector surveys in the late summer / autumn migratory period, indicating migration to and from Europe. There is evidence of bats crossing the North Sea and English Channel to and from mainland Europe and the UK. Such migratory movements are likely to be on a relatively broad front and there is no evidence to indicate that the Site is particularly important for this species or that relatively high levels of activity would be likely to occur at any time of year.

A6.3.3.18 The range of Nathusius' pipistrelle in the UK appears to have expanded in recent years, however, reliable information on current distribution and favoured migration routes is lacking. The distribution of records of the species in the UK appears to be associated with areas of freshwater, woodland, small areas of urbanization, higher minimum temperatures, and lower seasonal variation in temperature with intermediate rainfall levels (Lundy *et al*. 2010).

A6.3.3.19 Nathusius' pipistrelle, along with the common and soprano pipistrelle, are also considered to be at high risk of wind turbine mortality. Common and soprano pipistrelle are both relatively common and widespread bat species in Scotland. The Scottish common pipistrelle population has been estimated at 875,000 (range between 285,000 and 2,160,000) and soprano pipistrelle population at 1,210,000 (ranging between 512,000 to 2,180,000) as reported in Mathews *et al*. 2018).

A6.3.3.20 Detector Q22, which was monitoring for potential roost activity at Furmiston Copse, recorded elevated levels of common and soprano pipistrelle bat activity close to sunset, which could be associated with a roost site. The mean and maximum number of passes per night for *Myotis* species were 10.8 and 56 respectively. Pipistrelle activity was also higher than elsewhere on the site. Common pipistrelle recorded mean and maximum passes per night at 107 and 381, soprano pipistrelle mean and maximum passes per night were 25 and 76 respectively.

Bat Activity Relative to Weather Conditions, Season and Sunset

A6.3.3.21 The correlations between bat activity and air temperature and wind speed are summarised in Appendix 2, Figures 4 and 5. During 2020, the air temperature was recorded on a portable met station. During 2021, data from the portable met station was incomplete, so temperatures recorded from the SM4s at ground level were used, and wind speed from a weather station at Carsphairn was used. The portable met station temperatures and wind speeds are slightly below those recorded by the SM4s and the available weather records from other sources. However, these are considered to provide reasonable indicators of temperature and wind speed recorded at the met station and can be used as a proxy for weather conditions on Site.

A6.3.3.22 A positive correlation between bat activity and sunset temperature was found, particularly for the 2021 data. Peaks in bat activity corresponded with periods of warmer weather. This is to be expected due to several factors including the influence of air temperature on aerial insect abundance. It should be noted that during the 2020 survey only two survey nights (05/06/20 and 09/06/20 with temperatures of 5.1°C and 7.9°C respectively) had a sunset temperature below 8°C. On 05/06/20 the wind speed was also higher than 5 m/s, and no bats were recorded on any of the four deployed detectors. During the 2021 survey there were no nights where the sunset temperature was below 10.5°C.

A6.3.3.23 As expected, bat activity generally declined with increased sunset wind speed, again, particularly in 2021. Peaks in bat activity correspond to calmer periods during the survey. During the 2020 survey there were six nights with sunset wind speeds over 5 m/s, all except one had on average < 1 bat / night per detector on those nights. The exception being 25/08/20 when an average of 28 bat passes per night per detector with a wind speed of 5.8 m/s recorded on the portable weather station. In 2021 there were 34 nights where the wind speed was > 5m/s at Carsphairn, the average bat passes per night per detector for these night was 4.3.

A6.3.3.24 In 2020, the mean passes per detector night were 13.27 and 13.81 in the mid (03/06/20 – 02/07/20) and late summer seasons (11/08/20-18/09/20) respectively, with a mean of only 3.78 during the mid-summer period (02/07/20 – 06/08/20). In 2021, mean passes per detector night were 4.83 (08/06/21-28/06/21) and 4.99 (10/09/21-13/10/21) in the early summer and autumn seasons respectively. The mean passes per detector night was 15.97 for the summer/late summer season (20/07/21-11/09/21).

A6.3.3.25 Appendix 2, Figures 6 and 7, show bat pass times relative to sunset and species-specific roost emergence times (based on Russ 2012). None of the detector locations have significant clusters of activity at peak emergence times suggesting that there are no large bat roosts near to the sampling locations. In 2021, there was some common and soprano pipistrelle activity at Q10 and Q21 within the peak emergence period suggesting a small roost could be located near to these sampling points.

Ecobat Analysis

A6.3.3.26 Table 6.3.4 provides a summary of the bat activity survey data based on the results of the Ecobat analysis. It includes the number and percentage of nights (i.e. all detector/nights) where levels of bat activity were assigned to 'high', 'moderate-high' levels of activity. The same data, from 2020 only, is presented on Figure 6.7 to Chapter 6 of the EIAR.

Table 6.3.4: Percentage nights when bat activity exceeded 'Moderate' levels (i.e. 60th percentile) based on Ecobat comparative analysis (2020 and 2021 data)

Ref.	Year	% Detector Nights at High/Moderate-High Activity Levels (no. nights)					
		MYO sp.	NYCLEI	NYCNOC	PIPPIP	PIPPYG	PLEAUR
Q01	2020	15.4 (2)	7.7 (1)	7.7 (1)	53.9 (7)	38.5 (5)	0
Q02	2020	0	5.6 (2)	0	2.8 (1)	8.3 (3)	0
Q03	2020	0	2.6 (1)	0	5.3 (2)	7.9 (3)	0
Q04	2020	0	11.1 (4)	0	13.9 (2)	30.6 (11)	0
Q06	2020	0	3.2 (1)	0	16.1 (5)	25.8 (8)	0
Q08	2020	0	2.8 (1)	0	27.8 (10)	36.1 (13)	0
Q09	2020	0	16.1 (5)	3.2 (1)	38.7 (12)	64.5 (20)	0
Q10	2020	0	18.8 (3)	0	50.0 (8)	37.5 (6)	0
	2021	0	18.0 (18)	6.0 (6)	46.0 (46)	31.0 (31)	1.0 (1)
Q11	2020	0	6.5 (2)	0	58.1 (18)	45.2 (14)	0
Q13a	2020	0	0	0	5.7 (2)	5.7 (2)	0
Q13b	2021	0	2.8 (2)	0	6.9 (5)	16.7 (12)	0
Q14	2021	3.0 (3)	2.0 (2)	2.0 (2)	10.1 (10)	21.2 (21)	0
Q15	2020	0	0	0	0	2.9 (1)	0
Q17	2020	0	2.9 (1)	0	11.4 (4)	0	0
Q19	2020	0	0	0	2.9 (1)	0	0
Q21	2020	0	11.4 (4)	0	34.3 (12)	28.6 (10)	0
	2021	0	3.0 (3)	14.0 (14)	29.0 (29)	40.0 (40)	0

A6.3.3.27 The Ecobat analysis, as summarised in Table 6.3.4, broadly reflects the levels of bat activity recorded in 2020 and 2021. Leisler's bat, common and soprano pipistrelle nightly activity above moderate levels (i.e. 60th percentile) occurred across the site with the exception of a small number of sampling locations. Comparatively high numbers of nights with common and soprano pipistrelle activity above moderate levels were associated with locations near to plantation woodland and/or watercourses. Comparatively high levels of nightly Leisler's bat activity were associated with the Q9 and Q10 locations, both of which are near to small conifer plantations. Noctule nightly activity above moderate levels was recorded in fewer locations across the Site in comparison to Liesler's bat. There was a notable increase in Noctule activity in 2021, in comparison to 2020, at location Q21. This was related to a small number of nights in late July and mid-August 2021 where activity levels were elevated for this species at this location, and which also corresponded to relatively warm, dry nights with low wind speeds.

Overall Risk Assessment

A6.3.3.28 Estimating the vulnerability of bat populations to wind turbine related mortality is based on the consideration relative abundance (nationally); collision risk based on current guidance (NatureScot *et al*. 2021); and relative level of activity recorded at the Site. Five bat species in Scotland are considered to have a high collision risk (noctule, Leisler's bat, Nathusius' pipistrelle, soprano pipistrelle and common pipistrelle). Of these, three (noctule, Leisler's and Nathusius' pipistrelle) are considered to have high population vulnerability with the other two (soprano and common pipistrelle) having medium population vulnerability (see Table 6.3.1).

A6.3.3.29 An initial Stage 1 risk assessment rates the Site at a medium risk level (level 3) for bats, based on the Proposed Development being medium-sized and the Site providing moderate habitat suitability for bats.

A6.3.3.30 The Stage 2 overall risk assessment, incorporating the Site-wide Ecobat activity category, suggests that for a medium risk site and for high collision risk species (Pipistrelle sp. and Nyctalus sp.):

- Ecobat activity category of Nil (score 0) or Low (score 3) = Low (L) overall risk;
- Ecobat activity category of Low-Moderate (score 6), Moderate (score 9), or Moderate-High (score 12) = Medium (M) overall risk; and
- Ecobat activity category of High (score 15) = High (H) overall risk.

A6.3.3.31 Tables 6.3.5, 6.3.6 and 6.3.7 below show the overall Site risk assessment category for high collision risk species for the typical nightly activity and the peak nightly activity recorded during the 2020 and 2021 surveys, and all surveys combined.

Table 6.3.5: Overall site risk assessment for median and maximum bat activity recorded in 2020 (high collision risk species only)

Species / Species Group	Site-wide Ecobat Activity Level		Overall Site Risk Assessment for Bats (Score)	
	Typical Activity Levels (Median)	Peak Activity Levels (Max)	Typical Activity Levels (Median)	Peak Activity Levels (Max)
Leisler's bat	Low / Moderate	High	Moderate (6)	High (15)
Noctule	Low	High	Low (3)	High (15)
Common pipistrelle	Moderate	High	Moderate (9)	High (15)
Soprano pipistrelle	Moderate	High	Moderate (9)	High (15)

Table 6.3.6: Overall site risk assessment for median and maximum bat activity recorded in 2021 (high collision risk species only)

Species / Species Group	Site-wide Ecobat Activity Level		Overall Site Risk Assessment for Bats (Score)	
	Typical Activity Levels (Median)	Peak Activity Levels (Max)	Typical Activity Levels (Median)	Peak Activity Levels (Max)
Leisler's bat	Low / Moderate	High	Moderate (6)	High (15)
Noctule	Low / Moderate	High	Moderate (6)	High (15)
Common pipistrelle	Moderate	High	Moderate (9)	High (15)
Soprano pipistrelle	Moderate	High	Moderate (9)	High (15)

A6.3.3.32 Despite the expected variation in activity between the locations sampled in 2020 and 2021, the assessment of site-wide risk, following NatureScot guidance, is unchanged when considering the 2020 or the 2021 data (see Table 6.3.7 below).

Table 6.3.7: Overall site risk assessment for median and maximum bat activity recorded in 2020 and 2021, all data combined (high collision risk species only)

Species / Species Group	Site-wide Ecobat Activity Level		Overall Site Risk Assessment for Bats (Score)	
	Typical Activity Levels (Median)	Peak Activity Levels (Max)	Typical Activity Levels (Median)	Peak Activity Levels (Max)
Leisler's bat	Low / Moderate	High	Moderate (6)	High (15)
Noctule	Low	High	Low (3)	High (15)
Common pipistrelle	Moderate	High	Moderate (9)	High (15)
Soprano pipistrelle	Moderate	High	Moderate (9)	High (15)

A6.3.3.33 The risk assessment indicates that, in terms of the Site as a whole, there is a Low-Moderate risk, at typical activity levels, for all High collision risk species. At peak activity levels, all species meet the criteria for a High Site-wide risk. This indicates that under certain conditions (e.g. time of year, warm temperatures and relatively low wind speeds) the risk to species, such as Nyctalus bats, from turbine mortality may be significant. Although these conditions may only occur on only a relatively few nights in any one year there is the potential for relatively low levels of mortality to be significant for some species due to the vulnerability of their populations.

A6.3.3.34 It is important to emphasise that the analysis of Site-wide risk includes data from some bat detectors located in or near habitat types which will not be typical of conditions once the Proposed Development is constructed. Also, that the wind turbine layout has been adjusted to reduce potential effects on bats. For example, by ensuring that all turbines will be located away from the main watercourses and that woodland edges. This issue and the proposed approach to mitigating the risk to bats form the operation of the Proposed Development is discussed further within Chapter 6 (Ecology & Biodiversity).

REFERENCES

Barataud, M. (2015) Acoustic Ecology of European Bats: Species Identification, Study of their Habitats and Foraging Behaviour. Biotope – Muséum national d'Histoire naturelle, Paris, France.

EUROBATS (2014) Report of the intersessional working group on wind turbines and bat populations. [available from: http://www.eurobats.org]

Harris S., Morris, P., Wray, S. & Yalden, D. (1995). A review of British mammals: population estimates and conservation status of British mammals other than cetaceans. JNCC, Peterborough.

Hein, C. D., Gruver, J. & Arnett, E. B. (2013). Relating pre-construction bat activity and post-construction bat fatality to predict risk at wind energy facilities: a synthesis. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International, Austin, TX, USA.

Hundt, L., Barlow, K., Crompton, R., Graves, R., Markham, S., Matthews, J., & Sowler, S. (2012). Bat Surveys – Good Practice Guidelines (2nd Edition): Surveying for Onshore Wind Farms. Bat Conservation Trust, London.

Joint Nature Conservation Committee (2013). Species Conservation Status Reports - 3rd UK Habitats Directive Reporting 2013. Available at: http://jncc.defra.gov.uk/page-6564.

Lintott, P.R., Richardson, S., Hosken, D., Fensome, S., & Mathews, F. (2016). Ecological impact assessments fail to reduce risk of bat casualties at wind farms. Current Biology, (26) 1135–1136.

Natural England (2014). Bats and onshore wind turbines: Interim guidance. Technical Information Note TIN051, Third edition, 11 March 2014.

Newson, S.E., Evans, H.E., Gillings, S., Jarrett, D. & Wilson, M.W. 2017, A survey of high risk bat species across southern Scotland, Scottish Natural Heritage Commissioned Report No 1008.

Mathews, F., Richardson, S., Lintott, P., & Hosken, D. (2016). Understanding the Risk to European Protected Species (bats) at Onshore Wind Turbine Sites to inform Risk Management. Final Report to Defra [available from: http://randd.defra.gov.uk]

Mathews, F., Kubasiewicz, L.M., Gurnell, J., Harrower, C.A, McDonald, R.A., Shore, R.F. (2018) A Review of the Population and Conservation Status of British Mammals. A report by the Mammal Society under contract to Natural England, Natural Resources Wales and Scottish Natural Heritage. Natural England, Peterborough. ISBN 978-1-78354-494-3

Richardson, S. M., Lintott, P. R., Hosken, D. J. & Mathews, F. (2019). An evidence-based approach to specifying survey effort in ecological assessments of bat activity. Biological Conservation, (231) 98-102.

Russ J. (2012) British Bat Calls: A Guide to Species Identification. Pelagic Publishing, Exeter.

NatureScot et al. (2019) Bats and onshore wind turbines: survey, assessment and mitigation. Guidance document prepared jointly by Scottish Natural Heritage, Natural England, Natural Resources Wales, RenewableUK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter and the Bat Conservation Trust with input from other key stakeholders.

Wray, S., Wells, D., Long, E., Mitchell-Jones, A. J. (2010). Valuing bats in ecological impact assessment. In Practice, No. 70, Institute of Ecology and Environmental Management.

APPENDIX 1: BAT ACTIVITY SURVEY DATA

Introduction

A6.3.3.35 This appendix provides the tabulated results of the bat activity surveys undertaken at the Proposed Development site in 2020 and 2021.

Automated Bat Detector Locations

A6.3.3.36 The 22 locations for the automated bat detectors established at the Site are provided in Table A1.1.

Table A1.1: Locations of automated bat detectors (SM4s) and a description of habitat

Ref	Easting	Northing	Habitat	Detector Nights	Season	Survey dates
Q01	258309	595877	Rush pasture, edge of conifer plantation	13	Early summer	03/06/20-16/06/20
				0	Late summer	Equip failed
Q02	258518	594948	Blanket mire	13	Early summer	03/06/20-16/06/20
				23	Late summer	11/08/20-03/09/20
Q03	259098	595502	Rough grass / heath	23	Early summer	09/06/20-02/07/20
				15	Late summer	03/09/20-18/09/20
Q04	257536	594811	Rough grass / degraded mire	13	Early summer	03/06/20-16/06/20
				23	Late summer	11/08/20-03/09/20
Q06	259293	594585	Rush pasture	16	Early summer	16/06/20-02/07/20
				15	Late summer	03/09/20-18/09/20
Q08	258241	593985	Rough grass / rush pasture	13	Early summer	03/06/20-16/06/20
				23	Late summer	11/08/20-03/09/20
Q09	259125	593899	Rush pasture, conifer copse	16	Early summer	16/06/20-02/07/20
				15	Late summer	03/09/20-18/09/20
Q10	259725	594352	Rush pasture, conifer copse	16	Early summer	16/06/20-02/07/20
				0	Late summer	Equip failed
				18	Early summer	10/06/21-28/06/21
				53	Late summer	20/07/21-11/09/21
				28	Autumn	15/09/21-13/10/21
Q11	260555	594592	Rush pasture, small stream	16	Early summer	16/06/20-02/07/20
				15	Late summer	03/09/20-18/09/20
Q13a	260940	593851	Acid grassland, mire edge	35	Summer	02/07/20-06/08/20
Q13b	261136	593847	Acid grassland, mire edge	20	Early summer	08/06/21-28/06/21
				52	Late summer	21/07/21-11/09/21
				0	Autumn	Equip failed
Q14	260751	593428	Blanket mire / acid flush	20	Early summer	08/06/21-28/06/21
				52	Late summer	21/07/21-11/09/21
				28	Autumn	15/09/21-13/10/21
Q15	261752	594016	Blanket mire / acid flush	35	Summer	02/07/20-06/08/20
Q17	261097	595398	Molinia mire	35	Summer	02/07/20-06/08/20
Q19	261549	596296	Molinia mire	35	Summer	02/07/20-06/08/20
Q21	260391	592904	Bracken, mire, rush pasture	35	Summer	02/07/20-06/08/20
				20	Early summer	08/06/21-28/06/21
				52	Late summer	21/07/21-11/09/21
				28	Autumn	15/09/21-13/10/21

Survey Weather Details

A6.3.3.37 Weather data for the nights in which the automated detectors were recording was acquired from several sources. Temperature data throughout the survey period at was recorded at all SM4 locations. A portable meteorological station was deployed in 2020 (at NGR NX 58126 94969, on the western side of Quantans Hill) to record temperature, rainfall and wind speed. Portable met station data was unavailable from 08/06/21 to 09/08/21. Additional weather information (temperature, rainfall and wind speed) was obtained for the closest weather stations where data was available[2], as an indication of weather conditions in the area, and as a comparison for the data collected on site.

Table A1.2: Weather Details 2020

Date	Sunset Time	SM4	Portable Weather Station				Prestwick Airport		
		Sunset Temp (°C)	Sunset Temp (°C) at 2m a.g.l.	Sunset Wind Speed (m/s) at 2m a.g.l.	Sunset Wind Speed (mph) at 2m a.g.l.	Sunset Temp (°C)	Sunset Rain (Dry, Drizzle, Heavy)	Sunset Wind Speed (mph)
03/06/20	21:49	9.5	8.3	0.4	0.9	13	Dry	3
04/06/20	21:50	9.5	8.1	1.8	4.0	9	Dry	10
05/06/20	21:51	6	5.1	6.3	14.1	9	Drizzle	21
06/06/20	21:52	11.25	9.3	2.2	4.9	12	Drizzle	5
07/06/20	21:53	12.25	9.2	2.2	4.9	11	Dry	13
08/06/20	21:54	10.75	9.4	2.2	4.9	11	Dry	6
09/06/20	21:55	8.75	7.8	0	0.0	10	Drizzle	7
10/06/20	21:56	10.5	9.8	4	8.9	12	Dry	16
11/06/20	21:57	10	9.9	6.7	15.0	13	Dry	7
12/06/20	21:57	11.25	10.5	3.1	6.9	13	Dry	12
13/06/20	21:58	16.25	13.9	2.2	4.9	14	Dry	8
14/06/20	21:59	19.25	16.8	2.2	4.9	17	Dry	9
15/06/20	21:59	17.25	15.2	0.9	2.0	16	Dry	10
16/06/20	22:00	15.5	14.7	3.1	6.9	16	Dry	3
17/06/20	22:00	16	13.7	0.9	2.0	16	Dry	8
18/06/20	22:01	16.25	14.4	0.9	2.0	14	Dry	10

[2] Sourced from https://www.timeanddate.com/

19/06/20	22:01	15	12.3	0.4	0.9	15	Dry	5
20/06/20	22:01	13.75	11.7	4	8.9	15	Dry	5
21/06/20	22:01	12.25	10.8	0.4	0.9	12	Dry	12
22/06/20	22:01	14.5	12.9	4	8.9	16	Dry	15
23/06/20	22:02	15.5	13.6	2.7	6.0	16	Dry	6
24/06/20	22:02	18.75	15.2	0	0.0	16	Dry	2
25/06/20	22:01	22.5	20.5	4	8.9	21	Dry	10
26/06/20	22:01	15.5	13.5	1.3	2.9	17	Dry	3
27/06/20	22:01	12	10.4	3.1	6.9	12	Drizzle	15
28/06/20	22:01	11	10.1	4.9	11.0	12	Drizzle	18
29/06/20	22:01	11	9.7	4.9	11.0	13	Dry	13
30/06/20	22:00	13	11.1	0.9	2.0	13	Dry	6
01/07/20	22:00	12	10.5	2.2	4.9	11	Dry	12
02/07/20	21:59	10.75	9.1	0.4	0.9	11	Dry	8
03/07/20	21:59	11.75	9.9	1.3	2.9	11	Dry	2
04/07/20	21:58	14.25	13.5	2.7	6.0	13	Drizzle	9
05/07/20	21:57	9.75	9	6.7	15.0	11	Dry	13
06/07/20	21:56	10.25	9.4	4	8.9	12	Dry	8
07/07/20	21:56	10.25	8.6	0.9	2.0	12	Dry	3
08/07/20	21:55	12.25	11.1	1.8	4.0	12	Drizzle	6
09/07/20	21:54	10.5	9.6	4	8.9	12	Dry	5
10/07/20	21:53	10.5	9.6	2.7	6.0	13	Dry	12
11/07/20	21:52	11	9.4	0.9	2.0	12	Dry	6
12/07/20	21:51	13.25	12.1	2.7	6.0	16	Drizzle	12
13/07/20	21:50	11.75	10.3	3.6	8.1	13	Dry	12
14/07/20	21:48	11.75	10.6	1.3	2.9	13	Dry	6
15/07/20	21:47	12.5	11.3	4.9	11.0	14	Dry	10
16/07/20	21:46	16.5	14.9	1.8	4.0	16	Dry	15
17/07/20	21:45	14.25	13.1	0.9	2.0	14	Dry	7
18/07/20	21:43	10.75	9.4	3.6	8.1	13	Dry	12
19/07/20	21:42	10.25	9.4	2.2	4.9	11	Dry	9
20/07/20	21:40	10.25	9.8	3.1	6.9	12	Dry	13
21/07/20	21:39	13.25	11.7	0.9	2.0	13	Drizzle	12
22/07/20	21:37	14.25	13.3	2.2	4.9	15	Dry	8
23/07/20	21:35	13.5	12.1	2.7	6.0	12	Dry	7
24/07/20	21:34	12.75	12.2	3.1	6.9	14	Drizzle	9
25/07/20	21:32	14.5	13.1	0.9	2.0	14	Dry	3
26/07/20	21:30	12.75	12.2	1.3	2.9	13	Dry	7
27/07/20	21:29	11	10.3	5.4	12.1	12	Dry	12
28/07/20	21:27	10	9.2	4.5	10.1	12	Dry	13
29/07/20	21:25	11.25	9.8	0.9	2.0	12	Dry	9
30/07/20	21:23	14.25	14.3	3.1	6.9	15	Dry	7
31/07/20	21:21	16.75	15.4	0.9	2.0	17	Dry	5
01/08/20	21:19	13.5	11.4	0.4	0.9	14	Dry	8
02/08/20	21:17	12.25	10.4	2.2	4.9	12	Dry	5
03/08/20	21:15	12	10.2	0.4	0.9	12	Dry	7
04/08/20	21:13	15.25	14.7	3.1	6.9	17	Drizzle	18
05/08/20	21:11	15.5	14.1	3.1	6.9	15	Dry	6
11/08/20	20:58	21.75	18.6	0.9	2.0	20	Dry	10
12/08/20	20:56	22.75	19.5	0.4	0.9	20	Dry	7
13/08/20	20:54	19.5	15.9	1.8	4.0	16	Dry	15
14/08/20	20:52	20.5	16.3	1.3	2.9	17	Dry	12
15/08/20	20:49	19.5	16.9	1.3	2.9	16	Dry	13
16/08/20	20:47	16	14.1	1.8	4.0	15	Dry	12
17/08/20	20:45	16.5	14.9	0.4	0.9	15	Dry	8
18/08/20	20:42	16.5	14.7	0.9	2.0	17	Dry	2
19/08/20	20:40	17.25	16.1	5.4	12.1	17	Drizzle	17
20/08/20	20:38	14.75	13.8	3.6	8.1	17	Drizzle	13
21/08/20	20:35	15.5	14.4	3.6	8.1	16	Dry	9
22/08/20	20:33	15	12.4	0	0.0	16	Dry	8
23/08/20	20:30	12.75	10.3	1.8	4.0	13	Dry	7
24/08/20	20:28	13.25	9.4	1.8	4.0	13	Dry	3
25/08/20	20:25	15.25	13.7	5.8	13.0	15	Dry	20
26/08/20	20:23	14.75	12.8	0.4	0.9	14	Dry	3
27/08/20	20:21	12	11	2.2	4.9	13	Drizzle	8
28/08/20	20:18	13.25	9.1	0.4	0.9	13	Dry	6
29/08/20	20:16	13	9	0.9	2.0	13	Dry	8
30/08/20	20:13	11.75	9.6	0.9	2.0	14	Dry	5
31/08/20	20:11	11.75	9.8	0.9	2.0	14	Dry	12
01/09/20	20:08	14	12.7	2.7	6.0	16	Dry	2
02/09/20	20:06	15.25	14.1	3.1	6.9	16	Drizzle	8
03/09/20	20:03		11.7	2.2	4.9	13	Dry	10
04/09/20	20:00		9.6	4.9	11.0	12	Dry	10
05/09/20	19:58		9.8	1.8	4.0	12	Drizzle	5
06/09/20	19:55		11	1.3	2.9	14	Dry	7
07/09/20	19:53		13.8	3.1	6.9	16	Dry	13

08/09/20	19:50	17.9	4	8.9	18	Dry	20
09/09/20	19:48	9.3	2.7	6.0	11	Dry	8
10/09/20	19:45	9.6	2.2	4.9	13	Dry	15
11/09/20	19:42	9.9	4	8.9	13	Dry	17
12/09/20	19:40	10.2	2.7	6.0	12	Drizzle	20
13/09/20	19:37	14.4	3.6	8.1	17	Dry	14
14/09/20	19:35	14.4	1.3	2.9	16	Dry	1
15/09/20	19:32	16.9	2.7	6.0	18	Dry	5
16/09/20	19:29	10.9	1.8	4.0	13	Dry	9
17/09/20	19:27	12.2	1.3	2.9	15	Dry	3

Table A1.3: Weather Details 2021

Date	Sunset Time	SM4	Portable Weather Station			Carsphairn		
		Sunset Temp (°C)	Sunset Temp (°C) at 2m a.g.l.	Sunset Wind Speed (m/s) at 2m a.g.l.	Sunset Wind Speed (mph) at 2m a.g.l.	Sunset Temp (°C)	Sunset Rain (Dry, Drizzle, Heavy)	Sunset Wind Speed (mph)
08/06/21	21:54	14.25				16	Dry	12
09/06/21	21:55	14.25				17	Dry	9
10/06/21	21:56	14.5				17	Dry	16
11/06/21	21:56	12				13	Dry	14
12/06/21	21:57	14.75				15	Dry	1
13/06/21	21:58	13.75				17	Dry	13
14/06/21	21:58	10.5				12	Dry	15
15/06/21	21:59	13.75				16	Dry	18
16/06/21	21:59	13.25				14	Dry	6
17/06/21	22:00	12.5				13	Dry	15
18/06/21	22:00	13.5				15	Dry	7
19/06/21	22:01	14.75				15	Dry	2
20/06/21	22:01	14.25				14	Dry	7
21/06/21	22:01	13.25				14	Dry	2
22/06/21	22:01	11.5				12	Dry	8
23/06/21	22:01	15.25				15	Dry	6
24/06/21	22:01	13				13	Drizzle	10
25/06/21	22:01	10.75				13	Dry	3
26/06/21	22:01	14				14	Dry	6
27/06/21	22:01	14.5				15	Dry	7
28/06/21	22:01					15	Dry	9
20/07/21	21:41	21.75				19	Dry	2
21/07/21	21:39	24				20	Dry	2
22/07/21	21:38	23.5				22	Dry	3
23/07/21	21:36	23.25				21	Dry	5
24/07/21	21:34	20.25				18	Dry	2
25/07/21	21:33	20.5				19	Dry	2
26/07/21	21:31	15				16	Dry	7
27/07/21	21:29	16.5				16	Dry	8
28/07/21	21:27	13.75				15	Dry	13
29/07/21	21:26	14				15	Dry	9
30/07/21	21:24	15.5				16	Dry	12
31/07/21	21:22	13				15	Dry	5
01/08/21	21:20	14.5				14	Dry	12
02/08/21	21:18	14.5				15	Dry	8
03/08/21	21:16	16.25				16	Dry	5
04/08/21	21:14	15				17	Dry	3
05/08/21	21:12	14.75				16	Dry	13
06/08/21	21:10	15				15	Dry	5
07/08/21	21:08	15.5				17	Drizzle	2
08/08/21	21:06	14.25				15	Drizzle	13
09/08/21	21:03	16	13.4	0.3	0.7	15	Dry	9
10/08/21	21:01	15.5	10	0.9	2.0	15	Dry	9
11/08/21	20:59	12.75	11.8	1.5	3.4	14	Dry	6
12/08/21	20:57	14.75	12.8	0.3	0.7	15	Dry	7
13/08/21	20:55	15.25	12.9	1.9	4.3	14	Dry	12
14/08/21	20:52	15	12.4	0.5	1.1	15	Dry	8
15/08/21	20:50	13	10.9	4	8.9	14	Dry	14
16/08/21	20:48	13	11.2	3.1	6.9	14	Dry	14
17/08/21	20:45	14	12.5	4.1	9.2	15	Dry	20
18/08/21	20:43	13.75	11.8	3.6	8.1	14	Dry	12
19/08/21	20:41	15.75	13	0.8	1.8	14	Dry	6
20/08/21	20:38	16.5	14.7	3.3	7.4	17	Drizzle	14
21/08/21	20:36	15.25	13.5	1.1	2.5	16	Dry	5
22/08/21	20:34	18	15.5	1.5	3.4	17	Dry	7
23/08/21	20:31	19.25	15.6	1.5	3.4	16	Dry	3
24/08/21	20:29	21.25	17	2.7	6.0	17	Dry	5
25/08/21	20:26	22.25	17.7	2.8	6.3	19	Dry	2
26/08/21	20:24	19.5	13.4	1.5	3.4	19	Dry	1

27/08/21	20:21	18	12.2	2	4.5	15	Dry	3
28/08/21	20:19	17.25	14.2	3.6	8.1	16	Dry	5
29/08/21	20:16	15.5	12.9	0.8	1.8	14	Dry	6
30/08/21	20:14	14	11.8	1.3	2.9	14	Dry	6
31/08/21	20:11	15.25	13.5	0.8	1.8	16	Dry	2
01/09/21	20:09	20.75	13.3	1.4	3.1	15	Dry	5
02/09/21	20:06	20.5	12.4	2.1	4.7	16	Dry	6
03/09/21	20:04	13.5	11.5	1.1	2.5	15	Dry	5
04/09/21	20:01	14.75	12.4	0.9	2.0	16	Dry	2
05/09/21	19:59	16.5	14	2.1	4.7	17	Drizzle	3
06/09/21	19:56	17	14.9	1.5	3.4	17	Drizzle	3
07/09/21	19:54	22.75	16.3	1.4	3.1	16	Dry	2
08/09/21	19:51	26.5	18.5	2	4.5	21	Dry	1
09/09/21	19:49	18.75	16	0.8	1.8	18	Dry	0
10/09/21	19:46	18.25	15.7	1.1	2.5	17	Dry	6
15/09/21	19:33	16.25	13.5	1.3	2.9	15	Dry	6
16/09/21	19:31	14.25	12.5	1.8	4.0	15	Dry	12
17/09/21	19:28	14	11.9	2.4	5.4	14	Drizzle	5
18/09/21	19:25	16.75	14	1.1	2.5	16	Dry	3
19/09/21	19:23	14.25	10.7	1.8	4.0	14	Dry	7
20/09/21	19:20	14.25	12.7	2.2	4.9	15	Dry	15
21/09/21	19:18	15.75	12.6	0.6	1.3	16	Dry	9
22/09/21	19:15	16.5	14	3.9	8.7	17	Dry	14
23/09/21	19:12	13.75	12.3	2.7	6.0	14	Dry	16
24/09/21	19:10	15.75	13.7	3.8	8.5	15	Dry	15
25/09/21	19:07	16.25	14.6	2.2	4.9	17	Dry	10
26/09/21	19:05	15.75	14.1	4.4	9.8	17	Drizzle	17
27/09/21	19:02	12.5	8.9	2	4.5	13	Dry	10
28/09/21	19:00	11.5	8.7	0.7	1.6	10	Drizzle	6
29/09/21	18:57	10	7.1	1.2	2.7	12	Dry	12
30/09/21	18:54	13.25	11.8	4.8	10.7	14	Drizzle	14
01/10/21	18:52	9.25	7.6	4.8	10.7	12	Dry	26
02/10/21	18:49	10	7.9	1.5	3.4	11	Dry	7
03/10/21	18:47	11.25	9	3.4	7.6	12	Drizzle	15
04/10/21	18:44	11.75	8.8	0	0.0	11	Dry	8
05/10/21	18:42	12	9.9	3.2	7.2	12	Dry	16
06/10/21	18:39	11.25	9.1	2.4	5.4	12	Dry	8
07/10/21	18:37	15.75	14.2	4.6	10.3	16	Drizzle	16
08/10/21	18:34	15.25	13.4	1.5	3.4	16	Dry	12
09/10/21	18:32	14.25	12.3	2.7	6.0	14	Dry	12
10/10/21	18:29	10.75	8.6	4.2	9.4	12	Dry	16
11/10/21	18:27	12.75	10.5	2.9	6.5	13	Dry	15
12/10/21	18:24	14	12	2.4	5.4	14	Dry	8

Automated Bat Detector Results 2020

Table A1.4: Automated bat detector results 2020 – Part 1

Season	Location	Start	End	Nights	Number of bat passes recorded								Total Passes	Mean bat passes per night	Max bat passes per night	Min bat passes per night	Median bat passes per night
					MYOSP	NYCLEI	NYCNOC	PIPPIP	PIPPYG	PIPSP	PIPNAT	PLEAUR					
Early summer	Q01	03/06/20	16/06/20	13	34	23	15	624	263				959	73.77	281	0	13
	Q02	03/06/20	16/06/20	13	2	5	0	3	5				15	1.15	4	0	0
	Q03	09/06/20	02/07/20	23	2	11	9	54	38			1	115	5.00	45	0	1
	Q04	03/06/20	16/06/20	13	2	4	2	24	23				55	4.23	17	0	1
	Q06	16/06/20	02/07/20	16	4	9	1	15	16			1	46	2.88	10	0	2.5
	Q08	03/06/20	06/06/20	13	4	0	1	20	28			2	55	4.23	18	0	2
	Q09	16/06/20	02/07/20	16	5	52	14	33	77		1		182	11.38	35	0	10
	Q10	16/06/20	02/07/20	16	5	67	7	92	54	1	1	3	230	14.38	31	1	13.5
	Q11	16/06/20	02/07/20	16	4	47	1	89	44		2	1	188	11.75	26	0	11
	Early summer total			**139**	**62**	**218**	**50**	**954**	**548**	**1**	**4**	**8**	**1845**	**13.27**			
Mid-summer	Q13	02/07/20	06/08/20	35	0	14	15	24	21				74	2.11	13	0	1
	Q15	02/07/20	06/08/20	35	0	13	6	23	26				68	1.94	11	0	1
	Q17	02/07/20	06/08/20	35	8	16	9	44	13			1	91	2.60	11	0	2
	Q19	02/07/20	06/08/20	35	5	10	9	29	6				59	1.69	16	0	1
	Q21	02/07/20	06/08/20	35	9	48	6	194	109		1	2	369	10.54	43	0	5
	Mid-summer total			**175**	**22**	**101**	**45**	**314**	**175**	**0**	**1**	**3**	**661**	**3.78**			
Late summer	Q01	11/08/20	03/09/20	Equipment failed													
	Q02	11/08/20	03/09/20	23	5	20	11	17	37				90	3.91	17	0	1
	Q03	03/09/20	18/09/20	15	6	0	0	6	12			1	25	1.67	6	0	1
	Q04	11/08/20	03/09/20	23	7	45	18	55	90	1		1	217	9.43	56	1	5
	Q06	03/09/20	18/09/20	15	15	11	5	134	143			2	310	20.67	108	0	9
	Q08	11/08/20	03/09/20	23	12	24	10	122	146			5	319	13.87	66	1	10
	Q09	03/09/20	18/09/20	15	7	39	6	202	290			5	549	36.60	115	0	23
	Q10	03/09/20	18/09/20	Equipment failed													
	Q11	03/09/20	18/09/20	15	9	8	3	149	97		1	4	271	18.07	55	0	12
	Late summer total			**129**	**61**	**147**	**53**	**685**	**815**	**1**	**1**	**18**	**1781**	**13.81**			
	TOTAL			**443**	**145**	**466**	**148**	**1953**	**1538**	**2**	**6**	**29**	**4287**	**9.68**			

MYOSP: Myotis species; NYCLEI: Leisler's bat; NYCNOC: noctule; NYCSP: unknown Nyctalus species; PIPNAT: Nathusius' bat; PIPPIP: common pipistrelle; PIPPYG: soprano pipistrelle; PIPSP: unknown pipistrelle species (PIPPIP or PIPPYG); PLEAUR: brown long-eared bat

Table A1.5: Automated bat detector results 2020 – Part 2

Season	Location	Start	End	Nights out	MYOSP Passes per night		NYCLEI Passes per night		NYCNOC Passes per night		PIPPIP Passes per night		PIPPYG Passes per night	
					Median	Max	Median	Max	Median	Max	Median	Max	Median	Max
Early summer	Q01	03/06/20	16/06/20	13	1	12	0	23	0	14	7	206	2	92
	Q02	03/06/20	16/06/20	13	0	1	0	4	0	0	0	2	0	3
	Q03	09/06/20	02/07/20	23	0	1	0	6	0	2	0	29	0	12
	Q04	03/06/20	16/06/20	13	0	1	0	2	0	1	0	7	0	8
	Q06	16/06/20	02/07/20	16	0	2	0	3	0	1	0	5	0	4
	Q08	03/06/20	06/06/20	13	0	2	0	0	0	1	1	7	0	14
	Q09	16/06/20	02/07/20	16	0	2	1	19	0	7	1	7	4	13
	Q10	16/06/20	02/07/20	16	0	1	2	20	0	2	4.5	18	2	11
	Q11	16/06/20	02/07/20	16	0	3	1.5	19	0	1	6	10	1.5	11
Mid-summer	Q13	02/07/20	06/08/20	35	0	0	0	4	0	4	0	8	0	8
	Q15	02/07/20	06/08/20	35	0	0	0	3	0	2	0	4	0	7
	Q17	02/07/20	06/08/20	35	0	2	0	6	0	2	0	8	0	4
	Q19	02/07/20	06/08/20	35	0	1	0	4	0	2	0	12	0	3
	Q21	02/07/20	06/08/20	35	0	3	1	11	0	2	2	31	2	13
Late summer	Q01	11/08/20	03/09/20	No data										
	Q02	11/08/20	03/09/20	23	0	1	0	6	0	3	0	5	0	8
	Q03	03/09/20	18/09/20	15	0	2	0	0	0	0	0	4	0	6
	Q04	11/08/20	03/09/20	23	0	2	1	10	0	3	1	20	2	25
	Q06	03/09/20	18/09/20	15	1	4	0	6	0	2	3	47	6	54
	Q08	11/08/20	03/09/20	23	0	3	1	6	0	2	3	26	4	40
	Q09	03/09/20	18/09/20	15	0	2	2	13	0	3	8	71	12	66
	Q10	03/09/20	18/09/20	No data										
	Q11	03/09/20	18/09/20	15	0	4	0	2	0	2	6	44	5	19

Automated Bat Detector Results 2021

Table A1.6: Automated bat detector results 2021 – Part 1

Season	Location	Start	End	Nights out	Number of bat passes recorded							Total Passes	Mean bat passes per night	Max bat passes per night	Min bat passes per night	Median bat passes per night
					MYOSP	NYCLEI	NYCNOC	PIPPIP	PIPPYG	PIPNAT	PLEAUR					
Early summer	Q10	10/06/21	28/06/21	18	12	7	3	88	41	3	5	159	8.83	23	1	6.5
	Q13b	08/06/21	28/06/21	20	0	0	1	11	10	0	0	22	1.10	5	0	1
	Q14	08/06/21	28/06/21	20	3	1	2	9	5	0	0	20	1.00	3	0	1

	Q21	08/06/21	28/06/21	20	13	3	1	97	62	0	0	176	8.80	32	1	5
	Early summer total			**78**	**28**	**11**	**7**	**205**	**118**	**3**	**5**	**377**	**4.83**			
Summer	Q10	20/07/21	11/09/21	53	55	340	139	404	517	0	30	1485	28.02	107	1	14
	Q13b	21/07/21	11/09/21	52	12	54	39	76	162		8	351	6.75	38	0	1
	Q14	21/07/21	11/09/21	52	55	52	52	114	224	1	13	511	9.83	46	0	2
	Q21	21/07/21	11/09/21	52	38	89	220	217	413	0	13	990	19.04	62	1	7
	Summer total			**209**	**160**	**535**	**450**	**811**	**1316**	**1**	**64**	**3337**	**15.97**			
Autumn	Q10	15/09/21	13/10/21	28	23	1	0	61	59	0	7	151	5.39	26	0	3.5
	Q13b	10/09/21	13/10/21	Equipment failed												
	Q14	15/09/21	13/10/21	28	32	1	1	4	45	0	0	83	2.96	13	0	1.5
	Q21	15/09/21	13/10/21	28	4	2	2	53	120	1	3	185	6.61	44	0	3
	Autumn total			**84**	**59**	**4**	**3**	**118**	**224**	**1**	**10**	**419**	**4.99**			
	TOTAL			**371**	**247**	**550**	**460**	**1134**	**1658**	**5**	**79**	**4133**	**11.14**			

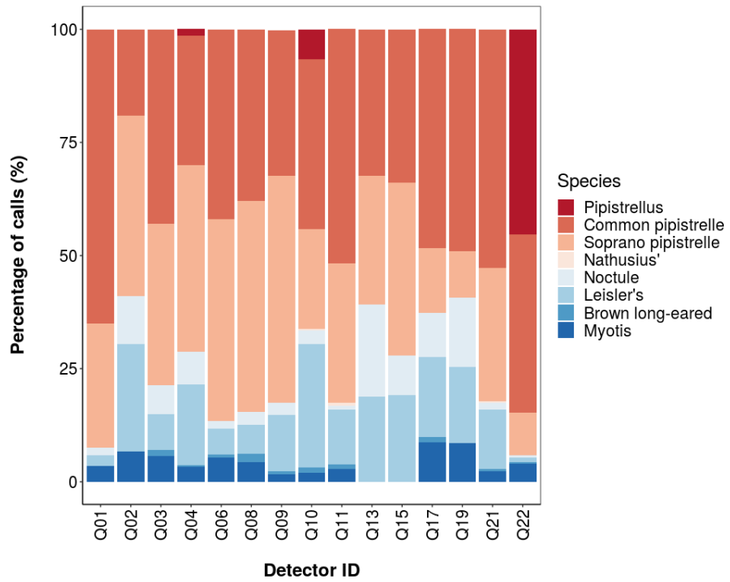
MYOSP: Myotis species; NYCLEI: Leisler's bat; NYCNOC: noctule; NYCSP: unknown Nyctalus species; PIPNAT: Nathusius' bat; PIPPIP: common pipistrelle; PIPPYG: soprano pipistrelle; PLEAUR: brown long-eared bat

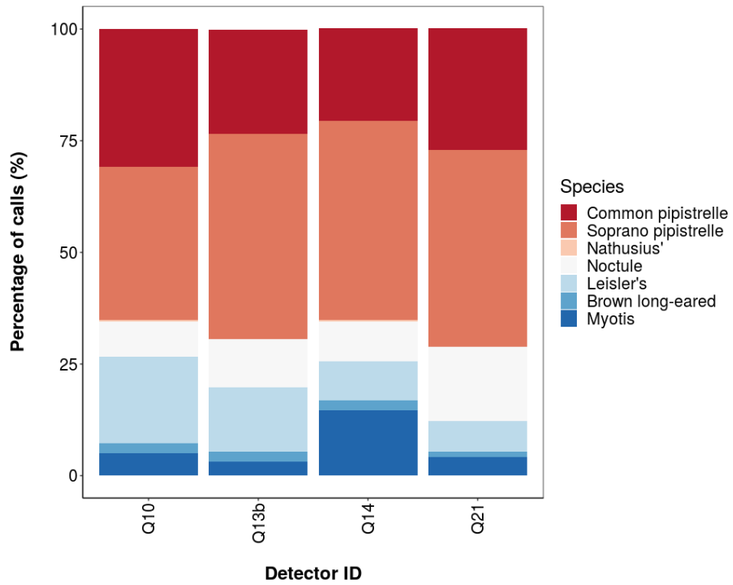
Table A1.7: Automated bat detector results 2021 – Part 2

Season	Location	Start	End	Nights out	MYOSP Passes per night		NYCLEI Passes per night		NYCNOC Passes per night		PIPPIP Passes per night		PIPPYG Passes per night	
					Median	Max	Median	Max	Median	Max	Median	Max	Median	Max
Early summer	Q10	10/06/21	28/06/21	18	0.5	3	0	4	0	1	4	16	1	12
	Q13b	08/06/21	28/06/21	20	0	0	0	0	0	1	0	4	0	2
	Q14	08/06/21	28/06/21	20	0	1	0	1	0	1	0	3	0	1
	Q21	08/06/21	28/06/21	20	0	4	0	1	0	1	2	29	2	17
Summer	Q10	20/07/21	11/09/21	53	1	4	0	64	0	32	5.5	21	3	54
	Q13b	21/07/21	11/09/21	52	0	3	0	8	0	4	0	11	1	25
	Q14	21/07/21	11/09/21	52	0	5	0	5	0	5	0	11	0	31
	Q21	21/07/21	11/09/21	52	0	4	0	14	0	55	3	15	2	30
Autumn	Q10	15/09/21	13/10/21	28	0.5	4	0	1	0	0	1	16	1	12
	Q13b	10/09/21	13/10/21	Equipment failed										
	Q14	15/09/21	13/10/21	28	0	8	0	1	0	1	0	2	1	6
	Q21	15/09/21	13/10/21	28	0	1	0	1	0	2	1	12	2	34

APPENDIX 2: BAT ACTIVITY SUMMARY PLOTS AND CHARTS

Figure 1. Percentage species composition of passes at each detector 2020 (left) and 2021 (right).





Note: The 2020 plot includes Q22, the Furmiston Copse detector for potential roost activity monitoring.

Figure 2. The recorded activity of bats during the survey 2020. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity). Note: Includes data from nights when bats were recorded, nights when no bats were recorded are not included in Ecobat analysis. Also includes Q22, the detector at Furmiston Copse monitoring for roost activity.

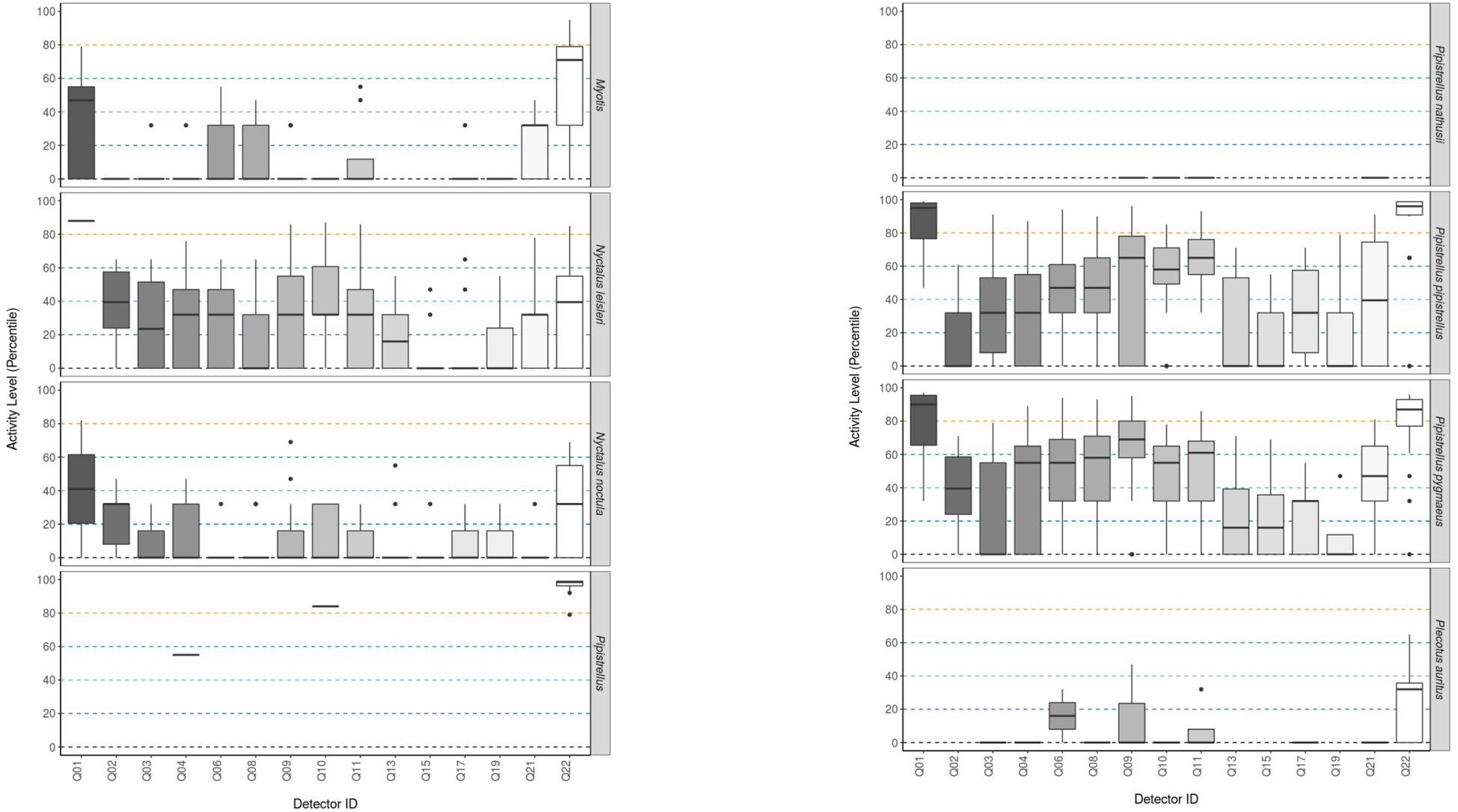


Figure 3. The recorded activity of bats during the survey (2021). The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity). Note: includes data from nights when bats were recorded, nights when no bats were recorded are not included in Ecobat analysis.

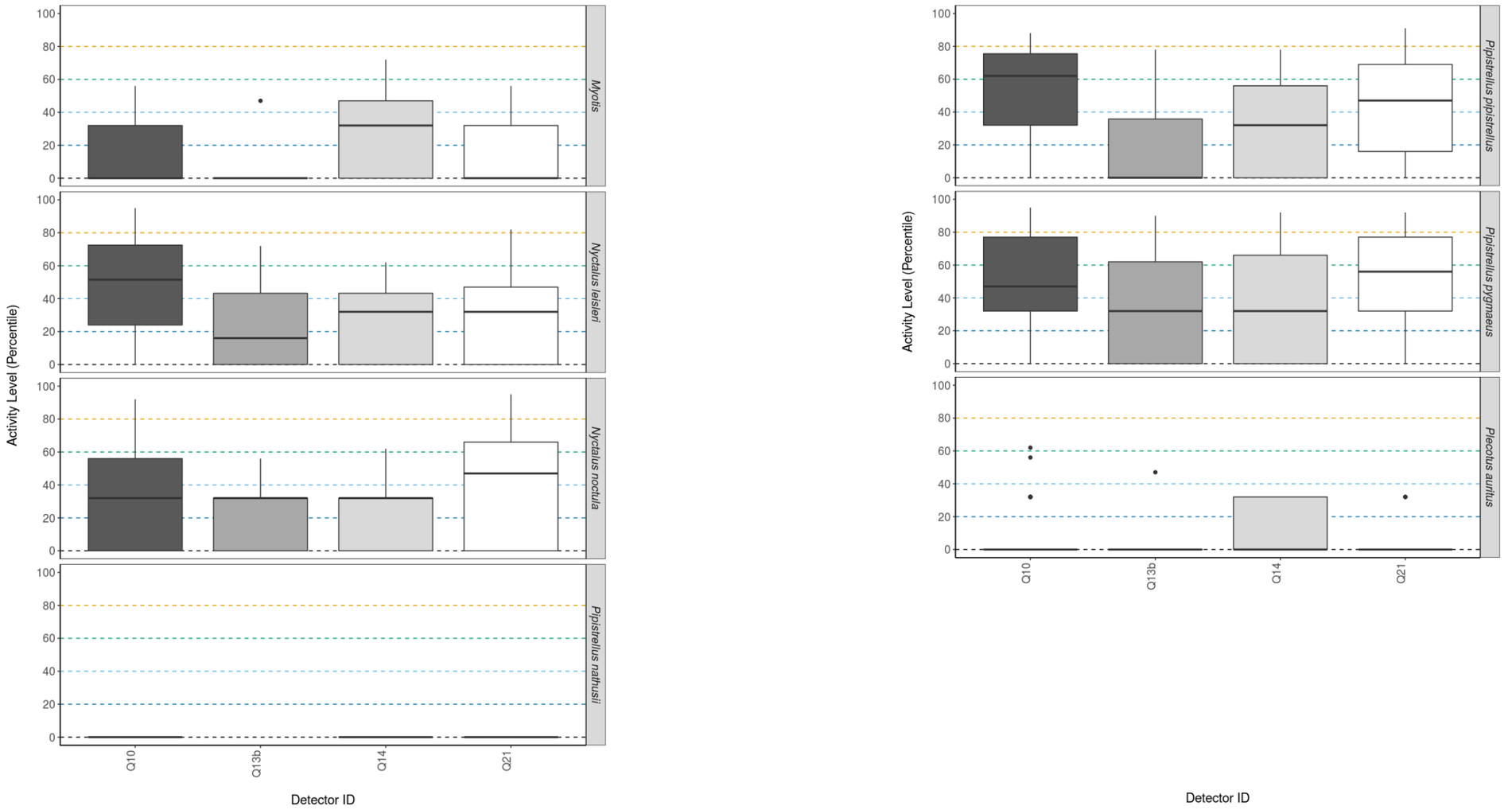
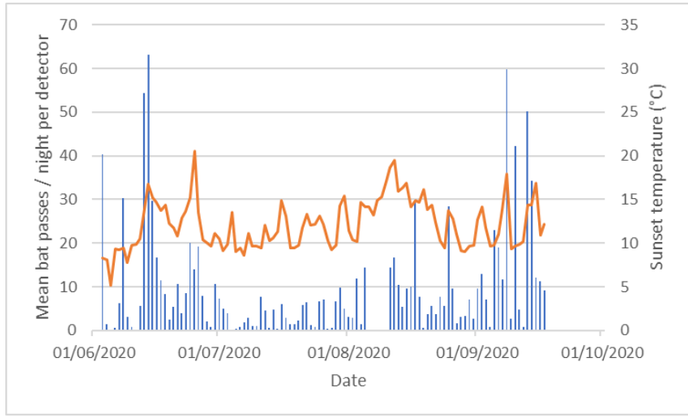
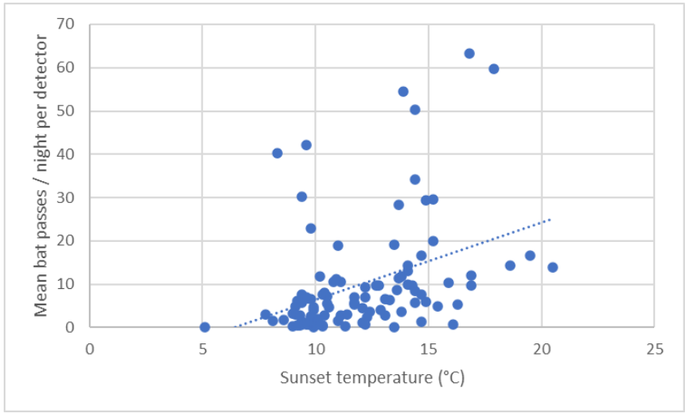
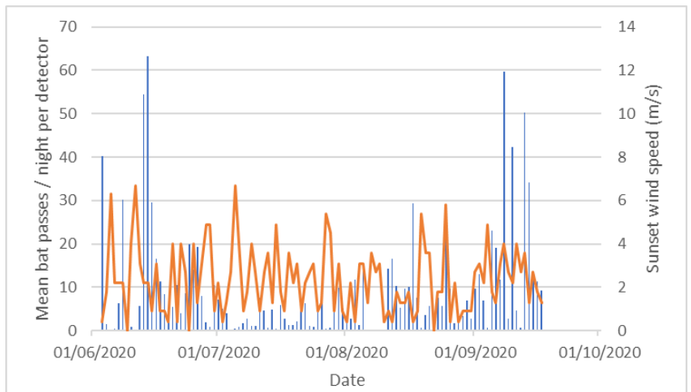


Figure 4: Mean bat passes per night per detector compared to temperature and wind speed (portable weather station) 2020.







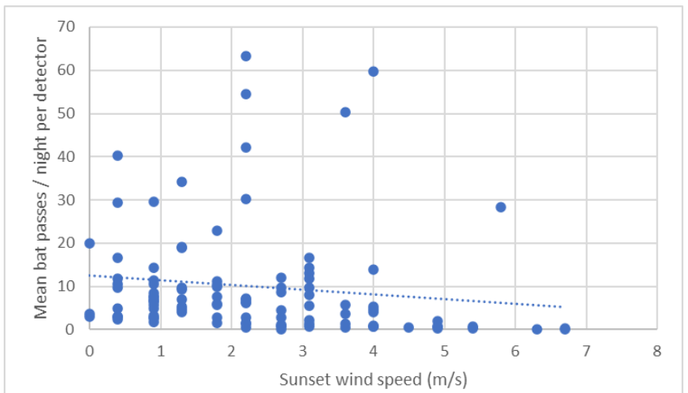
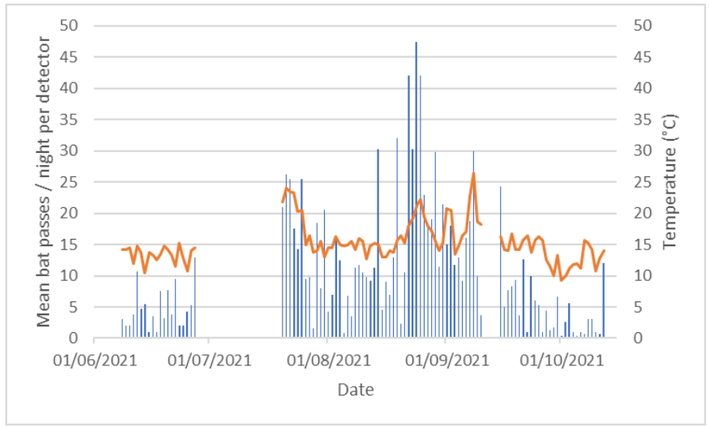
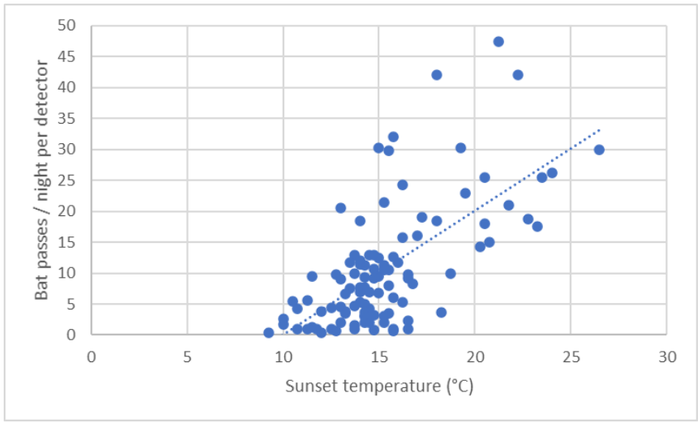
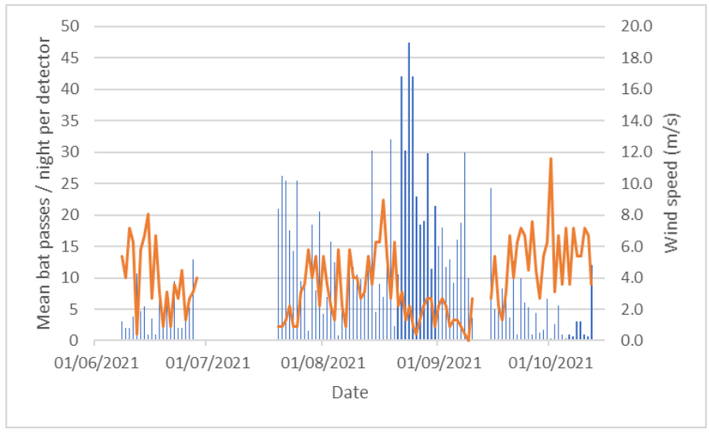


Figure 5: Mean bat passes per night per detector compared to temperature (SM4) and wind speed (Carsphairn) 2021







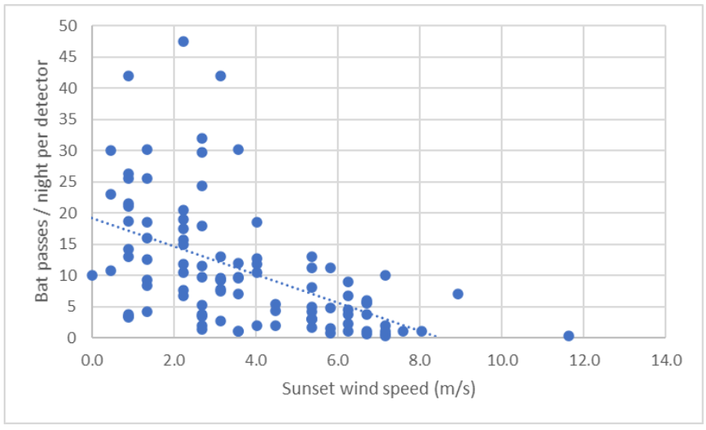
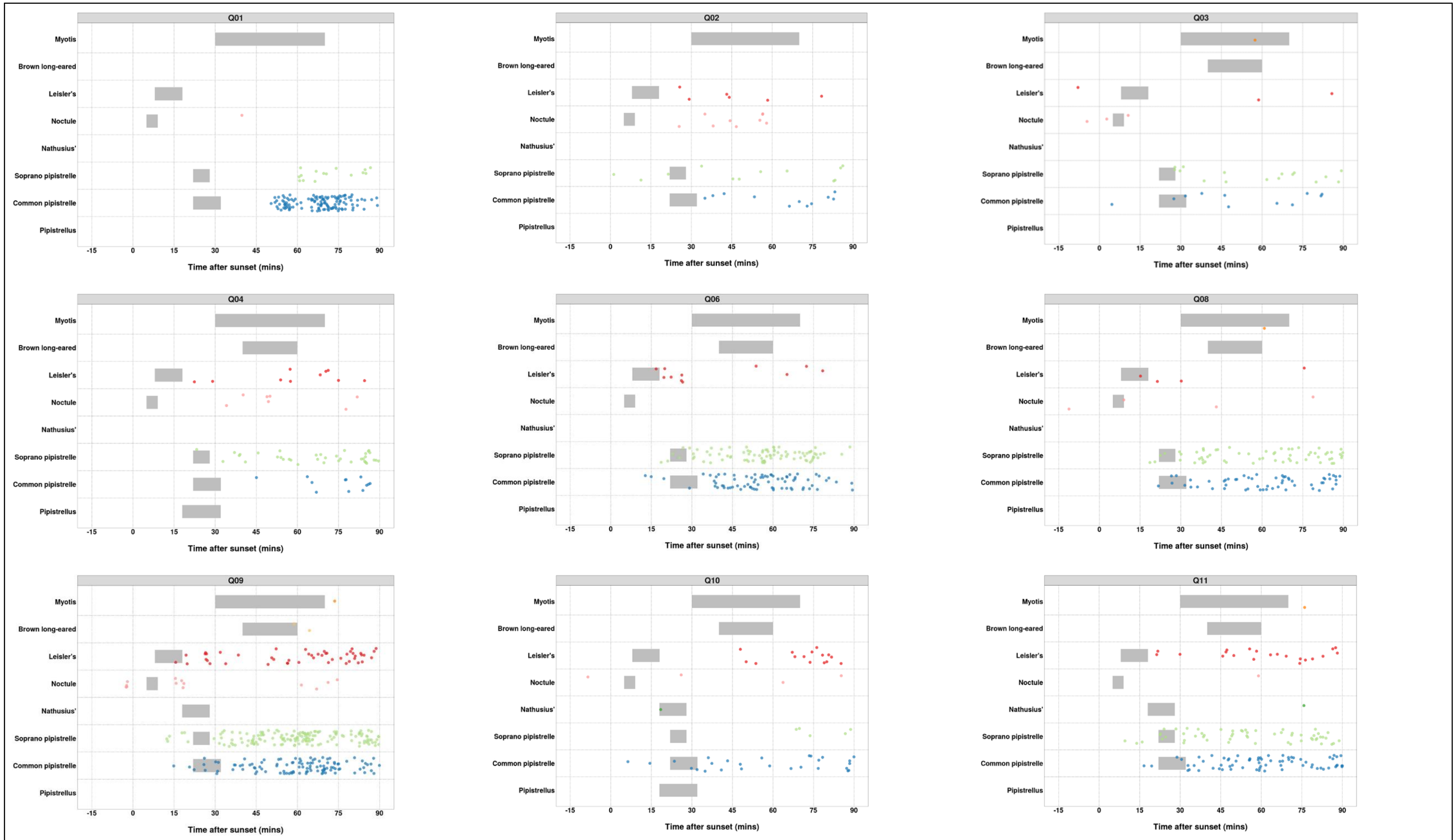


Figure 6: Times of recorded bat passes for each species at each SM4 location 2020 (Ecobat output). Figures show time from 15 minutes before sunset to 90 minutes after sunset. Species specific emergence time ranges (Russ 2012) are shown as grey bars. Bat passes overlapping species-specific grey bars, or occurring earlier than this time may potentially indicate the presence of a nearby roost (NB includes Q22, the detector at Furmiston Copse)



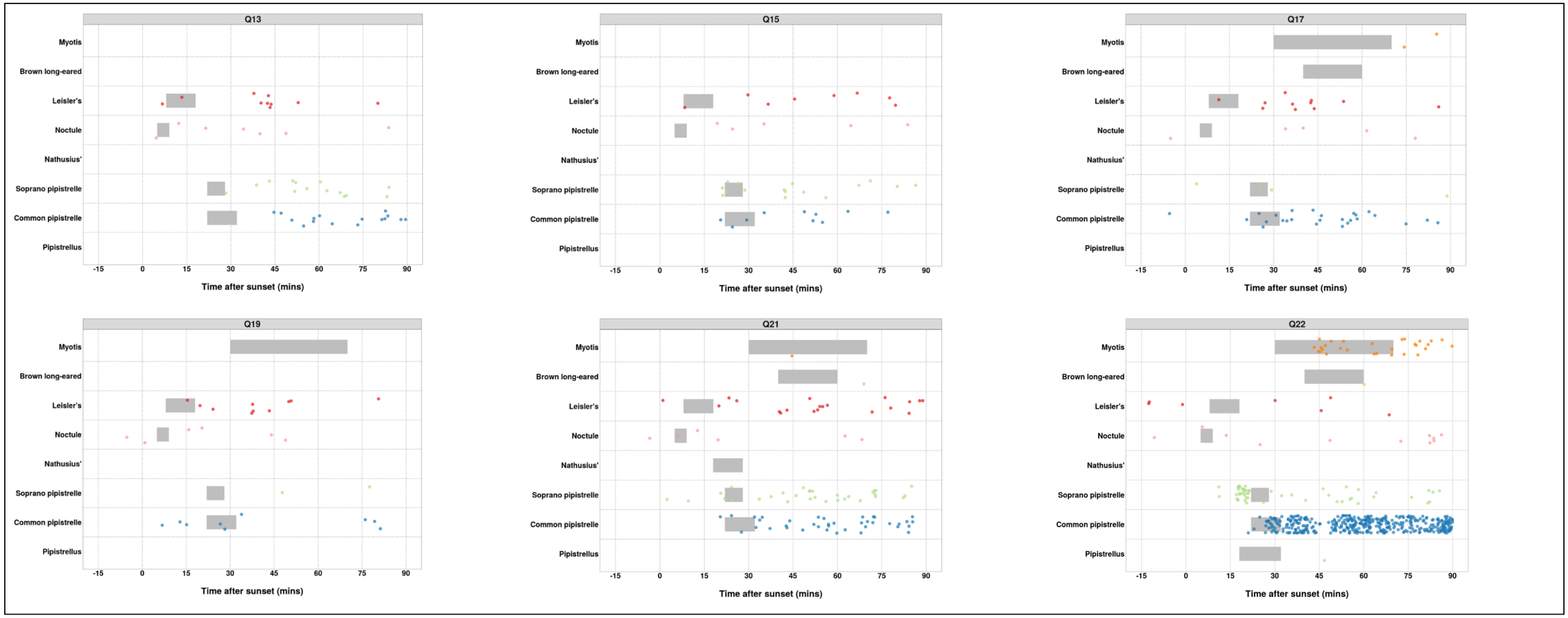
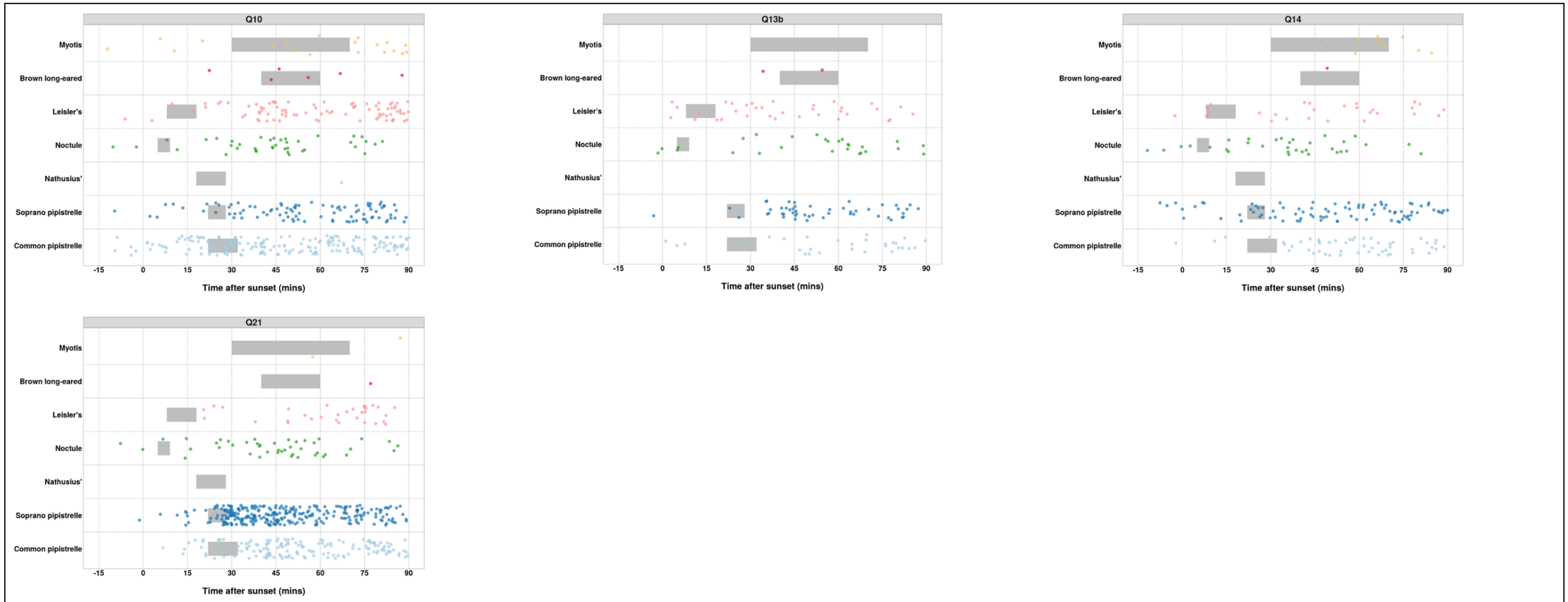

Q13
Q15
Q17
Q19
Q21
Q22
Myotis
Brown long-eared
Leisler's
Noctule
Nathusius'
Soprano pipistrelle
Common pipistrelle
Pipistrellus
-15
0
15
30
45
60
75
90
Time after sunset (mins)

Figure 7: Times of recorded bat passes for each species at each SM4 location 2021 (Ecobat output). Figures show time from 15 minutes before sunset to 90 minutes after sunset. Species specific emergence time ranges (Russ 2012) are shown as grey bars. Bat passes overlapping species-specific grey bars, or occurring earlier than this time may potentially indicate the presence of a nearby roost.



APPENDIX 3: ECOBAT ANALYSIS OUTPUT FOR REFERENCE DATASET COMPARISONS

Table 1. Summary table showing the number of nights recorded bat activity fell into each activity band for each species at each detector (2020).

Detector ID	Number of Detector Nights	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Q01	13	*Myotis*	0	2	3	1	**3**
Q01	13	*Nyctalus leisleri*	1	0	0	0	**0**
Q01	13	*Nyctalus noctula*	1	0	0	0	**1**
Q01	13	*Pipistrellus pipistrellus*	5	2	1	0	**0**
Q01	13	*Pipistrellus pygmaeus*	4	1	1	1	**0**
Q02	36	*Myotis*	0	0	0	0	**7**
Q02	36	*Nyctalus leisleri*	0	2	2	2	**2**
Q02	36	*Nyctalus noctula*	0	0	1	3	**2**
Q02	36	*Pipistrellus pipistrellus*	0	1	1	3	**6**
Q02	36	*Pipistrellus pygmaeus*	0	3	3	3	**3**
Q03	38	*Myotis*	0	0	0	1	**6**
Q03	38	*Nyctalus leisleri*	0	1	1	0	**2**
Q03	38	*Nyctalus noctula*	0	0	0	2	**5**
Q03	38	*Pipistrellus pipistrellus*	2	0	2	3	**3**
Q03	38	*Pipistrellus pygmaeus*	0	3	4	1	**9**
Q03	38	*Plecotus auritus*	0	0	0	0	**2**
Q04	36	*Myotis*	0	0	0	1	**7**
Q04	36	*Nyctalus leisleri*	0	4	2	3	**8**
Q04	36	*Nyctalus noctula*	0	0	3	1	**9**
Q04	36	*Pipistrellus*	0	0	1	0	**0**
Q04	36	*Pipistrellus pipistrellus*	1	4	3	4	**11**
Q04	36	*Pipistrellus pygmaeus*	1	10	3	2	**7**
Q04	36	*Plecotus auritus*	0	0	0	0	**1**
Q06	31	*Myotis*	0	0	2	3	**6**
Q06	31	*Nyctalus leisleri*	0	1	2	2	**4**
Q06	31	*Nyctalus noctula*	0	0	0	1	**4**
Q06	31	*Pipistrellus pipistrellus*	4	1	4	5	**3**
Q06	31	*Pipistrellus pygmaeus*	3	5	4	4	**3**
Q06	31	*Plecotus auritus*	0	0	0	1	**1**
Q08	36	*Myotis*	0	0	2	2	**6**
Q08	36	*Nyctalus leisleri*	0	1	2	2	**8**
Q08	36	*Nyctalus noctula*	0	0	0	2	**7**
Q08	36	*Pipistrellus pipistrellus*	2	8	5	7	**7**
Q08	36	*Pipistrellus pygmaeus*	3	10	5	6	**2**
Q08	36	*Plecotus auritus*	0	0	0	0	**7**
Q09	31	*Myotis*	0	0	0	2	**8**
Q09	31	*Nyctalus leisleri*	3	2	4	5	**7**
Q09	31	*Nyctalus noctula*	0	1	1	1	**8**
Q09	31	*Pipistrellus nathusii*	0	0	0	0	**1**
Q09	31	*Pipistrellus pipistrellus*	5	7	3	1	**7**
Q09	31	*Pipistrellus pygmaeus*	7	13	3	1	**3**
Q09	31	*Plecotus auritus*	0	0	1	0	**2**
Q10	16	*Myotis*	0	0	0	0	**5**
Q10	16	*Nyctalus leisleri*	2	1	2	5	**2**
Q10	16	*Nyctalus noctula*	0	0	0	2	**3**
Q10	16	*Pipistrellus*	1	0	0	0	**0**
Q10	16	*Pipistrellus nathusii*	0	0	0	0	**1**
Q10	16	*Pipistrellus pipistrellus*	1	7	4	2	**2**
Q10	16	*Pipistrellus pygmaeus*	0	6	1	3	**3**
Q10	16	*Plecotus auritus*	0	0	0	0	**3**
Q11	31	*Myotis*	0	0	2	0	**6**
Q11	31	*Nyctalus leisleri*	1	1	4	4	**7**
Q11	31	*Nyctalus noctula*	0	0	0	1	**2**
Q11	31	*Pipistrellus nathusii*	0	0	0	0	**3**
Q11	31	*Pipistrellus pipistrellus*	5	13	7	2	**0**
Q11	31	*Pipistrellus pygmaeus*	1	13	4	3	**6**
Q11	31	*Plecotus auritus*	0	0	0	1	**3**
Q13	35	*Nyctalus leisleri*	0	0	1	3	**4**
Q13	35	*Nyctalus noctula*	0	0	1	1	**9**
Q13	35	*Pipistrellus pipistrellus*	0	2	1	0	**5**
Q13	35	*Pipistrellus pygmaeus*	0	2	0	2	**4**
Q15	35	*Nyctalus leisleri*	0	0	1	1	**8**
Q15	35	*Nyctalus noctula*	0	0	0	1	**4**
Q15	35	*Pipistrellus pipistrellus*	0	0	1	4	**11**
Q15	35	*Pipistrellus pygmaeus*	0	1	2	3	**6**
Q17	35	*Myotis*	0	0	0	1	**6**
Q17	35	*Nyctalus leisleri*	0	1	1	0	**7**
Q17	35	*Nyctalus noctula*	0	0	0	2	**5**
Q17	35	*Pipistrellus pipistrellus*	0	4	2	4	**4**
Q17	35	*Pipistrellus pygmaeus*	0	0	1	3	**3**
Q17	35	*Plecotus auritus*	0	0	0	0	**1**
Q19	35	*Myotis*	0	0	0	0	**5**
Q19	35	*Nyctalus leisleri*	0	0	1	1	**4**
Q19	35	*Nyctalus noctula*	0	0	0	2	**5**
Q19	35	*Pipistrellus pipistrellus*	0	1	1	3	**7**

Detector ID	Number of Detector Nights	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Q19	35	*Pipistrellus pygmaeus*	0	0	1	0	**3**
Q21	35	*Myotis*	0	0	1	2	**2**
Q21	35	*Nyctalus leisleri*	0	4	0	6	**8**
Q21	35	*Nyctalus noctula*	0	0	0	1	**4**
Q21	35	*Pipistrellus nathusii*	0	0	0	0	**1**
Q21	35	*Pipistrellus pipistrellus*	6	6	4	5	**11**
Q21	35	*Pipistrellus pygmaeus*	1	9	5	4	**6**
Q21	35	*Plecotus auritus*	0	0	0	0	**2**

Table 2. Summary table showing key metrics for each species recorded at each detector (2020). The reference range is the number of nights for each species that your data were compared to. Ecobat recommend a Reference Range of 200+ to be confident in the relative activity level.

Detector ID	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Q01	*Myotis*	47	43.5 - 67	79	9	**1239**
Q01	*Nyctalus leisleri*	88	0	88	1	**1330**
Q01	*Nyctalus noctula*	41	41 - 41	82	2	**690**
Q01	*Pipistrellus pipistrellus*	95	69 - 98	99	8	**3369**
Q01	*Pipistrellus pygmaeus*	90	43.5 - 96.5	97	7	**3590**
Q02	*Myotis*	0	0 - 0	0	7	**1239**
Q02	*Nyctalus leisleri*	40	32 - 65	65	8	**1330**
Q02	*Nyctalus noctula*	32	32 - 32	47	6	**690**
Q02	*Pipistrellus pipistrellus*	0	32 - 46.5	61	11	**3369**
Q02	*Pipistrellus pygmaeus*	40	32 - 69	71	12	**3590**
Q03	*Myotis*	0	0 - 0	32	7	**1239**
Q03	*Nyctalus leisleri*	24	56 - 56	65	4	**1330**
Q03	*Nyctalus noctula*	0	0 - 0	32	7	**690**
Q03	*Pipistrellus pipistrellus*	32	32 - 69	91	10	**3369**
Q03	*Pipistrellus pygmaeus*	0	43.5 - 69	79	17	**3590**
Q03	*Plecotus auritus*	0	0 - 0	0	2	**142**
Q04	*Myotis*	0	0 - 0	32	8	**1239**
Q04	*Nyctalus leisleri*	32	32 - 69	76	17	**1330**
Q04	*Nyctalus noctula*	0	47 - 47	47	13	**690**
Q04	*Pipistrellus*	55	0	55	1	**4481**
Q04	*Pipistrellus pipistrellus*	32	39.5 - 69	87	23	**3369**
Q04	*Pipistrellus pygmaeus*	55	53 - 68	89	23	**3590**
Q04	*Plecotus auritus*	0	0	0	1	**142**
Q06	*Myotis*	0	32 - 43.5	55	11	**1239**
Q06	*Nyctalus leisleri*	32	32 - 56	65	9	**1330**
Q06	*Nyctalus noctula*	0	0 - 0	32	5	**690**
Q06	*Pipistrellus pipistrellus*	47	39.5 - 70	94	17	**3369**
Q06	*Pipistrellus pygmaeus*	55	48.5 - 71.5	94	19	**3590**
Q06	*Plecotus auritus*	16	16 - 16	32	2	**142**
Q08	*Myotis*	0	32 - 47	47	10	**1239**
Q08	*Nyctalus leisleri*	0	32 - 56	65	13	**1330**
Q08	*Nyctalus noctula*	0	0 - 0	32	9	**690**
Q08	*Pipistrellus pipistrellus*	47	46.5 - 64.5	90	29	**3369**
Q08	*Pipistrellus pygmaeus*	58	48.5 - 67	93	26	**3590**
Q08	*Plecotus auritus*	0	0 - 0	0	7	**142**
Q09	*Myotis*	0	0 - 0	32	10	**1239**
Q09	*Nyctalus leisleri*	32	43.5 - 68	86	21	**1330**
Q09	*Nyctalus noctula*	0	32 - 69	69	11	**690**
Q09	*Pipistrellus nathusii*	0	0	0	1	**69**
Q09	*Pipistrellus pipistrellus*	65	62 - 80.5	96	23	**3369**
Q09	*Pipistrellus pygmaeus*	69	66.5 - 79	95	27	**3590**
Q09	*Plecotus auritus*	0	0 - 0	47	3	**142**
Q10	*Myotis*	0	0 - 0	0	5	**1239**
Q10	*Nyctalus leisleri*	32	32 - 62.5	87	12	**1330**
Q10	*Nyctalus noctula*	0	0 - 0	32	5	**690**
Q10	*Pipistrellus*	84	0	84	1	**4481**
Q10	*Pipistrellus nathusii*	0	0	0	1	**69**
Q10	*Pipistrellus pipistrellus*	58	51.5 - 70	85	16	**3369**
Q10	*Pipistrellus pygmaeus*	55	43.5 - 68	78	13	**3590**
Q10	*Plecotus auritus*	0	0 - 0	0	3	**142**
Q11	*Myotis*	0	51 - 51	55	8	**1239**
Q11	*Nyctalus leisleri*	32	32 - 60.5	86	17	**1330**
Q11	*Nyctalus noctula*	0	0 - 0	32	3	**690**
Q11	*Pipistrellus nathusii*	0	0 - 0	0	3	**69**
Q11	*Pipistrellus pipistrellus*	65	59 - 71	93	27	**3369**
Q11	*Pipistrellus pygmaeus*	61	54 - 68.5	86	27	**3590**
Q11	*Plecotus auritus*	0	0 - 0	32	4	**142**
Q13	*Nyctalus leisleri*	16	32 - 32	55	8	**1330**
Q13	*Nyctalus noctula*	0	43.5 - 43.5	55	11	**690**
Q13	*Pipistrellus pipistrellus*	0	71 - 71	71	8	**3369**
Q13	*Pipistrellus pygmaeus*	16	32 - 61	71	8	**3590**
Q15	*Nyctalus leisleri*	0	39.5 - 39.5	47	10	**1330**
Q15	*Nyctalus noctula*	0	0 - 0	32	5	**690**
Q15	*Pipistrellus pipistrellus*	0	32 - 32	55	16	**3369**
Q15	*Pipistrellus pygmaeus*	16	32 - 55	69	12	**3590**
Q17	*Myotis*	0	0 - 0	32	7	**1239**
Q17	*Nyctalus leisleri*	0	56 - 56	65	9	**1330**
Q17	*Nyctalus noctula*	0	0 - 0	32	7	**690**

Detector ID	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Q17	*Pipistrellus pipistrellus*	32	32 - 65	71	14	**3369**
Q17	*Pipistrellus pygmaeus*	32	32 - 32	55	7	**3590**
Q17	*Plecotus auritus*	0	0	0	1	**142**
Q19	*Myotis*	0	0 - 0	0	5	**1239**
Q19	*Nyctalus leisleri*	0	43.5 - 43.5	55	6	**1330**
Q19	*Nyctalus noctula*	0	0 - 0	32	7	**690**
Q19	*Pipistrellus pipistrellus*	0	32 - 55.5	79	12	**3369**
Q19	*Pipistrellus pygmaeus*	0	0 - 0	47	4	**3590**
Q21	*Myotis*	32	32 - 32	47	5	**1239**
Q21	*Nyctalus leisleri*	32	32 - 55	78	18	**1330**
Q21	*Nyctalus noctula*	0	0 - 0	32	5	**690**
Q21	*Pipistrellus nathusii*	0	0	0	1	**69**
Q21	*Pipistrellus pipistrellus*	40	53 - 75	91	32	**3369**
Q21	*Pipistrellus pygmaeus*	47	48.5 - 66	81	25	**3590**
Q21	*Plecotus auritus*	0	0 - 0	0	2	**142**

Table 3. Summary table showing the number of nights recorded bat activity fell into each activity band for each species at each detector (2021).

Detector ID	Number of Detector Nights	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Q10	98	*Myotis*	0	0	11	13	**28**
Q10	98	*Nyctalus leisleri*	7	11	8	4	**10**
Q10	98	*Nyctalus noctula*	3	3	7	6	**10**
Q10	98	*Pipistrellus nathusii*	0	0	0	0	**3**
Q10	98	*Pipistrellus pipistrellus*	12	34	14	10	**17**
Q10	98	*Pipistrellus pygmaeus*	16	15	16	14	**16**
Q10	98	*Plecotus auritus*	0	1	1	5	**23**
Q13b	72	*Myotis*	0	0	1	0	**9**
Q13b	72	*Nyctalus leisleri*	0	2	5	6	**13**
Q13b	72	*Nyctalus noctula*	0	0	4	8	**9**
Q13b	72	*Pipistrellus pipistrellus*	0	5	4	8	**19**
Q13b	72	*Pipistrellus pygmaeus*	3	9	8	5	**17**
Q13b	72	*Plecotus auritus*	0	0	1	0	**5**
Q14	99	*Myotis*	0	3	10	10	**20**
Q14	99	*Nyctalus leisleri*	0	2	5	7	**12**
Q14	99	*Nyctalus noctula*	0	2	4	9	**14**
Q14	99	*Pipistrellus nathusii*	0	0	0	0	**1**
Q14	99	*Pipistrellus pipistrellus*	0	10	6	10	**17**
Q14	99	*Pipistrellus pygmaeus*	5	16	6	15	**18**
Q14	99	*Plecotus auritus*	0	0	0	4	**5**

Detector ID	Number of Detector Nights	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Q21	99	*Myotis*	0	0	3	10	**24**
Q21	99	*Nyctalus leisleri*	1	2	10	12	**14**
Q21	99	*Nyctalus noctula*	3	11	6	3	**12**
Q21	99	*Pipistrellus nathusii*	0	0	0	0	**1**
Q21	99	*Pipistrellus pipistrellus*	3	26	16	11	**19**
Q21	99	*Pipistrellus pygmaeus*	15	25	21	8	**14**
Q21	99	*Plecotus auritus*	0	0	0	3	**10**

Table 4. Summary table showing key metrics for each species recorded at each detector (2021). The reference range is the number of nights for each species that your data were compared to. Ecobat recommend a Reference Range of 200+ to be confident in the relative activity level.

Detector ID	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Q10	*Myotis*	0	32 - 44	56	52	**1373**
Q10	*Nyctalus leisleri*	52	56.5 - 71.5	95	40	**1461**
Q10	*Nyctalus noctula*	32	44 - 63.5	92	29	**804**
Q10	*Pipistrellus nathusii*	0	0 - 0	0	3	**74**
Q10	*Pipistrellus pipistrellus*	62	59.5 - 69.5	88	87	**3602**
Q10	*Pipistrellus pygmaeus*	47	56 - 67.5	95	77	**3845**
Q10	*Plecotus auritus*	0	32 - 44	62	30	**200**
Q13b	*Myotis*	0	0 - 0	47	10	**1373**
Q13b	*Nyctalus leisleri*	16	32 - 52	72	26	**1461**
Q13b	*Nyctalus noctula*	32	32 - 44	56	21	**804**
Q13b	*Pipistrellus pipistrellus*	0	32 - 55	78	36	**3602**
Q13b	*Pipistrellus pygmaeus*	32	47 - 64	90	42	**3845**
Q13b	*Plecotus auritus*	0	0 - 0	47	6	**200**
Q14	*Myotis*	32	39.5 - 47	72	43	**1373**
Q14	*Nyctalus leisleri*	32	32 - 51.5	62	26	**1461**
Q14	*Nyctalus noctula*	32	32 - 47	62	29	**804**
Q14	*Pipistrellus nathusii*	0	0	0	1	**74**
Q14	*Pipistrellus pipistrellus*	32	44 - 56.5	78	43	**3602**
Q14	*Pipistrellus pygmaeus*	32	49 - 61	92	60	**3845**
Q14	*Plecotus auritus*	0	0 - 0	32	9	**200**
Q21	*Myotis*	0	32 - 39.5	56	37	**1373**
Q21	*Nyctalus leisleri*	32	39.5 - 47	82	39	**1461**
Q21	*Nyctalus noctula*	47	54.5 - 69	95	35	**804**
Q21	*Pipistrellus nathusii*	0	0	0	1	**74**
Q21	*Pipistrellus pipistrellus*	47	53 - 63.5	91	75	**3602**
Q21	*Pipistrellus pygmaeus*	56	59 - 68	92	83	**3845**
Q21	*Plecotus auritus*	0	0 - 0	32	13	**200**

Table 5. Site-wide summary table showing the number of nights recorded bat activity fell into each activity band for each species (2020).

Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Myotis	0	2	10	13	**67**
Nyctalus leisleri	7	18	23	34	**71**
Nyctalus noctula	1	1	6	20	**68**
Pipistrellus	1	0	1	0	**0**
Pipistrellus nathusii	0	0	0	0	**6**
Pipistrellus pipistrellus	31	56	39	43	**77**
Pipistrellus pygmaeus	20	76	37	36	**58**
Plecotus auritus	0	0	1	2	**22**

Table 6. Site-wide summary table showing key metrics for each species recorded (2020)

Species/Species Group	Median Percentile	ECOBAT Activity Level (Median)	Max Percentile	ECOBAT Activity Level (Max)	Nights Recorded
Myotis	0	Low	79	Moderate-High	**91**
Nyctalus leisleri	32	Low-Moderate	88	High	**153**
Nyctalus noctula	0	Low	82	High	**95**
Pipistrellus	70	Moderate-High	84	High	**2**
Pipistrellus nathusii	0	Low	0	Low	**6**
Pipistrellus pipistrellus	47	Moderate	99	High	**244**
Pipistrellus pygmaeus	55	Moderate	97	High	**227**
Plecotus auritus	0	Low	47	Moderate	**25**

Table 7. Site-wide summary table showing the number of nights recorded bat activity fell into each activity band for each species (2021).

Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Myotis	0	3	25	33	**81**
Nyctalus leisleri	8	17	28	29	**49**
Nyctalus noctula	6	16	21	26	**45**
Pipistrellus nathusii	0	0	0	0	**5**
Pipistrellus pipistrellus	15	75	40	39	**72**
Pipistrellus pygmaeus	39	65	51	42	**65**
Plecotus auritus	0	1	2	12	**43**

Table 8. Site-wide summary table showing key metrics for each species recorded (2021).

Species/Species Group	Median Percentile	ECOBAT Activity Level (Median)	Max Percentile	ECOBAT Activity Level (Max)	Nights Recorded
Myotis	0	Low	72	Moderate-High	**142**
Nyctalus leisleri	32	Low-Moderate	95	High	**131**
Nyctalus noctula	32	Low-Moderate	95	High	**114**
Pipistrellus nathusii	0	Low	0	Low	**5**
Pipistrellus pipistrellus	47	Moderate	91	High	**241**
Pipistrellus pygmaeus	47	Moderate	95	High	**262**
Plecotus auritus	0	Low	62	Moderate-High	**58**

Document history

Author	Paul Bradshaw	17/11/2021
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Client Details	
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Appendix 6.4

Fish Population and Fish Habitat Survey Results

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.4.1 Introduction

Purpose of this Document

A6.4.1.1 This is a Technical Appendix to Chapter 6: Ecology & Biodiversity of the Environmental Impact Assessment Report (EIAR) for the proposed Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with that Chapter.

A6.4.1.2 This Technical Appendix comprises two reports produced by Galloway Fisheries Trust (GFT). GFT were commissioned by the Applicant to undertake baseline fish population surveys and fish habitat surveys to inform the design and EIA process for the Proposed Development, as follows:

- Fisheries electrofishing survey for Quantans Hill Wind Farm. November 2020. (GFT Report No. – SBAD191120); and
- Fisheries habitat survey for Quantans Hill Wind Farm. August 2021. (GFT Report No. – SBAD030821).

A6.4.1.3 The results of these surveys have been fully considered within the assessment of effects on fish and aquatic habitats and the proposed mitigation and monitoring measures to protect fish populations during the construction and operation and decommissioning phases of the Proposed Development.

Electrofishing Survey

A6.4.1.4 The GFT report of the results of the baseline electrofishing survey of the Proposed Development site, completed during September 2020, are provided in full as Appendix 1 to this document. A summary of the key findings is provided in Chapter 6: Ecology & Biodiversity of the EIAR (see Section 6.6).

Fish Habitat Survey

A6.4.1.5 The GFT completed a fish habitat survey in July 2021, which focused on the proposed watercourse crossing locations where there was the potential for salmonid fish to be present. The report from this survey is provided in full as Appendix 2 to this document. A summary of the key findings is provided in Chapter 6: Ecology & Biodiversity of the EIAR (see Section 6.6).

Appendix 1: Electrofishing Survey Report

A Scottish Registered Charity
No. SC 020751

Commissioned Report No. – SBAD191120

Fisheries electrofishing survey for Quantans Wind Farm

For further information on this report please contact:

Name of GFT Project Manager – S V Beck
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This report should be quoted as:

Galloway Fisheries Trust. November 2020. Fisheries electrofishing survey for Quantans Wind Farm.
Galloway Fisheries Trust Report No. – SBAD191120

Summary

Fisheries electrofishing survey for Quantans Wind Farm

Commissioned Report No.: Report No. – SBAD191120
Contractor: MBEC
Year of publication: November 2020

Keywords

Electrofishing; Quantans; Kirkcudbrightshire Dee catchment; Wind Farm; lampreys; salmonids; juvenile surveys; baseline.

Background

The Galloway Fisheries Trust (GFT) was commissioned by MBEC to carry out an electrofishing survey for the proposed Quantans Wind Farm (herein referred to as the 'Development'), which will lie within the Kirkcudbrightshire Dee catchment in Dumfries and Galloway.

Surveys were undertaken in September 2020 in the Dee catchment to complete baseline fish surveys within the vicinity of the proposed development. These surveys were selected based on previous knowledge and utilising maps of the Development, to determine habitats with the potential to support a fish population. This work was completed to inform MBEC of the status of fish populations in the vicinity of the development in the pre-construction phase.

Main findings of the 2020 electrofishing survey

- Seven sites located within the development area and three control sites outside the development area were surveyed using electrofishing techniques for this study. All sites were located within the Dee catchment area.
- The sites for this electrofishing survey ranged from poor to good quality instream habitat.
- Six sites were considered as suitable to potentially support freshwater pearl mussels.
- Juvenile salmon were recorded in low densities at one site only, which was a control site and the only site with access to migratory fishes.
- Seven of the 10 sites held trout populations, where juvenile trout were recorded in very low to moderate densities.
- Minnows and stone loach were the only non-salmonid fish species encountered during the surveys, being present at two sites only.

For further information on this project contact:
Name of Project Manager – S V Beck
Telephone No. of Project Manager – 01671 403011

Table of Contents **Page**

1 INTRODUCTION

Galloway Fisheries Trust (GFT) was commissioned by MBEC to undertake pre-construction electrofishing surveys for the proposed Quantans Wind Farm. The development is within the River Dee catchment in the South West of Scotland, which is managed by the Kirkcudbrightshire Dee District Salmon Fisheries Board (KDDSFB) and is covered by GFT.

There is a variety of legislation, regulations and guidance in place relating to fish species that may be present in watercourses within the Dee catchment:

1) Atlantic salmon (*Salmon salar*) are an internationally important fish species which is listed under Annex II and V of the European Habitats Directive (1992) (only in freshwater), Appendix III of the Bern Convention (1979) (only in freshwater) and are a local priority species in the Dumfries and Galloway Local Biodiversity Action Plan. Atlantic salmon are also a species of Conservation Concern on a UK level.
2) Brown trout/sea trout (*Salmo trutta*) are also a UK Biodiversity Action Plan species.
3) Brook lampreys (*Lampetra planeri*) are protected under Annex IIa and III of the EC Habitats and Species Directive 1992.
4) Freshwater Pearl mussels (*Margaritifera margaritifera*) are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), are listed on the EU Habitats and Species Directive (Annexes II and V) and Appendix III of the Bern Convention 1979. They are included on the IUCN Invertebrate Red List, where their status is described as Vulnerable. Freshwater Pearl mussels are also classified as a priority species in the UK Biodiversity Action Plan.

The possible impacts that any land-based wind farm development and its associated infrastructure could have on surrounding fish populations are well known. The potential for fish species and their habitats to be affected by the development mainly occurs during the construction and decommissioning phases of the development. During the construction phase, potential impacts include siltation from ground disturbance, accelerated or exacerbated erosion of watercourse banksides, hydrological changes to watercourses and surface water run-off, pollution of watercourses, and the blocking or hindering of the upstream/downstream migration of fish. During the operational phase, concerns include the effects of poor road drainage, accelerated levels of erosion, fish access issues through watercourse crossings such as culverts, and the maintenance of silt traps and watercourse crossings. Potential risks to fish populations and their habitats during the decommissioning phase are broadly similar to those in the construction phase. These potential effects could all impact fish populations by: 1) causing direct mortality of juveniles and adults; 2) changes in food availability; 3) creating avoidance behaviour resulting in unused habitat; 3) blocking fish migration routes to spawning grounds; and finally 4) causing damage to instream and riparian habitats.

GFT identified potential sites that should be targeted for electrofishing surveys based on the proposed distribution of turbines, combined with those rivers that contain suitable habitats to potentially support a fish population. These sites will provide baseline data of fish diversity for the main watercourses draining the proposed Development prior to its construction. It was recommended that electrofishing surveys should be undertaken at a total of 10 sites within the upper Kirkcudbrightshire Dee catchment, three of which should be designated as control sites located outside the Development vicinity to enable future comparisons between undisturbed and disturbed sites.

The Development is located upstream of Kendoon Loch (reservoir) where the lack of a fish pass prevents access to migratory species (e.g. salmon or sea trout). The only site that migratory fishes have access to is the Polharrow Burn (QWF10), a control site. The absence of eels (*Anguilla anguilla*), river lampreys (*Lampetra fluviatiliis*) and sea lampreys (*Petromyzon marinus*) within the Dee is attributed to not being able to pass Tongland Fish ladder further downstream, in the lower part of the catchment. However, brook lampreys (*Lampetra planeri)* may still be detected as they complete their lifecycle entirely in freshwater.

2 AIMS

The aims of this work were as follows:

2.1 To undertake baseline electrofishing surveys within the boundary of the proposed Quantans Wind Farm Development on the Kirkcudbrightshire Dee catchment.

2.2 Undertake a detailed bankside and habitat survey at each electrofishing survey site.

2.3 To analyse and present results from the surveys in report form, briefly discussing any particular sensitivities and/or issues relating to juvenile salmonids found within the surveys.

3 METHODOLOGY

3.1 Data recording

The GFT is a partner in the Scottish Fisheries Co-ordination Centre (SFCC), an initiative involving 26 Scottish Fishery Trusts and others, including Marine Scotland Science (Scottish Government), the Tweed Foundation, the Spey Research Trust, the Tay Foundation and the Cromarty Firth Fisheries Trust[1].

This group has, in partnership, developed a set of agreed survey and data collection methodologies for electrofishing surveys and an associated database in which to record information gathered from such surveys. The electrofishing surveys undertaken by GFT for this study have been completed to the high standards that are required by the SFCC and recorded using the agreed methodologies.

3.2 Electrofishing surveys

To assess those fish populations present within a section of river, various techniques have been developed in recent decades. The main method of determining the status of a juvenile salmonid population is through employing the use of electrofishing equipment.

Electrofishing involves the 'stunning' of fish using an electric current which overpowers the nervous system of the fish and enables the operator to remove them from the water. Once captured, the fish recover in a holding container. They are then anaesthetised using a specific fish anaesthetic, identified to species level, measured and recorded. Once recovered, they are then returned unharmed to the area from which they were captured. This method of fishing involves the anode operator drawing stunned fish downstream to a net held against the current by an assistant. A hand net operator completes the three-man team. Captured fish are then transferred to a water-filled recovery container. The fishing team works its way across the survey section and upstream, thereby thoroughly fishing all the water in the chosen survey area.

To obtain fully quantitative information on the fish populations (primarily juvenile salmonids – see Section 3.2.1) within an area of interest, each survey site is fished through up to four times consecutively to allow the calculation of a more accurate estimate of the fish population present. A Zippin estimation of a fish population is a common calculation carried out using data derived from the depletion method of fishing (i.e., multiple-run fishing)[2]. The result provides an estimate

[1] http://www.sfcc.co.uk/

[2] Zippin, C. (1958). The Removal Method of Population Estimation. Journal of Wildlife Management, 22. Pp 82-90.

of the fish population density per 100 m^2 of water, including the 95% confidence limits. When the calculation of a Zippin estimate of the population is not possible, a minimum estimate of the fish population is calculated for that section of river.

For this study, electrofishing was undertaken by three trained GFT staff at all survey sites (Figure S1 in Appendix). After the electrofishing exercise has been completed, a targeted and detailed SFCC habitat survey is completed of the actual fishing site. Results from 2020 are provided in Section 4.1.3.

3.2.1 Limitations of electrofishing surveys

The SFCC method of electrofishing was primarily developed to survey juvenile salmonids in relatively shallow running water. Non-salmonid fish species may be present and caught during these surveys, but their populations may not be properly determined using this method of electrofishing. Any non-salmonid fish species are counted but no population estimate is made.

Electrofishing will never capture all the fish in a survey site, therefore densities presented in this report are an estimate - either a minimum estimate, or, where possible, the calculation of a Zippin estimate of the juvenile salmonid population residing within the site has been presented (see Section 4.1.2 and 4.1.3). The absence of fish cannot be ascertained with certainty using electrofishing techniques so a density of zero does not always guarantee fish are altogether absent from the surveyed section of watercourse. Finally, although a low density of fish can be assessed with electrofishing techniques, low and patchy distributions of fish may make drawing conclusions from the data more difficult.

The juvenile salmonid density classification scheme is based solely on data from surveyed sites containing fish in 1997 to 2002 and refers to regional conditions at that time[3]; it must only be used as a very relative guide and not be used to draw conclusions (Table 1). Moreover, the figures for juvenile trout are less reliable for various reasons (eg some surveyed populations of trout are isolated; sea trout contributing to stock in some areas etc) and so can only be used as a relative indication of numbers (Table 1).

Table 1: Quintile ranges for juvenile salmonids (per 100 m^2 of water; see Table 2 for salmonid age classifications) based on one-run electrofishing events, calculated on densities >0 over 291 sites in the Solway Statistical Region

	Salmon 0+	Salmon 1++	Trout 0+	Trout 1++
Minimum (Very Low)	0.22	0.38	0.38	0.35
20th Percentile (Low)	5.21	2.86	4.14	2.27
40th Percentile (Moderate)	12.68	5.87	12.09	4.71
60th Percentile (High)	25.28	9.12	26.63	8.25
80th Percentile (Very High)	46.53	15.03	56.49	16.28

3.2.2 Electrofishing equipment

The location of all the electrofishing survey sites selected for this study required the use of a mobile backpack electrofishing kit. The battery powered E-fish backpack electrofishing kit consists of an electronic controller unit with a linked cathode of braided copper (placed instream) and a linked, mobile, single anode, consisting of a pole-mounted stainless-steel ring and trigger switch, which is used instream to capture the fish. Smooth direct current was used in all survey sites.

[3] Godfrey, J. D. (2006), Site Condition Monitoring of Atlantic Salmon SACs: Report by the SFCC to Scottish Natural Heritage, Contract F02AC608 https://www2.gov.scot/resource/doc/295194/0096508.pdf

3.2.3 Age determination and density

For this study the electrofishing survey concentrated on assessing the status of juvenile salmonid species, namely salmon and trout. In the majority of cases age determination can be made by assessment of the length of fish present. However, with older fish it is often more difficult to clarify age classes. In these cases, a small number of scale samples can be taken from fish, in addition to taking length assessments, to verify the ages of fish whose age cannot be determined with certainty from the length.

In this study, juvenile salmonids are differentiated into fry (age 0+) and parr (age 1++) age groups, as well as species (Table 2).

Table 2: Salmonid age classifications referred to in this report

Salmon Fry (0+):	Young fish less than one year old resulting from spawning at the end of 2019
Trout Fry (0+):	Young fish less than one year old resulting from spawning at the end of 2019
Salmon Parr (1+ and older (1++)):	Young fish of greater than one year and greater than two years old (where present) from spawning in 2018 or previously
Trout Parr (1+ and older (1++)):	Young fish of greater than one year and greater than two years old (where present) from spawning in 2018 or previously. Trout of up to three or four years old are also included in this category

Juvenile salmonid numbers recorded have also been classified into several 'density' categories. A classification scheme for densities of salmonids was previously generated by the SFCC using data collected from 1,638 Scottish electrofishing survey sites covering the period 1997 to 2002[(3)]. From this, regional figures were created to allow more accurate local 'density ranges' (Table 1). The categories referred to in this report are based on quintile ranges for one-run electrofishing events in the Solway region (Solway Salmon Fishery Statistical Region), within which the Dee catchment lies.

3.2.4 Non-salmonid fish species

At each survey site the presence of non-salmonid fish species is noted. Population densities for these species are not calculated (see Section 3.2.1) but numbers of individuals are counted.

3.2.5 Site measurement

At each survey site a total site length was recorded, and average wet and channel widths calculated. The average wet width is calculated from five or more individual widths recorded at equidistant intervals from the bottom of the site (0 m) to the top. At each site the final width is noted at the upper limit of the surveyed water. From these site measurements the total area fished can be calculated.

3.2.6 Bankside/instream electrofishing site habitat assessment

At each electrofishing site a detailed habitat assessment using SFCC protocol is made of the instream habitat available for older (parr (1++) aged) fish. This assessment grades the instream 'cover' available to salmonids as none, poor, moderate, good or excellent. This grading provides an index of instream cover where diverse substrate compositions will score more favorably than areas of uniform substrate which provides lower levels of cover for individuals.

In accordance with SFCC protocols, percentage estimates of depths, substrate type and flow type are made at each electrofishing site. Additionally, percentage estimates of the quantity of the

bankside cover features such as undercut banks, draped vegetation, bare banks and marginal vegetation are made.

When any reference to left or right bank is made, it is always classed as left and right bank when facing downstream.

3.2.7 Survey areas and site selection

Sites were selected by GFT and agreed with MBEC. Sites were selected based on previous knowledge of salmonid distribution, combined with potential suitable fish habitats within the proposed Development area. Survey work was carried out between 1st September and 15th September 2020, which is within the optimal time for surveying for juvenile salmonids.

3.2.8 Site sensitivity

Data from across the survey was assessed using a traffic light sensitivity rating to highlight those sites particularly sensitive to disturbance (Table 3):

- For a water to be classified as having a Green sensitivity rating (Low Sensitivity) it was found to contain any of the following: no fish present, site is a field ditch/drain, has unsuitable habitat to support fish, no watercourse visible during the surveys.
- For a water to be classified as having an Amber sensitivity ration (Moderately Sensitive) it was found to contain any of the following: only non-salmonid species of fish. In general, the habitat was not suitable to support salmon or trout populations.
- For a water to be classified as having a Red sensitivity rating (Very Sensitive) it was found to contain any of the following: presence of salmonids in any density or display habitats of particular significance.

Table 3: Traffic light rating of sensitivity based on densities of juvenile salmonids found at each location

Traffic Light Rating	Description
Green	Not sensitive for fish at the survey location and unlikely to cause a localised effect. Works could still potentially cause downstream impact, so mitigations still need to be in place. No fish rescue required for any instream works.
Amber	Moderately sensitive for fish at the survey location as non-salmonid fish species are present. Fish rescue will be required prior to any instream work such as culvert placement. May cause a localised and downstream impact so strict pollution requirements still stand.
Red	Very sensitive for fish at the survey location and work could potentially cause a localised and downstream impact on fish populations. Fish rescue required prior to any instream works.

All watercourses which have an Amber or Red sensitivity rating should be monitored during construction and post construction phases.

4 RESULTS

4.1 Electrofishing survey

The results of the electrofishing survey are outlined in this section and presented in detail in Table 4, which provides information on the population densities of juvenile salmonids at each survey site. Site code, watercourse, site location, O.S. Grid reference, survey date, non-salmonid species and area fished (m^2) are also shown in Table 4.

4.1.1 Site sensitivity

Only three sites (Marbrack Burn, QWF2; Polhay Burn, QWF5; and Knockgray Burn, QWF6) were found to have low sensitivity due to the absence of any detected fish species. The remaining sites were highly sensitive to disturbance (Table 4).

4.1.2 Electrofishing summary

- QWF1: Water of Deugh, Furmiston Lane Grid ref: 260347 592589

Trout parr were present in low densities. No other fish species were present at this site.

- QWF2: Water of Deugh, Marbrack Burn Grid ref: 261307 594985

No fish were recorded at this site.

- QWF3: Water of Deugh, Polshagg Burn Grid ref: 261172 594981

Trout fry and parr were present at this site in low and very low densities, respectively.

- QWF4: Water of Deugh, Marbrack Burn Grid ref: 259850 593542

Trout parr were present in low densities.

- QWF5: Water of Deugh, Marbrack Burn, Polhay Burn Grid ref: 259823 593597

No fish were recorded at this site.

- QWF6: Water of Deugh, Knockgray Burn Grid ref: 257828 593704

No fish were recorded at this site.

- QWF7: Water of Deugh, Benloch Burn Grid ref: 257504 594732

Both trout fry and parr were recorded in low densities at this site. Stone loach were also present.

- QWF8: Water of Ken, Craigengillan Burn Grid ref: 263328 593822

Juvenile trout were present at this site, with fry recorded at moderate densities and parr at low densities.

- QWF9: Water of Deugh, Meadowhead Burn Grid ref: 251819 599075

Trout fry were recorded at moderate densities, whilst parr were recorded at low densities within this site.

- QWF10: Water of Ken, Polharrow Burn Grid ref: 260331 584342

Juvenile salmon (both fry and parr) were present in low densities. Trout juveniles were also present, with fry at low densities and parr at very low densities. Minnows were also recorded at this site.

4.1.3 Electrofishing and habitat survey results

- QWF1, Furmiston Lane

Instream cover was recorded as being poor. Wetted width averaged 1.3 m wide with an area of 41.8 m^2 being fished during the survey. Water depths were recorded up to 40 cm deep, with 21-30 cm being the predominant depth. Water flows were dominated by run, with sections of riffle and shallow glide. The substrates within the site were primarily cobbles, with a few boulders, pebbles and patches of gravel and silt. A good level of bankside cover was available in the form of undercut banks, but primarily shade came from draped vegetation on both banksides (Figure 1a). No canopy cover was shading the site.

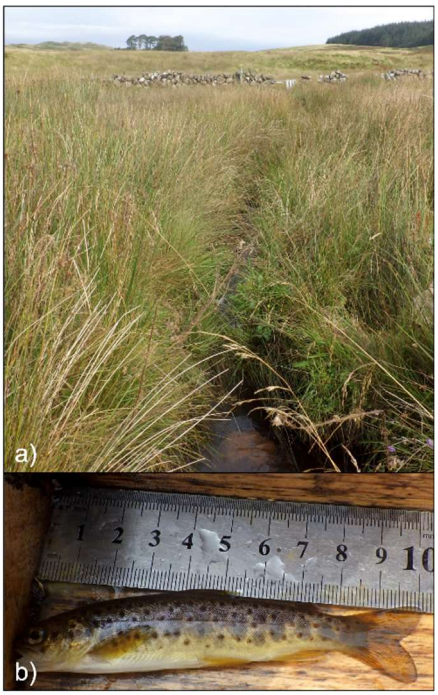


Figure 1: Electrofishing site 1 at Furmiston Lane (a), where trout parr were found (b)

Trout fry were absent but trout parr were present at a low density (>2.39 per 100 m^2 of water; Figure 1b). All fish were found in an upstream pool, below a fall at the top of the site.

- QWF2, Marbrack Burn

Instream habitat at this site was considered to be poor. Wetted width averaged 1.3 m with 50.4 m^2 of water being fished in the survey. Cobbles were the primary substrate, intermixed with some gravel, pebbles and boulders. Flows within the site were dominated by run, as well as deep and shallow glides. This site was narrow and deep, with 60% of the depths between 21 – 40 cm. Banksides were primarily bare (60%), with most shade originating from either draped vegetation (30%) or undercut banks (10%) on both sides (Figure 2). This site is grazed by sheep and conifers are situated on the left bankside.

Figure 2: Photo of site 2 on the Marbrack Burn

No fish were recorded at this site.

- QWF3, Polshagg Burn

Instream cover was considered to be moderate. The wetted width averaged 2 m and an area of 68 m^2 was surveyed. Flows in the site were dominated by shallow glide and smaller areas of run. Small sections of riffle and deep glide were also present. Depths were all <40 cm, with half of the site being <10 cm deep. The substrate primarily consisted of gravel and pebbles with some cobbles and small sections of sand and boulder. Banksides were primarily bare with small sections of draping vegetation and undercut banks (Figure 3).

Trout fry and parr were present at low and very low densities (>4.41 and >1.47 per 100 m^2 of water, respectively).

Figure 3: Electrofishing site 3 on the Polshagg Burn

- QWF4, Marbrack Burn

Instream cover at this site was moderate. Wetted width averaged 3.5 m and an area of 55.9 m^2 was surveyed. A good mixture of substrates were found within this site: boulders were the dominant form of substrate, followed by a mixture of pebbles, cobbles, bedrock and gravel. Water

depths were primarily between 21 – 30 cm, which was the deepest part of the site. There was a strong flow through the site, dominated by riffle (50%) and run (40%), with small sections of shallow glide (10%). The site was primarily bare, with draping vegetation providing the only bankside shading for fish (Figure 4a). There was no canopy cover on this site.

Trout parr (1++) were present at this site in low densities (>2.63 per 100 m^2 of water; Figure 4b) measuring between 165 – 169 mm.

Figure 4: Electrofishing site 4 on Marbrack Burn (a) where low densities of trout parr (b) are present

- Site 5, Polhay Burn

Instream cover at this site was considered to be good, with an average wet width of 2.1 m. The total area surveyed was 66.3 m^2. Substrates were of a good mix, with the dominant form of substrates consisting of cobbles, pebbles and gravel, alongside smaller sections of boulders and patches of sand. This site had a good range of flows, primarily consisting of run and shallow glides, but also large sections of riffle and small areas of deep pools too. Maximum depth was 50 cm, with 40% of the site being between 21 – 30 cm. Banksides were predominantly bare, with some undercut banks, draped vegetation and a few rocks being the only form of shading for fish. Banksides were quite high and eroded (Figure 5).

No fish were found at this site

Figure 5: Electrofishing site 5, Polhay Burn, showing eroded banksides

- Site 6, Knockgray Burn

Instream cover at this site was considered to be moderate. Wetted width averaged 2.1 m and an area of 57.9 m^2 was surveyed. There was a good mixture of substrates, with pebbles, cobbles, boulders and gravel being the predominant form, with small areas of sand and bedrock. Most of the depth at this site was between 11 – 30 cm, with maximum depths of 40 cm. Flow was primarily shallow glide and run with areas of riffle and small sections of deep and shallow pools. Both banksides were primarily bare, with some shading provided by draping vegetation, undercut banks and rocks (Figure 6).

No fish were recorded at this site.

Figure 6: Site 6 on Knockgray Burn

- Site 7, Benloch Burn

Instream cover at this site was considered to be good. Wetted width averaged 3 m and an area of 74.9 m^2 was surveyed. A good mixture of pebbles, cobbles, boulders and gravel were present at this site, with small sections of sand and bedrock. Depth ranged from <10 cm to 40 cm deep, with 65% of the depth being between 21 – 30 cm deep. Flow was primarily run (50%), with equal proportions of riffle and shallow glide (40%) and small areas of deep pool (10%). The left bankside provided more shading in the form of undercut banks and draping vegetation than the right bankside (Figure 7a:c). Erosion was evident at both banksides.

Trout fry and parr were present at this site in low densities (>5.34 and >4 per 100 m^2, respectively Figure 7d). Stone loach was the only other fish species present (Table 4).

Figure 7: Electrofishing site on Benloch Burn (a:c) where juvenile trout were present (d)

- Site 8, Craigengillan Burn (control)

Instream cover at this site was considered to be good. An area of 37.2 m^2 was surveyed with an averaged wetted width of 2.1 m. The dominant form of substrate was gravel and boulders, intermixed with pebbles and cobbles. The burn was mostly <20 cm deep, with small areas between 21 – 30 cm deep. Flow was primarily run with sections of deep and shallow glide, as well as riffle. The site was primarily bare, especially on the right bankside which provided no bankside cover for fish. The only form of shading present on the left bankside was provided by draping vegetation, undercut banks and some overhanging branches (Figure 8). A conifer plantation exists on the right bankside.

Trout fry and parr were detected at this site in moderate (24.58 ± 2.63 per 100 m^2) and low densitites (>2.69 per 100 m^2), respectively (Table 4).

Figure 8: Electrofishing site at Craigengillan Burn

- Site 9, Meadowhead Burn (control)

Instream cover at this site was considered to be good. An area of 33 m^2 was surveyed with an averaged wetted width of 1.5 m. The dominant form of substrate was a mixture of pebbles and cobbles, as well as smaller sections of gravel and boulders. Maximum depth at this site was 40 cm, with a large proportion of depth being <10 cm. Flow was primarily run and shallow glide, as well as some riffle and areas of deep glide. There was very little cover for fish (Figure 9), any cover provided was due to a few undercut banks, draping vegetation and, on the left bankside only, rocks.

Juvenile salmon were absent from this site, but trout fry (>12.39) and parr (>3.03) were present in moderate and low densities per 100 m^2, respectively.

Figure 9: Electrofishing control site on the Meadowhead Burn

- Site 10 Polharrow Burn (control)

Instream cover at this site was good. An area of 130.1 m^2 was surveyed with an averaged wetted width of 7.4 m. The substrate primarily consisted of cobbles and boulders, with small sections of pebbles, bedrock and gravel. The burn had a wide range of depths, with 10% being <10 cm and 5% going deeper than 50 cm. The most dominant depth lay between 21 – 30 cm. For health and safety reasons, only half the site was fished. Run dominated the flow, but there was also a good mixture of shallow glide and riffle, with smaller areas of deep glide intermixed with some small sections of deep and shallow pools. The left bankside was completely bare (as only half the channel was fished), whilst the right bankside provided some shading in the form of draped vegetation and rocks (Figure 10). Canopy provided 10% cover at this site due to overhanging boughs from woodland on the right bankside.

Juvenile salmon were present at this site, with both fry and parr occurring in low densities (>12.30 and >4.61 per 100 m^2, respectively). Trout fry were also present in low densities (>7.69). Minnows were the only other fish species present at this site (Table 4).

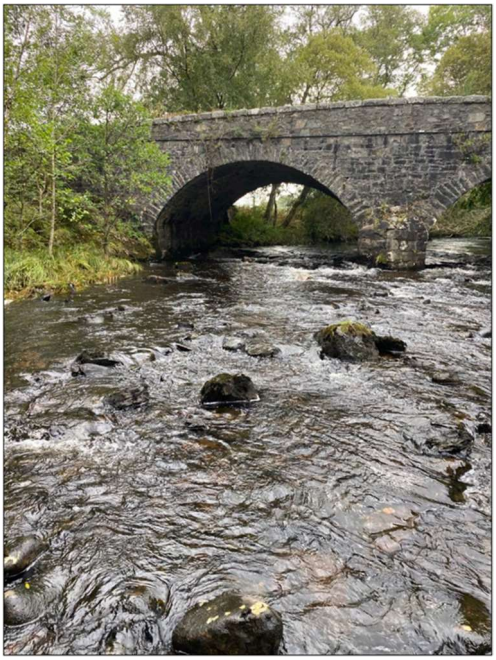


Figure 10: Electrofishing site on the Polharrow Burn

Table 4: Results from the 2020 electrofishing survey within the Dee catchment for Quantans Wind Farm

Site Code	Watercourse /River Order	Grid Ref	Survey Date			Area Fished (m2)	Density per 100m2				Sensitivity
				Stone Loach	Minnow		Salmon Fry (0+)	Salmon Parr (1++)	Trout Fry (0+)	Trout Parr (1++)	
QWF1	Water of Deugh, Furmiston Lane	260347 592589	15/09/2020			41.8				>2.39	Very sensitive
QWF2	Water of Deugh, Marbrack Burn	261307 594985	15/09/2020			50.4					Not sensitive
QWF3	Water of Deugh, Marbrack Burn, Polshagg Burn	261172 594981	15/09/2020			68			>4.41	>1.47	Very sensitive
QWF4	Water of Deugh, Marbrack Burn	259850 593542	15/09/2020			55.1				>2.63	Very sensitive
QWF5	Water of Deugh, Marbrack Burn, Polhay Burn	259823 593597	15/09/2020			66.3					Not sensitive
QWF6	Water of Deugh, Knockgray Burn	257828 593704	15/09/2020			57.9					Not sensitive
QWF7	Water of Deugh, Benloch Burn	257504 594732	15/09/2020	2		74.9			>5.34	>4.00	Very sensitive
QWF8 *(Control)*	Water of Ken, Craigengillan Burn	263328 593822	15/09/2020			37.2			24.58 ± 2.63	>2.69	Very sensitive
QWF9 *(Control)*	Water of Deugh, Meadowhead Burn	251819 599075	15/09/2020			33			>12.13	>3.03	Very sensitive
QWF10 *(Control)*	Pollharrow Burn	260331 584342	01/09/2020		7	130.1	>12.30	>4.61	>7.69		Very sensitive

**Where a Zippin (1958) calculation could be carried out, 95% confidence limits are shown. In cases where a Zippin calculation was not possible, only the minimum estimate of fish density per 100 m^2 is shown.*
Traffic light colour coding represents sensitivity of sites with regards to fish, with red indicating very sensitive, amber moderately sensitive and green not sensitive

5 DISCUSSION

A total of 10 sites were surveyed within the Kirkcudbrightshire Dee catchment to gather baseline data for the proposed Quantans Wind Farm, three of which (QWF8-10) were control sites. Juvenile salmon were present at the only site capable of harbouring migratory salmonids due to the lack of a fish pass at Kendoon Loch (reservoir), Polharrow Burn (QWF10), a control site. Juvenile trout were present at four sites and at all three control sites. Minnows and stone loach were the only non-salmonid fish species recorded during the survey, whilst three sites (QWF2, QWF5 and QWF6) had no detected fish species. The Tongland fish ladder is unpassable to eels, river lampreys and sea lampreys, all of which are consequently absent from upstream catchment areas.

Due to the presence of salmonids, four sites within the development were found to be highly sensitive to disturbance (Table 4). Efforts must therefore be taken to ensure that fish access is not impeded, habitats are protected, and fish rescues conducted where necessary to remove fish from work sites. Any Construction / Post Construction Fish Monitoring Plan would need to include these sites and the three control sites as a minimum.

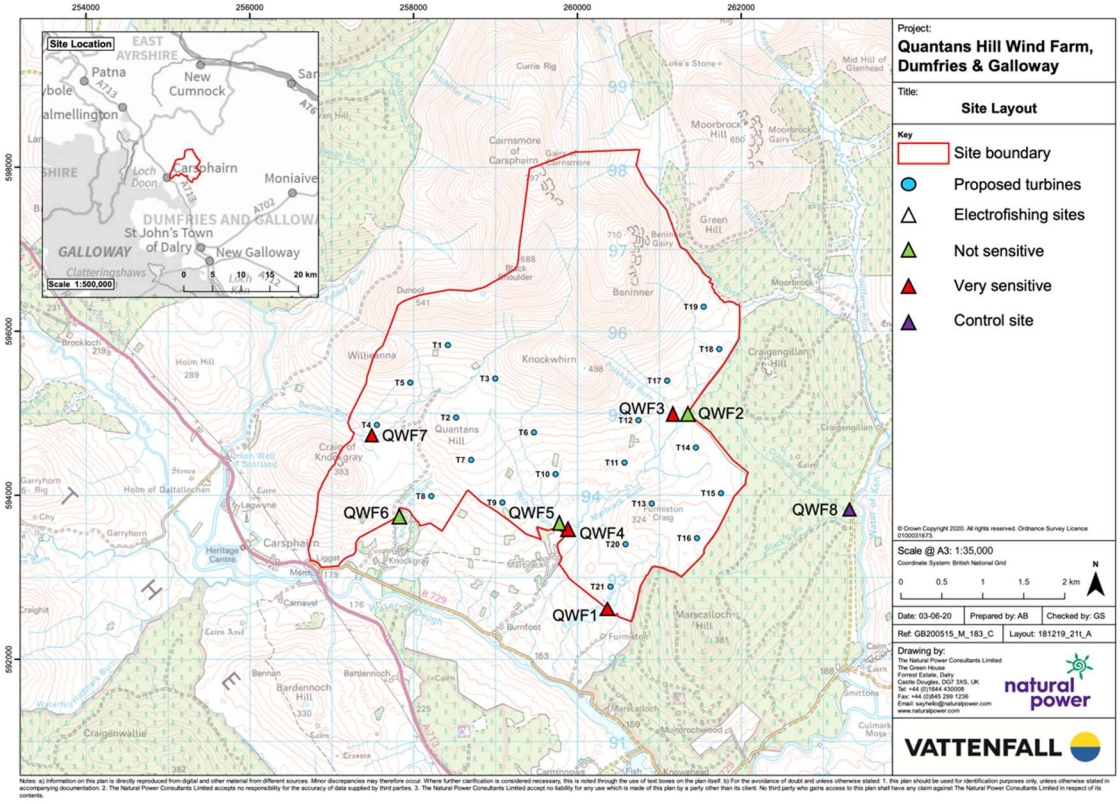
The main potential impacts from this development to surrounding fish populations are most likely to occur during the construction phase. Given the elevated position of the proposed turbines, pollutants can be carried downstream to other watercourses, potentially causing numerous fish mortalities, degradation of habitats and the decline of resources (eg habitat and prey items). Issues such as watercourse crossings, large scale excavation work (eg turbine bases) and road drainage must be carefully considered and designed to ensure minimal disturbance to fish species residing within the vicinity as well as downstream of the development site. In the opinion of GFT, it should be possible to mitigate against these impacts through the design and utilising best practice protocols to address potential fish access issues, silt management and pollution risks.

Freshwater Pearl mussels (*Margaritifera margaritifera*) are another species which could be at risk of disturbance during the construction of this development if they are present. This species is highly sensitive to pollution and eutrophication, especially at early life-stages. They require a mixture of substrates such as sand, gravel, cobbles and boulders. Sites QWF4, 6, 7, 8, 9 and 10 are watercourses that are large enough and contain substrates suitable for freshwater pearl mussels. As such, GFT recommends conducting surveys at these sites to determine their presence before construction of turbines.

This pre-construction fisheries survey provides a baseline dataset upon which comparison can be made in future, during- and post- construction fisheries surveys. This will provide a robust Fish Monitoring Plan to enable any impacts to be highlighted and mitigation measures carried out.

6 APPENDIX S1

Figure S1: Map of proposed Quantans Wind Farm showing locations of both turbines and electrofishing survey sites. Sensitivity of electrofishing sites are shown with the exception of control sites that are situated outside of the Development.



Electrofishing site names match those detailed in Table 4. Note that control sites QWF9 and QWF10 are out of range of this map.

Appendix 2: Fish Habitat Survey Report

A Scottish Registered Charity
No. SC 020751

Commissioned Report No. – SBAD030821

Fisheries habitat survey for Quantans Wind Farm

For further information on this report please contact:

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This report should be quoted as:

Galloway Fisheries Trust. August 2021. Fisheries habitat survey for Quantans Wind Farm. *Galloway Fisheries Trust Report No. – SBAD030821*

Summary

Fisheries habitat survey for Quantans Wind Farm

Commissioned Report No.: SBAD030821
Contractor: MBEC
Year of publication: August 2021

Keywords

Quantans; Kirkcudbrightshire Dee catchment; wind farm; habitat survey

Background

The Galloway Fisheries Trust (GFT) was commissioned by MBEC to carry out a targeted walk-over fisheries habitat survey for the proposed Quantans Wind Farm (herein referred to as the 'Development'), which will lie within the Kirkcudbrightshire Dee catchment in Dumfries and Galloway.

The habitat surveys were undertaken in July 2021 in the Dee catchment and were selected based on proposed crossing points for the Development. The Development is located upstream of an impassable dam and therefore only habitats for non-migratory species will be examined. The surveys were undertaken to assess the potential of these watercourses to support brown trout (*Salmo trutta*), Freshwater Pearl mussels (*Margaritifera margaritifera*) and Brook lamprey (*Lampetra planeri*) populations and make recommendations regarding whether additional surveys would be required.

All surveys were conducted during a severe drought and therefore habitats may change as water levels increase.

Main findings

- A total of 13 watercourses were surveyed to determine their sensitivity to proposed crossing points.
- Site A, Benloch Burn: this watercourse contains a range of good quality instream habitats, with potential for presence of trout and Freshwater Pearl mussels.
- Site B, Un-named tributary of the Water of Deugh: mixed juvenile habitats and spawning substrates for trout exist at this site.
- Site C, Knockgray Burn: good shading and plenty of instream cover and woody debris but numerous obstructions and very little water makes this site unlikely to support fish at this time but may contain some habitat for Brook lamprey. Higher water levels may enable this site to support trout.
- Site D, Un-named tributary of the Polhay Burn: not suitable habitat for fish, Freshwater Pearl mussels or Brook lamprey were present at this site during such low water levels.

- Site E, Un-named tributary of the Polhay Burn: the lack of smaller substrates and the multiple dried out sections of the burn makes it unlikely to support fish, Brook lamprey or Freshwater Pearl mussels.

- Site F, Un-named tributary of the Marbrack Burn: it is unlikely that habitat at this site will contain fish, Freshwater Pearl mussels or Brook lamprey.

- Site G, Un-named tributary of the Marbrack Burn: suitable habitat for trout exists at this site, but not for Freshwater Pearl mussels or Brook lampreys.

- Site H, Marbrack Burn: habitat at this site is likely to support brown trout and potentially Brook lamprey and Freshwater Pearl mussels as well.

- Site I, Furmiston Lane: this burn has habitat to support brown trout, but unlikely to support Freshwater Pearl mussels or Brook lamprey.

- Site J, Furmiston Lane: this habitat is unlikely to support fish, Freshwater Pearl mussels or Brook lamprey.

- Site K, Un-named tributary of Furmiston Lane: there was no suitable habitat for fish, Freshwater Pearl mussels or Brook lamprey at this site.

- Site L, Un-named tributary of the Marbrack Burn: there was no suitable habitat for fish, Freshwater Pearl mussels or Brook lamprey at this site.

- Site M, Polhay Burn: the habitat in this burn is unlikely to support fish, Brook lamprey or Freshwater Pearl mussels.

- Fish rescues are recommended at the five sites that may contain fish (Sites A, B, G, H and I).

- We recommend bridges to be built, instead of culverts, at two sites containing sensitive habitats (site A: Benloch Burn and site H: Marbrack Burn) and Construction / Post Construction Fish Monitoring Plans be conducted.

For further information on this project contact:
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Table of Contents **Page**

1 INTRODUCTION

Galloway Fisheries Trust (GFT) was commissioned by MBEC to carry out a targeted walk-over fisheries habitat survey for the proposed Quantans Wind Farm. The development is within the River Dee catchment in the South West of Scotland, which is managed by the Kirkcudbrightshire Dee District Salmon Fisheries Board (KDDSFB) and is covered by GFT.

There is a variety of legislation, regulations and guidance in place relating to fish species that may be present in watercourses within the Dee catchment:

1) Atlantic salmon (*Salmon salar*) are an internationally important fish species which is listed under Annex II and V of the European Habitats Directive (1992) (only in freshwater), Appendix III of the Bern Convention (1979) (only in freshwater) and are a local priority species in the Dumfries and Galloway Local Biodiversity Action Plan. Atlantic salmon are also a species of Conservation Concern on a UK level.
2) Brown trout/sea trout (*Salmo trutta*) are also a UK Biodiversity Action Plan species.
3) Brook lampreys (*Lampetra planeri*) are protected under Annex IIa and III of the EC Habitats and Species Directive 1992.
4) Freshwater Pearl mussels (*Margaritifera margaritifera*) are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), are listed on the EU Habitats and Species Directive under Annexes II and V and Appendix III of the Bern Convention (1979). They are included on the IUCN Invertebrate Red List, where their status is described as Vulnerable. Freshwater Pearl mussels are also classified as a priority species in the UK Biodiversity Action Plan.

The possible impacts that any land-based wind farm development and its associated infrastructure could have on surrounding fish populations are well known. The potential for fish species and their habitats to be affected by the Development mainly occurs during the construction and decommissioning phases of the Development. During the construction phase, potential impacts include siltation from ground disturbance, accelerated or exacerbated erosion of watercourse banksides, hydrological changes to watercourses and surface water run-off, pollution of watercourses, and the blocking or hindering of the upstream/downstream migration of fish. During the operational phase, concerns include the effects of poor road drainage, accelerated levels of erosion, fish access issues through watercourse crossings such as culverts, and the maintenance of silt traps and watercourse crossings. Potential risks to fish populations and their habitats during the decommissioning phase are broadly similar to those in the construction phase. These potential effects could all impact fish populations by: 1) causing direct mortality of juveniles and adults; 2) changes in food availability; 3) creating avoidance behaviour resulting in unused habitat; 4) blocking fish migration routes to spawning grounds; and finally, 5) causing damage to instream and riparian habitats.

The habitat surveys were undertaken in the upper Dee catchment in watercourses that drain into the Water of Deugh. The Development is located upstream of Kendoon Loch (reservoir) where the lack of a fish pass prevents access to migratory species (e.g. Atlantic salmon and sea trout). The absence of eels (*Anguilla anguilla*), River lampreys (*Lampetra fluviatiliis*) and Sea lampreys (*Petromyzon marinus*) within the Dee is attributed to not being able to pass Tongland Fish ladder further downstream, in the lower part of the catchment. However, Brook lampreys may still be detected as they complete their lifecycle entirely in freshwater. A total of 13 sites distributed throughout the Development were chosen due to their assignment as locations for proposed crossing points. The surveys were undertaken to assess the sensitivity of these watercourses to disturbance by identifying their potential to support brown trout, Freshwater Pearl mussels and Brook lampreys, as well as to make any recommendations for additional surveys.

2 AIMS

The aims of this work were as follows:

2.1 To undertake fisheries habitat surveys at 13 proposed crossing point locations within the boundary of the Quantans Wind Farm Development on the Kirkcudbrightshire Dee catchment.

2.2 To analyse and present results from the surveys in report form, briefly discussing any sensitivities and/or issues relating to the disturbance created by proposed crossing points.

3 METHODOLOGY

3.1 Data recording

A total of 13 walk-over habitat surveys were undertaken on the 13th, 14th and 20th July 2021 and aimed to provide general information on the status of instream and bankside habitats present within watercourses designated as potential crossing point locations (Figure 1). The total surveyed area was 150 m (50 m upstream and 100 m downstream of proposed crossing point). A modified Hendry and Cragg-Hine (1997)[1] was used as it enables surveyors to cover more ground whilst gathering the maximal amount of information in the minimum amount of time. A standard Hendry and Cragg-Hine survey distinguishes between fry and parr habitat, but there is often a degree of overlap between the two and therefore the modified method was adopted to enable such habitats to be encompassed under the umbrella term, 'mixed juvenile habitats'. However, specific fry or parr habitats may still be identified in some areas.

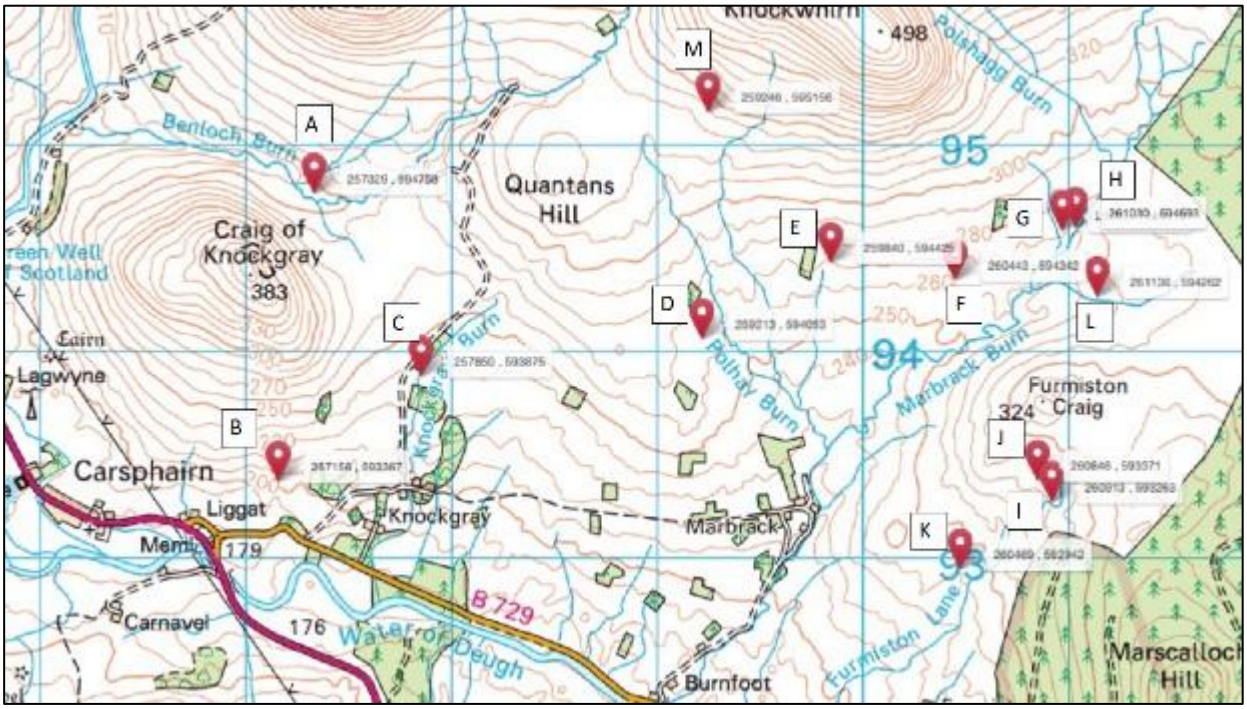

Figure 1: Proposed 13 crossing locations within Quantans Wind Farm Development. Letters indicated match those described in the Results

These walk-over habitat surveys provide an insight into the status and locations of spawning gravels and juvenile habitat areas within the watercourses. During the surveys, information on substrate type, bank structure and obstructions to fish movement are recorded. General comments on individual stretches of river are recorded to assist in the rapid overview of the survey area as a whole. If present, problematic bank structures such as areas of erosion were also recorded, as well as any evident reason for the problem (e.g. over-grazing by sheep causing a collapsing bank). Obstructions were assessed for complete impassability at any flow or for being passable under certain flow conditions. Additional comments were also made as to the nature and permanency of the obstruction. Photographs were taken throughout the survey and of all major obstructions. Instream characteristics are described, moving in an upstream direction. Banksides are referenced as right or left bank in a downstream direction. The watercourses were each surveyed by two experienced GFT surveyors, with predominant habitat type recorded within specific stretches, and defined as described in Table 1. The habitats

[1] Hendry & Cragg-Hine (1997). Restoration of Riverine Salmon Habitats: A Guidance Manual. R&D Technical Report W44, Version 1.0/07-97.

described are not disparate but regarded as definable parts of a spectrum of habitats found in a river. The bankside structure and surrounding land use was also described where appropriate. The report will also highlight stretches of habitat suitable for Freshwater Pearl mussels and juvenile Brook lampreys.

Table 1: Classification of different habitat types for salmonids

Habitat Type	**Classification**
Spawning gravel	Stable gravel up to 30 centimetre (cm) deep that is not compacted or contains excessive silt. Substrate size with a diameter of 0.8 to 10.2 cm
Silted spawning habitat	Stable gravel up to 30 cm deep that is compacted or contains excessive silt. Substrate size with a diameter of 0.8 to 10.2 cm
Fry habitat	Shallow (<0.2 metre (m)) and fast flowing water indicative of riffles and runs with a substrate dominated by gravel (16 – 64 millimetre (mm)) and cobbles (64 – 256 mm)
Parr habitat	Riffle – run habitat that is generally faster and deeper than fry habitat (0.2 – 0.4 m). Substrate consists of gravels (16 – 64 mm), cobbles (64 – 256 mm) and boulders (> 256 mm)
Mixed juvenile habitat	A mix of fry and parr habitat, suited to both age classes in combination – the deeper, faster, larger substrate areas used by parr, and the shallower, slower, smaller substrate areas used by fry
Glides	Smooth laminar flow with little surface turbulence and generally greater than 0.3 m deep
Pools	No perceptible flow and usually greater than 1 m deep
Flow constriction	Where physical features provide a narrowing of the channel resulting in increased velocity and depth (often combined with a localised increase in gradient and bedrock substrates)
Obstacles/Obstruction to migration	A structure or item identified as a potential obstruction to fish passage at certain water heights (e.g. impassable falls, weirs, bridge aprons, shallow braided river sections preventing upstream migration during low flows)

In accordance with GFT policy, all relevant equipment was disinfected prior to and following work in each river catchment to ensure there is no transfer of non-native invasive species.

4 RESULTS

Surveys were conducted during a period of severe drought and water levels were particularly low, therefore report bank widths (as opposed to wet widths) and refer to habitats that may potentially be available during higher flows.

4.1 Habitat survey

All habitats were surveyed during an extreme drought and therefore results must be approached with caution as reduced water levels may temporarily move species out of site until water levels rise again. Table 2 only summarises the *likelihood* of surveyed habitats to support fish, Freshwater Pearl mussels and Brook lamprey at the actual time of the survey and such suitability to support these species may alter as water levels arise. Further details of each site and associated photos can be found below.

Table 2: Summary of each surveyed habitats' potential to support fish (i.e., brown trout), Freshwater Pearl mussel (FWPM) and Brook lamprey across 13 sites at the Quantans Wind Farm development

Site	Burn	Contains suitable habitat for:		
		Fish	FWPM	Brook lamprey
A	Benloch Burn	√	√	X
B	Un-named tributary of the Water of Deugh	√	X	X
C	Knockgray Burn	X	X	√
D	Un-named tributary of the Polhay Burn	X	X	X
E	Un-named tributary of the Polhay Burn	X	X	X
F	Un-named tributary of the Marbrack Burn	X	X	X
G	Un-named tributary of the Marbrack Burn	√	X	X
H	Marbrack Burn	√	√	√
I	Furmiston Lane	√	X	X
J	Furmiston Lane	X	X	X
K	Un-named tributary of Furmiston Lane	X	X	X
L	Un-named tributary of the Marbrack Burn	X	X	X
M	Polhay Burn	X	X	X

4.1.1 A: Benloch Burn

The survey was conducted on 13th July 2021, starting at NX 57241 94801 (Figure 1a), 100 m downstream of the proposed crossing point. The surrounding area is grazed moorlands, with the overhanging-eroded banks and draping vegetation being the only source of bankside shading (Figure 1b). Bank widths varied between ~2 - 3 m wide and the majority of the site was <20 cm deep.

Figure 1: Photos moving upstream during survey on Benloch Burn (site A), showing areas of: a) small cascades and glides at start of survey; b) eroded and overhanging banksides; c) dried areas with small glides and constriction; d) bedrock with constriction; e) natural ledge and glide; and f) small cascades into pools with sections of gravel at the sides

Under higher flow conditions, there would be a good range of substrates for **mixed juvenile habitats**, with small pockets of spawning gravels distributed throughout site (Figure 1c). This site has numerous constrictions (Figures 1c, d, f) and a series of small cascades and shallow glides/pools (Figures 1a:f). The currently exposed substrate would provide riffle habitat for fry when submerged (Figures 1c, f), whilst the glides/pools and instream boulders provide good habitat and instream cover for parr (e.g., Figure 1e). The substrate becomes more bedrock upstream of NX 57281 94780, with some areas constricting flow (Figure 1d). The survey ended 50 m upstream (NX 57372 94727) of proposed crossing point.

Overall, this site is likely to support brown trout. There are little/no fine substrates suitable for Brook lamprey. Although habitat does exit for Freshwater Pearl mussels, the lack of deciduous trees to provide shading, and the current low water levels, limits the suitability of this site to support Freshwater Pearl mussels.

4.1.2 B: Un-named tributary of the Water of Deugh

The survey was conducted on 13th July 2021, starting at NX 57163 93297, 100 m downstream of proposed crossing point in a grazed moorland. It is a shallow (<5 cm deep) and narrow (<50 cm wide) burn with good gradient (Figure 2a).

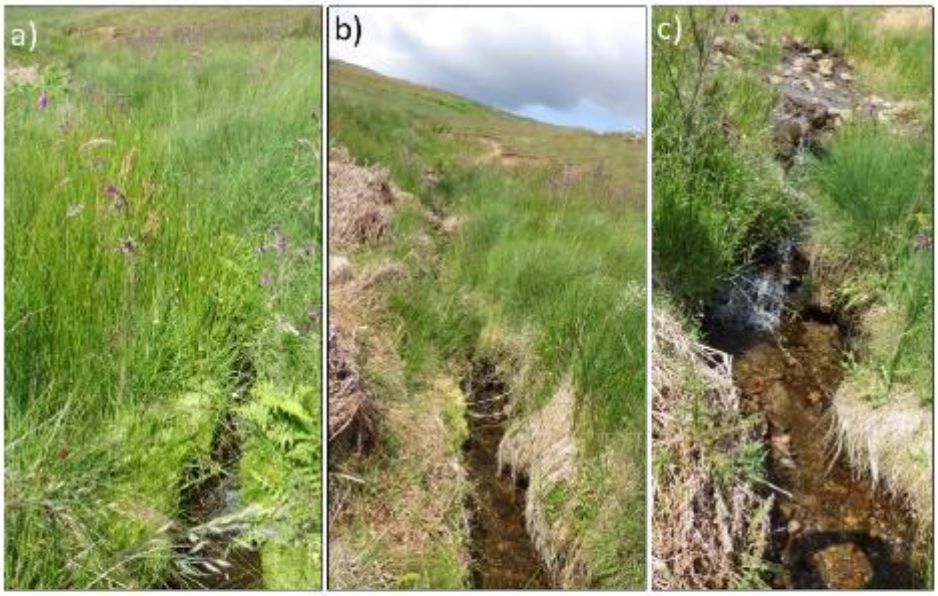

Figure 2: Un-named tributary of the Water of Deugh (site B), showing: a) draping vegetation and narrowness of burn; b) substrates, overhanging banksides and erosion further upstream; and c) cascade and potential obstruction downstream of a pre-existing crossing point

The site is mainly shaded by overhanging (and in some places, eroded; Figure 1b) banks and draping vegetation, with substrate primarily consisting of a gravel/pebble/cobble mix (Figures 2b, c). Such substrates provide **mixed juvenile habitats**, but the lack of instream cover limits its potential to support parr. Numerous small cascades exist at this site, with Figure 2c showing a cascade below a pre-existing crossing point (NX 57166 93326), both of which will likely obstruct fish movement. Few boulders exist at this site and were found to constrict the burn upstream of the proposed crossing point (NX 57156 93367). The survey ended 50 m upstream of proposed crossing point at NX 57138 93414, where banksides become ~2 m high.

Overall, this burn has the potential to support brown trout (more suited to fry but parr habitat does exist), with some areas containing **spawning substrates.** However, its suitability is limited due to its shallow nature, potential obstructions and lack of shading. There is very little fine substrate and therefore unlikely for this section of the burn to harbour any Brook lamprey, nor is there suitable habitat for Freshwater Pearl mussels.

4.1.3 C: Knockgray Burn

This survey was conducted on 13th July 2021, starting at NX 57860 93783, 100 m downstream of proposed crossing point (NX 57850 93875), within deciduous riparian woodlands (Figure 1a). Water levels were again very shallow (<10 cm), with numerous areas being completely dry, and had a 1-2 m width.

Figure 3: Knockgray Burn (site C), showing: a) start of the site, 100 m downstream of proposed crossing point, within deciduous riparian woodlands; b) constriction; c) obstruction; d) dried out section of burn; e) crossing point upstream of pool; and f) orange-coloured water

The deciduous trees provide good shading and deposit large amounts of wooded debris, creating an ideal habitat for salmonids. However, very little flow was present and numerous constrictions and obstructions were present throughout the site (e.g. Figures 1b and c). There was a good mix of substrate throughout the site but although small patches of spawning gravel existed, the amount of silt makes it unlikely that spawning occurs at this site. Waters were cloudy orange (Figure 1), indicating high iron content potentially from surrounding land use, which was primarily grasslands grazed by sheep. However, again it must be noted that the survey was taken during a period of extreme drought and such conditions may become more suitable for fish as water levels increase.

The survey site opens out onto the grasslands at NX 57849 93845, where it is separated by a gate and stacked boulders, creating another obstruction. A ford already exists at the proposed crossing point (Figure 3e), just upstream of a 50 cm deep pool. Bankside erosion and narrowing of burns occur in the area surrounding the proposed crossing point, up to where the survey was ended 50 m upstream (NX 57874 93904).

Overall, it is unlikely that the habitats present at the time of survey would support any fish. Fine areas of sediment in some sections of the burn suggest potential for Brook lamprey, but no suitable habitat for freshwater pearl mussels.

4.1.4 D: Un-named tributary of the Polhay Burn

This survey was conducted on 20th July 2021. There was no burn present at proposed crossing point (NX 59213 94053) so survey was moved 10 m to NX 59219 94065. The survey started 100 m downstream of this point at NX 59269 94010 where the burn was ~50 cm wide, gravel substrate but no flow, surrounded by grazed tall herbs and high banksides (Figure 4a). The burn dries up and the crossing point acts as an obstruction (Figure 4b) before widening and becoming dry in numerous dry areas. At NX 59202 94076 the burn dries up completely and the survey was terminated at NX 59186 94090.

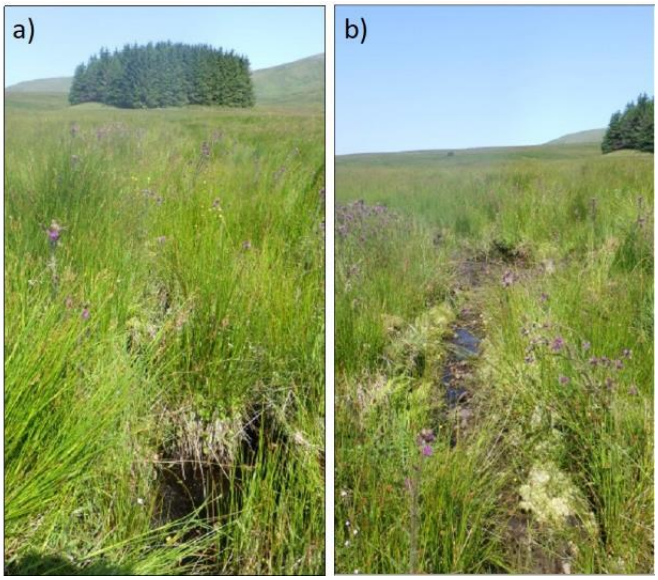

Figure 4: Un-named tributary of the Polhay Burn (site D), showing: a) starting point; and b) widening of burn by crossing point, which also acts as an obstruction

Overall, the habitat available at the time of survey was unlikely to support fish, Freshwater Pearl mussels or Brook lamprey.

4.1.5 E: Un-named tributary of the Polhay Burn

This survey was conducted on 14th July 2021 at NX 59832 94361 within a fenced area that has been mounded and planted with conifers. A small ~70 cm deep pool was present 7 m upstream from the start (Figure 5a) but otherwise the site was primarily ~30 cm wide, <2 cm deep with very little water and no flow, surrounded by grazed tall herbs (Figures 5b, c). Substrates primarily consisted of pebbles. The burn split at NX 59843 94410 and the survey continued to the left where it ended at NX 59833 94458.

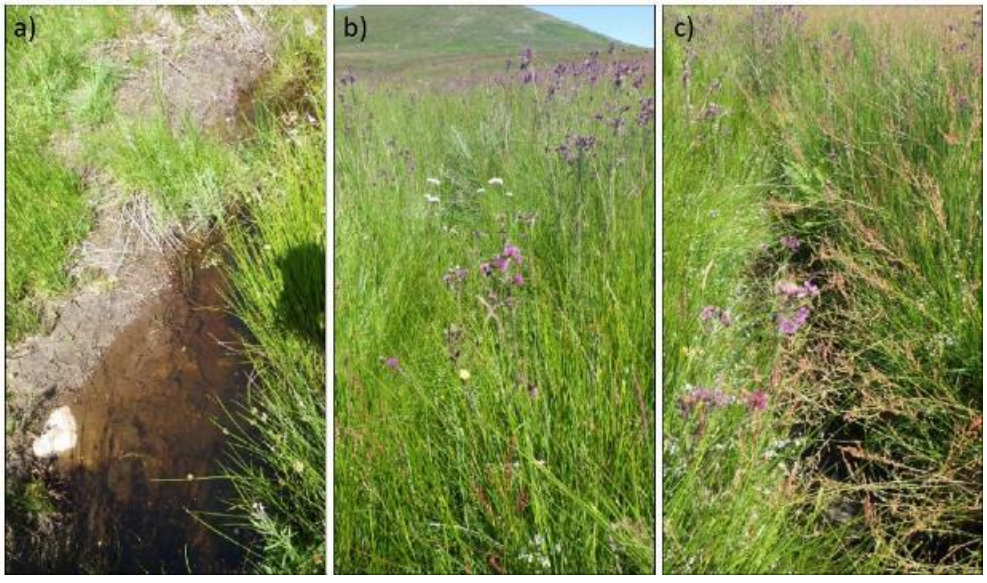

Figure 5: Another un-named tributary of the Polhay Burn, showing: a) pool just upstream of starting point; b) tall herbs and narrowness of burn; and c) one of the very few sections where the burn was visible

Overall, the lack of smaller substrates and the multiple dried out sections of the burn makes it unlikely to support fish, Brook lamprey or Freshwater Pearl mussels.

4.1.6 F: Un-named tributary of the Marbrack Burn

This survey was conducted on 14th July 2021 at NX 60433 94270 just outside a fenced area, within tall herbs and peaty grounds (Figure 6a). The width of the burn was ~50 cm and ~2 cm deep, with no flow and pebble substrate. Numerous sections of the burn had dried up completely (Figure 6b) and other sections had very peaty waters, even turning into small ditches in some places (e.g. NX 60441 94322; Figure 6d). The survey ended at NX 60482 94379.

Figure 6: Un-named tributary of the Marbrack burn, showing: a) tall herbs at the start of the survey; b) section of dried-up burn; c) area outside of fence; and d) where the burn turns into a shallow ditch

Overall, it is unlikely that habitat at this site will contain fish, Freshwater Pearl mussels or Brook lamprey.

4.1.7 G: Un-named tributary of the Marbrack Burn

This survey was conducted on 14th July 2021 at NX 60980 94511 just above confluence with another tributary. The surrounding landscape consisted of tall herbs within a moorland grazed by sheep. The burn averaged ~30 cm deep and 70 cm wide and was shaded by draping vegetation (Figures 7a, b). The substrate primarily consisted of cobbles.

Figure 7: Un-named tributary of the Marbrack Burn, showing: a) draping vegetation 100 m downstream of proposed crossing point; b) larger cobbles and small boulders that obstructs fish migration; and c) where the burn begins to narrow just downstream of fenced area

Numerous sections of the river have been dried and obstructions present due to larger cobbles and boulders (Figure 7b). No suitable spawning substrate present. After fenced area (NX 609068 94555; Figure 7c) the burn narrows to ~30 cm wide until the crossing point is reached where the burn widens to 1.5 m and the banksides become steeper upstream. The survey ended at NX 60946 94621.

Overall, although no spawning substrate exists, there does appear to be suitable **mixed juvenile habitats** and therefore fish are likely to be present, especially when water levels rise. However, there is no suitable habitat for Freshwater Pearl mussels or Brook lamprey.

4.1.8 H: Marbrack Burn

This survey was conducted on 14th July 2021 and began at NX 60999 94505 in an area of grazed moorland. The burn was ~4 m wide and consisting of a good mix of substrates but mainly comprised of large cobbles interspersed with boulders, (Figure 8a) with depths averaging <15 cm. The burn has been dried up in numerous areas but still had good flow in some sections and areas of pools/glides (Figure 8b) and potential areas of riffle suitable for fry in higher water conditions (Figure 8c). Small pockets of spawning substrates were distributed throughout the site, with bedrock becoming more prominent near to the crossing point situated just upstream of cascade that may act as a potential obstruction to fish passage. The survey ended at NX 61062 94624.

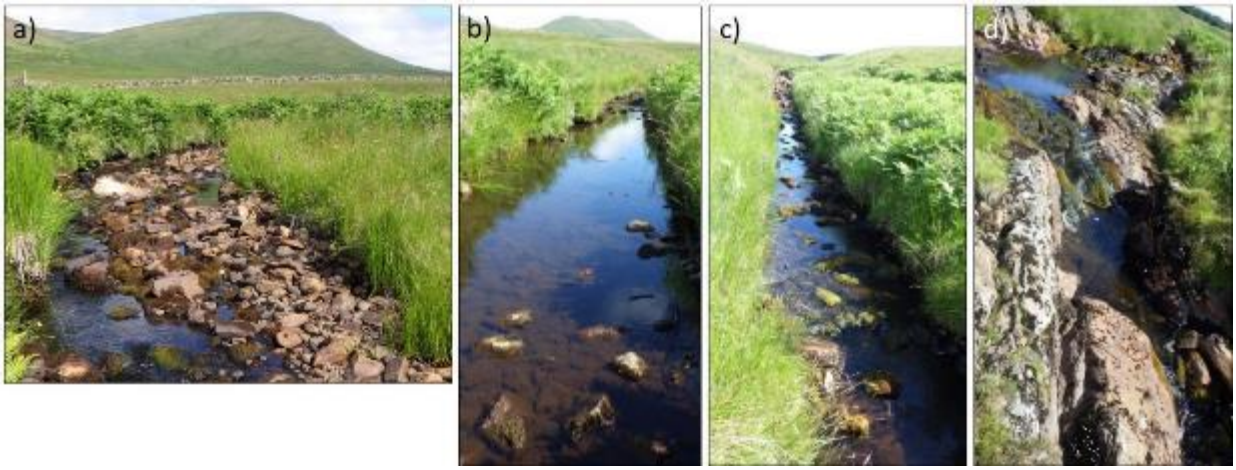

Figure 8: The Marbrack Burn, showing: a) mixed substrate at start of site; b) pool; c) potential riffle habitat under high flow conditions; and d) bedrock at proposed crossing point with cascade that may act as potential obstruction to fish movement

Overall, habitat at this site is likely to support brown trout and potentially Brook lamprey as well. Despite the lack of shading at this site, it could potentially have habitat to support Freshwater Pearl mussels.

4.1.9 I: Furmiston Lane

This survey started at NX 60873 93210 on 20th July 2021. The average width was <1 m with a shallow pool and an obstruction just 3 m upstream of start point due to large boulder (Figure 9a). There was a good mix of substrate, consisting of pebbles/cobbles/boulders, with some gravel patches. Large areas of the burn have been dried up (Figure 9b) causing numerous constrictions and obstructions throughout the burn, including the crossing point (Figure 9c). The substrate turns to mud 10 m upstream of crossing point and narrows to 30 cm wide before reaching completely dry rocky area (Figure 9d), after which a narrow urn appears again. The survey stopped at NX 60951 93241.

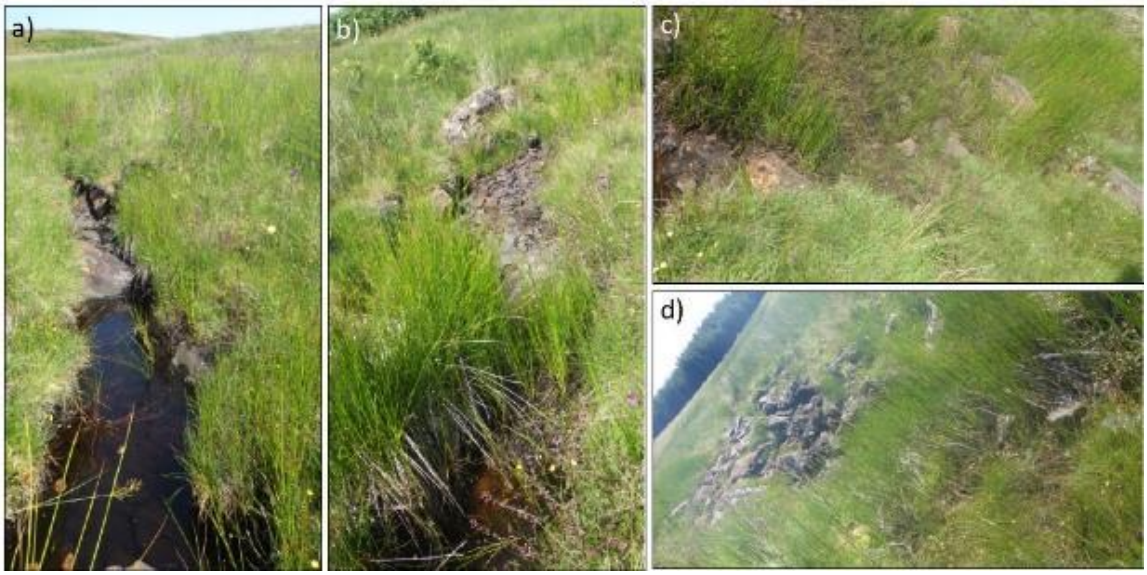

Figure 9: Furmiston Lane, showing: a) start of survey and large boulder causing obstruction; b) dried up section of the burn revealing substrates; c) crossing point and obstruction; and d) completely dry rock section just below finishing point

Overall, this burn has **mixed juvenile habitats** and small sections of **spawning substrate** present for brown trout if water levels were higher. Brook lampreys and Freshwater Pearl mussels are unlikely to be present at this site.

4.1.10 J: Furmiston Lane

This survey started at NX 60831 93309 in a boggy area with no clear channel (Figure 10a), in a moorland surrounded by grazed tall herbs. Moving upstream, a channel becomes more visible at NX 60840 93334 and is ~30 cm wide. Banks become very peaty and ~2 m deep just 10 m upstream (NX 60845 93362) and width increases to 1 - 2 m wide (Figure 10b). Depth of banks come to an abrupt halt at GR 60849 93371, with steep peaty obstruction above boulder (Figure 10c). Returns to very shallow bog/drain upstream of obstruction but eventually disappears completely. The survey was terminated at NX 60857 93407.

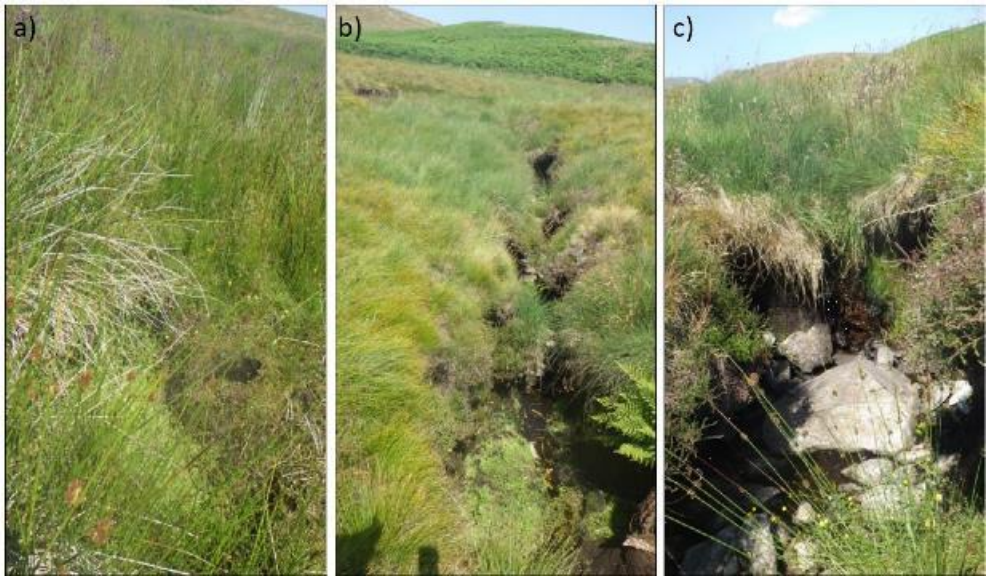

Figure 10: Un-named tributary of Furmiston Lane, showing: a) boddy start; b) channel with steep peaty banksides; narrowing of channel back into boggy area

Overall, this habitat is unlikely to support fish, Freshwater Pearl mussels or Brook lamprey.

4.1.11 K: Un-named tributary of Furmiston Lane

This survey was conducted on 20th July 2021, starting at NX 60476 92876. The site was situated in grazed moorland with tall herbs shading the site. The site was more bog than burn with water completely stopping at NX 60465 92951, by the wall.

Figure 11: Un-named tributary of Furmiston Lane, showing: a) starting point; and b) only section of water visible through tall herbs

Overall, there was no suitable habitat for fish, Freshwater Pearl mussels or Brook lamprey at this site.

4.1.12 L: Un-named tributary of the Marbrack Burn

The survey started at NX 61059 94288 in moorland heath, grazed by sheep. This site was very peaty and had high iron levels (Figure 12a), evident from the orange water and shine on the surface (Figure 12b).

Figure 12: Un-named tributary on Furmiston Lane, showing: a) peaty water and iron content; b) obstruction; c) obstruction and subtract; d) shine on water and exposed substrate due to low water levels; and e) pool downstream of large boulder

Situated within grazed moorlands, this site was ~3 cm deep and 30 cm wide with no flow. An obstruction was present 3 m upstream from start (Figure 12b) and substrate was cobbles and peat/mud (Figures 12c, d). Upstream of crossing point the burn widens and has a 50 cm deep pool with a large boulder upstream that may obstruct fish passage through the burn (Figure 12e).

Overall, there is very little suitable habitat for fish, Freshwater Pearl mussels or Brook lamprey at this site.

4.1.13 M: Polhay Burn

The survey was conducted on 13th July 2021 and started at NX 59216 95061 (Figure 13a). The burn averaged ~30 cm wide and 5 cm deep and was situated within grazed moorland with tall herbs overhanging the burn (Figures 13b, c). The substrate was primarily gravel but there was no instream cover for fish. High banksides and draping vegetation were the only shading for this site (Figures 13a:c). Just before the fence line (NX 59226 95084) is a crossing point, which acts as an obstruction during low water levels (Figures 13d). Further upstream is a large boulder that also acts as an obstruction before the burn then narrows and survey ends at NX 59260 95202.

Figure 13: Polhay Burn, showing: a) start of survey; b) overhanging banksides; c) narrowness of burn; d) crossing point acting as obstruction; and e) large boulder

Overall, the habitat in this burn is unlikely to support fish, Brook lamprey or Freshwater Pearl mussels.

5 DISCUSSION

A total of 13 proposed crossing points were surveyed (100 m downstream and 50 m upstream) on the proposed Quantans Wind Farm Development in the upper Kirkcudbrightshire River Dee catchment area to determine whether habitats are likely to support fish (i.e. brown trout, as migratory species are unable to migrate past Kendoon reservoir, above which all 13 sites are located), Freshwater Pearl mussels or Brook lamprey populations. Out of 13 sites, five contained habitats capable of supporting brown trout, two sites had habitat suitable to support Brook lampreys and another two sites had habitat suitable for Freshwater Pearl mussels (Table 2).

Due to the potential presence of the salmonid, brown trout, these five sites should be considered as highly sensitive to disturbance. In particular, the Benloch Burn and Marbrack Burn also have habitat capable of supporting Freshwater Pearl mussels (as well as brown trout), making these two sites especially sensitive to disturbance. Therefore, the construction of bridges is recommended as opposed to culverts at these two sites to minimise any negative impacts on habitats. Efforts must also be taken to ensure that fish access is not impeded at all other sites that could support fish, their habitats protected, and fish rescues conducted to remove fish from work sites. It is recommended that Construction / Post Construction Fish Monitoring Plans be conducted for the Benloch Burn and Marbrack Burn where the suggested bridges are to be constructed instead of culverts.

The main potential impacts from this development to surrounding fish populations are most likely to occur during the construction phase. Pollutants can be carried downstream to other watercourses, potentially causing numerous fish mortalities, degradation of habitats and the decline of resources (e.g. habitat and prey items). Watercourse crossings must therefore be carefully considered and designed to ensure minimal disturbance to fish species residing within the vicinity, as well as downstream of the development site. In the opinion of GFT, it should be possible to mitigate against these impacts through the design and utilising best practice protocols to address potential fish access issues, silt management and pollution risks.

These fisheries habitat surveys were conducted during a period of extreme drought and may therefore change should water levels rise. Nevertheless, these surveys document the likelihood of each site to harbour species sensitive to environmental disturbance and highlight the importance of fish rescues and pollution prevention to reduce negative impacts on freshwater biodiversity.

VATTENFALL

Appendix 6.5

Outline Species Protection Plans

Document history

Author	Paul Bradshaw	17/11/2021
Checked	Lesley Cartwright	18/11/2021
Approved	Emily Galloway	19/11/2021

Client Details	
Contact	Matt Bacon
Client Name	Vattenfall Wind Power Ltd

Issue	Date	Revision Details
A	17/11/2021	Issued for review
B	20/12/2021	Released

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.5.1 Introduction

Purpose of this Document

A6.5.1.1 This a technical appendix to Chapter 6 (Ecology & Biodiversity) of the Quantans Hill wind farm (the 'Proposed Development') Environmental Impact Assessment Report (EIAR) and should be read in conjunction with that Chapter.

A6.5.1.2 This document sets out the proposed approach to avoid / minimise impacts on certain protected species during construction and operation of the Proposed Development in the form of outline Species Protection Plans (SPPs).

A6.5.1.3 The following protected terrestrial species occur, or could occur, within the Proposed Development Area and may be at risk of impacts during the enabling works and construction phase:

- Badger (*Meles meles*);
- Bats (all species);
- Otter (*Lutra lutra*);
- Pine marten (*Martes martes*);
- Red squirrel (*Sciurus vulgaris*);
- Reptiles (e.g. common lizard, adder, slow worm).

A6.5.1.4 All of the above species are legally protected in Scotland, to varying degrees under various statutes, and there is a requirement to ensure that all works required to construct the Proposed Development, including enabling works such as tree felling and clearance, proceed lawfully with respect to this legislation.

A6.5.1.5 This document provides outline SPPs which would be developed into detailed documents in advance of the commencement of works (i.e. prior to any enabling works related to wind farm construction and following the proposed pre-works surveys).

A6.5.1.6 A separate outline protection plan document has been produced for birds (see Technical Appendix 7.3 to Chapter 7 Ornithology) and an outline monitoring plan in relation to the protection of fish and fish habitats (see Technical Appendix 6.4.).

Relevant Legislation & Guidance

A6.5.1.7 The relevant aspects of the following legislation have been considered in preparing this document:

- The Conservation (Natural Habitats &c.) Regulations 1994 ('The Habitats Regulations');
- The Conservation of Habitats and Species Regulations 2017;
- Wildlife and Countryside Act 1981;
- Nature Conservation (Scotland) Act 2004;
- Wildlife and Natural Environment (Scotland) Act 2011; and
- The Protection of Badgers Act 1992.

A6.5.1.8 The proposed approach and measures outlined in the SPPs are based on current best practice guidance, including consideration of the following publications:

- European Protected Species, Development sites and the planning system: interim guidance for local authorities on licensing arrangements (Scottish Executive, 2001);
- NatureScot Standing Advice Notes for protected species;[1]
- NatureScot (2019) Good Practice during Wind Farm Construction;
- Forestry Commission Scotland (2006). FCS Guidance Note 33: Forest operations and red squirrels in Scottish forests - the law and good practice;
- Forestry Commission Scotland (2007). FCS Guidance Note 34: Forest operations and European protected species in Scottish forests - implications of legal changes from February 2007;
- Forestry Commission Scotland (2009). FCS Guidance Note 35a: Forest operations and bats in Scotland;
- Forestry Commission Scotland (2009). FCS Guidance Note 35c: Forest operations and otters in Scotland; and
- Collins, J. (ed.) (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines, (3rd edn.). Bat Conservation Trust, London.

Consultation

A6.5.1.9 It is intended that following completion of the pre-works surveys and ahead of works for the proposed wind farm commencing (including tree felling operations) detailed versions of the SPPs will be provided for review and comment by NatureScot and DGC.

Summary of Relevant Legal Protections

A6.5.1.10 The information provided here is primarily derived from the NatureScot website[2]. The original legislation should be referred to for definitive guidance. Copies of the original, i.e. as enacted, and revised versions of UK and Scottish Government legislation are available online from http://www.legislation.gov.uk.

European Protected Species (EPS)

A6.5.1.11 Bats and otter are listed on Annex IV of EC Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the 'Habitats Directive') as species of community interest in need of strict protection. The Habitats Directive is transposed into Scottish law by the Conservation (Natural Habitats &c.) Regulations 1994, also known as the 'Habitats Regulations'. The relevant Habitats Directive Annex IV species are referred to as European Protected Species and are listed on Schedule 2 of the Habitats Regulations. The Habitats Regulations have been amended in Scotland as a result of the UK leaving the EU. Essentially, the legal protections (as derived from the Habitats Directive) continue to apply to EPS following the UK's departure from the EU.

A6.5.1.12 For the relevant EPS it is an offence under the Habitats Regulations (in Scotland) to deliberately or recklessly:

- capture, injure or kill such an animal;
- harass an animal or group of animals;
- disturb an animal while it is occupying a structure or place used for shelter or protection;
- disturb an animal while it is rearing or otherwise caring for its young;
- obstruct access to a breeding site or resting place, or otherwise deny an animal use of a breeding site or resting place;
- disturb an animal in a manner or in circumstances likely to significantly affect the local distribution or abundance of the species;
- disturb an animal in a manner or in circumstances likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young; and
- disturb an animal while it is migrating or hibernating.

[1]Available from: [https://www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/planning-and-development-standing-advice-and-guidance-documents]. Accessed October 2021.

[2] See: https://www.nature.scot/professional-advice/protected-areas-and-species/protected-species/legal-framework

A6.5.1.1 It is also an offence of strict liability to damage or destroy a breeding site or resting place of such an animal. These sites and places are protected even when the animal is not present. For example, roost sites that bats use only during the summer months are protected at other times of the year.

Schedule 5 Species

A6.5.1.2 Red squirrel and pine marten are legally protected in Scotland through the Wildlife & Countryside Act (1981). Both species are listed on Schedule 5 of the Wildlife & Countryside Act. For any species listed on Schedule 5 it is an offence to intentionally or recklessly:

- kill, injure or take a red squirrel or pine marten;
- damage, destroy or obstruct access to a drey / nest / den or any other structure or place which a red squirrel or pine marten uses for shelter or protection; and
- disturb a red squirrel or pine marten when it is occupying a structure or place for shelter or protection.

A6.5.1.3 This means that if a red squirrel or pine marten could be affected in these ways by development works, and no action is taken to prevent it, an offence may be committed.

Badger

A6.5.1.4 Badgers are legally protected under the Protection of Badgers Act 1992.

A6.5.1.5 The 1992 Act defines a badger sett as “any structure or place which displays signs indicating current use by a badger”. Offences under the Act include:

- wilfully taking, injuring or killing a badger;
- cruelty to a badger; and
- intentional or reckless interference with a badger sett.

A6.5.1.1 Interfering with a badger sett includes:

- damaging or destroying a sett or any part of it;
- obstructing access to a sett; and
- disturbing a badger while it is in a sett.

Reptiles

A6.5.1.1 Under the Wildlife and Countryside Act 1981, common lizard (*Zootoca vivipara*), adder (*Vipera berus*) and slow-worm (*Anguis fragilis*) are protected against intentional or reckless killing and injury.

A6.5.1.2 There is no licensing provision to allow the lawful killing or injuring of reptiles. Therefore, where reptiles are likely to be present, appropriate measures must be put in place to minimise the risk of this happening on construction sites.

EPS Development Licencing

A6.5.1.3 Works that would, or could, result in an offence being committed under the Habitats Regulations can only be lawfully undertaken if there is a derogation licence in place. The issuing of such licences is a responsibility of NatureScot. EPS development licences can only be granted if the requirements of the following Habitats Regulations legal ‘tests’ are met:

- The purpose of the licence must be for preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature;
- A licence cannot be granted unless there is no satisfactory alternative; and
- That the action authorised must not be detrimental to the maintenance of the population at a favourable conservation status in their natural range.

A6.5.1.4 As well as providing sufficient evidence to inform a detailed consideration of the above tests, the licence application will also need to be supported by a suitably detailed and current survey report and a species protection plan, which will set out the proposed mitigation required in each case.

A6.5.1.5 If a licence is granted it is likely to include a set of conditions, relating to the implementation of the agreed protection plan, which must be strictly adhered to in order for the works under the licence to proceed lawfully. This may include restrictions on the timing of works to avoid more sensitive periods, such as the breeding season.

A6.5.1.6 Depending on the circumstances it may not be possible for the third test (i.e. in relation to maintenance of the favourable conservation status of the species) to be met in all cases. Therefore, NatureScot would not be able to issue a derogation licence and the proposed works will have to be delayed or modified.

Non-EPS Licencing

A6.5.1.7 NatureScot is also the authority that issues licenses for development related activities that could affect Schedule 5 species (i.e. in this case red squirrels and pine marten). Licenses can only be issued if the proposed activity will contribute to significant social, economic or environmental benefit; there is no satisfactory alternative; and there is no significant negative impact on the conservation status of the species.

A6.5.1.8 Similarly to EPS, an application for a licence will need to be supported by a current survey report and a protection plan detailing the measures that will be followed to avoid a significant adverse effect on the species.

A6.5.1.9 In relation to badgers and their setts a licence may be required if planned works could result in disturbance or destruction of a badger sett. Similarly to other protected species, NatureScot can issue licences, providing certain conditions are met, to allow works to proceed that would otherwise be unlawful under the Protection of Badgers Act.

A6.5.1.10 As with other protected species, suitable supporting information will need to be provided with the application for a licence. Measures to protect badgers during temporary or permanent sett exclusions will have to follow best practice and be implemented by suitably experienced ecologists.

A6.5.1.11 In relation to licencing for badger, red squirrel and pine marten, there may be conditions placed on the licence by NatureScot that restricts the timing of works to avoid the more sensitive periods such as the breeding season (i.e. when pregnant females or their dependant young may be present and particularly vulnerable to impacts from the proposed works).

National and Local Conservation Status

A6.5.1.12 Table 6.5.1 provides a summary of the conservation and statutory designations applicable to each species / taxon and a summary of the local status (i.e. in the context of the Proposed Development Area) of the key species considered in this document. Further information and discussion on local status and the potential effects of the proposed development are provided in Chapter 6: Ecology & Biodiversity.

Table 6.5.1: Summary of the Conservation Status of Protected Species relevant to the Proposed Development Area and Current Status at the Site-level

Species / Taxon	UK / Scottish Conservation Status	Site Status
Badger	• Current UK-wide assessment - Not assessed. • IUCN Red List status - ‘Least Concern’ (Scotland). • Not currently of conservation concern but badgers remain at risk of human persecution.	• Present within the Proposed Development Area, although habitat suitability is generally poor for badger within much of the proposed wind farm area.

Species / Taxon	UK / Scottish Conservation Status	Site Status
		• The design of the Proposed Development has taken into consideration sett locations and they have been avoided, however there is the potential for new setts to be excavated and old ones re-occupied before works commence on site.
Bats (all relevant species)	• Current UK-wide assessments -'Favourable' (applies to all established species in Scotland with the exception of Nathusius' pipistrelle which has a status of 'Unknown'). • IUCN Red List status for Scotland: Daubenton's bat - 'Least Concern' Natterer's bat - 'Least Concern' **Leisler's bat** - 'Near Threatened' Noctule - 'Least Concern' Common pipistrelle - 'Least Concern' Soprano pipistrelle - 'Least Concern' **Nathusius' pipistrelle** - 'Vulnerable' Brown long-eared bat - 'Least Concern'	• At least seven bat species have been recorded using the Proposed Development Area based on bat detector survey results. • Habitat quality (roosting, commuting and foraging) is generally low across much of the Proposed Development Area. • The proposed tree felling areas (including the recently established plantations) offer poor opportunities for roosting bats.
Otter	• Current UK-wide assessment - 'Favourable'. • IUCN Red List status - 'Vulnerable' (Scotland). • Widespread in Scotland, with the population having reoccupied most if not all catchments previously lost within its range.	• Present within the Proposed Development Area, with evidence of otter found along the Benloch and Marbrack Burns. • There are a number of potentially suitable resting site features for otter (couches, lie-ups) along these main watercourses but no evidence that any of these sites were in active use at the time of the baseline surveys
Pine marten	• Current UK-wide assessment - 'Favourable'. • IUCN Red List status - 'Least Concern' (Scotland). • Was once found throughout Britain, suffered dramatic declines during the 19th century. Since legal protection came into force in the 1980s the population has made a significant recovery with an expansion south and eastwards from the core areas in the northwest Highlands. There is a population present in southern Dumfries and Galloway centred on Galloway Forest Park.	• No evidence during the baseline survey that pine marten use the Proposed Development Area. Habitat suitability is generally poor across most of the Proposed Development Area for this species. However the site is near to the current range of the species in SW Scotland and this species may occur in the future.
Red squirrel	• Current UK-wide assessment - Not assessed. • IUCN Red List status - 'Near Threatened' (Scotland). • Long-term decline in population size and range in the UK. Strongholds are in the Highlands and southern Scotland south of the Central Belt.	• No evidence during the baseline survey that red squirrel are present within the Proposed Development Area. Red squirrel are present within suitable woodland habitat in the wider surrounding area. • Habitat suitability is poor across most of the Proposed Development Area.
Water vole	• Current UK-wide assessment - Not assessed. • IUCN Red List status - 'Near Threatened' (Scotland). • Very large declines in population size and in species distribution in the UK and Scotland in the 1980s and	• No evidence during the baseline survey that water vole are present within the Proposed Development Area. • There is extensive suitable habitat for water vole within the Proposed Development Area associated with

Species / Taxon	UK / Scottish Conservation Status	Site Status
	1990s, without recovery. Due to habitat loss/change and predation by American mink (*Neovison vison*).	watercourses, ditches, bog and marshy grassland areas.
Reptiles	• The conservation status of national reptile populations is unclear. There are believed to be general long-term declines in most of the reptile species present in Scotland, including adder, common lizard and slow worm. • The declines are thought to be due to a combination of factors including habitat fragmentation, land management and site disturbance.	• Formal surveys for reptiles were not undertaken to inform the EIA. The Proposed Development Area is within the distributional range of all three species listed in this table and there is suitable habitat present within the Site and the Proposed Development Area.

Breeding Ecology, Protection Zones & Sensitive Periods

A6.5.2.1 Table 6.5.2 (overleaf) provides a summary of the relevant aspects of the breeding ecology of the species considered in this document along with the distances and periods when the species and their resting places (in this context 'resting places' is used as a collective term for all places of shelter including breeding sites) are considered to be particularly vulnerable to impacts from felling or construction works. This information is provided for general guidance only. Specific mitigation requirements will need to be considered by a suitably experienced ecologist on a case-by-case basis.

Table 6.5.2: Summary of Ecology, Impact Vulnerability, Zones and Periods of High Sensitivity for Relevant Protected Mammals

Species/ Taxon	Key Aspects of Species Ecology	Impact Vulnerability	Protection Zones / Periods of Increased Sensitivity
Badger	Badgers form territorial social groups and typically excavate setts in suitable, well-drained sandy soils within woodland, scrub or near to hedges. Locations near to good foraging habitat (e.g. lowland farmland and suburban parkland areas) are preferred. Setts can also be found in open ground, boulder piles and rock cavities. Sett densities are comparatively low in upland areas with heather moorland. The main breeding season is December to June inclusive. Mating is most likely to occur in February (implantation of the embryo is then delayed), pregnancy from December to February, birth of a litter of 3 on average in February with the cubs emerging for the first time in April and weaned by May-June.	Tree felling / construction works Noise Vibration Lighting Road traffic	Protection zones around setts: a minimum of 50 m from sett entrances (100 m for piling or blasting). Where the required protection zone is not achievable, a licence from NatureScot will be required before works can proceed. The main breeding season is December to June inclusive. Licences to exclude or disturb badger setts do not normally allow works during this period.
Bats	Bats have a relatively low reproductive rate (breeding females typically have one pup per year, rarely twins) and are relatively long-lived for their size. Bats mate in the autumn or winter. Gestation is then delayed and lasts between 40 to 70 days, depending on the species, with births occurring from late June to early August. Bats use roosts for shelter, mating and breeding. They will move between different roost sites depending on their ecological and physiological requirements at different times of the year. Bats can roost in a wide variety of natural and artificial structures including features associated with trees (e.g. bark slabs, cavities formed by damage or decay or woodpeckers) and a wide range of suitable voids or crevices associated with buildings. They may also use underground sites such as caves and mines, typically during the winter. During the pregnancy-birth-rearing period female bats typically form nursery colonies which can number several hundred bats or more, depending on the species. Roosts used during this period are often occupied for many years and potentially many decades in relation to some buildings. The loss of such maternity roosts can be catastrophic for the local population.	Tree felling Lighting	Roost protection zone requirements will vary depending on the specific circumstances, but typically not less than 50 m. Where the required protection zone is not achievable, a licence from NatureScot will be required before works can proceed. The main active period is April to October. Breeding females and their young are particularly vulnerable during May to July. Licences to exclude or disturb maternity roost sites do not normally allow works during this period. Hibernation occurs between November and March.
Otter	Otters are mostly solitary and nocturnally active (particularly inland populations) and are typically associated with freshwater and coastal habitats but they can be present some distance away from water (e.g. when moving between watersheds or when foraging for amphibians in the spring). Adult females are highly territorial and defend large home ranges that are overlapped by one or more males. Adult females can breed at any time of the year. They typically have a single litter of 2-3 cubs, pregnancy lasts for c. 60 days and the cubs are independent at c. 10 months. Otter holts are underground shelters (e.g. natural hole, old mammal burrow) that can also be used for breeding. They are difficult to locate as otters may not leave any obvious external evidence of their presence (this is particularly the case with breeding holts). Otters may also use above-ground shelters, with some degree of cover, often referred to as ‘couches’ and ‘lie-ups’. Their dependence on water, and fish / amphibian prey, means that otters are particularly vulnerable to aquatic pollution.	Tree felling / construction works Noise Vibration Lighting Road traffic Aquatic pollution	For breeding sites the protection zone should be at least 200 m. May be reduced to 100 m depending on the nature of the works, topography and natural screening. For non-breeding sites the protection zone should be at least 50 m. Where the required protection zone is not achievable, a licence from NatureScot will be required before works can proceed. Licences to destroy or disturb breeding sites do not normally cover the period of active use. Breeding can occur at any time of year.
Pine marten	Pine martens are associated with woodland, including conifer plantations. However, in Scotland they also use open areas, away from woodland, particularly in the north and west of the country. Pine marten dens are usually hollow trees, among rocks or in disused bird nests or squirrel dreys. In some parts of Scotland, pine martens can use suitable enclosed spaces in the roofs of buildings as dens. Typically pine martens will have a large number of dens within their territory. Pine martens are mostly active between dusk and dawn but can also be active during the day in summer. Mating can occur between June-August and births usually occur in late March-April	Tree felling / construction works Noise Vibration Lighting Road traffic	For non-breeding dens the protection zone should be at least 50 m. For breeding dens the protection zone should be at least 100 m. Where the required protection zone is not achievable, a licence from NatueScot will be required before works can proceed. Licences to exclude or disturb breeding sites do not normally allow works when the site is in use. The main breeding season is March-June inclusive.

Species/ Taxon	Key Aspects of Species Ecology	Impact Vulnerability	Protection Zones / Periods of Increased Sensitivity
	with a mean litter size of 3. Natal dens are occupied for 50-60 days and then the litter is often moved by the mother to another site. The young emerge from the den for the first time at 7-8 weeks of age.		
Red squirrel	Within their current range in Scotland the red squirrel is present in both conifer and broadleaved woodland, as well as in mixed forests and parks and gardens. Woodlands with mixtures of tree species provide a more reliable year-to-year food supply. Red squirrels create dreys (nests) that they use for shelter and breeding. Typically they build dreys in trees that are at least 15 years old. A single red squirrel may have several dreys that they use within its home range at any one time. They can build a new drey in a few days. Breeding mostly occurs between February and September with two peaks in spring and summer depending on food availability. Gestation lasts for 36-42 days, average litter size is 3. Lactation occurs for 50-70 days. The young begin to venture outside their drey at 8-10 weeks old. Red squirrels do no hibernate during winter.	Tree felling Noise Lighting Road traffic	For dreys during the non-breeding season (October to January inclusive) the protection zone should be at least one trees distance or 5 m. During the breeding season the protection zone should be at least 100 m. Where the required protection zone is not achievable, a licence from NatureScot will be required before works can proceed. Licences to destroy or disturb dreys do not normally allow works during the breeding season. The main breeding season is February to September inclusive.

A6.5.2. ENABLING WORKS & CONSTRUCTION

Introduction

A6.5.2.2 The purpose of the outline SPPs is to set out how the potential effects on protected species arising from the construction of the proposed development will be avoided / minimised so that the works can proceed lawfully and following best practice.

A6.5.2.3 The potential impacts on protected species from the proposed development, which have been fully considered and assessed within the EIAR (see Chapter 6), are summarised as follows:

- Felling – tree felling and clearance operations in advance of construction could result in the loss or disturbance to resting places, habitat fragmentation, the temporary disturbance to protected species and their displacement from supporting habitats.
- Construction – borrow pit operations, earthworks, presence of construction workers, lighting and machinery etc. could be a source of disturbance resulting in temporary obstruction or displacement from supporting habitats / resting places.
- Decommissioning – similarly to the construction phase, there is the potential for disturbance to arise from the dismantling of wind turbines, removal / covering of old bases and access tracks resulting in temporary displacement from supporting habitats / resting places.

A6.5.2.4 The measures proposed in the outline SPPs will be subject to further review and consultation with NatureScot before any works (including tree felling) occur. This is to ensure that any relevant information that emerges, subsequent to the EIAR being submitted, is taken into consideration and that the proposed measures follow current best-practice.

A6.5.2.5 The proposed tree felling is limited to a relatively small area of mature conifer shelterbelt and areas of recently planted trees (mostly commercial conifers).

A6.5.2.6 The decommissioning of the proposed development is anticipated to occur 35 years after the wind farm becomes operational. There is the potential for what is currently considered to be best practice to change over this period. It is also possible that the range of species that need to be considered will be different. It is therefore proposed that the methods of the pre-decommissioning surveys for protected species and the proposed SPPs (or equivalent as required at that time) would be reviewed, in consultation with the relevant authorities, not more than 12 months before decommissioning works are due to commence.

Ecological Clerk of Works

A6.5.2.7 A suitably experienced and qualified Ecological Clerk of Works (ECoW) will be appointed by the applicant for the duration of the pre-works, construction and site restoration phases. The ECoW will have authority to immediately halt any works that have the potential to adversely affect protected species or that would contravene the ecological / environmental commitments.

A6.5.2.8 The ECoW will have responsibility for checking that the SPP measures, as outlined in this document, are properly implemented and adhered to. Also that the potential presence of protected species is regularly monitored during the works and that appropriate action is taken should any breeding sites/resting places be at risk of disturbance (e.g. sites not previously identified during the pre-works surveys).

A6.5.2.9 The ECoW will provide reports on the progress of the works in relation to the implementation of the environmental protection measures (including measures under the SPP) and a final report at the end of the construction and site restoration works. Copies of these reports will be provided to NatureScot and DGC.

Pre-construction Surveys

Introduction

A6.5.2.10 A detailed survey method statement will be developed, discussed and agreed with NatureScot well in advance of any felling or construction works commencing for the proposed development (i.e. at least 12 months in advance). All methods will follow current best practice and surveys will be completed by suitably experienced ecologists with valid protected species survey licences as required.

A6.5.2.11 The surveys will be completed at the appropriate time of year and not more than eight months prior to the commencement of felling / construction.

A6.5.2.12 Should construction works follow on immediately from the tree felling and site clearance (i.e. within eight months) then the need for a further pre-construction survey will be reviewed and determined by the ECoW. If works are delayed more than 8 months after tree clearance then a pre-construction survey will be completed.

A6.5.2.13 The results of the pre-felling / pre-construction surveys will be provided to NatureScot and DGC.

Initial Walkover Survey

A6.5.2.14 A staged approach will be taken with an initial desk-based review (ensuring that available information on all relevant protected species is collated for the area from all relevant sources) followed by walkover and site assessment followed by more intensive surveys, as required.

A6.5.2.15 The initial survey and assessment will include a walkover by a suitably experienced ecologist to assess habitat quality, search for field signs and identify and describe potential resting places (i.e. all types of potential shelter used by the relevant species). This initial walkover survey and assessment will be completed within appropriate buffer zones from the outer limits of the proposed works.

A6.5.2.16 Areas of impenetrable thicket plantation or very steep ground, which cannot be fully accessed by the surveyor, will be surveyed as thoroughly as possible from the perimeter. A risk-based assessment would be made on the likelihood, based on the available evidence and quality of the habitats present, that the area could provide opportunities for protected species to use as a resting place.

A6.5.2.17 Should any evidence of any protected species be found and/or features that are suitable as resting places then this will trigger the need for more detailed surveys to be carried out.

A6.5.2.18 As some species, such as otter for example, tend not to leave obvious evidence of their presence at breeding sites a precautionary approach will be followed. It will be assumed that any suitable features are resting places until sufficient monitoring has been completed to make an informed judgement. What is considered sufficient monitoring will be set out within the survey method statement and agreed in advance with NatureScot.

Detailed Surveys / Monitoring

A6.5.2.19 Depending on the findings from the initial walkover, this could trigger the need for more detailed surveys to determine the use and status of any potential or confirmed resting places or other suitable habitats. The most appropriate and effective methods will vary according to the focal species. All surveyors will be experienced in the survey methods and ecology of the species and will hold valid NatureScot survey licences where applicable.

A6.5.2.20 For example, this may include monitoring of any potential otter holts or couches with automated wildlife trail cameras, or observing a potential pine marten den using a thermal imaging scope from a suitable hide located away from the feature.

A6.5.2.21 A reptile survey may also be carried out for areas of suitable habitat affected by the works. The survey would be completed at the appropriate time of year when reptiles are most active (i.e. April, May and September). This survey, in relation to adder and common lizard, typically entails searching for basking individuals in the morning or

late afternoon on warm, dry, still days. As slow worms rarely bask in the open a search is undertaken under refugia such as logs and stones. Artificial refugia may be set out, in suitable habitats, to assist with the reptile survey (e.g. black carpet tiles).

General Measures

Pre-felling / Pre-construction Induction

A6.5.2.22 Prior to any personnel working within the felling or construction area they will be fully briefed by the ECoW on the potential for protected species to be present in the area, their status and legal protection, relevant details of the SPPs and what actions they need to take should any protected species or their signs be encountered during their work.

Felling / Works Timing and Extents

A6.5.2.23 The extent of advanced tree felling required for the construction of the wind farm will be kept to the minimum necessary.

Badger - Outline Protection Measures

A6.5.2.24 Measures to minimise impacts on badgers will follow the standard mitigation hierarchy of avoidance, mitigation and compensation:

Impact Avoidance

- Where possible micro-site the development and construction methods to avoid damage or disturbance to setts and to avoid disturbance of badgers;
- Establish appropriate protection zones around any setts near to works, a minimum of 50 m from sett entrances (100 m for piling, rock pecking or blasting);
- Felling / construction works will be restricted to daylight hours only (avoiding dusk / dawn periods);
- Trees will be felled away from badger setts and will avoid blocking badger paths;
- Vehicle speed restrictions of <15 mph on site will be strictly imposed;
- Use of security lighting will be kept to the minimum necessary and will be directed away from any setts or important badger commuting routes in the vicinity;
- Generators will be turned off at night; and
- Any exposed pipes or deep excavations that badgers could be trapped in will be covered overnight and exit ramps will be provided in the excavations.

Mitigation / Compensation

A6.5.2.25 If it is not possible to avoid works within the protection zones outlined above then it will be necessary to request a development licence from NatureScot. Licences are not normally granted for works during the badger breeding season (December to June inclusive).

A6.5.2.26 Any licence application will be supported by a suitably detailed survey report and assessment by an ecologist. The assessment will consider the potential impacts on the social group affected along with a best practice approach during the works. The required mitigation will vary depending on the type and scale of the proposed works and the associated impacts.

A6.5.2.27 A licence to cover the disturbance or destruction of a sett will only be issued if there are alternative suitable setts for badgers to use within the same territory. If there are no alternative setts available, an artificial sett will need be provided. However, this is considered the least preferred option if alternative approaches are available to avoid sett loss.

Bats - Outline Protection Measures

Impact Avoidance

- Where possible micro-site the development and construction methods to avoid damage or disturbance to roost sites and to avoid disturbance to bats;
- Establish appropriate protection zones around any roost sites near to works (i.e. a minimum of 50 m); and
- Use of security lighting will be kept to the minimum necessary and will be directed away from any roost site or important bat commuting routes in the vicinity.

Mitigation / Compensation

A6.5.2.1 If it is not possible to avoid works within the protection zones outlined above then it will be necessary to request a development licence from NatureScot. Licences are not issued to cover works affecting a maternity roost site during the breeding season.

A6.5.2.2 Any licence application will be supported by a suitably detailed survey report and assessment by an ecologist. The assessment will consider the potential impacts on the roost affected along with a best practice approach during the works. The required mitigation will vary depending on the type and scale of the proposed works and the associated impacts.

A6.5.2.3 Compensatory measures are unlikely to be necessary unless a roost has to be destroyed or bats temporarily or permanently excluded from the roost site. Should this be required it will have to be fully justified (i.e. there are no suitable alternatives) and a plan will have to be agreed with NatureScot to ensure that appropriate alternative roosting opportunities (e.g. bat boxes) are provided as compensation for roost loss before the works commence.

Otter - Outline Protection Measures

Impact Avoidance

- Where possible micro-site the development and construction methods to avoid damage or disturbance to otter holts or couches;
- Establish appropriate protection zones around any resting places near to works, a minimum of 50 m from non-breeding sites and 200 m for breeding holts;
- Felling / construction works will be restricted to daylight hours only (avoiding dusk / dawn periods);
- Trees will be felled away from otter resting places and will avoid blocking or damaging watercourses;
- Vehicle speed restrictions of <15 mph on site will be strictly imposed;
- Use of security lighting will be kept to the minimum necessary and will be directed away from any resting places or important otter habitats in the vicinity;
- Generators will be turned off at night; and
- Any exposed pipes or deep excavations that otters could be trapped in will be covered overnight and exit ramps will be provided in the excavations.

Mitigation / Compensation

A6.5.2.1 If it is not possible to avoid works within the protection zones outlined above then it will be necessary to request a development licence from NatureScot. Licences are not normally granted for works affecting a breeding site while it is in use.

A6.5.2.2 Any licence application will be supported by a suitably detailed survey report and assessment by an ecologist. The assessment will consider the potential impacts the otter population affected along with a best practice approach during the works. The required mitigation will vary depending on the type and scale of the proposed works and the associated impacts.

A6.5.2.3 A licence to cover the disturbance or destruction of an otter resting place will only be issued if there are suitable alternative sites for otter to use within the same territory. If there are no alternative sites available, an artificial holt(s) will need be provided.

Pine marten - Outline Protection Measures

Impact Avoidance

- Where possible micro-site the development and construction methods to avoid damage or disturbance to pine marten dens and other places of shelter;
- Establish appropriate protection zones around any dens or other places of shelter near to works;
- The protection zone should be at least 100 m where dens are used for breeding, and 30 m where breeding is not suspected; and
- Vehicle speed restrictions of <15 mph on site will be strictly imposed.

Mitigation / Compensation

A6.5.2.1 If it is not possible to avoid works within the protection zones outlined above then it will be necessary to request a development licence from NatureScot. Licences are not normally granted for works affecting pine marten dens during the breeding season.

A6.5.2.2 Any licence application will be supported by a suitably detailed survey report and assessment by an ecologist. The assessment will consider the potential impacts the pine marten population along with a best practice approach during the works. The required mitigation will vary depending on the type and scale of the proposed works and the associated impacts.

Red squirrel - Outline Protection Measures

Impact Avoidance

- Where possible micro-site the development and construction methods to avoid damage or disturbance to red squirrel dreys;
- Establish appropriate protection zones around any dreys near to works;
- Manage felling process, leave escape corridors and fell progressively to avoid isolating red squirrels;
- For dreys during the non-breeding season (October to January inclusive) the protection zone should be at least one trees distance or 5 m. During the breeding season the protection zone should be at least 100 m; and
- Vehicle speed restrictions of <15 mph on site will be strictly imposed.

Mitigation / Compensation

A6.5.2.1 If it is not possible to avoid works within the protection zones outlined above then it will be necessary to request a development licence from NatureScot. Licences are not normally granted for works affecting red squirrel dreys during the breeding season.

A6.5.2.2 Any licence application will be supported by a suitably detailed survey report and assessment by an ecologist. The assessment will consider the potential impacts to the red squirrel population along with a best practice approach during the works. The required mitigation will vary depending on the type and scale of the proposed works and the associated impacts.

Reptiles - Outline Protection Measures

A6.5.2.3 The risk to reptiles from the proposed works would be further assessed during the pre-construction survey period and a SPP would be developed at that time. The need for specific measures to reduce the risk to reptiles from construction works may include the following:

- avoidance of refugia features to avoid loss or damage;
- timing works to avoid the period when reptiles may be hibernating (October-March);
- reducing habitat suitability to encourage reptiles away from areas where they could be killed or injured (e.g. careful strimming of grassland to a short sward), provided there is a suitable safe area nearby that they can easily move to; and
- use of fencing to prevent reptiles moving into areas where they could be killed or injured.

A6.5.3. OPERATIONAL MEASURES

Introduction

A6.5.3.1 This section outlines the measures proposed to avoid / minimise potential impacts on protected species during the operation of the Proposed Development.

Maintenance Works

A6.5.3.2 During the operational phase, periodic maintenance would be required on the wind turbines and tracks. Access to areas requiring maintenance would be confined to areas previously used for construction activities with no new access tracks constructed.

A6.5.3.3 Under a site operational EMP, method statements for all potential maintenance and emergency maintenance works would be developed in accordance with environmental best practice to ensure that the risk of disturbance to protected species and appreciable physical damage or pollution to sensitive terrestrial and freshwater habitats during operational Site activities are avoided / minimised.

Bat Mortality Risk

A6.5.3.4 An operational Bat Protection Plan would be developed prior to the start of wind farm operation, in consultation and agreement with NatureScot, which would include details of the measures that would be implemented to monitor bats and minimise the risk of fatalities occurring during wind farm operation

A6.5.3.5 The following is a summary of the proposed operational phase bat protection measures, further detail is provided in Chapter 6: Ecology & Biodiversity of the EIAR.

A6.5.3.6 For all of the wind turbines located within or near woodland, once the trees are felled / cleared during the construction phase, a buffer zone would remain unplanted for the duration of the wind farm, to ensure that the minimum recommended distance (i.e. 50 m) between the wind turbine blade tips and forest edge habitats within the Site would be maintained in the long-term (see Figure 12.3).

A6.5.3.7 The following operational / monitoring measures would also be implemented:

- Bat activity monitoring (including monitoring at wind turbine hub height) would be completed for at least three years after the Proposed Development becomes operational, in order to inform the need for a wind turbine bat management protocol (see below);
- The “feathering” of turbine blades to reduce rotation speeds while idling will be implemented; and
- A bat carcass search programme for at least three years after the Proposed Development becomes operational, would be implemented. It would include trials to determine values for Proposed Development Area-specific biases that affect estimates of bat mortality from carcass searches, such as scavenger removal rates and search accuracy.

A6.5.3.1 If the monitoring identifies a level of bat mortality occurring above an ‘incidental’ level (subject to agreement with NatureScot as to what rate of mortality is considered ‘incidental’) a wind turbine bat mitigation protocol would be developed and implemented. The aim of the protocol would be to minimise the risk of fatalities occurring during periods of elevated risk to bats. This could be achieved by opening the blade pitch into the fully feathered position, which reduces blade rotation speed to <1 rpm (referred to as ‘curtailment’).

A6.5.3.2 The details of any turbine bat mitigation protocol that is required (e.g. the trigger points for blade feathering and unfeathering, which would be software controlled) would be determined based on the results of weather (e.g. rain, wind speed and temperature) and bat activity monitoring. This is so that the conditions that correspond to nights with comparatively high bat activity at turbine height can be determined. From this, a protocol would be developed which is effective at minimising the risk to bats whilst also ensuring that curtailment is as efficient as possible. That is, avoiding curtailment occurring unnecessarily when the risk to bats is low temporally (e.g. daytime, nights outside of active period) or spatially (e.g. some wind turbine locations may have consistently low levels of activity).

A6.5.3.3 The effectiveness of the turbine bat management protocol would also be monitored for three years through a robust bat carcass search programme. A method using specially trained dogs, developed by Exeter University, has been proven to be far more effective than human searches particularly on difficult terrain such as clear-fell areas (see Appendix 4 of the NatureScot *et al*. 2021 guidance document for further details).

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VATTENFALL

Appendix 6.6

Outline Habitat Management Plan

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.6.1 INTRODUCTION

Purpose of this Document

A6.6.1.1 This is a Technical Appendix to Chapter 6: Ecology & Biodiversity of the Environmental Impact Assessment Report (EIAR) for the proposed Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with that Chapter.

A6.6.1.2 The document outlines proposed habitat creation and enhancement measures related to offsetting the residual adverse ecological effects of the Proposed Development. Additionally, opportunities for biodiversity benefit are also outlined here.

A6.6.1.3 A detailed Habitat Management Plan (HMP) is proposed to be developed, in discussion with all relevant stakeholders (i.e. landowners, local authority, NatureScot, RSPB, Galloway Fisheries Trust), following consent and prior to the commencement of construction works. The detailed HMP would include the agreed areas and objectives, management prescriptions, costs/budget, programme, monitoring methods and reporting regime.

A6.6.1.4 The capital and maintenance costs of implementing any detailed HMP which comes forward, and potential consequences with respect to changes in land management and existing commercial interests, will be subject to an agreement between the Applicant and the landowners and are not addressed here.

A6.6.1.5 The Applicant is also proposing an alternative to an on-site HMP, which would be subject to consultation and agreement with the local authority and other relevant parties. This alternative, discussed further in Chapter 6 (section 6.7), would entail funding off-site habitat creation and enhancement measures, i.e. directly supporting regional nature conservation projects and policy objectives.

Aims of the HMP

A6.6.1.6 The overall aims of the HMP would be as follows:

- To offset the unavoidable direct and indirect adverse effects of the Proposed Development on certain sensitive habitats and fauna (guided by the findings of the EIA process and local / national government biodiversity and nature conservation policy objectives).
- To identify opportunities for the proposed development to meaningfully contribute towards local and national government biodiversity policy objectives.
- To contribute towards other local and national policy objectives related to biodiversity and climate change (e.g. ameliorating flood risk, improving woodland habitat connectivity, carbon sequestration capacity in peatlands).
- Finally, to address (partially or wholly) the potential compensatory tree planting requirements for the proposed development related to the Scottish Government's policy on the control of woodland removal.

A6.6.1.7 This document discusses the proposed areas of habitat creation and enhancement within the Site (i.e. as defined by the red line boundary) as shown on Figure 6.9.

A6.6.1.8 Table 6.6.2 at the end of this document provides an overview of the proposed HMP areas, proposed management aims and measures.

Rationale for the HMP

A6.6.1.9 The Proposed Development has been designed to minimise the loss of sensitive habitats of importance for nature conservation such as blanket bog. However, some impact on these habitats is unavoidable. Table 6.6.1 provides the estimated habitat loss / degradation from the construction of the Proposed Development (NB this does not account for habitats that would be lost in time as a result of canopy closure within the recently established tree plantation areas).

Table 6.6.1: Estimated habitat loss and degradation (i.e. due to localised changes to peat hydrology) from the Proposed Development

Habitat Type	Area (hectares)
Marsh / marshy grassland	30.72
Wet modified bog	14.52
Semi-improved acid grassland	11.11
Wet dwarf shrub heath	4.33
Blanket bog	1.88
Coniferous plantation woodland	0.75
Acid / neutral flush	0.17
Continuous / scattered bracken	0.93
Semi-improved neutral grassland	0.89
Total	65.30

A6.6.1.12 The proposed HMP would specifically address the loss of bog and wet heath habitats, due to the construction of the Proposed Development, through the enhancement of similar, degraded habitat types within the Site. The areas proposed for conservation management are outside of the proposed wind turbine locations. They have been degraded, in terms of their ecological potential, through the long-term effects of stock grazing, trampling, nutrient enrichment and artificial drainage. The total area of blanket bog habitats that would be placed under nature conservation management is estimated, as a minimum, at c. 100 ha (which is about 6 times the amount of bog habitat that would be affected by the Proposed Development).

A6.6.1.13 The long-term effects of land management have a resulted in modified bog and heath vegetation communities that are not in an ecologically favourable condition. They are generally lacking in dwarf-shrub cover, often becoming over-dominated by plants that are less palatable to grazing sheep, such as purple moor-grass (*Molinia caerulea*) and with a reduced extent and diversity of peat-forming species (primarily sphagnum mosses). Over the long-term, grazing animals also affect bog and heath vegetation by altering the nutrient levels within the peat / soil leading to an increase in dominance of grasses in the sward, as bog and heath plants can out-compete grasses only when nutrient levels are relatively low. It is also likely that some areas of blanket bog vegetation have been influenced, in the long-term, by the presence of drainage ditches ('moor grips') cut into the peat many decades ago. These ditches will have reduced the wetness of the upper layers of peat and made conditions less favourable for sphagnum growth and potentially reduced the extent and diversity of sphagnum species that might otherwise be expected to occur.

A6.6.1.14 Whilst the degree of grazing and trampling impact varies to some extent across the proposed HMP areas the effects on heath and bog vegetation are evident throughout. It is estimated (based on stock information provided by the landowners) that the average stocking rate across the proposed HMP areas is between 0.1 and 0.15 LU/ha/yr[1] (almost exclusively ewes and lambs that are not off-wintered). In relation to the blanket bog areas, this

[1] LU – livestock unit, 1 LU is equivalent to: 0.12 ewe; 0.15 ewe and lamb; 0.6 beef cattle 6-24 months; 1.0 beef cattle >24 months; 1.0 suckler cow and calf.

Quantans Hill

level of grazing intensity (particularly during the autumn/winter) is much greater than is recommended to help maintain this habitat in a favourable ecological condition (NatureScot 2014[2]).

A6.6.1.15 The estimated total area of tree clearance / felling to accommodate the Proposed Development, and which would not be re-planted for the lifetime of the wind farm, is estimated to be 13.8 ha (see Technical Appendix 12.1). The majority of this area (c. 95%) is comprised largely of recently planted (i.e. during 2020-21) commercial conifers and a small area of conifer shelterbelt, which are of negligible ecological value. As part of the proposed HMP, the loss of these areas would be compensated for by establishing native broadleaved woodland along suitable sections of the main watercourses within the Proposed Development Area, as indicated on Figure 6.9. The total area of proposed tree planting is c. 29 ha, more than twice the area of recently planted conifers that would be removed due to the Proposed Development. Establishing native woodland along riparian corridors will improve habitat quality and connectivity for a wide range of species, help to reduce bankside erosion and make an appreciable contribution to regional objectives to increase native woodland cover (see the Dumfries & Galloway Forestry and Woodland Strategy, 2014[3]).

A6.6.2 OUTLINE HMP

Bog Restoration

A6.6.2.1 Blanket bog habitats within the Proposed Development Area have become modified, to varying extents, through the long-term effects of artificial drainage and grazing / trampling / nutrient enrichment by livestock. There are opportunities to improve the quality of blanket bog habitats (i.e. improve ecological condition / functioning) to both compensate for the areas of similar habitat directly affected by the Proposed Development and to also contribute to regional and national biodiversity / nature conservation policy objectives. For example, the restoration of degraded peatland habitats is one of the key objectives of Scotland's National Peatland Plan (NatureScot 2015[4]).

A6.6.2.2 Blanket bog restoration would be attempted through a combination of the careful blocking of artificial drainage ditches (also referred to as 'grip blocking') and reducing sheep and cattle stocking rates to counteract the adverse effects of grazing and trampling on blanket bog vegetation and bring the habitat into a better ecological condition. It is important to note that bog restoration is a long-term aim, as the ecological benefits can take many years to be realised.

A6.6.2.3 The appropriate stocking rate to achieve the general aims of the HMP will vary from location to location based on a range of variables. For the purposes of the outline HMP, initial maximum stocking rates have been proposed based on current guidance (e.g. NatureScot and Scottish Rural Development Programme Farm Advisory Service). In practice, there will be a need to carefully monitor the response of bog vegetation to the reduced stocking rates over time, to ensure that grazing levels are appropriate to achieve the HMP objectives in the long-term. Insufficient grazing can also be detrimental to achieving good ecological condition, for example due to scrub encroachment or over dominance of Molinia (purple moor-grass). Therefore, it may be appropriate to increase stocking rates or change grazing management in some locations depending on the vegetation monitoring results.

A6.6.2.4 Suitable peat, and vegetated turves, excavated for the construction of the Proposed Development could be used to block drains within the bog restoration areas to raise water levels within the peat. Blocking drainage ditches allows the gradual restoration of more natural water levels in the upper layers of the peat (also referred to as 're-wetting'). This encourages the recovery of Sphagnum mosses, which helps to retain water and to create a more 'active', peat-building bog habitat. This will result in benefits for a wide range of plant and animal species that are dependent on bog habitats. There would also be several wider environmental benefits, in the long-term, such as the improved capacity for carbon-capture within the bog and some degree of flood-water attenuation and flood risk alleviation within the catchment downstream from the Proposed Development Area.

A6.6.2.5 The HMP would also include the removal of any encroaching trees and scrub to reduce water loss to the bog through evapotranspiration.

A6.6.2.6 Blanket bog restoration would be undertaken in two main areas to the west and east of the Proposed Development (see Figure 6.9) comprising:

- Area C (Knockgray, West) = c. 27.3 ha
- Area E (Furmiston mire) = c. 71.9 ha

A6.6.2.7 The main aims for these blanket bog areas will be to:

- Restore and maintain peat-building conditions.
- Increase the cover of peat forming species, i.e. Sphagnum mosses.
- Raise and maintain the height of the water table.
- Monitor condition regularly.

A6.6.2.8 The proposed actions are outlined as follows:

- Reduce grazing pressure by lowering the stocking rate initially to 0.02 LU/ha/yr and to off-winter all stock (includes bog/wet heath areas on Figure 1).
- Artificial drains (as identified in the drain blocking plan) would be blocked using machine excavated peat dams.
- Larger drains would be blocked with peat, where possible, or with plastic piling.
- Encroaching scrub and trees would be removed.

Recovery of Dwarf Shrub-Heath

A6.6.2.9 Within the parts of the Proposed Development Area that could support wet and dry heath habitats the dwarf-shrub component of the vegetation has been lost (or is supressed) due to grazing and, potentially, historic burning. This has reduced the suitability of this habitat for species such as black grouse, which feed on the shoots, seeds and berries of plants like blueberry (Vaccinium myrtillus). In large parts of the Proposed Development Area, Molinia, which is less palatable for sheep than heather and blaeberry, has become dominant. Some cattle breeds are more capable of digesting Molinia than sheep and can be effective in helping to encourage the recovery of dwarf shrubs where Molinia is too dominant.

A6.6.2.10 Dwarf-shrub heath restoration would be undertaken in three areas in the northwest and northeast of the Proposed Development Area (see Figure 6.9), there is also the potential for some blanket bog restoration within these areas where the conditions are suitable. These areas are as follows:

- Area A (Willieanna/Dunool), focus on dry heath restoration = c. 87.0 ha
- Area B (Riders Knowe), focus on wet heath with some potential for bog restoration = c. 34.6 ha
- Area D (Knockgray, East), focus on wet heath with some potential for bog restoration = c. 23.5 ha

A6.6.2.11 The main aims for these areas would be to:

- Reduce the over-dominance, where this occurs, of Molinia.
- Encourage heather and blaeberry recovery and increase structural diversity.
- Retain acid / marshy grassland communities (i.e. encourage a habitat 'mosaic').
- Improve habitat condition for the benefit for a wide range of moorland plant and invertebrate species.

[2] Available from: https://www.nature.scot/sites/default/files/2017-11/Guidance-Peatland-Action-guidance-on-peatland-grazing-A1268255.pdf

[3] Available from: https://www.dumgal.gov.uk/media/17433/Dumfries-and-Galloway-Forestry-and-Woodland-Strategy/pdf/Forestry_and_Woodland_Strategy_April_FINAL1.pdf

[4] Available from: https://www.nature.scot/scotlands-national-peatland-plan-working-our-future

Quantans Hill

- Improve habitat quality for moorland bird species including black grouse.

A6.6.2.12 The proposed actions are outlined as follows:

- Remove livestock over winter and reduce stocking rates.
- For wet heath in poor condition, reduce stocking rate to 0.05 LU/ha/yr. Stocking rate may be increased following assessment of habitat condition.
- For dry heath in poor condition, grazing at a maximum stocking rate of 0.10 LU/ha/yr. Stocking rate may be increased following assessment of habitat condition.
- For Molinia dominated areas introduce cattle during the spring and summer (0.25 LU/ha/yr).

Establishment of Native Broadleaved Woodland

A6.6.2.13 There is very limited native or semi-natural woodland present within the extensive upland parts of the Site. The restoration of native woodland and improving woodland connectivity would be beneficial for a wide range of flora and fauna including species potentially affected by the Proposed Development such as a range of bat species, black grouse and brown trout. This would also help to address the loss of young plantation woodland from the construction of the Prosed Development. Establishing woodland in riparian zones will also help to stabilise the riverbanks and reduce erosion and sediment release into the watercourse. Planting on a large enough scale may also contribute towards reducing flood risk within the wider catchment by delaying storm flow and reducing peak discharge.

A6.6.2.14 Native woodland establishment would be undertaken in several areas, primarily focused on the banks of the main watercourses within the Site (i.e. the Benloch and Marbrack Burns). Figure 6.9 shows an indicative total area of c. 29 ha of riparian tree planting. In these areas the following is proposed:

- Develop detailed tree planting plans.
- A mix of native tree species suited to the location, local soil type and hydrology.
- Using tree species of local genetic provenance, where possible.
- Standard measures as required to protect the whips/young trees from damage by stock, rabbits and deer (e.g. stock-proof fencing, with appropriate marking to reduce black grouse collision risk, tree guards).
- Beating-up in the second season to replace any failures.

Black Grouse Habitats

A6.6.2.15 The measures outlined above should improve habitat quality for black grouse by increasing the diversity and extent of suitable vegetation for adults to feed on. Additional measures to maintain and improve habitat quality for black grouse are also proposed. These include the following:

- Maintenance of suitable lekking sites (short-grazed grassland near to suitable extensive mosaics of breeding / wintering habitat).
- Avoiding disturbance to lek sites during the spring.
- Maintenance of areas of wet rush pasture and flush vegetation to provide good insect-rich brood-rearing habitats.
- Site-wide predator control plan (to reduce predation pressure on ground-nesting birds of conservation concern such as curlew and black grouse).

Other Related Measures / Considerations

A6.6.2.16 The locations of the proposed wind turbines are shown on Figure 6.9 along with nominal 100 m radius buffer zones. Within these areas additional mitigation measures may be proposed to address potentially significant ecological impacts. For example, avoiding the planting (re-planting) of trees to reduce the potential risk to bat populations from wind turbine mortality.

Summary of HMP Areas / Measures

A6.6.2.17 The following table (see overleaf) provides a summary of the proposed HMP aims and management measures for each of the ecological enhancement areas shown on Figure 6.9.

Table 6.6.2: Summary of Proposed Habitat Enhancement Areas, Aims and Measures (see Figure 6.9)

Ref. code	Indicative area (ha)	Name (landholding)	Main habitat types (existing)	Key Aims	Summary of Proposed Measures
n/a	c. 29.0 ha	Riparian native woodland (Benloch and Marbrack Burns)	Marshy grassland, rush pasture, acid grassland	• General ecological benefits from the restoration of native woodland and improving woodland connectivity for a wide range of flora and fauna including species potentially affected by the Proposed Development such as bats and black grouse. • Addresses compensatory planting requirements under the Scottish Government woodland removal policy. • Contribute to the stabilising of riverbank sides, and potential to reduce flood risk within the wider catchment.	• Indicative areas within which a native riparian tree planting plans would be developed. • Native woodland establishment with a mix of tree species suited to the location, local soil type and hydrology. • Tree species of local genetic provenance where possible. • Standard measures as required to protect the whips/young trees from damage by stock, rabbits and deer (e.g. stock-proof fencing, tree guards). • Beating-up in the second season to replace any failures.
A	c. 87 ha	Willieanna/ Dunool	Semi-improved acid grassland, marshy grassland	• Improve habitat condition for the benefit for a wide range of moorland plant and invertebrate species. • Improve habitat quality for moorland bird species including black grouse.	• Indicative area within which a dwarf-shrub heath restoration plan would be developed. • Management grazing to reduce the over-dominance, in some areas, of Molinia. For example, through control of sheep grazing, summer grazing with suitable native cattle breeds. • Encouragement of heather and blaeberry recovery by adjusting stocking density and avoiding winter grazing, cutting and re-seeding may also be considered. • Retain acid / marshy grassland communities, adjusting stocking density and to encourage herb-rich vegetation, allowing flowering plants to set-seed. • Monitor vegetation recovery and adjust grazing management accordingly.
B	c. 34.6 ha	Riders Knowe	Modified bog, Molinia mire, rush pasture, acid grassland	• Improve habitat condition for the benefit for a wide range of moorland plant and invertebrate species. • Improve habitat quality for moorland bird species, specifically black grouse. • Targeted blanket bog restoration / improvement of ecological functioning to directly offset impacts from the proposed development. • Contribute towards local and national biodiversity and climate change policy objectives. • Reducing flood risk within the wider catchment by delaying storm flow and reducing peak discharge.	• Indicative area within which a blanket bog and dwarf-shrub heath restoration plan would be developed. • Management grazing to reduce the over-dominance, in some areas, of Molinia. For example, through control of sheep grazing, summer grazing with suitable native cattle breeds and cutting/flailing where practicable (not always feasible on stony, steep or wet ground). • Encouragement of heather and blaeberry recovery by adjusting sheep stocking density and avoiding winter grazing. • Retain acid / marshy grassland communities, adjusting stocking density and to encourage herb-rich vegetation, allowing flowering plants to set-seed. • Monitor vegetation recovery and adjust grazing management accordingly.
C	c. 27.3 ha	Knockgray, West	Blanket bog, Molinia mire	• Blanket bog restoration / improvement of ecological functioning to directly offset impacts from the proposed development. • Potential to improve habitat suitability for moorland bird species affected by the proposed development. • Contribute towards local and national biodiversity and climate change policy objectives. • Reducing flood risk within the wider catchment by delaying storm flow and reducing peak discharge.	• Indicative area within which a detailed bog restoration plan would be developed. Further hydrological site assessment would be required to confirm the proposed drain blocking measures. • Ditch/grip blocking to raise the water level within the bog hydrological units to encourage the growth/extent of sphagnum and other bog plants. • Mange grazing to help with bog recovery, reduce stocking density as appropriate, and remove all stock in autumn and winter. • Management prescriptions to reduce the over-dominance, in area D, of Molinia (purple moor-grass). For example, through control of sheep grazing, summer grazing with suitable native cattle breeds.

					• Monitor vegetation recovery and adjust grazing management accordingly.
D	c. 23.5 ha	Knockgray, East	Molinia mire, marshy grassland	• Improve habitat condition for the benefit for a wide range of moorland plant and invertebrate species. • Improve habitat quality for moorland bird species, specifically black grouse. • Increase dwarf-shrub cover in areas where wet heath can be improved / established.	• Indicative area within which a blanket bog and dwarf-shrub heath restoration plan would be developed. • Management grazing to reduce the over-dominance, in some areas, of Molinia. For example, through control of sheep grazing, summer grazing with suitable native cattle breeds and cutting/flailing where practicable (not always feasible on stony, steep or wet ground). • Encouragement of heather and blaeberry recovery by adjusting sheep stocking density and avoiding winter grazing. • Retain acid / marshy grassland communities, adjusting stocking density and to encourage herb-rich vegetation, allowing flowering plants to set-seed. • Monitor vegetation recovery and adjust grazing management accordingly.
E	c. 72 ha	Furmiston Mire	Blanket bog, acid flush, sedge mire, rush pasture.	• Blanket bog restoration / improvement of ecological functioning to directly offset impacts from the proposed development. • Potential to improve habitat suitability for moorland bird species affected by the proposed development. • Contribute towards local and national biodiversity and climate change policy objectives. • Reducing flood risk within the wider catchment by delaying storm flow and reducing peak discharge.	• Indicative area within which a bog restoration plan would be developed. • Ditch/grip blocking to raise the water level within the bog hydrological unit to encourage the growth/extent of sphagnum and other specialist bog plants. • Mange grazing to help with vegetation recovery, reduce stocking density as appropriate, and remove all stock in autumn and winter. • Monitor vegetation recovery and adjust grazing management accordingly.

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Appendix 6.7

Outline Fish Monitoring Plan

Contents

Glossary

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 6: Ecology & Biodiversity in Volume 2 of the EIAR for the List of Abbreviations.

A6.7.1 INTRODUCTION

Purpose of this Document

A6.7.1. This is a Technical Appendix to Chapter 6: Ecology & Biodiversity of the Environmental Impact Assessment Report (EIAR) for the proposed Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with that Chapter.

A6.7.2. This document outlines the proposed approach and methods that would be followed to monitor the health of fish populations within the sub-catchments that the Proposed Development would be located within prior to, during and following the construction phase. It is proposed that a detailed Fish Monitoring Plan (FMP), based on this outline document, would be developed prior to commencement of works on the proposed development, and that this would form one of the planning conditions should the Application be approved.

Proposed Consultation

A6.7.3. The detailed FMP will be developed into a final implementable version, in agreement with Dumfries & Galloway Council (DGC) in consultation with Scottish Environment Protection Agency (SEPA), Marine Scotland (MS), Dee (Kirkcudbright) District Salmon Fishery Board (DDSFB) and Galloway Fisheries Trust (GFT), following consent, if granted, and at least 12 months prior to the commencement of construction works for the Proposed Development.

Site Context

A6.7.4. The Proposed Development is located in Dumfries & Galloway, to the northeast of the settlement of Carsphairn. The Proposed Development is located within the catchment of the Water of Deugh, which is part of the Ken/Dee system. There are several tributaries of the Water of Deugh that rise upslope of the Proposed Development Area and pass through it, including the Benloch Burn, which flows south-west, the Knockgray, Polhay/Marbrack and Furmiston Burns flowing generally south through the Proposed Development Area towards the Water of Deugh which is located just outside of the Site, to the south of the B729.

A6.7.5. The overall condition of the two sections of the Water of Deugh closest to the Site (Water of Deugh (u/s Carsphairn Lane and Water of Deugh, Carsphairn Lane to Water of Ken) are currently rated as Poor (SEPA 2014), with the following breakdown for the various categories monitored by SEPA[1]:

- Access for fish migration - Poor;
- Water flows and levels - Moderate;
- Physical condition - Good;
- Freedom from invasive species - High; and
- Water quality - Good.

A6.7.6. None of the watercourses draining the Site are classified by Marine Scotland as Scottish Salmon Rivers, and there is no connectivity to such classified areas within the wider Dee catchment due to impassable obstacles for migratory fish at the dams on Loch Kendoon.

A6.7.7. The Water of Deugh does not currently support any populations of Atlantic salmon (*Salmo salar*) or sea trout (*S. trutta trutta*) due to barriers impassable to fish on the Kendoon Hydroelectric Dam. The main watercourses within the site do support brown trout (*S. trutta*) populations.

A6.7.8. Electrofishing surveys of the main watercourses within / downstream of the Proposed Development Area were carried out during September 2020 by the GFT. The locations of the electrofishing sampling points are shown on Figure 6.8. The full results of these surveys are provided in Technical Appendix 6.4. In summary, a total of seven sites located within the Proposed Development Area and three control sites outside the Proposed Development Area were surveyed using standard, fully quantitative, electrofishing techniques. All sampling points were located within the Dee catchment area. The sites ranged from poor to good quality instream fish habitat. Juvenile salmon were recorded in low densities at one site only, which was a control site (located outside of the potential zone of effect of the Proposed Development) and the only site with access to migratory fish. Seven of the 10 sites held brown trout populations, where juvenile trout were recorded in very low to moderate densities. Minnows and stone loach were the only non-salmonid fish species encountered during the surveys, being present at two sites only.

A6.7.9. Data from across the survey was assessed using a traffic light sensitivity rating to highlight those sites particularly sensitive to construction disturbance. For a water to be classified as having a Low Sensitivity it was found to have no fish present and unsuitable habitat to support fish. Moderate sensitivity was defined as watercourses (sampling locations) found to contain only non-salmonid species and with habitat was not suitable to support salmon or trout populations. The highest sensitivity rating (Very Sensitive) was given to sites where salmonids were found to be present in any density or to display habitats of particular significance.

A6.7.10. Four of the sampling locations within the Site were assessed to be 'Very Sensitive', these were on the Furmiston Burn, Polshagg/Marbrack Burn, Marbrack Burn and Benloch Burn. All of the other locations were considered to be 'Not Sensitive'.

Summary of Relevant Legislation

A6.7.11. Atlantic salmon is listed in Annexes II and V of the EC Habitats Directive (94/43/EEC) and as a priority species on the UK Biodiversity Action Plan (UK BAP). Legal protection is provided under the Salmon Act 1986 and the Conservation (Natural Habitats, &c.) Regulations 1994 (the 'Habitats Regulations').

A6.7.12. Brown trout have also been accorded greater priority in recent years by statutory bodies in the UK with management and conservation work targeting the preservation of natural self-sustaining populations. Brown trout and sea trout are listed as a priority species on the UK BAP and on the Scottish Biodiversity List.

A6.7.13. Grayling and river lamprey are also protected under Schedule 3 of the Habitats Regulations 1994. The brook lamprey is listed in Annex II of the Habitats Directive, Appendix III of the Bern Convention and is on the Scottish Biodiversity List.

A6.7.14. Protection of salmonids and other native fish species of conservation concern is also incorporated into the Water Environment and Water Services (Scotland) Act 2003, which has the objective of protecting and enhancing the ecological status of water bodies in Scotland.

A6.7.15. The importance of protecting fish, particularly salmon, sea trout, and brown trout at a river and tributary level has been recognised because there are likely to be genetic differences between stocks even within a river system because of a range of distinct isolated spawning populations.

A6.7.16. There are also widespread concerns about declining populations of European eel at both national and international level. European eel is a priority species under the UK BAP and is on the Scottish Biodiversity List.

Overview of Potential Impacts and Mitigation

A6.7.17. An evaluation of the sensitivity of watercourses (and associated sub-catchments) and their fish populations within and adjacent to the wind farm is provided in Chapter 6: Ecology & Biodiversity along with an assessment of the potential impacts of the proposed wind farm scheme on these receptors. Potential impacts on hydrology and water quality are also considered in Chapter 8: Hydrology, Geology & Hydrogeology.

[1] https://www.sepa.org.uk/data-visualisation/water-environment-hub/ [accessed August 2021]

Potential Impacts

A6.7.18. For the purpose of the EIA, all watercourses within the Proposed Development Area were considered to be highly sensitive receptors. The following potential impacts during the construction phase were considered in the assessment:

- Habitat loss / degradation (e.g. potential loss of fish habitats as a result of the installation of new watercourse crossings);
- Reduction in water quality (e.g. from construction earthworks, chemical pollution from fuels, oils and concrete);
- Impacts arising from changes in the flow regime (e.g. increased run-off, localised flow changes at new / upgraded watercourse crossings);
- Impacts from vibration near to waterbodies during construction; and
- Impediments to fish migration (e.g. from poorly designed and/or installed watercourse crossings).

Design Mitigation

A6.7.19. Various measures were proposed in the EIAR to ensure that potentially significant adverse effects on fish habitats and populations would be avoided. These measures are detailed within Chapters 6, and 8 of the EIAR, and are summarised below.

A6.7.20. The wind farm layout design has undergone an iterative process to minimise impacts on sensitive environmental receptors including watercourses (see Chapter 2: Site Design & Evolution for further information on the wind farm design process).

Appropriate set back distances from watercourses have been applied to all infrastructure (100 m for rivers in Benloch Burn, 50 m for all other watercourses mapped on 1:50k OS map and 10 m for all remaining minor channels). This has reduced the potential scale of impact from the Proposed Development on in-stream habitats and the fish populations they support. The number of new watercourse crossings has been kept to the minimum necessary to construct and operate the Proposed Development.

A6.7.21. All new watercourse crossings will be subject to detailed design that will take into consideration design requirements, following current best practice guidance, to minimise impacts on in-stream habitats and affecting the free movement of fish up or downstream from the new crossing structure (see Technical Appendix 8.1 for further detail).

A6.7.22. A suitably experienced ecologist, or the Environmental Clerk of Works (ECoW), will be appointed to ensure that sensitive habitats, including watercourses, are fully considered during decisions on any proposed micro-siting of project infrastructure (including temporary works).

Construction Best Practice & Mitigation

A6.7.23. The wind farm construction works also have the potential to impact water quality in surrounding watercourses, through the mobilisation of fine sediments from excavations (including peat), borrow pits, compounds, platforms and tracks and the risk of chemical pollution from construction materials and machinery. The avoidance of such impacts will be a key focus for the construction phase and will be achieved by following recognised best practice during the works including effective drainage design and pollution control measures. Previous experience with the construction of the other wind farms has shown that such impacts on fish habitats and populations can be avoided through good planning and construction site management.

A6.7.24. The Construction Environmental Management Plan (CEMP) and Pollution Prevention and Incident Plan (PPIP, see Chapter 8: Hydrology, Geology & Hydrogeology), detail the measures to safeguard sensitive aquatic habitats and surface water quality during the construction of the Proposed Development. The CEMP will also set out the proposed water quality monitoring programme. These documents would be developed further, for approval by the planning authority and in consultation with SEPA, Scottish Water and MS), well in advance of commencement of construction of the Proposed Development.

A6.7.25. A suitably experienced and independent ECoW will also be appointed to oversee the detailed implementation of the measures to protect surface waters, fish and fish habitats during wind farm construction. The ECoW will have the power to stop works should there be a significant risk to fish or aquatic habitats.

A6.7.2 OUTLINE FMP

Introduction

A6.7.26. Fish population and aquatic macroinvertebrate surveys will be undertaken prior to, during and following construction of the Proposed Development. Sampling will include upstream and downstream locations and at suitable control sites.

A6.7.27. The proposed monitoring will focus on sections of the following tributaries of the Water of Deugh within / downstream of the Site:

- Benloch Burn;
- Knockgray Burn;
- Polhay / Marbrack Burn; and
- Furmiston Lane.

A6.7.28. Monitoring will be undertaken during all phases of the development including pre-works baseline surveys. The exact number and locations for the proposed monitoring will be agreed with DGC (in consultation with MS, GFT the DDSFB) and will be selected to ensure that there is sufficient coverage to monitor the potential effects arising from the construction of the Proposed Development, separately to other potential near-by sources of pollution to surface waters. Monitoring of suitable agreed control sites will also be carried out and will be located where potential impacts are unlikely because of the Proposed Development or other developments / operations that have hydrological connectivity with the Site.

Outline Programme

A6.7.29. The FMP will take account of all relevant best practice guidelines and application specific advice / requirements from the relevant consultees and will include the following:

- Fish population monitoring will include fully quantitative electrofishing surveys at suitable locations on watercourses potentially impacted by the Proposed Development and at suitable control sites at least 12 months before construction commences, during construction and for at least 12 months after construction.
- Aquatic macroinvertebrate monitoring would be completed upstream and downstream of locations where access tracks for the Proposed Development cross watercourses. Sampling would be completed at these locations at least 12 months before construction commences, during construction and for at least 12 months after construction is completed.
- Fish rescues prior to the installation of new watercourse crossings at four locations.

A6.7.30. The collection of robust baseline data, that determines the quality and sensitivity of the watercourses for fish populations, is important as it allows meaningful comparison to monitoring completed during and following construction works, allowing impacts to be identified and to inform decisions about remedial measures should they be required. It is also important that suitable control sites are also monitored (at the same time, following the same protocols) so that changes that may be attributable to natural variation can also be reliably identified. Control sites

are located on similar watercourses (supporting populations of the same fish species) and ideally within the same wider catchment but outside of the potential influence of the Proposed Development.

A6.7.31. In addition to the above, there would be a programme of regular water quality monitoring prior to and during the construction period. A programme of surface water quality monitoring would be confirmed in detail following consent if granted (see Chapter 8: Hydrology, Geology and Hydrogeology for further details).

During Construction

A6.7.32. During the construction period monthly water quality sampling would be continue from the same locations as the pre-construction baseline survey with the same field measurements and laboratory analysis undertaken (see above).

A6.7.33. The ECoW would also monitor water quality visually during the construction period and advise on appropriate methods to further reduce risk of pollution. The ECoW would consult with GFT and DDSFB on any measures that may be required to address impacts to fish habitats arising from the construction of the Proposed Development.

A6.7.34. The results of the pre-construction baseline surveys will be reported in a timely manner, copies of which would be submitted to DGC (and circulated to MS, DDSFB and SEPA).

A6.7.35. Due to the presence of salmonids (i.e. brown tout), four sites within the Proposed Development Area were found to be highly sensitive to disturbance (see Technical Appendix 6.4: Fish Population and Fish Habitat Survey Results). The GFT have recommended that fish rescues are completed prior to any in-stream works at these locations. At these locations particular focus would also be given to ensuring that fish access is not impeded, and that in-stream habitats are protected during the works.

Post-Construction

A6.7.36. The scope and duration of post-construction monitoring would be determined, in agreement with the relevant consultees. Sampling would be completed from the same locations as the pre-construction baseline survey.

A6.7.37. Prior to the end of the first 12 months of post-construction monitoring the need for monitoring to continue based on the findings to date would be agreed with DGC (in consultation with SEPA, GFT and DDSFB).

A6.7.38. Targeted monitoring of water quality may be appropriate during the operational phase of the proposed development subject to need. For example, in relation to significant access track / culvert / bridge repair works near to watercourses.

Fish Population Surveys

A6.7.39. The proposed locations for the fish population surveys would be agreed with DGC, in consultation with MS, GFT and DDSFB. It is likely that many of the sampling locations that were surveyed as part of the baseline fish population monitoring to inform the design and EIA of the Proposed Development would be appropriate to be included in the construction monitoring programme (see Figure 6.8).

A6.7.40. A minimum of one round of pre-works baseline electrofishing surveys would be completed for each monitoring site. At least two control sites, beyond the potential influence of the Proposed Development, will also be included in the survey. Repeat surveys would be completed during the construction phase and for period (to be agreed) following completion of construction / site restoration.

A6.7.41. In each year of monitoring, in order to establish the composition and abundance of the fish populations, it is proposed that a series of fully quantitative triple catch (3-run) samplings will be completed at each of the sampling locations.

A6.7.42. Electrofishing is the preferred technique to determine the species present and health of a fish population. Electrofishing involves using specialist equipment that allows an electric current to be passed through the water to stun the fish, which enables the operator to remove the fish from the water unharmed. Once captured the fish recover in a holding container. They are then anaesthetised using a specific fish anaesthetic, identified, measured and recorded, and once recovered, returned unharmed to the area of capture. Further analysis allows the number and density to be calculated for all species and life stages within the monitoring site.

A6.7.43. The surveys will be carried out by suitably qualified fisheries biologists accredited by the Scottish Fisheries Co-ordination Centre (SFCC) and in accordance with SFCC best practice methods. The SFCC has an agreed set of methodologies and data recording sheets that are used when electrofishing by all members to promote consistency and best practice (see references / guidance at the end of this document).

Fish Habitat Surveys

A6.7.44. Standard fish habitat surveys will also be completed at each electrofishing location and adjacent to infrastructure (e.g. watercourse crossings) following relevant best practice guidance from the SFCC (see references / guidance at the end of this document).

A6.7.45. A short walk-over survey of each electrofishing site will be completed. This involves a combination of a linear survey and a point survey. In the linear survey the relative proportions of different fish habitat characteristics, such as substrate and flow types, are estimated within the selected river stretch. The point survey is used to record features that lie at a particular location, or 'point', within each river stretch, such as obstacles to migration and pollution sources.

A6.7.46. In total eight categories of information are recorded for each survey stretch. These are divided into sections on the record sheets as follows:

- Part A: General locational and context information about the survey stretch.
- Linear Survey -
- Part B: Information on the channel characteristics
- Part C: Information on the characteristics of the left river bank
- Part D: Information on the characteristics of the right river bank
- Part E: Photographic information for the survey stretch
- Point survey -
- Part F: Information on point pollution sources
- Part G: Information on obstacles to migration
- Part H: Information on channel and bank modifications

A6.7.47. The data collected throughout the eight categories can be used by trained and experienced interpreters to evaluate, for example, the quality of habitat for juvenile salmon, to identify potential spawning locations, to identify areas of excessive silt loading and/or to identify pollution sources.

Aquatic Macroinvertebrate Surveys

A6.7.48. Benthic aquatic macroinvertebrate sampling and analysis is proposed to supplement the water chemistry and suspended sediment monitoring. Changes to aquatic invertebrate communities, as a result of non-natural perturbations to water quality, provide a longer-term indicator of stream health; potentially long-after the pollutants have been flushed from the watercourse.

A6.7.49. Aquatic macroinvertebrate monitoring will be completed during the pre-works, construction and post-construction phases. The locations that will be monitored are to be determined in consultation with MS, SEPA, GFT and DDSFB.

A6.7.50. A minimum of one year of pre-works survey would be completed for each of the monitoring sites (i.e. replicating the electrofishing locations). Repeat surveys would be completed during the construction phase and for a period following completion of the wind farm construction, to be determined in agreement with the relevant consultees and based on the results of the construction water quality monitoring.

Sampling Method

A6.7.51. In summary, aquatic macroinvertebrates will be collected using the SEPA approved kick sampling technique in normal to low flow conditions during the late summer / autumn (SEPA 2001). This is the standard semi-quantitative method for obtaining benthic macroinvertebrate community data for water quality monitoring and nature conservation purposes.

A6.7.52. The typical sampling method for streams and rivers involves a th-minute kick/sweep sample using a standard 1 mm mesh pond (hand) net, followed by a one-minute stone search and examination of the water surface. The different habitat types in the stream are sampled proportionately to their occurrence (e.g. fast moving riffles, shallow water, slow water, weeds and tree roots) to ensure that the full complement of invertebrates at the site is represented in the sample. The invertebrates in the sample will be carefully collected and preserved for later sorting, identification and analysis.

A6.7.53. Various environmental parameters of each sampling location will also be recorded (e.g. stream bed width, depth, flow and substrate type). The exact location (i.e. sampling area) that the samples were taken will be recorded using hand-help GPS (accuracy of c. +/- 7m). Representative photographs of the sampling area will also be taken.

Sample Analysis

A6.7.54. For each sample the Biological Monitoring Working Party (BMWP) score will be determined following the standard scoring system. The scoring system is designed to reflect the variation in sensitivity of different aquatic invertebrates to pollution (i.e. primarily organic pollution, which can reduce the availability of dissolved oxygen in the water).

A6.7.55. The ASPT (Average Score Per Taxon) score will also be calculated. The ASPT method is much less sensitive to natural variation in invertebrate diversity and is therefore considered to provide a much more reliable index of pollution impact than the BMWP score.

A6.7.56. The samples will also be scored using the WHPT (Whalley, Hawkes, Paisley, Trigg) metric. The WHPT classification method allows for the assessment of benthic invertebrate communities in rivers in relation to degradation of ecological status, including from organic pollution. WHPT metrics have replaced BMWP scores for the purposes of river status monitoring under the Water Framework Directive (WFD).

A6.7.57. In order to determine WFD Class, the online River Invertebrate Classification Tool (RICT) can be used.

A6.7.58. Additionally, the invertebrate samples can be scored using the PSI (Proportion of Sediment-sensitive Invertebrates) index at the family level. This scoring system measures the abundance-weighted proportional frequency of taxa which are sensitive to fine sediment deposition.

Reporting

A6.7.59. The results of the electrofishing, fish habitat and aquatic macroinvertebrate monitoring surveys would be provided to the relevant authorities and organisations via annual reports provided in a timely manner.

A6.7.60. The results of the water quality monitoring would be provided to the relevant authorities and organisations via monthly data tables and final reports following completion of the pre-works, construction and post-construction monitoring phases.

References / Guidance

- Marine Scotland Science (2018). Scoping advice on information required in Environmental Impact Assessment reports in relation to assessing risk to freshwater and diadromous fish associated fisheries. April 2018. Available from: https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Research/onshoreren/OnshoreGuide
- Marine Scotland Science (2018). Generic monitoring programme for monitoring watercourses in relation to onshore wind farm developments. April 2018. Available from: https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Research/onshoreren/watercourse
- NatrureScot guidance on wind farm developments – available from https://www.nature.scot/professional-advice/planning-and-development/adviceplanners-and-developers/renewable-energy-development/onshore-windenergy/advice-wind-farm
- SEPA guidance on wind farm development – available from https://www.sepa.org.uk/environment/energy/renewable/#wind
- SEPA (2001). Sampling of Freshwater Benthic Invertebrates. Method number NWM/ECOL/002.
- SFCC (2007). Electrofishing Survey Training Course Manual. Scottish Fisheries Co-ordination Centre, Pitlochry.
- SFCC (2007). Habitat Surveys Training Course Manual. Scottish Fisheries Co-ordination Centre, Pitlochry.
- SFCC (2019). Catch Fish Using Electrofishing Techniques. Scottish Fisheries Co-ordination Centre Fisheries Management: SVQ Level 2. Inverness College UHI.
- SFCC (2014). Manage Electrofishing Operations. Scottish Fisheries Co-ordination Centre Team Leader Electrofishing Manual. Inverness/Barony College.
- A joint publication by Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, Historic Environment Scotland, MSS and Association of Environmental and Ecological Clerks of Works (2019) Good Practice during Wind Farm Construction – available form https://www.nature.scot/guidance-good-practice-during-wind-farmconstruction

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Appendix 7.1

Ornithological Desk Study & Survey Results

Contents

Glossary

Refer to Chapter 7: Ornithology in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 7: Ornithology in Volume 2 of the EIAR for the List of Abbreviations.

A7.1.1. INTRODUCTION

A7.1.1.1 This Technical Appendix provides further background information in relation to the desk study and surveys completed to characterise the baseline ornithological interest and inform the impact assessment of the Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with the Chapter 7: Ornithology of the Environmental Impact Assessment Report (EIAR).

A7.1.1.2 A range of ornithological surveys was completed in order to systematically assess the use of all habitats within the Proposed Development study area by breeding and non-breeding birds, with a particular focus on species of UK conservation concern and species/groups that are potentially sensitive to wind farm development (referred to in Chapter 7 as Important Ornithological Features or IOFs). All surveys were completed by suitably experienced surveyors following established survey methods, largely based on NatureScot guidance, current at the time the surveys were planned. The baseline surveys were completed between April 2018 and March 2021. The following surveys were completed:

- Summer and winter flight activity surveys (April 2018 to August 2019 and September 2020 to March 2021);
- Breeding moorland wader surveys (April to July, 2018 and 2019);
- Breeding raptor surveys (April to August 2018 and March to August 2019, 2020);
- Black grouse lek survey (April and May 2018, 2019 and 2020); and
- Wintering goose and swan surveys, e.g. waterbody and grazing counts (October 2018 to May 2019).

A7.1.1.3 The survey scope, focal species, methods and survey effort was agreed in consultation with NatureScot as part of the EIA scoping process.

A7.1.2. METHODS

Desk Study

A7.1.2.1 An initial high level desk study was completed prior to the start of fieldwork in April 2018. The purpose of this initial study was to ensure that all relevant species that could potentially be present in the study area, based on their known breeding or wintering ranges and the broad habitats present, were taken into consideration in survey planning. A precautionary approach was followed, informed by professional judgement and current relevant guidance, in determining the species that would need to be considered in terms of survey planning.

A7.1.2.2 Information on designated sites (local, regional, national and international) that have ornithological interest was also collated during the initial desk study. In addition to this, following NatureScot guidance on SPA bird populations and potential connectivity to habitats affected by onshore wind farm development, any potentially relevant SPAs up to 20 km from Proposed Development Area were also considered (NatureScot 2016[1]).

A7.1.2.3 Details of international and national designated sites, such as Special Areas of Conservation (SACs) and SSSIs, were obtained through NatureScot's Natural Spaces website[2] and associated Geographic Information System (GIS) data made publicly available by NatureScot.

A7.1.2.4 The results of bird surveys completed to inform the EIA of a previous wind farm proposal at the same general location were also reviewed. Published assessments for other wind farm developments in the surrounding area that are operational or in the planning process were consulted in relation to collating relevant information for the assessment of potential cumulative effects.

A7.1.2.5 A further desk study was completed during the wind farm design phase in 2020-21. This involved contacting organisations that hold bird records and requesting any relevant data they may hold for the study area. Requests for notable records of species of conservation concern for the study area were placed with the following:

- Royal Society for the Protection of Birds (RSPB);
- Dumfries & Galloway Raptor Study Group (DGRSG);
- Southwest Scotland Environmental Information Centre (SWSEIC); and
- The Wildfowl & Wetlands Trust (WWT).

A7.1.2.6 The information from these desk studies and the subsequent field surveys was also used in the wind farm design process as well as helping to inform the assessment of IOF sensitivity during the EIA phase for the Proposed Development.

A7.1.2.7 The desk studies and surveys focused on populations of bird species that are known to be sensitive to effects from the construction and / or operation of onshore wind farms and to those species whose populations are also of conservation concern. These include:

- Species listed on Annex I of the European Council Directive 2009/147/EC on the Conservation of Wild Birds (i.e. 'Annex I' species);
- Species listed on Schedule 1 to the Wildlife and Countryside Act 1981, as amended (i.e. 'Schedule 1' species); and
- Species of national conservation concern, not included within the above categories, but that are present within the study area in nationally or regionally important numbers.

A7.1.2.8 Table A7.1.1 provides the list of focal species that were considered in the desk study and the approach to the baseline surveys. Also included in this table is a summary of the current conservation status, nature conservation policy and legal designations for each species.

Table A7.1.1: List of Focal Species and their Designations

Common Name	Scientific Name	Species Designations
Whooper swan	*Cygnus cygnus*	Ann. I[i], Sch. 1[ii], UK Amber List[iii], SBL[v]
Greylag goose	*Anser anser*	UK Amber List[iii]
Pink-footed goose	*Anser brachyrhynchus*	UK Amber List[iii]
Black grouse	*Lyrurus tetrix*	UK Red List[iii], UK BAP[iv], SBL[v]
Osprey	*Pandion haliaetus*	Ann. I[i], Sch. 1[ii], UK Amber List[iii], SBL[v]
Goshawk	*Accipiter gentilis*	Sch. 1[ii]
Hen harrier	*Circus cyaneus*	Ann. I[i], Sch. 1[ii], UK Red List[iii], SBL[v]
Red kite	*Milvus milvus*	Ann. I[i], Sch. 1[ii], SBL[v]
Lapwing	*Vanellus vanellus*	UK Red List[iii], UK BAP[iv], SBL[v]
Curlew	*Numenius arquata*	UK Red List[iii], UK BAP[iv], SBL[v]
Barn owl	*Tyto alba*	Sch. 1[ii], SBL[v]
Short-eared owl	*Asio flammeus*	Ann. I[i], UK Amber List[iii], SBL[v]
Merlin	*Falco columbarius*	Ann. I[i], Sch. 1[ii], UK Red List[iii], SBL[v]
Peregrine falcon	*Falco peregrinus*	Ann. I[i], Sch. 1[ii], SBL[v]

[1] Scottish Natural Heritage (2016). Assessing Connectivity with Special Protection Areas. Version 3, June 2016. Available at: https://www.nature.scot/sites/default/files/2018-08/Assessing%20connectivity%20with%20special%20protection%20areas.pdf

[2] NatureScot. Natural Spaces. Available at https://gateway.snh.gov.uk/natural-spaces/index.jsp

i. Species listed on Annex I of the EC Birds Directive (Directive 2009/147/EC on the conservation of wild birds - the codified version). These species are the subject of special conservation measures concerning their habitat, in order to ensure their survival and reproduction within their area of distribution.
ii. Species listed on Schedule 1 to the Wildlife and Countryside Act 1981 (as amended). All wild birds their nests eggs and dependant young are protected under the Wildlife and Countryside Act. Schedule 1 species receive additional legal protection under the Act.
iii. Birds of Conservation Concern (BoCC) in the UK (Eaton et al. 2015). The population status of birds regularly found in the UK is reviewed every five years to provide an up-to-date assessment of conservation priorities. Quantitative criteria are used to assess the population status of each species and to place it on the Red, Amber or Green list. These are global conservation status, recent decline, historical decline, European conservation status, rare breeders, localised species and international importance.
iv. Priority species in the 2007 UK Biodiversity Action Plan (UK). Local Biodiversity Action Plan species are given in the Dumfries and Galloway LBAP (April 2009). The UK BAP was superseded by the UK Post-2010 Biodiversity Framework (JNCC 2012).
v. Species included on the Scottish Biodiversity List (Scott Wilson 2005), which is part of the Scottish Biodiversity Strategy (published by the Scottish Government in May 2004).

Survey Constraints / Data Limitations

A7.1.2.9 The following summarises constraints specific to the baseline surveys and assessment of the Proposed Development. It was not possible to agree permission to access all landholdings within the survey areas shown on Figure 7.1. However, all areas within the Site and within at least 500 m of the majority of the Proposed Development were accessible to the surveyors. Where access was restricted, surveyors monitored suitable habitats from the nearest accessible location within the Site or from public roads and footpaths (e.g. ad hoc vantage points to monitor for breeding raptor activity). In combination with the data collated during the desk study, there is considered to be sufficient information available to make an accurate assessment of the current ornithological sensitivity of the study area and its use by the key species relevant to this assessment.

A7.1.2.10 One of the VPs (VP3) for the initial survey period (April 2018 to August 2019) was selected before the potential wind farm layout was known and is located very close to turbine 11. However, the VP location was on the corner of a small conifer plantation, which provided some screening to the west and meant that the surveyor was back-clothed by the trees and not silhouetted against the sky helping to reduce their visibility. This VP was not used for the September 2020 to March 2021 survey, following a review of the emerging wind turbine layout.

A7.1.2.11 During part of the baseline survey period (2020-21) a section of the central part of Proposed Development Area (on the Marbrack landholding) was planted with trees, primarily Sitka spruce (*Picea sitchensis*) saplings. The location of the plantation area is shown on Figure 12.2. there is no evidence that the works associated with this (e.g. track construction, fencing, tree planting) appreciably affected the baseline data, with respect to the key bird species that are the focus of this assessment, as most of this work was completed outside of the period when the flight activity surveys were being undertaken. The potential influence that the establishment of this new plantation, and a similar planting scheme proposed for the landholding within the Proposed Development Area to the east of this plantation (Furmiston), may have in the long-term for the use of this area by species such as red kite, hen harrier and black grouse has been taken into consideration in the impact assessment.

A7.1.2.12 The Scottish Government measures to control the Covid-19 pandemic constrained travel for fieldwork during 2020, particularly during the spring/summer. This resulted in some adjustments being made to the number and timing of survey visits, but it was possible to complete an adequate survey effort within the key survey periods.

A7.1.2.13 In conclusion, whilst there were some unavoidable site-specific limitations to some aspects of the field surveys, the baseline data, supplemented with the information derived from the desk study, are sufficiently extensive and detailed to identify and accurately characterise the use of Proposed Development Area by the key species and to inform a robust assessment of IOF sensitivity and the potential effects of the Proposed Development.

Flight Activity Surveys

A7.1.2.14 Data on bird flight activity, flight behaviour, direction and height above ground level for focal species (primarily wildfowl, waders and raptors of conservation concern) were collected following the methods described in Band *et al.* (2007[3]) and NatureScot (2017[4]). Flight activity surveys were carried out to systematically sample, record and quantify the use of the airspace over the survey area by focal species. Surveyors, stationed at fixed vantage points (VPs), recorded the proportion of time that these key species spent flying at different elevations relative to the potential turbine blade swept height. The data has been used to identify constraints, such as regularly used flight corridors and areas of concentrated flight activity, which may be taken into consideration in the wind farm design process to reduce impacts. The flight activity data is also used to inform the EIA process and is used in the collision risk model to provide an estimate of annual collision mortality.

A7.1.2.15 The VPs were selected to provide a combined visibility of the potential development area. For the 2018-19 survey, the VPs were established before the potential layout of the wind farm was known. The vantage point locations and their viewsheds (areas of theoretical visibility) are shown on Figure 7.3a. For the flight activity survey completed between October 2020 and March 2021 the number of VPs was reduced (from five to three) and some of the positions were changed. This was in response to the emerging wind farm layout, which was smaller than the original potential development area, and to provide better coverage with respect to the turbine 11 area.

A7.1.2.16 The VP locations and indicative viewsheds for this period of the flight activity survey are shown on Figure 7.3b and a summary of the flight activity survey effort is provided in Table A7.2. A total of 78 hours of observation was completed from each VP during April to December 2018, 72 hours from January to August 2019. Full details of the flight activity survey effort, including timings and weather conditions, are provided in Appendix 2 to this document.

A7.1.2.17 During the September 2020 to March 2021 survey period a further 60 hours of observation were completed from each of the three VPs (see Table A7.3). This survey ended in March 2021 in time for the data to be available to inform the wind farm design process. Additional survey effort was targeted to the autumn migration period.

A7.1.2.18 For the flight activity survey, species were divided into two groups of 'target' and 'secondary'. Target species were those considered to be of relatively high conservation concern and sensitivity to wind turbines. This list is based on guidance on the sensitivity of different bird species to wind farm development, the location of the Proposed Development relative to the known breeding or winter range of the species, and the presence of potentially suitable habitats for the species within and adjacent to the Site.

A7.1.2.19 Observers preferentially record target species when both target and secondary species are present in their field of view. The two groups are as follows:

- Target species - black grouse, all Schedule 1 raptors (e.g., merlin, peregrine, goshawk, red kite, hen harrier, osprey), wild geese and swan species (e.g. whooper swan, pink-footed goose, greylag goose), curlew and golden plover; and
- Secondary species / groups - all other raptors (excluding common buzzard), all other wildfowl, waders and waterbirds (including gull species).

A7.1.2.20 Watches were also timed to ensure that observations from the VP were spread evenly through different times of day (including dawn and dusk) across the survey period. To assist with this distribution of the timing of the watches a schedule was used which divided days into survey periods, dependent upon day length. In the summer months, with longer day lengths, five survey periods were adopted, whilst in the autumn and spring passage

[3] Band, W., Madders, M. and Whitfield, D.P. (2007). Developing field and analytical methods to assess avian collision risk at wind farms. In: de Lucas, M., Janss, G. F. E. and Ferrer, M. (Eds.). *Birds and Wind Farms: Risk Assessment and Mitigation*, pp. 259-275. Quercus, Madrid.

[4] NatureScot (2017). Recommended bird survey methods to inform impact assessment of onshore windfarms. March 2017, Version 2. Available from: https://www.nature.scot/doc/recommended-bird-survey-methods-inform-impact-assessment-onshore-windfarms

periods this was reduced to four. Over the winter period, with the shortest day lengths, three survey periods were used.

A7.1.2.21 Flight activity watches were carried out in a variety of weather conditions, only being curtailed when persistent poor visibility or high wind speeds was adversely affecting flight activity by target or secondary species.

A7.1.2.22 During each watch the area in view (also referred to as the viewshed) was scanned constantly, by eye and by using binoculars and telescope, until a target species was detected in flight. Once detected, the target bird was followed until it ceased flying or was lost to view. The routes taken by the birds (flight lines) were plotted in the field onto appropriately scaled maps. The time the bird(s) was first detected, the approximate height (in pre-defined height bands, see below) and the duration of the flight, while in view, were recorded on standardised forms.

A7.1.2.23 Height bands were defined based on the range of wind turbine models that were being considered at the time and allowed for an error margin in height band estimation. The height bands used during the 2018-19 and 2020-21 flight activity survey differ slightly due to changes in the preferred wind turbine model between the survey periods. The height bands adopted for the two flight activity survey periods were as follows:

2018-19

- Very high > 250 m (above ground level)
- M2 = 150 - 250 m
- M1 = 50 - 150 m
- Low = 20 - 50 m
- Very Low < 20 m

2020-21

- Very high > 300 m (above ground level)
- High = 270 - 300 m
- M2 = 70 - 270 m
- M1 = 20 - 70 m
- Low < 20 m

A7.1.2.24 In addition to gathering timed observations of flight activity by target or secondary species, summaries of all bird activity during five-minute intervals throughout a watch were also made. However, priority was given to watching for and recording flight activity by target species as accurately as possible.

A7.1.2.25 The data collected during the flight activity surveys were used alongside standard modelling techniques, to provide quantitative estimates of annual bird mortality from collisions, following the methods described in Band *et al.* (2007[3]). The estimates of annual collisions were used to inform the assessment of the potential operational impacts of the Proposed Development on target species. Differences between the height bands and the actual dimensions of the proposed model of wind turbine are adjusted for in the collision risk modelling (see Technical Appendix 7.2).

Black Grouse Survey

A7.1.2.26 Black grouse lek reconnaissance lek count surveys were carried out in spring 2018, 2019 and 2020 following the method described in Gilbert *et al.* (19987). The survey focused on areas of suitable habitat within the Site and up to 1.5 km from the Site boundary where access was permitted by the landowner. Existing records of black grouse lek locations identified during the desk study were reviewed in advance of the survey. Preparatory visits to assess habitat suitability and identify potential lekking locations were made during a daytime walkover. A walkover survey was carried out to search for any signs indicating the presence of this species. This included any areas where black grouse were observed during other survey work or where there were historical records within the study area.

A7.1.2.27 Areas considered to provide potentially suitable habitat were visited at dawn in suitable weather conditions on at least two occasions between late March and mid-May to listen for lekking males and to search for any signs indicating the presence of black grouse including droppings and cast feathers.

A7.1.2.28 In locations where lekking activity was identified during the reconnaissance survey, a follow-up survey to count males and females attending the lek was carried out. Surveys to count birds attending any identified leks were undertaken in calm, dry conditions with good visibility within two hours of dawn. Leks were surveyed form a suitable vantage point, which avoided disturbing the lek site, to determine the number of males and females attending. The maximum number of males attending the lek was counted in the period between one hour before and one hour after sunrise. All males (not just those displaying) and all females were counted. Lekking areas that were > 200 m apart were treated as separate leks.

Scarce Breeding Raptors & Owls

A7.1.2.29 The main objective of the breeding raptor surveys was to systematically search for and record any behaviour indicative of breeding by rare or scarce species of conservation concern within suitable habitats in the survey area (see Figure 7.1 of Chapter 7). Several focal species were identified for the raptor survey, based on the presence of potentially suitable habitats, and the distribution of the species in Scotland relative to the site location (see Table A7.1.1).

A7.1.2.30 The focal species of interest for this survey were those that are relatively rare (i.e. less than 300 pairs in the UK), and/or of a relatively high conservation concern status and/or listed on Schedule 1 of the Wildlife & Countryside Act 1981 (amended) and/or Annex I of the EC Birds Directive, such as hen harrier, merlin, peregrine falcon, red kite, barn owl and short-eared owl.

A7.1.2.31 Secondary species included those that are generally more widespread and common, but the list may include species whose national populations are of conservation concern such as common kestrel (*Falco tinnunculus*). Finally, for comparatively common and widespread species, were not surveyed systematically but breeding observations were noted, for example common buzzard (*Buteo buteo*), sparrowhawk (*Accipiter nisus*) and tawny owl (*Strix aluco*).

A7.1.2.32 The area surveyed extended up to 2 km from the Site boundary where there was suitable habitat for the relevant focal species, following NatureScot guidance, and where access permission from the landowner was obtained. Where direct access was not possible then vantage points were used to observe the area from locations where access was permitted. The surveyor followed species-specific methods detailed in Hardey *et al.* (2013[5]). A summary of the approach to the species-specific surveys and the objectives for the various site visits is provided in Table A7.1.2 below. If it was established there was no evidence of occupancy or breeding activity during the first 1-2 visits to an area, then follow-up visits were not carried out.

A7.1.2.33 Surveyors concentrated on areas of suitable habitat, based on a review of OS maps and during the initial site visit made to confirm the presence of suitable habitats and determine the logistics of completing the survey as accurately and efficiently as possible. Where available any existing information about breeding by the focal species in the general area was also taken into consideration (e.g. 'traditional' nest sites or breeding records known to the local raptor study group). The surveyor covered the areas of suitable habitat with a combination of walked routes and specially selected vantage points, which allowed monitoring of an area for any evidence of territory occupancy and breeding behaviour (e.g. display flights, pair bonding, mating etc. during the early part of the breeding season).

[5] Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). *Raptors: a field guide to survey and monitoring (3rd Edition)*. The Stationery Office, Edinburgh.

A7.1.2.34 The surveyors covered the areas of suitable habitat with a combination of walked routes and selected vantage points, which allowed monitoring of an area for any evidence of territory occupancy and breeding behaviour (e.g. display flights, pair bonding, mating etc. during the early part of the breeding season).

Table A7.1.2: Indicative Focal Species Survey Visit Schedule and Breeding Habitat Preferences (source: Hardey *et al.* 2013)

Species	Summary Visit Schedule (with primary objective in parentheses)				Breeding Habitat
	Visit 1	Visit 2	Visit 3	Visit 4	
Red kite	March to early April (check for occupancy)	Late April to mid-May (visit known nests and locate new nests)	Late May to late June (check for young)	July and August (check for fledged young)	Mature woodland, in trees at 4 – 30 m from the ground, with areas of open ground for foraging.
Hen harrier	March to mid-April (check for occupancy)	Mid-April to late May (locate incubating females)	Late May to late June (check for young / evidence of breeding)	Late June to late August (check for fledged young)	Moorland (below c. 600 m) with abundance of old, deep heather; also, heather in young conifer plantations.
Barn owl	November to January (check for suitable nesting sites and signs of occupancy)	April to June (locate active nests with eggs)	May to June (check for young and late/second clutches)	July to August (check for fledged young and late nests/second clutches)	Variety of open enclosed farmland habitats and young conifer plantations
Merlin	Late March to April (check for occupancy)	Early May to early June (locate active nests)	Mid- to late June (check for young)	July to early August (check for fledged young)	Open, upland heather moorland. May nest on ground in heather, rocky outcrop or in old crow's nest in tree, if open moorland is close by.
Peregrine	March to early April (check for occupancy)	Late March to early May (locate active eyries)	Late May to mid-June (check for young / evidence of breeding)	Mid-June to early July (check for fledged young)	Wide range of habitats with suitable supply of birds to hunt. Nests are typically on undisturbed cliffs and crags; or quarries, open-cast coal workings and mines excavations, suitable tall buildings / structures.
Short-eared owl	Early March to mid-April (check for occupancy)	Mid-April to May (locate activity nests)	June (check for young, dispersed or still in nest)	July (check for fledged young and any late nests)	Extensive areas of open moorland or rough grassland, young forestry plantations, bogs, sand dunes and salt marshes.

A7.1.2.35 In general, surveys required a mixture of walked routes (e.g. to within c. 250 m of suitable breeding/nesting habitat for upland moorland species) searching for evidence of occupancy/breeding activity, coupled with periodic watches over areas of suitable nesting habitat from carefully selected vantage points at a distance and location that minimises the risk of disturbance to any nesting birds.

A7.1.2.36 All survey work was conducted during good weather conditions (that is, in good visibility, avoiding persistently wet, low-cloud and windy conditions). Care was taken to avoid/minimise disturbance to birds at their breeding sites, particularly during the sensitive early phases of the season when disturbance may cause the birds to move on and during incubation and early brood-rearing.

A7.1.2.37 On the maps and forms provided, the details and location of all key species, or relevant field signs, seen or heard were recorded as accurately as possible using standard BTO species codes and target notes. On the fieldwork maps, any parts of the defined survey area that were not surveyed due to lack of suitable habitat or access constraints were clearly recorded.

A7.1.2.38 At the end of the survey the information gathered during the various visits, and relevant observations from other surveys (e.g. breeding behaviour noted during the flight activity surveys) was collated and any identified raptor activity or breeding evidence was categorised as being a possible, probable or confirmed breeding territory/nest site following the species-specific methods detailed in Hardey *et al.* (2013[5]).

Breeding Wader Surveys

A7.1.2.39 Moorland breeding wader surveys followed an adapted version of the method described by Brown and Shepherd (1993[6]) to census upland breeding waders. Surveys were undertaken of all suitable habitats (within the core survey area, see Figure 7.1) between April and July 2018 and in 2019 and included four repeat visits spaced approximately 4 weeks apart. Fieldwork was generally conducted between 0830 and 1800 and not undertaken in high winds (greater than Beaufort force 5), in persistent rain / snow or when visibility is poor (< 300 m).

A7.1.2.40 The core survey area was covered by a defined walked route to ensure that all ground was visible, pausing (approximately every 100 m) at appropriate vantage points to visually scan and to listen. All accessible areas were approached to within c. 100 m. Standard Common Birds Census recording codes were used to annotate field maps (Marchant 1983).

A7.1.2.41 Birds were assumed to be breeding or holding territory if one or more of the following was noted:

- A bird displaying or singing;
- nests, eggs or young seen;
- adults repeatedly alarm-calling;
- distraction displays; and/or
- territorial disputes.

A7.1.2.42 Any additional observations were noted onto recording forms. Any areas not surveyed (e.g. due to access constraints) were clearly marked on the map and an explanation provided as to why the area was not surveyed.

A7.1.2.43 Estimates of the number of apparent territories were derived by comparing the results from the separate visits (see Gilbert *et al.* 1998[7] for further details). The central location of each apparently occupied territory (i.e. this is not necessarily the location of a nest) after comparing the mapped data between the survey visits, was plotted on a final map for presentation. It is important to note that for many species these estimates are not a full census of the entire population within a survey area, but they confirm the presence of breeding pairs and provide an indication of breeding density and the spatial distribution of territories.

[6] Brown, A.F., & Shepherd, H.B., (1993) A method for censuring upland breeding waders. Bird Study 40: 189-195.

[7] Gilbert, G., Gibbons, D.W. and Evans, J. (1998). Bird Monitoring Methods. Royal Society for the Protection of Birds, Sandy.

Wintering / Passage Geese & Swans

A7.1.2.44 A survey for wintering / passage geese and swans using waterbodies and adjacent fields / moorland areas within the core survey area (see Figure 7.1) was completed between September 2018 to May 2019. In addition to recording flights by wild geese and swan species during the passage and winter period flight activity surveys, goose/swan grazing surveys were also completed every c. 2 weeks during this period. Surveyors were instructed to record the presence of any geese or swans in fields or other habitat observed at any time within the core and wider survey areas.

A7.1.2.45 Survey methods followed those used for the Wetland Bird Survey (UK wide survey of coastal and inland wetlands co-ordinated by the BTO, see Gilbert *et al.* 19987). Surveys were postponed if there were unsuitable weather conditions (e.g. poor visibility).

A7.1.3. RESULTS

Designated Sites

A7.1.3.1 The locations of natural heritage designated sites within 10 km of Proposed Development Area are shown on Figure 6.2. There are no statutory designated sites (e.g. Special Protection Areas, Special Areas of Conservation, Sites of Special Scientific Interest) within the Site or adjacent to it. The nearest such designation is Cleugh SSSI, which is within 5 km of the Site and a further two SSSI's within 7 km of the Site boundary (Loch Doon and Merrick Kells, which is also a SAC). The citations for these designations do not mention any specific ornithological interest

A7.1.3.2 Table A7.1.3 provides a summary of the Special Protection Areas (SPAs) within 20 km of the Proposed Development. For this assessment the potential for adverse effects to occur beyond this distance from the Proposed Development, alone or in combination with any other plan or project, is considered negligible, with respect to bird populations that are the qualifying features of SPAs, and may also occur within or near to the Proposed Development Area. This considers NatureScot guidance on species-specific SPA population connectivity. Therefore, the need to undertake an assessment under the provisions of the Habitats Regulations 1994 (as amended) protecting these sites is not considered to be required in the case of this Application.

Table A7.1.3: Special Protection Areas within c. 20 km of the proposed development and a summary of their qualifying features.

Name	Designation	Distance from Site	Qualifying Species (Latest Assessed Condition)
Loch Ken and River Dee Marshes	SPA / Ramsar Site (including Kenmure Holms and River Dee (Parton to Crossmichael) SSSI)	15 km South	This SPA is an internationally important site for: Greenland white-fronted goose, wintering (Favourable Maintained, 14 Nov 2010) Greylag goose, wintering (Favourable Maintained', 30 Apr 2007). The SPA also supports important breeding populations of common tern, kingfisher, wigeon, teal, mallard, shoveler, tufted duck, goosander, water rail, coot, oystercatcher, lapwing, redshank, curlew, and black-headed gull. The following species of wintering wildfowl are notable: whooper swan; bean goose; wigeon; teal; pintail; goldeneye; smew; and goosander.
Muirkirk and North Lowther Uplands	SPA (various SSSIs)	c. 18 km north	This SPA supports populations of European importance of: Golden plover (*Pluvialis apricaria*), breeding (Unfavourable Declining, 30 Jun 2015). Hen harrier, breeding (Unfavourable Declining, 20 Jul 2008). Hen harrier, non-breeding (Unfavourable Declining, 2 Dec 2004). Merlin, breeding (Unfavourable No Change, 25 Jul 2009).

A7.1.3.2 Loch Doon SSSI is located c. 8 km west of the Proposed Development Area. The SSSI citation does not include the ornithological interest of the loch but it is an important site for breeding osprey and is also used by whooper swans during the winter. Bogton Loch SSSI, further to the north (c. 15 km northwest of the Proposed Development Area) is also a regionally important site for wintering whooper swans.

A7.1.3.3 Loch Ken and River Dee Marshes SPA, c. 15 km south of the Proposed Development Area is also used by whooper swans. The Proposed Development is, however, well outside of the foraging range for birds wintering within the SPA. Whooper swans do pass through the general area on migration, as recorded during the baseline surveys (see below), and small groups occasionally use the carse land near Carsphairn.

A7.1.3.4 There are no non-statutory sites designated for their natural heritage within or adjacent to the Proposed Development Area (e.g. Local Nature Reserves, Local Nature Conservation Sites, Wildlife Sites, and Provisional Wildlife Sites).

A7.1.3.5 Galloway Forest Park Important Bird Area (IBA[8]) is a large non-statutory designated area (58,295 ha in total) located to the south and west of the Proposed Development Area. The IBA designation process was originally triggered due to the importance of the area for black grouse, peregrine and short-eared owl. The IBA comprises lochs, forest, moorland and mountain habitats that mostly corresponds to the boundary of the Galloway Forest Park. A section of the IBA extends into Proposed Development Area boundary near to Furmiston but is located just outside of the Proposed Development area.

A7.1.3.6 The Proposed Development Area is located within the Galloway and Southern Ayrshire Biosphere Reserve. This is a non-statutory designation conferred by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in recognition of the special natural qualities of the area. Galloway and Southern Ayrshire Biosphere Reserve was designated in 2012, it includes areas within Dumfries & Galloway, East Ayrshire and South Ayrshire and is comprised of three zones: Core; Buffer and Transition. The Proposed Development Area is located within the Transition zone, which is the largest zone of the Biosphere Reserve. The Core zone is formed by sites with statutory nature conservation designations and includes the Merrick Kells SSSI and SAC and the Cairnsmore of Fleet SSSI and NNR. The Buffer Zone corresponds approximately with the boundary of Galloway Forest Park.

Desk Study Records

A7.1.3.7 Figure 7.2 of Chapter 7 shows the locations of non-confidential ornithological records for the study area collated from various sources. This includes non-confidential records provided by RSPB and SWSEIC and records of key species from surveys of the area in relation to a previous wind farm development proposal. Records considered to be sensitive (e.g. relating to a breeding site at risk from human disturbance, persecution or exploitation) are fully considered within this assessment but due to their confidential nature are provided in a separate Confidential Annex to this Chapter.

[8] IBAs are a global designation selected by Birdlife International, in partnership with the RSPB in the UK, which identify sites as a priority for conservation. Designation as an IBA does not confer any statutory protection.

A7.1.3.8 The findings from baseline ornithological surveys conducted for the previous Quantans Hill wind farm proposal (during the period autumn 2009 and spring 2011) were also reviewed as part of the desk study. The survey areas differed slightly to those completed for the Proposed Development, but a large proportion of the current Site was included in the 2009-2011 surveys. The key findings are summarised below:

- A black grouse lek of two males plus another two non-lekking males;
- Two barn owl nest sites, out with the Proposed Development Area boundary but within 500 m of it;
- Infrequent flights of greylag and pink-footed geese during winter and early spring
- Infrequent activity of hen harrier, however no evidence of nesting or roosting within the wider survey area;
- Records of other protected raptors including golden eagle (one flight), osprey (one flight), red kite (recorded during walkover survey), goshawk (one flight, one incidental), merlin (two flights) and peregrine (one);
- Three territories of curlew within the Proposed Development Area boundary (plus two in wider survey area) and two territories of snipe (plus one in wider survey area); and
- No regular wildfowl or wader flights or significant use of nearby waterbodies (Kendoon Loch and Water of Deugh) in winter.

A7.1.3.9 The RSPB provided records of black grouse and red kite for the period 2010 to 2020. As these records are sensitive the full details have been included in the Confidential Annex. A summary of the information is provided below:

- Black grouse – records of small numbers of lekking males (1-2 individuals, 5 records over the 10-year period), all of which were located outside of the Proposed Development Area, c. 2 km from the Site boundary. There were no records more recent than 2014. There was a Forestry Commission record of a single non-displaying male from 2013, provided at the 10x10 km OS Grid square scale, and the Proposed Development Area is located party within this square.
- Red kite – Five records of confirmed breeding (recently fledged young or nests with eggs), and two observations of non-breeding birds, during the period 2015 to 2018. One of the breeding records (from 2015) is within 1 km of the Proposed Development. However, this site has not been re-used by a breeding pair since 2015 (i.e. up to and including 2021). It is understood that this pair favour another breeding location, which is >2 km from the Proposed Development.

A7.1.3.10 Dumfries & Galloway Raptor Study Group also provided records for the period 2010-20 in relation to breeding red kite as well as breeding peregrine falcon. Two peregrine breeding locations were reported for the study area, both of which are more than 2 km from the Proposed Development. The red kite breeding records mirror those provided by the RSPB but with the addition of some other breeding records (three locations in total) that are more than 2 km from the Proposed Development. However, one of the breeding sites is within 1.5 km of the Proposed Development. Further detail is provided in the Confidential Annex to Chapter 7.

A7.1.3.11 SWSEIC also provided notable bird records for the study area, the records relating to species of conservation concern and potential relevance to the assessment are shown in Table A7.1.4 below.

Table 7.1.4: Summary of key bird records provided by SWSEIC

Common Name	Scientific Name	Year	Month	No. Records	Location
Whooper swan	*Cygnus cygnus*	2015	Feb.	2 (2 birds)	Carsphairn, carse land to northwest
		2015	Mar.	2 (14 birds)	
		2015	Apr.	1 (2 birds)	
		2016	Mar.	1 (23 birds)	Dundeugh fish farm
Black grouse	*Lyrurus tetrix*	2008	Nov.	1 (2, pair)	Moorbrock
		2017	May	1 (1 adult female)	Cairnsmore of Carsphairn
Red kite	*Milvus milvus*	2014	April	1	Loch Sherrow
		2015	Jan.	1	Carsphairn
		2015	Feb.	2	Carsphairn
		2015	Mar.	1	Carsphairn
		2015	Apr.	1	Carsphairn
		2015	Apr.	1	Kendoon
		2015	Apr.	1	Knockgray Farm
		2015	May	1	Carsphairn
White-tailed Eagle	*Haliaeetus albicilla*	2015	Mar.	1	Kendoon fish farm
Hen Harrier	*Circus cyaneus*	2013	Nov.	1 male(s)	Marbrack Farm, Carsphairn
Osprey	*Pandion haliaetus*	2011	Sep.	1	Kendoon Loch.
		2015	May	1 (2 birds)	Carsphairn
		2016	May	1 (3, together)	Kendoon Fish Farm
Dotterel	*Charadrius morinellus*	2009	May	1 (5 birds)	Cairnsmore of Carsphairn
		2010	May	3 (flock of 22)	Cairnsmore of Carsphairn
		2011	April	2 (8 and 5 birds)	Cairnsmore of Carsphairn
		2012	May	3 (flock of 10)	Cairnsmore of Carsphairn
		2014	Apr	1 (3 birds)	Cairnsmore of Carsphairn

A7.1.3.12 With the exception of the winter hen harrier record at Marbrack, the majority of these records are in locations well outside of the Proposed Development. The dotterel records relate to a well-used stopover site for this species on migration on, or near, the summit of Cairnsmore of Carsphairn, which, although within the Proposed Development Area, is more than 2 km from the Proposed Development.

A7.1.3.13 Data in relation to satellite tracking studies of goose and whooper swan migration was requested from WWT in September 2021. Unfortunately, no data was provided in time for the completion of the assessment and submission of the EIAR.

Flight Activity Surveys

A7.1.3.14 The following is a summary of the results of the two flight activity survey periods. Further discussion of the flight activity survey findings is provided in the species accounts section that follows this initial overview. The species accounts are listed in taxonomic order. Further information about these surveys in also provided in the tables provided at the end of this document (see Appendix 3).

A7.1.3.15 The location of the VPs selected for the flight activity surveys are shown on Figure 7.3a and b to Chapter 7. The mapped flight lines, for 'target species' (i.e. focal species for the surveys and this assessment), relative to the location of the proposed wind turbines, are shown on Figures 7.5 and 7.6 with the data sub-divided into seasons. The mapped flight lines of other species (referred to as 'secondary') are provided on figures TA7.1a-d accompanying this document, as follows:

- Figure TA 7.1a Flight Activity by Secondary Species - Apr-Aug 2018;
- Figure TA 7.1b Flight Activity by Secondary Species - Sept 2018-Mar 2019;
- Figure TA 7.1c Flight Activity by Secondary Species - Apr-Aug 2019; and
- Figure TA 7.1d Flight Activity by Secondary Species - Sept 2020-Mar 2021;

A7.1.3.16 During the initial April 2018 to August 2019 survey period a total of 150 hours of observation were completed from each of the VPs, 78 hours per VP in 2018 and 72 hours per VP in 2019 (see Table A7.1.5). An elevated level of survey effort was targeted for the autumn and spring migration periods.

Table A7.1.5: Hours of Observation Completed at each Vantage Point (April 2018 to August 2019)

Year	Month	VP1	VP2	VP3	VP4	VP5	Total
2018	April	6	6	6	3	3	24
	May	12	9	9	12	12	54
	June	6	9	9	9	9	42
	July	6	6	6	6	6	30
	August	6	6	6	6	6	30
	September	9	9	6	9	9	42
	October	12	15	15	9	9	61
	November	15	12	12	12	12	64
	December	6	6	9	12	12	45
Total		78	78	78	78	78	392
2019	January	6	6	6	6	6	30
	February	6	6	6	6	6	30
	March	9	9	9	9	9	45
	April	12	12	18	12	12	66
	May	15	9	9	9	9	51
	June	9	15	9	15	15	63
	July	6	9	9	9	9	42
	August	9	6	6	6	6	33
Total		72	72	72	72	72	360

A7.1.3.17 A summary of the number of observations of target and secondary species with flights wholly or partially at 'collision risk height' (CRH) is provided in in Table A7.1.6. Also shown are the number of flights that were within or partly within the wind turbine envelope (i.e. the 'collision risk area' or CRA, defined by a 500 m wide buffer of the outermost proposed wind turbines).

Table A7.1.6: Flight Lines of Target and Secondary Species at Collison Risk Height (figures in parentheses give the number of birds for flight lines representing more than one individual)

Year	Month	Flight Lines Recorded within the CRA (no. birds)
2018	April	1 red kite;
	May	5 red kite; 9 kestrel
	Jun.	4 (5) red kite; 5 (6) kestrel; 2 (13) common gull
	Jul.	3 (5) red kite; 7 kestrel
	Aug.	3 red kite; 6 kestrel
	Sep.	3 (4) red kite; 2 (4) common snipe
	Oct.	2 red kite; 1 peregrine; 1 (6) golden plover; 2 kestrel
	Nov.	6 (7) red kite; 1 golden eagle; 6 kestrel
	Dec.	1 kestrel
2019	Jan.	1 red kite; 1 hen harrier; 1 (4) greylag goose
	Feb.	5 red kite
	Mar.	4 (5) red kite; 1 (28) whooper swan; 1 (15) pink-footed goose; 1 curlew; 4 kestrel
	Apr.	12 (13) red kite; 1 peregrine; 1 merlin; 1 goshawk; 1 (3) greylag goose; 2 kestrel
	May	8 red kite; 1 peregrine; 2 (3) curlew
	Jun.	9 (11) red kite; 1 kestrel
	Jul.	3 (5) red kite; 1 (1) herring gull; 2 common snipe
	Aug.	1 red kite

A7.1.3.18 Red kite was the most frequently observed target species throughout much of the April 2018 to August 2019 survey period with a high proportion of flight activity within the collision risk area (CRA). Activity by other target raptor species was relatively sporadic and indicative of non-breeding birds passing through the area or hunting for short periods before moving on.

A7.1.3.19 There were a small number of pink-footed goose, greylag goose and whooper swan flights that passed through the CRA during the spring migration period in 2019.

A7.1.3.20 Breeding waders such as curlew and snipe were infrequently recorded, although it is important to note that snipe is often under-recorded in standard flight activity survey due the species relatively small size and tendency to be more active in the air during dusk and at night. Curlew were confirmed as breeding in several locations during the 2019 survey but were only recorded in flight within the CRA once in March 2019 and on two occasions in May 2019.

A7.1.3.21 During the September 2020 to March 2021 survey period a further 60 hours of observation were completed from each of the three VPs (see Table A7.1.6). This survey ended in March 2021 in time for the data to be available to inform the wind farm design process. Additional survey effort was targeted to the autumn migration period.

Table A7.1.6: Hours of Observation Completed at each Vantage Point (September 2020 to March 2021)

Year	Month	VP6	VP7	VP8	Total
2020	September	9	9	9	27
	October	12	15	15	42
	November	15	12	12	39
	December	6	6	6	18
2021	January	6	6	6	18
	February	6	6	6	18

	March	6	6	6	18
Totals		60	60	60	180

A7.1.3.22 A summary of the number of observations of target and secondary species with flights wholly or partially at CRH within the CRA during this period is provided in Table A7.1.7.

Table A7.1.7: Flight Lines of Target and Secondary Species at Risk Height (figures in parentheses give the number of birds for flight lines representing more than one individual)

Year	Month	Flight Lines Recorded within the CRA (no. birds)
2020	Sep.	4 red kite; 5 kestrel
	Oct.	7 red kite; 1 hen harrier; 1 goshawk; 5 (6) kestrel
	Nov.	4 red kite; 1 hen harrier; 1 (15) whooper swan; 1 (119) pink-footed goose; 6 kestrel
	Dec.	1 kite; 1 merlin; 3 kestrel
2021	Jan.	9 red kite; 2 kestrel
	Feb.	5 (6) red kite; 2 (27) pink-footed goose; 2 kestrel
	Mar.	5 (4) red kite; 1 kestrel

A7.1.3.23 During the September 2020 to March 2021 flight activity survey, red kite remained the most frequently recorded target species within the CRA. Hen harrier activity had apparently increased from the previous survey period being recorded through the autumn months and on into December. Merlin was recorded on two occasions.

A7.1.3.24 There were a small number of pink-footed goose and whooper swan flights that passed through the CRA during autumn migration in 2020, part of a pattern of movement that occurs over a broader front (e.g. along the Glenkens valley).

Whooper swan

A7.1.3.25 Whooper swan were recorded on three occasions during the flight activity surveys, for a total of 225 seconds, of which 89% of the activity was at CRH9. A group of 27 birds (adults and juveniles) flying southeast through the survey area, over North Liggat, were observed on 19 October 2018. On 8 March 2019 another flight was recorded of 28 birds, partly within the CRA and at CRH, heading southwest then west over the Proposed Development Area. On 17 November 2020 a group of 15 birds (12 adults and 3 juveniles) were recorded flying south, at CRH, to the east of Craig of Knockgray.

Greylag goose

A7.1.3.26 Greylag goose were recorded on four occasions during the flight activity surveys resulting in 280 seconds of flight time with 54% of that at CRH. On 11 January 2019 four adults were seen flying northeast across the Site from VP 5. On 1 April 2019 three birds were seen heading southwest from the Furmiston Craig area. On 3 June 2019 two greylags were recorded heading southwest from west side of Knockwhirn. Finally, two were recorded on 4 June 2019 flying to north-northwest from VP 5 heading over Water of Deugh, passing Knockgray Park and Craig of Knockgray. Both of these records are likely to relate to the native breeding population (i.e. not forming part of the Icelandic wintering population).

Pink-footed goose

A7.1.3.27 Pink-footed goose were recorded on six occasions during the flight activity surveys, most of the activity was recorded during the peak spring and autumn passage periods. A total of 975 seconds of flight time was recorded of which 49% was at CRH. On 8 March 2019 two separate skeins (one of 15 birds and one of 55) were seen from VP 3 flying well above CRH and into clouds. A group of 15 birds were recorded on 22 March 2019 from VP 3, flying at CRH, heading northwest and southwest across the Site. On 24 September 2020 a group of 19 pink-footed geese were recorded flying south over Proposed Development Area past Furmiston Craig towards Furmiston Bridge. On 5 November 2020 a large skein of 119 birds was seen from VP 6 heading westwards across Site, to the north of Quantans Hill and Craig of Knockgray. A group of 20 birds were seen on 17 February 2021 from VP 6 flying west across the Site changing direction several times. Finally, on the same day, about 20 minutes later, presumably the same group were seen in flight west over Quantans Hill and then away southwest and over Tup Park Knowe.

Black grouse

A7.1.3.28 Black grouse were recorded on only two occasions during the flight activity surveys, neither of these flights were within the CRA at CRH. A single displaying male was accidently flushed by the surveyor near to VP 3 on 7 May 2018. An adult female was recorded in flight from VP 5 on 15 April 2019, the bird circled at Rider's Knowe and headed away southwest towards Knockwhirn.

Osprey

A7.1.3.29 Osprey were recorded only on two occasions during the flight activity surveys, neither of these flights were within the CRA at CRH. On 5 September an osprey was seen in flight high over Proposed Development Area from VP 4, heading northeast over Rider's Knowe and past Green Hill. On 22 May 2019 an osprey was seen to the north of Proposed Development Area flying along Polsue Burn valley.

Goshawk

A7.1.3.30 Goshawk was infrequently recorded during the flight activity surveys and none of the observations were of birds flying at CRH. On 1 April 2019 an adult male was seen hunting near a small conifer plantation and then heading north past Quantans Hill. On 21 October 2020 a male was seen hunting from VP 6, heading west into Gardenhead Plantation.

Hen harrier

A7.1.3.31 Hen harrier was recorded on 12 separate occasions during the flight activity surveys for a total of 1363 seconds of observation of which c. 89% was below the rotor swept zone. Hen harrier were seen hunting at various locations across the survey area, mostly during the autumn and early winter period of 2020, when nine of these observations were made. This apparent increase in activity, in comparison to the 2018-19 autumn/winter period, may have been related to natural variation in the abundance of short-tailed field vole (*Microtus agrestis*), a key prey species for hen harrier[10]. Most of the hen harrier flight activity was below CRH, reflecting the typical hunting

[9] Activity at collision risk height, it does not account for the number of birds associated with the recorded flightline and may or may not be within the collision risk area. These factors are accounted for during the collision risk modelling process.

[10] Field vole abundance can vary widely between years as a result of natural population cycles and this can influence breeding attempts and breeding success of a number of raptor and owl species that rely on small mammals as prey during the breeding season. The abundance of field voles was reported to be at peak levels in Dumfries & Galloway during spring 2019 (Challis, A., Wilson, M.W., Schönberg, N., Eaton, M.A., Stevenson, A. & Stirling-Aird, P. (2020). Scottish Raptor Monitoring Scheme Report 2019. BTO Scotland, Stirling).

technique of this species, quartering low over rush, mire and rough grassland. No activity was recorded during the breeding season.

Red kite

A7.1.3.32 During the flight activity surveys there were 135 red kite flight lines recorded (comprising 152 individuals), comprising a total of 33,881 seconds (9.4 hrs) of total observation time. 104 flights were within, or partly within, the CRA area at CRH. A comparatively high proportion of total flight activity time (43%) was within the CRH band. Most of the remaining time (51% of the total) was spent below the rotor swept zone. Most of the birds observed were recorded as adults, or of uncertain age, only 4% were confirmed to be juveniles or immature birds.

A7.1.3.33 Red kite activity, primarily confirmed or assumed to be hunting flights, was recorded across the entire survey area but with some concentrations of activity in apparently more favoured hunting areas. Observations from VP 5 (overlooking the Marbrack Burn and Furmiston Craig areas) were responsible for 36% of the total activity recorded during the April 2018 to August 2019 survey. In comparison, VPs 1 and 4 were responsible for c. 12% each. During the September 2020 to March 2021 survey the observation rates (in this case flights recorded per hour) for red kite increased, in comparison to the previous survey period, from an average of 0.13 per hour to 0.22 per hour. Table A7.1.8 provides a breakdown of the number and rate of red kite flights recorded from each of the VPs.

Table A7.1.8 Distribution of Red Kite Flights Recorded from each VP

VP	Views Over	VP Hrs	No. flights	Flights/hr	% of Flights*
1	Willieanna, Quantans Hill, Craig of Knockgray	150	11	0.07	11.6
2	Quantans Hill, Knockgray	150	19	0.13	20.0
3	Knockwhirn, Marbrack, Furmiston Craig	150	19	0.13	20.0
4	Knockwhirn, Beninner	150	12	0.08	12.6
5	Marbrack, Furmiston Craig	150	34	0.23	35.8
6	Willieanna, Quantans Hll, Knockgray	60	10	0.17	25.0
7	Knockgray, Marbrack, Furmiston Craig	60	17	0.28	42.5
8	Marbrack, Knockwhirn, Beninner	60	13	0.22	32.5

*sub-divided by survey period

A7.1.3.34 Red kite flight activity was recorded in most months across the survey period, the only exceptions being December 2018, January 2019, August 2019 and January 2020. Table A7.1.9 provides a summary of activity recorded per month for red kite based on the number of birds observed per hour of observation.

Table A7.1.9: Summary of Red Kite Activity per Month

Year	Month	Birds (all VPs)	Secs (all VPs)	VP hrs	Birds/hr	Secs/hr
2018	April	4	675	24	0.17	28.13
2018	May	5	1000	54	0.09	18.52
2018	June	6	1585	42	0.14	37.74
2018	July	7	1446	30	0.23	48.20
2018	August	4	1225	30	0.13	40.83
2018	September	5	1240	42	0.12	29.52
2018	October	2	437	60	0.03	7.28
2018	November	11	2878	63	0.17	45.68
2018	December	0	0	45	0.00	0.00
2019	January	2	355	30	0.07	11.83
2019	February	5	1157	30	0.17	38.57
2019	March	9	653	45	0.20	14.51
2019	April	14	3719	66	0.21	56.35
2019	May	13	2690	51	0.25	52.75
2019	June	14	1934	63	0.22	30.70
2019	July	7	2569	42	0.17	61.17
2019	August	0	0	33	0.00	0.00
2020	September	7	600	27	0.26	22.22
2020	October	7	990	42	0.17	23.57
2020	November	4	610	39	0.10	15.64
2020	December	1	210	18	0.06	11.67
2021	January	12	5093	18	0.67	282.94
2021	February	6	1545	18	0.33	85.83
2021	March	7	1270	18	0.39	70.56

A7.1.3.35 The observation rates for red kite were appreciably higher during the later winter early spring of 2021, peaking in January 2021 at a rate of 0.67, which was nearly four times higher than the average observation rate per month (0.18) for the whole survey period. Similarly, to the increase in hen harrier activity that was also noted at this time, this may have been the result of a relatively high density of small mammal prey available during this period. However, there is also the potential that some of the increase during the late summer was due to a change in breeding site in 2020, with a pair nesting relatively close to the Proposed Development Area in a new location that was not in use during the 2018-19 period surveys.

Curlew

A7.1.3.36 Curlew were recorded on 11 occasions during the flight activity surveys with activity mostly occurring near to their breeding areas within the Site. A total of 637 seconds of flight activity was recorded with c. 90% occurring below CRH. There were three flights recorded in April-June 2018 including a territorial display flight to the west of Quantans Hill. All flights were below the rotor swept zone. During late March 2019 there were three curlew flights recorded, with activity focused to the west of Quantans Hill or birds passing through the Site, one of these flights was at CRH and within the CRA. There were five flights recoded in May-June 2019, all from VP 5, associated with birds that were nesting to the north of the Furmiston Craig area, on one occasion two curlew were seen mobbing a passing red kite. Two of these flights were at (or partly at) CRH and within the CRA.

Merlin

A7.1.3.37 Merlin was recorded seven times during the flight activity surveys, resulting in a total of 349 seconds of observation of which c. 80% was below CRH or outside of the CRA. Most of the activity recorded was outside of the main breeding season. On 17 October 2018 a juvenile female merlin was seen from VP 2 hunting east and south of Tup Park Knowe. What was assumed to be the same bird was seen later hunting west of Heathery Wood. On 9 April 2019 an adult female was seen from VP 3 passing low over Proposed Development Area, heading northwest. On 15 April 2019 an adult female flew low over open ground to the west of Craigengillan Hill and was then joined by a male. On 28 September 2019 an adult female, with a juvenile, were seen in fast low flight towards VP 8 then taking a quick turn before continuing outside of the viewshed. On 21 October 2020 a male was seen from VP 6 hunting at a low height, heading south towards Heathery Wood. Finally, on 20

December 2020 an adult female was seen from VP 6, flying east-southeast from Craig of Knockgray and then south and out of view.

Peregrine

A7.1.3.38 Peregrine were recorded on six occasions during the flight activity surveys, comprising 512 seconds of observation in total and with a high proportion of that activity at CRH (c. 73%). On 22 August 2019 two peregrine falcons (an adult female and a juvenile) were seen from VP 1 flying together at low height to the north of Heathery Wood, heading northeast. On 30 October 2018 an adult (possibly a female) was seen from VP 3 flying at CRH northwest over Big Loskie and Quantans Hill. On 9 April 2019 an adult female was seen flying over VP 3 before soaring and heading to the northwest. On 10 May 2019 a peregrine was seen heading southwest to the south of Knockwhirn from VP 5. On 24 October 2020 a distant peregrine was recorded from VP 8, well outside of the Proposed Development Area. Finally, on 24 October 2020 another distant view of a peregrine from VP 8, observed hunting thrushes, also well outside of the Proposed Development area.

Gulls

A7.1.3.39 Gull species were only infrequently observed within the Proposed Development Area during the flight activity surveys. Most gull activity was focused on fields along the course of the Water of Deugh or within or adjacent to the Site but to the south and west of the Proposed Development.

A7.1.3.40 Common gull (*Larus canus*) and herring gull (*Larus argentatus*) were recorded at CRH and within the CRA on two occasions during the flight activity surveys. On 11 June 2018 small groups of common gull were seen from VP 2, foraging in an area to the north of Knockgray Park, with occasional short flights throughout the watch, mostly below CRH. On 12 June 2019 an adult common gull was seen from VP drifting very low over fields, moving southeast. On 16 July 2019 an adult HG was seen from VP 2, near Tup Park Knowe plantation, before circling and drifting off in a south-southeast direction beyond the viewshed.

Secondary Species

A7.1.3.41 After red kite, common kestrel (*Falco tinnunculus*) was the most frequently recorded raptor species during the flight activity survey with a total of 109 flight observations (comprising 114 birds) of which 81 flights were at, or partly at, CRH and within the CRA. In total, for the whole flight activity survey period, 16,479 seconds of kestrel flight activity was recorded, of which c. 34% was at CRH. During April to August 2018 most of the kestrel activity was focused on the Knockwhirn and north Furmiston Craig areas. During September 2018 to March 2019 most of the recorded activity was on the other side of Proposed Development Area over Craig of Knockgray and Willieanna. There was much less activity during the 2019 breeding season in comparison to 2018. Then there was a clear peak in activity during October and November 2020, corresponding to peaks in activity by other raptor species that also hunt on small mammals. Activity was focused on the eastern side of the Proposed Development Area near Knockwhirn, Marbrack Burn and Furmiston Craig areas.

A7.1.3.42 Goosander (*Mergus merganser*) flights were recorded on four occasions (comprising 6 individuals), either individuals or small flocks passing through the survey area or associated with the Polhay and Markbrack Burns or other watercourses outside of Proposed Development Area. All of this activity was below CRH.

A7.1.3.43 Grey heron (*Ardea cinerea*) was recorded on three occasions during the flight activity survey, all records were towards the eastern end of Proposed Development Area, mostly associated with birds hunting along the Marbrack Burn.

A7.1.3.44 Cormorant (*Phalacrocorax carbo*) was recorded twice during the flight activity survey, both records were on 30 November 2018 from VP 2 of birds flying through the survey area.

A7.1.3.45 Sparrowhawk (*Accipiter nisus*) was recorded once during the flight activity survey, on 12 June 2019 an adult male was seen flying low over the moorland to the east of VP 5, then flying south past Marbrack.

A7.1.3.46 Common snipe (*Gallinago gallinago*) was recorded on 9 occasions (12 individuals) mostly from VPs 4 and 5 in the Marbrack and Furmiston areas and including some breeding display flights at CRH.

Other Notable Species

A7.1.3.47 An adult golden eagle, possibly a female, was seen from VP 4 on 13 November 2018 flying southwest across Site from the direction of Green Hill. This flight was partly at CRH and within the CRA. Whilst this is a species of high conservation importance nationally and for the region, there was no evidence to indicate that the Proposed Development Area forms part of a breeding territory or is important for non-breeding golden eagles. This species is therefore not considered further in this assessment.

A7.1.3.48 A flock of six golden plover were seen from VP 3 on 17 October 2018 near Knockwhirn, flying south-southwest at CRH. They continued south-southwest quickly past the east side of the VP. Golden plover is a species considered to be at risk from wind farm development, particularly in relation to wind turbine displacement at its breeding sites. However, in this case, there was no evidence of regular flight activity by golden plover across the Proposed Development Area and there were no records of breeding or wintering/passage use of habitats within the Site. This species there therefore not considered further in this assessment.

Breeding Bird Surveys

A7.1.3.49 The following is a summary of the key findings from the baseline breeding bird surveys completed in 2018 and 2019. The non-confidential mapped results from the various surveys are provided as the following figures to Chapter 7:

- Figure 7.4a Non-Confidential Breeding Bird Survey Results - Waders 2018-19
- Figure 7.4b Non-Confidential Breeding Bird Survey Results - Others 2018
- Figure 7.4c Non-Confidential Breeding Bird Survey Results - Others 2019

A7.1.3.50 Sensitive breeding records related to Schedule 1 species (e.g. red kite and peregrine) are provided in the separate Confidential Annex. Further background information on the completed surveys including dates, weather conditions, key observations are provided in Appendix 4 to this document.

Black Grouse

A7.1.3.51 During spring 2018 there were two male black grouse recorded lekking in the survey area, towards the southern end of Proposed Development Area, to the south of Quantans Hill (this is close to the proposed location for turbine 10). A female was also recorded in May 2018, flushed from the ground near Quantans Hill. There were two other sightings of black grouse during the flight activity surveys in 2018, one of which was of a male in the same location as the lek site. This is c. 1.5 km southeast of another lek site, attended by 2 males, recorded during the surveys for the previous Quantans Hill wind farm proposal (during baseline surveys in 2002-11). There was no evidence of lekking activity in that area in 2018, 2019 or 2020.

A7.1.3.52 Surveys in spring 2019 found no evidence of black grouse lekking anywhere within the survey area. An adult female was seen during a flight activity survey in April 2019 from VP 4, it circled over Rider's Knowe, c. 1.5 km north of the Proposed Development, and then headed southwest towards Knockwhirn.

A7.1.3.53 Surveys in spring 2020 also found no evidence of black grouse lekking anywhere within the survey area. There were no observations of black grouse during other surveys completed during 2020 (e.g. including Phase I habitat and protected species walkover surveys).

Osprey

A7.1.3.54 There are some potentially suitable nesting opportunities for osprey within the survey area but there was no evidence in any year of breeding activity. Osprey were occasionally seen hunting over Kendoon Loch, c. 2 km to the south of the Proposed Development.

Goshawk

A7.1.3.55 There is limited suitable habitat for goshawk within the Proposed Development Area. The extensive conifer plantation to the east of Proposed Development Area is likely to support breeding goshawk. Due to the lack of suitable habitat, it was not a focal species for the breeding raptor surveys. There were no observations from the flight activity survey of any territorial or breeding display behaviour by this species within or near to the Proposed Development Area in any year.

Hen harrier

A7.1.3.56 There is currently limited suitable nesting habitat for hen harrier within the Site. If the Proposed Development Area provided important supporting habitat for pairs that may be breeding in the wider area then that should have been apparent from the results of the flight activity surveys. However, there were no observations of this species using the Site or Proposed Development Area during the breeding season in 2018, 2019 or 2020.

Red kite

A7.1.3.57 Surveys for breeding red kite were completed in 2018, 2019 and 2020. The Site and surrounding area provide suitable breeding habitat for red kite with numerous mature woodlands with potentially suitable trees for nesting adjacent to extensive farmland and open moorland that provides a wide range of food sources (e.g. sheep carrion, rabbits, voles, field mice, birds, worms, and invertebrate prey).

A7.1.3.58 There was no evidence to indicate that red kite were nesting within the Site in 2018, 2019 or 2020. However, during 2020 a breeding attempt was discovered in a location that is near to the edge of the Site, and c. 800 m from the Proposed Development. This site is referred to as KT1. A marked increase in red kite flight activity within the Site, in comparison to the 2018-19 survey period, was noted during later summer 2020. This may have been partly related to the activity associated with this breeding attempt.

A7.1.3.59 The DGRSG provided information on the history of red kite breeding activity within the wider study area (i.e. up to c. 2 km from the Site boundary) covering the period 2015 and 2020. From at least 2010, red kites had regularly bred at a site that was on the fringes of the study area and > 2km from the Proposed Development. Prior to 2015 there had been no confirmed records of breeding by red kite closer to the Site although there had been reports of a pair in the area in 2014. In 2015 a pair were found to be nesting at a location c. 800m from the Proposed Development (referred to as KT2). Subsequent visits by DGRSG surveyors to this area in 2016 and 2017 failed to find any evidence of breeding. However, the same pair were linked to a different breeding location in 2018, which is >2km from the Proposed Development. In 2018, DGRSG received a report by a landowner of red kites nesting in a similar location to KT1. It is suspected that the breeding attempted failed early in the season as the baseline surveys, commencing April 2018, did not find evidence of an ongoing breeding attempt[11]. In 2019 this pair used an alternative site which is about 1.5 km from the Proposed Development (referred to as KT3). In 2020 this pair moved further away and nested at a site more than 2 km from the Proposed Development.

A7.1.3.60 In conclusion, the baseline surveys have coincided with an apparent expansion of red kite breeding activity in this general area in the past five years. The available evidence suggests there are up to three pairs of red kite nesting within 2 km of the Site and are likely to be using habitats within the Proposed Development area for hunting to varying extents. This is a fluid situation which may change again in the near future as red kites move between their favoured nest sites or new pairs settle in the area. Red kites are not particularly territorial, other than in defending their nest sites, and there are several alternative nesting sites that have not been occupied for several years.

Curlew

A7.1.3.61 Surveys for breeding curlew were completed in 2018 and 2019. During the 2018 survey two breeding curlew territories were recorded just outside of Proposed Development Area in fields near to the Water of Deugh. During 2019, curlew breeding activity occurred in two areas within the Site (see Figure 7.4a of Chapter 7). To the northeast of Furmiston Craig and to the east of Craig of Knockgray. A total of three curlew breeding territories were recorded in 2019.

Barn owl

A7.1.3.62 There are several known, and potentially suitable, sites for nesting barn owl within the survey area and there is also abundant rough grassland habitat for hunting in the general area. One of these sites was confirmed to be occupied by a breeding pair in 2019. This site is >500 m from the Proposed Development. Further information is provided in the Confidential Annex.

Short-eared owl

A7.1.3.63 There is extensive suitable habitat for short-eared owl within the Site, associated with the more elevated and remote parts of the Site where there are large areas of rough grassland, wet heath and mire that provide suitable foraging habitat.

A7.1.3.64 No evidence of the presence of breeding short-eared owl was recorded during any of the surveys in 2018 or 2019. A single bird was flushed from Molina mire to the east of Knockwhirn in August 2020 and another bird was seen in the same general area during September 2020. These observations also coincided with an increase in hen harrier and red kite activity recorded during the flight activity surveys in this part of the Site during later summer, autumn and early winter. Short-eared owls are highly nomadic in their breeding behaviour, moving locations in response to population cycles in their favoured small mammal prey. It is possible that this species will breed in or near the Proposed Development Area in future years.

Merlin

A7.1.3.65 There is extensive suitable hunting habitat for merlin within the Site and plenty of prey available given the densities of common moorland songbirds present. Ground-nesting opportunities are more limited with the general absence of suitable heather banks. Old corvid nests in the plantation areas have some potential to be used but there was no evidence of this occurring during the raptor surveys in 2018 and 2019. There was one observation of a male and female merlin in April 2019 west of Craigengillan Hill, to the north of the Proposed Development in a relatively remote part of the Site. No evidence of the presence of a breeding attempt (e.g. prey remains, plucks) was found in this area in 2018 or 2019. There is extensive plantation forest to the east of the Site which may be used by breeding merlin. However, the flight activity surveys did not record much merlin activity during the breeding season, most observations were outside this period, which also indicates that the Proposed Development Area was not important in terms of supporting pairs that may have been nesting outside of the Site.

[11] Due to the risk of disturbance that this time of year surveyors were cautious about entering any woods with active nests.

Peregrine

A7.1.3.66 There was no evidence of any known or potential peregrine breeding sites within the survey area being occupied by breeding pairs in 2018 or 2019. Based on information provided by DGRSG, there are breeding sites in the wider area (i.e. more than 2 km from the Proposed Development) that were confirmed to be occupied by pairs in 2018 and 2019, although breeding was thought to have been unsuccessful in both years. There is a historical breeding site which was abandoned due to afforestation which may be used again in the future once the trees are cleared. This site is closer to the Proposed Development although >1.5 km from the nearest proposed wind turbine. Further information is provided in the Confidential Annex.

Other Raptors / Owls

A7.1.3.67 Common kestrel were confirmed to be breeding in 2018 with one pair located just outside of the Proposed Development area. There was no evidence of breeding occurring during 2019. During 2020, observations during other surveys (Phase I habitat and protected species survey visits) indicated that a pair nested in a plantation c. 400 m west of the proposed location for wind turbine 10, in the Knockgray Farm area. There was also behaviour to suggest that breeding may have also occurred towards the Knockwhirn area in a plantation located between proposed wind turbines 3 and 9.

A7.1.3.68 Common buzzard (*Buteo buteo*) and tawny owl (*Strix aluco*) are also known to breed within the mature mixed woodland around Knockgray Farm and Marbrack Farm, these areas are within the Site but well outside of the Proposed Development area.

Other Waders

A7.1.3.69 Breeding common snipe territories were recorded in two locations in 2018 and 2019. One is on the southern slopes of Dunool, just outside of the Proposed Development Area, the other is south and east of Knockwhirn. Two territories were recorded within the Site in both years. However, this is likely to be an underestimate of the number of breeding pairs present as this species tends to be under-recorded using standard daytime moorland wader survey methods. During other surveys in 2020 (e.g. Phase 1 habitat and protected species surveys) displaying common snipe were also heard in the Furmiston area in marshy grassland to the north of the farmhouse, southeast of the proposed location for turbine 14.

Songbirds & Others

A7.1.3.70 The breeding bird surveys carried out in 2018 and 2019 revealed the presence of a range of widespread and commonly occurring passerines that are considered to typical of the types of habitats present (open moorland, woodlands, farmland and coniferous plantation). Several species, whose populations are of high or moderate conservation concern at a national level, were recorded breeding within the Site in suitable habitat and at typical densities, these included cuckoo (*Cuculus canorus*), skylark (*Alauda arvensis*), meadow pipit (*Anthus pratensis*), song thrush (*Turdus philomelos*), spotted flycatcher (*Muscicapa striata*). Small groups of common crossbill (*Loxia curvirostra*) were also recorded on a number of occasions during surveys of the eastern side of the Site and are considered very likely to be breeding in the extensive conifer plantation areas further to the east. Red grouse (*Lagopus lagopus*) are also present, apparently in low numbers, primarily within the western and northern parts of the Site. There was also at least one pair of raven (*Corvus corax*) that regularly breed or attempt to breed within the Site, in the Marbrack (central) area.

Wintering/Passage Birds

Geese and Swans

A7.1.3.71 During surveys completed in the winters of 2018-19 and 2020-21 there was no evidence of appreciable numbers of roosting or feeding geese or swans occurring within the survey area. The carse fields to the west and north of Carsphairn (c. 2km west of the Proposed Development) are occasionally used by whopper swans but there were no swans recorded using that area during the survey period.

A7.1.3.72 The dates and weather conditions during the formal goose and swan roosting and grazing counts is provided in Appendix 5 to this document.

Raptors

A7.1.3.73 During winter 2018-19 and winter 2020-21 there was no evidence of the presence of any regularly used communal winter roost sites for short-eared owl, hen harrier or red kite within the Proposed Development Area or surrounding survey area.

Waders

A7.1.3.74 There was a single small flock of golden plover recorded during the flight activity surveys in October 2018. There was no evidence during winter 2018-19 or winter 2020-21 of any use of the Proposed Development Area by flocks of wintering golden plover or other wader species.

A7.1.3.75 Dotterel (*Charadrius morinellus*) were recorded on the summit of Cairnsmore of Carsphairn, towards the north-eastern edge of the Site, in spring of both 2018 and 2019, comprising a single bird in May 2018 and a group of five in May 2019. These sightings were birds on passage, most likely on migration to breeding grounds in the Grampians and Scandinavia. There was no evidence of any breeding occurring in either year, despite the presence of potentially suitable habitat. Dotterel is a scarce breeding and migrant wader in Scotland, with breeding confined to montane alpine habitats above approximately 700 m AOD. Dotterel is listed on Schedule 1 to the WCA, Annex I of the EC Birds Directive and is on the UK Red list of Birds of Conservation Concern due to recent breeding population and range declines (Eaton *et al.* 2015).

APPENDIX 1: All Birds Recorded and their Status

A full list of all species recorded during all ornithological surveys completed between April 2018 and March 2021 is provided in Table A1.1 below. This table also includes details of the status of each species within the site (e.g. breeding, non-breeding, wintering and passage), the number of breeding territories recorded (where applicable), the conservation concern status of each species population at a national level, the legal status of the species and nature conservation policy status of the species regionally and nationally.

Table A1.1: All Bird Species Recorded During Surveys at Quantans Hill between April 2018 and March 2021 and their Status

Common Name	Scientific Name	BTO Code	Site Status[i]	No. Breeding Territories Recorded		Legal Status[ii]	UK BoCC Status[iii]	UKBAP / LBAP[iv]	SBL[v]
				2018	2019				
Whooper swan	*Cygnus cygnus*	WS	P/Ww			Sch. 1, Ann. I	*Amber*	L	✓
Pink-footed goose	*Anser brachyrhynchus*	PG	P				*Amber*		
(Iceland) Greylag goose	*Anser anser*	GJ	P				*Amber*		
Canada goose	*Branta canadensis*	CG	NB				*n/a*		
Mallard	*Anas platyrhynchos*	MA	pBw				*Amber*		
Goosander	*Mergus merganser*	GD	pBw				*Green*		
Quail	*Coturnix coturnix*	Q.	pBw			Sch. 1	*Amber*		
Black grouse	*Lyrurus tetrix*	BK	pBc			Ann. I	*Red*	UK, L	✓
Grey heron	*Ardea cinerea*	H.	NB				*Green*		
Red kite	*Milvus milvus*	KT	Bw			Sch. 1, Ann. I	*Green*	L	✓
Hen harrier	*Circus cyaneus*	HH	NB/Ww			Sch. 1, Ann. I	*Red*	L	✓
Goshawk	*Accipiter gentilis*	GI	pBw			Sch. 1	*Green*		
Sparrowhawk	*Accipiter nisus*	SH	pBw				*Green*		
Common buzzard	*Buteo buteo*	BZ	Bc/Bw				*Green*		
Golden eagle	*Aquila chrysaetos*	EA	NB			Sch. 1, Ann. I	*Green*	L	✓
Osprey	*Pandion haliaetus*	OP	NB/P			Sch. 1, Ann. I	*Amber*	L	✓
Oystercatcher	*Haematopus ostralegus*	OC	pBw				*Amber*		
Golden plover	*Pluvialis apricaria*	GP	P			Ann. I	*Green*	L	✓
Dotterel	*Charadrius morinellus*	DO	P			Sch. 1, Ann. I	*Red*	L	✓
Curlew	*Numenius arquata*	CU	Bc	2	3		*Red*	UK, L	✓
Common sandpiper	*Actitis hypoleucos*	CS	Bw				*Amber*		
Common snipe	*Gallinago gallinago*	SN	Bc	2	2		*Amber*		
Black-headed gull	*Chroicocephalus ridibundus*	BH	NB				*Amber*	L	✓

Common Name	Scientific Name	BTO Code	Site Status[i]	No. Breeding Territories Recorded		Legal Status[ii]	UK BoCC Status[iii]	UKBAP / LBAP[iv]	SBL[v]
				2018	2019				
Common gull	*Larus canus*	CM	NB				*Amber*		
Lesser black-backed gull	*Larus fuscus*	LB	NB				*Amber*		
Herring gull	*Larus argentatus*	HG	NB				*Red*	UK, L	✓
Great black-backed gull	*Larus marinus*	GB	NB				*Amber*		
Woodpigeon	*Columba palumbus*	WP	Bc				*Green*		
Cuckoo	*Cuculus canorus*	CK	Bc		4		*Red*	UK	✓
Barn owl	*Tyto alba*	BO	Bw			Sch. 1	*Green*	L	✓
Common swift	*Apus apus*	SI	NB				*Amber*	L	✓
Great spotted woodpecker	*Dendrocopos major*	GS	pBw				*Green*		
Common kestrel	*Falco tinnunculus*	K.	Bc				*Amber*	L	✓
Merlin	*Falco columbarius*	ML	NB			Sch. 1, Ann. I	*Red*	L	✓
Peregrine falcon	*Falco peregrinus*	PE	Bw			Sch. 1, Ann. I	*Green*	L	✓
Jay	*Garrulus glandarius*	J.	pBw				*Green*		
Carrion crow	*Corvus corone*	C.	Bc	1			*Green*		
Raven	*Corvus corax*	RN	Bc				*Green*		
Goldcrest	*Regulus regulus*	GC	Bc	1	1		*Green*		
Blue tit	*Cyanistes caeruleus*	BT	Bc				*Green*		
Great tit	*Parus major*	GT	Bc		1		*Green*		
Coal tit	*Periparus ater*	CT	Bc	7	4		*Green*		
Skylark	*Alauda arvensis*	S.	Bc	82	123		*Red*	UK, L	✓
Sand martin	*Riparia riparia*	SM	Bc				*Green*		
Swallow	*Hirundo rustica*	SL	Bc		1		*Green*		
Chiffchaff	*Phylloscopus collybita*	CC	Bc	3			*Green*		
Willow warbler	*Phylloscopus trochilus*	WW	Bc	20	23		*Amber*		
Blackcap	*Sylvia atricapilla*	BC	Bc	3			*Green*		
Sedge warbler	*Acrocephalus schoenobaenus*	SW	pBw				*Green*		
Wren	*Troglodytes troglodytes*	WR	Bc	8	3		*Green*		
Starling	*Sturnus vulgaris*	SG	pBw				*Red*	UK	✓
Dipper	*Cinclus cinclus*	DI	Bc		1		*Amber*		

Common Name	Scientific Name	BTO Code	Site Status[i]	No. Breeding Territories Recorded		Legal Status[ii]	UK BoCC Status[iii]	UKBAP / LBAP[iv]	SBL[v]
				2018	2019				
Blackbird	*Turdus merula*	B.	Bc	3			*Green*		
Song thrush	*Turdus philomelos*	ST	Bc	3	2		*Red*	UK, L	✓
Mistle thrush	*Turdus viscivorus*	M.	pBw				*Red*		
Spotted flycatcher	*Muscicapa striata*	SF	Bc		3		*Red*	UK, L	✓
Robin	*Erithacus rubecula*	R.	Bc	7			*Green*		
Whinchat	*Saxicola rubetra*	WC	Bc		2		*Red*		
Stonechat	*Saxicola rubicola*	SC	pBw				*Green*		
Northern wheatear	*Oenanthe oenanthe*	W.	Bc	1	5		*Green*		
Dunnock	*Prunella modularis*	D.	Bc	1			*Amber*		
House sparrow	*Passer domesticus*	HS	Bc	1			*Red*	UK, L	✓
Grey wagtail	*Motacilla cinerea*	GL	pBw				*Red*		
Pied wagtail	*Motacilla alba*	PW	Bc	2	1		*Green*		
Tree pipit	*Anthus trivialis*	TP	pBw				*Red*	UK	✓
Meadow pipit	*Anthus pratensis*	MP	Bc	132	223		*Amber*		
Chaffinch	*Fringilla coelebs*	CH	Bc	22	9		*Green*		
Bullfinch	*Pyrrhula pyrrhula*	BF	pBw				*Amber*	UK, L	✓
Linnet	*Linaria cannabina*	LI	pBw				*Red*	UK, L	✓
Lesser redpoll	*Acanthis cabaret*	LR	pBw				*Red*	UK	✓
Common crossbill	*Loxia curvirostra*	CR	pBw			Sch. 1	*Green*		
Reed bunting	*Emberiza schoeniclus*	RB	Bc		1		*Amber*	UK, L	✓

i – Overall status of the species within the survey area (2018 – 2020): NB – not breeding; Bc – confirmed breeding in the core survey area; pBC – probably breeding within the core survey area; Wc – wintering in the core survey area; Bw – confirmed breeding in the wider area; pBw – possibly breeding in the wider area; Ww – wintering in the wider area; and P – passage migrant.

ii - Sch. 1 - Species listed on Schedule 1 to the Wildlife and Countryside Act 1981 (as amended). Ann. I - Species listed on Annex I of the EC Birds Directive (Directive 2009/147/EC on the conservation of wild birds - the codified version). NB – all wild bird species and their nests and eggs are protected under the Wildlife & Countryside Act 1981, as amended.

iii - Birds of Conservation Concern (BoCC) in the UK (Eaton et al. 2015). All regularly occurring species that do not qualify under any of the red or amber criteria are green listed. The Green list also includes those species listed as recovering from Historical Decline in the last review that have continued to recover and do not qualify under any of the other criteria.

iv - Priority species in the UK Biodiversity Action Plan (UK) and the Dumfries & Galloway Local Biodiversity Action Plan (L).

v – Priority species on the Scottish Biodiversity List (SBL).

APPENDIX 2: Flight Activity Survey Details

This appendix provides further details of the flight activity surveys completed for the proposed Quantans Hill wind farm site, between April 2018 to August 2019 and September 2020 to March 2021. This includes details of the timing of the individual watches and the weather conditions during the watches. The detailed results of the flight activity surveys are provided in Appendix 3.

The following tables (A2.1 and A2.2) provide details of the timings of the individual vantage point watches and the weather conditions during the flight activity surveys.

Table A2.1: Flight Activity Survey Dates, Timings and General Notes – April 2018 to August 2019 and September 2020 to March 2021

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0001	20/04/18	**2**	3	AJM	13:00	16:00	03:00	
0002	20/04/18	**3**	3	RS	13:00	16:00	03:00	No target species flights recorded.
0003	20/04/18	**2**	5	AJM	16:30	19:30	03:00	
0004	20/04/18	**3**	5	RS	16:30	19:30	03:00	
0005	22/04/18	**1**	2	AJM	09:10	12:10	03:00	
0006	22/04/18	**1**	3	AJM	12:40	15:40	03:00	
0007	30/04/18	**4N**	4	AJM	14:35	17:35	03:00	
0008	30/04/18	**4S**	5	AJM	18:05	21:05	03:00	
0009	07/05/18	**2**	4	AJM	15:30	18:30	03:00	
0010	07/05/18	**3**	4	PC	15:30	18:30	03:00	
0011	07/05/18	**2**	5	AJM	19:00	21:00	02:00	
0012	07/05/18	**3**	5	PC	19:00	21:00	02:00	
0013	15/05/18	**4N**	3	PC	10:50	13:50	03:00	
0014	15/05/18	**4S**	3	AJM	10:50	13:50	03:00	
0015	15/05/18	**4N**	4	AJM	14:20	17:20	03:00	
0016	15/05/18	**4S**	4	PC	14:20	17:20	03:00	
0017	16/05/18	**2**	2	AJM	08:45	09:45	01:00	No target species flights recorded.
0018	16/05/18	**3**	2	PC	08:50	09:50	01:00	No target species flights recorded.
0019	21/05/18	**1**	3	AJM	12:10	15:10	03:00	Cloud was very thin. Bright day. No target species flights recorded.
0020	21/05/18	**1**	4	AJM	15:40	18:40	03:00	
0021	23/05/18	**3**	2	AJM	08:35	11:35	03:00	
0022	23/05/18	**4N**	2	RS	09:30	12:30	03:00	
0023	23/05/18	**2**	3	AJM	12:05	15:05	03:00	
0024	23/05/18	**4S**	3	RS	13:00	16:00	03:00	
0025	28/05/18	**1**	4	AJM	14:15	17:15	03:00	
0026	28/05/18	**1**	5	AJM	17:45	20:45	03:00	
0027	30/05/18	**4N**	4	PC	15:35	18:35	03:00	No target species flights recorded.
0028	30/05/18	**4S**	4	AJM	15:35	18:35	03:00	
0029	05/06/18	**4S**	4	AJM	15:40	18:40	03:00	
0030	05/06/18	**4N**	4	PC	15:40	18:40	03:00	
0031	11/06/18	**3**	2	AJM	09:05	12:05	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0032	11/06/18	**2**	2	PC	09:10	12:10	03:00	
0033	11/06/18	**3**	3	AJM	12:35	15:35	03:00	
0034	11/06/18	**2**	3	PC	12:40	15:40	03:00	
0035	12/06/18	**4S**	1	AJM	04:10	07:10	03:00	No target species flights recorded.
0036	12/06/18	**4N**	1	PC	04:10	07:10	03:00	No target species flights recorded.
0037	19/06/18	**4S**	4	AJM	14:30	17:30	03:00	
0038	19/06/18	**4N**	4	RS	14:30	17:30	03:00	
0039	20/06/18	**2**	4	AJM	16:30	19:30	03:00	
0040	20/06/18	**3**	4	RS	16:40	19:40	03:00	
0041	27/06/18	**1**	3	RI	10:10	13:10	03:00	
0042	27/06/18	**1**	4	RI	13:40	16:40	03:00	
0043	06/07/18	**2**	2	AJM	07:30	10:30	03:00	No target species flights recorded.
0044	06/07/18	**3**	2	RS	07:45	10:45	03:00	No target species flights recorded.
0045	06/07/18	**2**	3	AJM	11:00	14:00	03:00	No target species flights recorded.
0046	06/07/18	**3**	3	RS	11:15	14:15	03:00	
0047	10/07/18	**4S**	3	AJM	13:40	16:40	03:00	
0048	10/07/18	**4N**	3	PC	13:40	16:40	03:00	No target species flights recorded.
0049	17/07/18	**1**	1	AJM	05:25	08:25	03:00	
0050	17/07/18	**1**	2	AJM	08:55	11:55	03:00	
0051	25/07/18	**4S**	3	AJM	10:15	13:15	03:00	
0052	25/07/18	**4N**	3	PC	10:15	13:15	03:00	
0053	07/08/18	**4S**	3	PC	10:30	13:30	03:00	
0054	07/08/18	**4N**	4	PC	14:00	17:00	03:00	
0055	08/08/18	**2**	1	AJM	04:50	07:50	03:00	
0056	08/08/18	**3**	1	RS	05:00	08:00	03:00	
0057	08/08/18	**2**	2	AJM	08:20	11:20	03:00	
0058	08/08/18	**3**	2	RS	08:30	11:30	03:00	
0059	22/08/18	**1**	3	AJM	11:50	14:50	03:00	
0060	22/08/18	**4S**	3	RS	12:20	15:20	03:00	
0061	22/08/18	**1**	4	AJM	15:20	18:20	03:00	
0062	22/08/18	**4N**	4	RS	15:50	18:50	03:00	
0063	05/09/18	**1**	4	PC	14:00	17:00	03:00	No target species flights recorded.
0064	05/09/18	**4N**	4	GP	14:00	17:00	03:00	
0065	05/09/18	**4S**	4	RS	14:00	17:00	03:00	
0066	05/09/18	**1**	5	PC	17:30	20:30	03:00	
0067	05/09/18	**4N**	5	GP	17:30	20:30	03:00	
0068	05/09/18	**4S**	5	RS	17:30	20:30	03:00	
0069	13/09/18	**3**	1	PC	06:45	09:45	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0070	13/09/18	**3**	2	PC	10:15	13:15	03:00	No target species flights recorded.
0071	17/09/18	**2**	1	AJM	07:55	10:55	03:00	
0072	17/09/18	**2**	2	AJM	11:25	14:25	03:00	
0073	25/09/18	**1**	2	AJM	10:55	13:55	03:00	
0074	25/09/18	**4N**	2	RS	11:15	14:15	03:00	No target species flights recorded.
0075	25/09/18	**4S**	4	RS	14:45	17:45	03:00	
0076	25/09/18	**2**	4	AJM	14:50	17:50	03:00	
0077	01/10/18	**4S**	5	PC	16:20	19:20	03:00	
0078	01/10/18	**4N**	5	AD	16:20	19:20	03:00	No target species flights recorded.
0079	17/10/18	**2**	4	AD	12:00	15:00	03:00	
0080	17/10/18	**3**	4	RI	12:10	15:10	03:00	
0081	17/10/18	**2**	5	AD	15:30	18:30	03:00	No target species flights recorded.
0082	17/10/18	**3**	5	RI	15:40	18:40	03:00	
0083	19/10/18	**1**	4	AD	12:10	15:10	03:00	No target species flights recorded.
0084	19/10/18	**4N**	4	AJM	12:10	15:10	03:00	Very light rain. Barely drizzle.
0085	19/10/18	**4S**	5	AJM	15:40	18:40	03:00	Very light rain. Barely drizzle. Cloud >300 m all day.
0086	19/10/18	**1**	5	AD	15:45	18:45	03:00	
0087	26/10/18	**4N**	1	AJM	08:30	11:30	03:00	No target species flights recorded.
0088	26/10/18	**1**	4	RTW	11:40	14:40	03:00	
0089	26/10/18	**4S**	4	AJM	12:00	15:00	03:00	
0090	26/10/18	**1**	5	RTW	15:10	18:10	03:00	
0091	29/10/18	**2**	1	RTW	06:45	09:45	03:00	
0092	29/10/18	**2**	2	RTW	10:15	13:15	03:00	
0093	30/10/18	**3**	1	RTW	06:45	09:45	03:00	
0094	30/10/18	**3**	2	RTW	10:15	13:15	03:00	
0095	31/10/18	**3**	1	RTW	06:50	09:50	03:00	Sheep herding in viewshed throughout survey.
0096	31/10/18	**2**	4	RTW	11:20	14:20	03:00	
0097	13/11/18	**2**	3	AD	10:10	13:10	03:00	
0098	13/11/18	**4N**	3	TL	10:30	13:30	03:00	
0099	13/11/18	**4S**	3	SP	10:30	13:30	03:00	
0100	13/11/18	**2**	5	AD	13:40	16:40	03:00	No target species flights recorded.
0101	13/11/18	**4N**	5	SP	14:00	17:00	03:00	
0102	13/11/18	**4S**	5	TL	14:00	17:00	03:00	
0103	19/11/18	**4N**	3	AD	10:00	13:00	03:00	
0104	19/11/18	**4S**	5	AD	13:30	16:30	03:00	
0105	20/11/18	**1**	1	RTW	07:50	10:50	03:00	
0106	20/11/18	**1**	3	RTW	11:20	14:20	03:00	No target species flights recorded
0107	21/11/18	**4N**	1	PC	08:15	11:15	03:00	No target species flights recorded

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0108	21/11/18	**4S**	1	AD	08:15	11:15	03:00	
0109	21/11/18	**3**	3	RTW	09:45	12:45	03:00	No target species flights recorded
0110	21/11/18	**3**	5	RTW	13:15	16:15	03:00	No target species flights recorded
0111	23/11/18	**1**	3	RTW	09:45	12:45	03:00	No target species flights recorded
0112	23/11/18	**1**	5	RTW	13:15	16:15	03:00	No target species flights recorded
0113	26/11/18	**1**	3	RTW	09:05	12:05	03:00	Farmer on quad briefly behind VP between 10:21 and 10:40.
0114	26/11/18	**3**	5	RTW	13:10	16:10	03:00	
0115	29/11/18	**3**	5	RTW	13:10	16:10	03:00	
0116	30/11/18	**2**	1	RTW	08:00	11:00	03:00	
0117	30/11/18	**2**	3	RTW	11:30	14:30	03:00	
0118	03/12/18	**4N**	3	PC	09:40	12:40	03:00	No target species flights recorded
0119	03/12/18	**4S**	3	AJM	09:40	12:40	03:00	
0120	03/12/18	**4N**	5	AJM	13:10	16:10	03:00	
0121	03/12/18	**4S**	5	PC	13:10	16:10	03:00	
0122	09/12/18	**2**	3	AJM	09:40	12:40	03:00	
0123	09/12/18	**3**	3	PC	09:40	12:40	03:00	
0124	09/12/18	**2**	5	AJM	13:10	16:10	03:00	
0125	09/12/18	**3**	5	PC	13:10	16:10	03:00	
0126	10/12/18	**4S**	3	AJM	09:30	12:30	03:00	
0127	10/12/18	**4N**	5	AJM	13:00	16:00	03:00	
0128	14/12/18	**4N**	3	PC	09:15	12:15	03:00	
0129	14/12/18	**4S**	5	PC	12:45	15:45	03:00	
0130	19/12/18	**1**	1	AJM	08:35	11:35	03:00	Occasional isolated fog patch for first two hours but mostly clear. Fog blew through quickly.
0131	19/12/18	**1**	3	AJM	12:05	15:05	03:00	
0132	20/12/18	**3**	1	RTW	08:25	11:25	03:00	No target species flights recorded
0133	11/01/19	**4N**	3	PC	09:45	12:45	03:00	No target species flights recorded
0134	11/01/19	**4S**	3	TB	09:45	12:45	03:00	
0135	11/01/19	**4N**	5	TB	13:15	16:15	03:00	No target species flights recorded
0136	11/01/19	**4S**	5	PC	13:15	16:15	03:00	
0137	21/01/19	**2**	3	AJM	09:30	12:30	03:00	
0138	21/01/19	**3**	3	PC	09:50	12:50	03:00	
0139	21/01/19	**2**	5	AJM	13:00	16:00	03:00	
0140	21/01/19	**3**	5	PC	13:20	16:20	03:00	
0141	30/01/19	**1**	3	AJM	10:40	13:40	03:00	
0142	30/01/19	**1**	5	AJM	14:10	17:10	03:00	
0143	11/02/19	**4N**	4	TB	12:30	15:30	03:00	
0144	12/02/19	**2**	2	TB	09:40	12:40	03:00	Wind briefly peaked at Force 6 in hour 3.
0145	12/02/19	**3**	2	PH	09:40	12:40	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0146	12/02/19	**2**	4	TB	13:10	16:10	03:00	
0147	12/02/19	**3**	4	PH	13:10	16:10	03:00	No target species flights recorded.
0148	14/02/19	**1**	2	PH	10:05	13:05	03:00	
0149	14/02/19	**1**	4	PH	13:35	16:35	03:00	
0150	25/02/19	**4S**	2	PH	10:25	13:25	03:00	
0151	25/02/19	**4S**	4	PH	13:55	16:55	03:00	
0152	27/02/19	**4N**	1	TB	07:35	10:35	03:00	
0153	08/03/19	**3**	1	TB	07:45	10:45	03:00	
0154	08/03/19	**2**	1	PH	07:55	10:55	03:00	
0155	11/03/19	**4N**	2	PH	10:15	13:15	03:00	
0156	11/03/19	**4S**	2	TB	10:15	13:15	03:00	
0157	11/03/19	**4N**	4	TB	13:45	16:45	03:00	
0158	11/03/19	**4S**	4	PH	13:45	16:45	03:00	
0159	14/03/19	**3**	4	TB	13:30	16:30	03:00	
0160	14/03/19	**2**	4	PH	13:40	16:40	03:00	
0161	22/03/19	**3**	2	TB	08:50	11:50	03:00	
0162	27/03/19	**1**	2	RTW	09:20	12:20	03:00	
0163	27/03/19	**2**	4	RTW	13:20	16:20	03:00	
0164	28/03/19	**1**	2	TB	09:20	12:20	03:00	
0165	28/03/19	**4N**	2	PH	09:40	12:40	03:00	
0166	28/03/19	**1**	4	TB	12:50	15:50	03:00	
0167	28/03/19	**4S**	4	PH	13:10	16:10	03:00	
0168	01/04/19	**2**	4	AJM	13:10	16:10	03:00	
0169	01/04/19	**3**	4	PC	13:30	16:30	03:00	
0170	01/04/19	**2**	5	AJM	16:40	19:40	03:00	
0171	01/04/19	**3**	5	PC	17:00	20:00	03:00	Visibility and cloud height variable across viewshed.
0172	02/04/19	**4N**	2	PH	08:50	11:50	03:00	
0173	02/04/19	**4S**	2	TB	08:50	11:50	03:00	
0174	02/04/19	**4N**	3	TB	12:20	15:20	03:00	
0175	02/04/19	**4S**	3	PH	12:20	15:20	03:00	
0176	09/04/19	**3**	2	GP	10:10	13:10	03:00	
0177	09/04/19	**3**	4	GP	13:40	16:40	03:00	
0178	11/04/19	**1**	2	RTW	08:00	11:00	03:00	
0179	11/04/19	**1**	3	RTW	11:30	14:30	03:00	No target species flights recorded.
0180	15/04/19	**4N**	2	DH	09:50	12:50	03:00	No target species flights recorded
0181	15/04/19	**4S**	2	TB	09:50	12:50	03:00	
0182	15/04/19	**4N**	3	TB	13:20	16:20	03:00	
0183	15/04/19	**4S**	2	DH	13:20	16:20	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0184	22/04/19	**2**	3	AR	11:30	14:30	03:00	
0185	22/04/19	**3**	3	GP	11:30	14:30	03:00	Wind gusting throughout.
0186	22/04/19	**2**	4	AR	15:00	18:00	03:00	No target species flights recorded
0187	22/04/19	**3**	4	GP	15:00	18:00	03:00	Wind gusting; light cloud.
0188	24/04/19	**1**	3	RI	10:10	13:10	03:00	
0189	24/04/19	**1**	4	RI	13:40	16:40	03:00	
0190	03/05/19	**2**	3	AR	10:15	13:15	03:00	No target species flights recorded.
0191	03/05/19	**3**	3	GP	10:20	13:20	03:00	
0192	03/05/19	**2**	4	AR	13:45	16:45	03:00	No target or secondary species.
0193	03/05/19	**3**	4	GP	13:50	16:50	03:00	
0194	10/05/19	**4N**	2	AR	07:55	10:55	03:00	
0195	10/05/19	**4S**	2	PC	07:55	10:55	03:00	
0196	10/05/19	**4N**	3	PC	11:25	14:25	03:00	
0197	10/05/19	**4S**	3	AR	11:25	14:25	03:00	
0198	14/05/19	**1**	3	TB	10:10	13:10	03:00	
0199	14/05/19	**1**	4	TB	13:40	16:40	03:00	
0250	20/05/19	**1**	3	PB	12:00	13:30	01:30	No target or secondary species.
0251	20/05/19	**1**	4	PB	16:30	18:00	01:30	No target or secondary species.
0252	22/05/19	**2**	4	PB	16:00	19:00	03:00	Very clear conditions, Cumbrian fells visible to south.
0253	23/05/19	**3**	4	PB	15:30	18:30	03:00	
0200	27/05/19	**1**	3	PC	12:00	15:00	03:00	No notable records.
0201	27/05/19	**4N**	3	AJM	12:20	15:20	03:00	
0202	27/05/19	**1**	4	PC	15:30	18:30	03:00	
0203	27/05/19	**4S**	4	AJM	15:50	18:50	03:00	Thin cloud covering all of sky burned off in last hour.
0204	03/06/19	**2**	4	TB	15:45	18:45	03:00	
0205	03/06/19	**2**	5	TB	19:15	22:15	03:00	
0206	04/06/19	**4N**	1	PC	04:20	07:20	03:00	No notable records.
0207	04/06/19	**4S**	1	AJM	04:20	07:20	03:00	
0208	04/06/19	**4N**	2	AJM	07:50	10:50	03:00	
0209	04/06/19	**4S**	2	PC	07:50	10:50	03:00	
0210	05/06/19	**1**	3	AJM	10:45	13:45	03:00	
0211	05/06/19	**1**	4	AJM	14:15	17:15	03:00	No target species flights recorded.
0212	12/06/19	**4N**	3	DH	10:15	13:15	03:00	
0213	12/06/19	**4S**	3	TB	10:15	13:15	03:00	
0214	12/06/19	**4N**	4	TB	13:45	16:45	03:00	
0215	12/06/19	**4S**	4	DH	13:45	16:45	03:00	
0216	14/06/19	**2**	2	NB	06:05	09:05	03:00	Good visibility and no rain.
0217	14/06/19	**3**	2	RI	06:05	09:05	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0218	14/06/19	**2**	3	NB	09:35	12:35	03:00	High, fast-moving cloud, with some sunny periods but no rain. No target species flights recorded.
0219	14/06/19	**3**	3	RI	09:35	12:35	03:00	
0220	18/06/19	**4S**	3	TB	10:00	13:00	03:00	Snipe heard chipping throughout session, c.50 m in front of VP.
0221	18/06/19	**4N**	4	TB	13:30	16:30	03:00	
0222	23/06/19	**1**	2	RI	07:45	10:45	03:00	Two snipe heard calling in field to south of VP. Curlew calling to southwest of VP but out of view. No target species flights recorded
0223	23/06/19	**3**	3	RI	11:40	14:40	03:00	
0224	23/06/19	**2**	4	RI	15:25	18:25	03:00	
0225	04/07/19	**1**	3	TB	10:30	13:30	03:00	
0226	04/07/19	**1**	4	TB	14:00	17:00	03:00	
0227	05/07/19	**4S**	2	AR	08:45	11:45	03:00	Cloudy and distant hills were not in optimum viewing conditions but this improved during the second hour of the survey.
0228	05/07/19	**4N**	3	AR	12:15	15:15	03:00	No target or secondary species.
0229	07/07/19	**2**	1	DH	04:10	07:10	03:00	No target or secondary species.
0230	07/07/19	**3**	1	RI	04:20	07:20	03:00	Quail calling to the northeast of the VP throughout.
0231	10/07/19	**4N**	3	DH	12:00	15:00	03:00	
0232	10/07/19	**4S**	3	AJM	12:00	15:00	03:00	
0233	10/07/19	**4S**	4	DH	15:30	18:30	03:00	
0234	10/07/19	**4N**	4	AJM	15:30	18:30	03:00	No target or secondary species.
0235	16/07/19	**2**	3	NB	10:10	13:10	03:00	Good visibility, light wind, slightly hazy at large distance.
0236	16/07/19	**2**	4	NB	13:40	16:40	03:00	Dry, light wind, generally overcast.
0237	29/07/19	**3**	4	TB	15:00	18:00	03:00	
0238	29/07/19	**3**	5	TB	18:30	21:30	03:00	
0239	01/08/19	**4N**	2	GP	09:15	12:15	03:00	
0240	01/08/19	**4S**	2	AR	09:15	12:15	03:00	
0241	01/08/19	**4N**	3	GP	12:45	15:45	03:00	
0242	01/08/19	**4S**	3	AR	12:45	15:45	03:00	
0243	12/08/19	**1**	2	TB	09:30	12:30	03:00	
0244	12/08/19	**1**	3	TB	13:00	16:00	03:00	
0247	15/08/19	**3**	1	AJM	05:30	08:30	03:00	
0248	15/08/19	**3**	2	AJM	09:00	12:00	03:00	
0245	15/08/19	**2**	3	TB	10:20	13:20	03:00	
0246	15/08/19	**2**	4	TB	13:50	16:50	03:00	
0249	21/08/19	**1**	3	AJM	11:15	14:15	03:00	
0257	24/09/20	**7**	1	AJM	07:05	10:05	03:00	
0258	24/09/20	**7**	2	AJM	10:35	13:35	03:00	Feeding frenzy at carcass from earlier (recorded in previous survey) effectively over.
0254	25/09/20	**6**	1	AJM	07:05	10:05	03:00	
0259	25/09/20	**8**	2	TB	09:15	12:15	03:00	
0255	25/09/20	**6**	2	AJM	10:35	13:35	03:00	
0260	25/09/20	**8**	4	TB	12:45	15:45	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0261	28/09/20	**8**	1	TB	07:25	10:25	03:00	
0262	29/09/20	**7**	1	AJM	07:45	10:45	03:00	
0256	29/09/20	**6**	4	AJM	12:10	15:10	03:00	
0267	02/10/20	**7**	2	AJM	08:45	11:45	03:00	
0268	02/10/20	**7**	4	AJM	12:15	15:15	03:00	
0263	09/10/20	**6**	4	AJM	12:40	15:40	03:00	
0264	09/10/20	**6**	5	AJM	16:10	19:10	03:00	
0269	14/10/20	**8**	1	AJM	07:05	10:05	03:00	
0270	14/10/20	**8**	2	AJM	10:35	13:35	03:00	
0265	21/10/20	**6**	1	AJM	07:20	10:20	03:00	
0266	21/10/20	**6**	2	AJM	10:50	13:50	03:00	
0272	23/10/20	**7**	1	AJM	07:30	10:30	03:00	
0271	23/10/20	**8**	4	AJM	11:45	14:45	03:00	
0273	24/10/20	**8**	4	AJM	12:05	15:05	03:00	
0274	24/10/20	**8**	5	AJM	15:35	18:35	03:00	
0275	28/10/20	**7**	4	AJM	10:55	13:55	03:00	Two people walking in viewshed for first 15 minutes.
0276	28/10/20	**7**	5	AJM	14:25	17:25	03:00	Two people in viewshed from 15:30 to 16:00.
0277	05/11/20	**6**	3	AJM	10:25	13:25	03:00	
0278	12/11/20	**8**	3	AJM	10:05	13:05	03:00	
0279	12/11/20	**8**	5	AJM	13:35	16:35	03:00	
0281	16/11/20	**7**	3	AJM	10:00	13:00	03:00	
0282	16/11/20	**7**	5	AJM	13:30	16:30	03:00	
0280	17/11/20	**6**	1	AJM	07:35	10:35	03:00	
0283	17/11/20	**6**	3	AJM	11:05	14:05	03:00	
0284	22/11/20	**8**	1	AJM	07:45	10:45	03:00	Disturbance: sheep-herding. Low level.
0285	22/11/20	**8**	3	AJM	11:15	14:15	03:00	
0286	26/11/20	**7**	1	AJM	07:30	10:30	03:00	Walkers: no effect on birds.
0287	26/11/20	**7**	3	AJM	11:00	14:00	03:00	
0288	27/11/20	**6**	3	AJM	09:50	12:50	03:00	
0289	27/11/20	**6**	5	AJM	13:20	16:20	03:00	
0290	20/12/20	**6**	3	AJM	09:20	12:20	03:00	Walkers on site: Low level disturbance.
0291	20/12/20	**6**	5	AJM	12:50	15:50	03:00	
0292	22/12/20	**7**	1	AJM	08:55	11:55	03:00	Track being constructed, going north out of Marbrack. Three excavators working.
0294	22/12/20	**7**	5	AJM	12:25	15:25	03:00	Track construction ongoing. A few gunshots very distantly to the southwest - doesn't disturb birds on site.
0293	23/12/20	**8**	1	AJM	08:00	11:00	03:00	
0295	23/12/20	**8**	3	AJM	11:30	14:30	03:00	
0296	22/01/21	**6**	1	AJM	08:15	11:15	03:00	
0297	22/01/21	**6**	3	AJM	11:45	14:45	03:00	

Survey Ref	Date Surveyed	VP	Period	Surveyor	Start	End	Duration	General Notes
0298	27/01/21	**7**	3	PC	10:05	13:05	03:00	
0299	27/01/21	**7**	5	PC	13:35	16:35	03:00	
0300	31/01/21	**8**	3	PC	09:40	12:40	03:00	
0301	31/01/21	**8**	5	PC	13:10	16:10	03:00	
0302	12/02/21	**8**	2	AJM	11:00	14:00	03:00	
0303	12/02/21	**8**	5	AJM	14:30	17:30	03:00	
0304	17/02/21	**6**	2	AJM	08:50	11:50	03:00	
0305	17/02/21	**6**	4	AJM	12:20	15:20	03:00	
0306	26/02/21	**7**	2	TB	09:45	12:45	03:00	
0307	26/02/21	**7**	4	TB	13:15	16:15	03:00	
0308	19/03/21	**6**	4	AJM	11:40	14:40	03:00	Low-level disturbance: couple of walkers up the track. No effect on birds.
0309	19/03/21	**6**	5	AJM	15:10	18:10	03:00	
0310	22/03/21	**7**	4	TB	12:15	15:15	03:00	
0311	22/03/21	**7**	5	TB	15:45	18:45	03:00	
0312	24/03/21	**8**	2	TB	07:55	10:55	03:00	
0313	24/03/21	**8**	4	TB	11:25	14:25	03:00	

Table A2.2: Flight Activity Survey Weather Conditions– April 2018 to August 2019 and September 2020 to March 2021

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0001	20/04/18	2	1	W	>1000	40	2	>10	15	None	n/a	n/a	n/a
0003	20/04/18	2	1	W	>1000	50	2	>10	15	None	n/a	n/a	n/a
0001	20/04/18	2	2	W	>1000	50	2	>10	15	None	n/a	n/a	n/a
0003	20/04/18	2	2	W	>1000	40	2	>10	14	None	n/a	n/a	n/a
0001	20/04/18	2	3	W	>1000	40	2	>10	15	None	n/a	n/a	n/a
0003	20/04/18	2	3	W	>1000	40	2	>10	13	None	n/a	n/a	n/a
0002	20/04/18	3	1	W	>1000	50	3	>10	13	None	n/a	n/a	n/a
0004	20/04/18	3	1	W	>1000	60	3	>10	12	None	n/a	n/a	n/a
0002	20/04/18	3	2	W	>1000	50	3	>10	13	None	n/a	n/a	n/a
0004	20/04/18	3	2	W	>1000	60	3	>10	12	None	n/a	n/a	n/a
0002	20/04/18	3	3	W	>1000	60	3	>10	14	None	n/a	n/a	n/a
0004	20/04/18	3	3	W	>1000	40	3	>10	11	None	n/a	n/a	n/a
0005	22/04/18	1	1	S	500-1000	10	3	>10	10	Rain	40	Light	Intermittent
0006	22/04/18	1	1	SW	500-1000	95	2	>10	12	Rain	20	Light	Intermittent
0005	22/04/18	1	2	S	500-1000	95	2	>10	10	Rain	30	Light	Intermittent
0006	22/04/18	1	2	SW	500-1000	100	1	>10	12	Rain	10	Light	Intermittent
0005	22/04/18	1	3	S	<100	100	2	1-2	11	Rain	10	Light	Intermittent

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0006	22/04/18	1	3	W	500-1000	90	1	>10	13	Rain	20	Moderate	Intermittent
0007	30/04/18	4N	1	NE	>1000	20	2	>10	10	None	n/a	n/a	n/a
0007	30/04/18	4N	2	N	>1000	10	2	>10	10	None	n/a	n/a	n/a
0007	30/04/18	4N	3	NW	>1000	10	2	>10	10	None	n/a	n/a	n/a
0008	30/04/18	4S	1	NW	>1000	20	2	>10	10	None	n/a	n/a	n/a
0008	30/04/18	4S	2	NW	>1000	10	2	>10	10	None	n/a	n/a	n/a
0008	30/04/18	4S	3	NW	>1000	10	2	>10	9	None	n/a	n/a	n/a
0009	07/05/18	2	1	S	>1000	50	4	>10	14	None	n/a	n/a	n/a
0011	07/05/18	2	1	S	>1000	50	1	>10	12	None	n/a	n/a	n/a
0009	07/05/18	2	2	SW	>1000	40	4	>10	14	None	n/a	n/a	n/a
0011	07/05/18	2	2	S	>1000	60	1	>10	12	None	n/a	n/a	n/a
0009	07/05/18	2	3	SW	>1000	30	4	>10	14	None	n/a	n/a	n/a
0010	07/05/18	3	1	S	>1000	85	2-3	>10	13	None	n/a	n/a	n/a
0012	07/05/18	3	1	S	>1000	50	1-3	>10	12	None	n/a	n/a	n/a
0010	07/05/18	3	2	S	>1000	70	2-3	>10	12	None	n/a	n/a	n/a
0012	07/05/18	3	2	S	>1000	50	1-2	>10	10	None	n/a	n/a	n/a
0010	07/05/18	3	3	S	>1000	50	3	>10	12	None	n/a	n/a	n/a
0013	15/05/18	4N	1	SW	>1000	90	2-3	>10	14	None	n/a	n/a	n/a
0015	15/05/18	4N	1	W	>1000	100	2	>10	13	None	n/a	n/a	n/a
0013	15/05/18	4N	2	SW	>1000	90	2-3	>10	14	None	n/a	n/a	n/a
0015	15/05/18	4N	2	NW	500-1000	100	3	>10	11	Rain	50	Light	Intermittent
0013	15/05/18	4N	3	SW	>1000	100	2-3	>10	13	None	n/a	n/a	n/a
0015	15/05/18	4N	3	NW	500-1000	100	3	2-5	10	Rain	60	Light	Intermittent
0014	15/05/18	4S	1	SW	>1000	90	2	>10	14	None	n/a	n/a	n/a
0016	15/05/18	4S	1	SW-W	>1000	100	3	>10	10	None	n/a	n/a	n/a
0014	15/05/18	4S	2	SW	>1000	90	2	>10	14	None	n/a	n/a	n/a
0016	15/05/18	4S	2	W-NW	500-1000	100	3	>10	10	Rain	50	Light	Intermittent
0014	15/05/18	4S	3	SW	>1000	95	2	>10	14	None	n/a	n/a	n/a
0016	15/05/18	4S	3	NW	500-1000	100	3	>10-5	9	Rain	50	Light	Intermittent
0017	16/05/18	2	1	N	>1000	5	2	>10	7	None	n/a	n/a	n/a
0018	16/05/18	3	1	N-NE	>1000	5	2-3	>10	7	None	n/a	n/a	n/a
0019	21/05/18	1	1	S	>1000	100	3	>10	15	None	n/a	n/a	n/a
0020	21/05/18	1	1	SW	>1000	80	3	>10	16	None	n/a	n/a	n/a
0019	21/05/18	1	2	S	>1000	90	3	>10	15	None	n/a	n/a	n/a
0020	21/05/18	1	2	W	>1000	70	2	>10	15	None	n/a	n/a	n/a
0019	21/05/18	1	3	SW	>1000	90	3	>10	15	None	n/a	n/a	n/a
0020	21/05/18	1	3	W	>1000	70	3	>10	13	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0023	23/05/18	2	1	E	>1000	5	2	>10	15	None	n/a	n/a	n/a
0023	23/05/18	2	2	E	>1000	<5	2	>10	16	None	n/a	n/a	n/a
0023	23/05/18	2	3	E	>1000	<5	2	>10	17	None	n/a	n/a	n/a
0021	23/05/18	3	1	SE	500-1000	90	3	5-10	10	None	n/a	n/a	n/a
0021	23/05/18	3	2	E	500-1000	40	2	>10	13	None	n/a	n/a	n/a
0021	23/05/18	3	3	NE	>1000	10	2	>10	15	None	n/a	n/a	n/a
0022	23/05/18	4N	1	E	>1000	5	1	>10	9-13	None	n/a	n/a	n/a
0022	23/05/18	4N	2	S	>1000	1	1	>10	13-16	None	n/a	n/a	n/a
0022	23/05/18	4N	3	SE	>1000	1	2	>10	16	None	n/a	n/a	n/a
0024	23/05/18	4S	1	E	>1000	1	2	>10	17-18	None	n/a	n/a	n/a
0024	23/05/18	4S	2	SE	>1000	5	2	>10	18-20	None	n/a	n/a	n/a
0024	23/05/18	4S	3	SE	>1000	2	2	>10	17-20	None	n/a	n/a	n/a
0025	28/05/18	1	1	E	>1000	30	2	>10	20	None	n/a	n/a	n/a
0026	28/05/18	1	1	E	>1000	10	2	>10	20	None	n/a	n/a	n/a
0025	28/05/18	1	2	E	>1000	40	2	>10	20	None	n/a	n/a	n/a
0026	28/05/18	1	2	E	>1000	15	2	>10	19	None	n/a	n/a	n/a
0025	28/05/18	1	3	E	>1000	25	2	>10	21	None	n/a	n/a	n/a
0026	28/05/18	1	3	E	>1000	10	2	>10	18	None	n/a	n/a	n/a
0027	30/05/18	4N	1	NE	>1000	90	3	>10	19	None	n/a	n/a	n/a
0027	30/05/18	4N	2	NE	>1000	90	3	>10	17	None	n/a	n/a	n/a
0027	30/05/18	4N	3	NE	>1000	100	3	>10	16	None	n/a	n/a	n/a
0028	30/05/18	4S	1	NE	>1000	80	3	>10	19	None	n/a	n/a	n/a
0028	30/05/18	4S	2	NE	>1000	90	3	>10	18	None	n/a	n/a	n/a
0028	30/05/18	4S	3	N	>1000	95	2	>10	17	None	n/a	n/a	n/a
0030	05/06/18	4N	1	NE	>1000	40	2	>10	18	None	n/a	n/a	n/a
0030	05/06/18	4N	2	NE	>1000	90	2	>10	15	None	n/a	n/a	n/a
0030	05/06/18	4N	3	NE	>1000	95	2	>10	14	None	n/a	n/a	n/a
0029	05/06/18	4S	1	NE	>1000	60	2	>10	19	None	n/a	n/a	n/a
0029	05/06/18	4S	2	NE	>1000	80	1	>10	17	None	n/a	n/a	n/a
0029	05/06/18	4S	3	NE	>1000	80	1	>10	17	None	n/a	n/a	n/a
0032	11/06/18	2	1	NW	>1000	100	3	>10	13	None	n/a	n/a	n/a
0034	11/06/18	2	1	NW	>1000	98	2-3	>10	15	None	n/a	n/a	n/a
0032	11/06/18	2	2	NW	>1000	98	3-2	>10	14	None	n/a	n/a	n/a
0034	11/06/18	2	2	NW	>1000	90	2	>10	16	None	n/a	n/a	n/a
0032	11/06/18	2	3	NW	>1000	99	3-2	>10	14	None	n/a	n/a	n/a
0034	11/06/18	2	3	N	>1000	100	2-3	>10	16	None	n/a	n/a	n/a
0031	11/06/18	3	1	NW	500-1000	90	2	>10	13	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0033	11/06/18	3	1	NW	>1000	70	2	>10	17	None	n/a	n/a	n/a
0031	11/06/18	3	2	NW	>1000	90	2	>10	15	None	n/a	n/a	n/a
0033	11/06/18	3	2	N	>1000	90	2	>10	17	None	n/a	n/a	n/a
0031	11/06/18	3	3	NW	>1000	80	2	>10	16	None	n/a	n/a	n/a
0033	11/06/18	3	3	N	>1000	95	1	>10	17	None	n/a	n/a	n/a
0036	12/06/18	4N	1	SE	500-1000	100	0-1	5-10	11	None	n/a	n/a	n/a
0036	12/06/18	4N	2	SE	500-1000	100	0-1	>10	12	None	n/a	n/a	n/a
0036	12/06/18	4N	3	NW	500-1000	100	0-1	>10	12	None	n/a	n/a	n/a
0035	12/06/18	4S	1	SE	500-1000	100	1	>10	11	None	n/a	n/a	n/a
0035	12/06/18	4S	2	SE	500-1000	100	1	>10	12	None	n/a	n/a	n/a
0035	12/06/18	4S	3	W	500-1000	100	1	>10	13	None	n/a	n/a	n/a
0038	19/06/18	4N	1	SW	>1000	100	2	>10	14-16	None	n/a	n/a	n/a
0038	19/06/18	4N	2	SW	>1000	100	1	>10	13-14	None	n/a	n/a	n/a
0038	19/06/18	4N	3	SW	>1000	100	1	>10	12-13	Rain	30	Light	Intermittent
0037	19/06/18	4S	1	S	>1000	100	2	>10	14	None	n/a	n/a	n/a
0037	19/06/18	4S	2	SW	>1000	100	2	>10	14	None	n/a	n/a	n/a
0037	19/06/18	4S	3	SW	>1000	100	2	>10	13	None	n/a	n/a	n/a
0039	20/06/18	2	1	NW	>1000	90	2	>10	15	None	n/a	n/a	n/a
0039	20/06/18	2	2	W	>1000	95	2	>10	13	None	n/a	n/a	n/a
0039	20/06/18	2	3	W	>1000	100	2	>10	11	None	n/a	n/a	n/a
0040	20/06/18	3	1	W	>1000	100	3	>10	12	None	n/a	n/a	n/a
0040	20/06/18	3	2	W	>1000	100	3	>10	11	None	n/a	n/a	n/a
0040	20/06/18	3	3	W	>1000	100	3	>10	10	None	n/a	n/a	n/a
0041	27/06/18	1	1	N	>1000	10	1	>10	20	None	n/a	n/a	n/a
0042	27/06/18	1	1	NE	>1000	10	1	>10	25	None	n/a	n/a	n/a
0041	27/06/18	1	2	NE	>1000	10	1	>10	21	None	n/a	n/a	n/a
0042	27/06/18	1	2	S	>1000	~	1	>10	26	None	n/a	n/a	n/a
0041	27/06/18	1	3	NE	>1000	10	1	>10	23	None	n/a	n/a	n/a
0042	27/06/18	1	3	S	>1000	~	2	>10	27	None	n/a	n/a	n/a
0043	06/07/18	2	1	NW	>1000	40	3	>10	15	None	n/a	n/a	n/a
0045	06/07/18	2	1	NW	>1000	30	2	>10	19	None	n/a	n/a	n/a
0043	06/07/18	2	2	NW	>1000	30	3	>10	18	None	n/a	n/a	n/a
0045	06/07/18	2	2	W	>1000	60	2	>10	19	None	n/a	n/a	n/a
0043	06/07/18	2	3	NW	>1000	30	3	>10	19	None	n/a	n/a	n/a
0045	06/07/18	2	3	W	>1000	80	2	>10	18	None	n/a	n/a	n/a
0044	06/07/18	3	1	NW	>1000	30	3	>10	12-14	None	n/a	n/a	n/a
0046	06/07/18	3	1	NW	>1000	20	2	>10	20	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0044	06/07/18	3	2	NW	>1000	20	2	>10	14-18	None	n/a	n/a	n/a
0046	06/07/18	3	2	NW	>1000	80	2	>10	20	None	n/a	n/a	n/a
0044	06/07/18	3	3	NW	>1000	10	2	>10	18-20	None	n/a	n/a	n/a
0046	06/07/18	3	3	NW	>1000	100	2	>10	20-21	None	n/a	n/a	n/a
0048	10/07/18	4N	1	SW	>1000	100	1	>10	17	None	n/a	n/a	n/a
0048	10/07/18	4N	2	SW	>1000	100	1	>10	17	None	n/a	n/a	n/a
0048	10/07/18	4N	3	SW	>1000	100	1	>10	17	None	n/a	n/a	n/a
0047	10/07/18	4S	1	SW	>1000	100	1	>10	17	None	n/a	n/a	n/a
0047	10/07/18	4S	2	SW	>1000	100	1	>10	17	None	n/a	n/a	n/a
0047	10/07/18	4S	3	W	>1000	100	1	>10	16	None	n/a	n/a	n/a
0049	17/07/18	1	1	W	500-1000	90	2	>10	12	None	n/a	n/a	n/a
0050	17/07/18	1	1	W	500-1000	90	2	5-10	14	Rain	10	Light	Continuous
0049	17/07/18	1	2	W	500-1000	95	2	>10	12	Rain	20	Light	Intermittent
0050	17/07/18	1	2	W	500-1000	90	2	>10	16	None	n/a	n/a	n/a
0049	17/07/18	1	3	W	100-500	95	2	5-10	13	Rain	20	Light	Intermittent
0050	17/07/18	1	3	W	500-1000	80	2	>10	17	None	n/a	n/a	n/a
0052	25/07/18	4N	1	S	500-1000	90	2	>10	17	None	n/a	n/a	n/a
0052	25/07/18	4N	2	S	>1000	85	2-3	>10	17	None	n/a	n/a	n/a
0052	25/07/18	4N	3	S	>1000	70	2-3	>10	18	None	n/a	n/a	n/a
0051	25/07/18	4S	1	S	500-1000	90	2	>10	17	None	n/a	n/a	n/a
0051	25/07/18	4S	2	S	>1000	80	2	>10	17	None	n/a	n/a	n/a
0051	25/07/18	4S	3	SE	>1000	80	3	>10	17	None	n/a	n/a	n/a
0054	07/08/18	4N	1	SW	>1000	100	2-3	>10	16	None	n/a	n/a	n/a
0054	07/08/18	4N	2	SW	>1000	90	2-3	>10	16	None	n/a	n/a	n/a
0054	07/08/18	4N	3	SW	>1000	90	2-3	>10	16	None	n/a	n/a	n/a
0053	07/08/18	4S	1	SW	500-1000	100	2-3	>10	14	None	n/a	n/a	n/a
0053	07/08/18	4S	2	SW	500-1000	90	2-3	>10	15	None	n/a	n/a	n/a
0053	07/08/18	4S	3	SW	>1000	90	2-3	>10	15	None	n/a	n/a	n/a
0055	08/08/18	2	1	SW	500-1000	70	1	>10	11	None	n/a	n/a	n/a
0057	08/08/18	2	1	S	500-1000	100	2	>10	12	None	n/a	n/a	n/a
0055	08/08/18	2	2	S	500-1000	90	1	>100	11	None	n/a	n/a	n/a
0057	08/08/18	2	2	S	100-500	95	2	>10	12	Rain	30	Light	Intermittent
0055	08/08/18	2	3	S	500-1000	90	1	>10	12	None	n/a	n/a	n/a
0057	08/08/18	2	3	SE	100-500	95	2	5-10	12	Rain	30	Light	Intermittent
0056	08/08/18	3	1	SW	500-1000	100	0	>10	11	None	n/a	n/a	n/a
0058	08/08/18	3	1	S	500-1000	100	1	>10	11	Rain	25	Light	Intermittent
0056	08/08/18	3	2	S	500-1000	99	1	>10	11	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0058	08/08/18	3	2	S	500-1000	90	1	>10	11-13	Rain	10	Light	Intermittent
0056	08/08/18	3	3	S	500-1000	100	1	>10	11	None	n/a	n/a	n/a
0058	08/08/18	3	3	SW	500-1000	95	1	>10	13	Rain	15	Light	Intermittent
0059	22/08/18	1	1	W	100-500	90	3	2-5	14	Rain	50	Light	Intermittent
0061	22/08/18	1	1	W	500-1000	80	3	>10	17	None	n/a	n/a	n/a
0059	22/08/18	1	2	W	100-500	80	3	>10	14	Rain	20	Light	Continuous
0061	22/08/18	1	2	W	500-1000	90	3	>10	16	Rain	<5	Light	Continuous
0059	22/08/18	1	3	W	100-500	80	3	>10	17	Rain	<10	Light	Intermittent
0061	22/08/18	1	3	W	500-1000	80	3	>10	16	None	n/a	n/a	n/a
0062	22/08/18	4N	1	W	500-1000	95	2	>10	16	None	n/a	n/a	n/a
0062	22/08/18	4N	2	W	500-1000	80	2	>10	17	None	n/a	n/a	n/a
0062	22/08/18	4N	3	W	500-1000	85	2	>10	16	None	n/a	n/a	n/a
0060	22/08/18	4S	1	W	100-500	90	3	2-5	14	Rain	50	Light	Intermittent
0060	22/08/18	4S	2	W	500-1000	80	2	5-10	16	None	n/a	n/a	n/a
0060	22/08/18	4S	3	W	500-1000	98	2	5-10	15	Rain	15	Light	Intermittent
0063	05/09/18	1	1	SW	>1000	95	2	>10	15	None	n/a	n/a	n/a
0066	05/09/18	1	1	SW	>1000	100	2	>10	14	None	n/a	n/a	n/a
0063	05/09/18	1	2	SW	>1000	95	2	>10	15	None	n/a	n/a	n/a
0066	05/09/18	1	2	SW	>1000	100	2-3	>10	13	Rain	60	Light	Intermittent
0063	05/09/18	1	3	SW	>1000	100	2	>10	14	None	n/a	n/a	n/a
0066	05/09/18	1	3	SW	500-1000	100	1-2	>10	13	Rain	60	Light	Intermittent
0064	05/09/18	4N	1	W	500-1000	98	1	>10	18	None	n/a	n/a	n/a
0067	05/09/18	4N	1	S	500-1000	100	2	>10	14	None	n/a	n/a	n/a
0064	05/09/18	4N	2	W	500-1000	100	1	>10	17	None	n/a	n/a	n/a
0067	05/09/18	4N	2	n/a	500-1000	100	2	>10	13	Rain	43	Light	Continuous
0064	05/09/18	4N	3	S	500-1000	100	2	>10	15	None	n/a	n/a	n/a
0067	05/09/18	4N	3	n/a	100-500	100	0	5-10	12	Rain	20	Light	Continuous
0065	05/09/18	4S	1	W	500-1000	100	1	>10	18	None	n/a	n/a	n/a
0068	05/09/18	4S	1	S	500-1000	100	2	>10	14	None	n/a	n/a	n/a
0065	05/09/18	4S	2	W	500-1000	95	1	>10	17	None	n/a	n/a	n/a
0068	05/09/18	4S	2	n/a	500-1000	100	0	>10	13	Rain	43	Light	Continuous
0065	05/09/18	4S	3	S	500-1000	100	2	>10	15-17	None	n/a	n/a	n/a
0068	05/09/18	4S	3	S	500-1000	100	1	5-10	12	Rain	20	Light	Continuous
0069	13/09/18	3	1	SW	500-1000	100	3	>10	9	Rain	50	Light	Intermittent
0070	13/09/18	3	1	SW	500->1000	100	3	>10	11	Rain	40	Light	Continuous
0069	13/09/18	3	2	SW	500-1000	90	2-3	>10	10	Rain	20	Light	Intermittent
0070	13/09/18	3	2	SW	500-1000	100	3	>10	12	Rain	20	Light	Intermittent

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0069	13/09/18	3	3	SW	500-1000	100	2-3	>10	11	None	n/a	n/a	n/a
0070	13/09/18	3	3	SW	500->1000	100	3	5->10	12	None	n/a	n/a	n/a
0071	17/09/18	2	1	S	100-500	100	3	>10	12	None	n/a	n/a	n/a
0072	17/09/18	2	1	S	500-1000	100	4	>10	13	None	n/a	n/a	n/a
0071	17/09/18	2	2	S	100-500	95	3	>10	12	None	n/a	n/a	n/a
0072	17/09/18	2	2	S	500-1000	100	4	>10	13	Rain	5	Light	Continuous
0071	17/09/18	2	3	S	500-1000	95	3	>10	12	None	n/a	n/a	n/a
0072	17/09/18	2	3	S	100-500	100	4	1-2	13	Rain	80	Light	Continuous
0073	25/09/18	1	1	SW	>1000	90	5	>10	9	None	n/a	n/a	n/a
0073	25/09/18	1	2	SW	>1000	90	5	>10	9	None	n/a	n/a	n/a
0073	25/09/18	1	3	SW	>1000	95	5	>10	9	None	n/a	n/a	n/a
0076	25/09/18	2	1	S	500-1000	95	4	>10	10	None	n/a	n/a	n/a
0076	25/09/18	2	2	S	500-1000	100	3	>10	10	Rain	20	Light	Intermittent
0076	25/09/18	2	3	S	500-1000	100	3	5-10	10	Rain	25	Light	Continuous
0074	25/09/18	4N	1	SW	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0074	25/09/18	4N	2	SW	500-1000	95	3	>10	11	None	n/a	n/a	n/a
0074	25/09/18	4N	3	SW	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0075	25/09/18	4S	1	SW	500-1000	100	3	5-10	11	None	n/a	n/a	n/a
0075	25/09/18	4S	2	SW	500-1000	100	3	5-10	11	None	n/a	n/a	n/a
0075	25/09/18	4S	3	SW	500-1000	100	3	2-5	10	None	n/a	n/a	n/a
0078	01/10/18	4N	1	SW	>1000	100	2	>10	9	None	n/a	n/a	n/a
0078	01/10/18	4N	2	SW	500->1000	100	2	5->10	8	None	n/a	n/a	n/a
0078	01/10/18	4N	3	SW	500-1000	100	3	2-5	7	Rain	100	Light-Mod.	Continuous
0077	01/10/18	4S	1	SW	>1000	100	2	>10	9	None	n/a	n/a	n/a
0077	01/10/18	4S	2	SW	500->1000	100	2	5->10	8	None	n/a	n/a	n/a
0077	01/10/18	4S	3	SW	500-1000	100	3	2-5	7	Rain	100	Light-Mod.	Continuous
0079	17/10/18	2	1	SW	>1000	50	3	>10	13	Rain	10	Light	Intermittent
0081	17/10/18	2	1	SW	>1000	50	2	>10	12	None	n/a	n/a	n/a
0079	17/10/18	2	2	SW	>1000	70	3	>10	13	Rain	20	Light	Continuous
0081	17/10/18	2	2	SW	>1000	50	3	>10	12	None	n/a	n/a	n/a
0079	17/10/18	2	3	SW	>1000	60	3	>10	13	None	n/a	n/a	n/a
0081	17/10/18	2	3	SW	>1000	60	2	>10	10	None	n/a	n/a	n/a
0080	17/10/18	3	1	NW	>1000	25	4	>10	11	None	n/a	n/a	n/a
0082	17/10/18	3	1	NW	>1000	50	3	>10	11	None	n/a	n/a	n/a
0080	17/10/18	3	2	NW	500-1000	75	4	5-10	11	Rain	20	Light	Continuous
0082	17/10/18	3	2	NW	>1000	30	3	>10	10	None	n/a	n/a	n/a
0080	17/10/18	3	3	NW	>1000	50	3	>10	11	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0082	17/10/18	3	3	NW	>1000	75	2	>10	9	None	n/a	n/a	n/a
0083	19/10/18	1	1	SW	500-1000	90	2	5-10	10	None	n/a	n/a	n/a
0086	19/10/18	1	1	SW	500-1000	100	2	5-10	9	Rain	20	Light	Intermittent
0083	19/10/18	1	2	SW	500-1000	100	2	5-10	10	Rain	20	Light	Intermittent
0086	19/10/18	1	2	SW	100-1000	100	2	2-10	8	Rain	50	Light	Continuous
0083	19/10/18	1	3	SW	500-1000	100	2	5-10	10	Rain	40	Light	Continuous
0086	19/10/18	1	3	SW	500-1000	90	2	5-10	8	None	n/a	n/a	n/a
0084	19/10/18	4N	1	SW	500-1000	100	2	>10	10	Rain	50	Light	Intermittent
0084	19/10/18	4N	2	SW	>10	100	2	>10	10	Rain	40	Light	Intermittent
0084	19/10/18	4N	3	SW	>10	100	3	>10	10	None	n/a	n/a	n/a
0085	19/10/18	4S	1	SW	100-500	100	3	>10	10	Rain	40	Light	Intermittent
0085	19/10/18	4S	2	SW	100-500	95	2	>10	9	Rain	20	Light	Intermittent
0085	19/10/18	4S	3	SW	100-500	95	1	>10	9	Rain	5	Light	Intermittent
0088	26/10/18	1	1	NW	>1000	25	2	>10	8	None	n/a	n/a	n/a
0090	26/10/18	1	1	NW	>1000	30	3	>10	6	None	n/a	n/a	n/a
0088	26/10/18	1	2	NW	>1000	30	3	>10	8	None	n/a	n/a	n/a
0090	26/10/18	1	2	NW	>1000	35	2	>10	5	None	n/a	n/a	n/a
0088	26/10/18	1	3	NW	>1000	30	3	>10	7	None	n/a	n/a	n/a
0090	26/10/18	1	3	NW	>1000	35	2	>10	4	None	n/a	n/a	n/a
0087	26/10/18	4N	1	NW	>1000	10	4	>10	10	None	n/a	n/a	n/a
0087	26/10/18	4N	2	NW	>1000	10	4	>10	10	None	n/a	n/a	n/a
0087	26/10/18	4N	3	NW	>1000	10	4	>10	10	None	n/a	n/a	n/a
0089	26/10/18	4S	1	NW	>1000	20	4	>10	8	None	n/a	n/a	n/a
0089	26/10/18	4S	2	NW	>1000	30	4	>10	8	None	n/a	n/a	n/a
0089	26/10/18	4S	3	NW	>1000	40	3	>10	8	None	n/a	n/a	n/a
0091	29/10/18	2	1	S	>1000	0	0	>10	-2	None	n/a	n/a	n/a
0092	29/10/18	2	1	S	>1000	10	1	>10	0	None	n/a	n/a	n/a
0091	29/10/18	2	2	S	>1000	0	0	>10	-2	None	n/a	n/a	n/a
0092	29/10/18	2	2	S	>1000	15	2	>10	0	None	n/a	n/a	n/a
0091	29/10/18	2	3	S	>1000	0	1	>10	-1	None	n/a	n/a	n/a
0092	29/10/18	2	3	S	>1000	20	1	>10	1	None	n/a	n/a	n/a
0093	30/10/18	3	1	S	>1000	10	1	>10	0	None	n/a	n/a	n/a
0094	30/10/18	3	1	S	>1000	15	1	>10	1	None	n/a	n/a	n/a
0093	30/10/18	3	2	S	>1000	10	1	>10	1	None	n/a	n/a	n/a
0094	30/10/18	3	2	S	>1000	15	1	>10	1	None	n/a	n/a	n/a
0093	30/10/18	3	3	S	>1000	15	1	>10	1	None	n/a	n/a	n/a
0094	30/10/18	3	3	S	>1000	20	1	>10	1	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0096	31/10/18	2	1	S	>1000	45	2	>10	1	None	n/a	n/a	n/a
0096	31/10/18	2	2	S	>1000	55	2	>10	1	None	n/a	n/a	n/a
0096	31/10/18	2	3	S	>1000	80	2	>10	1	Rain	15	Light	Intermittent
0095	31/10/18	3	1	S	500-1000	80	1	>10	0	None	n/a	n/a	n/a
0095	31/10/18	3	2	S	500-1000	75	1	>10	0	None	n/a	n/a	n/a
0095	31/10/18	3	3	S	>1000	60	1	>10	0	None	n/a	n/a	n/a
0097	13/11/18	2	1	SW	500-1000	40	2	>10	8	None	n/a	n/a	n/a
0100	13/11/18	2	1	SW	>1000	70	3	>10	9	None	n/a	n/a	n/a
0097	13/11/18	2	2	SW	500-1000	50	2	>10	9	None	n/a	n/a	n/a
0100	13/11/18	2	2	SW	>1000	80	3	>10	8	None	n/a	n/a	n/a
0097	13/11/18	2	3	SW	>1000	80	2	>10	9	None	n/a	n/a	n/a
0100	13/11/18	2	3	S	>1000	80	3	>10	6	None	n/a	n/a	n/a
0098	13/11/18	4N	1	W	500-1000	20	3	>10	8	None	n/a	n/a	n/a
0101	13/11/18	4N	1	S	>1000	80	3	>10	10	None	n/a	n/a	n/a
0098	13/11/18	4N	2	W	500-1000	40	3	>10	9	None	n/a	n/a	n/a
0101	13/11/18	4N	2	S	>1000	30	3	>10	9	None	n/a	n/a	n/a
0098	13/11/18	4N	3	W	500-1000	60	3	>10	9	None	n/a	n/a	n/a
0101	13/11/18	4N	3	S	500-1000	70	3	>10	8	None	n/a	n/a	n/a
0099	13/11/18	4S	1	W	500-1000	20	3	>10	8	None	n/a	n/a	n/a
0102	13/11/18	4S	1	S	>1000	80	3	>10	10	None	n/a	n/a	n/a
0099	13/11/18	4S	2	W	500-1000	40	3	>10	9	None	n/a	n/a	n/a
0102	13/11/18	4S	2	S	>1000	30	3	>10	9	None	n/a	n/a	n/a
0099	13/11/18	4S	3	W	500-1000	60	3	>10	9	None	n/a	n/a	n/a
0102	13/11/18	4S	3	S	500-1000	70	3	>10	8	None	n/a	n/a	n/a
0103	19/11/18	4N	1	E	>1000	80	1	>10	7	None	n/a	n/a	n/a
0103	19/11/18	4N	2	E	>1000	90	2	>10	7	None	n/a	n/a	n/a
0103	19/11/18	4N	3	E	>1000	100	2	>10	7	None	n/a	n/a	n/a
0104	19/11/18	4S	1	NE	>1000	90	2	>10	7	None	n/a	n/a	n/a
0104	19/11/18	4S	2	E	>1000	50	2	>10	7	None	n/a	n/a	n/a
0104	19/11/18	4S	3	NE	>1000	90	2	>10	6	None	n/a	n/a	n/a
0105	20/11/18	1	1	SE	500-1000	30	2	>10	0	None	n/a	n/a	n/a
0106	20/11/18	1	1	SE	500-1000	35	3	>10	0	None	n/a	n/a	n/a
0105	20/11/18	1	2	SE	500-1000	30	3	>10	0	None	n/a	n/a	n/a
0106	20/11/18	1	2	SE	>1000	30	3	>10	1	Rain	10	Light	Intermittent
0105	20/11/18	1	3	SE	500-1000	30	3	>10	0	None	n/a	n/a	n/a
0106	20/11/18	1	3	SE	>1000	40	4	>10	1	Rain	5	Light	Intermittent
0109	21/11/18	3	1	SW	500-1000	100	3	>10	2	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0110	21/11/18	3	1	SW	500-1000	90	3	5-10	2	None	n/a	n/a	n/a
0109	21/11/18	3	2	SW	500-1000	100	3	5-10	2	Rain	15	Light	Intermittent
0110	21/11/18	3	2	SW	500-1000	90	3	>10	2	None	n/a	n/a	n/a
0109	21/11/18	3	3	SW	500-1000	100	3	5-10	2	Sleet	15	Light	Intermittent
0110	21/11/18	3	3	SW	500-1000	100	3	5-10	2	Sleet	20	Light	Intermittent
0107	21/11/18	4N	1	NE	500-1000	90	2	>10	5	Rain	30	Light	Intermittent
0107	21/11/18	4N	2	NE	500-1000	90	2	>10	5	Rain	15	Light	Intermittent
0107	21/11/18	4N	3	NE	500-1000	100	2	>10	5	Rain	15	Light	Intermittent
0108	21/11/18	4S	1	E	500-1000	100	2	5-10	5	Rain	30	Light	Continuous
0108	21/11/18	4S	2	NE	500-1000	90	2	>10	5	Rain	70	Light	Intermittent
0108	21/11/18	4S	3	NE	500-1000	90	2	>10	5	Rain	60	Light	Intermittent
0111	23/11/18	1	1	SE	500-1000	35	2	>10	4	None	n/a	n/a	n/a
0112	23/11/18	1	1	E-SE	500-1000	75	1	>10	7	None	n/a	n/a	n/a
0111	23/11/18	1	2	SE	500-1000	55	2	>10	4	None	n/a	n/a	n/a
0112	23/11/18	1	2	E-SE	500-1000	60	1	>10	7	None	n/a	n/a	n/a
0111	23/11/18	1	3	E-SE	500-1000	40	2	>10	5	None	n/a	n/a	n/a
0112	23/11/18	1	3	SE	500-1000	55	2	>10	6	None	n/a	n/a	n/a
0113	26/11/18	1	1	E	>1000	10	2	>10	0	None	n/a	n/a	n/a
0113	26/11/18	1	2	E	>1000	10	2	>10	0	None	n/a	n/a	n/a
0113	26/11/18	1	3	E	>1000	15	2	>10	0	None	n/a	n/a	n/a
0114	26/11/18	3	1	E	>1000	15	2	>10	0	None	n/a	n/a	n/a
0114	26/11/18	3	2	E	>1000	10	2	>10	0	None	n/a	n/a	n/a
0114	26/11/18	3	3	E	>1000	10	2	>10	0	None	n/a	n/a	n/a
0115	29/11/18	3	1	W	500-1000	100	4	2-5	-1	Sleet	25	Mod.	Intermittent
0115	29/11/18	3	2	W	500-1000	100	4	5-10	-1	Sleet	10	Light	Intermittent
0115	29/11/18	3	3	W	500-1000	100	4	>10	-1	Sleet	10	Light	Intermittent
0116	30/11/18	2	1	W	500-1000	100	4	>10	-2	Sleet	15	Light	Intermittent
0117	30/11/18	2	1	W	500-1000	100	4	>10	-1	None	n/a	n/a	n/a
0116	30/11/18	2	2	W	500-1000	100	4	>10	-2	Sleet	5	Light	Intermittent
0117	30/11/18	2	2	W	500-1000	100	4	2-5	1	Sleet	15	Mod.	Intermittent
0116	30/11/18	2	3	W	500-1000	100	4	>10	-2	Sleet	20	Light	Intermittent
0117	30/11/18	2	3	W	500-1000	100	4	5-10	1	Sleet	20	Light	Intermittent
0118	03/12/18	4N	1	NW	>1000	35	2-3	>10	4	None	n/a	n/a	n/a
0120	03/12/18	4N	1	NW	500-1000	10	2	>10	6	None	n/a	n/a	n/a
0118	03/12/18	4N	2	NW	>1000	20	2-3	>10	5	None	n/a	n/a	n/a
0120	03/12/18	4N	2	NW	500-1000	10	2	>10	6	None	n/a	n/a	n/a
0118	03/12/18	4N	3	NW	>1000	2	2-3	>10	6	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0120	03/12/18	4N	3	NW	500-1000	5	2	>10	3	None	n/a	n/a	n/a
0119	03/12/18	4S	1	NW	500-1000	60	3	>10	4	None	n/a	n/a	n/a
0121	03/12/18	4S	1	NW	>1000	30	2	>10	6	None	n/a	n/a	n/a
0119	03/12/18	4S	2	NW	500-1000	20	3	>10	5	None	n/a	n/a	n/a
0121	03/12/18	4S	2	NW	>1000	15	2-3	>10	6	None	n/a	n/a	n/a
0119	03/12/18	4S	3	NW	500-1000	10	3	>10	6	None	n/a	n/a	n/a
0121	03/12/18	4S	3	NW	>1000	5	2	>10	5	None	n/a	n/a	n/a
0122	09/12/18	2	1	NW	500-1000	10	3	>10	4	None	n/a	n/a	n/a
0124	09/12/18	2	1	W	500-1000	50	2	>10	5	None	n/a	n/a	n/a
0122	09/12/18	2	2	NW	500-1000	5	3	>10	5	None	n/a	n/a	n/a
0124	09/12/18	2	2	W	500-1000	80	1	>10	5	None	n/a	n/a	n/a
0122	09/12/18	2	3	W	500-1000	5	3	>10	6	None	n/a	n/a	n/a
0124	09/12/18	2	3	W	500-1000	70	2	>10	4	None	n/a	n/a	n/a
0123	09/12/18	3	1	NW	>1000	2	2-3	>10	3	None	n/a	n/a	n/a
0125	09/12/18	3	1	NW	>1000	20	4	>10	5	None	n/a	n/a	n/a
0123	09/12/18	3	2	NW	>1000	5	3	>10	4	None	n/a	n/a	n/a
0125	09/12/18	3	2	NW	>1000	80	2-3	>10	6	None	n/a	n/a	n/a
0123	09/12/18	3	3	NW	>1000	1	2-4	>10	4	None	n/a	n/a	n/a
0125	09/12/18	3	3	NW	>1000	85	2-4	>10	5	None	n/a	n/a	n/a
0127	10/12/18	4N	1	SE	>1000	90	1	>10	5	None	n/a	n/a	n/a
0127	10/12/18	4N	2	SE	>1000	40	1	>10	5	None	n/a	n/a	n/a
0127	10/12/18	4N	3	SE	500-1000	90	1	>10	3	None	n/a	n/a	n/a
0126	10/12/18	4S	1	NW	500-1000	90	1	>10	4	None	n/a	n/a	n/a
0126	10/12/18	4S	2	NW	>1000	95	1	>10	5	None	n/a	n/a	n/a
0126	10/12/18	4S	3	SE	>1000	95	1	>10	5	None	n/a	n/a	n/a
0128	14/12/18	4N	1	SE	>1000	20	1	>10	-1	None	n/a	n/a	n/a
0128	14/12/18	4N	2	SE	>1000	85	2-3	>10	0	None	n/a	n/a	n/a
0128	14/12/18	4N	3	SE	>1000	95	2-3	>10	1	None	n/a	n/a	n/a
0129	14/12/18	4S	1	SE	>1000	95	2-3	>10	1	None	n/a	n/a	n/a
0129	14/12/18	4S	2	SE	>1000	95	2-3	>10	1	None	n/a	n/a	n/a
0129	14/12/18	4S	3	SE	>1000	95	2-3	>10	1	None	n/a	n/a	n/a
0130	19/12/18	1	1	SE	100-500	70	2	2-5	4	Rain	10	Light	Continuous
0131	19/12/18	1	1	SE	500-1000	70	5	>10	5	Rain	10	Light	Intermittent
0130	19/12/18	1	2	SE	100-500	50	4	2-5	5	Rain	<5	Light	Continuous
0131	19/12/18	1	2	SE	500-1000	80	5	>10	5	Rain	20	Mod.	Intermittent
0130	19/12/18	1	3	SE	500-1000	30	4	>10	5	None	n/a	n/a	n/a
0131	19/12/18	1	3	SE	500-1000	90	5	5-10	5	Rain	50	Mod.	Intermittent

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0132	20/12/18	3	1	SW	500-1000	100	3	5-10	1	None	n/a	n/a	n/a
0132	20/12/18	3	2	SW	500-1000	100	3	5-10	1	None	n/a	n/a	n/a
0132	20/12/18	3	3	SW	500-1000	100	3	5-10	1	Sleet	15	Light	Intermittent
0133	11/01/19	4N	1	W-NW	>1000	80	2	>10	8	None	n/a	n/a	n/a
0135	11/01/19	4N	1	W	500-1000	100	1	>10	9	Rain	30	Light	Intermittent
0133	11/01/19	4N	2	W	>1000	95	2	>10	8	None	n/a	n/a	n/a
0135	11/01/19	4N	2	W	500-1000	100	2	>10	8	Rain	10	Light	Intermittent
0133	11/01/19	4N	3	W	>1000	100	1	>10	9	None	n/a	n/a	n/a
0135	11/01/19	4N	3	W	500-1000	95	2	>10	7	Rain	10	Light	Intermittent
0134	11/01/19	4S	1	W-NW	>1000	80	2	>10	8	None	n/a	n/a	n/a
0136	11/01/19	4S	1	W	>1000	100	1	>10	9	Rain	30	Light	Intermittent
0134	11/01/19	4S	2	W	>1000	95	2	>10	8	None	n/a	n/a	n/a
0136	11/01/19	4S	2	W	>1000	100	2	>10	8	Rain	10	Light	Intermittent
0134	11/01/19	4S	3	W	>1000	100	1	>10	9	None	n/a	n/a	n/a
0136	11/01/19	4S	3	W	>1000	95	2	>10	7	Rain	10	Light	Intermittent
0137	21/01/19	2	1	E	500-1000	100	2	1-2	0	Snow	10	Light	Intermittent
0139	21/01/19	2	1	S	>1000	100	3	>10	2	None	n/a	n/a	n/a
0137	21/01/19	2	2	E	500-1000	100	2	5-10	1	None	n/a	n/a	n/a
0139	21/01/19	2	2	SW	>1000	100	3	>10	2	None	n/a	n/a	n/a
0137	21/01/19	2	3	S	500-1000	100	2	5-10	1	None	n/a	n/a	n/a
0139	21/01/19	2	3	SW	500-1000	100	3	>10	2	Sleet	60	Light	Intermittent
0138	21/01/19	3	1	E	500-1000	100	1	2-5	0	None	n/a	n/a	n/a
0140	21/01/19	3	1	SE	>1000	100	2	>10	3	None	n/a	n/a	n/a
0138	21/01/19	3	2	E-SE	500-1000	100	1	5-10	1	None	n/a	n/a	n/a
0140	21/01/19	3	2	S	>1000	100	2	>10	3	Rain	30	Light	Continuous
0138	21/01/19	3	3	SE	500-1000	100	2	5-10	2	None	n/a	n/a	n/a
0140	21/01/19	3	3	S	>1000	100	2	5-10	3	Rain	30	Light	Continuous
0141	30/01/19	1	1	W	100-500	60	1	2-5	1	Snow	10	Light	Continuous
0142	30/01/19	1	1	W	500-1000	40	1	>10	1	None	n/a	n/a	n/a
0141	30/01/19	1	2	W	500-1000	50	2	>10	1	Snow	20	Light	Continuous
0142	30/01/19	1	2	W	500-1000	50	1	>10	1	None	n/a	n/a	n/a
0141	30/01/19	1	3	W	100-500	60	2	2-5	1	Snow	40	Mod.	Intermittent
0142	30/01/19	1	3	W	500-1000	60	1	5-10	0	Snow	10	Light	Intermittent
0143	11/02/19	4N	1	SW	>1000	80	2	>10	9	None	n/a	n/a	n/a
0143	11/02/19	4N	2	SW	>1000	50	2	>10	9	None	n/a	n/a	n/a
0143	11/02/19	4N	3	SW	>1000	40	1	>10	6	None	n/a	n/a	n/a
0144	12/02/19	2	1	S	>1000	90	2	>10	7	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0146	12/02/19	2	1	SW	500-1000	100	4	5-10	7.5	None	n/a	n/a	n/a
0144	12/02/19	2	2	SW	>1000	100	4	>10	8	Rain	10	Light	Intermittent
0146	12/02/19	2	2	SW	500-1000	100	3	5-10	7.5	None	n/a	n/a	n/a
0144	12/02/19	2	3	SW	>1000	100	5	>10	7.5	None	n/a	n/a	n/a
0146	12/02/19	2	3	SW	500-1000	100	1	>10	9	None	n/a	n/a	n/a
0145	12/02/19	3	1	SW	100-5000	90	3	2-5	7	None	n/a	n/a	n/a
0147	12/02/19	3	1	SW	500-1000	100	2	5-10	9	None	n/a	n/a	n/a
0145	12/02/19	3	2	SW	500-1000	90	2	>10	8	None	n/a	n/a	n/a
0147	12/02/19	3	2	SW	500-1000	100	3	5-10	9	Rain	10	Light	Intermittent
0145	12/02/19	3	3	S	500-1000	90	2	>10	8	Rain	5	Light	Continuous
0147	12/02/19	3	3	SW	500-1000	90	2	>10	9	None	n/a	n/a	n/a
0148	14/02/19	1	1	S	500-1000	100	5	5-10	8	None	n/a	n/a	n/a
0149	14/02/19	1	1	S	500-1000	90	3	5-10	8	None	n/a	n/a	n/a
0148	14/02/19	1	2	SE	100-500	100	4	5-10	8	Rain	15	Light	Intermittent
0149	14/02/19	1	2	S	500-1000	90	3	5-10	8	None	n/a	n/a	n/a
0148	14/02/19	1	3	S	500-1000	100	4	5-10	8	Rain	10	Light	Intermittent
0149	14/02/19	1	3	SE	500-1000	90	3	5-10	8	None	n/a	n/a	n/a
0150	25/02/19	4S	1	SE-S	500-1000	60	0-1	5-10	9	None	n/a	n/a	n/a
0151	25/02/19	4S	1	SE	500-1000	70	1-2	5-10	11	None	n/a	n/a	n/a
0150	25/02/19	4S	2	SE	>1000	35	1	5-10	10	None	n/a	n/a	n/a
0151	25/02/19	4S	2	SE	500-1000	75	1-2	5-10	11	None	n/a	n/a	n/a
0150	25/02/19	4S	3	SE	>1000	40	2	5-10	10	None	n/a	n/a	n/a
0151	25/02/19	4S	3	SE	500-1000	80	1	5-10	10	None	n/a	n/a	n/a
0152	27/02/19	4N	1	E	>1000	2	1	>10	0	None	n/a	n/a	n/a
0152	27/02/19	4N	2	n/a	>1000	0	0	>10	5	None	n/a	n/a	n/a
0152	27/02/19	4N	3	n/a	>1000	2	0	>10	10	None	n/a	n/a	n/a
0154	08/03/19	2	1	S	500-1000	100	2	>10	-2	None	n/a	n/a	n/a
0154	08/03/19	2	2	S	100-500	100	2	2-5	-1	Rain	35	Light	Continuous
0154	08/03/19	2	3	S	100-500	100	2	1-2	1	Rain	80	Mod.	Intermittent
0153	08/03/19	3	1	n/a	500-1000	100	0	>10	1.5	None	n/a	n/a	n/a
0153	08/03/19	3	2	n/a	500-1000	100	0	>10	2	Rain	50	Light	Intermittent
0153	08/03/19	3	3	n/a	500-1000	100	0	5-10	2.5	Rain	100	Light	Continuous
0155	11/03/19	4N	1	W	500-1000	60	2	>10	4	None	n/a	n/a	n/a
0157	11/03/19	4N	1	SW	500-1000	70	2	>10	6	None	n/a	n/a	n/a
0155	11/03/19	4N	2	W	>1000	80	3	>10	5	None	n/a	n/a	n/a
0157	11/03/19	4N	2	S	500-1000	90	3	>10	4	None	n/a	n/a	n/a
0155	11/03/19	4N	3	SW	500-1000	70	3	>10	4	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0157	11/03/19	4N	3	S	500-1000	100	3	>10	4.5	None	n/a	n/a	n/a
0156	11/03/19	4S	1	W	>1000	60	2	>10	4	None	n/a	n/a	n/a
0158	11/03/19	4S	1	SW	500-1000	70	2	>10	6	None	n/a	n/a	n/a
0156	11/03/19	4S	2	W	>1000	80	3	>10	5	None	n/a	n/a	n/a
0158	11/03/19	4S	2	S	500-1000	90	3	>10	4	None	n/a	n/a	n/a
0156	11/03/19	4S	3	SW	500-1000	70	3	>10	4	None	n/a	n/a	n/a
0158	11/03/19	4S	3	S	500-1000	100	3	>10	4.5	None	n/a	n/a	n/a
0160	14/03/19	2	1	W	500-1000	60	3-4	>10	6	None	n/a	n/a	n/a
0160	14/03/19	2	2	W	500-1000	60	3	>10	5	Rain	5	Light	Continuous
0160	14/03/19	2	3	W	500-1000	80	3	5-10	5	Rain	15	Mod.	Intermittent
0159	14/03/19	3	1	SW	>1000	70	4	>10	9	None	n/a	n/a	n/a
0159	14/03/19	3	2	SW	>1000	80	4	>10	6.5	Rain	5	Light	Intermittent
0159	14/03/19	3	3	SW	>1000	90	4	>10	6	Rain	5	Light	Intermittent
0161	22/03/19	3	1	S	100-500	100	2	>10	9	None	n/a	n/a	n/a
0161	22/03/19	3	2	S	100-500	100	2	>10	9	None	n/a	n/a	n/a
0161	22/03/19	3	3	S	100-500	100	2	>10	8.5	Rain	50	Light	Continuous
0162	27/03/19	1	1	SW	>1000	70	4	>10	4	None	n/a	n/a	n/a
0162	27/03/19	1	2	SW	>1000	70	4	>10	4	None	n/a	n/a	n/a
0162	27/03/19	1	3	SW	>1000	70	5	>10	5	None	n/a	n/a	n/a
0163	27/03/19	2	1	SW	>1000	65	3	>10	5	None	n/a	n/a	n/a
0163	27/03/19	2	2	SW	>1000	65	3	>10	5	None	n/a	n/a	n/a
0163	27/03/19	2	3	SW	>1000	70	3	>10	5	None	n/a	n/a	n/a
0164	28/03/19	1	1	SW	500-1000	100	2	>10	9	None	n/a	n/a	n/a
0166	28/03/19	1	1	S	>1000	30	3	>10	13	None	n/a	n/a	n/a
0164	28/03/19	1	2	SW	500-1000	70	2	>10	11	None	n/a	n/a	n/a
0166	28/03/19	1	2	SW	>1000	20	2	>10	13	None	n/a	n/a	n/a
0164	28/03/19	1	3	SW	>1000	40	2	>10	13	None	n/a	n/a	n/a
0166	28/03/19	1	3	SW	>1000	30	2	>10	12.5	None	n/a	n/a	n/a
0165	28/03/19	4N	1	SW	500-1000	60	2	>10	8	None	n/a	n/a	n/a
0165	28/03/19	4N	2	SW	>1000	70	3	>10	10	None	n/a	n/a	n/a
0165	28/03/19	4N	3	SW	>1000	40	2	>10	10	None	n/a	n/a	n/a
0167	28/03/19	4S	1	S	>1000	25	3	>10	10	None	n/a	n/a	n/a
0167	28/03/19	4S	2	S	>1000	15	3	>10	11	None	n/a	n/a	n/a
0167	28/03/19	4S	3	S	>1000	20	3	>10	10	None	n/a	n/a	n/a
0168	01/04/19	2	1	S	100-500	100	3	2-5	5	Rain	70	Light	Intermittent
0170	01/04/19	2	1	S	100-500	100	3	2-5	4	Rain	40	Light	Intermittent
0168	01/04/19	2	2	S	100-500	100	3	2-5	5	Rain	90	Light	Continuous

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0170	01/04/19	2	2	S	100-500	100	3	2-5	4	Rain	20	Light	Intermittent
0168	01/04/19	2	3	S	100-500	100	3	2-5	5	Rain	60	Light	Intermittent
0170	01/04/19	2	3	S	100-500	100	2	1-2	4	Rain	60	Light	Continuous
0169	01/04/19	3	1	W	500-1000	100	2	2-5	5	Rain	60	Light	Intermittent
0171	01/04/19	3	1	W	100-1000	100	3	2-5	5	Rain	15	Light	Intermittent
0169	01/04/19	3	2	W	100-1000	100	3	1-5	5	Rain	100	Light	Intermittent
0171	01/04/19	3	2	W	100-1000	100	3	1-10	5	Rain	30	Light	Intermittent
0169	01/04/19	3	3	W	100-1000	100	3	1-5	5	Rain	80	Light	Intermittent
0171	01/04/19	3	3	W	100-500	100	3	1-2	5	Rain	80	Light	Continuous
0172	02/04/19	4N	1	NW	500-1000	90	2	>10	4	Hail	5	Light	Continuous
0174	02/04/19	4N	1	NW	100-500	100	2	2-5	3	Hail, Sleet, Snow	95	Mod.	Continuous
0172	02/04/19	4N	2	W	500-1000	60	1	>10	7	None	n/a	n/a	n/a
0174	02/04/19	4N	2	SW	500-1000	80	2	>10	5	Sleet	20	Light	Continuous
0172	02/04/19	4N	3	W	500-1000	70	1	>10	5	Sleet	5	Mod.	Continuous
0174	02/04/19	4N	3	W	500-1000	60	2	>10	8	Rain	5	Light	Continuous
0173	02/04/19	4S	1	NW	500-1000	90	2	>10	4	Hail	5	Light	Continuous
0175	02/04/19	4S	1	NW	100-500	100	2	2-5	3	Hail, Sleet, Snow	95	Mod.	Continuous
0173	02/04/19	4S	2	W	500-1000	60	1	>10	7	None	n/a	n/a	n/a
0175	02/04/19	4S	2	SW	500-1000	80	2	>10	5	Sleet	20	Light	Continuous
0173	02/04/19	4S	3	W	500-1000	70	1	>10	5	Sleet	5	Mod.	Continuous
0175	02/04/19	4S	3	W	500-1000	60	2	>10	8	Rain	5	Light	Continuous
0176	09/04/19	3	1	E	>1000	12	3	>10	7	None	n/a	n/a	n/a
0177	09/04/19	3	1	E	>1000	1	3	>10	11	None	n/a	n/a	n/a
0176	09/04/19	3	2	E	>1000	0	3	>10	9	None	n/a	n/a	n/a
0177	09/04/19	3	2	E	>1000	13	3	>10	11	None	n/a	n/a	n/a
0176	09/04/19	3	3	E	>1000	0	3	>10	11	None	n/a	n/a	n/a
0177	09/04/19	3	3	NE	>1000	20	3	>10	11	None	n/a	n/a	n/a
0178	11/04/19	1	1	S	>1000	70	3	>10	8	None	n/a	n/a	n/a
0179	11/04/19	1	1	S	>1000	70	3	>10	10	None	n/a	n/a	n/a
0178	11/04/19	1	2	S	>1000	60	3	>10	8	None	n/a	n/a	n/a
0179	11/04/19	1	2	S	>1000	70	3	>10	10	None	n/a	n/a	n/a
0178	11/04/19	1	3	S	>1000	70	3	>10	9	None	n/a	n/a	n/a
0179	11/04/19	1	3	S	>1000	70	3	>10	10	None	n/a	n/a	n/a
0180	15/04/19	4N	1	E	>1000	95	3	>10	10	None	n/a	n/a	n/a
0182	15/04/19	4N	1	E	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0180	15/04/19	4N	2	E	>1000	85	3	>10	12	None	n/a	n/a	n/a
0182	15/04/19	4N	2	E	500-1000	100	3	>10	11	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0180	15/04/19	4N	3	E	>1000	90	3	>10	12.5	None	n/a	n/a	n/a
0182	15/04/19	4N	3	E	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0181	15/04/19	4S	1	E	500-1000	95	3	>10	10	None	n/a	n/a	n/a
0183	15/04/19	4S	1	E	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0181	15/04/19	4S	2	E	500-1000	90	3	>10	12	None	n/a	n/a	n/a
0183	15/04/19	4S	2	E	500-1000	95	3	>10	11	None	n/a	n/a	n/a
0181	15/04/19	4S	3	E	500-1000	95	3	>10	12.5	None	n/a	n/a	n/a
0183	15/04/19	4S	3	E	500-1000	95	3	>10	11	None	n/a	n/a	n/a
0184	22/04/19	2	1	SE	500-1000	80	2	>10	8	None	n/a	n/a	n/a
0186	22/04/19	2	1	E	>1000	85	3	>10	8	None	n/a	n/a	n/a
0184	22/04/19	2	2	E	500-1000	85	3	>10	9	None	n/a	n/a	n/a
0186	22/04/19	2	2	E	>1000	90	4	>10	8	None	n/a	n/a	n/a
0184	22/04/19	2	3	E	500-1000	80	3	>10	10	None	n/a	n/a	n/a
0186	22/04/19	2	3	E	>1000	90	3	>10	9	None	n/a	n/a	n/a
0185	22/04/19	3	1	S	>1000	0	4	>10	18	None	n/a	n/a	n/a
0187	22/04/19	3	1	S	>1000	0	3	>10	18	None	n/a	n/a	n/a
0185	22/04/19	3	2	S	>1000	0	4	>10	18	None	n/a	n/a	n/a
0187	22/04/19	3	2	S	>1000	1	3	>10	18	None	n/a	n/a	n/a
0185	22/04/19	3	3	S	>1000	0	4	>10	18	None	n/a	n/a	n/a
0187	22/04/19	3	3	S	>1000	40	2	>10	18	None	n/a	n/a	n/a
0188	24/04/19	1	1	E	>1000	30	4	>10	8	None	n/a	n/a	n/a
0189	24/04/19	1	1	E	>1000	60	4	>10	14	None	n/a	n/a	n/a
0188	24/04/19	1	2	E	>1000	50	4	>10	11	None	n/a	n/a	n/a
0189	24/04/19	1	2	E	>1000	60	5	>10	14	None	n/a	n/a	n/a
0188	24/04/19	1	3	SE	>1000	50	4	>10	13	None	n/a	n/a	n/a
0189	24/04/19	1	3	E	>1000	90	5	>10	13	None	n/a	n/a	n/a
0190	03/05/19	2	1	NE	500-1000	95	1	5-10	8	None	n/a	n/a	n/a
0192	03/05/19	2	1	N	500-1000	90	1	5-10	10	None	n/a	n/a	n/a
0190	03/05/19	2	2	N	500-1000	90	1	5-10	8	None	n/a	n/a	n/a
0192	03/05/19	2	2	N	500-1000	90	2	5-10	11	None	n/a	n/a	n/a
0190	03/05/19	2	3	N	500-1000	95	1	5-10	10	None	n/a	n/a	n/a
0192	03/05/19	2	3	NE	500-1000	95	2	5-10	10	None	n/a	n/a	n/a
0191	03/05/19	3	1	N	>1000	88	2	>10	6	None	n/a	n/a	n/a
0193	03/05/19	3	1	NW	>1000	99	2	>10	8	None	n/a	n/a	n/a
0191	03/05/19	3	2	NW	>1000	90	2	>10	7	None	n/a	n/a	n/a
0193	03/05/19	3	2	NW	>1000	100	2	>10	9	None	n/a	n/a	n/a
0191	03/05/19	3	3	NW	>1000	99	3	>10	7	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0193	03/05/19	3	3	NW	>1000	100	2	>10	9	None	n/a	n/a	n/a
0194	10/05/19	4N	1	E	>1000	80	2	2-5	6	None	n/a	n/a	n/a
0196	10/05/19	4N	1	E	>1000	80	2	>10	8	None	n/a	n/a	n/a
0194	10/05/19	4N	2	E	>1000	75	2	2-5	6	None	n/a	n/a	n/a
0196	10/05/19	4N	2	E	>1000	75	2	>10	10	None	n/a	n/a	n/a
0194	10/05/19	4N	3	E	>1000	75	2	2-5	7	None	n/a	n/a	n/a
0196	10/05/19	4N	3	E	>1000	60	2	>10	11	None	n/a	n/a	n/a
0195	10/05/19	4S	1	E	>1000	30	1-2	>10	6	None	n/a	n/a	n/a
0197	10/05/19	4S	1	E	500-1000	70	2	5-10	8	None	n/a	n/a	n/a
0195	10/05/19	4S	2	E	>1000	20	2	>10	6	None	n/a	n/a	n/a
0197	10/05/19	4S	2	E	500-1000	75	1	5-10	10	None	n/a	n/a	n/a
0195	10/05/19	4S	3	E	>1000	20	2	>10	8	None	n/a	n/a	n/a
0197	10/05/19	4S	3	E	500-1000	75	2	5-10	11	None	n/a	n/a	n/a
0198	14/05/19	1	1	SE	>1000	40	2	>10	14	None	n/a	n/a	n/a
0199	14/05/19	1	1	SE	>1000	30	3	>10	18	None	n/a	n/a	n/a
0198	14/05/19	1	2	SE	>1000	40	1	>10	16	None	n/a	n/a	n/a
0199	14/05/19	1	2	SE	>1000	20	2-3	>10	18	None	n/a	n/a	n/a
0198	14/05/19	1	3	SE	>1000	50	3	>10	17	None	n/a	n/a	n/a
0199	14/05/19	1	3	S	>1000	10	2	>10	17	None	n/a	n/a	n/a
0250	20/05/19	1	1	NW	>1000	90	2	>10	12	None	n/a	n/a	n/a
0251	20/05/19	1	1	NW	>1000	90	2	>10	12	~	~	~	~
0250	20/05/19	1	2	NW	>1000	90	2	>10	12	~	~	~	~
0251	20/05/19	1	2	NW	>1000	40	2	>10	15	None	n/a	n/a	n/a
0252	22/05/19	2	1	W	>1000	20	2-3	>10	14	None	n/a	n/a	n/a
0252	22/05/19	2	2	W	>1000	15	3	>10	13	None	n/a	n/a	n/a
0252	22/05/19	2	3	W	>1000	10	3	>10	13	None	n/a	n/a	n/a
0253	23/05/19	3	1	W	>1000	10	3-4	>10	14	None	n/a	n/a	n/a
0253	23/05/19	3	2	W	>1000	10	3	>10	13	None	n/a	n/a	n/a
0253	23/05/19	3	3	W	>1000	10	3-4	>10	13	None	n/a	n/a	n/a
0200	27/05/19	1	1	NW	>1000	90	2-3	>10	11	None	n/a	n/a	n/a
0202	27/05/19	1	1	W-NW	>1000	100	2	>10	12	None	n/a	n/a	n/a
0200	27/05/19	1	2	NW	>1000	100	2-3	>10	12	None	n/a	n/a	n/a
0202	27/05/19	1	2	W	>1000	100	2	>10	11	None	n/a	n/a	n/a
0200	27/05/19	1	3	NW	>1000	100	2-3	>10	12	None	n/a	n/a	n/a
0202	27/05/19	1	3	W	>1000	95	2	>10	11	None	n/a	n/a	n/a
0201	27/05/19	4N	1	W	>1000	90	3	>10	14	None	n/a	n/a	n/a
0201	27/05/19	4N	2	W	>1000	95	2	>10	14	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0201	27/05/19	4N	3	W	>1000	100	2	>10	14	None	n/a	n/a	n/a
0203	27/05/19	4S	1	SW	>1000	100	2	>10	14	None	n/a	n/a	n/a
0203	27/05/19	4S	2	W	>1000	100	2	>10	13	None	n/a	n/a	n/a
0203	27/05/19	4S	3	W	>1000	70	2	>10	13	None	n/a	n/a	n/a
0204	03/06/19	2	1	SW	500-1000	80	4	>10	13	None	n/a	n/a	n/a
0205	03/06/19	2	1	SW	500-1000	50	3	>10	12	None	n/a	n/a	n/a
0204	03/06/19	2	2	SW	500-1000	70	4	>10	13.5	None	n/a	n/a	n/a
0205	03/06/19	2	2	SW	500-1000	90	2-3	>10	11	Rain	25	Light	Intermittent
0204	03/06/19	2	3	SW	500-1000	70	4	>10	13	None	n/a	n/a	n/a
0205	03/06/19	2	3	SW	500-1000	90	2	>10	10	None	n/a	n/a	n/a
0206	04/06/19	4N	1	SE	100-500	100	1	1-2	8	None	n/a	n/a	n/a
0208	04/06/19	4N	1	SE	500-1000	60	1	>10	10	None	n/a	n/a	n/a
0206	04/06/19	4N	2	SE	100-1000	95	1	1-5	9	None	n/a	n/a	n/a
0208	04/06/19	4N	2	SE	500-1000	70	1	>10	12	None	n/a	n/a	n/a
0206	04/06/19	4N	3	SE	500-1000	80	1	2-5	9	None	n/a	n/a	n/a
0208	04/06/19	4N	3	SW	>1000	70	1	>10	13	None	n/a	n/a	n/a
0207	04/06/19	4S	1	SE	100-500	90	1	5-10	8	None	n/a	n/a	n/a
0209	04/06/19	4S	1	SE-S	>1000	80	1-2	>10	10	None	n/a	n/a	n/a
0207	04/06/19	4S	2	E	100-500	80	1	>10	9	None	n/a	n/a	n/a
0209	04/06/19	4S	2	S	>1000	80	2	>10	10	None	n/a	n/a	n/a
0207	04/06/19	4S	3	SE	500-1000	60	1	>10	10	None	n/a	n/a	n/a
0209	04/06/19	4S	3	S	>1000	80	1	>10	11	None	n/a	n/a	n/a
0210	05/06/19	1	1	SE	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0211	05/06/19	1	1	S	>1000	90	3	>10	12	Rain	30	Light	Intermittent
0210	05/06/19	1	2	SE	500-1000	90	3	>10	12	None	n/a	n/a	n/a
0211	05/06/19	1	2	SW	>1000	80	2	>10	12	Rain	30	Light	Intermittent
0210	05/06/19	1	3	S	500-1000	90	2	>10	12	Rain	40	Mod.	Continuous
0211	05/06/19	1	3	SW	>1000	90	2	>10	12	Rain	20	Light	Intermittent
0212	12/06/19	4N	1	NE	500-1000	95	3	>10	12	None	n/a	n/a	n/a
0214	12/06/19	4N	1	NE	500-1000	100	3	>10	13	None	n/a	n/a	n/a
0212	12/06/19	4N	2	NE	500-1000	85	3	>10	12	None	n/a	n/a	n/a
0214	12/06/19	4N	2	NE	500-1000	95	4	>10	13	None	n/a	n/a	n/a
0212	12/06/19	4N	3	NE	500-1000	90	3	>10	12.5	None	n/a	n/a	n/a
0214	12/06/19	4N	3	NE	500-1000	98	4	>10	12.5	None	n/a	n/a	n/a
0213	12/06/19	4S	1	N-NE	500-1000	100	3	>10	12	None	n/a	n/a	n/a
0215	12/06/19	4S	1	NE	500-1000	100	3	>10	12.5	None	n/a	n/a	n/a
0213	12/06/19	4S	2	NE	500-1000	95	3	>10	12	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0215	12/06/19	4S	2	NE	500-1000	90	3	>10	13	None	n/a	n/a	n/a
0213	12/06/19	4S	3	NE	500-1000	95	3	>10	12.5	None	n/a	n/a	n/a
0215	12/06/19	4S	3	NE	500-1000	95	4	>10	12	None	n/a	n/a	n/a
0216	14/06/19	2	1	SW	500-1000	60	2	>10	11	None	n/a	n/a	n/a
0218	14/06/19	2	1	SW	>1000	80	3	>10	12	None	n/a	n/a	n/a
0216	14/06/19	2	2	SW	500-1000	80	2	5-10	12	None	n/a	n/a	n/a
0218	14/06/19	2	2	SW	>1000	75	4	>10	12	None	n/a	n/a	n/a
0216	14/06/19	2	3	SE	500-1000	85	3	5-10	12	None	n/a	n/a	n/a
0218	14/06/19	2	3	SW	>1000	75	4	>10	14	None	n/a	n/a	n/a
0217	14/06/19	3	1	SW	>1000	50	1	>10	6	None	n/a	n/a	n/a
0219	14/06/19	3	1	SW	>1000	90	1	>10	10	None	n/a	n/a	n/a
0217	14/06/19	3	2	SW	>1000	75	1	>10	8	None	n/a	n/a	n/a
0219	14/06/19	3	2	SW	>1000	90	2	>10	11	None	n/a	n/a	n/a
0217	14/06/19	3	3	SW	>1000	80	1	>10	9	None	n/a	n/a	n/a
0219	14/06/19	3	3	SW	>1000	~	2	>10	12	None	n/a	n/a	n/a
0221	18/06/19	4N	1	W	>1000	80	2	>10	15	None	n/a	n/a	n/a
0221	18/06/19	4N	2	W	>1000	90	2	>10	17	None	n/a	n/a	n/a
0221	18/06/19	4N	3	SW	>1000	90	2	>10	15	None	n/a	n/a	n/a
0220	18/06/19	4S	1	SW	>1000	20	4	>10	13	None	n/a	n/a	n/a
0220	18/06/19	4S	2	SW	>1000	40	3	>10	18	None	n/a	n/a	n/a
0220	18/06/19	4S	3	SW	>1000	70	2	>10	13.5	None	n/a	n/a	n/a
0222	23/06/19	1	1	SE	>1000	100	2	>10	9	None	n/a	n/a	n/a
0222	23/06/19	1	2	SE	>1000	100	3	>10	11	None	n/a	n/a	n/a
0222	23/06/19	1	3	SE	>1000	100	2	>10	12	None	n/a	n/a	n/a
0224	23/06/19	2	1	SE	>1000	100	4	>10	15	None	n/a	n/a	n/a
0224	23/06/19	2	2	SE	>1000	100	4	>10	15	None	n/a	n/a	n/a
0224	23/06/19	2	3	SE	>1000	100	5	>10	14	None	n/a	n/a	n/a
0223	23/06/19	3	1	SE	>1000	100	3	>10	12	None	n/a	n/a	n/a
0223	23/06/19	3	2	SE	>1000	100	2	>10	14	None	n/a	n/a	n/a
0223	23/06/19	3	3	SE	>1000	90	3	>10	14	None	n/a	n/a	n/a
0225	04/07/19	1	1	W	500-1000	100	2	>10	15	None	n/a	n/a	n/a
0226	04/07/19	1	1	W	500-1000	100	2	>10	15.5	None	n/a	n/a	n/a
0225	04/07/19	1	2	W	>10	100	2	>10	15	None	n/a	n/a	n/a
0226	04/07/19	1	2	W	500-1000	100	2	>10	15.5	None	n/a	n/a	n/a
0225	04/07/19	1	3	W	>10	100	2	>10	15.5	None	n/a	n/a	n/a
0226	04/07/19	1	3	W	500-1000	100	2	>10	15	None	n/a	n/a	n/a
0228	05/07/19	4N	1	S	500-1000	85	2	5-10	12	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0228	05/07/19	4N	2	S	500-1000	90	2	5-10	12	None	n/a	n/a	n/a
0228	05/07/19	4N	3	S	500-1000	100	3	5-10	12	None	n/a	n/a	n/a
0227	05/07/19	4S	1	SE	500-1000	100	2	2-5	10	Rain	10	Light	Intermittent
0227	05/07/19	4S	2	SE	500-1000	90	3	5-10	12	Rain	5	Light	Intermittent
0227	05/07/19	4S	3	S	500-1000	85	2	5-10	12	None	n/a	n/a	n/a
0229	07/07/19	2	1	SW	>1000	10	1	>10	4.5	None	n/a	n/a	n/a
0229	07/07/19	2	2	SW	>1000	5	1	>10	8	None	n/a	n/a	n/a
0229	07/07/19	2	3	SE	>1000	20	1	>10	11.5	None	n/a	n/a	n/a
0230	07/07/19	3	1	n/a	>1000	5	0	>10	4	None	n/a	n/a	n/a
0230	07/07/19	3	2	n/a	>1000	25	0	>10	5	None	n/a	n/a	n/a
0230	07/07/19	3	3	SE	>1000	40	1	>10	6	None	n/a	n/a	n/a
0231	10/07/19	4N	1	S	500-1000	100	2	5-10	15.5	Rain	20	Light	Intermittent
0234	10/07/19	4N	1	SW	500-1000	100	2	>10	15	Rain	40	Light	Intermittent
0231	10/07/19	4N	2	S	500-1000	100	2	5-10	15.5	Rain	20	Mod.	Intermittent
0234	10/07/19	4N	2	SW	500-1000	100	2	>10	15	Rain	50	Light	Intermittent
0231	10/07/19	4N	3	SW	500-1000	100	1	5-10	16	Rain	30	Mod.	Intermittent
0234	10/07/19	4N	3	SW	100-500	100	2	>10	14	Rain	50	Light	Intermittent
0232	10/07/19	4S	1	S	500-1000	100	2	>10	15	Rain	20	Light	Intermittent
0233	10/07/19	4S	1	SW	500-1000	100	3	>10	15.5	Rain	40	Light	Intermittent
0232	10/07/19	4S	2	SW	500-1000	100	2	>10	16	Rain	20	Light	Intermittent
0233	10/07/19	4S	2	SW	500-1000	100	2	5-10	15.5	Rain	50	Light	Intermittent
0232	10/07/19	4S	3	SW	~	100	2	~	16	Rain	30	Mod.	Intermittent
0233	10/07/19	4S	3	SW	100-500	100	1	5-10	15	Rain	50	Mod.	Intermittent
0235	16/07/19	2	1	SE	>1000	90	1	5-10	17	None	n/a	n/a	n/a
0236	16/07/19	2	1	S	>1000	85	1	>10	17	None	n/a	n/a	n/a
0235	16/07/19	2	2	S	500-1000	95	2	>10	17	None	n/a	n/a	n/a
0236	16/07/19	2	2	SW	500-1000	90	~	5-10	17	None	n/a	n/a	n/a
0235	16/07/19	2	3	S	>1000	80	2	>10	18	None	n/a	n/a	n/a
0236	16/07/19	2	3	SW	500-1000	85	1	>10	18	None	n/a	n/a	n/a
0237	29/07/19	3	1	SW	500-1000	100	1	>10	18	None	n/a	n/a	n/a
0238	29/07/19	3	1	SW	>1000	40	1	>10	16	None	n/a	n/a	n/a
0237	29/07/19	3	2	SW	500-1000	80	1	>10	22	None	n/a	n/a	n/a
0238	29/07/19	3	2	SW	>1000	20	1	>10	14	None	n/a	n/a	n/a
0237	29/07/19	3	3	SW	>1000	50	1	>10	19	None	n/a	n/a	n/a
0238	29/07/19	3	3	SW	>1000	10	1	>10	12	None	n/a	n/a	n/a
0239	01/08/19	4N	1	n/a	500-1000	85	0	>10	17	None	n/a	n/a	n/a
0241	01/08/19	4N	1	n/a	500-1000	95	0	5-10	18	Rain	60	Mod.	Intermittent

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0239	01/08/19	4N	2	SW	>10	95	1	>10	17	None	n/a	n/a	n/a
0241	01/08/19	4N	2	1	>1000	90	1	>10	19	Rain	30	~	Intermittent
0239	01/08/19	4N	3	S	>10	85	1	>10	18	None	n/a	n/a	n/a
0241	01/08/19	4N	3	2	>1000	70	2	>10	20	None	n/a	n/a	n/a
0240	01/08/19	4S	1	SW	500-1000	85	0	>10	16	None	n/a	n/a	n/a
0242	01/08/19	4S	1	SW	500->1000	95	0-1	>10	18	Rain	60	n/a	n/a
0240	01/08/19	4S	2	SW	>1000	95	1	>10	17	None	n/a	n/a	n/a
0242	01/08/19	4S	2	SW	>1000	90	1	>10	19	Rain	30	n/a	n/a
0240	01/08/19	4S	3	SW	>1000	85	1	>10	18	None	n/a	n/a	n/a
0242	01/08/19	4S	3	SW	>1000	70	2	>10	20	None	n/a	n/a	n/a
0243	12/08/19	1	1	W	500-1000	70	2	>10	12	None	n/a	n/a	n/a
0244	12/08/19	1	1	W	500-1000	80	2	>10	13.5	None	n/a	n/a	n/a
0243	12/08/19	1	2	W	500-1000	60	2	>10	13	None	n/a	n/a	n/a
0244	12/08/19	1	2	W	500-1000	80	2	>10	15	None	n/a	n/a	n/a
0243	12/08/19	1	3	W	500-1000	60	1	>10	14.5	None	n/a	n/a	n/a
0244	12/08/19	1	3	SW	500-1000	80	2	>10	15	None	n/a	n/a	n/a
0245	15/08/19	2	1	W	500-1000	80	4	>10	13	None	n/a	n/a	n/a
0246	15/08/19	2	1	W	>1000	70	4	>10	14	None	n/a	n/a	n/a
0245	15/08/19	2	2	W	500-1000	70	4	>10	14.5	None	n/a	n/a	n/a
0246	15/08/19	2	2	W	>1000	70	4	>10	13	None	n/a	n/a	n/a
0245	15/08/19	2	3	W	>1000	70	4	>10	15	None	n/a	n/a	n/a
0246	15/08/19	2	3	W	>1000	70	4	>10	13.5	None	n/a	n/a	n/a
0247	15/08/19	3	1	W	100-500	90	3	2-5	12	Rain	30	Light	Intermittent
0248	15/08/19	3	1	W	500-1000	80	4	~	13	Rain	10	Light	Continuous
0247	15/08/19	3	2	W	500-1000	90	3	5-10	12	Rain	30	Light	Intermittent
0248	15/08/19	3	2	W	500-1000	80	4	>10	13	Rain	10	Light	Continuous
0247	15/08/19	3	3	W	100-500	90	4	5-10	13	Rain	20	Light	Continuous
0248	15/08/19	3	3	W	>1000	40	4	>10	14	None	n/a	n/a	n/a
0249	21/08/19	1	1	SW	500-1000	100	4	>10	14	None	n/a	n/a	n/a
0249	21/08/19	1	2	SW	500-1000	80	5	>10	14	None	n/a	n/a	n/a
0249	21/08/19	1	3	SW	500-1000	90	5	>10	14	Rain	25	Mod.	Continuous
0257	24/09/20	7	1	NE	>1000	50	3	>10	-1	None	n/a	n/a	n/a
0258	24/09/20	7	1	NE	>1000	80	3	>10	3	None	n/a	n/a	n/a
0257	24/09/20	7	2	NE	>1000	50	3	>10	1	None	n/a	n/a	n/a
0258	24/09/20	7	2	E	>1000	70	3	>10	3	None	n/a	n/a	n/a
0257	24/09/20	7	3	NE	>1000	70	3	>10	3	None	n/a	n/a	n/a
0258	24/09/20	7	3	E	>1000	70	3	>10	4	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0254	25/09/20	6	1	NW	>1000	5	3	>10	1	None	n/a	n/a	n/a
0255	25/09/20	6	1	NW	>1000	5	3	>10	5	None	n/a	n/a	n/a
0254	25/09/20	6	2	NW	>1000	5	2	>10	3	None	n/a	n/a	n/a
0255	25/09/20	6	2	NW	>1000	25	4	>10	7	None	n/a	n/a	n/a
0254	25/09/20	6	3	NW	>1000	5	3	>10	5	None	n/a	n/a	n/a
0255	25/09/20	6	3	NW	>1000	40	3	>10	7	None	n/a	n/a	n/a
0259	25/09/20	8	1	NW	>1000	5	3	>10	8	None	n/a	n/a	n/a
0260	25/09/20	8	1	NW	>1000	90	3	>10	11.5	None	n/a	n/a	n/a
0259	25/09/20	8	2	NW	>1000	5	3	>10	9	None	n/a	n/a	n/a
0260	25/09/20	8	2	NW	500-1000	100	3	>10	11	None	n/a	n/a	n/a
0259	25/09/20	8	3	NW	>1000	40	3	>10	11	None	n/a	n/a	n/a
0260	25/09/20	8	3	NW	500-1000	80	3	>10	10.5	None	n/a	n/a	n/a
0261	28/09/20	8	1	n/a	100-500	100	0	2-5	8	None	n/a	n/a	n/a
0261	28/09/20	8	2	n/a	100-500	100	0	2-5	8.5	None	n/a	n/a	n/a
0261	28/09/20	8	3	n/a	<100	100	0	1-2	9	None	n/a	n/a	n/a
0256	29/09/20	6	1	SE	>1000	30	1	>10	9	None	n/a	n/a	n/a
0256	29/09/20	6	2	S	>1000	40	1	>10	9	None	n/a	n/a	n/a
0256	29/09/20	6	3	S	>1000	25	3	>10	9	None	n/a	n/a	n/a
0262	29/09/20	7	1	N	>1000	10	1	>10	1	None	n/a	n/a	n/a
0262	29/09/20	7	2	NE	>1000	10	1	>10	4	None	n/a	n/a	n/a
0262	29/09/20	7	3	SE	>1000	20	1	>10	6	None	n/a	n/a	n/a
0267	02/10/20	7	1	NE	>1000	10	1	>10	4	None	n/a	n/a	n/a
0268	02/10/20	7	1	NE	>1000	30	2	>10	9	None	n/a	n/a	n/a
0267	02/10/20	7	2	NE	>1000	10	1	>10	7	None	n/a	n/a	n/a
0268	02/10/20	7	2	NE	>1000	40	3	>10	11	None	n/a	n/a	n/a
0267	02/10/20	7	3	NE	>1000	20	2	>10	8	None	n/a	n/a	n/a
0268	02/10/20	7	3	NE	>1000	40	3	>10	11	None	n/a	n/a	n/a
0263	09/10/20	6	1	NW	500-1000	80	4	>10	8	Rain	40	Light	~
0264	09/10/20	6	1	NW	500-1000	60	4	>10	8	Rain	20	Mod.	~
0263	09/10/20	6	2	NW	500-1000	60	4	>10	8	Rain	25	Light	~
0264	09/10/20	6	2	NW	500-1000	80	4	>10	7	None	n/a	n/a	n/a
0263	09/10/20	6	3	NW	500-1000	60	4	>10	8	None	n/a	n/a	n/a
0264	09/10/20	6	3	NW	500-1000	80	4	>10	6	Rain	25	Light	~
0269	14/10/20	8	1	NE	500-1000	90	2	>10	6	Rain	20	Light	~
0270	14/10/20	8	1	NE	>1000	60	1	>10	7	None	n/a	n/a	n/a
0269	14/10/20	8	2	NE	>1000	80	1	>10	6	None	n/a	n/a	n/a
0270	14/10/20	8	2	NE	>1000	50	1	>10	7	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0269	14/10/20	8	3	NE	>1000	70	1	>10	6	None	n/a	n/a	n/a
0270	14/10/20	8	3	NE	>1000	70	1	>10	7	None	n/a	n/a	n/a
0265	21/10/20	6	1	SE	500-1000	90	3	>10	10	Rain	20	Light	~
0266	21/10/20	6	1	SE	500-1000	100	3	>10	12	Rain	10	Light	~
0265	21/10/20	6	2	SE	500-1000	90	2	>10	11	Rain	10	Light	~
0266	21/10/20	6	2	S	500-1000	100	3	>10	12	Rain	20	Light	~
0265	21/10/20	6	3	SE	500-1000	90	3	>10	12	Rain	25	Light	~
0266	21/10/20	6	3	S	100-500	100	3	2-5	12	Rain	20	Light	~
0272	23/10/20	7	1	SW	500-1000	100	3	>10	6	Rain	30	Light	~
0272	23/10/20	7	2	SW	100-500	100	3	1-2	6	Rain	40	Mod.	~
0272	23/10/20	7	3	SW	500-1000	90	3	>10	6	Rain	30	Light	~
0271	23/10/20	8	1	SW	500-1000	80	3	>10	7	None	n/a	n/a	n/a
0271	23/10/20	8	2	SW	500-1000	60	3	>10	7	None	n/a	n/a	n/a
0271	23/10/20	8	3	SW	500-1000	60	3	>10	7	None	n/a	n/a	n/a
0273	24/10/20	8	1	SW	>1000	70	3	>10	8	None	n/a	n/a	n/a
0274	24/10/20	8	1	S	>1000	70	2	>10	8	None	n/a	n/a	n/a
0273	24/10/20	8	2	SW	>1000	70	3	>10	7	None	n/a	n/a	n/a
0274	24/10/20	8	2	S	>1000	80	2	>10	8	None	n/a	n/a	n/a
0273	24/10/20	8	3	S	>1000	60	2	>10	7	None	n/a	n/a	n/a
0274	24/10/20	8	3	S	>1000	70	1	>10	8	None	n/a	n/a	n/a
0275	28/10/20	7	1	SW	~	100	3	5-10	6	Rain	30	Mod.	~
0276	28/10/20	7	1	SW	500-1000	90	3	>10	6	Rain	20	Light	~
0275	28/10/20	7	2	SW	~	100	3	5-10	6	Rain	25	Light	~
0276	28/10/20	7	2	SW	500-1000	70	3	>10	5	None	n/a	n/a	n/a
0275	28/10/20	7	3	SW	~	100	3	5-10	6	Rain	20	Mod.	~
0276	28/10/20	7	3	SW	500-1000	80	3	>10	5	None	n/a	n/a	n/a
0277	05/11/20	6	1	W	100-500	90	2	>10	7	None	n/a	n/a	n/a
0277	05/11/20	6	2	n/a	100-500	90	0	>10	7	Rain	10	Light	Intermittent
0277	05/11/20	6	3	n/a	100-500	80	0	>10	7	Rain	10	Light	Continuous
0278	12/11/20	8	1	S	500-1000	100	2	>10	5	None	n/a	n/a	n/a
0279	12/11/20	8	1	S	500-1000	70	3	>10	5	None	n/a	n/a	n/a
0278	12/11/20	8	2	S	500-1000	100	3	>10	5	None	n/a	n/a	n/a
0279	12/11/20	8	2	S	500-1000	70	2	>10	5	None	n/a	n/a	n/a
0278	12/11/20	8	3	S	500-1000	90	3	>10	5	None	n/a	n/a	n/a
0279	12/11/20	8	3	S	500-1000	80	4	>10	4	None	n/a	n/a	n/a
0281	16/11/20	7	1	SW	500-1000	100	3	>10	8	None	n/a	n/a	n/a
0282	16/11/20	7	1	SW	500-1000	100	2	~	8	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0281	16/11/20	7	2	SW	500-1000	100	3	>10	8	None	n/a	n/a	n/a
0282	16/11/20	7	2	SW	500-1000	90	3	~	8	None	n/a	n/a	n/a
0281	16/11/20	7	3	SW	500-1000	90	2	>10	8	None	n/a	n/a	n/a
0282	16/11/20	7	3	SW	500-1000	100	4	2-5	8	Rain	50	Mod.	~
0280	17/11/20	6	1	SW	500-1000	100	4	2-5	9	Rain	40	Light	Intermittent
0283	17/11/20	6	1	SW	500-1000	100	4	>10	10	Rain	20	Light	~
0280	17/11/20	6	2	SW	500-1000	100	5	2-5	9	Rain	40	Light	Intermittent
0283	17/11/20	6	2	~	500-1000	100	3	>10	10	None	n/a	n/a	n/a
0280	17/11/20	6	3	SW	500-1000	100	4	>10	10	Rain	20	Light	Intermittent
0283	17/11/20	6	3	~	500-1000	100	3	>10	10	None	n/a	n/a	n/a
0284	22/11/20	8	1	SW	500-1000	70	3	>10	6	None	n/a	n/a	n/a
0285	22/11/20	8	1	SW	500-1000	80	3	>10	7	None	n/a	n/a	n/a
0284	22/11/20	8	2	SW	500-1000	80	3	>10	7	Rain	20	Light	~
0285	22/11/20	8	2	SW	500-1000	90	4	>10	7	None	n/a	n/a	n/a
0284	22/11/20	8	3	SW	500-1000	90	4	>10	7	None	n/a	n/a	n/a
0285	22/11/20	8	3	SW	500-1000	90	4	>10	7	None	n/a	n/a	n/a
0286	26/11/20	7	1	SW	500-1000	20	2	>10	4	None	n/a	n/a	n/a
0287	26/11/20	7	1	SW	500-1000	50	2	>10	5	None	n/a	n/a	n/a
0286	26/11/20	7	2	SW	500-1000	20	2	>10	5	None	n/a	n/a	n/a
0287	26/11/20	7	2	SW	100-500	50	3	>10	5	None	n/a	n/a	n/a
0286	26/11/20	7	3	SW	500-1000	30	2	>10	5	None	n/a	n/a	n/a
0287	26/11/20	7	3	SW	500-1000	20	3	>10	5	Rain	20	Light	Continuous
0288	27/11/20	6	1	N	>1000	10	1	>10	4	None	n/a	n/a	n/a
0289	27/11/20	6	1	SE	>1000	30	2	>10	4	None	n/a	n/a	n/a
0288	27/11/20	6	2	S	>1000	10	2	>10	4	None	n/a	n/a	n/a
0289	27/11/20	6	2	SE	>1000	60	2	>10	4	None	n/a	n/a	n/a
0288	27/11/20	6	3	SE	>1000	30	2	>10	4	None	n/a	n/a	n/a
0289	27/11/20	6	3	SE	>1000	80	3	>10	4	None	n/a	n/a	n/a
0290	20/12/20	6	1	SW	500-1000	70	3	>10	6	None	n/a	n/a	n/a
0291	20/12/20	6	1	SW	>1000	80	6	>10	6	Rain	10	~	Continuous
0290	20/12/20	6	2	SW	500-1000	80	3	>10	6	None	n/a	n/a	n/a
0291	20/12/20	6	2	SW	>1000	80	6	>10	6	None	n/a	n/a	n/a
0290	20/12/20	6	3	SW	500-1000	90	3	>10	6	None	n/a	n/a	n/a
0291	20/12/20	6	3	SW	>1000	70	5	>10	5	None	n/a	n/a	n/a
0292	22/12/20	7	1	W	500-1000	80	3	>10	2	Rain	30	Light	Intermittent
0294	22/12/20	7	1	W	500-1000	60	3	>10	2	None	n/a	n/a	n/a
0292	22/12/20	7	2	W	500-1000	80	3	>10	2	Rain	30	Light	Intermittent

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0294	22/12/20	7	2	W	500-1000	40	3	>10	2	None	n/a	n/a	n/a
0292	22/12/20	7	3	W	500-1000	60	3	>10	2	Rain	20	Light	Intermittent
0294	22/12/20	7	3	W	500-1000	20	3	>10	2	None	n/a	n/a	n/a
0293	23/12/20	8	1	NE	500-1000	100	1	>10	2	Rain	20	Light	Intermittent
0295	23/12/20	8	1	NE	500-1000	100	3	>10	2	Rain	10	Light	Continuous
0293	23/12/20	8	2	NE	500-1000	100	2	>10	2	Rain	25	Light	Intermittent
0295	23/12/20	8	2	NE	500-1000	90	3	>10	2	None	n/a	n/a	n/a
0293	23/12/20	8	3	NE	500-1000	90	2	>10	2	Rain	20	Light	Intermittent
0295	23/12/20	8	3	NE	500-1000	90	3	>10	2	None	n/a	n/a	n/a
0296	22/01/21	6	1	W	500-1000	30	1	>10	1	None	n/a	n/a	n/a
0297	22/01/21	6	1	W	500-1000	70	2	>10	2	None	n/a	n/a	n/a
0296	22/01/21	6	2	W	500-1000	30	1	>10	2	None	n/a	n/a	n/a
0297	22/01/21	6	2	W	500-1000	70	2	>10	2	None	n/a	n/a	n/a
0296	22/01/21	6	3	W	500-1000	70	2	>10	2	None	n/a	n/a	n/a
0297	22/01/21	6	3	W	500-1000	70	2	>10	2	None	n/a	n/a	n/a
0298	27/01/21	7	1	W	500-1000	100	1-2	>10	6	None	n/a	n/a	n/a
0299	27/01/21	7	1	W	>1000	100	1	>10	7	None	n/a	n/a	n/a
0298	27/01/21	7	2	W	500-1000	100	2	>10	6	None	n/a	n/a	n/a
0299	27/01/21	7	2	W	>1000	90	1	>10	7	None	n/a	n/a	n/a
0298	27/01/21	7	3	W	>1000	100	1-2	>10	6	None	n/a	n/a	n/a
0299	27/01/21	7	3	W	>1000	90	1	>10	6	None	n/a	n/a	n/a
0300	31/01/21	8	1	E	>1000	90	2	>10	0	None	n/a	n/a	n/a
0301	31/01/21	8	1	E	>1000	80	2	>10	2	None	n/a	n/a	n/a
0300	31/01/21	8	2	E	>1000	100	2	>10	0	None	n/a	n/a	n/a
0301	31/01/21	8	2	E	>1000	100	2-3	>10	2	None	n/a	n/a	n/a
0300	31/01/21	8	3	E	>1000	100	2-3	>10	2	None	n/a	n/a	n/a
0301	31/01/21	8	3	E	>1000	100	2-3	>10	1	None	n/a	n/a	n/a
0302	12/02/21	8	1	SE	>1000	10	2	>10	1	None	n/a	n/a	n/a
0303	12/02/21	8	1	SE	>1000	<5	2	>10	1	None	n/a	n/a	n/a
0302	12/02/21	8	2	SE	>1000	<5	2	>10	1	None	n/a	n/a	n/a
0303	12/02/21	8	2	SE	>1000	<5	2	>10	1	None	n/a	n/a	n/a
0302	12/02/21	8	3	SE	>1000	<5	3	>10	1	None	n/a	n/a	n/a
0303	12/02/21	8	3	SE	>1000	<5	3	>10	1	None	n/a	n/a	n/a
0304	17/02/21	6	1	SW	500-1000	70	3	>10	2	None	n/a	n/a	n/a
0305	17/02/21	6	1	SW	>1000	70	3	>10	3	None	n/a	n/a	n/a
0304	17/02/21	6	2	SW	500-1000	60	3	>10	3	None	n/a	n/a	n/a
0305	17/02/21	6	2	SW	>1000	50	4	>10	3	None	n/a	n/a	n/a

Survey Ref	Date	VP	Hour	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp (°C)	Precipitation	Pptn. (% Hr)	Intensity	Duration
0304	17/02/21	6	3	SW	>1000	70	4	>10	3	None	n/a	n/a	n/a
0305	17/02/21	6	3	SW	>1000	60	4	>10	3	None	n/a	n/a	n/a
0306	26/02/21	7	1	n/a	100-500	100	0	2-5	5.5	None	n/a	n/a	n/a
0307	26/02/21	7	1	SW	500-1000	40	3	>10	9	None	n/a	n/a	n/a
0306	26/02/21	7	2	SW	100-500	99	1	5-10	6.5	None	n/a	n/a	n/a
0307	26/02/21	7	2	SW	500-1000	55	3	>10	8	None	n/a	n/a	n/a
0306	26/02/21	7	3	SW	500-1000	80	1	>10	9	None	n/a	n/a	n/a
0307	26/02/21	7	3	SW	500-1000	45	3	>10	7.5	None	n/a	n/a	n/a
0308	19/03/21	6	1	W	>1000	30	2	>10	11	None	n/a	n/a	n/a
0309	19/03/21	6	1	S	>1000	70	2	>10	11	None	n/a	n/a	n/a
0308	19/03/21	6	2	W	>1000	40	2	>10	12	None	n/a	n/a	n/a
0309	19/03/21	6	2	S	>1000	80	1	>10	10	None	n/a	n/a	n/a
0308	19/03/21	6	3	SW	>1000	70	2	>10	11	None	n/a	n/a	n/a
0309	19/03/21	6	3	S	>1000	80	2	>10	9	None	n/a	n/a	n/a
0310	22/03/21	7	1	SW	500-1000	100	2	>10	8.5	None	n/a	n/a	n/a
0311	22/03/21	7	1	SW	500-1000	100	2	>10	7.5	None	n/a	n/a	n/a
0310	22/03/21	7	2	SW	500-1000	100	3	>10	8	None	n/a	n/a	n/a
0311	22/03/21	7	2	SW	500-1000	100	1	>10	7	None	n/a	n/a	n/a
0310	22/03/21	7	3	SW	500-1000	100	2	>10	8	None	n/a	n/a	n/a
0311	22/03/21	7	3	SW	100-500	100	1	>10	7	None	n/a	n/a	n/a
0312	24/03/21	8	1	SW	500-1000	70	3	>10	5	None	n/a	n/a	n/a
0313	24/03/21	8	1	SW	500-1000	50	3	>10	11	None	n/a	n/a	n/a
0312	24/03/21	8	2	SW	500-1000	70	3	>10	8.5	None	n/a	n/a	n/a
0313	24/03/21	8	2	SW	500-1000	80	3	>10	12	None	n/a	n/a	n/a
0312	24/03/21	8	3	SW	500-1000	80	3	>10	8.5	None	n/a	n/a	n/a
0313	24/03/21	8	3	SW	500-1000	100	3	>10	10,5	None	n/a	n/a	n/a

APPENDIX 3: Flight Activity Survey Results

This appendix provides the five-minute summary records and the detailed target and secondary species data from the flight activity surveys completed between April 2018 to August 2019 and September 2020 to March 2021.

Table A3.1 provides the notes from five-minute summaries of all bird activity, including non-target/secondary species, recorded during the individual watches. Species names for the corresponding BTO code are provided in Table A1.1: All Birds Recorded and their Status. Records of flight activity for which the duration at each flight height band were recorded are provided in Table A3.2. Any notable non-flying bird records from the flight activity surveys are included in Table A3.3.

Table A3.1: Flight Activity Survey Details – Five Minute Summaries (April 2018 to August 2019 and September 2020 to March 2021)

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0001	20/04/18	2	13:45	13:50		BZ		Common buzzard in buffer by Knockgray Farm (Low height).
0001	20/04/18	2	14:10	14:15		BZ		Common buzzard on site at M1 height band.
0001	20/04/18	2	14:20	14:25		RN		Raven on site. Flying north over Heathery Wood.
0003	20/04/18	2	16:45	16:50	1	GD		Three flying at Low height, heading northwest past Dalbonniton Knowe.
0003	20/04/18	2	16:50	16:55	2	CU		Flying at Low height, heading southwest to the southeast of the VP.
0004	20/04/18	3	17:25	17:30		SH		Female sparrowhawk flew south 20 m away from VP3, Very Low for 15 seconds.
0005	22/04/18	1	09:20	09:25		BZ		Common buzzard flew east over site at M1 height.
0005	22/04/18	1	09:50	09:55		RN		Raven flew southeast past VP at Low height.
0005	22/04/18	1	10:20	10:25		RN		Two ravens flew north past VP.
0006	22/04/18	1	12:55	13:00		RN		One raven at Low height, flew southeast past VP then through site.
0007	30/04/18	4N	14:50	14:55		BZ		Common buzzard to north of VP along forest edge.
0007	30/04/18	4N	15:30	15:35		BZ		Pair of common buzzards north of VP along forest edge.
0007	30/04/18	4N	16:35	16:40		BZ		Six common buzzards to northeast of VP.
0007	30/04/18	4N	16:40	16:45		SH	BZ	Female sparrowhawk came from wood south past VP then flew over site. Three common buzzards still active.
0007	30/04/18	4N	16:45	16:50	1	KT		Two red kites - probably a pair. To the north of the VP, heading southeast over the forestry and away east. At Medium and High heights.
0007	30/04/18	4N	16:50	16:55	1	KT		Continuation of previous record.
0008	30/04/18	4S	18:55	19:00	1	KT	BZ	Red kite out hunting at M1 height. Three common buzzard over Furmiston Craig at M1 height.
0008	30/04/18	4S	19:00	19:05		RN	BZ	Three common buzzard still active. Raven in T-shaped wood flying at Very Low height to southwest of VP.
0008	30/04/18	4S	19:35	19:40		RN		Raven again, Very Low at same T-shaped Wood.
0008	30/04/18	4S	19:40	19:45		RN		Raven again around T-shaped wood - Very Low.
0008	30/04/18	4S	19:55	20:00		RN		Raven again around T-shaped wood - Very Low.
0008	30/04/18	4S	20:10	20:15	2	KT		To the west of the VP at Very Low height.
0010	07/05/18	3	15:50	15:55		BZ		One common buzzard hunting at Low and M1 heights.
0009	07/05/18	2	16:25	16:30		BZ		Common buzzard in buffer to south of site at M2 height.
0010	07/05/18	3	16:30	16:35	1	KT		Red kite hunting, moving west from Knockwhirn to Willieanna at Very Low height.
0010	07/05/18	3	17:00	17:05		RN		One adult raven at Very Low height.
0010	07/05/18	3	17:10	17:15		BZ		One common buzzard at High and M2 heights.
0010	07/05/18	3	17:25	17:30		BZ		One common buzzard at High and M2 heights.
0011	07/05/18	2	19:15	19:20		RN		Three ravens in middle of site at Low height.
0012	07/05/18	3	19:20	19:25	1	BK		Adult male black grouse lekking near VP. Accidentally flushed when trying to locate it.
0012	07/05/18	3	20:15	20:20		RN		Two adult ravens at Low and Very Low heights.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0014	15/05/18	4S	11:10	11:15		RN		Two ravens at Very Low height, on site towards Furmiston Craig.
0014	15/05/18	4S	11:20	11:25	1	K.	RN	Common kestrel hunting around sheepfold to west of VP at Low and M1 heights. One raven flying at Very Low height.
0013	15/05/18	4N	11:25	11:30		BZ		One common buzzard hunting at M2 and Very High heights.
0013	15/05/18	4N	11:30	11:35		BZ		One common buzzard hunting at M2 and Very High heights.
0014	15/05/18	4S	11:35	11:40		RN		One raven Very Low on Furmiston Craig.
0013	15/05/18	4N	11:40	11:45		BZ		One common buzzard hunting at Very Low, Low and M1 heights.
0014	15/05/18	4S	11:50	11:55	2	K.		Female common kestrel hunting again at Low height, in same area as previous record.
0014	15/05/18	4S	11:55	12:00		BZ		At M2 height to southeast of the VP.
0013	15/05/18	4N	12:00	12:05		BZ		Three common buzzards hunting together at M1 and Very High heights.
0014	15/05/18	4S	12:00	12:05		BZ		Two common buzzards still, another common buzzard at M1 height onsite to west-southwest of VP.
0014	15/05/18	4S	12:05	12:10		RN		Two ravens by Furmiston Craig, on site at M2 height.
0013	15/05/18	4N	12:10	12:15		RN		One raven at Low and M1 heights.
0014	15/05/18	4S	12:15	12:20		RN	BZ	One raven at M1 height by Furmiston Craig. One common buzzard hunting near "T" plantation at High to Low heights.
0014	15/05/18	4S	12:35	12:40		BZ		One common buzzard, M1 height to southwest of VP.
0014	15/05/18	4S	12:40	12:45		BZ		Continuation of previous record.
0014	15/05/18	4S	12:50	12:55	3	K.		To southwest of the VP, close to the previous two records. Low and M1 heights.
0013	15/05/18	4N	13:00	13:05		RN	BZ	One raven and one common buzzard heading southwest. Common buzzard at Very High and M2 heights, the raven at M1, Low and Very Low heights.
0013	15/05/18	4N	13:05	13:10		RN	BZ	Raven at Low and M1 heights with some display flighting. One common buzzard at Low and M1 heights over Knockwhirn.
0014	15/05/18	4S	13:05	13:10		RN	BZ	Raven flew into T-shaped plantation from the north at Low height. Common buzzard onsite to the southwest of the VP at M1 height.
0014	15/05/18	4S	13:10	13:15		RN		Raven by T-shaped plantation at Very Low height.
0014	15/05/18	4S	13:15	13:20		RN		Raven by T-shaped plantation at Very Low height.
0014	15/05/18	4S	13:25	13:30		RN	BZ	Raven by T-shaped plantation at Very Low height. One common buzzard at M2 height to southwest of VP. Three ravens onsite, north off Furmiston Craig.
0013	15/05/18	4N	13:30	13:35		BZ		Common buzzard hunting at low and Very Low heights over Knockwhirn.
0014	15/05/18	4S	13:30	13:35	4	K.	RN	Female common kestrel hunting to south of VP, swooped down and lost to view. Raven around T-shaped plantation.
0014	15/05/18	4S	13:45	13:50		RN		One raven over Furmiston Craig at Very Low height.
0016	15/05/18	4S	14:35	14:40		RN		Raven at Very Low height.
0016	15/05/18	4S	14:45	14:50	1	K.		Male common kestrel direct southwesterly flight to south of the VP, no hovering, lost low to ground.
0015	15/05/18	4N	15:05	15:10		BZ		Common buzzard off to north at M2 height.
0015	15/05/18	4N	15:10	15:15		BZ		Continuation of previous record.
0016	15/05/18	4S	15:15	15:20		BZ	C.	One common buzzard being mobbed by a carrion crow, then a second common buzzard appeared. Both birds then hunting over Furmiston Craig.
0016	15/05/18	4S	15:20	15:25	2	K.	BZ	Three common buzzards hunting over Furmiston Craig at Low, M1 and M2 heights. Adult male common kestrel hunting to south of VP.
0016	15/05/18	4S	15:25	15:30		BZ		One common buzzard hunting over Furmiston Craig at Low and M1 heights.
0016	15/05/18	4S	15:30	15:35	3	K.	BZ	Same adult male common kestrel hunting as above. Common buzzard still hunting over Furmiston Craig at low height.
0016	15/05/18	4S	17:00	17:05	4	KT		Red kite hunting, heading south towards Furmiston Craig. Lost low against background.
0019	21/05/18	1	13:20	13:25		BZ		One common buzzard at M1 height in middle of site.
0020	21/05/18	1	17:00	17:05		RN		One raven to east of VP, flew south at Low height.
0021	23/05/18	3	09:35	09:40	1	CU		Flying northwest over Quantans Hill at Very Low height.
0022	23/05/18	4N	09:55	10:00	1	K.		Male common kestrel hunting at Very Low height around Rider's Knowe.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0022	23/05/18	4N	10:00	10:05	1	K.		Continuation of previous record.
0021	23/05/18	3	10:35	10:40	2	KT		Circled to west of Knockwhirn then headed south over Marbrack and beyond at M2 and Very High heights.
0021	23/05/18	3	10:40	10:45	2	KT		Continuation of previous record.
0022	23/05/18	4N	12:05	12:09	2	K.		Female common kestrel hunting to south of Knockwhirn at Low height.
0023	23/05/18	2	12:25	12:30		BZ		Three common buzzards in buffer to south. Height M2 - drifted southeast.
0023	23/05/18	2	13:10	13:15		RN		One raven flew northeast past VP then onto site at M1 height.
0024	23/05/18	4S	13:40	13:45		BZ		Single common buzzard soaring to north of Marscalloch Hill, drifted southeast at M1 height.
0024	23/05/18	4S	13:50	13:55		BZ		Pair of common buzzards soaring to north of Marscalloch Hill, drifted north towards Craigengillan Hill.
0023	23/05/18	2	14:25	14:30		RN		Two ravens flew from the middle of the site west and then into west buffer.
0025	28/05/18	1	14:25	14:30		BZ		One common buzzard at M1 height, flew east past VP hunting.
0025	28/05/18	1	14:30	14:35		RN		Two ravens onsite at M1 height, circling to the northeast of VP.
0025	28/05/18	1	15:20	15:25	1	K.	RN	Male common kestrel headed east from Willieanna towards Knockwhirn and headed away north. Also two ravens over VP at M2 height.
0025	28/05/18	1	15:35	15:40	2	KT		Picked up to south of Dunool. Headed southeast over Quantans Hill, then turned northeast and then south and out of viewshed.
0025	28/05/18	1	15:40	15:45	2	KT		Continuation of previous record.
0026	28/05/18	1	19:15	19:20	1	KT		Red kite at M1 height over Willieanna and heading northeast.
0026	28/05/18	1	19:30	19:35		RN		Raven flying west past VP at Low height.
0026	28/05/18	1	19:45	19:50		RN		Raven flying west past VP at Low height.
0028	30/05/18	4S	15:40	15:45		RN		Raven at Low height, onsite by Furmiston Craig.
0028	30/05/18	4S	16:20	16:25		RN		Two ravens at Very Low height around T-shaped wood west-southwest of the VP.
0028	30/05/18	4S	16:45	16:50		RN		One raven, Very Low around the T-shaped wood.
0028	30/05/18	4S	17:00	17:05		BZ		One common buzzard at M1 height, onsite, hunting approx. 1.5 km south-southeast of VP.
0028	30/05/18	4S	17:05	17:10	1	K.		Common kestrel hunting to north of Furmiston Craig.
0028	30/05/18	4S	17:15	17:20	2	K.		Same bird as previous record, still hunting to northeast of Furmiston Craig.
0029	05/06/18	4S	15:55	16:00	1	KT		Two red kites picked up to east of Furmiston Craig, headed towards Little Loskie and then turned northeast and flew across the site and out of viewshed.
0029	05/06/18	4S	16:00	16:05	1	KT		Continuation of previous record.
0030	05/06/18	4N	16:00	16:05		BZ		One common buzzard hunting in buffer at M1 height.
0029	05/06/18	4S	16:15	16:20	2	K.	BZ	Common kestrel at Low and Very Low heights to northeast of Furmiston Craig. Common buzzard at M1 height over Furmiston Craig.
0030	05/06/18	4N	16:15	16:20	1	K.		Common kestrel hunting over Knockwhirn.
0029	05/06/18	4S	16:50	16:55	3	KT	BZ	One red kite over Marbrack and away southeast at High height. One common buzzard flying at Low height around Furmiston Craig.
0029	05/06/18	4S	17:30	17:35		BZ		Common buzzard onsite towards VP3 at High and M1 heights.
0029	05/06/18	4S	17:45	17:50	4	SN		Short display flight near sheepfold to southwest of VP.
0029	05/06/18	4S	17:50	17:55		RN		One raven at M1 height, flying west over site.
0032	11/06/18	2	09:10	12:10	A	CM		Five common gulls at Very Low and Low heights in area to north of Knockgray Park, foraging on site with occasional short flights.
0031	11/06/18	3	10:15	10:20		BZ		Common buzzard hunting onsite to north-northeast of VP at M1 heights.
0031	11/06/18	3	10:45	10:50	1	K.		Common kestrel hunting, heading south past Marback.
0032	11/06/18	2	11:35	11:40		LB		One lesser black-backed gull at M1 height, heading east.
0034	11/06/18	2	12:40	13:30	A	CM		Eight adult common gulls foraging in area to North of Knockgray Park. Many short flights at Very Low and Low heights. All headed off west and southwest.
0033	11/06/18	3	13:25	13:30		BZ		Common buzzard (M1 height). Flew from plantation to north of VP out to hunt.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0033	11/06/18	3	13:30	13:35		BZ		Continuation of previous record.
0033	11/06/18	3	13:35	13:40		BZ		Continuation of previous record.
0033	11/06/18	3	13:40	13:45		BZ		Continuation of previous record.
0033	11/06/18	3	15:30	15:35		RN		Raven at M1 height flying south through site.
0037	19/06/18	4S	14:35	14:40		BZ		Common buzzard at M1 height, hunting over Knockwhirn.
0038	19/06/18	4N	14:55	15:00		BZ		Single common buzzard hunting at top of Green Hill, and one hunting on west flank of Green Hill.
0038	19/06/18	4N	15:05	15:10		BZ		Single common buzzard over woodland on the east side of Green Hill, at Low height.
0038	19/06/18	4N	15:15	15:20		RN	C.	At least six ravens circling at Low height with carrion crows on the south side of Black Shoulder.
0037	19/06/18	4S	15:25	15:30	1	KT		Red kite at Medium height, heading north past VP and away west.
0038	19/06/18	4N	15:30	15:35		RN		Single raven circled at Low height for 10 seconds on the south flank of Beninner.
0037	19/06/18	4S	15:45	15:50		BZ		Common buzzard hunting at Medium height near "T" shaped wood.
0037	19/06/18	4S	15:50	15:55		BZ		Common buzzard hunting at Medium height near "T" shaped wood.
0037	19/06/18	4S	16:05	16:10	2	KT		Red kite at Medium height, heading south past Furmiston Craig.
0038	19/06/18	4N	16:10	16:15		BZ		Two common buzzards circling over Green Hill.
0037	19/06/18	4S	16:20	16:25		RN		Four ravens around Furmiston Craig at Low height.
0039	20/06/18	2	16:40	16:45		CM		Two common gulls at Very Low height over field just north of Knockgray.
0039	20/06/18	2	16:55	17:00		BZ		Common buzzard at Low height in buffer to south of VP.
0039	20/06/18	2	17:00	17:05		RN		Raven at Low height flew east past VP, then onto site.
0040	20/06/18	3	17:30	17:35		BZ		Common buzzard flew southwest from the conifer block to north of VP3 at Very Low height.
0041	27/06/18	1	11:15	11:20	1	CU		An adult curlew flying Very Low along the valley, calling constantly. Territorial flight.
0041	27/06/18	1	11:35	11:40		RN		Raven flew west past the south side of the VP at Low height.
0041	27/06/18	1	12:20	12:25	2	K.		Adult male common kestrel flying and constantly calling in area on eastern side of Willieanna.
0041	27/06/18	1	13:10	13:15	3	K.		A pair of common kestrel hunting to the south of Willieanna. Both returned to the small wood area to the east of the VP.
0042	27/06/18	1	13:45	13:50		RN		Two adult ravens flew low past the south side of the VP heading east.
0042	27/06/18	1	16:10	16:15	1	KT		Red kite gliding low past the south side of the VP heading west.
0046	06/07/18	3	12:45	12:50		BZ		Common buzzard circling to the southeast of Knockwhirn at M2 and High heights.
0046	06/07/18	3	12:50	12:55		BZ		Continuation of previous record.
0046	06/07/18	3	12:55	13:00		BZ		Common buzzard drifting towards Knockwhirn at High height.
0046	06/07/18	3	13:05	13:10		BZ		Common buzzard circling over Marcalloch Hill at M2 and High heights. Dropped behind hill at 13:08.
0047	10/07/18	4S	14:25	14:30	1	K.		Common kestrel hunting in a looping flight from north of Furmiston Craig and heading east.
0047	10/07/18	4S	15:45	15:50		RN		Raven flew west over site at M1 height.
0049	17/07/18	1	06:25	06:30		RN		Raven flew east over site at M1 height.
0049	17/07/18	1	07:50	07:55		RN		Two ravens flew over site at Low height.
0050	17/07/18	1	11:25	11:30		RN		Raven at Very Low height near VP.
0051	25/07/18	4S	10:15	10:20		BZ		Common buzzard near "T" shaped wood, west-southwest of VP, at M1 height.
0052	25/07/18	4N	10:15	10:35	1	KT		Three birds initially but one split off and headed northeast after a minute or so. Both birds remaining, hunted together and apart before moving off at Very Low height to the west and lost behind Knockwhirn.
0052	25/07/18	4N	10:16	11:00	2A	K.		Two common kestrels silhouetted and unable to age or sex them as a result. Hunting on side of Knockwhirn together. Dropped out of view behind skyline from time to time but reappeared again relatively quickly each time.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0051	25/07/18	4S	10:20	10:25		BZ		Common buzzard near "T" shaped wood, west-southwest of VP, at M1 height.
0051	25/07/18	4S	10:35	10:40		BZ		Common buzzard near "T" shaped wood, west-southwest of VP, at M1 height.
0051	25/07/18	4S	10:45	10:50	1	K.	BZ	Common kestrel went to ground - hunting sheepfold area to west of the VP. Also common buzzard at M1 height, again by "T" shaped wood.
0052	25/07/18	4N	10:45	11:00	2B	K.		Common kestrel hunting on lower slopes of Knockwhirn before moving up to join previous two birds, suggests that previous two birds are either its young or young and female as no dispute and hunted together.
0051	25/07/18	4S	10:50	10:55		BZ		Common buzzard at M2 height again by "T" shaped wood.
0052	25/07/18	4N	10:55	11:00		BZ		Two common buzzards at M2, M1 and Low heights circling and calling over Knockwhirn before heading northeast together.
0051	25/07/18	4S	11:00	11:05		BZ		Common buzzard at M2 height again by "T" shaped wood.
0052	25/07/18	4N	11:05	11:10	3	KT		Adult red kite briefly flew around top of Knockwhirn.
0051	25/07/18	4S	11:10	11:15		BZ		Common buzzard at M2 height again by "T" shaped wood.
0051	25/07/18	4S	11:15	11:20	2	K.		Common kestrel hunting at plantation to west of the VP.
0052	25/07/18	4N	11:15	11:20		BZ		Common buzzard on lower slopes of Knockwhirn at Very Low and Low heights.
0052	25/07/18	4N	11:20	11:25		BZ		Continuation of previous record.
0052	25/07/18	4N	11:25	11:30		BZ		Continuation of previous record.
0051	25/07/18	4S	11:30	11:35	3	K.		Common kestrel hunting over sheepfold / plantation area to west of the VP and heading away to north.
0052	25/07/18	4N	11:30	11:35	4	KT		Red kite hunting to south of Beninner.
0052	25/07/18	4N	11:35	11:40	5	K.		Common kestrel hunting to east of Knockwhirn.
0051	25/07/18	4S	11:40	11:45		RN	BZ	Raven at Low height on slope of Knockwhirn. Two common buzzards in the southeast of the site at M2 height.
0052	25/07/18	4N	11:45	11:50	6	K.	BZ, RN	Two common kestrels hunting together to south of Beninner; common buzzard at High height hunting between Knockwhirn and Beninner; raven at High height heading west.
0052	25/07/18	4N	11:50	11:55		BZ		Common buzzard on lower slopes of Knockwhirn at Very Low and Low heights, still hunting, and second common buzzard lower down in Glenkens at M1 and Low heights.
0052	25/07/18	4N	11:55	12:00		BZ		Both common buzzards from previous record hunting in Glenkens at M1 and Low heights.
0052	25/07/18	4N	12:00	12:05	7	KT		Red kite hunting, heading east from Knockwhirn and then south.
0051	25/07/18	4S	12:05	12:10	4	KT		Red kite hunting, heading southeast past VP.
0051	25/07/18	4S	12:15	12:20	5	K.	RN	Common kestrel hunting at sheepfold to west of VP; raven at Very Low height alongside the common kestrel.
0051	25/07/18	4S	12:25	12:30		BZ		Common buzzard to the west-southwest of VP at M1 height.
0052	25/07/18	4N	12:25	12:30		BZ		Two common buzzards at High height hunting towards Green Hill; one common buzzard at Low height hunting over Polshagg Burn area.
0051	25/07/18	4S	12:30	12:35		BZ		Continuation of previous record.
0051	25/07/18	4S	12:35	12:40		RN	BZ	Five ravens over east corner of site at M1 height. Common buzzard at M1 height on slope of Knockwhirn.
0051	25/07/18	4S	12:40	12:45		BZ		Common buzzard at M1 height on the slope of Knockwhirn still.
0052	25/07/18	4N	12:40	12:45		RN		Raven at High height heading west over shoulder of Beninner.
0051	25/07/18	4S	12:55	13:00	6	K.		Common kestrel hunting, heading south past sheepfold to west of VP.
0051	25/07/18	4S	13:05	13:10		BZ		Common buzzard at M1 height to west-southwest of VP.
0052	25/07/18	4N	13:05	13:10		BZ		Common buzzard at High height hunting towards Green Hill.
0051	25/07/18	4S	13:10	13:15		BZ		Continuation of previous record.
0053	07/08/18	4S	11:35	11:40		BZ		Common buzzard hunting at Low height over Furmiston Craig.
0053	07/08/18	4S	12:00	12:05		BZ		Common buzzard hunting over Furmiston Craig again at M1 height.
0053	07/08/18	4S	12:20	12:25	1	K.	BZ	Adult female common kestrel hunting northeast of Furmiston Craig; two common buzzards hunting over Furmiston Craig at Low and M1 heights.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0053	07/08/18	4S	12:25	12:30	2	K.	BZ	Same adult female common kestrel hunting over Furmiston Craig at M1 and M2 heights.
0053	07/08/18	4S	12:35	12:40		BZ		Common buzzard hunting to east of Furmiston Craig at Low and M1 heights.
0053	07/08/18	4S	12:50	12:55	3	KT		Adult red kite hunting over area to east of Furmiston Craig.
0053	07/08/18	4S	13:10	13:15		BZ		Two common buzzards hunting at Low and M1 heights.
0053	07/08/18	4S	13:15	13:20		BZ		Three common buzzards hunting at Low and M1 heights.
0053	07/08/18	4S	13:20	13:25	4	KT	BZ	Adult red kite hunting to north of Furmiston Craig. Three common buzzards still hunting at Low and M1 heights.
0054	07/08/18	4N	14:55	15:00	1	KT		Red kite in brief flight across valley north of Knockwhirn.
0054	07/08/18	4N	15:00	15:05		BZ		Common buzzard hunting low down on slope of Knockwhirn at Very Low and Low heights.
0054	07/08/18	4N	15:40	15:45	2	K.		Juvenile common kestrel hunting over sheepfold area on edge of forestry to east of Knockwhirn.
0055	08/08/18	2	05:20	05:25		BZ	RN	Common buzzard over a belt of trees east-southeast of VP. Seven ravens flew from roosting near Knockgray.
0056	08/08/18	3	05:25	05:30		RN		Two ravens flew northwest over VP3 then west over next woodland block at Low height.
0055	08/08/18	2	05:50	05:55		HG		Herring gull at M2 height in buffer going west up river to south of VP.
0056	08/08/18	3	07:05	07:10	HH1	HH		Female hen harrier at Low height, heading north past Quantans Hill.
0055	08/08/18	2	07:25	07:30		RN		Two ravens at M1 height, south from site into buffer.
0057	08/08/18	2	09:40	09:45		RN		Raven flew east past VP at Low height.
0058	08/08/18	3	10:10	10:15		RN		Two ravens flew southwest over VP3, at Low height.
0057	08/08/18	2	10:15	10:20		RN		Two ravens near VP in buffer at M1 height.
0058	08/08/18	3	10:20	10:25		BZ		Common buzzard circled to the north of VP3, then flew into woodland block to northwest of VP3.
0058	08/08/18	3	10:35	10:40		RN		One raven flew west over Quantans Hill, at Low height.
0058	08/08/18	3	11:05	11:10		BZ		Two common buzzards circling over the east side of Knockwhirn.
0057	08/08/18	2	11:10	11:15		RN		Five ravens near VP. Aerial acrobatics at M2 height.
0058	08/08/18	3	11:10	11:15		BZ		As above (M2, M1) then lost against Knockwhirn background.
0059	22/08/18	1	12:10	12:15	1	K.		Common kestrel at Low height at Quantans Hill.
0059	22/08/18	1	12:35	12:40	2	K.		Common kestrel at Low height at Quantans Hill.
0060	22/08/18	4S	13:45	13:50	K.1	K.		Common kestrel at Low and Medium heights heading north from Furmiston Craig.
0060	22/08/18	4S	14:15	14:20		RN		Raven flew from Knockwhirn over Furmiston Craig.
0060	22/08/18	4S	14:55	15:00	KT1	KT		Red kite at Very Low and Low heights heading south past Furmiston Craig towards Big Loskie.
0062	22/08/18	4N	16:40	16:45		RN		Two ravens flew along the edge of the forestry on the east side of The Glenkens.
0061	22/08/18	1	18:10	18:15	1	PE		Two female peregrine falcons at Very Low height to north of Heathery Wood, heading northeast.
0065	05/09/18	4S	14:35	14:40		RN		Two ravens flew north from Furmiston Craig to T-shaped plantation at Low height.
0065	05/09/18	4S	15:35	15:40		RN		One raven flew southwest from woodland to the left of VP4 down the Marbrack Burn at Very Low height.
0065	05/09/18	4S	16:00	16:05	1	OP	RN	Osprey high over site, picked up over sheepfold to west of the VP and heading north-northeast. Two ravens flew from Furmiston Craig at High height to chase osprey. Osprey continued beyond VP4S into VP4N.
0064	05/09/18	4N	16:05	16:10	1	OP	RN	Osprey High over site (continuation from VP4S), heading notheast over Rider's Knowe and past Green Hill. Two ravens over site reacting to osprey.
0064	05/09/18	4N	16:10	16:15	1	OP	RN	Continuation of previous record. Five ravens over buffer.
0064	05/09/18	4N	16:45	16:50		RN		Two ravens over buffer.
0066	05/09/18	1	17:50	17:55		RN		One raven at heights M2 and high, heading south.
0067	05/09/18	4N	18:05	18:10		RN		Raven flying south over site.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0068	05/09/18	4S	18:05	18:10		RN		Raven flew south over VP towards Furmiston Crag at Low height.
0067	05/09/18	4N	18:10	18:15		BZ		Common buzzard flying east-northeast over site.
0066	05/09/18	1	18:15	18:20		RN		Two ravens at Low height, flying to west of VP calling.
0066	05/09/18	1	18:30	18:35		RN		Two ravens still in same area to west of VP at Low height.
0068	05/09/18	4S	19:10	19:15	1	SN		Two common snipe over sheepfold area to west of VP at M1 and M2 heights.
0068	05/09/18	4S	20:05	20:10		RN		One raven flew north from Furmiston Crag over VP at Low height. One raven flew from T-shaped plantation over VP at Low height.
0069	13/09/18	3	08:00	08:05		RN		Two ravens heading south at M1 height.
0071	17/09/18	2	08:05	08:10		BZ		Common buzzard at Low height at south edge of site.
0071	17/09/18	2	09:15	09:20	1	K.		Female common kestrel at Low height, heading north from Tup Park Knowe.
0071	17/09/18	2	09:40	09:45		RN		Two ravens flying north past VP then onto site at Low height.
0071	17/09/18	2	10:20	10:25		RN		One raven in buffer near VP at Very Low height.
0072	17/09/18	2	11:30	11:35		RN		One raven in buffer near VP at M1 height.
0072	17/09/18	2	11:50	11:55		RN		Two ravens at Low height in buffer to south.
0072	17/09/18	2	12:00	12:05		RN		One raven onsite to north of VP at M1 height.
0072	17/09/18	2	13:05	13:10		RN		Five ravens at M1 height flying east-northeast over VP then onto site.
0072	17/09/18	2	13:15	13:20	1	KT		One red kite flying at Low height, flying west, to the north of Tup Park Knowe
0073	25/09/18	1	11:00	11:05		RN		Two ravens onsite between VP1 and VP2 at M1 height.
0073	25/09/18	1	12:15	12:25	1	KT		Juvenile red kite at M1 and M2 heights, heading east from Willieanna to Knockwhirn.
0073	25/09/18	1	12:25	12:40	2	KT		Two adult red kites at M1 and Low heights, over Willieanna and Quantans Hill and away west.
0073	25/09/18	1	12:50	12:55		RN		One raven flew northeast past VP at Low height.
0073	25/09/18	1	13:10	13:15		RN		Raven flew north over VP at M1 height.
0073	25/09/18	1	13:25	13:30		RN		Two ravens at M1 height. On flying east over site at Low height.
0073	25/09/18	1	13:40	13:45		RN		Two ravens at M1 height near VP again.
0073	25/09/18	1	13:45	13:50		RN		Raven at Low height near VP.
0076	25/09/18	2	14:50	14:55		RN		Four ravens to south of VP at M1 height.
0076	25/09/18	2	14:55	15:00	1	K.		Adult female common kestrel hunting at Very Low height close to VP.
0075	25/09/18	4S	15:00	15:05		BZ		Common buzzard hunting on lower southern slope of Knockwhirn.
0075	25/09/18	4S	15:05	15:10		BZ		Continuation of previous record.
0075	25/09/18	4S	15:10	15:15		BZ		Continuation of previous record.
0076	25/09/18	2	15:10	15:15		RN		Two ravens flew east over site at M1 height.
0075	25/09/18	4S	15:15	15:20		BZ		Common buzzard as above, then drifted west at Low height.
0075	25/09/18	4S	15:50	15:55		H.		Grey heron flew low south, landed in ditch/burn by sheepfold 300 m northwest of VP4.
0075	25/09/18	4S	16:00	16:05	SN1	SN	RN	Two ravens flew at Very Low height to southwest over Furmiston Craig. Two common snipe at M1 height over sheepfold area to west of VP.
0076	25/09/18	2	16:05	16:10		RN		One raven flying near VP at Low height.
0075	25/09/18	4S	16:15	16:20	KT1	KT		One red kite at Low height heading east from Knockwhirn and then south, lost to sight/landed.
0076	25/09/18	2	16:20	16:25		RN		Two ravens flew north from near farm onto site at Low height.
0076	25/09/18	2	16:40	16:45		BZ		Common buzzard in middle of site at M1 height, hunting.
0075	25/09/18	4S	16:45	16:50		BZ		Common buzzard hunting at Low height on lower southern slope of Knockwhirn (possibly same bird as above).

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0075	25/09/18	4S	16:50	16:55		BZ		Common buzzard hunting low on lower southern slope of Knockwhirn still.
0075	25/09/18	4S	16:55	17:00		BZ		Two common buzzards hunting on slope of Knockwhirn, both birds drifted west together at Very Low height.
0077	01/10/18	4S	16:50	16:55		RN		One over Furmiston Crag, Very Low.
0078	01/10/18	4N	17:40	17:45		BZ		One hunting over Knockwhirn at M2 height.
0079	17/10/18	2	12:05	12:10		RN		Flew south over Tup Park Knowe.
0079	17/10/18	2	12:10	12:15		BZ		Adult hunting.
0080	17/10/18	3	12:55	13:00		RN		Flew southwest from Quantans Hill past VP and behind small plantation at Low and Very Low heights.
0079	17/10/18	2	13:15	13:20		RN		Flew north over VP.
0079	17/10/18	2	14:10	14:15	1	ML		Female juvenile hunting east and south of Tup Park Knowe - lost behind trees.
0080	17/10/18	3	14:15	14:20		BZ		Flew northwest from Knockwhirn area over Quantans Hill at Low height.
0079	17/10/18	2	14:35	14:40	2	ML		Female juvenile hunting west of Heathery Wood - lost behind trees. Same bird as previous record.
0082	17/10/18	3	15:45	15:50	1	GP		A flock of six golden plover picked up in the direction of Knockwhirn, flying south-southwest at M1 height. Continued quickly past the east side of the VP.
0081	17/10/18	2	16:00	16:05		BZ		Adult hunting.
0082	17/10/18	3	16:30	16:35		RN		Two ravens flying at Low height along the ridge of Knckwhirn, heading west before banking southwest towards and beyond Quantans Hill.
0081	17/10/18	2	17:10	17:15		RN		One flying over Knockgray Farm.
0082	17/10/18	3	17:20	17:25	2	SN		Two snipe took of from the rough pasture to the northeast of the VP and flew south at Very Low height, appearing to land again as they went over the brow.
0081	17/10/18	2	18:15	18:20		RN		One flew over Knockgray Farm at Low height.
0083	19/10/18	1	12:30	12:35		RN		Flying southwest along Benloch Burn at Low height.
0084	19/10/18	4N	13:10	13:15	1	H.		Northwest past VP at Very Low, Low and M1 heights.
0084	19/10/18	4N	13:15	13:20		RN		West from edge of site towards Knockwhirn at M1 height.
0083	19/10/18	1	13:20	13:25		RN		Flying northeast along Benloch Burn at Low height.
0083	19/10/18	1	13:55	14:00		RN		Two circling above vantage point before flying to Knockwhirn at M1 and M2 heights.
0084	19/10/18	4N	14:25	14:30		RN		Flew south past VP then on towards Furmiston at M1 height.
0083	19/10/18	1	14:35	14:40		RN		Circling over VP at Low height.
0083	19/10/18	1	14:55	15:00		BZ		Adult hunting.
0085	19/10/18	4S	15:45	15:50		RN		South over VP towards Furmiston at M1 height.
0085	19/10/18	4S	15:55	16:00		RN		Two to northeast of VP at Low height.
0086	19/10/18	1	16:05	16:10		RN		Flying over Knockwhirn at Low height.
0086	19/10/18	1	16:25	16:30		RN		Flying east over Knockwhirn at Low height.
0085	19/10/18	4S	16:40	16:45		RN		One flying east over site at Low height.
0086	19/10/18	1	17:25	17:30		RN		Two ravens circling over VP at Low height.
0086	19/10/18	1	17:35	17:40	1	WS		27 whooper swans flying southeast over North Liggat (19 adults and 8 juveniles).
0085	19/10/18	4S	17:45	17:50		RN		Two to north of VP on edge of site. Low height.
0087	26/10/18	4N	09:10	09:15		RN		One flew north over east side of site at M1 height.
0087	26/10/18	4N	11:05	11:10		RN		Two flew north over VP at M1 height.
0088	26/10/18	1	12:25	12:30		K.		Hunting north of Willieanna.
0088	26/10/18	1	12:55	13:00		K.		Hunting south of Willieanna.
0088	26/10/18	1	13:35	13:40		BZ		Adult flew from north to southeast at M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0089	26/10/18	4S	13:50	13:55	1	K.		Hunting, moving east to the north of Furmiston Craig.
0088	26/10/18	1	13:55	14:00		RN		Flew from east to west at M1 height.
0090	26/10/18	1	16:35	16:40		RN		Flew southwest across site at Low height.
0091	29/10/18	2	07:10	07:15		RN		Two birds at M1 height.
0091	29/10/18	2	07:25	07:30		RN		Three birds at M1 height.
0091	29/10/18	2	08:20	08:25		BZ		One adult at Low and M1 heights.
0091	29/10/18	2	08:35	08:40		RN		One bird at M1 height.
0091	29/10/18	2	09:10	09:15	1	KT		One circling northeast to the east of Craig of Knockgray before circling back southwest towards Carsphairn.
0091	29/10/18	2	09:25	09:30	2	KT		Circling around Tup Park Knowe.
0091	29/10/18	2	09:40	09:45	3	KT		Flying northeast past VP, then west over Craig of Knockgray.
0092	29/10/18	2	10:55	11:00		RN		Two birds at Low height.
0092	29/10/18	2	11:30	11:35		RN		One bird at M1 height.
0093	30/10/18	3	07:25	07:30		RN		Two birds at M1 height.
0093	30/10/18	3	07:50	07:55		RN		Two birds at M1 height.
0093	30/10/18	3	08:10	08:15		BZ		Adult bird flying south at Low height.
0094	30/10/18	3	10:55	11:00	1	PE		Possibly female bird, at M1 height heading northwest over Big Loskie and Quantans Hill.
0094	30/10/18	3	11:25	11:30		RN		Two birds at M2 height.
0095	31/10/18	3	07:35	07:40		RN		Flying southeast at M1 height.
0095	31/10/18	3	07:55	08:00		RN		Two flying around VP at M1 height.
0095	31/10/18	3	08:20	08:25		BZ		Flying south at Low height.
0095	31/10/18	3	09:05	09:10		RN		Two flying north at M1 height.
0096	31/10/18	2	11:45	11:50		RN		Flying east at M1 height.
0096	31/10/18	2	11:50	11:55		RN		Flying northeast at M2 height.
0096	31/10/18	2	12:25	12:30		RN		Flying around VP near plantation at Low height.
0096	31/10/18	2	12:35	12:40	1	KT		Hunting / foraging over Tup Park Knowe / Craig of Knockgray - hunting but not flying low at any point.
0096	31/10/18	2	13:05	13:10		BZ		Plantation near VP. One bird at M1 height.
0096	31/10/18	2	13:45	13:50		BZ		Plantation near VP. One bird at M1 height.
0096	31/10/18	2	14:20	14:25		RN		Two around plantation near VP at Low height.
0096	31/10/18	2	14:25	14:30		BZ		Adult bird flying north over VP.
0097	13/11/18	2	10:20	10:25		RN		Two ravens lingering around Knockgray Farm at Very Low height.
0097	13/11/18	2	10:25	10:30		RN		Two ravens still present at Knockgray Farm at Very Low height.
0099	13/11/18	4S	10:35	10:40	1	KT		Two birds flew south towards Furmiston Craig, circled over and headed northeast before looping back and heading away southwest.
0099	13/11/18	4S	10:35	10:40		BZ		Flew from sheepfold T-shaped wood and lingered over Furmiston Craig.
0099	13/11/18	4S	10:45	10:50		BZ		Flew south over VP towards east side of Furmiston Craig at Low height.
0099	13/11/18	4S	10:45	10:50		RN		Four birds west-southwest of Furmiston Hill at Low height.
0099	13/11/18	4S	10:55	11:00		RN		Two over Furmiston Hill then flew northeast at Low height.
0098	13/11/18	4N	11:20	11:25		BZ		Buzzard hunting along southern slope of Green Hill at Very Low and Low heights for 16 minutes.
0099	13/11/18	4S	11:20	11:25		BZ		Lingering over forest southeast of VP.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0098	13/11/18	4N	11:25	11:30		RN		Two ravens southwest over Beninner
0099	13/11/18	4S	11:25	11:30		RN		Four birds west-southwest of Furmiston Hill at Low height.
0098	13/11/18	4N	11:35	11:40		BZ		Hunting along forest edge to northeast of VP at Very Low and Low heights.
0097	13/11/18	2	11:40	11:45		RN		Flew east across viewshed.
0098	13/11/18	4N	11:40	11:45		RN		Four circling near Beninner Gairy then drifted south-southeast - flight at Low and M1 heights.
0099	13/11/18	4S	11:45	11:50		RN		Two flew west-southwest over VP then west over Furmiston Hill at Low height.
0098	13/11/18	4N	11:50	11:55		RN		Two circling over Green Hill at Low and Very Low heights.
0099	13/11/18	4S	11:50	11:55		BZ		Two lingering southwest of Furmiston Hill.
0099	13/11/18	4S	11:50	11:55	2	KT		Briefly in view heading west before lost behind Furmiston Craig.
0098	13/11/18	4N	12:00	12:05		RN		Flew southwest from Beninner to Knockwhirn at Low height.
0098	13/11/18	4N	12:00	12:05		BZ		Hunting southern slope of Green Hill at Very Low and Low heights.
0098	13/11/18	4N	12:05	12:10		BZ		Hunting southeast slope of Knockwhirn at Very Low height.
0099	13/11/18	4S	12:05	12:10		RN		Six over forestry west-northwest of Marscalloch Hill at Low height.
0098	13/11/18	4N	12:10	12:15	1	KT		Hunting to south of Nick of the Lochans.
0098	13/11/18	4N	12:10	12:15		BZ		Hunting to northwest of Polshagg Burn at Very Low and Low heights.
0098	13/11/18	4N	12:10	12:15		RN		Flew southwest from Rider's Knowe to Knockwhirn at Low height.
0099	13/11/18	4S	12:10	12:15		RN		Two flew west over T-shaped wood then over west side of Furmiston Craig at M1 height.
0099	13/11/18	4S	12:10	12:15		RN		Six birds. Three flew over northeast side of Furmiston Wood at Low height, two flew northeast at Low height, and one flew north from Furmiston Craig towards T-shaped wood.
0099	13/11/18	4S	12:15	12:20		RN		Three flew northeast from Furmiston Craig at Low heights.
0099	13/11/18	4S	12:15	12:20		RN		Two flew north-northwest from Furmiston Craig and east of T-shaped wood at M2 and Low heights.
0097	13/11/18	2	12:20	12:25		RN		Two ravens flying over VP at Craig of Knockgray.
0098	13/11/18	4N	12:20	12:25		RN		Eight calling over Green Hill / Beninner at Low and M1 heights.
0097	13/11/18	2	12:30	12:35	1	KT		Adult circling high over Craig of Knockgray before leaving viewshed.
0098	13/11/18	4N	12:30	12:35		RN		12 flew north over VP to Green Hill, then joined flock of eight. In view for 25 minutes at Very Low, Low and M1 heights.
0098	13/11/18	4N	12:30	12:35		BZ		Hunting southern slope of Green Hill at Very Low and Low heights.
0099	13/11/18	4S	12:35	12:40		RN		Four flew north-northeast from Marbrack then flew northeast over VP at M1 height.
0099	13/11/18	4S	12:35	12:40		RN		Eight over Furmiston Craig then flew northeast, to southeast of VP at M1 height.
0099	13/11/18	4S	12:40	12:45		RN		Two over forestry to south-southeast of VP at Low height.
0098	13/11/18	4N	12:50	12:55		RN		Flew north over west side of Beninner at Low height.
0099	13/11/18	4S	12:50	12:55		RN		One flew north-northwest from the west side of Furmiston Craig at Low height.
0099	13/11/18	4S	12:55	13:00		RN		Two lingering over forestry southeast of Furmiston Craig at M1 and Low heights.
0099	13/11/18	4S	12:55	13:00		RN		Five flew north-northwest from west side of Furmiston Craig at Low height.
0098	13/11/18	4N	13:00	13:05		RN		North over Knockwhirn at Very Low and Low heights.
0098	13/11/18	4N	13:00	13:05		RN		Northwest in front of VP at Low height.
0099	13/11/18	4S	13:00	13:05		RN		Two lingering at Very Low height over Furmiston Craig then landed.
0099	13/11/18	4S	13:05	13:10		RN		Same two birds as previous record - lingering over Furmiston Craig at Very Low height.
0099	13/11/18	4S	13:15	13:20		RN		Two lingering over forestry to southeast of Furmiston Craig at M1 and Low heights.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0098	13/11/18	4N	13:20	13:25		RN		Two flew southwest over Beninner at Very Low height.
0099	13/11/18	4S	13:20	13:25	3	KT		Circled up from Marbrack.
0100	13/11/18	2	13:40	13:45		RN		Flew over VP towards Knockgray Farm at Low height.
0100	13/11/18	2	14:00	14:05		BZ		Adult hunting near Knockgray Farm.
0102	13/11/18	4S	14:05	14:10		BZ		Hunting south of T-shaped wood at Very Low and Low heights.
0100	13/11/18	2	14:10	14:15		RN		Two flew over viewshed at Low height.
0102	13/11/18	4S	14:10	14:15		RN		Two west over Marbrack Burn at Low height.
0101	13/11/18	4N	14:15	14:20		BZ		Circling northwest of Knockwhirn at M1 height then drifted west.
0101	13/11/18	4N	14:20	14:25		RN		Two flew west-southwest from Green Hill summit and into valley at Low height.
0101	13/11/18	4N	14:25	14:25		RN		Circling Beninner at Low height.
0101	13/11/18	4N	14:25	14:30		RN		Flew northwest over VP along northeast side of Knockwhirn at M1 and Low heights.
0102	13/11/18	4S	14:25	14:30		RN		Northeast over forestry at Very Low height.
0102	13/11/18	4S	14:25	14:30		BZ		West over Furmiston Craig at Low and Very Low heights.
0101	13/11/18	4N	14:30	14:35		BZ		Lingering over south side of Knockwhirn at Low height.
0101	13/11/18	4N	14:30	14:35		RN		Lingering over south slope of Beninner at Low height.
0102	13/11/18	4S	14:30	14:35		RN		Circling over forestry east-southeast of VP at Very Low and Low heights.
0102	13/11/18	4S	14:30	14:35	1	GD		Flying northeast, following the Marbrack Burn.
0102	13/11/18	4S	14:30	14:35		RN		West over T-shaped wood at M1 height.
0101	13/11/18	4N	14:35	14:40	1	GD		Flew northeast over VP, following line of edge of forestry.
0100	13/11/18	2	15:00	15:05		RN		Two lingering around VP.
0102	13/11/18	4S	15:00	15:05		RN		Seven northeast over forestry to east of Furmiston Craig, at Very Low and Low heights.
0100	13/11/18	2	15:05	15:10		RN		Same two ravens as previous record - lingering around VP.
0102	13/11/18	4S	15:15	15:20		BZ		Southwest beyond Furmiston Craig at Very Low and low heights.
0102	13/11/18	4S	15:15	15:20		RN		Two northeast over Furmiston Craig at Low height.
0100	13/11/18	2	15:20	15:25		BZ		Adult bird hunting.
0101	13/11/18	4N	15:20	15:25		RN		Flew east-northeast between Beninner and Green Hill at M1 and Low heights.
0101	13/11/18	4N	15:25	15:30		RN		Flew northwest from forest at Craigengillan Hill then between Beninner and Green Hill at Low height.
0102	13/11/18	4S	15:25	15:30		RN		Two circling over forestry to east of Furmiston Craig, at Low height.
0101	13/11/18	4N	15:30	15:35		BZ		Hovering over northeast slope of Kockwhirn at Very Low and Low heights.
0101	13/11/18	4N	15:30	15:35		RN		Flew over Green Hill to Beninner at Low height.
0101	13/11/18	4N	15:35	15:40		RN		Flew north-northeast over southwest slope of Beninner at Low height.
0102	13/11/18	4S	15:40	15:45		RN		Southwest over T-shaped wood at Low height.
0102	13/11/18	4S	15:40	15:45		RN		West over Furmiston Craig at Very Low and Low heights.
0101	13/11/18	4N	15:55	16:00	2	EA		Probable female flew southwest across site from Green Hill direction.
0101	13/11/18	4N	15:55	16:00		RN	EA	Mobbing golden eagle.
0100	13/11/18	2	16:00	16:05		RN		Flew west through viewshed.
0102	13/11/18	4S	16:00	16:05		RN		Southwest from Knockwhirn at Low and Very Low heights.
0101	13/11/18	4N	16:10	16:15		RN		Lingering over Beninner at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0100	13/11/18	2	16:20	16:25		RN		Two ravens lingering around Knockgray Farm.
0102	13/11/18	4S	16:40	16:45		RN		South over T-shaped wood at Very Low height.
0103	19/11/18	4N	10:05	10:10		RN		Two flying southwest through viewshed at Low height.
0103	19/11/18	4N	10:15	10:20		RN		Four lingering over Green Hill at Low height.
0103	19/11/18	4N	10:20	10:25		RN		Two flying south over Beninner at Low height.
0103	19/11/18	4N	10:50	10:55		RN		Two lingering over Knockwhirn.
0103	19/11/18	4N	10:55	11:00		RN		Two lingering over Knockwhirn at Low height.
0103	19/11/18	4N	11:00	11:05		RN		Two flew east across viewshed at Low height.
0103	19/11/18	4N	11:40	11:45		BZ		Adult hunting over Knockwhirn.
0103	19/11/18	4N	11:45	11:50		RN		Four circling over Green Hill at Low height.
0103	19/11/18	4N	12:05	12:10	1	KT		Adult hunting over Beninner then behind Knockwhirn.
0103	19/11/18	4N	12:10	12:15	1	KT		Same bird as previous record. Still hunting.
0103	19/11/18	4N	12:40	12:45		RN		Two flew east across viewshed.
0104	19/11/18	4S	13:40	13:45		RN		Three lingering over Knockwhirn,
0104	19/11/18	4S	14:00	14:05		RN		Flying west across viewshed.
0104	19/11/18	4S	14:05	14:10		RN		Flying west across viewshed.
0104	19/11/18	4S	14:20	14:25	1	K.		Female / juvenile hunting over Furmiston Craig.
0104	19/11/18	4S	14:40	14:45		RN		Two flying east across viewshed.
0104	19/11/18	4S	14:50	14:55	2	KT		Hunting over Furmiston Craig before lost behind terrain.
0104	19/11/18	4S	15:30	15:35		RN		Flying east over viewshed.
0104	19/11/18	4S	15:50	15:55		RN		Two circling near Furmiston Craig.
0104	19/11/18	4S	15:55	16:00		RN		Two still present around Furmiston Craig.
0105	20/11/18	1	08:05	08:10		RN		At M1 height.
0105	20/11/18	1	09:00	09:05	1	KT		Adult / Immature female around Willieanna.
0105	20/11/18	1	09:55	10:00	2	KT		To the east and north of Craig of Knockgray.
0105	20/11/18	1	10:35	10:40		RN		Two at Low height.
0105	20/11/18	1	10:35	10:40		BZ		One at M1 height.
0105	20/11/18	1	10:45	10:50		RN		One at Low height.
0106	20/11/18	1	13:35	13:40		BZ		Two adults at High height.
0106	20/11/18	1	13:40	13:45		BZ		Two adults at High height.
0108	21/11/18	4S	08:25	08:30		RN		Two flying east across viewshed at Low height.
0108	21/11/18	4S	09:00	09:05		RN		Flying east over Furmiston Craig at Low height.
0108	21/11/18	4S	09:05	09:05		RN		Still lingering over Furmiston Craig at Very Low height.
0107	21/11/18	4N	09:35	09:40		RN		Two at Low and M1 heights across site, heading west.
0108	21/11/18	4S	09:35	09:40		RN		Two flew south through viewshed.
0108	21/11/18	4S	09:50	09:55	1	K.		Female juvenile hunting around copse of trees then flew towards Knockwhirn.
0109	21/11/18	3	09:50	09:55		RN		Two flying south at height.
0108	21/11/18	4S	09:55	10:00		RN		Two flying east across viewshed at Very Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0108	21/11/18	4S	10:25	10:30		RN		Flying north through viewshed at Very Low height.
0107	21/11/18	4N	10:45	10:50		RN		Heading northwest at Low and Very Low heights across site.
0108	21/11/18	4S	10:55	11:00	2	H.		Flew north through viewshed before landing in a burn to west of VP.
0109	21/11/18	3	11:15	11:20		RN		Adult flying and hunting to east of VP.
0110	21/11/18	3	15:20	15:25		RN		Three flying south at height.
0110	21/11/18	3	15:55	16:00		RN		One flying northwest.
0111	23/11/18	1	10:35	10:40		RN		One flying east.
0111	23/11/18	1	11:05	11:10		RN		One flying east.
0111	23/11/18	1	12:10	12:15		RN		Three flying over VP going west.
0111	23/11/18	1	12:25	12:30		RN		Two flying east.
0112	23/11/18	1	14:45	14:50		RN		Five flying over VP, slowly going west.
0112	23/11/18	1	15:10	15:15		RN		One flying southeast.
0113	26/11/18	1	09:05	09:10		RN		Two flying north past VP.
0113	26/11/18	1	09:15	09:20	1	K.		Hunting at Willieanna.
0113	26/11/18	1	09:35	09:40	2	K.		Hunting at Willieanna.
0113	26/11/18	1	11:30	11:35	3	K.		Adult to east of Craig of Knockgray.
0114	26/11/18	3	13:45	13:50		RN		One flying south.
0114	26/11/18	3	14:10	14:15		RN		Two flying south.
0115	29/11/18	3	14:20	14:25		RN		Two birds.
0115	29/11/18	3	15:05	15:10		RN		One bird.
0116	30/11/18	2	08:00	08:05	1	CA		Flying northwest over Tup Park Knowe.
0116	30/11/18	2	08:10	08:15		RN		One bird.
0116	30/11/18	2	08:15	08:20		RN		Two birds.
0116	30/11/18	2	09:25	09:30	2	K.		Hunting at Craig of Knockgray.
0116	30/11/18	2	10:00	10:05		BZ		One adult.
0116	30/11/18	2	10:10	10:15	3	KT		Circling over Tup Park Knowe and heading away west.
0116	30/11/18	2	10:40	10:45	4	CA		Flying northwest from Knockgray Park area.
0116	30/11/18	2	10:50	10:55		RN		Two birds.
0117	30/11/18	2	11:45	11:50		BZ		One adult.
0117	30/11/18	2	13:40	13:45	1	K.		Hunting over Tup Park Knowe.
0117	30/11/18	2	14:05	14:10	2	KT		Flew in southeast towards Heathery Wood, circling, then headed away in direction of Liggat Plantation.
0117	30/11/18	2	14:25	14:30		SH		Female bird (unaged).
0119	03/12/18	4S	10:00	10:05		RN		North past VP from site into buffer at Low height.
0119	03/12/18	4S	10:35	10:40		RN		North past VP from site into buffer at M1 height.
0119	03/12/18	4S	11:55	12:00		RN		Circling at south side of site near Marbrack at High height.
0119	03/12/18	4S	12:15	12:20		RN		Two birds over Furmiston Craig at M2 height.
0119	03/12/18	4S	12:20	12:25		RN		Same two birds as previous record, drifted northeast at M2 height.
0119	03/12/18	4S	12:20	12:25		BZ		Near Marbrack at M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0119	03/12/18	4S	12:25	12:30		RN		Still in buffer at east of site, at M1 height.
0119	03/12/18	4S	12:30	12:35		RN		Over site from Furmiston at M2 height.
0119	03/12/18	4S	12:30	12:35		BZ		Very distant at south of site near Marbrack, at High height.
0121	03/12/18	4S	13:15	13:20		RN		Two at Low height.
0121	03/12/18	4S	14:25	14:30		RN		Eight different birds at various heights over Furmiston Craig with two heading off northwest.
0121	03/12/18	4S	14:25	14:30		BZ		One over Furmiston Craig at Low to High heights.
0121	03/12/18	4S	14:30	14:35		RN		Two at High height then off northwest.
0121	03/12/18	4S	14:30	14:35		BZ		One hunting at High height.
0121	03/12/18	4S	14:35	14:40	1	K.		Hunting over Furmiston Craig but silhouetted and too far off to age or sex.
0120	03/12/18	4N	15:20	15:25		RN		Two ravens in northeast of site at M1 height.
0122	09/12/18	2	10:30	10:35		RN		One east past VP at Low height, then along south edge of site.
0123	09/12/18	3	11:10	11:15		RN		Two south over Furmiston Craig at Low height.
0123	09/12/18	3	12:15	12:20		RN		Five over Furmiston Craig at varying heights, with some display.
0123	09/12/18	3	12:20	12:25		RN		Three over Furmiston Craig at Very Low to M1 heights, then one flew off north at Very Low height and two off to west at Very Low height.
0124	09/12/18	2	13:20	13:25		RN		Two at M1 height past VP then through south of site.
0125	09/12/18	3	13:25	13:30		BZ		Hunting at Low and M1 heights over Furmiston Craig.
0125	09/12/18	3	14:10	14:15		RN		Two over Furmiston Craig at Low and Very Low height.
0124	09/12/18	2	14:25	14:30		RN		North through site from Knockgray.
0124	09/12/18	2	15:45	15:50		RN		Northeast through site at Low height.
0124	09/12/18	2	15:45	15:50		BZ		One by Knockgray Farm at Low hieght, presumably going into roost.
0126	10/12/18	4S	09:45	09:50		RN		Flew northeast from Furmiston Craig over site at M1 height.
0126	10/12/18	4S	10:05	10:10		RN		Different bird from previous record. Flew south over VP then through site at M1 height.
0126	10/12/18	4S	10:35	10:40		RN		Flew north from Furmiston Craig then into buffer at M1 height.
0126	10/12/18	4S	11:20	11:25		RN		Two flew north from Furmiston Craig then into buffer at M1 height.
0126	10/12/18	4S	11:20	11:25		RN		Two flew south past VP then through site at M1 height.
0127	10/12/18	4N	14:05	14:10		RN		One flew northeast from Knockwhirn at M1 height.
0127	10/12/18	4N	14:10	14:15		RN		Same bird as previous - still flying northeast through site then into buffer.
0127	10/12/18	4N	14:20	14:25		RN		Two in northeast corner of site at M1 height.
0127	10/12/18	4N	14:25	14:30		RN		Same two birds still in northeast corner of site at M1 height.
0127	10/12/18	4N	15:05	15:10		RN		One flew in from north then still going south past VP at Low height.
0128	14/12/18	4N	12:05	12:10		RN		Two birds at M1 height heading south, calling.
0129	14/12/18	4S	12:50	12:55		BZ		One hunting at Very Low height on upper slope of Knockwhirn.
0129	14/12/18	4S	12:55	13:00		BZ		Continuation of previous record.
0129	14/12/18	4S	13:00	13:05		BZ		Continuation of previous record.
0129	14/12/18	4S	13:00	13:05		RN		Three on slopes of Knockwhirn at Very Low and Low heights.
0129	14/12/18	4S	13:05	13:10		BZ		Same bird as previous record - still hunting at Very Low and Low heights on lower slopes of Knockwhirn.
0129	14/12/18	4S	13:10	13:15		BZ		Continuation of previous record.
0129	14/12/18	4S	13:15	13:20		BZ		Same bird as previous - still hunting.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0129	14/12/18	4S	13:20	13:25		BZ		Continuation of previous record.
0129	14/12/18	4S	13:25	13:30		BZ		Same bird as previous - still hunting on lower slopes of Knockwhirn.
0129	14/12/18	4S	13:25	13:30		RN		Four on lower slopes of Knockwhirn at various heights.
0129	14/12/18	4S	13:50	13:55		RN	BZ	Two at Low height harassing buzzard, which landed in a tree.
0129	14/12/18	4S	13:50	13:55		BZ	RN	Being harassed by two ravens then landed in a tree.
0129	14/12/18	4S	14:15	14:20		RN	BZ	Two at Very Low, Low and M1 heights. Harassing buzzard again, this time over slopes of Knockwhirn then off south.
0129	14/12/18	4S	14:15	14:20		BZ	RN	Being harassed by two ravens again.
0129	14/12/18	4S	14:30	14:35		RN		Two north past VP at Very Low and Low heights, calling.
0129	14/12/18	4S	14:55	15:00		RN		Two south past VP at Very Low and Low heights, calling.
0129	14/12/18	4S	15:10	15:15		RN		One over small stand of trees at Low height, calling.
0130	19/12/18	1	08:35	08:40		RN		Three hanging around VP on edge of site, at M1 height.
0130	19/12/18	1	08:40	08:45		RN		Two at M1 height.
0130	19/12/18	1	08:45	08:50		RN		Two at Low height, flew west.
0130	19/12/18	1	09:20	09:25		RN		Two east past VP and through site at Low height.
0130	19/12/18	1	09:45	09:50		RN		Three around VP at M1 site.
0130	19/12/18	1	09:50	09:55		RN		Same three as previous record at M1 height.
0130	19/12/18	1	10:40	10:45		RN		Two in front of VP at Low height.
0130	19/12/18	1	10:45	10:50		RN		Same two as previous, flew east through site.
0130	19/12/18	1	11:00	11:05		RN		One near to VP.
0130	19/12/18	1	11:20	11:25		BZ		Hunting on site in front of VP at M1 height.
0131	19/12/18	1	12:40	12:45		RN		Two east over site at Low height.
0131	19/12/18	1	13:00	13:05		RN		Southeast over VP then through site at M1 height.
0131	19/12/18	1	14:15	14:20		RN		Very low around sheepfold in front of VP.
0132	20/12/18	3	09:25	09:30		RN		Flying east over VP.
0132	20/12/18	3	09:50	09:55		RN		Flying east over VP.
0134	11/01/19	4S	09:45	09:50		RN		One at Low height.
0136	11/01/19	4S	13:15	13:20	1	GJ		Four adults flying northeast across site.
0137	21/01/19	2	09:45	09:50		RN		Two loitering in southwest of site at Low height.
0137	21/01/19	2	09:50	09:55		RN		Continuation of previous record.
0138	21/01/19	3	09:50	09:55		RN		One at Low and Very Low heights.
0137	21/01/19	2	10:50	10:55		RN		One at south of site at M1 height.
0138	21/01/19	3	10:50	10:55		RN		Two at Low and Very Low heights.
0138	21/01/19	3	11:05	11:10		RN		One at Low and Very Low heights.
0137	21/01/19	2	11:15	11:20		RN		Five southeast from site into buffer at M1 site.
0138	21/01/19	3	11:20	11:25		BZ		One at very Low height.
0138	21/01/19	3	11:20	11:25		RN		Two at Very Low height.
0138	21/01/19	3	11:25	11:30		RN		One at Low and Very Low heights.
0137	21/01/19	2	11:30	11:35		RN		One south through site at M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0137	21/01/19	2	11:30	11:35	1	KT		Flew south around Craig of Knockgray and away west.
0138	21/01/19	3	11:30	11:35		GB		One at Low height.
0138	21/01/19	3	11:45	11:50		RN		Eight at Very Low to M1 heights.
0137	21/01/19	2	11:50	11:55		BZ		To southeast of VP at Very Low height.
0138	21/01/19	3	11:50	11:55		RN		Two at M2 to Low heights.
0137	21/01/19	2	11:55	12:00		RN		In southwest of site, hanging around, at M1 height.
0138	21/01/19	3	11:55	12:00		RN		One displaying.
0137	21/01/19	2	12:20	12:25		RN		Two south over VP at M1 height.
0137	21/01/19	2	12:20	12:25		BZ		Hunting at south of site at M1 height.
0138	21/01/19	3	12:40	12:45		RN		One at Low height.
0140	21/01/19	3	13:20	13:25		RN		Four at M1 and M2 heights.
0140	21/01/19	3	13:20	13:25		BZ		One at M2 and high heights, hunting.
0139	21/01/19	2	13:30	13:35		RN		Two at south of site, at M1 height.
0140	21/01/19	3	13:35	13:40		RN		One at M1 height.
0140	21/01/19	3	13:40	13:45		RN		Three at Low, M1 and M2 heights.
0140	21/01/19	3	13:40	13:45		BZ		One hunting at M1, M2 and High heights.
0139	21/01/19	2	14:00	14:05	1	HH		Hunting and quartering in Knockgray Farm area.
0140	21/01/19	3	14:00	14:05		RN		Four at M1 and Low heights.
0140	21/01/19	3	14:05	14:10		GB		One at Low and Very Low heights.
0139	21/01/19	2	14:15	14:20	2	KT		Flew northeast over site, from Craig of Knockgray area and over Quantans Hill.
0139	21/01/19	2	14:15	14:20		RN		One at Low height, in buffer to south.
0140	21/01/19	3	14:30	14:35		RN		Three at M1, Low and Very Low heights.
0139	21/01/19	2	14:40	14:45		RN		One northeast past VP then through site at M1 height.
0140	21/01/19	3	15:35	15:40		RN		One at Very Low height.
0141	30/01/19	1	10:50	10:55		RN		Two at west edge of site in valley below VP, at M1 height.
0141	30/01/19	1	11:30	11:35		RN		Four in valley below VP, at M1 height.
0141	30/01/19	1	11:45	11:50		RN		Two around Quantans Hill, flying west at Low height.
0141	30/01/19	1	12:10	12:15		RN		Circling VP at Low height.
0141	30/01/19	1	12:20	12:25		RN		One at Very Low height.
0141	30/01/19	1	12:50	12:55		RN		One above VP which then flew south at M1 height.
0141	30/01/19	1	13:05	13:10		RN		Two in valley below VP, flew southeast at Low height.
0141	30/01/19	1	13:15	13:20		RN		One in valley below VP, flew southwest at Very Low height.
0141	30/01/19	1	13:20	13:25		RN		Around small wood to east of VP at M1 height.
0142	30/01/19	1	14:20	14:25		RN		One in valley below VP at Very Low height.
0142	30/01/19	1	14:45	14:50		RN		Three in valley below VP at Low height.
0142	30/01/19	1	15:05	15:10		RN		Two around Quantans Hill at Low height.
0142	30/01/19	1	15:30	15:35		RN		Two to east of VP, flew southwest at M1 height.
0142	30/01/19	1	16:20	16:25		RN		One northeast past Quantans Hill at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0145	12/02/19	3	09:40	09:45		RN		Over site at M1 height.
0145	12/02/19	3	09:50	09:55		RN		Pair in courtship display at Low and M1 heights.
0145	12/02/19	3	09:55	10:00		RN		Four birds in chase/territorial dispute at Low and M1 heights.
0145	12/02/19	3	10:00	10:05		RN		Across site at Low height.
0145	12/02/19	3	10:00	10:05		BZ		Hunting at Low to M2 heights.
0145	12/02/19	3	10:05	10:10		RN		Pair in 'mirroring' display flight at M2 height.
0145	12/02/19	3	10:20	10:25		RN		Two across site at M1 height.
0145	12/02/19	3	10:20	10:25	1	KT		Hunting and heading southwest, roughly following route of the Marbrack Burn.
0145	12/02/19	3	10:30	10:35		RN		Two across site at M1 height.
0145	12/02/19	3	10:45	10:50		RN		Four foraging at Low height over the site.
0145	12/02/19	3	10:45	10:50	2	KT		Hunting over open ground to east of VP, heading south.
0144	12/02/19	2	10:50	10:55		BZ		Two at M1 height.
0145	12/02/19	3	11:00	11:05		RN		One foraging at Low height.
0145	12/02/19	3	11:20	11:25		BZ		Hunting at M1 and Low heights.
0145	12/02/19	3	11:20	11:25		BZ		Two birds soaring together over conifer block at M1 to High heights.
0145	12/02/19	3	11:30	11:35	3	KT		Foraging from western side of Furmiston Craig heading north before turning southwest and away in the direction of Marbrack.
0145	12/02/19	3	11:50	11:55		RN		Four foraging at Low height over the site.
0145	12/02/19	3	12:00	12:05		RN		Over site at Low and M1 height.
0145	12/02/19	3	12:15	12:20		BZ		Two foraging at Low height.
0145	12/02/19	3	12:15	12:20		RN		Two displaying briefly above plantation at M1 and Low height.
0145	12/02/19	3	12:25	12:30	4	KT		Soaring over open ground to east of VP, heading over Furmiston Craig and away northeast.
0147	12/02/19	3	13:25	13:30		RN		Two over site at Low height.
0147	12/02/19	3	14:00	14:05		RN		Flying at M1 height.
0147	12/02/19	3	14:05	14:10		RN		Across site at Low height.
0147	12/02/19	3	14:15	14:20		BZ		Hunting at Low height.
0147	12/02/19	3	14:15	14:20		BZ		Hunting at Low height - different bird from previous record.
0147	12/02/19	3	14:40	14:45		RN		Foraging at Low height.
0147	12/02/19	3	14:50	14:55		RN		Across site at Low and M1 heights.
0147	12/02/19	3	15:00	15:05		BZ		Across site at Low height.
0147	12/02/19	3	15:05	15:10		RN		Flying around conifer block at Low and M1 heights.
0147	12/02/19	3	15:05	15:10		RN		Four foraging at Low height over the site.
0146	12/02/19	2	15:10	15:15		RN		One at Very Low height.
0147	12/02/19	3	15:15	15:20		BZ		Low flight across the site.
0146	12/02/19	2	15:25	15:30		BZ		One at M1 height.
0147	12/02/19	3	15:25	15:30		RN		Low foraging flight.
0147	12/02/19	3	15:35	15:40		RN		Across site at M1 height.
0147	12/02/19	3	15:40	15:45		RN		Two soaring together at M1 to High heights.
0147	12/02/19	3	15:50	15:55		RN		Two Low across site.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0148	14/02/19	1	10:15	10:20		RN		Two around Willieanna at Very Low and Low heights.
0148	14/02/19	1	10:55	11:00		RN		Around the VP at Low and Very Low heights.
0148	14/02/19	1	11:15	11:20		BZ		Hunting north at Low heights.
0148	14/02/19	1	11:40	11:45		RN		Two around conifer block at Very Low and Low heights.
0148	14/02/19	1	11:50	11:55		RN		One flew north at Low height.
0148	14/02/19	1	12:40	12:45		RN		One around conifer block at Low height.
0149	14/02/19	1	13:55	14:00		RN		Flew northeast at Low height.
0149	14/02/19	1	15:20	15:25		RN		Displaying between VP and conifer block at Low and M1 heights.
0149	14/02/19	1	16:05	16:10		HH		Hunting at Very Low height around Quantans Hill.
0150	25/02/19	4S	10:35	10:40		RN		Two foraging at Very Low height to west of the VP.
0150	25/02/19	4S	10:45	10:50		RN		Four at Very Low and Low heights in forestry to east of the VP.
0150	25/02/19	4S	10:50	10:55		RN		Two southwest over Furmiston Craig at Low height.
0150	25/02/19	4S	11:05	11:10		RN		One flew north past the VP at Low height.
0150	25/02/19	4S	11:20	11:25		RN		Pair displaying at M1 height above plantation to southwest of the VP.
0150	25/02/19	4S	11:40	11:45		RN		One foraging on Furmiston Craig at Very Low height.
0150	25/02/19	4S	11:50	11:55		RN		Two circling at M2 and High heights to southwest of the VP.
0150	25/02/19	4S	12:10	12:15		BZ		Circling at Low and M1 heights to southwest of the VP.
0150	25/02/19	4S	12:25	12:30		RN		Flew north out of viewshed to west of VP at Very Low height.
0150	25/02/19	4S	12:50	12:55		RN		Two foraging to west of VP at Very Low height.
0150	25/02/19	4S	12:55	13:00	1	KT		Soaring at M1 to High heights to northeast of Furmiston Craig, heading away northeast.
0150	25/02/19	4S	13:10	13:15		RN		Foraging to southwest of VP at Very Low height then into plantation.
0150	25/02/19	4S	13:20	13:25		BZ		Soaring at M2 and High heights to southwest of the VP.
0151	25/02/19	4S	13:55	14:00		BZ		Two circling above forestry to east of the VP at M1 and M2 heights.
0151	25/02/19	4S	14:00	14:05		RN		Two foraging to southeast of the VP at Very Low heights.
0151	25/02/19	4S	14:00	14:05		RN		One flew into plantation to southwest of the VP at Very Low height.
0151	25/02/19	4S	15:00	15:05		BZ		One soaring at High height to south of the VP.
0151	25/02/19	4S	15:50	15:55		BZ		Low over forest canopy to southwest of VP at Low height.
0151	25/02/19	4S	16:25	16:30		BZ		Two circling together southeast of the VP at Low and M1 heights.
0152	27/02/19	4N	09:40	09:45		RN		Two at Very Low height.
0152	27/02/19	4N	09:55	10:00		RN		Two at Very Low height.
0152	27/02/19	4N	10:00	10:05		RN		Continuation of previous record.
0153	08/03/19	3	07:50	07:55		PG		Two separate skeins - one of 15 birds and one of 55 - disappeared into cloud above hills.
0154	08/03/19	2	08:05	08:10		RN		Around distant (c.1.5 km) conifer block southeast of VP at Low and Very Low heights.
0153	08/03/19	3	08:15	08:20		WS		28 birds at Medium and Low heights heading southwest then west over site.
0153	08/03/19	3	09:00	09:05		BZ		One at Low height.
0153	08/03/19	3	09:10	09:15		BZ		One at Very Low height.
0153	08/03/19	3	09:30	09:35		BZ		One at Low height.
0154	08/03/19	2	10:05	10:10		RN		Foraging around Quantans Hill at Very Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0153	08/03/19	3	10:35	10:40		GD		One landed in Polhay Burn.
0156	11/03/19	4S	11:15	11:20		BZ		One at M1 height.
0155	11/03/19	4N	12:20	12:25		BZ		Over foresty to east of VP at Low height.
0156	11/03/19	4S	12:25	12:30		BZ		Two at M2 height.
0155	11/03/19	4N	12:30	12:35		RN		South over forestry to east of VP at Low height.
0156	11/03/19	4S	12:30	12:35		RN		One at Low height.
0155	11/03/19	4N	12:35	12:40		RN		Two south over forestry to east of VP at Low height. Different birds from the previous sighting.
0156	11/03/19	4S	12:35	12:40		RN		Two at Low height.
0156	11/03/19	4S	12:40	12:45		RN		One at Very Low height.
0156	11/03/19	4S	12:40	12:45		BZ		One at Low height.
0155	11/03/19	4N	12:45	12:50		BZ		To northeast of the VP skimming over canopy at Very Low height.
0156	11/03/19	4S	12:45	12:50		BZ		One at M1 height.
0156	11/03/19	4S	12:50	12:55		BZ		One at Low height.
0156	11/03/19	4S	12:55	13:00		BZ		Two at M1 height.
0156	11/03/19	4S	12:55	13:00		RN		One at Very Low height.
0157	11/03/19	4N	14:15	14:20		BZ		One at M1 then M2 height.
0158	11/03/19	4S	14:20	14:25		BZ		Soaring above Furmiston Craig at M2 and High heights.
0158	11/03/19	4S	14:30	14:35		RN		Carrying food into plantation to southwest at VP at Very Low height.
0158	11/03/19	4S	15:10	15:15		BZ		Circling east of Furmiston Craig at M1 and M2 heights.
0158	11/03/19	4S	15:25	15:30		BZ		Two circling above forestry to east of the VP at M1 height.
0157	11/03/19	4N	16:15	16:20		BZ		One at Very Low height.
0158	11/03/19	4S	16:15	16:20		RN		One southwest across the site at Very Low height.
0158	11/03/19	4S	16:25	16:30		RN		Two southwest across the site at Low and Very Low heights.
0159	14/03/19	3	13:35	13:40		KT		One to west of Furmiston Craig at Medium and Low heights.
0160	14/03/19	2	14:05	14:10		HG		Seven along Water of Deugh heading northwest at Very Low and Low heights.
0159	14/03/19	3	14:25	14:30		RN		Two at Very Low height.
0160	14/03/19	2	14:40	14:45		RN		Two well to southeast of the VP at Low and Very Low heights.
0160	14/03/19	2	14:45	14:50		GB		One northwest along Water of Deugh valley at Low height.
0159	14/03/19	3	14:50	14:55		KT		One southwest over site at Very Low height.
0160	14/03/19	2	15:00	15:05		BZ		One foraging at Low height over ground to southeast of the VP.
0160	14/03/19	2	15:00	15:05		RN		One foraging at Low height over ground to southeast of the VP.
0160	14/03/19	2	15:30	15:35		RN		One foraging on Quantans Hill at Low height.
0159	14/03/19	3	15:40	15:45		RN		One flying mostly at Very Low but also at Low height.
0161	22/03/19	3	09:15	09:20		BZ		One at Low height.
0161	22/03/19	3	09:40	09:45		K.		Immature male heading northeast across the site at Low and M1 heights.
0161	22/03/19	3	09:40	09:45		BZ		Two at Low height.
0161	22/03/19	3	09:55	10:00		BZ		One at Low height.
0161	22/03/19	3	10:00	10:05		PG		Fifteen at M1 height heading northwest then southwest across the site.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0161	22/03/19	3	10:05	10:10		BZ		One at Low height.
0161	22/03/19	3	11:05	11:10		CU		One heading southeast across the site and then away north at M1 and Low heights.
0162	27/03/19	1	11:25	11:30		RN		Three flying southwest past the VP.
0162	27/03/19	1	11:50	11:55		BZ		One adult to southeast of the VP.
0163	27/03/19	2	13:20	13:25		RN		Two birds.
0163	27/03/19	2	13:30	13:35		RN		Two birds.
0163	27/03/19	2	13:45	13:50		KT		Two adults at Medium height to east of Craig of Knockgray.
0163	27/03/19	2	13:50	13:55		KT		Continuation of previous record.
0163	27/03/19	2	14:15	14:20		RN		One flying north.
0163	27/03/19	2	15:05	15:10		K.		Adult male hunting over Tup Park Knowe and heading west.
0164	28/03/19	1	09:40	09:45		RN		One at Low height.
0165	28/03/19	4N	09:55	10:00		BZ		Circling above Craigengillan Hill at Low and M1 heights.
0165	28/03/19	4N	10:15	10:20	1	K.		Gliding, then hunting and hovering briefly to northwest and west of VP, heading south.
0165	28/03/19	4N	10:20	10:25		BZ		Soaring over south slopes of Beninner at High height.
0165	28/03/19	4N	10:35	10:40		BZ		Soaring north of VP at High height.
0165	28/03/19	4N	10:55	11:00		SH		Along forestry edge to northeast of VP at M1 height.
0164	28/03/19	1	11:10	11:15	1	CU		Two to southwest of Quantans Hill at Very Low and Low heights.
0165	28/03/19	4N	11:10	11:15		BZ		Soaring above Knockwhirn at High height.
0164	28/03/19	1	11:40	11:45	2	KT	C.	One to southwest of Quantans Hill. Mobbed by two carrion crow at first.
0165	28/03/19	4N	11:40	11:45		BZ		Between Knockwhirn and Beninner at Low and M1 heights.
0165	28/03/19	4N	11:45	11:50		BZ		Two soaring above Lower Green Hill at High height.
0165	28/03/19	4N	11:45	11:50		RN		Two in territorial dispute above Knockwhirn at Low and M1 heights.
0164	28/03/19	1	11:50	11:55	3	CU		Three at Low and Very Low heights to west of Quantans Hill.
0165	28/03/19	4N	12:10	12:15	2	K.		Gliding over Knockwhirn at M1 height, heading west.
0165	28/03/19	4N	12:35	12:40		BZ		Soaring above Beninner at Medium height.
0165	28/03/19	4N	12:35	12:40		RN		Two around top of Beninner at Very Low and Low heights.
0166	28/03/19	1	12:55	13:00	1	K.		Two at M1 height in area south of Dunool / east of Willieanna. Both together for half of total flight time, with courtship interaction.
0166	28/03/19	1	12:55	13:00		BZ		One at Low height.
0166	28/03/19	1	13:15	13:20		BZ		Two at M1 height.
0167	28/03/19	4S	13:25	13:30		BZ		Hunting to southwest of VP at Low and M1 heights.
0167	28/03/19	4S	13:30	13:35		BZ		Four soaring above forestry south-southeast of VP at High height.
0167	28/03/19	4S	13:40	13:45		BZ		Hunting to southwest of VP at Low height.
0166	28/03/19	1	13:45	13:50		BZ		One at Very Low height.
0166	28/03/19	1	13:50	13:55		BZ		Two at Low and M1 heights.
0167	28/03/19	4S	13:55	14:00		RN		Foraging north of Furmiston Craig at Very Low height.
0166	28/03/19	1	14:00	14:05		BZ		Three at M1 height.
0167	28/03/19	4S	14:05	14:10		RN		Into conifer block southwest of VP at Very Low height.
0167	28/03/19	4S	14:05	14:10		BZ		Hunting southwest of VP at Very Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0166	28/03/19	1	14:10	14:15		RN		One at Low height.
0167	28/03/19	4S	14:15	14:20	1	KT		Briefly through viewshed at Low and M1 height. Heading north from sheepfold west of VP.
0167	28/03/19	4S	14:30	14:35	2	KT		Two north over VP and away northeast at Low height.
0166	28/03/19	1	14:35	14:40	2	KT		One at Dunool, heading away west. Flight at M1 and Low heights.
0166	28/03/19	1	14:45	14:50		BZ		Three at Low height.
0167	28/03/19	4S	15:00	15:05		BZ		Hunting southwest of VP at Low and M1 height.
0167	28/03/19	4S	15:15	15:20		RN		North across site, to east of VP, at Low height.
0166	28/03/19	1	15:30	15:35		RN		One at M1 height.
0167	28/03/19	4S	16:00	16:05		RN		Into conifer block southwest of VP at Low and Very Low height.
0168	01/04/19	2	13:25	13:30		RN		Three to south of VP at M1 height.
0168	01/04/19	2	13:35	13:40		RN		One over site at M1 height.
0168	01/04/19	2	14:10	14:15		RN		Two by VP at M1 height.
0169	01/04/19	3	14:30	14:35		RN		Two past VP at Very Low height, heading southeast.
0168	01/04/19	2	14:40	14:45		RN		Two at southwest of site at Low height.
0169	01/04/19	3	14:55	15:00	1	GJ		Three heading southwest from Furmiston Craig area.
0168	01/04/19	2	15:25	15:30		BZ		One at M1 height near Knockgray.
0169	01/04/19	3	15:50	15:55		BZ		Two heard calling then seen to south of VP. Possible courtship behaviour. Very Low, Low and M1 heights.
0169	01/04/19	3	15:55	16:00		BZ		One of the two birds seen previously, hunting in front of VP then into small block of trees, at Low and Very Low heights.
0168	01/04/19	2	16:05	16:10		RN		One at south of site, flying north.
0169	01/04/19	3	16:25	16:30		RN		One at Low height.
0170	01/04/19	2	17:00	17:05		RN		One at M1 height, flying north past VP and through site.
0170	01/04/19	2	17:10	17:15		RN		One at Low height by VP.
0171	01/04/19	3	17:15	17:20	1	GI		Adult male hunting at Very Low and Low heights from small plantation and heading north past Quantans Hill.
0171	01/04/19	3	17:30	17:35	2	KT		Adult hunting at Low and M1 heights heading south across site and over Marbrack.
0171	01/04/19	3	18:05	18:10		RN		Two at Low height.
0171	01/04/19	3	18:10	18:15		BZ		One hunting and calling at Low height.
0173	02/04/19	4S	09:15	09:20		RN		One at Low height.
0172	02/04/19	4N	09:55	10:00		BZ		Over forestry northwest of VP at Very Low and Low heights.
0172	02/04/19	4N	10:55	11:00		BZ		Over forestry northwest of VP at Very Low height.
0172	02/04/19	4N	11:20	11:25		BZ		Over nearby forestry at Low height.
0172	02/04/19	4N	11:25	11:30		BZ		In same area as previous record, at Very Low height.
0173	02/04/19	4S	11:30	11:35		RN		One at Low height, returning to copse to south of VP.
0172	02/04/19	4N	11:40	11:45		BZ		In same area as previous record, at Low height.
0174	02/04/19	4N	12:35	12:40		BZ		One at M1 then Low height.
0175	02/04/19	4S	12:40	12:45		RN		Into conifer block to southwest of VP at Very Low height.
0175	02/04/19	4S	13:35	13:40	1	KT		Two birds circling over Furmiston Craig and heading west.
0175	02/04/19	4S	13:35	13:40		BZ		Circling above Furmiston Craig at M1 and M2 heights.
0175	02/04/19	4S	13:35	13:40		RN		Two towards conifer block southwest of VP at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0175	02/04/19	4S	13:50	13:55		RN		One circling above conifer block at M1 height.
0175	02/04/19	4S	14:10	14:15		RN		One displaying at M1 height to southwest of VP.
0175	02/04/19	4S	14:10	14:15		BZ		Hunting south of VP at Low and M1 heights.
0175	02/04/19	4S	14:35	14:40		RN		Two south of VP at Low and M1 heights.
0175	02/04/19	4S	14:45	14:50		BZ		Hunting southwest of VP at Low height.
0175	02/04/19	4S	14:50	14:55		BZ		Two circling over forestry southeast of VP at Low and M1 heights.
0174	02/04/19	4N	14:55	15:00		BZ		One at Very Low height.
0175	02/04/19	4S	14:55	15:00		RN		Into conifer block to southwest of VP at Very Low height.
0175	02/04/19	4S	15:05	15:10		BZ		Soaring southwest of VP at High height.
0175	02/04/19	4S	15:10	15:15		BZ		Circling southwest of VP at Low and M1 heights.
0176	09/04/19	3	10:20	10:25	1	KT		Circling and heading south towards Furmiston Farm (outside of site boundary).
0176	09/04/19	3	10:45	10:50		RN		Six over site at varying heights.
0176	09/04/19	3	10:50	10:55	2	PE		Over top of VP then flying around site for a short while then soaring and heading away northwest.
0176	09/04/19	3	11:00	11:05		BZ		Two over trees to north of VP. One at M1 height; one at M2 height.
0176	09/04/19	3	11:10	11:15		BZ		Hunting over site.
0176	09/04/19	3	11:15	11:20		BZ		Two hunting over site.
0176	09/04/19	3	11:25	11:30		RN		Two flying around site.
0176	09/04/19	3	11:25	11:30		BZ		Hunting over site.
0176	09/04/19	3	11:45	11:50		BZ		Two hunting over site.
0176	09/04/19	3	12:10	12:15	3	KT	BZ	Initially divebombing buzzard on ground then circling over site and heading away northeast.
0176	09/04/19	3	12:15	12:20	3	KT		Continuation of previous record.
0176	09/04/19	3	12:15	12:20		BZ	KT	Being harassed by red kite (previous record).
0176	09/04/19	3	12:40	12:45	4	KT		Flight off site, circling near Furmiston and heading away southwest.
0176	09/04/19	3	12:55	13:00		BZ		Hunting over site.
0177	09/04/19	3	14:35	14:40		BZ		Hunting over hill north-northwest of VP.
0177	09/04/19	3	15:55	16:00	1	KT		Briefly over Furmiston Craig at Very Low height over site.
0177	09/04/19	3	16:00	16:05		BZ		Hunting over site.
0177	09/04/19	3	16:05	16:10	2	KT		Juvenile bird circling over site to north of VP and heading away southwest.
0177	09/04/19	3	16:15	16:20		RN		Two over site at High height.
0177	09/04/19	3	16:30	16:35		RN		Flying around site.
0177	09/04/19	3	16:35	16:40	3	ML		Very Low over site to north of VP, heading northwest.
0178	11/04/19	1	08:20	08:25		RN		Flying northwest.
0178	11/04/19	1	08:20	08:25		BZ		Two flying to southeast of VP.
0178	11/04/19	1	09:05	09:10	1	K.		Hunting at Low and Medium heights at Willieanna.
0178	11/04/19	1	09:15	09:20	2	K.		Hunting at M1 and Low heights at Willieanna.
0178	11/04/19	1	10:00	10:05	3	KT		Heading south past Craig of Knockgray at M1 height.
0178	11/04/19	1	10:40	10:45		RN		Two flying east past VP.
0179	11/04/19	1	14:10	14:15		RN		Three flying east.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0180	15/04/19	4N	10:00	10:05		BZ		One at Very Low height.
0180	15/04/19	4N	10:05	10:10		BZ		One at Low height.
0181	15/04/19	4S	10:10	10:15		RN		One at Low height, came out of copse in front of VP.
0180	15/04/19	4N	10:20	10:25		RN		Five over Beninner at M1 height.
0181	15/04/19	4S	10:25	10:30	1	SN		Chipping calls heard immediately prior to brief flight to southwest of VP.
0180	15/04/19	4N	11:05	11:10		GB		One at Low height.
0180	15/04/19	4N	11:05	11:10		BZ		One hunting at Low height.
0181	15/04/19	4S	11:05	11:10		GB	C.	Immature bird at Low height, mobbed by a carrion crow.
0180	15/04/19	4N	11:25	11:30		BZ		One heading south at M1 height.
0181	15/04/19	4S	11:25	11:30		BZ		One at Low height below Knockwhirn.
0180	15/04/19	4N	11:30	11:35		BZ		One heading east at M1 height.
0181	15/04/19	4S	11:50	11:55		RN		Three at Low height around Furmiston Craig.
0180	15/04/19	4N	12:05	12:10		BZ		One heading west at M1 height.
0180	15/04/19	4N	12:30	12:35		BZ		Two hunting at M1 height.
0183	15/04/19	4S	13:30	13:35		RN	BZ	Raven mobbing buzzard, heading north at Low height.
0183	15/04/19	4S	13:35	13:40	1	KT		Heading east past Furmiston Craig at M1 and Low heights.
0183	15/04/19	4S	13:45	13:50	2	KT		Flying southwest towards Little Loskie then heading away northeast, at M1 and Low heights.
0182	15/04/19	4N	13:50	13:55		BZ		One Very Low into forest.
0182	15/04/19	4N	14:00	14:05		BZ		One hovering against the breeze over open ground at Very Low height.
0183	15/04/19	4S	14:20	14:25		BZ		Hunting, heading slowly north at M1 height.
0182	15/04/19	4N	14:35	14:40		BZ		One at M1 height then drifted south, passing Beninner and Knockwhirn at Low height.
0182	15/04/19	4N	15:05	15:10		RN		One at Low height, on north edge of viewshed.
0183	15/04/19	4S	15:10	15:15		RN		Two soaring and heading east at M1 height.
0182	15/04/19	4N	15:40	15:45	1	ML		Female bird joined by male at end of flight over open ground to west of Craigengillan Hill.
0182	15/04/19	4N	16:00	16:05		BZ		One at Low height.
0182	15/04/19	4N	16:05	16:10		BZ		Two at M1 and Low heights, in different places.
0182	15/04/19	4N	16:10	16:15	2	BK		Female bird circled at Rider's Knowe and headed away southwest towards Knockwhirn.
0185	22/04/19	3	11:35	11:40		BZ		Hunting over site.
0184	22/04/19	2	11:45	11:50		RN		Two flew over VP towards the farm.
0185	22/04/19	3	12:20	12:25		BZ		High over site.
0185	22/04/19	3	13:15	13:20		BZ		Over trees to north of VP.
0185	22/04/19	3	13:20	13:25		BZ		Hunting to north-northeast of VP.
0184	22/04/19	2	13:25	13:30	1	KT		Adult soaring slowly over viewshed, circling over Tup Park Knowe area and heading away northeast.
0185	22/04/19	3	14:20	14:25		SH		Hunting near VP.
0184	22/04/19	2	14:40	14:45		BZ		Pair seen flying together above shelterbelt.
0187	22/04/19	3	15:25	15:30		BZ		Hunting near farm.
0187	22/04/19	3	15:25	15:30		BZ		Hunting high over hills.
0185	22/04/19	3	15:35	15:40	1	KT		Over site, heading south over Furmiston Craig and over edge of forestry.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0185	22/04/19	3	15:40	15:45	1	KT		Continuation of previous record.
0185	22/04/19	3	15:45	15:50	1	KT		Continuation of previous record.
0185	22/04/19	3	15:45	15:50		RN		Over buffer.
0185	22/04/19	3	15:50	15:55	1	KT		Continuation of previous record.
0186	22/04/19	2	16:10	16:15		RN		Flying and calling over VP2 while heading south towards fields where crows had gathered.
0187	22/04/19	3	16:20	16:25	1	RN		Flying around site.
0187	22/04/19	3	16:35	16:40	1	KT		Over site near edge of forestry to south of Furmiston Craig.
0187	22/04/19	3	16:40	16:45		KT		Continuation of previous record.
0188	24/04/19	1	10:40	10:45		BZ		Soaring at M1 height over south side of Quantans Hill, heading southwest.
0188	24/04/19	1	11:30	11:35		BZ		Three soaring low over rough pasture to west of Heathery Wood at Low to Very Low heights, before moving south.
0188	24/04/19	1	12:50	12:55		RN		Flying east Very Low in front of the VP and lost to sight to the north of Quantans Hill.
0189	24/04/19	1	14:15	14:20		RN		Flew northwest over small plantation to the east of the VP, moving behind the VP and out of sight. Low to M1 height.
0191	03/05/19	3	10:50	10:55		KT		To northwest of VP (off the map) at M2 height.
0191	03/05/19	3	10:50	10:55		MA		Two in short flight north of VP to stream at Low height.
0191	03/05/19	3	11:10	11:15		BZ		Hunting over site to east of VP.
0191	03/05/19	3	11:15	11:20		BZ		Continuation of previous record.
0191	03/05/19	3	11:35	11:40	1	KT		Flew northeast from Furmiston Craig and then along edge of forestry, heading away northwest.
0191	03/05/19	3	11:40	11:45	1	KT		Continuation of previous record.
0191	03/05/19	3	12:10	12:15		BZ		Two birds just beyond wood to northeast of VP, soaring.
0191	03/05/19	3	12:15	12:20	2	KT		Over eastern side of Knockwhirn at Very Low height.
0191	03/05/19	3	12:15	12:20		RN		Flying around site.
0190	03/05/19	2	12:50	13:50		RN		Flying north over VP calling from farm fields below.
0194	10/05/19	4N	08:15	08:20		RN		Flying from valley base up steep hillside.
0194	10/05/19	4N	08:15	08:20		BZ		Hanging in wind before going into display flight.
0194	10/05/19	4N	08:25	08:30		BZ		Appeared above ridge, circled high into the air for 40 seconds before leaving to return from the direction it arrived.
0194	10/05/19	4N	08:40	08:45		CG		Flying.
0195	10/05/19	4S	08:40	08:45	1	KT	RN	Hunting to south of Knockwhirn then mobbed by a raven.
0194	10/05/19	4N	08:45	08:50	1	KT		Flying north along ridge between Knockwhirn and Beninner.
0195	10/05/19	4S	09:00	09:05	2	CU		Short display flight to northeast of Furmiston Craig.
0194	10/05/19	4N	09:05	09:05	2	KT		Hunting on eastern slope of Beninner.
0195	10/05/19	4S	09:20	09:25		RN		One at Very Low height.
0195	10/05/19	4S	09:40	09:45		BZ		One hunting at Low and Very Low heights.
0195	10/05/19	4S	10:00	10:05	3	CU		Brief low flight northeast of Furmiston Craig.
0194	10/05/19	4N	10:35	10:40		BZ	KT	Hunting above Knockwhirn, later joined by red kite.
0194	10/05/19	4N	10:35	10:40	3	KT		Hunting low over base of Knockwhirn and Beninner.
0197	10/05/19	4S	11:25	11:30		RN		Pair calling while flying west over moorland towards large plantation. All at M1 height.
0195	10/05/19	4S	11:30	11:35		BZ		Hunting at M1 and M2 heights.
0196	10/05/19	4N	11:40	11:45		BZ		Two hunting at Low and M1 heights, one to north and one to west of the VP.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0196	10/05/19	4N	12:00	12:05		BZ		Hunting on Knockwhirn at Low and Very Low heights.
0196	10/05/19	4N	12:15	12:20		BZ		Hunting to the north at M1, M2 and Low heights.
0197	10/05/19	4S	12:20	12:25		RN	BZ	Pair over small woodland block, calling and interacting with buzzard pair. Flight mostly at M1 height.
0197	10/05/19	4S	12:20	12:25		BZ	RN	Interacting with raven pair aggressively above a small woodland block before being forced east. Flights were mostly at M1 height.
0196	10/05/19	4N	12:55	13:00		RN		One at Low height.
0196	10/05/19	4N	12:55	13:00		BZ		One hunting at M1 and M2 heights.
0196	10/05/19	4N	13:00	13:05		RN		One at M1 and M2 heights.
0197	10/05/19	4S	13:05	13:10		BZ		Displaying high over woodland block.
0196	10/05/19	4N	13:30	13:35		BZ		One hunting at Low height. Went to ground after prey on a couple of occasions.
0196	10/05/19	4N	13:35	13:40		BZ		One hunting at Low height. Same bird as previous record.
0197	10/05/19	4S	13:35	13:40	1	KT	RN	Red kite mobbed by a raven over T-shaped wood before departing over Knockwhirn.
0196	10/05/19	4N	13:45	13:50		BZ		Hunting on Knockwhirn at Low and Very Low heights.
0196	10/05/19	4N	13:50	13:55		RN	BZ	Raven mobbing buzzard.
0196	10/05/19	4N	14:00	14:05		BZ		Hunting at Low height.
0196	10/05/19	4N	14:05	14:10		BZ		Same bird as previous record, still hunting at Very Low, Low and M1 heights.
0196	10/05/19	4N	14:10	14:15	1	KT		Hunting over small area at Rider's Knowe. Wheeling back and forth and up and down on ridge, never gaining any height. Moved off east and out of view.
0196	10/05/19	4N	14:20	14:25	2	PE		Heading southwest to the south of Knockwhirn.
0198	14/05/19	1	10:20	10:25		RN		Off Dunool at Low height.
0198	14/05/19	1	10:30	10:35	1	KT		Appeared to north of Quantans Hill, heading west, then south past Craig of Knockgray and over Tup Park Knowe. All at Low and Very Low heights.
0198	14/05/19	1	11:55	12:00		RN		Two at M1 height by side of Knockgray and past VP.
0198	14/05/19	1	12:00	12:05		RN		Two circling above Dunool.
0198	14/05/19	1	12:15	12:20		BZ	C.	Mobbed by a carrion crow. Flight at Low height.
0198	14/05/19	1	12:20	12;25		BZ		Flight at M1 height. Drifted behind viewshed.
0198	14/05/19	1	12:45	12:50		RN		Flew twice around VP at Low height then at M1 height.
0199	14/05/19	1	13:55	14:00		BZ		One at Low height off Dunool.
0199	14/05/19	1	14:05	14:10	1	KT		Flight at Low height around the south side of Willieanna.
0199	14/05/19	1	14:15	14:20		RN		One at Low height by Quantans Hill.
0199	14/05/19	1	15:10	15:15		BZ		Two flew directly over VP, calling, one at Low height and one at M1 height.
0252	22/05/19	2	16:30	16:35	1	OP	BZ	Flight at High to Very High heights along Polsue Burn valley. Buzzard pair nearby.
0252	22/05/19	2	18:40	18:45		BZ		Thermalling to the north over Dunool.
0253	23/05/19	3	16:00	16:05	1	KT		Hunting; flying into wind at Medium height to Very Low heights, quartering and moving slowly.
0253	23/05/19	3	17:55	18:00		BZ		Pair circling over Furmiston Craig, mobbed by crows.
0201	27/05/19	4N	12:25	12:30		BZ		One to east at Low height.
0201	27/05/19	4N	12:30	12:35		BZ		Same bird as previous record, hunting in front of VP at M1 height.
0201	27/05/19	4N	12:35	12:40		BZ		Same bird as previous record, hunting at M2 height and drifting north.
0201	27/05/19	4N	12:40	13:45		RN		One to west of VP at Low height.
0201	27/05/19	4N	14:50	14:55		RN		Around Knockwhirn at Very Low height.
0202	27/05/19	1	15:35	15:40		RN		Adult to Low height past VP to west, calling.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0203	27/05/19	4S	16:05	16:10		BZ		Towards southeast corner of the site at M1 height.
0203	27/05/19	4S	16:05	16:10	1	KT		Short flight southeast of Furmiston Craig at Low height.
0203	27/05/19	4S	16:30	16:35	2	CU		On east side of Furmiston Craig at Very Low height.
0202	27/05/19	1	16:45	16:50		RN		At Low and Very Low heights, heading north.
0202	27/05/19	1	16:45	16:50		BZ		Around small plantation to east of VP, calling, at Very Low height.
0203	27/05/19	4S	16:50	16:55	3	KT		Southwest across site towards Big Loskie and beyond at M1 height.
0203	27/05/19	4S	16:50	16:55	4	CU	KT	Two birds on eastern side of Furmiston Craig, mobbing red kite from previous record.
0202	27/05/19	1	17:30	17:35		BZ		Over site at M1 and M2 heights.
0204	03/06/19	2	16:25	16:30		RN		Two at Very Low height.
0204	03/06/19	2	17:50	17:55		CM		One at Very Low height, landed in a tilled field and was joined by a second bird.
0204	03/06/19	2	18:05	18:10		LB		Immature bird at Very Low height.
0204	03/06/19	2	18:35	18:40	1	KT		Flew east from VP area and headed away north. Green tag on left wing.
0205	03/06/19	2	19:25	19:30		CM		Two at Very Low height, flying around a tilled field.
0205	03/06/19	2	20:00	20:05		RN		One at M1 height.
0205	03/06/19	2	20:05	20:10		RN		Two at Low height.
0205	03/06/19	2	20:20	20:25		LB		Five at Very Low height.
0205	03/06/19	2	20:40	20:45		CM	LB	Nine common gull and one lesser black-backed gull flew onto tilled field at Very Low height.
0205	03/06/19	2	21:20	21:25		CM	LB	One common gull and one lesser black-backed gull at Very Low height.
0207	04/06/19	4S	06:25	06:30		RN		One east over southern end of site at M1 height.
0209	04/06/19	4S	08:15	08:20		RN		Over Furmiston Craig at Very Low height.
0208	04/06/19	4N	08:30	08:35		BZ		Hunting at northeast of site at M1 height.
0208	04/06/19	4N	08:35	08:40		BZ		Continuation of previous record.
0209	04/06/19	4S	08:40	08:45	1	GJ		Two heading southwest from west side of Knockwhirn.
0209	04/06/19	4S	08:45	08:50		RN		Two at Very Low height around bottom of Knockwhirn.
0208	04/06/19	4N	08:55	09:00		BZ		Continuation of previous record.
0208	04/06/19	4N	09:00	09:05		BZ		Same bird as previous records, hunting on slope of Beninner at M1 height.
0209	04/06/19	4S	09:10	09:15		BZ		Hunting lower slopes of Knockwhirn at Low and Very Low heights.
0208	04/06/19	4N	09:50	09:55		BZ		Continuation of previous record.
0208	04/06/19	4N	10:15	10:20		RN		Two around Knockwhirn at Very Low height.
0209	04/06/19	4S	10:20	10:25		BZ		Hunting near Knockwhirn at Low height.
0209	04/06/19	4S	10:25	10:30		RN		One at M1 height.
0208	04/06/19	4N	10:30	10:35		BZ	C.	Over Beninner at M2 height. Getting a hard time from a carrion crow.
0208	04/06/19	4N	10:35	10:40		BZ		Same bird as previous record. Gained height to High.
0208	04/06/19	4N	10:35	10:40	1	KT		Appeared from Knockwhirn area and headed northeast over site.
0209	04/06/19	4S	10:35	10:40	2	KT		Hunting southern side of Knockwhirn.
0210	05/06/19	1	11:20	11:25		BZ		Over Knockwhirn at Low height, and another distantly over Marbrack at M2 height.
0213	12/06/19	4S	10:25	10:30		BZ		One at Low height.
0213	12/06/19	4S	10:35	10:40		BZ		One at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0213	12/06/19	4S	10:50	10:55		BZ		One at Low height.
0213	12/06/19	4S	11:00	11:05		BZ		One at Low height, mobbed by two carrion crows.
0213	12/06/19	4S	11:00	11:05		RN		Two at Low height, then landed on ground.
0212	12/06/19	4N	11:25	11:30		RN		Two flew southwest to the north of Green Hill at M1 height.
0213	12/06/19	4S	11:40	11:45		BZ		One at M1 height.
0213	12/06/19	4S	12:00	12:05		BZ		One at M1 height.
0212	12/06/19	4N	12:10	12:15		RN		One flew west from forestry at Very Low height.
0212	12/06/19	4N	12:15	12:20		RN		Flew south at Low height.
0213	12/06/19	4S	12:15	12:20		RN		One at Low height.
0212	12/06/19	4N	12:20	12:25		BZ		Hovering over hillside at Low and Very Low heights.
0213	12/06/19	4S	12:20	12:25		BZ		One at Very Low height, landed on the ground.
0212	12/06/19	4N	12:35	12:40		LB		Two flew north at Low height.
0212	12/06/19	4N	12:35	12:40	1	KT		Flew south-southwest along forest edge to west of Craigengillan Hill.
0213	12/06/19	4S	12:40	12:45	1	KT		Flew southwest to the west of the VP around Furmiston Craig and away southeast.
0213	12/06/19	4S	12:50	12:55		BZ		One at Very Low height, landed on ground.
0213	12/06/19	4S	12:50	12:50		RN		One at Low height.
0213	12/06/19	4S	13:00	13:05	2	KT		Flew northeast from over open ground and away over forestry.
0215	12/06/19	4S	14:15	14:20		LB		Six circling southwest at M2 height for 180 seconds.
0215	12/06/19	4S	14:15	14:20		BZ		One flew north at Low and M1 height for 60 seconds.
0215	12/06/19	4S	14:40	14:45		BZ		One hovering at Low height then flew east.
0215	12/06/19	4S	14:55	15:00	1	KT		To southeast of Furmiston Craig, at forestry edge.
0215	12/06/19	4S	15:20	15:20		GB		Immature distantly northeast at M1 height.
0215	12/06/19	4S	16:05	16:10		BZ		One distantly east at Low height.
0216	14/06/19	2	07:40	07:45	1	GJ		Two adults flying at c.140 m height to north-northwest from over Water of Deugh, over Knockgray Park and past Craig of Knockgray.
0217	14/06/19	3	07:40	07:45	1	CU		Display flight to north of Marbrack. Calling continuously and returned west.
0216	14/06/19	2	07:45	07:50		GJ		Continuation of previous record.
0217	14/06/19	3	08:00	08:05		RN		Flying north past the VP at Very Low and Low heights.
0216	14/06/19	2	08:25	08:30		BZ		Made a brief flight of about 10 seconds from within Tup Park Knowe woodland and back in again at Low height.
0217	14/06/19	3	08:35	08:40	2	H.		Short flight along Marbrack Burn and landed out of sight.
0219	14/06/19	3	09:55	10:00		BZ		Two soaring over small plantation northeast of the VP, one landing in the plantation. All at Very Low height.
0219	14/06/19	3	10:45	10:50		BZ		Continuation of previous record.
0219	14/06/19	3	10:45	10:50		BZ		Soaring and calling over Marbrack Farm.
0219	14/06/19	3	12:00	12:05		BZ		Continuation of previous record.
0220	18/06/19	4S	10:25	10:30		BZ		One at M1 height.
0220	18/06/19	4S	10:30	10:35		BZ		One at M2 height.
0220	18/06/19	4S	12:45	12:50		RN		Four at M1 height.
0220	18/06/19	4S	12:55	13:00		BZ		One at M1 height.
0221	18/06/19	4N	13:30	13:35	1	KT		Moving along forest edge to north of VP and away northwest.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0221	18/06/19	4N	15:30	15:35		BZ		One at Low height.
0222	23/06/19	1	08:40	08:45		BZ		Flying at Low height, south over Quantans Hill.
0222	23/06/19	1	09:15	09:20		BZ		Soaring Low over Heathery Wood to the south of the VP.
0222	23/06/19	1	09:20	09:25		RN		Two adults flying west at M1 height towards Bridge-end.
0223	23/06/19	3	12:35	13:40		BZ		Soaring Low over Furmiston Craig.
0223	23/06/19	3	13:30	13:35		RN		Two over small copse to the northeast of the VP.
0223	23/06/19	3	13:55	14:00		BZ		Low over wood near to Furmiston Farm.
0223	23/06/19	3	14:15	14:20	1	SH		Adult male Low over the moorland to the east of the VP, flying south past Marbrack.
0224	23/06/19	2	15:50	15:55		BZ		Flying Low over Heathery Wood, heading north.
0224	23/06/19	2	16:15	16:20		BZ		Soaring over Knockgray Farm at Low and M1 heights.
0224	23/06/19	2	17:25	17:30	1	KT		Adult drifting north-northwest from Heather Wood, hunting Low along the moors.
0224	23/06/19	2	18:15	18:20	2	KT		Adult hunting along the moorland and rough pasture, moving slowly north along field edges.
0224	23/06/19	2	18:20	18:25	3	CM		Adult drifting Very Low over the fields, moving southeast.
0225	04/07/19	1	11:35	11:40	1	K.		Flew south from Quantans Hill area then headed southeast and away from site.
0225	04/07/19	1	12:00	12:05		LB		One at Very Low height.
0226	04/07/19	1	16:25	16:30	1	KT		Flew south from Quantans Hill at Low height.
0227	05/07/19	4S	10:15	10:15	1	KT		Three adult birds flying close together, out from Furmiston Craig and heading northeast.
0227	05/07/19	4S	11:00	11:05	2	SN		Displaying male to north of Furmiston Craig.
0227	05/07/19	4S	11:15	11:20	3	KT		Hunting low over brow of Furmiston Hill. Not seen for long before heading back south and out of view.
0236	06/07/19	2	13:40	13:45		KT	1	Adult flew over VP and directly towards Willieanna before being lost over the ridge. Increased height to M2 due to the valley topography.
0236	06/07/19	2	14:50	14:55		RN		Flew along distant ridge above Willieanna before disappearing behind ridge.
0236	06/07/19	2	15:55	16:00		RN		Flew along valley from Knockgray towards Willieanna at M2 height then disappeared out of view from Craig of Knockgray.
0229	07/07/19	2	04:55	05:00		CM		Two adults flew west at Low and Very Low heights.
0229	07/07/19	2	05:10	05:15		RN		One flew southeast at Low height.
0230	07/07/19	3	05:25	05:30		RN		Two flew over VP from the southwest, circled several times before moving off north. All at Low height.
0229	07/07/19	2	05:40	05:45		H.		Two flew west along Water of Deugh at Low height.
0229	07/07/19	2	05:50	05:55		BH		Flew west at Low height.
0229	07/07/19	2	05:50	05:55		LB		One west at M1 height.
0230	07/07/19	3	05:55	06:00		RN		Two flew from southwest over the VP, calling, then moved north. All at Low height.
0229	07/07/19	2	06:20	06:25		LB		One north at Low height.
0229	07/07/19	2	07:10	07:15		LB		Five flew northwest at Low height.
0231	10/07/19	4N	12:15	12:20		KT	1	Patrolling upper slopes of Knockwhirn.
0232	10/07/19	4S	12:20	12:25		RN		Two west over the site at M1 height.
0232	10/07/19	4S	12:55	13:00		RN		One at east side of site at Very Low height.
0231	10/07/19	4N	13:20	13:25		RN		Flew west from plantation at Very Low height.
0231	10/07/19	4N	13:40	13:45		SN	2	Display flight to northwest of VP.
0233	10/07/19	4S	16:45	16:50		RN		Flew southwest at Low height.
0233	10/07/19	4S	17:40	17:45		SN	1	Display flight near sheepfold to west of the VP.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0235	16/07/19	2	10:15	10:20		RN		Three - two adults and one juvenile - flew from Tup Park Knowe around the hillside and disappeared around the hill. Constantly calling. All at Low height.
0235	16/07/19	2	10:30	10:32		BZ		Two came up calling from Tup Park Knowe, flying at Low height and calling before drifting away southwest towards Carsphairn.
0235	16/07/19	2	11:20	11:25		HG	1	Adult bird appeared near Tup Park Knowe plantation at M1 height before circling tightly between Tup Park Knowe and Heathery Wood, reaching M2 height. It then gradually gained more height (to High) before drifting off and gaining height in a south-southeast direction beyond the viewshed.
0235	16/07/19	2	11:25	11:30		RN		Flew from beyond Heathery Wood and directly over VP, calling. All at M1 height.
0235	16/07/19	2	12:10	12:15		RN		Two flying at M1 height over Willieanna then dropping into area over ridge.
0237	29/07/19	3	15:10	15:15	1	KT		Three birds in area to north of Furmiston Craig, around the sheepfold.
0237	29/07/19	3	15:10	15:15		RN		Two at M1 height.
0237	29/07/19	3	16:10	16:15	2	KT		Flew north across site to Knockwhirn and away to west.
0237	29/07/19	3	16:10	16:15		RN		Two at Low height.
0237	29/07/19	3	17:00	17:05		RN		One at M1 height.
0237	29/07/19	3	17:20	17:25		BZ		One at M1 height.
0237	29/07/19	3	17:35	17:40		RN		One at Low height.
0238	29/07/19	3	18:55	19:00	1	K.	C.	To west of Knockwhirn at Very Low height, constantly mobbed by a carrion crow.
0238	29/07/19	3	19:15	19:20	2	K.		Same bird as previous record, over top of Knockwhirn. Again mobbed by a carrion crow. Soared higher after this, then joined by a second kestrel in last 90 seconds of flight.
0238	29/07/19	3	19:25	19:30		BZ		One at Very Low height.
0238	29/07/19	3	19:35	19:40		RN		Four at M1 height.
0238	29/07/19	3	19:55	20:00		RN		One at Low height.
0238	29/07/19	3	20:00	20:05		RN		Two at M1 height.
0238	29/07/19	3	20:40	20:45		RN		Two at M1 height.
0240	01/08/19	4S	09:40	09:45		RN		Arriving from west end of Knockwhirn before landing near the summit.
0240	01/08/19	4S	10:35	10:40		RN		Six feeding with crows at Knockwhirn before flying at Low height northwest until out of view behind the hill.
0240	01/08/19	4S	10:55	11:00		RN		Two flying east-northeast over T-shaped plantation towards Craigengillan Hill. At Low and M1 heights.
0239	01/08/19	4N	11:10	11:15		BZ		North of VP, flying west between hills at Very Low height.
0239	01/08/19	4N	11:35	11:40		RN		Two flying north-northeast over site at M2 height.
0240	01/08/19	4S	11:35	11:40		RN		Four flying low over Knockwhirn. Landed near the summit. All at Very Low height.
0240	01/08/19	4S	11:35	11:40		RN		Two flying north over Knockwhirn at M1 height.
0241	01/08/19	4N	12:50	12:55		RN		Four over top of the to south-southeast of VP at M2 height.
0242	01/08/19	4S	12:55	13:00		RN		Two flew southwest over plantation on to viewshed, circled over stone wall eight times before heading northeast back over the plantation. All at M1 height.
0242	01/08/19	4S	14:05	14:10		RN		Flying northeast over moor, past VP to fly north along plantation edge at M1 height.
0241	01/08/19	4N	15:30	15:35		BZ		Over side of hill to north of VP at Low height.
0243	12/08/19	1	11:35	11:40		RN		One at Very Low height.
0243	12/08/19	1	11:50	11:55		BZ		Two mostly at Very Low height, but one at Low height for a smaller portion of time.
0243	12/08/19	1	12:00	12:05		BZ		One at M2 height.
0244	12/08/19	1	15:15	15:20		RN		Five at M1 height.
0244	12/08/19	1	15:30	15:35		RN		Four at M2 height.
0247	15/08/19	3	07:50	07:55		RN		Flew north at Very Low height.
0247	15/08/19	3	08:10	08:15		GB		Adult to southeast of VP.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0248	15/08/19	3	09:45	09:50		RN		One close to VP at Very Low height.
0248	15/08/19	3	09:50	09:55		RN		Continuation of previous record.
0248	15/08/19	3	10:10	10:15		RN		Two around VP at Very Low height.
0248	15/08/19	3	10:25	10:30		RN		Two around VP at Very Low height.
0248	15/08/19	3	10:35	10:40		RN		Two around VP at Very Low height.
0248	15/08/19	3	10:50	10:55		RN		Two around VP at Very Low height.
0245	15/08/19	2	13:00	13:05		BZ		One at Very Low height.
0246	15/08/19	2	15:00	15:05		RN		One at Low height.
0249	21/08/19	1	11:20	11:25		BZ		Two at Low height over Quantans Hill.
0249	21/08/19	1	11:50	11:55		RN		Two at Low height heading north through middle of site.
0249	21/08/19	1	11:55	12:00		RN		Two at Low height heading north through west of site.
0249	21/08/19	1	12:40	12:45		RN		Over Knockwhirn at Very Low height.
0249	21/08/19	1	12:50	12:55	1	K.		Hunting to south of Willieanna, moving west.
0249	21/08/19	1	12:50	12:55		RN		Two near VP at Very Low height.
0249	21/08/19	1	13:20	13:25		RN		Two near VP at Low height.
0257	24/09/20	7	07:05	07:10		RN		Four around carcass at Low height.
0257	24/09/20	7	07:10	07:15		RN		Five around carcass at Low height.
0257	24/09/20	7	07:20	07:25		BZ	RN	Two buzzards and three ravens around carcass.
0257	24/09/20	7	07:25	07:30		BZ	RN	Three buzzards and six ravens around carcass at Low height.
0257	24/09/20	7	07:30	07:35		RN	BZ	Two ravens and one buzzard around carcass.
0257	24/09/20	7	07:35	07:40		BZ	RN	Six buzzards and four ravens around carcass.
0257	24/09/20	7	07:40	07:45		RN		Three flew north across site from carcass.
0257	24/09/20	7	07:40	07:45		BZ		Two birds at M1 height by carcass. Another four sitting in trees nearby.
0257	24/09/20	7	07:45	07:50		BZ		Three at M1 height hunting / hovering on site to north of carcass.
0257	24/09/20	7	07:45	07:50		RN		Eight around carcass at Low height.
0257	24/09/20	7	07:50	07:55		RN		Four flew to carcass from west at Low height.
0257	24/09/20	7	07:50	07:55		RN		Three flew east away from carcass at Low height.
0257	24/09/20	7	07:50	07:55		BZ		Two hunting to south of VP at M1 height.
0257	24/09/20	7	07:55	08:00		BZ		Continuation of previous record.
0257	24/09/20	7	07:55	08:00		RN		Nine at carcass at Low height.
0257	24/09/20	7	08:00	08:05	1	KT		Hunting northwest of Marbrack.
0257	24/09/20	7	08:00	08:05		RN		Four flew in to carcass from west.
0257	24/09/20	7	08:00	08:05		BZ		One still hunting.
0257	24/09/20	7	08:05	08:10		RN		11 birds Low around carcass.
0257	24/09/20	7	08:05	08:10		BZ		Three hunting to south of VP at M1 height.
0257	24/09/20	7	08:10	08:15		BZ		Two still hunting.
0257	24/09/20	7	08:10	08:15		RN		Four Low around carcass. Another three flew east from carcass at M1 height.
0257	24/09/20	7	08:15	08:20		BZ		Five birds dispersed in all directions from carcass at Low to M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0257	24/09/20	7	08:15	08:20		RN		Five around carcass at Low height.
0257	24/09/20	7	08:20	08:25		BZ		Three still nearby.
0257	24/09/20	7	08:20	08:25		RN		Two flew northeast from carcass.
0257	24/09/20	7	08:25	08:30		BZ		One hunting to north of carcass.
0257	24/09/20	7	08:25	08:30		RN		Three Low by carcass.
0257	24/09/20	7	08:30	08:35		RN		Six Low by carcass.
0257	24/09/20	7	08:35	08:40		BZ		Hunting at M1 height.
0257	24/09/20	7	08:35	08:40		RN		Three flew west from carcass at Low to M1 height.
0257	24/09/20	7	08:40	08:45		RN		Nine by carcass at Low height.
0257	24/09/20	7	08:40	08:45	2	K.		Hunting to northwest of Marbrack.
0257	24/09/20	7	08:45	08:50		RN		Seven by carcass at Low height.
0257	24/09/20	7	08:45	08:50		BZ		Three circling near VP3.
0257	24/09/20	7	08:45	08:50	3	PG		Nineteen birds flying south over site past Furmiston Craig towards Furmiston Bridge.
0257	24/09/20	7	08:50	08:55		RN		Two by carcass at Low height.
0257	24/09/20	7	08:55	09:00		BZ		Two near carcass at M1 height.
0257	24/09/20	7	08:55	09:00		RN		Four by carcass at Low height.
0257	24/09/20	7	08:55	09:00	4	KT		With a couple of swoops onto / by carcass northwest of Marbrack. Realised it wasn't worth corvid hassle and drifted west.
0257	24/09/20	7	09:00	09:05	4	KT		Continuation of previous record.
0257	24/09/20	7	09:00	09:05		BZ		Four near carcass, mostly at M1 height.
0257	24/09/20	7	09:00	09:05		RN		Four near carcass at Low height.
0257	24/09/20	7	09:05	09:10		BZ		Three still near carcass.
0257	24/09/20	7	09:05	09:10		RN		Five still near carcass.
0257	24/09/20	7	09:10	09:15		BZ		Juvenile hunting near VP at M1 height.
0257	24/09/20	7	09:10	09:15		BZ		Two hunting to north of carcass at Low height.
0257	24/09/20	7	09:10	09:15		RN		One by carcass at Low height; flew east.
0257	24/09/20	7	09:15	09:20		BZ		Two hovering to south of VP at M1 height.
0257	24/09/20	7	09:15	09:20		RN		Three flew north through site from carcass.
0257	24/09/20	7	09:20	09:25		BZ		Two around old VP3 at M1 height.
0257	24/09/20	7	09:20	09:25		RN		Three flew north through site from carcass.
0257	24/09/20	7	09:25	09:30		BZ		Juvenile hunting near VP at M1 height.
0257	24/09/20	7	09:25	09:30		BZ		One still around old VP3 at M1 height.
0257	24/09/20	7	09:25	09:30		RN		One flew northeast through site.
0257	24/09/20	7	09:30	09:35		BZ		Two still by old VP3 at Low height.
0257	24/09/20	7	09:30	09:35		RN		Two around carcass.
0257	24/09/20	7	09:35	09:40		BZ		One hunting to south of VP: Low then M1 height.
0257	24/09/20	7	09:35	09:40		RN		One flew south from carcass.
0257	24/09/20	7	09:40	09:45		RN		Three flew east-southeast from carcass at Low then M1 height.
0257	24/09/20	7	09:40	09:45		BZ		One still hunting to south of VP at M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0257	24/09/20	7	09:45	09:50		RN		One by carcass at Low height.
0257	24/09/20	7	09:45	09:50		RN		Eight from carcass: went High and drifted west.
0257	24/09/20	7	09:45	09:50	5	KT		Over open ground north of VP3 and headed away southwest.
0257	24/09/20	7	09:50	09:55		BZ		Juvenile near VP.
0257	24/09/20	7	09:50	09:55		RN		Two flew north through site from carcass.
0257	24/09/20	7	09:55	10:00		RN		One east past VP at M1 height.
0257	24/09/20	7	09:55	10:00		RN		Six east from carcass at Low height.
0257	24/09/20	7	10:00	10:05		BZ		One hunting by VP3 at M1 height.
0258	24/09/20	7	10:00	10:05		RN		Two flew east past VP.
0258	24/09/20	7	10:40	10:45		RN		Two east past VP at M1 height.
0258	24/09/20	7	10:45	10:50		RN		Two near VP. Calling, at M1 height.
0258	24/09/20	7	10:45	10:50		BZ		Pair in synchronised flying display.
0258	24/09/20	7	10:50	10:55		RN		Two flew northeast through site at M1 height.
0258	24/09/20	7	10:50	10:55		BZ		Two hunting in front of old VP3 at M1 height.
0258	24/09/20	7	10:50	10:55		BZ		Flying at Low height, investigating remains of carcass.
0258	24/09/20	7	10:55	11:00		BZ		One hunting by VP3 at M1 height.
0258	24/09/20	7	10:55	11:00		RN		Two flying near buzzard (previous record) at M1 height.
0258	24/09/20	7	10:55	11:00	1	K.		Hunting over ground to north of Marbrack. Dropped down on something and lost to view.
0258	24/09/20	7	11:00	11:05		RN		Continuation of previous record.
0258	24/09/20	7	11:00	11:05		BZ		Continuation of previous record.
0258	24/09/20	7	11:05	11:10		RN		Two flew west through site.
0258	24/09/20	7	11:05	11:10		RN		One at carcass at Low height.
0258	24/09/20	7	11:10	11:15		BZ		One hovering to south of VP at M1 height.
0258	24/09/20	7	11:15	11:20		BZ		One flying east through site.
0258	24/09/20	7	11:15	11:20		BZ		One hovering to south of VP at M1 height.
0258	24/09/20	7	11:25	11:30		BZ		One circling at east of site, at M2 height.
0258	24/09/20	7	11:35	11:40		RN		Five flew west through site at M1 height.
0258	24/09/20	7	11:35	11:40		RN		Two flew Low around carcass.
0258	24/09/20	7	11:40	11:45		BZ		Hovering at east of site, at M1 height.
0258	24/09/20	7	11:40	11:45		BZ		Two by old VP3 at Low height.
0258	24/09/20	7	11:40	11:45		RN		One near carcass at M1 height.
0258	24/09/20	7	11:50	11:55		RN		One flew east through site.
0258	24/09/20	7	11:50	11:55		BZ		Hovering to south of VP at M1 height.
0258	24/09/20	7	12:00	12:05		BZ		One hunting at centre of site, at M1 height.
0258	24/09/20	7	12:05	12:10		BZ		Continuation of previous record.
0258	24/09/20	7	12:10	12:15		BZ		Continuation of previous record.
0258	24/09/20	7	12:10	12:15		RN		One southeast through site at M1 height.
0258	24/09/20	7	12:20	12:25		RN		One briefly around carcass at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0258	24/09/20	7	12:25	12:30		BZ		Hovering near Marbrack at M1 height.
0258	24/09/20	7	12:30	12:35		BZ		Circling to east of site at M2 height.
0258	24/09/20	7	12:30	12:35		BZ		Hunting in front of VP3 at M1 height.
0258	24/09/20	7	12:35	12:40		RN		Two Low around carcass.
0258	24/09/20	7	12:40	12:45		BZ		Hunting to south of VP at Low height.
0258	24/09/20	7	12:50	12:55		RN		Two scared from carcass by sheepdog and flew west at Low height.
0258	24/09/20	7	12:50	12:55		BZ		Flew in at Low height and landed in trees by VP3.
0258	24/09/20	7	12:55	13:00		RN		East through site at Low height.
0258	24/09/20	7	13:00	13:05		BZ		Hunting at east of site at M1 height.
0258	24/09/20	7	13:05	13:10		BZ		Continuation of previous record.
0258	24/09/20	7	13:05	13:10		BZ		Briefly by Marbrack at Low height.
0258	24/09/20	7	13:10	13:15		RN		One by carcass.
0258	24/09/20	7	13:15	13:20		BZ		Hovering at south of site at M1 height.
0258	24/09/20	7	13:15	13:20		RN		Over carcass at M1 height.
0258	24/09/20	7	13:20	13:25		RN		Three near VP, heading east at M1 height.
0258	24/09/20	7	13:20	13:25		BZ		One still at south of site at M1 height.
0258	24/09/20	7	13:25	13:30		RN		Continuation of previous record.
0258	24/09/20	7	13:30	13:35		RN		Two circling near VP3 at M1 height.
0254	25/09/20	6	07:40	07:45		RN		East through site at M1 height.
0254	25/09/20	6	08:15	08:20		BZ		Hunting briefly below VP at M1 height.
0254	25/09/20	6	08:15	08:20		RN		Northeast through site at Low height.
0254	25/09/20	6	08:30	08:35		RN		East through site at Low height.
0254	25/09/20	6	09:05	09:10		BZ		Hunting near middle of site at M1 height.
0254	25/09/20	6	09:15	09:20		RN		Two birds loitering out towards VP3 at Low height.
0254	25/09/20	6	09:50	09:55		BZ		Again hunting near middle of site at M1 height.
0254	25/09/20	6	09:55	10:00		BZ		Continuation of previous record.
0255	25/09/20	6	10:35	10:40	1	KT		Two birds playing / chasing over plantations to east of Knockgray farm.
0255	25/09/20	6	10:50	10:55	2	K.		Single bird hunting to east of Heathery Wood.
0255	25/09/20	6	11:05	11:10		BZ		Hunting at north of site, at M1 height.
0259	25/09/20	8	11:05	11:10		BZ		One at M1 height.
0255	25/09/20	6	11:20	11:25		RN		Two flew southeast through middle of site at M1 height.
0259	25/09/20	8	11:25	11:30		RN		One at M1 height.
0255	25/09/20	6	11:50	11:55		BZ		Hunting at south edge of site at M1 height.
0255	25/09/20	6	11:55	12:00		BZ		Continuation of previous record.
0255	25/09/20	6	11:55	12:00		BZ		Hunting at M1 height towards middle of site.
0260	25/09/20	8	13:40	13:45		BZ		One at Low height.
0260	25/09/20	8	14:10	14:15		BZ		Two at M1 height.
0260	25/09/20	8	14:30	14:35	1	HH		Juvenile bird flew around close to VP; ended flight going down to lower ground.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0260	25/09/20	8	15:00	15:05		BZ		One at M1 height.
0260	25/09/20	8	15:10	15:15		BZ		One at M1 height.
0260	25/09/20	8	15:20	15:25		K.		Hovered to south of Knockwhirn at M1 to Low height.
0260	25/09/20	8	15:20	15:25		BZ		Two at Low height.
0260	25/09/20	8	15:35	15:40		RN		Two at M1 height.
0261	28/09/20	8	07:45	07:50		BZ		One at Low height.
0261	28/09/20	8	07:50	07:55		K.		Hovering to southeast of Knockwhirn.
0261	28/09/20	8	09:00	09:10	2	ML		Female / juvenile in fast direct flight towards surveyor then a quick turn, continuing behind the viewshed.
0262	29/09/20	7	08:10	08:15		RN		Two north through the site at Low height.
0262	29/09/20	7	08:30	08:35		RN		One north through the site at M1 height.
0262	29/09/20	7	08:35	08:40		BZ		Two hunting by T-shaped wood at M1 height.
0262	29/09/20	7	09:10	09:15		BZ		One hunting to south of VP at M1 height.
0262	29/09/20	7	09:20	09:25		RN		Three east through site at M1 height.
0262	29/09/20	7	09:30	09:35		BZ		Hunting at M1 height.
0262	29/09/20	7	09:35	09:40		BZ		Continuation of previous record.
0262	29/09/20	7	09:40	09:45		BZ		Two hunting to south at M1 height.
0262	29/09/20	7	09:40	09:45		RN		Two northeast through site at M1 height.
0262	29/09/20	7	10:00	10:05	1	K.		Adult female hunting to north of Marbrack. Dropped and lost to view.
0262	29/09/20	7	10:00	10:05		RN		Flew south past VP then through site at Low height.
0262	29/09/20	7	10:15	10:20		RN		Three flew south through site at Low height.
0256	29/09/20	6	12:10	12:15		BZ		Three birds hunting towards middle of site at M1 height.
0256	29/09/20	6	12:15	12:20		BZ		Continuation of previous record.
0256	29/09/20	6	12:15	12:20		RN		Two birds south through site at M2 height.
0256	29/09/20	6	12:20	12:25	1	KT		Hunting to east of Craig of Knockgray, following contours, heading south.
0256	29/09/20	6	12:20	12:25		BZ		Continuation of previous record.
0256	29/09/20	6	12:20	12:25		RN		Continuation of previous record.
0256	29/09/20	6	12:25	12:30	1	KT		Continuation of previous record.
0256	29/09/20	6	12:25	12:30	2			Heading southwest from north of Heathery Wood to Tup Park Knowe.
0256	29/09/20	6	12:25	12:30		BZ		Two birds from previous record still in view.
0256	29/09/20	6	12:30	12:35		BZ		Continuation of previous record.
0256	29/09/20	6	12:30	12:35		RN		One north through the site at Low height.
0256	29/09/20	6	12:45	12:50		BZ		One hunting in front of VP at M1 height.
0256	29/09/20	6	13:05	13:10		BZ		Continuation of previous record.
0256	29/09/20	6	13:35	13:40		BZ		Three hunting to south of site at M1 height.
0256	29/09/20	6	13:40	13:45		BZ		Two birds from previous record still in view.
0256	29/09/20	6	13:40	13:45		RN		One north past VP.
0256	29/09/20	6	13:50	13:55		BZ		One hunting to south of site.
0256	29/09/20	6	13:55	14:00		BZ		Continuation of previous record.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0256	29/09/20	6	14:05	14:10	3	K.		Adult female hunting over Quantans Hill.
0256	29/09/20	6	14:25	14:30		BZ		Hunting to west of site at M1 height.
0256	29/09/20	6	14:50	14:55		BZ		One hunting over Quantans Hill at M1 height.
0256	29/09/20	6	14:55	15:00		BZ		Now two hunting over Quantans Hill at M1 height.
0256	29/09/20	6	15:00	15:05		BZ		Now four hunting over Quantans Hill at M1 height.
0256	29/09/20	6	15:00	15:05	4	K.		Adult male hunting to south of Quantans Hill.
0256	29/09/20	6	15:05	15:10		BZ		Two hunting over Quantans Hill at M1 height.
0267	02/10/20	7	09:40	09:45		RN		Two east through site at M1 height.
0267	02/10/20	7	10:00	10:05		BZ		Hunting over middle of site at M1 height.
0267	02/10/20	7	10:05	10:10		BZ		Three hunting over middle of site at M1 height.
0267	02/10/20	7	10:05	10:10	1	K.		Male bird hunting on south side of Knockwhirn, heading north.
0267	02/10/20	7	10:15	10:20	2	KT		Circling at Little Loskie, then headed away southwest.
0267	02/10/20	7	10:20	10:25		BZ		Two hunting by Marbrack at M1 height.
0267	02/10/20	7	10:30	10:35		RN		Northeast through site.
0267	02/10/20	7	10:35	10:40		RN		Two flew west through site.
0267	02/10/20	7	10:35	10:40	3	K.		To southeast of Knockwhirn at Low height.
0267	02/10/20	7	10:50	10:55		BZ		Hovering towards middle of site at M2 height.
0267	02/10/20	7	10:50	10:55		BZ		Hunting near VP at M1 height.
0267	02/10/20	7	10:50	10:55		RN		Northwest past VP.
0267	02/10/20	7	10:55	11:00		BZ		Continuation of previous record.
0267	02/10/20	7	11:10	11:15		BZ		Two hunting in middle of site at M2 height.
0267	02/10/20	7	11:15	11:20		BZ		M2 height.
0267	02/10/20	7	11:20	11:25		RN		Four flying west-southwest through site.
0267	02/10/20	7	11:30	11:35		BZ		Hunting near VP at M2 height; drifted south.
0267	02/10/20	7	11:40	11:45		RN		Low in front of VP.
0268	02/10/20	7	13:40	13:45		BZ		Hovering to south of site at M1 height.
0268	02/10/20	7	13:50	13:55		RN		Two southwest past VP at Low height.
0268	02/10/20	7	14:10	14:15		RN		Behind VP at M1 height.
0268	02/10/20	7	14:25	14:30		BZ		Two hunting by Marbrack at M2 height.
0268	02/10/20	7	14:30	14:35		BZ		Continuation of previous record.
0263	09/10/20	6	13:15	13:20	1	KT		Drifted past to east of Craig of Knockgray, heading south.
0263	09/10/20	6	13:20	13:25		RN		Two flying north through site at M1 height.
0263	09/10/20	6	13:45	13:50		BZ		Hunting over Quantans Hill at M2 height.
0263	09/10/20	6	14:25	14:30	2	K.		Brief flight to east of Gardenhead Plantation.
0263	09/10/20	6	14:25	14:30		RN		Three flew east through site at Low height.
0263	09/10/20	6	14:40	14:45		BZ		Two hunting at west of site at M1 height.
0263	09/10/20	6	14:40	14:45		RN		Flew south through site.
0263	09/10/20	6	15:20	15:25		RN		South past VP at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0264	09/10/20	6	16:10	16:15		RN		North through site at Low height.
0264	09/10/20	6	16:15	16:20		BZ		Hovering over Quantans Hill at M1 height.
0264	09/10/20	6	17:05	17:10		RN		Two west through site (probably a pair: bit of displaying) at M1 height.
0264	09/10/20	6	17:05	17:10	1	K.		Hunting over Quantans Hill.
0269	14/10/20	8	07:35	07:40		RN		North through site at Low height.
0269	14/10/20	8	08:10	08:15		RN		West through site.
0269	14/10/20	8	08:30	08:35		BZ		Hunting to northwest of VP at M1 height.
0269	14/10/20	8	09:45	09:50	1	K.		In flight over The Glenkens, to the west of Riders Knowe, heading away north.
0270	14/10/20	8	10:45	10:50		RN		Circling over Beninner at M1 height.
0270	14/10/20	8	11:10	11:15		RN		Two flying north through site at M1 height.
0270	14/10/20	8	11:20	11:25		RN		Circling at north of site at M1 height.
0270	14/10/20	8	11:35	11:40		BZ		Circling towards north of site at M1 height.
0270	14/10/20	8	12:15	12:20		RN		Circling VP then flying northwest through site.
0265	21/10/20	6	07:50	07:55	1	GI		Early morning hunt: heading west into Gardenhead Plantation.
0265	21/10/20	6	08:10	08:15		RN		Two east through site at Low height.
0265	21/10/20	6	08:35	08:40		BZ		One briefly at southwest of site, at M1 height.
0265	21/10/20	6	09:00	09:05	2	ML		Hunting at Low height: heading south towards Heathery Wood.
0265	21/10/20	6	09:00	09:05		RN		Two east through site.
0265	21/10/20	6	09:15	09:20		BZ		Hunting at west of site, to M1 height.
0265	21/10/20	6	09:20	09:25		BZ		Continuation of previous record.
0265	21/10/20	6	09:50	09:55		RN		South through site at Low height.
0266	21/10/20	6	10:55	11:00	1	K.		Hunting over Quantans Hill.
0266	21/10/20	6	11:10	11:15		RN		Two northeast past VP at M1 height.
0266	21/10/20	6	11:55	12:00		BZ		One circling near VP at M1 height.
0266	21/10/20	6	12:00	12:05		BZ		Continuation of previous record.
0266	21/10/20	6	12:25	12:30		RN		Two northwest through site at M2 height.
0266	21/10/20	6	13:00	13:05	2	K.		Two hunting to south of Quantans Hill.
0266	21/10/20	6	13:10	13:15		BZ		Hunting near VP at M1 height.
0266	21/10/20	6	13:10	13:15		RN		Three circling VP then drifted east.
0272	23/10/20	7	08:20	08:25		RN		Two north through site at Low height.
0272	23/10/20	7	08:40	08:45		BZ		Hunting by T-shaped wood at M1 height.
0272	23/10/20	7	08:45	08:50		BZ		Continuation of previous record.
0272	23/10/20	7	09:10	09:15	1	K.		Hunting on west side of Furmiston Craig at Low height.
0272	23/10/20	7	09:10	09:15		RN		West past VP.
0271	23/10/20	8	12:00	12:05		RN		North past VP at M1 height.
0271	23/10/20	8	12:20	12:25		RN		Two over Beninner at M1 height.
0271	23/10/20	8	12:35	12:40	1	HH		Adult female. Hunting to south of VP initially, then gained height, heading east, went behind VP and another appeared behind it.
0271	23/10/20	8	12:35	12:40	2	HH		Second bird - a juvenile male - circled over open ground to south of VP and headed away east.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0271	23/10/20	8	12:40	12:45		BZ		Hunting towards T-shaped wood at M1 height.
0271	23/10/20	8	12:40	12:45		RN		Two hunting over Beninner at M1 height.
0271	23/10/20	8	13:00	13:05		BZ		Two hunting over Knockwhirn at M1 height.
0271	23/10/20	8	13:05	13:10		RN		Two north through site at Low height.
0271	23/10/20	8	13:45	13:50		RN		Four south through site.
0271	23/10/20	8	13:45	13:50	3	K.		Heading south over T-shaped wood.
0271	23/10/20	8	14:20	14:25		RN		Two south through site at M1 height.
0273	24/10/20	8	12:10	12:15		RN		Two north through site at Low height.
0273	24/10/20	8	12:20	12:25	1	PE		Probably a male. Seen briefly at crags at Beninner; only seen in flight when above skyline. Very distant.
0273	24/10/20	8	12:25	12:30		BZ		Hovering at T-shaped wood at M1 height.
0273	24/10/20	8	12:50	12:55		RN		Two past VP at M1 height.
0273	24/10/20	8	13:05	13:10		RN		Two southwest past VP at M1 height.
0273	24/10/20	8	13:05	13:10	2	PE		Hunting thrushes at southern end of Beninner crags.
0273	24/10/20	8	13:30	13:35	3	KT		Flying southwest from Furmiston Craig towards Little Loskie at M2 height.
0273	24/10/20	8	13:30	13:35		BZ		Hunting to north of site at M1 height.
0273	24/10/20	8	14:10	14:15		RN		Flew north at Low height.
0273	24/10/20	8	14:15	14:20		RN		Flew north at Low height.
0273	24/10/20	8	14:15	14:20	4	K.		Adult male hunting around T-shaped wood.
0273	24/10/20	8	14:25	14:30		RN		Three south through site from Beninner.
0273	24/10/20	8	14:25	14:30		BZ		Two over Knockwhirn at M1 height.
0273	24/10/20	8	14:40	14:45		BZ		South through site at Low height.
0273	24/10/20	8	15:00	15:05		RN		Two north past VP.
0274	24/10/20	8	16:00	16:05		BZ		Two hunting over Knockwhirn at M1 height.
0274	24/10/20	8	16:05	16:10		BZ		Continuation of previous record.
0274	24/10/20	8	16:30	16:35		RN		Two south through site at M1 height.
0274	24/10/20	8	17:10	17:15		RN		Three east over VP from site at M1 height.
0275	28/10/20	7	11:00	11:05	1	KT		Flew slowly past westwards, past T-shaped wood and then towards Knockwhirn. Blue tag on the right wing.
0275	28/10/20	7	11:00	11:05		BZ		Hunting towards Furmiston at M2 height.
0275	28/10/20	7	11:05	11:10		RN		Two north past VP at Low height.
0275	28/10/20	7	11:05	11:10		BZ		Two hunting towards Furmiston at M2 height.
0275	28/10/20	7	11:20	11:25		RN		Three east through site.
0275	28/10/20	7	11:20	11:25	2	KT		Different bird from previous record. Flew southwest over T-shaped wood and beyond.
0275	28/10/20	7	11:40	11:45	3	KT		Flew in southeast towards Furmiston Craig then turned towards Little Loskie and out of view.
0275	28/10/20	7	11:40	11:45		BZ		Hunting near Marbrack at M1 height.
0275	28/10/20	7	12:10	12:15	4	HH		Lost behind T-shaped wood in Low hunting flight - may have landed.
0275	28/10/20	7	12:10	12:15		BZ		Two hunting near VP at M2 height.
0275	28/10/20	7	12:45	12:50		BZ		Hunting towards Marbrack at M1 height.
0275	28/10/20	7	12:45	12:50	5	K.		Female bird hunting on northwest slope of Furmiston Craig.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0275	28/10/20	7	13:40	13:45		RN		Two east through site.
0276	28/10/20	7	15:15	15:20		RN		Two south through site at Low height.
0276	28/10/20	7	15:20	15:25		BZ		Two hunting near VP.
0276	28/10/20	7	15:25	15:30		BZ		Four near VP at M1 height.
0276	28/10/20	7	15:25	15:30	1	KT		Direct flight east-northeast, over T-shaped wood and beyond.
0276	28/10/20	7	15:30	15:35		BZ		Two at M1 height.
0276	28/10/20	7	15:50	15:55		RN		Three flew east-northeast through the site.
0276	28/10/20	7	15:50	15:55	2	K.		Hunting on west side of Furmiston Craig, moving southwest.
0276	28/10/20	7	16:05	16:10		BZ		Hunting in middle of site at M2 height.
0276	28/10/20	7	16:10	16:15		BZ		Continuation of previous record.
0276	28/10/20	7	16:30	16:35		RN		Two flew east through site.
0276	28/10/20	7	16:30	16:35	3	HH		Heading south-southwest past T-shaped wood. Appeared to land on prey. Not seen after so may have roosted in rank grass.
0277	05/11/20	6	10:45	10:50		RN		One southeast through site at M1 height.
0277	05/11/20	6	11:45	11:50	1	PG		119 birds westwards across site, to the north of Quantans Hill and Craig of Knockgray, gaining height.
0278	12/11/20	8	10:25	10:30		BZ		Hunting to south of site at M1 height.
0278	12/11/20	8	10:30	10:35		BZ		Another bird joined the first (from previous record) and flew at M1 height.
0278	12/11/20	8	10:50	10:55		RN		North past VP at Low height.
0278	12/11/20	8	11:40	11:45		BZ		Two towards middle of site, hovering, at M1 height.
0278	12/11/20	8	12:15	12:20		BZ		Hovering at middle of site at M1 height.
0278	12/11/20	8	12:15	12:20		RN		North past VP at Low height.
0279	12/11/20	8	13:40	13:45	1	K.		Circled over south side of Knockwhirn and headed away north.
0279	12/11/20	8	14:10	14:15		RN		North past VP at M1 height.
0279	12/11/20	8	14:15	14:20	2	KT		Seen to the south of the T-shaped wood. Flew west and then away to the south.
0279	12/11/20	8	14:40	14:45		BZ		Over Knockwhirn at M1 height.
0279	12/11/20	8	14:45	14:50		BZ		Continuation of previous record.
0279	12/11/20	8	15:00	15:05		RN		Two flew south through site.
0279	12/11/20	8	15:45	15:50	3	K.		Flew southwest, over the southern slope of Knockwhirn.
0279	12/11/20	8	15:45	15:50		BZ		One by VP at M1 height.
0279	12/11/20	8	16:05	16:10		RN		Two east over VP at M1 height.
0281	16/11/20	7	11:10	11:15		BZ		Hunting to south at M1 height.
0281	16/11/20	7	11:15	11:20		BZ		Continuation of previous record.
0281	16/11/20	7	11:15	11:20		BZ		Flew north through site.
0281	16/11/20	7	11:50	11:55		BZ		Hunting to south of VP at M1 height.
0281	16/11/20	7	11:55	12:00		BZ		Continuation of previous record.
0281	16/11/20	7	12:25	12:30		BZ		Circling behind VP at M2 height.
0282	16/11/20	7	13:30	13:35		BZ		Three hunting to south at M1 height.
0282	16/11/20	7	13:35	13:40		BZ		One still hunting to south at M1 height.
0282	16/11/20	7	14:10	14:15		BZ		One south past VP onto site at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0282	16/11/20	7	14:20	14:25	1	KT		Flew west across site, to the south of the T-shaped wood and then headed away northwest.
0282	16/11/20	7	14:40	14:45	2	K.		Circled several times over Furmiston Craig and headed away to south.
0282	16/11/20	7	14:40	14:45		BZ		Hunting to southwest of VP at M1 height.
0282	16/11/20	7	14:45	14:50	3	KT		Few south across site, over Little Loskie and beyond.
0280	17/11/20	6	09:20	09:25		BZ		Hunting towards middle of site at M1 height.
0280	17/11/20	6	09:25	09:30		BZ		First buzzard joined by a second.
0280	17/11/20	6	09:30	09:35		BZ		Continuation of previous record.
0280	17/11/20	6	09:55	10:00		BZ		Circling at west of site at M2 height.
0280	17/11/20	6	10:05	10:10		RN		Southwest through site.
0280	17/11/20	6	10:20	10:25	1	WS		15 birds - 12 adult and 3 juvenile - flying south at M2 height, to east of Craig of Knockgray.
0280	17/11/20	6	10:30	10:35	2	K.		Two circled over Willieanna at Low height.
0280	17/11/20	6	10:30	10:35		RN		Circling near VP at M1 height.
0283	17/11/20	6	11:10	11:15		BZ		Over Willieanna at M1 height.
0283	17/11/20	6	11:30	11:35		BZ	RN	Buzzard hunting towards middle of site at M1 height. Raven circling nearby.
0283	17/11/20	6	11:45	11:50		BZ		Two near middle of site at M2 height.
0283	17/11/20	6	11:50	11:55		BZ		Two still hunting in middle of site at M1 height.
0283	17/11/20	6	12:00	12:05		BZ		Two hunting on site at M1 height.
0283	17/11/20	6	12:00	12:05	1	KT		Flew west towards Quantans Hill, looped around and flew away to the east.
0283	17/11/20	6	12:15	12:20		BZ		Hovering over Quantans Hill at M1 height.
0283	17/11/20	6	12:15	12:20	2	K.		Brief flight to east of Gardenhead Plantation.
0284	22/11/20	8	08:30	08:35		BZ		To southwest, hunting at M1 height.
0284	22/11/20	8	08:35	08:40		RN		Two flew north through site at M1 height.
0284	22/11/20	8	08:55	09:00		RN		Southwest past VP at Low height.
0284	22/11/20	8	09:10	09:15		HH		Juvenile male hunting on eastern edge of site, moving towards Rider's Knowe.
0284	22/11/20	8	09:15	09:20		HH		Continuation of previous record.
0284	22/11/20	8	09:35	09:40		BZ		Hunting to southwest at M1 height.
0284	22/11/20	8	09:35	09:40		RN		One flew south through site.
0284	22/11/20	8	10:05	10:10		RN		One flew south through site.
0285	22/11/20	8	11:25	11:30	1	K.		Hunting at Rider's Knowe.
0285	22/11/20	8	11:40	11:45	2	K.		Brief flight on south side of Knockwhirn.
0285	22/11/20	8	11:50	11:55	3	K.		Hunting to south of T-shaped wood, moving south.
0285	22/11/20	8	11:50	11:55		RN		North past VP at M1 height.
0285	22/11/20	8	12:00	12:05		BZ		Three circling to south-southwest at M1 height.
0285	22/11/20	8	12:05	12:10		BZ		Two circling to south-southwest at M1 height.
0285	22/11/20	8	12:35	12:40	4	K.		Hunting on west side of Rider's Knowe.
0285	22/11/20	8	13:10	13:15		BZ	RN	Hunting over Knockwhirn. Raven circling close by.
0285	22/11/20	8	13:40	13:45	5	K.		Hunting to west of T-shaped wood, moving south.
0285	22/11/20	8	13:45	13:50		RN		Two east past VP at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0286	26/11/20	7	07:55	08:00		RN		Southwest through site at Low height.
0286	26/11/20	7	08:10	08:15		RN		East through site.
0286	26/11/20	7	09:00	09:05	1	K.		Briefly hovering at Furmiston Craig summit and moving west then south.
0286	26/11/20	7	09:00	09:05		BZ		Hunting to south at M1 height.
0286	26/11/20	7	10:05	10:10	2	K.		Hunting to north of Marbrack.
0286	26/11/20	7	10:15	10:20		BZ		Briefly in buffer to south at M1 height.
0287	26/11/20	7	12:10	12:15		BZ		Three briefly by Marbrack at Low height.
0287	26/11/20	7	12:25	12:30		RN		East through site.
0287	26/11/20	7	13:05	13:10		RN		Two east through site.
0288	27/11/20	6	10:05	10:10		BZ		Hunting towards middle of site at M1 height.
0288	27/11/20	6	10:20	10:25		BZ		Two in buffer to southeast at M1 height.
0288	27/11/20	6	10:30	10:35	1	K.		To the east of Gardenhead Plantation, heading southwest.
0288	27/11/20	6	11:55	12:00		BZ		Hunting near VP at M1 height.
0288	27/11/20	6	12:15	12:20		RN		Two flew southwest through site.
0288	27/11/20	6	12:25	12:30		RN		East past VP at Low height.
0288	27/11/20	6	12:35	12:40	2	K.		Over Quantans Hill, heading northeast.
0289	27/11/20	6	15:00	15:05		RN		Two southwest through site at Low height.
0289	27/11/20	6	15:35	15:40		RN		West past VP at M1 height.
0290	20/12/20	6	09:25	09:30	1	ML		Adult female flew east-southeast from Craig of Knockgray and then south and out of view.
0290	20/12/20	6	09:25	09:30		BZ		Two hovering towards middle of site at M1 height.
0290	20/12/20	6	09:30	09:35		BZ		One of the two from previous record still hunting in centre of site at M1 height.
0290	20/12/20	6	09:55	10:55		BZ		Hunting towards middle of site.
0290	20/12/20	6	10:20	10:25		RN		In buffer to south of site at Low height.
0290	20/12/20	6	10:40	10:45		BZ		Hunting on site at M1 height.
0290	20/12/20	6	11:05	11:10		RN		Two at Low height to south.
0290	20/12/20	6	11:15	11:20		RN		Two at Low height to south.
0290	20/12/20	6	11:55	12:00		BZ		Hunting towards middle of site at M1 height.
0290	20/12/20	6	12:00	12:05		RN		South through site at M1 height.
0290	20/12/20	6	12:05	12:10		RN		Continuation of previous record.
0291	20/12/20	6	13:05	13:10		BZ		Hunting on site at M1 height.
0291	20/12/20	6	13:15	13:20	1	K.		Hunting over Quantans Hill.
0291	20/12/20	6	13:15	13:20		BZ		Two hunting on site at M1 height.
0291	20/12/20	6	13:20	13:25		BZ		One of the birds from previous record still hunting at M1 height.
0291	20/12/20	6	13:25	13:30		BZ		Two circling above Quantans Hill at M1 height.
0291	20/12/20	6	13:40	13:45		BZ		In south buffer at Low height.
0291	20/12/20	6	13:50	13:55	2	KT		South-easterly flight through centre of site.
0291	20/12/20	6	13:50	13:55		BZ		Two in south buffer at Low height.
0291	20/12/20	6	14:10	14:15		RN		East past VP and then through site at M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0291	20/12/20	6	15:00	15:05		RN		Two northwest through site at Low height.
0291	20/12/20	6	15:10	15:15		BZ		Hunting on Quantans Hill at M1 height.
0291	20/12/20	6	15:15	15:20		BZ		Continuation of previous record.
0291	20/12/20	6	15:15	15:20	3	HH		Immature female hunting on eastern side of Craig of Knockgray and towards Heathery Wood.
0291	20/12/20	6	15:30	15:30		RN		By VP at Low height.
0292	22/12/20	7	09:40	09:45		RN		Two flew into T-shaped wood at Low height.
0292	22/12/20	7	10:00	10:05		RN		One around T-shaped wood at Low height.
0292	22/12/20	7	10:00	10:05		BZ		Hunting in front of VP at M1 height.
0292	22/12/20	7	10:15	10:20		RN		Two around T-shaped wood at Low height.
0292	22/12/20	7	10:20	10:25		RN		Two around T-shaped wood.
0292	22/12/20	7	10:20	10:25		BZ		Two hunting near Marbrack at M1 height.
0292	22/12/20	7	10:35	10:40		RN		Two flew west from T-shaped wood.
0292	22/12/20	7	10:35	10:40	1	K.		Circling northwest slope of Furmiston Craig.
0292	22/12/20	7	11:00	11:05		BZ		Two hunting in centre of site at M1 height.
0292	22/12/20	7	11:05	11:10		BZ		Continuation of previous record.
0292	22/12/20	7	11:30	11:35		RN		Two returned from west to T-shaped wood.
0292	22/12/20	7	11:45	11:50		RN		Three flew southeast through site.
0294	22/12/20	7	12:25	12:30		RN		One around T-shaped wood at M1 height.
0294	22/12/20	7	12:35	12:40		RN		Continuation of previous record.
0294	22/12/20	7	12:50	12:55		RN		Two around T-shaped wood at M1 height.
0294	22/12/20	7	12:50	12:55		BZ		Hunting on site at M1 height.
0294	22/12/20	7	13:10	13:15		RN		Two flew south from T-shaped wood at Low to M1 hight.
0294	22/12/20	7	13:20	13:25		BZ		Two hunting on site at M1 height.
0294	22/12/20	7	13:20	13:25	1	HH		Adult female with damaged left wing hunting on south side of Knockwhirn, heading away northwest.
0294	22/12/20	7	14:00	14:05	2	K.		Hunting on northwest slope of Furmiston Craig.
0294	22/12/20	7	14:20	14:25		RN		Two flew south past VP.
0294	22/12/20	7	14:30	14:35		BZ		Hunting on site at M1 height.
0293	23/12/20	8	09:00	09:05		RN		Two around T-shaped wood at M1 height.
0293	23/12/20	8	09:10	09:15		RN		One flew west over VP on to site.
0293	23/12/20	8	09:30	09:35		BZ		Hunting over Knockwhirn at M1 height.
0293	23/12/20	8	09:45	09:50		RN		Two flew north through site at M1 height.
0293	23/12/20	8	10:05	10:10		BZ		Hunting to southwest of VP at M1 height.
0293	23/12/20	8	10:20	10:25		RN		One west over VP at Low height.
0293	23/12/20	8	10:40	10:45		RN		Flew southwest past VP at M1 height.
0295	23/12/20	8	11:30	11:35		RN		Two flew south past VP at Low height.
0295	23/12/20	8	11:35	11:40		RN		Continuation of previous record.
0295	23/12/20	8	11:40	11:45	1	K.		Hunting to the east of the T-shaped wood at M1 height.
0295	23/12/20	8	11:40	11:45		BZ		Hunting to southwest at M1 height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0295	23/12/20	8	12:30	12:35		RN		Two around T-shaped wood at M1 height, calling.
0295	23/12/20	8	12:40	12:45		BZ		Hunting over Knockwhirn at M1 height.
0295	23/12/20	8	12:45	12:50		BZ		Continuation of previous record.
0295	23/12/20	8	13:15	13:20	2	K.		Hunting over Knockwhirn at M1 height.
0295	23/12/20	8	13:35	13:40		RN		One around T-shaped wood at M1 height.
0295	23/12/20	8	13:50	13:55		RN		Continuation of previous record.
0295	23/12/20	8	14:15	14:20		RN		Two around T-shaped wood at M1 height.
0296	22/01/21	6	08:55	09:00		RN		One west-northwest through site at Low height.
0296	22/01/21	6	09:35	09:40		RN		Two west through site at Low height.
0296	22/01/21	6	09:45	09:50		BZ		One hunting in south of buffer at M1 height.
0296	22/01/21	6	09:45	09:50		RN		Two behind VP at M1 height.
0296	22/01/21	6	11:00	11:05		RN		One circling towards middle of site at M1 height.
0296	22/01/21	6	11:05	11:10		RN		Two circling towards middle of site at M1 height, drifting south.
0297	22/01/21	6	11:50	11:55		RN		Two east through site at M1 height.
0297	22/01/21	6	12:25	12:30		BZ		Two hunting in south buffer at M1 height.
0297	22/01/21	6	12:40	12:45		RN		Two displaying over site at M1 height.
0297	22/01/21	6	12:45	12:50		RN		Continuation of previous record.
0297	22/01/21	6	13:05	13:10		RN		One northwest through site at Low height.
0297	22/01/21	6	13:20	13:25		RN		Two east past VP at M1 height.
0297	22/01/21	6	13:55	14:00		RN		One east through site.
0297	22/01/21	6	14:05	14:10		RN		One circling over site at M1 height.
0297	22/01/21	6	14:10	14:15		BZ		One hunting in south buffer at M1 height.
0297	22/01/21	6	14:40	14:45		RN		One west through site at Low height.
0298	27/01/21	7	10:15	10:20	1	KT		Adult hunting to southeast of Quantans Hill. Dropped out of view behind copse.
0298	27/01/21	7	10:55	11:00		RN		One flew southwest over Furmiston Craig and Low and M1 height.
0298	27/01/21	7	11:10	11:15		RN		One displaying, heading east at M2 and High height.
0298	27/01/21	7	11:10	11:15	2	K.		Hunting on east side of Furmiston Craig. Lost against background. Have stooped to the ground.
0298	27/01/21	7	11:45	11:50	3	K.		Adult male hunting to north of Marbrack. Landed in tree, perched for 90 seconds, then dropped out of view behind copse.
0298	27/01/21	7	12:10	12:15	4	KT		Adult hunting to north of Marbrack, moving west. Lost to view behind trees.
0298	27/01/21	7	12:25	12:30	5	K.		Adult male hunting on south side of Knockwhirn, moving northwest. Lost to view when dropped to ground. Judging by wear in tail, same bird as record (3).
0299	27/01/21	7	13:55	14:00		RN		Two heading northwest, separately.
0299	27/01/21	7	14:00	14:05	1	K.		Adult male hunting to north of Marbrack, then landed on post.
0299	27/01/21	7	14:20	14:25	2	K.		Adult female hunting on and off over area on the east side of Furmiston Craig.
0299	27/01/21	7	15:35	15:40	3	KT		Adult bird hunting alongside bird in flight (4), to the south of Knockwhirn and heading south. This bird took the lead and appeared to land in a tree at Marbrack.
0299	27/01/21	7	15:35	15:40	4	KT		Adult bird hunting close to bird in flight (3) but when it landed in a tree, this bird carried on, heading away west. Lost to view behind trees.
0299	27/01/21	7	15:50	15:55	5	HH		Adult male hunting to south of Knockwhirn, moving east. Perched on tussock partway through flight, for 50 seconds, then continued. Lost Low to ground.
0300	31/01/21	8	09:55	10:00	1A & 1B	KT	K.	First bird watched for ten and a half minutes, then joined by a second bird. Hunting on east side of Knockwhirn, often alighting briefly on hillside. Eventually lost against hillside, heading northwest. At around 6 minutes into initial flight, first bird flushed an adult female kestrel from a fence post. Flew southeast, past VP at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0300	31/01/21	8	10:40	10:45		BZ		One hunting at M1 and Low heights.
0300	31/01/21	8	11:00	11:05		RN		One at Low height, heading northeast.
0300	31/01/21	8	11:05	11:10		RN		One at Low and M1 heights, foraging around Knockwhirn. Also, two heading west from Craigengillan at Low, M1 and M2 heights.
0300	31/01/21	8	11:10	11:15		RN		Same two birds as above, circling north of VP at Low and M1 heights, moving southwest along lower slope of Beninner.
0300	31/01/21	8	11:15	11:20		RN		Continuation of previous record.
0300	31/01/21	8	11:30	11:35		BZ		One hunting near Beninner.
0300	31/01/21	8	11:35	11:40	2	KT		Adult hunting around T-shaped wood. Lost to view behind copse.
0300	31/01/21	8	11:35	11:40		BZ		Hunting around Knockwhirn.
0300	31/01/21	8	11:40	11:45		RN		One heading northwest at M1 height.
0300	31/01/21	8	11:45	11:50	3	KT		Adult hunting at Rider's Knowe. Dropped behind ridge.
0300	31/01/21	8	11:50	11:55		RN		Two heading south over VP.
0300	31/01/21	8	11:50	11:55	4	KT		Adult hunting over Knockwhirn. Out of sight behind ridge.
0300	31/01/21	8	12:15	12:20		BZ		Hunting on Knockwhirn.
0300	31/01/21	8	12:20	12:25		RN		Two over Knockwhirn. Some display flight.
0300	31/01/21	8	12:25	12:30	5	KT		Adult hunting, moving north over Knockwhirn and towards Beninner. Frequent, brief drops to ground.
0301	31/01/21	8	13:35	13:40		BZ		One hunting on side of Knockwhirn.
0301	31/01/21	8	13:40	13:45		BZ		Same bird as previous record, still hunting and joined by another bird.
0301	31/01/21	8	13:45	13:50		BZ		Same birds, still hunting together.
0301	31/01/21	8	13:50	13:55		BZ		One bird still hunting on Knockwhirn.
0301	31/01/21	8	13:50	13:55		RN		One heading northeast at Low and M1 height.
0301	31/01/21	8	13:55	14:00		BZ		Continuation of previous record.
0301	31/01/21	8	14:00	14:05	1	KT		Adult, hunting. Picked up to east of T-shaped wood: headed over Knockwhirn and away east.
0301	31/01/21	8	14:30	14:35		RN		Landed in T-shaped wood.
0301	31/01/21	8	14:50	14:55	2	KT		Adult, hunting over the southern side of Knockwhirn and heading away west.
0301	31/01/21	8	15:20	15:25		BZ		Hunting over Knockwhirn and Polshagg Burn.
0301	31/01/21	8	15:30	15:35		BZ		Hunting over Polshagg Burn area.
0301	31/01/21	8	15:35	15:40		RN		One heading northwest out of Craigengillan Forest.
0301	31/01/21	8	15:35	15:40		BZ		One hunting on Knockwhirn.
0301	31/01/21	8	15:45	15:50		BZ		Still hunting on Knockwhirn.
0301	31/01/21	8	15:50	15:55		RN		One Low along slope of Knockwhirn.
0302	12/02/21	8	11:20	11:25		RN		Two south through site at M1 height.
0302	12/02/21	8	11:20	11:25	1	K.		Hunting to east of T-shaped wood, then heading away south.
0302	12/02/21	8	11:45	11:50		RN		Two west over VP, then through site.
0302	12/02/21	8	11:45	11:50		BZ		One hovering to north of VP, drifting northwest, at M1 height.
0302	12/02/21	8	12:10	12:15	2	KT		Slowly flying northeast, picked up on south side of Knockwhirn.
0302	12/02/21	8	12:25	12:30		BZ		One circling and calling to north at M1 height.
0302	12/02/21	8	12:55	13:00		RN		Two circling by T-shaped wood at M1 height.
0302	12/02/21	8	13:40	13:45	3	K.		Hunting to south of T-shaped wood.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0302	12/02/21	8	13:40	13:45		RN		Two flew west through site.
0303	12/02/21	8	15:15	15:20		BZ		Briefly to north, flying east at M1 height.
0303	12/02/21	8	15:30	15:35		RN		Two to southeast of VP, circling then drifting south at M1 height.
0303	12/02/21	8	16:05	16:10	1	K.		Hunting to east of T-shaped wood.
0303	12/02/21	8	16:05	16:10	2	KT		Flew northwest towards T-shaped wood, then away southwest.
0303	12/02/21	8	16:25	16:30		RN		Two flew east through site.
0304	17/02/21	6	08:55	09:00		RN		One behind VP, calling, at M1 height.
0304	17/02/21	6	09:15	09:20		RN		Two east through site at Low height.
0304	17/02/21	6	09:35	09:40	1	PG		20 birds flew west across site. Appeared lost, really not sure where they wanted to go.
0304	17/02/21	6	09:35	09:40		RN		One at Low height over Quantans Hill.
0304	17/02/21	6	09:55	10:00	2	PG		Seven birds west over Quantans Hill and then away southwest and over Tup Park Knowe.
0304	17/02/21	6	10:40	10:45		BZ		One in buffer to south, circling, at M1 height.
0304	17/02/21	6	11:00	11:05		BZ		One briefly in south buffer at Low height.
0304	17/02/21	6	11:20	11:25		RN		Two east over VP then through site at M1 height.
0305	17/02/21	6	13:40	13:45		RN		One circling Quantans Hill at M1 height.
0305	17/02/21	6	13:45	13:50		RN		Bird from previous record drifted east.
0305	17/02/21	6	14:10	14:15		BZ		One in buffer to southeast.
0305	17/02/21	6	14:10	14:15	1	KT		Picked up to northeast of Heathery Wood, heading south.
0305	17/02/21	6	14:30	14:35		RN		One west through site at Low height.
0305	17/02/21	6	14:40	14:45		RN		Two circling Quantans Hill then flew west at M1 height.
0305	17/02/21	6	15:05	15:10		RN		One east-northeast past VP at M1 height.
0306	26/02/21	7	09:55	10:00		RN		Two at M1 height.
0306	26/02/21	7	09:55	10:00		BZ		One at M1 height.
0306	26/02/21	7	10:10	10:15		RN		One at M1 height.
0306	26/02/21	7	10:40	10:45		RN		One at Low height.
0306	26/02/21	7	12:35	12:40		RN		Two at Low height.
0307	26/02/21	7	13:25	13:30	1	KT		Flew south then southeast across site towards Marbrack, then away south.
0307	26/02/21	7	13:45	13:40		BZ		One at M1 and M2 height.
0307	26/02/21	7	13:55	14:00	2	KT		Large activity to the east and northeast of Marbrack, to the summit of Furmiston Craig.
0307	26/02/21	7	14:35	14:40		RN		Three at M2 height.
0307	26/02/21	7	16:10	16:15		RN		Two at M1 height.
0308	19/03/21	6	11:50	11:55		BZ		Circling in south of buffer at M1 height.
0308	19/03/21	6	11:50	11:55		RN		One flew east through site.
0308	19/03/21	6	12:05	12:10		BZ		Briefly in south buffer at Low height.
0308	19/03/21	6	12:15	12:20		RN		West through site at Low height.
0308	19/03/21	6	12:40	12:45		RN		Two north through site at Low height.
0308	19/03/21	6	12:40	12:45	1	KT		One very distantly, heading southeast past Furmiston Craig.
0308	19/03/21	6	12:50	12:55		BZ		Two circling in south of buffer at Low height.

Survey Ref	Date	VP	Start Time	End Time	Flight ID	BTO (main)	BTO (other)	Notes
0308	19/03/21	6	13:05	13:10	2	K.		Adult female hunting on south side of Quantans Hill.
0308	19/03/21	6	13:05	13:10		RN		One east through site at M1 height.
0308	19/03/21	6	13:40	13:45		BZ		One circling in buffer at M1 height.
0308	19/03/21	6	13:40	13:45		RN		One circling by middle of site at M1 height.
0308	19/03/21	6	13:45	13:50	3	KT		Two in semi-display to northeast of Tup Park Knowe.
0308	19/03/21	6	13:55	14:00		BZ		Two circling and calling in south buffer.
0308	19/03/21	6	14:00	14:05		BZ		Continuation of previous record.
0308	19/03/21	6	14:10	14:15	4	K.		Adult male hovering at Marbrack.
0309	19/03/21	6	16:00	16:05		BZ		One at west end of site at M1 height.
0309	19/03/21	6	16:05	16:10		BZ		Bird from previous record. Went up to M2 height, circling.
0309	19/03/21	6	16:05	16:10	1	KT		Pair to north of Heathery Wood at M1 height.
0309	19/03/21	6	16:50	16:55		RN		In south of buffer at Low height.
0309	19/03/21	6	17:15	17:20		BZ		One east past VP at Low height.
0310	22/03/21	7	12:20	12:25		BZ		One at M2 height.
0310	22/03/21	7	12:40	12:45		BZ		One at M1 height.
0310	22/03/21	7	12:45	12:50	1	KT		Immature bird moving east to the south of the VP.
0310	22/03/21	7	15:10	15:15		RN		Two at Low height.
0311	22/03/21	7	15:45	15:50		RN		Two at Low height.
0311	22/03/21	7	17:45	17:50		RN		One at Low height.
0312	24/03/21	8	08:05	08:10	1	KT		Flight activity in an area of Rider's Knowe and to south.
0312	24/03/21	8	08:35	08:40		RN	BZ	Two raven and one buzzard at M1 height.
0312	24/03/21	8	10:15	10:20		RN		Two at Low height.
0312	24/03/21	8	10:45	10:50		BZ		One at Low height.
0313	24/03/21	8	12:40	12:45		RN		Two at Low height.
0313	24/03/21	8	14:05	14:10		BZ		One at Low height.
0313	24/03/21	8	14:05	14:10		RN		One at M1 height.
0313	24/03/21	8	14:20	14:25		RN		Two at Low height.

Table A3.2: Target / Secondary Species Flight Activity Data (April 2018 to August 2019 and September 2020 to March 2021)

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0003	20/04/18	2	**1**	**GD**	**3**	2M, 1F	Ad.	16:46		40					40			Three flying at Low height, heading northwest past Dalbonniton Knowe.
0003	20/04/18	2	**2**	**CU**	**1**	Unk.	Ad.	16:53	5	20					25			Flying at Low height, heading southwest to the southeast of the VP.
0007	30/04/18	4N	**1**	**KT**	**2**		Ad.	16:58			**45**	**135**		130	310			Two red kites - probably a pair. To the north of the VP, heading southeast over the forestry and away east.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0008	30/04/18	4S	**1**	**KT**	**1**	Unk.	Ad.	18:56			**225**				225			Red kite out hunting. Heading south past Furmiston Craig.
0008	30/04/18	4S	**2**	**KT**	**1**	Unk.	Unk.	20:13	140						140			To the west of the VP at Very Low height.
0010	07/05/18	3	**1**	**KT**	**1**	Unk.	Ad.	16:30	15	30	**90**				135			Red kite hunting, moving west from Knockwhirn to Willieanna.
0012	07/05/18	3	**1**	**BK**	**1**	M	Ad.	19:29	18						18			Lekking male grouse accidentally flushed.
0014	15/05/18	4S	**1**	**K.**	**1**	F	Ad.	11:23		125	**75**				200			Common kestrel hunting around sheepfold to west of VP.
0014	15/05/18	4S	**2**	**K.**	**1**	F	Ad.	11:52		85					85			Common kestrel hunting again in same area as previous record.
0014	15/05/18	4S	**3**	**K.**	**1**	F	Ad.	12:51		45	**60**				105			To southwest of the VP, close to the previous two records.
0014	15/05/18	4S	**4**	**K.**	**1**	F	Ad.	13:30	5	105					110			Common kestrel hunting to south of VP, swooped down and lost to view.
0016	15/05/18	4S	**1**	**K.**	**1**	M	Ad.	14:45	25						25			Male common kestrel direct south-westerly flight to south of the VP, no hovering, lost low to ground.
0016	15/05/18	4S	**2**	**K.**	**1**	M	Ad.	15:24	2	90					92			Adult male hunting to south of VP. Dropped to ground and lost to view. Most of flight spent hovering.
0016	15/05/18	4S	**3**	**K.**	**1**	M	Ad.	15:33	2	88					90			Same male common kestrel as previous record, hunting to south of VP. Mainly hovering and again lost to view when it dropped to the ground.
0016	15/05/18	4S	**4**	**KT**	**1**	Unk.	Ad.	17:00	75	35					110			Red kite hunting, heading south towards Furmiston Craig. Lost low against background.
0021	23/05/18	3	**1**	**CU**	**1**	Unk.	Unk.	09:37	40						40			Flying northwest over Quantans Hill at Very Low height.
0022	23/05/18	4N	**1**	**K.**	**1**	M	Ad.	09:58	300						300			Male common kestrel hunting around Rider's Knowe.
0021	23/05/18	3	**2**	**KT**	**1**	Unk.	Ad.	10:37				**45**		255	300			Circled to west of Knockwhirn then headed south over Marbrack and beyond at M2 and Very High heights.
0022	23/05/18	4N	**2**	**K.**	**1**	F	~	12:05		220					220			Female common kestrel hunting to south of Knockwhirn.
0025	28/05/18	1	**1**	**K.**	**1**	M	Ad.	15:22			**310**				310			Male common kestrel headed east from Willieanna towards Knockwhirn and headed away north. Stopping to hover a lot. Never made a dive though. Lost against background.
0025	28/05/18	1	**2**	**KT**	**1**	Unk.	Unk.	15:39			**90**	**175**			265			Picked up to south of Dunool. Headed southeast over Quantans Hill, then turned northeast and then south and out of viewshed.
0026	28/05/18	1	**1**	**KT**	**1**	Unk.	Ad.	19:16			**190**				190			Red kite over Willieanna and heading northeast.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0028	30/05/18	4S	**1**	**K.**	**1**	Unk.	Unk.	17:08	5	15	**75**				95			Common kestrel hunting to north of Furmiston Craig, went to ground for prey.
0028	30/05/18	4S	**2**	**K.**	**1**	Unk.	Unk.	17:17		140					140			Same bird as previous record, still hunting to northeast of Furmiston Craig.
0029	05/06/18	4S	**1**	**KT**	**2**	Unk.	Unk.	15:57			**30**	**45**		345	420			Two red kites picked up to east of Furmiston Craig, headed towards Little Loskie and then turned northeast and flew across the site and out of viewshed.
0029	05/06/18	4S	**2**	**K.**	**1**	Unk.	Unk.	16:18	10	75					85			Common kestrel to northeast of Furmiston Craig.
0030	05/06/18	4N	**1**	**K.**	**1**	Unk.	Ad.	16:19	30	30	**45**	**90**		235	430			Common kestrel hunting over Knockwhirn. Frequent and prolonged hovering.
0029	05/06/18	4S	**3**	**KT**	**1**	Unk.	Unk.	16:53						315	315			One red kite over Marbrack and away southeast.
0029	05/06/18	4S	**4**	**SN**	**1**	M	Ad.	17:46	15						15			Common snipe short display flight near sheepfold to southwest of VP.
0032	11/06/18	2	**A**	**CM**	**5**	Unk.	Unk.	09:10	5400	5400					10800	0	03:00:00	Five common gulls in area to north of Knockgray Park, foraging on site with occasional short flights throughout survey.
0031	11/06/18	3	**1**	**K.**	**1**	F	Ad.	10:46			**90**				90			Common kestrel hunting, heading south past Marbrack.
0034	11/06/18	2	**A**	**CM**	**8**	Unk.	Unk.	12:40	1500	1500					3000	0	00:50:00	Eight adult common gulls foraging in area to north of Knockgray Park. Many short flights at Very Low and low heights. All headed off west and southwest at 13:30 at various heights.
0037	19/06/18	4S	**1**	**KT**	**1**	Unk.	Ad.	15:26			**465**				465			Red kite at medium height, heading north past VP and away west.
0037	19/06/18	4S	**2**	**KT**	**1**	Unk.	Unk.	16:05				**315**			315			Red kite at Medium height, heading south past Furmiston Craig.
0041	27/06/18	1	**1**	**CU**	**1**	Unk.	Ad.	11:16	130						130			An adult curlew flying Very Low along the valley to west of Quantans Hill, calling constantly. Territorial flight.
0041	27/06/18	1	**2**	**K.**	**1**	M.	Ad.	12:22	75	160					235	0	00:03:55	Adult male common kestrel active over eastern side of Willieanna, constantly calling throughout.
0041	27/06/18	1	**3**	**K.**	**2**	M & F	Ad.	13:11	60	320					380			A pair of common kestrel hunting to the south of Willieanna. Both returned to the small wood to the east., where they were calling earlier.
0042	27/06/18	1	**1**	**KT**	**1**	Unk.	Unk.	16:12		70					70			Red kite quickly gliding past the south side of the VP, moving west.
0047	10/07/18	4S	**1**	**K.**	**1**	F	Ad.	14:27			**135**				135			Common kestrel hunting in a looping flight from north of Furmiston Craig and heading east.
0052	25/07/18	4N	**1**	**KT**	**3**	Unk.	Ad.	10:16	108	432	**378**	**108**		54	1080	45	00:18:00	Three birds initially but one split off and headed northeast after a minute or so. Both birds remaining hunted together and apart

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
																		before moving off very low to the west and lost behind Knockwhirn
0052	25/07/18	4N	**2A**	**K.**	**2**	Unk.	Unk.	10:16	2214	246					2460	0	00:41:00	Two common kestrels silhouetted and unable to age or sex them as a result. Hunting on side of Knockwhirn together, in a relatively small area. Dropped out of view behind skyline from time to time, but reappeared again relatively quickly each time.
0051	25/07/18	4S	**1**	**K.**	**1**	M	Ad.	10:45	10	105	**90**				205			Common kestrel went to ground - hunting sheepfold area to west of the VP.
0052	25/07/18	4N	**2B**	**K.**	**1**	M	Ad.	10:45	612	72	**36**				720	5	00:12:00	Common kestrel hunting on lower slopes of Knockwhirn before moving up to join previous two birds, suggests that previous two birds are either its young or young and female as no dispute and hunted together.
0052	25/07/18	4N	**3**	**KT**	**1**	Unk.	Ad.	11:08		15					15			Red kite around top of Knockwhirn, hunting in brief flight.
0051	25/07/18	4S	**2**	**K.**	**1**	M	Ad.	11:19	10						10			Common kestrel hunting at plantation to west of the VP.
0051	25/07/18	4S	**3**	**K.**	**1**	Unk.	Imm.	11:32			**195**				195			Common kestrel hunting over sheepfold / plantation area to west of the VP and heading away to north.
0052	25/07/18	4N	**4**	**KT**	**1**	Unk.	Unk.	11:33						40	40			Red kite hunting to south of Beninner but lost to view against background.
0052	25/07/18	4N	**5**	**K.**	**1**	Unk.	Unk.	11:35	2	15		**60**		60	137			Common kestrel hunting to east of Knockwhirn, then dropped to ground and lost to view.
0052	25/07/18	4N	**6**	**K.**	**2**	Unk.	Unk.	11:47				**12**		45	57			Two common kestrels hunting together to south of Beninner but silhouetted so unable to age or sex them. Lost to view against background.
0052	25/07/18	4N	**7**	**KT**	**1**	Unk.	Ad.	12:03			**101**	**15**			116			Red kite adult hunting, heading east from Knockwhirn and then south. Flight continues at VP4S at 12:05.
0051	25/07/18	4S	**4**	**KT**	**1**	Unk.	Ad.	12:05			**195**				195			Red kite hunting, heading southeast past VP.
0051	25/07/18	4S	**5**	**K.**	**1**	Unk.	Unk.	12:16		85					85			Common kestrel hunting at sheepfold to west of VP.
0051	25/07/18	4S	**6**	**K.**	**1**	F	Ad.	12:56		30	**180**				210			Common kestrel hunting, heading south past sheepfold to west of VP.
0053	07/08/18	4S	**1**	**K.**	**1**	F	Ad.	12:20		32	**60**				92			Common kestrel hunting northeast of Furmiston Craig, lost to view after dropping to the ground.
0053	07/08/18	4S	**2**	**K.**	**1**	F	Ad.	12:26	2	135					137			Common kestrel north of Furmiston Craig, dropped to ground again after hunting. Same bird as previous record.
0053	07/08/18	4S	**3**	**KT**	**1**	Unk.	Ad.	12:50	96	768	**96**				960	10	00:16:00	Red kite over area to east of Furmiston Craig.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0053	07/08/18	4S	**4**	**KT**	**1**	Unk.	Ad.	13:21		70	**30**				100			Adult red kite hunting to north of Furmiston Craig, probably same bird as above.
0054	07/08/18	4N	**1**	**KT**	**1**	Unk.	Ad.	14:58				**30**			30			Red kite in brief flight across valley, lost to view behind ridge of Knockwhirn.
0054	07/08/18	4N	**2**	**K.**	**1**	Unk.	Juv.	15:40	3	120					123			Common kestrel hunting over sheepfold area on edge of forestry to east of Knockwhirn.
0056	08/08/18	3	**HH1**	**HH**	**1**	F	Ad.	07:09	20						20			Hen harrier at Low height, heading north past Quantans Hill.
0059	22/08/18	1	**1**	**K.**	**1**	M	Juv.	12:10		75					75			Common kestrel at Low height at Quantans Hill.
0059	22/08/18	1	**2**	**K.**	**1**	M	Juv.	12:37		90					90			Common kestrel at Low height at Quantans Hill.
0060	22/08/18	4S	**K.1**	**K.**	**1**	F	Ad.	13:46		30	**90**	**60**			180			Common kestrel at Low and Medium heights heading north from Furmiston Craig.
0060	22/08/18	4S	**KT1**	**KT**	**1**	Unk.	Unk.	14:58	90	45					135			Red kite at Very Low and Low heights heading south past Furmiston Craig towards Big Loskie.
0061	22/08/18	1	**1**	**PE**	**2**	F	Ad. & Juv.	18:11	45						45			Two peregrine falcons at Very Low height to north of Heathery Wood, heading northeast.
0065	05/09/18	4S	**1**	**OP**	**1**	Unk.	Unk.	16:03						180	180			Osprey high over site picked up over sheepfold to west of the VP and heading north-northeast. Continued beyond 4S viewshed, pursued by two ravens.
0064	05/09/18	4N	**1**	**OP**	**1**	Unk.	Unk.	16:06						405	405			Osprey high over site, heading northeast over Rider's Knowe and past Green Hill. Continuation from flight recorded initially from VP4S.
0068	05/09/18	4S	**1**	**SN**	**2**	Unk.	Unk.	19:11		10	**135**	**60**			205			Two common snipe over sheepfold area to west of VP
0071	17/09/18	2	**1**	**K.**	**1**	F	Ad.	09:18		40					40			Female common kestrel at Low height, heading north from Tup Park Knowe.
0072	17/09/18	2	**1**	**KT**	**1**	Unk.	Ad.	13:15		65					65			One red kite flying west, to the north of Tup Park Knowe.
0073	25/09/18	1	**1**	**KT**	**1**	Unk.	Juv.	12:16			**225**	**140**			365			Juvenile red kite heading east from Willieanna to Knockwhirn.
0073	25/09/18	1	**2**	**KT**	**2**	Unk.	Ad.	12:28		315	**255**				570			Two adult red kites over Willieanna and Quantans Hill and away west.
0076	25/09/18	2	**1**	**K.**	**1**	F	Ad.	14:57	45						45			Female common kestrel hunting at Very Low height close to VP.
0075	25/09/18	4S	**SN1**	**SN**	**2**	Unk.	Unk.	16:04			**30**				30			Two common snipe at M1 height over sheepfold area to west of VP.
0075	25/09/18	4S	**KT1**	**KT**	**1**	Unk.	Ad.	16:17	90	150					240			One adult red kite at Low and Very Low heights, heading east from Knockwhirn and then south. Lost to sight/landed?
0079	17/10/18	2	**1**	**ML**	**1**	F	Juv.	14:12	37						37			Female juvenile hunting east and south of Tup Park Knowe - lost behind trees.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0079	17/10/18	2	**2**	**ML**	**1**	F	Juv.	14:37	22						22			Female juvenile hunting west of Heathery Wood - lost behind trees. Same bird as previous record.
0082	17/10/18	3	**1**	**GP**	**6**	Unk.	Unk.	15:48			**100**				100			Heard calling first. A flock of six golden plover picked up in the direction of Knockwhirn, flying south-southwest at M1 height. Continued south-southwest quickly past the east side of the VP.
0082	17/10/18	3	**2**	**SN**	**2**	Unk.	Unk.	17:21	35						35			Two snipe took off from the rough pasture to the northeast of the VP and flew Very Low south, appearing to land again as they went over the brow.
0084	19/10/18	4N	**1**	**H.**	**1**	Unk.	Ad.	13:13	15	15	**30**				60			Northwest past VP.
0086	19/10/18	1	**1**	**WS**	**27**	Unk.	Ad. & Juv.	17:38						20	20			Flew southeast over North Liggat.
0088	26/10/18	1	**1**	**K.**	**1**	F	Unk.	12:28		182					182			Hunting north of Willieanna.
0088	26/10/18	1	**2**	**K.**	**1**	F	Unk.	12:57		71					71			Hunting south of Willieanna.
0089	26/10/18	4S	**1**	**K.**	**1**	F	Unk.	13:53		95					95			Hunting, moving east to the north of Furmiston Craig.
0091	29/10/18	2	**1**	**KT**	**1**	Unk.	Ad.	09:11			**269**				269			One circling northeast to the east of Craig of Knockgray before circling back southwest towards Carsphairn.
0091	29/10/18	2	**2**	**K.**	**1**	M	Ad.	09:26		72	**30**				102			Circling around Tup Park Knowe.
0091	29/10/18	2	**3**	**K.**	**1**	M	Ad.	09:42		41					41			Flying northeast past VP, then west over Craig of Knockgray.
0094	30/10/18	3	**1**	**PE**	**1**	Unk.	Ad.	10:57			**115**				115			Possibly female bird, at M1 height heading northwest over Big Loskie and Quantans Hill.
0096	31/10/18	2	**1**	**KT**	**1**	Unk.	Ad.	12:39			**168**				168			Hunting / foraging over Tup Park Knowe / Craig of Knockgray - searching the ground for food but not flying low at any point.
0099	13/11/18	4S	**1**	**KT**	**2**	Unk.	Unk.	10:38	120	840	**240**				1200	10	00:27:00	Two birds flew south towards Furmiston Craig, circled over and headed northeast before looping back and heading away southwest.
0099	13/11/18	4S	**2**	**KT**	**1**	Unk.	Unk.	11:51		20					20			Briefly in view heading west before lost behind Furmiston Craig.
0098	13/11/18	4N	**1**	**KT**	**1**	Unk.	Ad.	12:12	15	50	**75**				140			Hunting to south of Nick of the Lochans, heading south.
0097	13/11/18	2	**1**	**KT**	**1**	Unk.	Unk.	12:32		30	**30**	**45**		67	172			Adult circling high over Knockgray Craig before leaving the viewshed.
0099	13/11/18	4S	**3**	**KT**	**1**	Unk.	Unk.	13:22		245					245			Circled up from Marbrack.
0102	13/11/18	4S	**1**	**GD**	**1**	F	Unk.	14:34		55					55			Flying northeast, following the Marbrack Burn.
0101	13/11/18	4N	**1**	**GD**	**1**	Unk.	Unk.	14:35		30					30			Flew northeast over VP, following line of edge of forestry. Flew southwest across site from Green Hill area.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0101	13/11/18	4N	**2**	**EA**	**1**	Unk.	Ad.	15:56	105	80	**15**				200			Probable female flew southwest across site from Green Hill direction.
0103	19/11/18	4N	**1**	**KT**	**1**	Unk.	Ad.	12:07	75	188	**60**				323			Hunting over Beninner before flying behind Knockwhirn.
0104	19/11/18	4S	**1**	**K.**	**1**	Unk.	Unk.	14:22	30	162					192			Female / juvenile hunting over Furmiston Craig.
0104	19/11/18	4S	**2**	**KT**	**1**	Unk.	Ad.	14:51	22	195					217			Hunting over Furmiston Craig before lost behind terrain.
0105	20/11/18	1	**1**	**K.**	**1**	Unk.	Unk.	09:00		42					42			Adult / Immature female around Willieanna.
0105	20/11/18	1	**2**	**KT**	**1**	Unk.	Ad.	09:57			**168**				168			To the east and north of Craig of Knockgray.
0108	21/11/18	4S	**1**	**K.**	**1**	F	Juv.	09:51	121						121			Female juvenile hunting around copse of trees then flew towards Knockwhirn.
0108	21/11/18	4S	**2**	**H.**	**1**	Unk.	Ad.	10:57	22						22			Flew north through viewshed before landing in a burn to west of VP.
0113	26/11/18	1	**1**	**K.**	**1**	M	Ad.	09:19	15	30	**148**				193			Hunting at Willieanna.
0113	26/11/18	1	**2**	**K.**	**1**	M	Ad.	09:38		75	**160**	**45**			280			Hunting at Willieanna.
0113	26/11/18	1	**3**	**K.**	**1**	Unk.	Ad.	11:33			**227**				227			Adult to east of Craig of Knockgray.
0116	30/11/18	2	**1**	**CA**	**1**	Unk.	Ad.	08:01			**81**				81			Flying northwest over Tup Park Knowe.
0116	30/11/18	2	**2**	**K.**	**1**	M	Ad.	09:25	45	422					467			Hunting at Craig of Knockgray.
0116	30/11/18	2	**3**	**KT**	**1**	Unk.	Ad.	10:13			**219**				219			Circling over Tup Park Knowe and heading away west.
0116	30/11/18	2	**4**	**CA**	**1**	Unk.	Ad.	10:44		75					75			Flying northwest from Knockgray Park area.
0117	30/11/18	2	**1**	**K.**	**1**	M	Ad.	13:43		120	**103**				223			Hunting over Tup Park Knowe.
0117	30/11/18	2	**2**	**KT**	**1**	Unk.	Ad.	14:07			**99**	**75**			174			Flew in southeast towards Heathery Wood, circling. Then headed away in direction of Liggat Plantation.
0121	03/12/18	4S	**1**	**K.**	**1**	Unk.	Unk.	14:38	2		**30**	**45**		120	197			Hunting over Furmiston Craig but silhouetted and too far off to age or sex.
0136	11/01/19	4S	**1**	**GJ**	**4**	Unk.	Ad.	15:23		14	**45**				59			Four adults flying northeast across site.
0137	21/01/19	2	**1**	**KT**	**1**	Unk.	Ad.	11:31		135					135			Flew south around Craig of Knockgray and away west.
0139	21/01/19	2	**1**	**HH**	**1**	M	Ad.	14:03	155	30					185			Hunting and quartering in Knockgray Farm area.
0139	21/01/19	2	**2**	**KT**	**1**	Unk.	Unk.	14:15			**220**				220			Flew northeast over site, from Craig of Knockgray area and over Quantans Hill.
0145	12/02/19	3	**1**	**KT**	**1**	Unk.	Ad.	10:22		210	**45**				255			Hunting and heading southwest, roughly following route of the Marbrack Burn.
0145	12/02/19	3	**2**	**KT**	**1**	Unk.	Ad.	10:49		190	**15**				205			Hunting over open ground to east of VP, heading south.
0145	12/02/19	3	**3**	**KT**	**1**	Unk.	Ad.	11:34		283	**45**				328			Foraging from western side of Furmiston Craig heading north before turning southwest and away in the direction of Marbrack.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0145	12/02/19	3	**4**	**KT**	**1**	Unk.	Ad.	12:26				**4**		60	64			Soaring over open ground to east of VP, heading over Furmiston Craig and away northeast.
0149	14/02/19	1	**1**	**HH**	**1**	M	Ad.	16:07	43						43			Hunting at Very Low height around Quantans Hill.
0150	25/02/19	4S	**1**	**KT**	**1**	Unk.	Ad.	12:58			**45**	**80**		180	305			Soaring at M1 to High heights to northeast of Furmiston Craig, heading away northeast.
0153	08/03/19	3	**1**	**PG**	**70**	Unk.	Unk.	07:52						120	120			Two separate skeins - one of 15 birds and one of 55 - disappeared into cloud above hills.
0153	08/03/19	3	**2**	**WS**	**28**	Unk.	Unk.	08:16		5	**75**	**30**			110			28 birds at medium and low heights heading southwest then west over site.
0153	08/03/19	3	**3**	**GD**	**1**	F	Ad.	10:39	15	30					45			Landed in Polhay Burn.
0159	14/03/19	3	**1**	**KT**	**1**	Unk.	Unk.	13:35		20	**30**				50			One to west of Furmiston Craig at Medium and Low heights.
0159	14/03/19	3	**2**	**KT**	**1**	Unk.	Unk.	14:51	75						75			One southwest over site at Very Low height.
0161	22/03/19	3	**1**	**K.**	**1**	M	Imm.	09:41		45	**15**				60			Immature male heading northeast across the site at Low and M1 heights.
0161	22/03/19	3	**2**	**PG**	**15**	Unk.	Unk.	10:03			**50**				50			Fifteen at M1 height heading northwest then southwest across the site.
0161	22/03/19	3	**3**	**CU**	**1**	Unk.	Unk.	11:08		5	**30**				35			One heading southeast across the site and then away north at M1 and Low heights.
0163	27/03/19	2	**1**	**KT**	**2**	Unk.	Ad.	13:49				**258**			258			Two adults at Medium height to east of Craig of Knockgray.
0163	27/03/19	2	**2**	**K.**	**1**	M	Ad.	15:06		66	**75**	**15**			156			Adult male hunting over Tup Park Knowe and heading west.
0165	28/03/19	4N	**1**	**K.**	**1**	M	Ad.	10:18			**5**	**75**		285	365			Gliding, then hunting and hovering briefly to northwest and west of VP, heading south.
0164	28/03/19	1	**1**	**CU**	**2**	Unk.	Unk.	11:30	30	70					100			Two to southwest of Quantans Hill at Very Low and Low heights.
0164	28/03/19	1	**2**	**KT**	**1**	Unk.	Ad.	11:40	30	75	**15**				120			One to southwest of Quantans Hill. Mobbed by two carrion crows at first.
0164	28/03/19	1	**3**	**CU**	**3**	Unk.	Unk.	11:53	20	30					50			Three at Low and Very Low heights to west of Quantans Hill.
0165	28/03/19	4N	**2**	**K.**	**1**	Unk.	Unk.	12:10			**95**				95			Gliding over Knockwhirn at M1 height, heading west.
0166	28/03/19	1	**1**	**K.**	**1**	Pr.	Ad.	12:56		60	**540**				600	90	00:10:00	Two at M1 height in area south of Dunool / east of Willieanna. Both together for half of total flight time, with courtship interaction.
0167	28/03/19	4S	**1**	**KT**	**1**	Unk.	Ad.	14:17		15	**7**				22			Briefly through viewshed at Low and M1 height. Heading north from sheepfold west of VP.
0167	28/03/19	4S	**2**	**KT**	**2**	Unk.	Ad.	14:31		38					38			Two north over VP and away northeast at Low height.
0166	28/03/19	1	**2**	**KT**	**1**	Unk.	Unk.	14:37		30	**60**				90			One at Dunool, heading away west. Flight at M1 and Low heights.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0169	01/04/19	3	**1**	**GJ**	**3**	Unk.	Ad.	14:52		65					65			Three heading southwest from Furmiston Craig area.
0171	01/04/19	3	**1**	**GI**	**1**	M	Ad.	17:16	31	30					61			Adult male hunting at Very Low and Low heights from small plantation and heading north past Quantans Hill.
0171	01/04/19	3	**2**	**KT**	**1**	Unk.	Ad.	17:30		201	**45**				246			Adult hunting at Low and M1 heights heading south across site and over Marbrack.
0175	02/04/19	4S	**1**	**KT**	**2**	Unk.	Ad.	13:37		135	**250**				385			Two birds circling over Furmiston Craig and heading west.
0176	09/04/19	3	**1**	**KT**	**1**	Unk.	Unk.	10:24	15	75	**90**	**30**			210			Circling and heading south towards Furmiston Farm (outside of site boundary).
0176	09/04/19	3	**2**	**PE**	**1**	F	Ad.	10:51		60	**60**	**105**			225			Over top of VP then flying around site for a short while then soaring and heading away northwest.
0176	09/04/19	3	**3**	**KT**	**1**	Unk.	Ad.	12:12	180	30	**45**	**45**		180	480			Initially divebombing buzzard on ground then circling over site and heading away northeast.
0176	09/04/19	3	**4**	**KT**	**1**	Unk.	Unk.	12:40	15	90	**75**				180			Flight off site, circling near Furmiston and heading away southwest.
0177	09/04/19	3	**1**	**KT**	**1**	Unk.	Unk.	15:55	20						20			Briefly over Furmiston Craig at Very Low over site.
0177	09/04/19	3	**2**	**KT**	**1**	Unk.	Juv.	16:08		15	**60**	**45**		90	210			Circling over site to north of VP and heading away southwest.
0177	09/04/19	3	**3**	**ML**	**1**	F	Ad.	16:36	25						25			Very Low over site to north of VP, heading northwest.
0178	11/04/19	1	**1**	**K.**	**1**	M	Ad.	09:07		60	**225**	**30**			315			Hunting at Low and Medium heights at Willieanna.
0178	11/04/19	1	**2**	**K.**	**1**	M	Ad.	09:18		90	**150**				240			Hunting at M1 and Low heights at Willieanna.
0178	11/04/19	1	**3**	**KT**	**1**	Unk.	Ad.	10:03			**113**				113			Heading south past Craig of Knockgray at M1 height.
0181	15/04/19	4S	**1**	**SN**	**1**	Unk.	Ad.	10:25	4						4			Chipping calls heard immediately prior to brief flight to southwest of VP.
0183	15/04/19	4S	**1**	**KT**	**1**	Unk.	Unk.	13:36		120	**30**				150			Heading east past Furmiston Craig at M1 and Low heights.
0183	15/04/19	4S	**2**	**KT**	**1**	Unk.	Unk.	13:47		60	**30**				90			Flying southwest towards Little Loskie then heading away northeast, at M1 and Low heights.
0182	15/04/19	4N	**1**	**ML**	**1**	F	Ad.	15:40		105					105			Female bird joined by male at end of flight over open ground to west of Craigengillan Hill.
0182	15/04/19	4N	**2**	**BK**	**1**	F	Unk.	16:14		30	**60**				90			Female bird circled at Rider's Knowe and headed away southwest towards Knockwhirn.
0184	22/04/19	2	**1**	**KT**	**1**	Unk.	Ad.	13:26		45	**135**	**165**			345			Adult soaring slowly over viewshed, circling over Tup Park Knowe area and heading away northeast.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0185	22/04/19	3	**1**	**KT**	**1**	Unk.	Juv.	15:36	420	360	**180**	**30**			990			Over site, heading south over Furmiston Craig and over edge of forestry.
0187	22/04/19	3	**1**	**KT**	**1**	Unk.	Unk.	16:39	60	195	**45**				300			Over site near edge of forestry to south of Furmiston Craig.
0191	03/05/19	3	**1**	**KT**	**1**	Unk.	Unk.	11:39	45	60	**120**	**60**			285			Flew northeast from Furmiston Craig and then along edge of forestry, heading away northwest.
0191	03/05/19	3	**2**	**KT**	**1**	Unk.	Unk.	12:17	10						10			Over eastern side of Knockwhirn at Very Low height.
0195	10/05/19	4S	**1**	**KT**	**1**	Unk.	Ad.	08:43	75	81					156			Hunting to south of Knockwhirn then mobbed by a raven.
0194	10/05/19	4N	**1**	**KT**	**1**	Unk.	Ad.	08:46	77	60					137			Flying north along ridge between Knockwhirn and Beninner.
0195	10/05/19	4S	**2**	**CU**	**1**	M	Ad.	09:01	2	30					32			Short display flight to northeast of Furmiston Craig.
0194	10/05/19	4N	**2**	**KT**	**1**	F	Ad.	09:06	105	114	**45**				264			Hunting on eastern slope of Beninner.
0195	10/05/19	4S	**3**	**CU**	**1**	Unk.	Ad.	10:03	15						15			Brief low flight to northeast of Furmiston Craig.
0194	10/05/19	4N	**3**	**KT**	**1**	Unk.	Ad.	10:39	45	91					136			Hunting low over base of Knockwhirn and Beninner.
0197	10/05/19	4S	**1**	**KT**	**1**	Unk.	Ad.	13:36		48	**180**				228			Red kite mobbed by a raven over T-shaped wood before departing over Knockwhirn.
0196	10/05/19	4S	**1**	**KT**	**1**	Unk.	Ad.	14:13	120	21					141			Hunting over small area at Rider's Knowe. Wheeling back and forth and up and down on ridge, never gaining any height. Moved off east and out of view.
0196	10/05/19	4S	**2**	**PE**	**1**	Unk.	Unk.	14:21		17	**30**				47			Heading southwest to the south of Knockwhirn.
0198	14/05/19	1	**1**	**KT**	**1**	Unk.	Unk.	10:30	520	50					570			Appeared to north of Quantans Hill, heading west, then south past Craig of Knockgray and over Tup Park Knowe.
0199	14/05/19	1	**1**	**KT**	**1**	Unk.	Imm.	14:05		33					33			Flight at Low height around the south side of Willieanna.
0252	22/05/19	2	**1**	**OP**	**1**	Unk.	Unk.	16:30				**75**		15	90			Flight at high (M2) and Very High heights along Polsue Burn valley.
0253	23/05/19	3	**1**	**KT**	**1**	Unk.	Unk.	16:00	120	120	**300**	**60**			600			Hunting.
0203	27/05/19	4S	**1**	**KT**	**1**	Unk.	Unk.	16:06		15					15			Short flight southeast of Furmiston Craig at Low height.
0203	27/05/19	4S	**2**	**CU**	**1**	Unk.	Ad.	16:33	55						55			On east side of Furmiston Craig at Very Low height.
0203	27/05/19	4S	**3**	**KT**	**1**	Unk.	Ad.	16:51			**115**				115			Southwest across site towards Big Loskie and beyond at M1 height.
0203	27/05/19	4S	**4**	**CU**	**2**	Unk.	Unk.	16:52	10	10	**30**				50			On eastern side of Furmiston Craig, mobbing red kite (3).
0209	03/06/19	2	**1**	**GJ**	**2**	Unk.	Ad.	08:40						51	51			Two heading southwest from west side of Knockwhirn.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0209	03/06/19	2	**2**	**KT**	**1**	Unk.	Ad.	10:35	45	50					95			Hunting southern side of Knockwhirn.
0208	03/06/19	2	**1**	**KT**	**1**	Unk.	Ad.	10:37	150	30	**85**				265			Appeared from Knockwhirn area and headed northeast over site.
0212	03/06/19	2	**1**	**KT**	**1**	Unk.	Unk.	12:39			**90**				90			Flew south-southwest along forest edge to west of Craigengillan Hill.
0213	03/06/19	2	**1**	**KT**	**1**	Unk.	Unk.	12:40			**128**				128			Flew southwest to the west of the VP around Furmiston Craig and away southeast.
0213	03/06/19	2	**2**	**KT**	**1**	Unk.	Unk.	13:02		60					60			Flew northeast from over open ground and away over forestry.
0204	03/06/19	2	**1**	**KT**	**1**	Unk.	Ad.	18:39		68					68			Flew east from VP area and headed away north. Green tag on left wing.
0216	04/06/19	4S	**1**	**GJ**	**2**	Unk.	Ad.	07:44			**105**				105			Two adults flying at c.140 m height to north-northwest from over Water of Deugh, over Knockgray Park and past Craig of Knockgray.
0215	04/06/19	4S	**1**	**KT**	**1**	Unk.	Unk.	14:55	45	45					90			To southeast of Furmiston Craig, at forestry edge.
0217	12/06/19	4S	**1**	**CU**	**1**	Unk.	Ad.	07:42	130						130			Display flight to north of Marbrack. Calling continuously and returned west.
0217	12/06/19	4S	**2**	**H.**	**1**	Unk.	Ad.	08:35	25						25			Short flight along Marbrack Burn and landed out of sight.
0227	12/06/19	4S	**1**	**KT**	**3**	1M, 2F	Ad.	10:16	170	115					285			Three adult birds flying close together, out from Furmiston Craig and heading northeast.
0225	12/06/19	4S	**1**	**K.**	**1**	M	Ad.	11:35		180	**60**				240			Flew south from Quantans Hill area then headed southeast and away from site.
0221	12/06/19	4S	**1**	**KT**	**1**	Unk.	Ad.	13:33		90	**48**				138			Moving along forest edge to north of VP and away northwest.
0223	12/06/19	4S	**1**	**SH**	**1**	M	Ad.	14:17	50						50			Adult male sparrowhawk flew low over the moorland to the east, then flying south past Marbrack.
0226	12/06/19	4S	**1**	**KT**	**1**	Unk.	Unk.	16:29		150					150			Flew south from Quantans Hill at Low height.
0224	12/06/19	4S	**1**	**KT**	**1**	Unk.	Ad.	17:27	45	180					225			Adult drifting north-northwest from Heathery Wood, hunting Low along the moors.
0224	12/06/19	4S	**2**	**KT**	**1**	Unk.	Ad.	18:15	60	280					340			Adult hunting along the moorland and rough pasture, moving slowly north along field edges.
0224	12/06/19	4S	**3**	**CM**	**1**	Unk.	Ad.	18:21	70						70			Adult drifting Very Low over the fields, moving southeast.
0227	05/07/19	4S	**2**	**SN**	**1**	M	Ad.	11:04	22						22			Displaying male to north of Furmiston Craig.
0227	05/07/19	4S	**3**	**KT**	**1**	Unk.	Ad.	11:19	34						34			Hunting low over brow of Furmiston Hill. Not seen for long before heading back south and out of view.
0231	10/07/19	4N	**1**	**KT**	**1**	Unk.	Unk.	12:19		75					75			Patrolling upper slopes of Knockwhirn.
0231	10/07/19	4N	**2**	**SN**	**1**	M	Ad.	13:40	30	15					45			Display flight to northwest of VP.
0233	10/07/19	4S	**1**	**SN**	**1**	M	Ad.	17:43	30	45					75			Display flight near sheepfold to west of the VP.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0235	16/07/19	2	**1**	**HG**	**1**	Unk.	Ad.	11:21			**90**	**75**		60	225			Adult bird appeared near Tup Park Knowe plantation at M1 height before circling tightly between Tup Knowe and Heathery Wood, reaching M2 height. It then gradually gained more height (to High) before drifting off and gaining height in a south-southeast direction beyond the viewshed.
0236	16/07/19	2	**1**	**KT**	**1**	Unk.	Ad.	13:43			**30**	**30**			60			Adult flew over VP and directly towards Willieanna before being lost over the ridge. As it crossed the valley it increased height to M2 due to the valley topography.
0237	16/07/19	2	**1**	**KT**	**3**	Unk.	Unk.	15:10	952	546	**62**				1560	4	00:26:00	Three birds in area to north of Furmiston Craig, around the sheepfold.
0237	16/07/19	2	**2**	**KT**	**1**	Unk.	Unk.	16:10	59	781					840			Flew north across site to Knockwhirn and away to west (14 mins total)
0238	29/07/19	3	**1**	**K.**	**1**	Unk.	Unk.	18:59	270						270			To west of Knockwhirn at Very Low height, constantly mobbed by a carrion crow.
0238	29/07/19	3	**2**	**K.**	**1**	Unk.	Unk.	19:17	120	95					215			Same bird as previous record, over top of Knockwhirn. Again, mobbed by a carrion crow. Soared higher after this, then joined by a second kestrel in last 90 seconds of flight.
0249	21/08/19	1	**1**	**K.**	**1**	F	Ad.	12:50		75					75			Hunting to south of Willieanna, moving west.
0257	24/09/20	7	**1**	**KT**	**1**	Unk.	Ad.	08:02		45					45			Off to hunt. Heading west.
0257	24/09/20	7	**2**	**K.**	**1**	Unk.	Unk.	08:41			**55**				55			Hunting to northwest of Marbrack.
0257	24/09/20	7	**3**	**PG**	**19**	Unk.	Unk.	08:50						165	165			Flying south over site past Furmiston Craig towards Furmiston Bridge.
0257	24/09/20	7	**4**	**KT**	**1**	Unk.	Unk.	08:59		155	**50**				205			Couple of swoops onto / by carcass northwest of Marbrack and then drifted west.
0257	24/09/20	7	**5**	**KT**	**1**	Unk.	Unk.	09:46			**110**				110			Over open ground north of VP3 and headed away southwest.
0258	24/09/20	7	**1**	**K.**	**1**	Unk.	Unk.	10:55		10	**45**				55			Hunting over ground to north of Marbrack. Dropped down on something and lost to view.
0255	25/09/20	6	**1**	**KT**	**2**	Unk.	Unk.	10:39		55					55			Two birds interacting over plantations to east of Knockgray farm.
0255	25/09/20	6	**2**	**K.**	**1**	Unk.	Unk.	10:51		70					70			Single bird hunting to east of Heathery Wood.
0260	25/09/20	8	**1**	**HH**	**1**	Unk.	Juv.	14:30		40					40			Juvenile bird flew around close to VP; ended flight going down to lower ground.
0260	25/09/20	8	**2**	**K.**	**1**	Unk.	Unk.	15:23		5	**40**				45			Hovered to south of Knockwhirn at M1 to Low height.
0261	28/09/20	8	**1**	**K.**	**1**	Unk.	Unk.	07:50			**35**				35			Juvenile bird flew around close to VP; ended flight going down to lower ground.
0261	28/09/20	8	**2**	**ML**	**1**	Unk.	Unk.	09:03		10					10			Female / juvenile in fast direct flight towards surveyor then a quick turn, continuing behind the viewshed.
0262	29/09/20	7	**1**	**K.**	**1**	F	Ad.	10:03		60	**40**				100			Hunting to north of Marbrack. Dropped and lost to view.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0256	29/09/20	6	**1**	**KT**	**1**	Unk.	Ad.	12:24		120	**20**				140			Hunting to east of Craig of Knockgray, following contours, heading south.
0256	29/09/20	6	**2**	**KT**	**1**	Unk.	Unk.	12:25			**45**				45			Heading southwest from north of Heathery Wood to Tup Park Knowe.
0256	29/09/20	6	**3**	**K.**	**1**	F	Ad.	14:08		10	**35**				45			Hunting over Quantans Hill.
0256	29/09/20	6	**4**	**K.**	**1**	M	Ad.	15:01		40					40			Hunting to south of Quantans Hill.
0267	02/10/20	7	**1**	**K.**	**1**	M	Unk.	10:08		85					85			Male bird hunting on south side of Knockwhirn, heading north.
0267	02/10/20	7	**2**	**KT**	**1**	Unk.	Unk.	10:16			**155**				155			Circling at Little Loskie, then headed away southwest.
0267	02/10/20	7	**3**	**K.**	**1**	Unk.	Unk.	10:35		70					70			To southeast of Knockwhirn at Low height.
0263	09/10/20	6	**1**	**KT**	**1**	Unk.	Ad.	13:16			**115**				115			Drifted past to east of Craig of Knockgray, heading south.
0263	09/10/20	6	**2**	**K.**	**1**	Unk.	Unk.	14:29		30					30			Brief flight to east of Gardenhead Plantation.
0264	09/10/20	6	**1**	**K.**	**1**	Unk.	Unk.	17:05		30	**90**				120			Hunting over Quantans Hill.
0269	14/10/20	8	**1**	**K.**	**1**	Unk.	Unk.	09:45		15	**80**				95			In flight over The Glenkens, to the west of Riders Knowe, heading away north.
0265	21/10/20	6	**1**	**GI**	**1**	M	Unk.	07:54		15					15			Early morning hunt: heading west into Gardenhead Plantation.
0265	21/10/20	6	**2**	**ML**	**1**	M	Unk.	09:01		45					45			Hunting at Low height: heading south towards Heathery Wood.
0266	21/10/20	6	**1**	**K.**	**1**	Unk.	Unk.	10:59		15	**25**				40			Hunting over Quantans Hill.
0266	21/10/20	6	**2**	**K.**	**2**	Unk.	Unk.	13:01		45	**40**				85			Two hunting to south of Quantans Hill.
0272	23/10/20	7	**1**	**K.**	**1**	Unk.	Unk.	09:11		95					95			Hunting on west side of Furmiston Craig at Low height.
0271	23/10/20	8	**1**	**HH**	**1**	F	Ad.	12:35		40	**45**				85			Adult female. Hunting to south of VP initially, then gained height, heading east, went behind VP and another appeared behind it.
0271	23/10/20	8	**2**	**HH**	**1**	M	Juv.	12:36			**75**				75			Second bird - a juvenile male - circled over open ground to south of VP and headed away east.
0271	23/10/20	8	**3**	**K.**	**1**	Unk.	Unk.	13:45		20	**45**				65			Heading south over T-shaped wood.
0273	24/10/20	8	**1**	**PE**	**1**	Unk.	Unk.	12:23			**20**				20			Probably a male. Seen briefly at crags at Beninner; only seen in flight when above skyline. Very distant.
0273	24/10/20	8	**2**	**PE**	**1**	Unk.	Unk.	13:08		15	**45**				60			Hunting thrushes at southern end of Beninner Crags.
0273	24/10/20	8	**3**	**KT**	**1**	Unk.	Unk.	13:31				**55**			55			Flying southwest from Furmiston Craig towards Little Loskie at M2 height.
0273	24/10/20	8	**4**	**K.**	**1**	M	Ad.	14:16:00		15	**65**				80			Hunting around T-shaped wood.
0275	28/10/20	7	**1**	**KT**	**1**	Unk.	Unk.	11:00			**155**				155			Flew slowly past westwards past T-shaped wood and then towards Knockwhirn. Blue tag on the right wing.
0275	28/10/20	7	**2**	**KT**	**1**	Unk.	Unk.	11:23			**125**	**65**			190			Different bird from previous record. Flew southwest over T-shaped wood and beyond.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0275	28/10/20	7	**3**	**KT**	**1**	Unk.	Unk.	11:41				**195**			195			Flew in southeast towards Furmiston Craig then turned towards Little Loskie and out of view.
0275	28/10/20	7	**4**	**HH**	**1**	F	Ad.	12:14		45					45			Lost behind T-shaped wood in Low hunting flight - may have landed.
0275	28/10/20	7	**5**	**K.**	**1**	F	Unk.	12:47		75					75			Female bird hunting on northwest slope of Furmiston Craig.
0276	28/10/20	7	**1**	**KT**	**1**	Unk.	Unk.	15:29			**125**				125			Direct flight east-northeast, over T-shaped wood and beyond.
0276	28/10/20	7	**2**	**K.**	**1**	Unk.	Unk.	15:51		55					55			Hunting on west side of Furmiston Craig, moving southwest.
0276	28/10/20	7	**3**	**HH**	**1**	F	Ad.	16:33		95					95			Heading south-southwest past T-shaped wood. Appeared to land on prey. Not seen after so may have roosted in rank grass.
0277	05/11/20	6	**1**	**PG**	**119**	Unk.	Unk.	11:46				**95**	30	180	305			119 birds westwards across site, to the north of Quantans Hill and Craig of Knockgray, gaining height.
0279	12/11/20	8	**1**	**K.**	**1**	Unk.	Unk.	13:40			**40**				40			Circled over south side of Knockwhirn and headed away north.
0279	12/11/20	8	**2**	**KT**	**1**	Unk.	Unk.	14:17			**95**				95			Seen to the south of the T-shaped wood. Flew west and then away to the south.
0279	12/11/20	8	**3**	**K.**	**1**	Unk.	Unk.	15:48		25					25			Flew southwest, over the southern slope of Knockwhirn.
0282	16/11/20	7	**1**	**KT**	**1**	Unk.	Unk.	14:23		40	**165**				205			Flew west across site, to the south of the T-shaped wood and then headed away northwest.
0282	16/11/20	7	**2**	**K.**	**1**	Unk.	Unk.	14:40		25	**40**				65			Circled several times over Furmiston Craig and headed away to south.
0282	16/11/20	7	**3**	**KT**	**1**	Unk.	Unk.	14:46			**165**				165			Few south across site, over Little Loskie and beyond.
0280	17/11/20	6	**1**	**WS**	**15**	Unk.	Ad. & Juv.	10:21				**95**			95			15 birds - 12 adult and 3 juvenile - flying south at M2 height, to east of Craig of Knockgray.
0280	17/11/20	6	**2**	**K.**	**2**	Unk.	Unk.	10:33		40					40			Two circled over Willieanna.
0283	17/11/20	6	**1**	**KT**	**1**	Unk.	Unk.	12:03			**145**				145			Flew west towards Quantans Hill, looped around and flew away to the east.
0283	17/11/20	6	**2**	**K.**	**1**	Unk.	Unk.	12:16		25					25			Brief flight to east of Gardenhead Plantation.
0284	22/11/20	8	**1**	**HH**	**1**	M	Juv.	09:14		290	**25**				315			Juvenile male hunting on eastern edge of site, moving towards Rider's Knowe.
0285	22/11/20	8	**1**	**K.**	**1**	Unk.	Unk.	11:26		15	**75**				90			Hunting at Rider's Knowe.
0285	22/11/20	8	**2**	**K.**	**1**	Unk.	Unk.	11:43		20					20			Brief flight on south side of Knockwhirn.
0285	22/11/20	8	**3**	**K.**	**1**	Unk.	Unk.	11:51		10	**95**				105			Hunting to south of T-shaped wood, moving south.
0285	22/11/20	8	**4**	**K.**	**1**	Unk.	Unk.	12:38			**110**				110			Hunting on west side of Rider's Knowe.
0285	22/11/20	8	**5**	**K.**	**1**	Unk.	Unk.	13:40		15	**70**				85			Hunting to west of T-shaped wood, moving south.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0286	26/11/20	7	**1**	**K.**	**1**	Unk.	Unk.	09:04		40					40			Briefly hovering at Furmiston Craig summit and moving west then south.
0286	26/11/20	7	**2**	**K.**	**1**	Unk.	Unk.	10:07		35	**65**				100			Hunting to north of Marbrack.
0288	27/11/20	6	**1**	**K.**	**1**	Unk.	Unk.	10:30			**55**				55			To the east of Gardenhead Plantation, heading southwest.
0288	27/11/20	6	**2**	**K.**	**1**	Unk.	Unk.	12:37			**115**				115			Over Quantans Hill, heading northeast.
0290	20/12/20	6	**1**	**ML**	**1**	F	Ad.	09:26		35	**70**				105			Flew east-southeast from Craig of Knockgray and then south and out of view.
0291	20/12/20	6	**1**	**K.**	**1**	Unk.	Unk.	13:19		10	**55**				65			Hunting over Quantans Hill.
0291	20/12/20	6	**2**	**KT**	**1**	Unk.	Unk.	13:53			**210**				210			South-easterly flight through centre of site.
0291	20/12/20	6	**3**	**HH**	**1**	F	Imm.	15:15		235					235			Hunting on eastern side of Craig of Knockgray and towards Heathery Wood.
0292	22/12/20	7	**1**	**K.**	**1**	Unk.	Unk.	11:35		10	**60**				70			Circling northwest slope of Furmiston Craig.
0294	22/12/20	7	**1**	**HH**	**1**	F	Ad.	13:21		155					155			Bird with damaged left wing. Hunting on south side of Knockwhirn, heading away northwest.
0294	22/12/20	7	**2**	**K.**	**1**	Unk.	Unk.	14:04		55					55			Hunting on northwest slope of Furmiston Craig.
0295	23/12/20	8	**1**	**K.**	**1**	Unk.	Unk.	11:43			**80**				80			Hunting to the east of the T-shaped wood.
0295	23/12/20	8	**2**	**K.**	**1**	Unk.	Unk.	13:18			**110**				110			Hunting over Knockwhirn.
0298	27/01/21	7	**1**	**KT**	**1**	Unk.	Ad.	10:15		4	**195**				199			Adult hunting to southeast of Quantans Hill. Dropped out of view behind copse.
0298	27/01/21	7	**2**	**K.**	**1**	Unk.	Unk.	11:13			**2**	**60**			62			Hunting on east side of Furmiston Craig. Lost against background. Have stooped to the ground.
0298	27/01/21	7	**3**	**K.**	**1**	M	Ad.	11:48		315	**90**				405			Adult male hunting to north of Marbrack. Landed in tree, perched for 90 seconds, then dropped out of view behind copse.
0298	27/01/21	7	**4**	**KT**	**1**	Unk.	Ad.	12:11		44	**120**				164			Adult hunting to north of Marbrack, moving west. Lost to view behind trees.
0298	27/01/21	7	**5**	**K.**	**1**	M	Ad.	12:29		190					190			Adult male hunting on south side of Knockwhirn, moving northwest. Lost to view when dropped to ground. Judging by wear in tail, same bird as record (3).
0299	27/01/21	7	**1**	**K.**	**1**	M	Ad.	14:01		25					25			Adult male hunting to north of Marbrack, then landed on post.
0299	27/01/21	7	**2**	**K.**	**1**	F	Ad.	14:20							0			Adult female hunting on and off over area on the east side of Furmiston Craig.
0299	27/01/21	7	**3**	**KT**	**1**	Unk.	Ad.	15:38		17	**105**				122			Adult bird hunting alongside bird in flight (4), to the south of Knockwhirn and heading south. This bird took the lead and appeared to land in a tree at Marbrack.
0299	27/01/21	7	**4**	**KT**	**1**	Unk.	Ad.	15:38		16	**120**				136			Adult bird hunting close to bird in flight (3) but when it landed in a tree, this bird carried on, heading away west. Lost to view behind trees.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0299	27/01/21	7	**5**	**HH**	**1**	M	Ad.	15:50		70					70			Adult male hunting to south of Knockwhirn, moving east. Perched on tussock partway through flight, for 50 seconds, then continued. Lost Low to ground.
0300	31/01/21	8	**1A**	**KT**	**1**	Unk.	Ad.	09:55		924	**396**				1320	30	00:22:00	First bird watched for ten and a half minutes (1A), then joined by a second bird (1B). Hunting on east side of Knockwhirn, often alighting briefly on hillside. Eventually lost against hillside, heading northwest.
0300	31/01/21	8	**1B**	**KT**	**1**	Unk.	Ad.	10:05		483	**207**				690	30	00:11:30	First bird watched for ten and a half minutes (1A), then joined by a second bird (1B). Hunting on east side of Knockwhirn, often alighting briefly on hillside. Eventually lost against hillside, heading northwest.
0300	31/01/21	8	**2**	**KT**	**1**	Unk.	Ad.	11:35		15	**38**				53			Adult hunting around T-shaped wood. Lost to view behind copse.
0300	31/01/21	8	**3**	**KT**	**1**	Unk.	Ad.	11:45		45	**60**				105			Adult hunting at Rider's Knowe. Dropped behind ridge.
0300	31/01/21	8	**4**	**KT**	**1**	Unk.	Ad.	11:58		44	**30**				74			Adult hunting over Knockwhirn. Out of sight behind ridge.
0300	31/01/21	8	**5**	**KT**	**1**	Unk.	Ad.	12:24		960					960			Adult hunting, moving north over Knockwhirn and towards Beninner. Frequent, brief drops to ground.
0301	31/01/21	8	**1**	**KT**	**1**	Unk.	Ad.	14:03		360	**120**	**120**	60	120	780			Adult, hunting. Picked up to east of T-shaped wood: headed over Knockwhirn and away east.
0301	31/01/21	8	**2**	**KT**	**1**	Unk.	Ad.	14:51		190	**300**				490			Adult, hunting over the southern side of Knockwhirn and heading away west.
0302	12/02/21	8	**1**	**K.**	**1**	Unk.	Unk.	11:20		10	**75**				85			Hunting to east of T-shaped wood, then heading away south.
0302	12/02/21	8	**2**	**KT**	**1**	Unk.	Unk.	12:12			**170**	**40**			210			Slowly flying northeast, picked up on south side of Knockwhirn.
0302	12/02/21	8	**3**	**K.**	**1**	Unk.	Unk.	13:43		5	**60**				65			Hunting to south of T-shaped wood.
0303	12/02/21	8	**1**	**K.**	**1**	Unk.	Unk.	16:06		50					50			Hunting to east of T-shaped wood.
0303	12/02/21	8	**2**	**KT**	**1**	Unk.	Unk.	16:07			**65**	**80**			145			Flew northwest towards T-shaped wood, then away southwest.
0304	17/02/21	6	**1**	**PG**	**20**	Unk.	Unk.	09:37				**195**			195			20 birds flew west across site. Appeared lost, not sure where they wanted to go.
0304	17/02/21	6	**2**	**PG**	**7**	Unk.	Unk.	09:56				**140**			140			Seven birds west over Quantans Hill and then away southwest and over Tup Park Knowe.
0305	17/02/21	6	**1**	**KT**	**1**	Unk.	Unk.	14:13			**95**				95			Picked up to northeast of Heathery Wood, heading south.
0307	26/02/21	7	**1**	**KT**	**1**	Unk.	Unk.	13:25			**75**				75			Flew south then southeast across site towards Marbrack, then away south.
0307	26/02/21	7	**2**	**KT**	**2**	Unk.	Ad.	13:56		347	**469**	**204**			1020	66	00:17:00	Extensive activity to the east and northeast of Marbrack, to the summit of Furmiston Craig.

Survey Ref	Date	VP	Flight ID	BTO	No. of birds	Sex	Age	Start time	VL	L	M1	M2	H	VH	Total Duration	M% (Activity Areas)	Total (Activity Areas)	Notes
0308	19/03/21	6	**1**	**KT**	**1**	Unk.	Unk.	12:43			**90**	**40**			130			One very distantly, heading southeast past Furmiston Craig.
0308	19/03/21	6	**2**	**K.**	**1**	F	Ad.	13:06		15	**95**				110			Adult female hunting on south side of Quantans Hill.
0308	19/03/21	6	**3**	**KT**	**2**	F	Ad.	13:45			**135**				135			Two in semi-display to northeast of Tup Park Knowe.
0308	19/03/21	6	**4**	**K.**	**1**	M	Ad.	14:14			**70**				70			Adult male hovering at Marbrack.
0309	19/03/21	6	**1**	**KT**	**2**	Pr	Ad.	16:08			**115**				115			Pair to north of Heathery Wood at M1 height.
0310	22/03/21	7	**1**	**KT**	**1**	Unk.	Imm.	12:45			**50**				50			Immature bird moving east, to the south of the VP.
0312	24/03/21	8	**1**	**KT**	**1**	Unk.	Ad.	08:05		126	**714**				840	85	00:14	Flight activity in an area of Rider's Knowe and to south.

APPENDIX 4: Breeding Bird Survey Details

This appendix provides the survey details (i.e. dates, times, weather conditions) and tabulated results of the various breeding bird surveys undertaken in 2018, 2019 and 2020. The results presented here are from the following surveys:

- Moorland breeding wader surveys (April to July 2018 and April to July 2019);
- Scarce breeding raptor and owl surveys (April to July 2018 and March to July 2019 and March to July 2020); and
- Black grouse lek survey results (April-May 2018, April-May 2019 and April-May 2020).

The non-confidential mapped results of the surveys are presented on Figures 7.4a-c. Details of nest site locations for those species listed on Schedule 1 to the Wildlife & Countryside Act 1981 (as amended) are reported in a separate Confidential Ornithological Annex to Chapter 7 of the EIAR.

Moorland Breeding Bird Survey

Table A4.1 details the survey visits and weather conditions during the moorland breeding bird surveys carried out in 2018 and 2019.

Table A4.1: Moorland Breeding Bird Survey 2018 and 2019 – Survey Timings and Weather Conditions

Date	Surveyor	Visit No.	Start Time	End Time	Wind Dir.	Cloud Base (m)	Cloud Cover (%)	Wind Speed (BS)	Visibility (km)	Temp. (°C)	Precipitation Type	Intensity	Duration
21/04/18	RS	1	08:10	14:10	E	>1000	30	1	>10	4-16	None	n/a	n/a
21/04/18	AJM	1	08:00	14:10	SW	>1000	30	2	>10	12	None	n/a	n/a
30/04/18	AJM	1	08:10	14:05	W	>1000	20	2	>10	10	None	n/a	n/a
01/05/18	AJM	1	08:50	14:40	SW	>1000	70	3	>10	9	Rain	Very light	Intermittent
16/05/18	PC	2	09:50	15:40	NE-SE	>1000	50	2-3	>10	15	None	n/a	n/a
16/05/18	AJM	2	09:45	16:10	E	>1000	30	2	>10	15	None	n/a	n/a
17/05/18	AJM	2	08:30	14:30	E	>1000	50	2	>10	14	None	n/a	n/a
17/05/18	PC	2	08:30	12:30	SE	>1000	50	2	>10	14	None	n/a	n/a
06/06/18	PC	3	08:55	15:10	E	>1000	5	2	>10	19	None	n/a	n/a
06/06/18	AJM	3	09:00	15:05	SE	>1000	10	2	>10	18	None	n/a	n/a
06/06/18	RS	3	09:05	15:05	SE	>1000	10	2	>10	13-22	None	n/a	n/a
06/06/18	RI	3	09:10	15:05	NE	>1000	10	3	>10	13	None	n/a	n/a
05/07/18	AJM	4	09:00	15:15	NW	500-1000	30	3	5-10	19	None	n/a	n/a
05/07/18	RI	4	09:00	15:20	NW	>1000	30	4	>10	17	None	n/a	n/a
05/07/18	RS	4	09:00	15:20	NW	500-1000	30	3	>10	16-20	None	n/a	n/a
05/07/18	PC	4	09:05	15:35	NW	>1000	40	3	>10	16	None	n/a	n/a
23/04/19	AJM	1	09:50	15:45	E	>1000	60	3	>10	18	None	n/a	n/a
23/04/19	AR	1	09:30	15:30	SW	500-1000	85	2	5-10	10	None	n/a	n/a
23/04/19	GP	1	09:50	15:50	E	>1000	80	3	>10	19	None	n/a	n/a
23/04/19	RI	1	09:50	15:40	SE	>1000	90	3	>10	16	None	n/a	n/a

21/05/19	PB	2	09:00	16:00	W	>1000	30	2-3	>10	15	None	n/a	n/a
22/05/19	PB	2	09:00	16:00	W	>1000	10	2	>10	14	None	n/a	n/a
25/06/19	AR	3	09:10	15:10	SW	500-1000	85	3	5-10	15	None	n/a	n/a
25/06/19	TB	3	09:15	15:15	NE	500-1000	100	3	>10	12	None	n/a	n/a
25/06/20	GP	3	09:15	15:15	NE	500-1000	100	3	5-10	16	None	n/a	n/a
25/06/19	RI	3	09:20	15:05	SE	>1000	100	3	>10	15	None	n/a	n/a
19/07/19	TB	4	08:45	14:15	S	100-1000	90	3-4	>10	12	Rain	Light	Intermittent
19/07/19	GP	4	08:45	14:15	S	100-500	90	2	2-5	12	Rain	Light	Intermittent
19/07/19	NB	4	08:45	15:00	SW	100-500	90	3	1-2	18	Rain	Mod.	Intermittent
19/07/19	EM	4	09:30	15:30	S	100-500	90	2	2-5	12	Rain	Light	Intermittent

Breeding Raptor Surveys 2018, 2019 and 2020

Table A4.2 details the survey visits and weather conditions during the scarce breeding raptor surveys carried out in 2018, 2019 and 2020 followed by the non-confidential observations associated with these surveys in Table A4.3. Information indicating nest sites / breeding locations for those species listed on Schedule 1 to the Wildlife & Countryside Act 1981 (as amended) are reported in a separate Confidential Annex.

Table A4.2: Breeding Raptor Surveys 2018, 2019 and 2020 – Survey Timings and Weather Conditions

Survey Ref	Surveyor	Date	Start Time	Finish Time	Wind Dir.	Cloud Base (m)	Cloud Cover (%)	Wind Sp. (BS)	Vis. (km)	Temp (°C)	Pptn. Type	Intensity	Duration
B0003	RS	22/04/18	09:00	15:10	W	500-1000	95	2	~	7	Rain	Light	Intermittent
B0008	AC	01/05/18	09:00	15:30	SW	>1000	70	3	>10	9	Rain	Light	
B0015	RS	28/05/18	13:30	20:15	E	>1000	25	2	>10	23	None	n/a	n/a
B0020	RS	07/06/18	09:25	15:40	SE	>1000	25	2	>10	17-23	None	n/a	n/a
B0021	RS	04/07/18	09:15	15:30	SW	>1000	10	1	>10	18-25	None	n/a	n/a
B0028	PH	11/04/19	08:10	14:15	S	500-1000	10-75	1-3	>10	2-11	None	n/a	n/a
B0030	AJM	02/05/19	10:00	16:30	NW	500-1000	80	2	>10	10	Rain	Light	Intermittent
B0029	PC	05/06/19	09:20	15:20	S	500->1000	95	1-3	>10	12	Rain	Light-Mod.	Intermittent
B0031	PC	05/07/19	08:45	14:45	W	500-1000	90	2-3	5-10	18	Rain	Light	Intermittent
B0032	AJM	11/07/19	11:55	18:00	SW	500-1000	60	2	>10	20	None	n/a	n/a
B0049	RTW	28/04/20	08:15	14:15	NW	>1000	35	2	>10	10	None	n/a	n/a
B0052	AJM	28/04/20	08:15	14:15	NW	>1000	35	2	>10	10	None	n/a	n/a
B0054	AJM	20/05/20	15:00	18:00	SE	>1000	20	1	>10	6	None	n/a	n/a
B0050	AJM	19/06/20	10:40	16:50	SE	>1000	70	2	>10	17	None	n/a	n/a
B0051	AJM	06/07/20	12:30	18:30	SE	>1000	70	3	>10	16	None	n/a	n/a

Table A4.3: Breeding Raptor Surveys 2018, 2019 and 2020 – Non-confidential Observations

Survey Ref	Date	BTO Code	Grid Ref. (OS Code NX)		Time	Age	Sex	No. Birds	Notes
			Easting	Northing					
B0008	01/05/18	KT	60	90	14:20	Ad.		1	Red kite followed for several minutes. Bird first appeared over road and was followed to fish farm. Lost to southeast.
B0008	01/05/18	OP	60	90	15:05	Ad.		1	Did not see where bird came from, appeared over the loch and fished for several minutes. Appeared to fly off east.
B0015	28/05/18	BO	57	93	14:02	Ad.		1	Further detail is provided in the Confidential Annex
B0020	07/06/18	KT	63	92	12:24	Ad.		1	One red kite flying.
B0020	07/06/18	KT	60	90	13:21	Ad.		1	Red kite flying over Kendoon Loch.
B0028	11/04/19	GI	62	95	09:55	Ad.	F	1	Adult female flew across forestry track at 'Very Low' height.
B0028	11/04/19	KT	60	90	13:42	Ad.		1	Adult gliding in trees at Low and Very Low heights.
B0029	05/06/19	KT	58	92	10:50	Ad.		1	Adult hunting. Headed off to southwest.
B0029	05/06/19	KT	60	90	11:22	Ad.		1	Adult hunting.
B0029	05/06/19	PE	-	-	11:50	Ad.	F	1	Adult female alarm calling. Further detail is provided in the Confidential Annex.
B0029	05/06/19	KT	63	95	14:45	Sub-ad.		1	Sub-adult, heavy moult in primaries, not bright rufous in tail or vent. Full crop.
B0030	02/05/19	KT	61	89	11:01			1	Bird flying through, outside site buffer.
B0030	02/05/19	KT	60	91	14:44			2	Pair out hunting.
B0030	02/05/19	KT	63	91	16:37		Pr	2	After end of survey. Pair displaying, just outside site buffer.
B0031	05/07/19	KT	60	91	11:07	Ad.		1	Adult hunting at Low height. Along road then over clearfell.
B0031	05/07/19	PE	-	-	11:40	Ad.	F	1	Adult female perched in tree, alarm calling. Further detail is provided in the Confidential Annex.
B0031	05/07/19	KT	60	90	11:53	Ad.		2	Two adults hunting at Low height. Pattern of wear on wing suggested one of them was bird from previous record (1).
B0031	05/07/19	KT	62	91	12:12	Ad.		1	Adult hunting over clearfell.
B0032	11/07/19	PE	-	-	13:42	Ad.	F	1	Adult female alarming as surveyor approached on foot. Stayed perched. Further detail is provided in the Confidential Annex.
B0032	11/07/19	KT	59	91	14:21	Ad.		1	Adult out hunting.
B0032	11/07/19	KT	59	91	17:46		Pr	2	Pair circling. Drifted well off to south.
B0049	28/04/20	PE	-	-	13:28	Ad.	Pr	2	Adult pair present - no sign of eggs or incubation yet. Further detail is provided in the Confidential Annex.

B0050	19/06/20	PE	-	-	10:44	Ad.	Pr	2	Female alarm-calling as surveyor approached. Soon settled down. She did a short flight to join male in nearby tree. Female flew in alarm-calling, suggesting a hidden chick. Further detail is provided in the Confidential Annex.
B0050	19/06/20	OP	60	90	11:02	Ad.		1	Unsuccessful fishing attempt. Perched in tree after.
B0050	19/06/20	OP	60	90	11:31	Ad.		1	Flew off and away from site.
B0050	19/06/20	KT	-	-	11:33	Ad.		1	Fly-past.
B0051	06/07/20	KT	-	-	13:05	Ad. & Juv		3	Very fresh juvenile and two adults. Adult bird had flown in to exact same place before surveyor came closer for a look. Further detail is provided in the Confidential Annex.
B0051	06/07/20	K.	59	93	13:21	Ad.		2	Two adults agitated at surveyor presence and watchful of red kites - suggests there is a breeding territory in this wood.
B0051	06/07/20	PE	-	-	14:06	Ad.		2	Male flew past. Female alarmed as a lesser black-backed gull flew over, hidden down in valley below dam. Suggests there is still a chick (fledged youngster) around. Further detail is provided in the Confidential Annex.
B0051	06/07/20	KT	-	-	14:53	Unk.		1	Seen landing in similar area as recorded in June. Quite a bit outside the 2 km buffer.

Black Grouse Surveys 2018, 2019 and 2020

An initial black grouse lek reconnaissance survey was completed in spring 2018 covering all potentially suitable habitat within the survey area (see Figure 7.1 of Chapter 7), with follow-up lek counts carried out in spring 2018, 2019 and 2020. Table A4.4 provides details of the survey visits and weather conditions along with notes associated with these surveys. Table A4.5 provides observations related to black grouse from other surveys.

Table A4.4: Black Grouse Surveys 2018, 2019 and 2020 – Survey Timings, Weather Conditions and Notes of Key Observations

Date	Surveyor	Start Time	End Time	Wind Dir.	Cloud Base (m)	Cloud Cover (%)	Wind Speed (BS)	Vis. (km)	Temp (^{0}C)	Precip.
21/04/18	RS	05:00	08:00	E	>1000	30	1	>10	3-4	None
Notes: Two males remained at lek (see Confidential Annex for location) until 0725 when they flew low north, then circled round Quantans Hill and were lost to sight on the southwest side of Quantans Hill.										
21/04/18	AJM	05:00	08:00	SW	>1000	40	2	>10	5	None
Notes: No black grouse seen or heard. Listening points: 1) NX 61267 93068; 2) NX 61453 93877; 3) NX 61338 94610; 4) NX 61427 95390; 5) NX 61722 96159.										
08/05/18	PC	04:20	07:20	S	100-1000	100	2	2-10	7	None
Notes: Female black grouse flushed from ground at NX 58858 94806. Single dropping found but no sign of a nest. No lekking males seen or heard.										
08/05/18	AJM	04:20	07:25	S	500-1000	100	2	5-10	7	None
Notes: No black grouse seen or heard despite suitable conditions										
02/04/19	PH	05:50	08:50	NW	500-1000	70	2	>10	3	Light snow, Intermittent

Notes: No black grouse were heard or seen despite suitable conditions.										
02/04/19	TB	05:50	08:50	NW	500-1000	70	2	>10	3	Light snow, Intermittent
Notes: No black grouse were heard or seen despite suitable conditions.										
28/04/20	RTW	04:40	07:40	NW	>1000	35	2	>10	10	None
Notes: No black grouse were heard or seen despite suitable conditions.										
10/05/20	RTW	04:15	07:15	SE	>1000	20	1	>10	6	None
Notes: No signs or sightings of black grouse or lekking activity. One male black grouse flushed from ground in slightly boggy area at NX 60749 95475.										

Table A4.5: Black Grouse Observations during other Surveys (2018 – 2020)

Date	Survey Type	VP	Start Time	End Time	Notes
07/05/18	FAS	3	19:20	19:25	Adult male black grouse lekking near VP. Accidentally flushed when trying to locate it.

APPENDIX 5: Details of Wintering Goose & Swan Surveys 2018-19

Surveyor	Date (Locked)	Time	Wind Dir.	Cloud Base (m AOD)	Cloud Cover (%)	Wind Speed (BS)	Visibility	Temp (°C)	Precipitation	Intensity	Duration	Notes
PC	24/09/18		W	>1000	60	2-4	>10	12	Rain	Light	Intermittent	No wildfowl were seen grazing. Carse of Water of Deugh checked but no wildfowl seen.
PC/AD	01/10/18	14:40	W	>1000	100	2	>10	10	Rain	Light	Intermittent	No birds.
PC	19/10/18	12:10	SW	500-1000	100	2	5-10	10	Rain	Light	Intermittent	No birds seen.
AD	02/11/18	14:20	SW	>1000	30	2	>10	7	None	n/a	n/a	No birds seen.
AD	16/11/18	14:20	S	100-500	100	2	1-2	9	None	n/a	n/a	No geese or swans.
AD	05/12/18	14:30	SW	500-1000	100	3	5-10	9	Rain	Light	Continuous	No birds seen.
PC	19/12/18	08:45	S	>1000	40	2-3	>10	6	None	n/a	n/a	No birds of note observed.
PC	10/01/19	09:40	NW	500->1000	100	2-3	2->10	6	None	n/a	n/a	No birds noted.
PC	30/01/19	10:30	SW	500-1000	30	2	>10	0	None	n/a	n/a	No birds recorded.
TB	14/02/19	09:30	SE	>1000	100	2	>10	8	None	n/a	n/a	No birds recorded.
TB	25/02/19	10:45	n/a	500-1000	90	0	>10	11	None	n/a	n/a	No birds recorded.
TB/PH	06/03/19	11:15	n/a	100-500	100	0	2-5	8	Rain	Light	Intermittent	No birds recorded.
TB	22/03/19	12:40	SW	100-500	100	2	>10	7	Rain	Light	Continuous	No birds recorded.
PH	15/04/19	10:10	E	500-1000	20-70	3-5	>10	4-10	None	n/a	n/a	No birds recorded.
TB	30/04/19	09:40	S	>1000	100	2	>10	12	None	n/a	n/a	No birds recorded.
TB	17/05/19	13:10	NE	>1000	90-30	2	>10	13-17	None	n/a	n/a	No birds recorded.
TB	31/05/19	11:15	S	100-500	100	1-2	2-5	12	Rain	Mod.	Intermittent	No birds recorded.

APPENDIX 6: Notable Species Records from other Surveys 2018, 2019 and 2020

Table A6.1: Notable species observation during other Surveys (2018 – 2020)

Survey Type	Date	Easting	Northing	Time	BTO Code	No. of Birds	Sex	Age	Notes
Protected Species	10/08/20	258709	594487	16:11	SE	1	Unk.	Unk.	Short-eared owl sighting. Flew low up from ground, lost to view over slight rise.
Bat activity survey	06/08/20	261273	595992		SE	1	Unk.	Unk.	Short-eared owl roosting alone in rank grass on the side of Beninner.
Bat activity survey	16/06/20	2579	5941		K.	2	Pr	Ads.	Pair of kestrels mobbing crows, likely nest site in conifer copse.
Bat activity survey	06/08/20	260670	594699		K.	1	Fem	Ad.	Behaviour suggesting nesting in this copse.

256000 258000 260000 262000 264000

598000

596000

594000

592000

Project:

Quantans Hill Wind Farm, Dumfries & Galloway

Title:

Figure TA 7.1a: Flight Activity by Secondary Species - Apr-Aug 2018

Key

- Site boundary
- Proposed turbine
- Proposed development
- 500m turbine buffer

Flight Activity

Risk Height* Other Heights

- Goosander
- Common snipe
- Common gull
- Common kestrel

Flight Area

- Common gull
- Common kestrel

Note

* 'Risk Height' refers to flights recorded within the Medum height band (50 - 250 m a.g.l.)

Scale @ A3: 1:30,000

Coordinate System: British National Grid

0 0.25 0.5 1 km

N

Date: 31-05-22	Prepared by: SR	Checked by: PB
Ref:	Layout: 010921_14t_A	

Drawing by:

mbec environmental consulting

VATTENFALL

256000 258000 260000 262000 264000

598000

596000

594000

592000

Project:

Quantans Hill Wind Farm, Dumfries & Galloway

Title:

Figure TA 7.1b: Flight Activity by Secondary Species - Sept 2018-Mar 2019

Key

- Site boundary
- Proposed turbine
- Proposed development
- 500m turbine buffer

Flight Activity

Risk Height* Other Heights

- Cormorant
- Goosander
- Grey heron
- Common snipe
- Common kestrel

Flight Area

- Common kestrel

Note

* 'Risk Height' refers to flights recorded within the Medum height band (50 - 250 m a.g.l.)

Scale @ A3: 1:30,000

Coordinate System: British National Grid

0 0.25 0.5 1 km

N

Date: 31-05-22	Prepared by: SR	Checked by: PB
Ref:	Layout: 010921_14t_A	

Drawing by:

mbec environmental consulting

VATTENFALL

256000 258000 260000 262000 264000

598000

596000

594000

592000

Project:

Quantans Hill Wind Farm, Dumfries & Galloway

Title:

Figure TA 7.1c: Flight Activity by Secondary Species - Apr-Aug 2019

Key

- Site boundary
- Proposed turbine
- Proposed development
- 500m turbine buffer

Flight Activity

Risk Height*	Other Heights
	Grey heron
	Sparrrowhawk
	Common snipe
	Common gull
	Herring gull
	Common kestrel

Note

* 'Risk Height' refers to flights recorded within the Medum height band (50 - 250 m a.g.l.)

Scale @ A3: 1:30,000

Coordinate System: British National Grid

0 0.25 0.5 1 km

N

Date: 31-05-22	Prepared by: SR	Checked by: PB
Ref:	Layout: 010921_14t_A	

Drawing by:

mbec environmental consulting

VATTENFALL

256000 258000 260000 262000 264000

598000 596000 594000 592000

Project:

Quantans Hill Wind Farm, Dumfries & Galloway

Title:

Figure TA 7.1d: Flight Activity by Secondary Species - Sept 2020-Mar 2021

Key

- Site boundary
- Proposed turbine
- Proposed development
- 500m turbine buffer

Flight Activity

Risk Height* Other Heights

- Common kestrel

Flight Area

- Common kestrel

Note

* 'Risk Height' refers to flights recorded within the Medum height band (50 - 250 m a.g.l.)

Scale @ A3: 1:30,000

Coordinate System: British National Grid

0 0.25 0.5 1 km

N

Date: 31-05-22	Prepared by: SR	Checked by: PB
Ref:	Layout: 010921_14t_A	

Drawing by:

mbec environmental consulting

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VATTENFALL

Appendix 7.2

Details of the Bird Collision Risk Modelling

Document history

Author	Paul Bradshaw	17/11/2021
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Approved	Emily Galloway	17/11/2021

Client Details	
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Client Name	Vattenfall Wind Power Ltd

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Contents

Glossary

Refer to Chapter 7: Ornithology in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 7: Ornithology in Volume 2 of the EIAR for the List of Abbreviations.

A7.2.1 Introduction

Purpose of this Document

A7.2.1.1 This a technical appendix to Chapter 7 (Ornithology) of the Quantans Hill wind farm (the 'Proposed Development') Environmental Impact Assessment Report (EIAR) and should be read in conjunction with that Chapter.

A7.2.1.2 This appendix provides further background information on the bird collision risk model (CRM) that has been used to inform the impact assessment for the key ornithological features (i.e. focal species for the assessment).

A7.2.1.3 The CRM follows the method widely known as the Band model (after Band *et al.* 2007[1]) and recommended by NatureScot. This method is based on the analysis of observational data collected from timed bird flight surveys at fixed vantage points overlooking the proposed wind farm development site. It provides an estimate of the number of birds that would collide with a proposed wind farm. Because birds may take action to avoid a wind farm, or to avoid collision with individual wind turbines, an avoidance rate is applied to the output from the CRM. Details of the methods, assumptions, parameters and avoidance rates used in this case are provided in this report.

A7.2.1.4 Further details of the flight activity survey (FAS) methods, survey effort and results are provided in Technical Appendix 7.1. The FAS vantage points and estimated viewsheds are shown on Figure 7.2.

The Proposed Wind Farm & Wind Turbine Parameters

A7.2.1.5 Details of the proposed wind farm are provided in Chapter 3: Project Description. Table 7.2.1 provides the assumed wind farm / wind turbine parameters relevant to the CRM calculations. The parameters are based on wind turbine model Siemens Gamesa Renewable Energy – SGRE170 – 200 m tip height.

Table 7.2.1: Wind farm and wind turbine parameters used in the flight activity and collision risk calculations.

Parameter	Value
No. turbines (no. of blades per turbine)	14 (3)
Flight risk area	878.14 ha
Blade length	85 m
Rotor diameter	170 m
Hub height	115 m
Max blade height	200 m
Min blade height	30 m
Max chord (max rotor depth)	4.5 m
Pitch	6°
Rotation period (fastest)	6 secs
Flight risk volume (V_w)	1492834927 m^3
Total rotor swept area	317772 m^2
Turbine operation time	90%

A7.2.1.6 The assumptions underlying the parameters listed in Table 7.2.1 are as follows:

- The flight risk area is the area defined by a boundary around the outermost turbines plus a 500 m wide buffer (v. LQULL033);
- Hub height, rotor diameter and max/min height are based on details provided for SGRE170 – 200 m tip height;
- Max chord was not specified so was assumed to be 4.5 m;
- Pitch was assumed to be 6 degrees (turbine specifications: pitch = variable);
- The rotational period is 6 secs (10 rpm);
- The flight risk volume is calculated by multiplying the diameter of the rotors by the flight risk area;
- The total rotor sweep area is the area swept by a set of rotating turbine blades (i.e. rotor radius^2 x π) multiplied by the number of wind turbines; and
- The Turbine operation time was assumed to be 90%.

Species Considered

A7.2.1.7 Table 7.2.2 lists the target bird species which had activity recorded within the flight risk area and at collision risk height, with the key species-specific metrics used in the CRM.

Table 7.2.2: Target Species for which CRM was applied and their key biometrics and avoidance rates.

Common name	Scientific name	Bird length (m) [i]	Wingspan (m)	Bird speed (m s^{-1}) [ii]	Avoidance rate (%) [iii]
Whooper swan	*Cygnus cygnus*	1.6	2.43	20	99.5
Pink-footed goose	*Anser brachyrhynchus*	0.75	1.7	15	99.8
Greylag goose	*Anser anser*	0.84	1.68	10	99.8
Red kite	*Milvus milvus*	0.6	1.8	10	99.0
Hen harrier	*Circus cyaneus*	0.52	1.2	12	99.0
Curlew	*Numenius arquata*	0.6	1	13	98.0
Common kestrel	*Falco tinnunculus*	0.37	0.8	10	95.0
Merlin	*Falco columbarius*	0.3	0.62	10	98.0
Peregrine	*Falco peregrinus*	0.51	1.13	13	98.0

i - Bird length / wingspan, largest reported size is used, most values taken from Snow, D. W. & Perrins, C. M. (1998). The Birds of the Western Palearctic Concise Edition.

ii – Bird flight speed values primarily from Alerstam T., Rosén M., Bäckman J., Ericson P.G.P., Hellgren O. (2007). Flight speeds among bird species: allometric and phylogenetic effects. PLoS Biol, 5, 1656-1662.

iii - Assumed avoidance rates taken from current NatureScot Guidance (i.e. Avoidance Rates for the onshore NatureScot Wind Farm Collision Risk Model, July 2017) and in the case of common gull from Furness, R.W. (2019). Avoidance rates of herring gull, great black-backed gull and common gull for use in the assessment of terrestrial wind farms in Scotland. Scottish Natural Heritage Research Report No. 1019.

A7.2.2 Methods

Introduction

A7.2.2.1 Wind turbine collision risk for key species has been estimated following the method developed by Band *et al.* (2007), commonly referred to as the Band Model. Estimates of collision risk/mortality have been calculated for key species where there was sufficient data to carry out the analysis. Species that are not included in the collision risk analysis are either not of conservation concern or are at low collision risk due to their flight behaviour, and/or are species which are infrequently present within the study area.

[1] Band, W., Madders, M. and Whitfield, D.P. (2007). Developing field and analytical methods to assess avian collision risk at Wind Farms. In de Lucas, M., Janss, G. and Ferrer, M. (eds.) Birds and Wind Power. Quercus.

A7.2.2.2 In summary, the band / NatureScot model involves three stages:

- Stage one is the estimation of the number of bird transits through the proposed rotor swept volume per year based on observed flight activity data and parameters of the wind farm and wind turbine design.
- Stage two involves the estimation of the predicted proportion of transits through the rotor swept volume that would result in a collision. All predicted collisions are assumed to be fatal. This provides an estimate of the number of fatalities per year for the wind farm but assumes that birds take no avoiding action to prevent at collision.
- Finally, an assumed rate for collision avoidance is applied to the estimate.

A7.2.2.3 In order to provide a biologically realistic estimate of collision risk it is necessary to assume that birds take action to avoid collision. The species-specific avoidance rates assumed in this assessment are given in Table 7.2.2.

A7.2.2.4 The following sections provide further information on the methods and assumptions applicable to each stage of the CRM process.

Data Processing

A7.2.2.5 The mapped bird flight activity data was digitised using MapInfo (Version 11.5.4) GIS software and the recorded parameters entered into a pre-formatted spreadsheet (MS Excel). The data is used to derive an estimate of the occupancy of the proposed wind farm flight risk volume and from this an estimate of the number of annual collisions based on data collected during different seasons.

A7.2.2.6 The vantage point viewsheds were created using OS Terrain 50 data and MapInfo's Vertical Mapper Viewshed Analysis tool (viewpoint height = 1.5 m; viewshed off-set for turbines = 30 m; viewing radius = 2000 m); the viewshed was then cut to a maximum of 180° field of view and to the wind farm area (i.e. 500 m turbine buffer).

A7.2.2.7 There are two approaches to CRM calculations the application of which depends on certain assumptions about the use of the flight risk volume by the species under consideration. The 'directional' flight CRM method is appropriate for species that regularly pass through a proposed wind farm area in a clear direction. A typical scenario where this method is appropriate are flights by geese or swans commuting across a site, moving regularly between habitually used night-time roosts and daytime feeding areas. The alternative method assumes that flight activity is non-directional (essentially random) within the flight risk volume. This method is generally applicable to species that are active across the site, such as raptors during the breeding season.

A7.2.2.8 In this case, observations from the flight activity surveys indicated that the non-directional method was applicable for all species included in the CRM calculations.

The Flight Risk Volume

A7.2.2.9 Target or secondary species recorded during the FAS were considered to be at potential risk of collision if they were active within the 'medium' height band and within or near to the proposed wind turbines. This is known as the 'flight risk volume' (FRV).

A7.2.2.10 In this case, the FRV is defined as the space between 30 to 200 m above ground level (the minimum and maximum blade tip heights) and within 500 m of the proposed wind turbines.

A7.2.2.11 Due to differences between the height bands adopted during the surveys (which were completed before the wind turbine model was confirmed) and the actual dimensions of the proposed model of wind turbine some adjustment has to be made to the bird flights activity data. The height bands assumed during the FAS were as follows:

2018-19

- Very high > 250 m (above ground level)
- M2 = 150 - 250 m
- M1 = 50 - 150 m
- Low = 20 - 50 m
- Very Low < 20 m

2020-21

- Very high > 300 m (above ground level)
- High = 270 - 300 m
- M2 = 70 - 270 m
- M1 = 20 - 70 m
- Low < 20 m

A7.2.2.12 To account for the difference between the height bands and the proposed wind turbine hub height and blade dimensions, flights at collision risk height were estimated as follows:

2018-19

- Collision risk height flights = 1/2 M2 flights + all M1 flights + 1/3 Low flights

2020-21

- Collision risk height flights = 13/20 M2 flights + 4/5 M1 flights

Seasons and Active Hours

A7.2.2.13 For each species, where there was sufficient data recorded, flight activity from various survey periods (seasons) was analysed separately in the CRM. These seasons and the assumed total hours of potential activity, extrapolated from data recorded in each period, for each species are detailed in Table 7.2.3 below.

A7.2.2.14 The relevant periods / potential active hours for each species are based on the pattern of observed activity during the survey periods (i.e. April 2018 to August 2019, and September 2020 to March 2021).

Table 7.2.3: Assumed active hours for each species for which CRM was undertaken.

Species	Season	Potential Active Hours	Details
Whooper swan	Passage/wintering (October to April)	2908	Daylight hours October to April (incl. dawn & dusk hours)
Pink-footed goose	Passage/wintering (mid-Sept to April)	3146	Daylight hours 15 Sept to 30 April (incl. dawn & dusk hours)
Greylag goose	Passage/wintering (October to April)	2908	Daylight hours October to April (incl. dawn & dusk hours)
Red kite	Winter	1747	Daylight hours September - February
Red kite	Summer	2636	Daylight hours March - August
Hen harrier	Winter	2861	Daylight hours (incl. dawn and dusk) September - March
Curlew	Summer	2636	Daylight hours March - August
Common kestrel	Winter	1747	Daylight hours September - February
Common kestrel	Summer	2636	Daylight hours March - August
Merlin	Winter	2119	Daylight hours September - March
Peregrine	Summer	2636	Daylight hours March - August

Calculating Total Transits

A7.2.2.15 For non-directional flights (all species) the number of transits of the proposed wind turbines was calculated.

A7.2.2.16 Total seconds of activity within the FRV (Vw) was derived from the survey data, accounting for survey effort, overlaps between vantage point viewsheds and any simultaneous watches from overlapping viewsheds, expressed as hours per hectare. This is then extrapolated for the relevant season and number of potentially active hours.

A7.2.2.17 The combined volume swept by the wind turbine blades (Vr) is calculated as follows:

- V_r = no. turbines x rotor swept area (πR^2) x (depth of the blade + bird length)
- The number of bird transits through the combined rotor swept volume is calculated from the ratio between Vr and Vw applied to the total seconds of activity within Vw.

Collision Probability

A7.2.2.18 The probability that a transit through the rotors would result in a collision was calculated for each species using a spreadsheet provided by NatureScot. The spreadsheet models collision risk based on species specific biometrics (i.e. wingspan and bird length), assumed flight speed, whether the bird is gliding or using flapping flight, wind direction and various parameters associated with the design and operation of the proposed wind turbines. Where there was a range of potential values (e.g. for bird biometrics or wind turbine parameters) the value that results in an increased collision probability was used. For example, rotor speed is variable and has a strong influence on collision probability, in this case the maximum rotor speed was used based on the reported specifications of the model of wind turbine proposed (or most similar model where the required parameters were unavailable).

A7.2.2.19 The predicted number of collisions per season/year, assuming that birds take no avoiding action, is calculated by applying the collision probability to the number of estimated transits through the rotor swept volume (Vr).

Assumed Avoidance Rates

A7.2.2.20 The predicted number of collisions is then adjusted by an assumed avoidance rate, which is typically between 95 and >99%. The avoidance rates, based on current NatureScot guidance, are species-specific where there is sufficient empirical data available from published wind farm monitoring studies or are generic, and precautionary, for other species. The avoidance rates assumed in this case are provided in Table 7.2.2.

A7.2.3 Results

Introduction

A7.2.3.1 The tables presented in this report provide further detail on the methods and calculations, following the NatureScot / Band Model, used to determine estimates of annual collision risk for key bird species based on the observed flight activity recorded at the study area between April 2018 and August 2019, and September 2020 and March 2021.

Summary Calculations to Estimate Flight Risk

A7.2.3.2 Table 7.2.4 provides a summary of the flight activity data within the FRA for the species considered in the CRM analysis.

A7.2.3.3 Table 7.2.5 provides a summary of the background calculations to estimate mean flight time at all heights and at risk height per hectare per hour within the wind farm area. This is based on 2 km radii cut-off for vantage point viewsheds, and data from April 2018 to August 2019, and September 2020 and March 2021.

A7.2.3.4 Table 7.2.6 provides the results of the calculations to determine the number of bird transits through the wind farm rotors per year or season.

Estimated Number of Collisions per Year

A7.2.3.5 Table 7.2.7 gives the estimated number of collisions per year for each relevant species, the estimated total number of collisions over the 35-year lifetime of the proposed development and the estimated rate of collision. This is adjusted by an assumed avoidance rate (following current published guidance) for each species, as detailed in Table 7.2.2.

Band Model Outputs

A7.2.3.6 Tables 7.2.8 to 7.2.16 provide the raw output from NatureScot / Band model collision probability spreadsheet for each species considered in the CRM.

Table 7.2.4: Summary Flight Activity Data for all Species considered in the CRM Analysis

Species (Season)	Data Available	Total Flights (Birds) Recorded	Flights (Birds) within FRA	Duration at 'Low' within FRA (secs) i, ii	Duration at 'Medium' within FRA (secs) i, ii	Duration at 'High' within FRA (secs) i, ii	Total Duration within FRA (secs) i	% Low	% Med.	% High
Whooper swan (Passage/wintering)	Oct 18 – Apr 19	2 (55)	1 (28)	47	2065	329	2440	1.91	84.62	13.47
	Oct 20 – Mar 21	1 (15)	1 (15)	0	454	244	698	0.00	65.00	35.00
Pink-footed goose (Passage/wintering)	Sept 18 – Apr 19	2 (85)	2 (85)	0	563	5327	5890	0.00	9.55	90.45
	Sept 20 – Mar 21	4 (165)	4 (165)	0	8495	19511	28006	0.00	30.33	69.67
Greylag goose (Passage/wintering)	Oct 18 – Apr 19	2 (7)	2 (7)	59	252	0	310	18.88	81.12	0.00
	Oct 20 – Mar 21	No Flights								
Red kite (winter)	Sept 18 – Feb 19	23 (25)	17 (19)	5720	4585	370	10674	53.59	42.95	3.46
	Sept 20 – Feb 21	35 (37)	32 (33)	2699	3077	359	6135	44.00	50.15	5.85
Red kite (summer)	Apr 18 – Aug 18	22 (26)	18 (21)	674	1745	1017	3436	19.62	50.78	29.60
	Mar 19 – Aug 19	50 (57)	40 (46)	5720	4585	370	10674	53.59	42.95	3.46
Hen harrier (winter)	Sept 18 – Mar 19	2 (2)	2 (2)	149	13	0	161	92.07	7.93	0.00
	Sept 20 – Mar 21	9 (9)	8 (8)	586	20	0	606	96.70	3.30	0.00
Curlew (summer)	Apr 18 – Aug 18	3 (3)	2 (2)	170	0	0	170	100.00	0.00	0.00
	Mar 19 – Aug 19	8 (12)	8 (12)	410	263	0	673	60.95	39.05	0.00
Common kestrel (winter)	Sept 18 – Feb 19	16 (16)	10 (10)	215	712	77	1004	21.43	70.86	7.70
	Sept 20 – Feb 21	47 (49)	41 (43)	1863	1138	21	3022	61.64	37.67	0.69
Common kestrel (summer)	Apr 18 – Aug 18	33 (36)	29 (30)	784	2121	76	2982	26.30	71.14	2.56
	Mar 19 – Aug 19	11 (11)	9 (9)	215	712	77	1004	21.43	70.86	7.70
Merlin (winter)	Sept 18 – Mar 19	2 (2)	1 (1)	13	0	0	13	100.00	0.00	0.00
	Sept 20 – Mar 21	3 (3)	2 (2)	88	33	0	121	72.98	27.02	0.00
Peregrine (summer)	Apr 18 - Aug 18	1 (2)	1 (2)	90	0	0	90	100.00	0.00	0.00
	Mar 19 – Aug 19	2 (2)	2 (2)	26	182	48	256	10.02	71.24	18.74

i. Duration = recorded time x proportion of flight line within FRA x number of birds.

ii. Activity within the height bands have been adjusted to account for differences between the height band categories for the flight activity survey and the dimensions of the proposed wind turbine model.

Table 7.2.5: Summary calculations to estimate mean flight time at all heights and at risk height per hectare per hour within the wind farm area based on 2 km radii cut-off for vantage point viewsheds, based on data from April 2018 to August 2019, and September 2020 to March 2021.

Species (data set)	VP	Viewshed area (ha)	Total VP observation time (hr)	Area x observation time (hahr) [i]	Time species observed (s)	Time species at risk height (s)	Total time (hr $hahr^{-1}$)	Risk height time (hr $hahr^{-1}$)	T Mean act. (hr hr^{-1})	RH Mean act. (hr hr^{-1})
Whooper swan (Oct 18 - Apr 19)	1	334.71	66.00	22090.72	0	0	0	0		
	2	213.71	66.00	12641.04			0	0		
	3	478.66	75.00	35899.65	2439.96	2064.73	1.88795E-05	1.59761E-05		
	4	55.20	66.00	3616.59			0	0		
	5	255.02	66.00	16520.77			0	0		
	Total	1337.30	339.00	90768.77	2439.96	2064.73	1.88795E-05	1.59761E-05		
	Mean						3.7759E-06	3.19522E-06	0.003315765	0.002805846
Whooper swan (Oct 20 – Mar 21)	6	393.36	51.00	20061.44	698.21	453.84	9.66769E-06	6.284E-06		
	7	446.22	51.00	22757.38			0	0		
	8	202.46	51.00	10325.21			0	0		
	Total	1042.04	153.00	53144.03	698.21	453.84	9.66769E-06	6.284E-06		
	Mean						3.22256E-06	2.09467E-06	0.002829856	0.001839407
Pink-footed goose (Sept 18 – Apr 19)	1	334.71	75.00	25103.10			0	0		
	2	213.71	75.00	14564.45			0	0		
	3	478.66	81.00	38771.62	5889.75	562.51	4.21969E-05	4.0301E-06		
	4	55.20	75.00	4113.42			0	0		
	5	255.02	75.00	18815.92			0	0		
	Total	1337.30	381.00	101368.50	5889.75	562.51	4.21969E-05	4.0301E-06		
	Mean						8.43938E-06	8.06019E-07	0.007410942	0.000707796
Pink-footed goose (Sept 20 – Mar 21)	6	393.36	60.00	23601.70	25694.47	8495.21	0.000302408	9.99835E-05		
	7	446.22	60.00	26773.39	2311.92	0.00	2.39865E-05	0		
	8	202.46	60.00	12147.31	0	0.00	0	0		
	Total	1042.04	180.00	62522.39	28006.39	8495.21	0.000326395	9.99835E-05		
	Mean						0.000108798	3.33278E-05	0.095539957	0.029266432
Greylag goose (Oct 18 - Apr 19)	1	334.71	66.00	22090.72			0	0		
	2	213.71	66.00	12641.04			0	0		

Species (data set)	VP	Viewshed area (ha)	Total VP observation time (hr)	Area x observation time (hahr) [i]	Time species observed (s)	Time species at risk height (s)	Total time (hr $hahr^{-1}$)	Risk height time (hr $hahr^{-1}$)	T Mean act. (hr hr^{-1})	RH Mean act. (hr hr^{-1})
	3	478.66	75.00	35899.65	175.67	117.11	1.35926E-06	9.06176E-07		
	4	55.20	66.00	3616.59			0	0		
	5	255.02	66.00	16520.77	134.49	134.49	2.26131E-06	2.26131E-06		
	Total	1337.30	339.00	90768.77	310.16	251.60	3.62057E-06	3.16748E-06		
	Mean						7.24114E-07	6.33497E-07	0.000635872	0.000556298
Red kite (Sept 18 – Feb 19)	1	334.71	54.00	18074.23	1218.62	1033.92	1.87286E-05	1.589E-05		
	2	213.71	54.00	10698.68	390.24	369.72	1.01322E-05	9.59934E-06		
	3	478.66	54.00	25847.75	551.91	361.21	5.93118E-06	3.88184E-06		
	4	55.20	54.00	2954.16	0.00	0.00	0	0		
	5	255.02	54.00	13460.57	2210.99	1458.79	4.5627E-05	3.01041E-05		
	Total	1337.30	270.00	71035.38	4371.76	3223.64	8.0419E-05	5.94753E-05		
	Mean						1.60838E-05	1.18951E-05	0.014123792	0.0104455
Red kite (Sept 20 – Feb 21)	6	393.36	54.00	21241.53	467.46	332.37	6.11305E-06	4.3465E-06		
	7	446.22	54.00	24096.05	3389.53	1995.51	3.90743E-05	2.30041E-05		
	8	202.46	54.00	10932.57	2278.42	749.05	5.78907E-05	1.90321E-05		
	Total	1042.04	162.00	56270.15	6135.41	3076.93	0.000103078	4.63827E-05		
	Mean						3.43593E-05	1.54609E-05	0.030172246	0.013576807
Red kite (Apr 18 – Aug 18)	1	334.71	36.00	12049.49	309.91	225.23	7.14435E-06	5.1922E-06		
	2	213.71	36.00	6531.62			0	0		
	3	478.66	36.00	17231.83	256.96	74.41	4.14224E-06	1.19952E-06		
	4	55.20	36.00	1950.15	789.08	550.63	0.000112395	7.84308E-05		
	5	255.02	36.00	9180.60	2080.16	894.51	6.29396E-05	2.70653E-05		
	Total	1337.30	180.00	46943.68	3436.11	1744.78	0.000186622	0.000111888		
	Mean						3.73243E-05	2.23776E-05	0.032775916	0.019650592
Red kite (Mar 19 – Aug 19)	1	334.71	60.00	20082.48	602.27	125.71	8.33058E-06	1.73877E-06		
	2	213.71	60.00	11602.88	5178.19	1685.88	0.000123968	4.03606E-05		
	3	478.66	60.00	28719.72	2633.60	1247.98	2.54722E-05	1.20705E-05		
	4	55.20	60.00	3312.17	0.00	0.00	0	0		

Species (data set)	VP	Viewshed area (ha)	Total VP observation time (hr)	Area x observation time (hahr) [i]	Time species observed (s)	Time species at risk height (s)	Total time (hr $hahr^{-1}$)	Risk height time (hr $hahr^{-1}$)	T Mean act. (hr hr^{-1})	RH Mean act. (hr hr^{-1})
	5	255.02	60.00	15301.00	2260.10	1525.14	4.10304E-05	2.76878E-05		
	Total	1337.30	300.00	79018.24	10674.17	4584.71	0.000198801	8.18577E-05		
	Mean						3.97603E-05	1.63715E-05	0.034915003	0.014376469
Hen harrier (Sept 18 – Mar 19)	1	334.71	63.00	21086.60	43.00	0.00	5.66447E-07	0		
	2	213.71	63.00	12414.57	118.40	12.80	2.64915E-06	2.86395E-07		
	3	478.66	63.00	30155.70			0	0		
	4	55.20	63.00	3450.98			0	0		
	5	255.02	63.00	15755.72			0	0		
	Total	1337.30	315.00	82863.57	161.40	12.80	3.2156E-06	2.86395E-07		
	Mean						6.4312E-07	5.72789E-08	0.000564748	5.02988E-05
Hen harrier (Sept 20 – Mar 21)	6	393.36	60.00	23601.70	129.05	0.00	1.51879E-06	0		
	7	446.22	60.00	26773.39	336.99	0.00	3.49628E-06	0		
	8	202.46	60.00	12147.31	140.34	20.00	3.20931E-06	4.57349E-07		
	Total	1042.04	180.00	62522.39	606.38	20.00	8.22438E-06	4.57349E-07		
	Mean						2.74146E-06	1.5245E-07	0.002407382	0.000133872
Curlew (Mar 19 – Aug 19)	1	334.71	60.00	20082.48	336.54	147.05	4.65497E-06	2.034E-06		
	2	213.71	60.00	11602.88			0	0		
	3	478.66	60.00	28719.72	35.00	33.33	3.38521E-07	3.22401E-07		
	4	55.20	60.00	3312.17			0	0		
	5	255.02	60.00	15301.00	301.85	82.56	5.47989E-06	1.49877E-06		
	Total	1337.30	300.00	79018.24	673.39	262.94	1.04734E-05	3.85517E-06		
	Mean						2.09468E-06	7.71035E-07	0.001839415	0.000677075
Common kestrel (Sept 18 – Feb 19)	1	334.71	54.00	18074.23	762.08	626.34	1.17122E-05	9.626E-06		
	2	213.71	54.00	10698.68	13.98	8.42	3.62944E-07	2.18647E-07		
	3	478.66	54.00	25847.75			0	0		
	4	55.20	54.00	2954.16			0	0		
	5	255.02	54.00	13460.57	497.60	165.60	1.02686E-05	3.41749E-06		

Species (data set)	VP	Viewshed area (ha)	Total VP observation time (hr)	Area x observation time (hahr) [i]	Time species observed (s)	Time species at risk height (s)	Total time (hr $hahr^{-1}$)	Risk height time (hr $hahr^{-1}$)	T Mean act. (hr hr^{-1})	RH Mean act. (hr hr^{-1})
	Total	1337.30	270.00	71035.38	1273.66	800.36	2.23437E-05	1.32621E-05		
	Mean						4.46875E-06	2.65243E-06	0.00392418	0.002329197
Common kestrel (Sept 20 – Feb 21)	6	393.36	54.00	21241.53	677.10	228.00	8.85447E-06	2.98158E-06		
	7	446.22	54.00	24096.05	1691.35	482.18	1.94977E-05	5.55852E-06		
	8	202.46	54.00	10932.57	653.42	428.07	1.66022E-05	1.08764E-05		
	Total	1042.04	162.00	56270.15	3021.86	1138.24	4.49544E-05	1.94165E-05		
	Mean						1.49848E-05	6.47216E-06	0.013158727	0.005683451
Common kestrel (Apr 18 – Aug 18)	1	334.71	36.00	12049.49	988.88	626.56	2.27968E-05	1.4444E-05		
	2	213.71	36.00	6531.62			0	0		
	3	478.66	36.00	17231.83	5.19	5.19	8.36789E-08	8.36789E-08		
	4	55.20	36.00	1950.15	381.46	172.62	5.43346E-05	2.45885E-05		
	5	255.02	36.00	9180.60	1606.03	1316.84	4.85937E-05	3.98437E-05		
	Total	1337.30	180.00	46943.68	2981.56	2121.21	0.000125809	7.89599E-05		
	Mean						2.51618E-05	1.5792E-05	0.022095503	0.013867533
Common kestrel (Mar 19 – Aug 19)	1	334.71	60.00	20082.48	489.38	436.57	6.76897E-06	6.03857E-06		
	2	213.71	60.00	11602.88	53.42	48.97	1.27898E-06	1.1724E-06		
	3	478.66	60.00	28719.72	170.87	45.00	1.65264E-06	4.35241E-07		
	4	55.20	60.00	3312.17	112.65	42.50	9.4476E-06	3.5643E-06		
	5	255.02	60.00	15301.00	178.12	138.75	3.23372E-06	2.5189E-06		
	Total	1337.30	300.00	79018.24	1004.44	711.79	2.23819E-05	1.37294E-05		
	Mean						4.47638E-06	2.74588E-06	0.003930881	0.002411263
Merlin (Sept 20 – Mar 21)	6	393.36	60.00	23601.70	120.79	32.63	1.42162E-06	3.84057E-07		
	7	446.22	60.00	26773.39	0.00	0.00	0	0		
	8	202.46	60.00	12147.31	0	0	0	0		
	Total	1042.04	180.00	62522.39	120.79	32.63	1.42162E-06	3.84057E-07		
	Mean						4.73875E-07	1.28019E-07	0.000416127	0.000112418
Peregrine (Mar 19 – Aug 19)	1	334.71	60.00	20082.48			0	0		

Species (data set)	VP	Viewshed area (ha)	Total VP observation time (hr)	Area x observation time (hahr) [i]	Time species observed (s)	Time species at risk height (s)	Total time (hr $hahr^{-1}$)	Risk height time (hr $hahr^{-1}$)	T Mean act. (hr hr^{-1})	RH Mean act. (hr hr^{-1})
	2	213.71	60.00	11602.88			0	0		
	3	478.66	60.00	28719.72	210.78	142.81	2.03871E-06	1.38123E-06		
	4	55.20	60.00	3312.17			0	0		
	5	255.02	60.00	15301.00	45.27	39.60	8.21814E-07	7.1894E-07		
	Total	1337.30	300.00	79018.24	256.05	182.41	2.86052E-06	2.10017E-06		
	Mean						5.72104E-07	4.20035E-07	0.000502386	0.000368849

i. Accounting for overlaps between vantage point viewsheds and any simultaneous watches from overlapping viewsheds.

Table 7.2.6: Results of calculations to determine the number of transits through the wind farm rotors per year

Species (data-set collision rates derived from)	Combined volume swept by rotors (V_r) (m^3) [i]	Occupancy of the flight risk volume (hr) [ii]	Occupancy of rotor swept volume (secs) [iii]	Time taken to clear rotors (secs) [iv]	Number of transits through rotors [v]	Average collision risk [vi]
Whooper swan (Oct 18 – Apr 19)	1938408.154	8.16	38.1412	0.3050	112.55	7.6
Whooper swan (Oct 20 – Mar 21)	1938408.154	5.35	25.0039	0.3050	73.78	7.6
Pink-footed goose (Sept 18 – Apr 19)	1668302.100	2.23	8.9584	0.3500	23.04	6.0
Pink-footed goose (Sept 20 – Mar 21)	1668302.100	92.07	370.4196	0.3500	952.51	6.0
Greylag goose (Oct 18 – Apr 19)	1696901.564	1.62	6.6199	0.5340	11.16	7.5
Red kite (Sept 18 – Feb 19)	1620636.325	18.25	71.3179	0.5100	125.86	6.5
Red kite (Sept 20 – Feb 21)	1620636.325	23.72	92.6972	0.5100	163.58	6.5
Red kite (Apr 18 – Aug 18)	1620636.325	51.80	202.4405	0.5100	357.25	6.5
Red kite (Mar 19 – Aug 19)	1620636.325	37.90	148.1064	0.5100	261.36	6.5
Hen Harrier (Sept 18 – Mar 19)	1595214.579	0.14	0.5536	0.4183	1.19	5.5
Hen Harrier (Sept 20 – Mar 21)	1595214.579	0.38	1.4734	0.4183	3.17	5.5
Curlew (Mar 19 – Aug 19)	1620636.325	1.78	6.9752	0.3923	16.00	5.6
Common kestrel (Sept 18 – Feb 19)	1547548.805	4.07	15.1857	0.4870	28.06	5.1
Common kestrel (Sept 20 – Feb 21)	1547548.805	9.93	37.0544	0.4870	68.48	5.1
Common kestrel (Apr 18 – Aug 18)	1547548.805	36.55	136.4205	0.4870	252.11	5.1
Common kestrel (Mar 19 – Aug 19)	1547548.805	6.36	23.7206	0.4870	43.84	5.1
Merlin (Sept 20 – Mar 21)	1525304.777	0.24	0.8762	0.4800	1.64	4.7
Peregrine (Mar 19 – Aug 19)	1592036.861	0.97	3.7328	0.3854	8.72	5.3

i - Total rotor sweep area (m^2) multiplied by (d+l) (i.e. the depth of the rotor back to front (max chord) and the bird length) (m).

ii - Occupancy of the flight risk volume in hours per year, taken from the mean risk-height flight time (hr $hahr^{-1}$) multiplied by the flight risk area (ha) multiplied by the annual active presence (hr) multiplied by risk height correction factor.

iii - Occupancy of rotor swept volume, taken from the occupancy of the flight risk volume (secs) divided by the flight risk volume (m^3) multiplied by the combined rotor volume (V_r) (m^3).

iv - Time taken for the bird to clear the rotors (secs), taken from maximum rotor depth (max chord) and bird length (d+l) (m), divided by the assumed flight speed ($m\ s^{-1}$).

v – Number of transits is taken from the occupancy of the rotor swept volume divided by the time taken for the bird to clear the rotors, multiplied by operation time.

vi - Average collision risk derived from the NatureScot probability spreadsheet (see tables below). The figure is based on an average between the upwind and downwind flight collision risk values. Flapping rather than gliding flight has been assumed in all cases.

Table 7.2.7: Estimated collisions per season/year at the assumed collision avoidance rates (NB these figures do not account for wind farm / turbine non-operational time)

Species (data-set collision rates derived from)	No Avoidance collisions	Avoidance Rate (%)	Collisions per season/year	Total over 35 years	Years between collisions
Whooper swan (Oct 18 – Apr 19)	8.55	99.5	0.04	1.50	23.38
Whooper swan (Oct 20 – Mar 21)	5.61	99.5	0.03	0.98	35.67
Pink-footed goose (Sept 18 – Apr 19)	1.38	99.8	0.00	0.10	361.75
Pink-footed goose (Sept 20 – Mar 21)	57.15	99.8	0.11	4.00	8.75
Greylag goose (Oct 18 – Apr 19)	0.84	99.8	0.00	0.06	597.53
Red kite (Sept 18 – Feb 19)	8.18	99	0.08	2.86	12.22
Red kite (Sept 20 – Feb 21)	10.63	99	0.11	3.72	9.40
Red kite (Apr 18 – Aug 18)	23.22	99	0.23	8.13	4.31
Red kite (Mar 19 – Aug 19)	16.99	99	0.17	5.95	5.89
Hen Harrier (Sept 18 – Mar 19)	0.07	99	0.00	0.02	1526.62
Hen Harrier (Sept 20 – Mar 21)	0.17	99	0.00	0.06	573.59
Curlew (Mar 19 – Aug 19)	0.90	98	0.02	0.63	55.80
Common kestrel (Sept 18 – Feb 19)	1.43	95	0.07	2.50	13.97
Common kestrel (Sept 20 – Feb 21)	3.49	95	0.17	6.11	5.73
Common kestrel (Apr 18 – Aug 18)	12.86	95	0.64	22.50	1.56
Common kestrel (Mar 19 – Aug 19)	2.24	95	0.11	3.91	8.95
Merlin (Sept 20 – Mar 21)	0.08	98	0.00	0.05	647.52
Peregrine (Mar 19 – Aug 19)	0.46	98	0.01	0.32	108.22

Table 7.2.8: Output from NatureScot / Band model collision probability spreadsheet for whooper swan

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3					Upwind:			Downwind:		
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	1.6	m	0.025	0.575	8.99	45.24	1.00	0.00125	44.70	1.00	0.00125
Wingspan	2.43	m	0.075	0.575	3.00	15.26	0.38	0.00286	14.72	0.37	0.00276
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.80	10.34	0.26	0.00323	9.68	0.24	0.00303
			0.175	0.860	1.28	8.47	0.21	0.00370	7.66	0.19	0.00335
Bird speed	20	m/sec	0.225	0.994	1.00	7.34	0.18	0.00413	6.40	0.16	0.00360
RotorDiam	170	m	0.275	0.947	0.82	5.89	0.15	0.00405	5.00	0.13	0.00344
RotationPeriod	6.00	sec	0.325	0.899	0.69	4.88	0.12	0.00397	4.04	0.10	0.00328
			0.375	0.851	0.60	4.28	0.11	0.00402	3.48	0.09	0.00326
			0.425	0.804	0.53	3.88	0.10	0.00412	3.12	0.08	0.00332
			0.475	0.756	0.47	3.56	0.09	0.00422	2.84	0.07	0.00338
Bird aspect ratioo: β	0.66		0.525	0.708	0.43	3.29	0.08	0.00432	2.62	0.07	0.00344
			0.575	0.660	0.39	3.07	0.08	0.00441	2.44	0.06	0.00351
			0.625	0.613	0.36	2.87	0.07	0.00449	2.30	0.06	0.00359
			0.675	0.565	0.33	2.71	0.07	0.00457	2.18	0.05	0.00367
			0.725	0.517	0.31	2.56	0.06	0.00464	2.07	0.05	0.00376
			0.775	0.470	0.29	2.43	0.06	0.00471	1.99	0.05	0.00385
			0.825	0.422	0.27	2.31	0.06	0.00477	1.92	0.05	0.00395
			0.875	0.374	0.26	2.21	0.06	0.00483	1.85	0.05	0.00406
			0.925	0.327	0.24	2.11	0.05	0.00488	1.80	0.05	0.00417
			0.975	0.279	0.23	2.02	0.05	0.00492	1.76	0.04	0.00428
			Overall p(collision) =			**Upwind**		**8.2%**	**Downwind**		**6.9%**
							Average		**7.6%**		

Table 7.2.9: Output from NatureScot / Band model collision probability spreadsheet for pink-footed goose

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.75	m	0.025	0.575	6.74	29.08	0.97	0.00121	28.53	0.95	0.00119
Wingspan	1.7	m	0.075	0.575	2.25	9.87	0.33	0.00247	9.33	0.31	0.00233
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.35	6.85	0.23	0.00286	6.19	0.21	0.00258
			0.175	0.860	0.96	5.75	0.19	0.00335	4.94	0.16	0.00288
Bird speed	15	m/sec	0.225	0.994	0.75	5.07	0.17	0.00381	4.14	0.14	0.00310
RotorDiam	170	m	0.275	0.947	0.61	4.08	0.14	0.00374	3.19	0.11	0.00293
RotationPeriod	6.00	sec	0.325	0.899	0.52	3.39	0.11	0.00367	2.54	0.08	0.00276
			0.375	0.851	0.45	2.88	0.10	0.00360	2.08	0.07	0.00259
			0.425	0.804	0.40	2.55	0.09	0.00362	1.80	0.06	0.00255
			0.475	0.756	0.35	2.31	0.08	0.00365	1.59	0.05	0.00252
Bird aspect ratioo: β	0.44		0.525	0.708	0.32	2.10	0.07	0.00368	1.43	0.05	0.00251
			0.575	0.660	0.29	1.93	0.06	0.00369	1.31	0.04	0.00250
			0.625	0.613	0.27	1.78	0.06	0.00370	1.20	0.04	0.00250
			0.675	0.565	0.25	1.65	0.05	0.00371	1.12	0.04	0.00251
			0.725	0.517	0.23	1.53	0.05	0.00370	1.04	0.03	0.00252
			0.775	0.470	0.22	1.43	0.05	0.00369	0.99	0.03	0.00255
			0.825	0.422	0.20	1.33	0.04	0.00367	0.94	0.03	0.00258
			0.875	0.374	0.19	1.25	0.04	0.00364	0.90	0.03	0.00261
			0.925	0.327	0.18	1.17	0.04	0.00361	0.86	0.03	0.00266
			0.975	0.279	0.17	1.10	0.04	0.00356	0.83	0.03	0.00271

Overall p(collision) = Upwind 6.9% Downwind 5.1%

Average 6.0%

Table 7.2.10: Output from NatureScot / Band model collision probability spreadsheet for greylag goose

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.84	m	0.025	0.575	4.49	19.38	0.97	0.00121	18.84	0.94	0.00118
Wingspan	1.68	m	0.075	0.575	1.50	6.64	0.33	0.00249	6.10	0.31	0.00229
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.90	4.66	0.23	0.00291	4.00	0.20	0.00250
			0.175	0.860	0.64	3.95	0.20	0.00346	3.15	0.16	0.00275
Bird speed	10	m/sec	0.225	0.994	0.50	3.53	0.18	0.00397	2.59	0.13	0.00292
RotorDiam	170	m	0.275	0.947	0.41	3.02	0.15	0.00415	2.13	0.11	0.00292
RotationPeriod	6.00	sec	0.325	0.899	0.35	2.65	0.13	0.00431	1.81	0.09	0.00294
			0.375	0.851	0.30	2.38	0.12	0.00447	1.58	0.08	0.00296
			0.425	0.804	0.26	2.17	0.11	0.00461	1.41	0.07	0.00300
			0.475	0.756	0.24	2.00	0.10	0.00474	1.28	0.06	0.00305
Bird aspect ratioo: β	0.50		0.525	0.708	0.21	1.85	0.09	0.00486	1.19	0.06	0.00311
			0.575	0.660	0.20	1.73	0.09	0.00497	1.11	0.06	0.00318
			0.625	0.613	0.18	1.62	0.08	0.00507	1.04	0.05	0.00326
			0.675	0.565	0.17	1.53	0.08	0.00515	1.00	0.05	0.00336
			0.725	0.517	0.15	1.44	0.07	0.00523	0.96	0.05	0.00346
			0.775	0.470	0.14	1.37	0.07	0.00529	0.92	0.05	0.00358
			0.825	0.422	0.14	1.30	0.06	0.00534	0.90	0.04	0.00371
			0.875	0.374	0.13	1.23	0.06	0.00539	0.88	0.04	0.00385
			0.925	0.327	0.12	1.17	0.06	0.00542	0.86	0.04	0.00400
			0.975	0.279	0.12	1.11	0.06	0.00544	0.85	0.04	0.00416

Overall p(collision) = Upwind 8.8% Downwind 6.2%

Average 7.5%

Table 7.2.11: Output from NatureScot / Band model collision probability spreadsheet for red kite

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.6	m	0.025	0.575	4.49	19.92	1.00	0.00125	19.38	0.97	0.00121
Wingspan	1.8	m	0.075	0.575	1.50	6.82	0.34	0.00256	6.28	0.31	0.00236
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.90	4.77	0.24	0.00298	4.11	0.21	0.00257
			0.175	0.860	0.64	4.03	0.20	0.00353	3.22	0.16	0.00282
Bird speed	10	m/sec	0.225	0.994	0.50	3.59	0.18	0.00404	2.65	0.13	0.00298
RotorDiam	170	m	0.275	0.947	0.41	2.91	0.15	0.00400	2.02	0.10	0.00278
RotationPeriod	6.00	sec	0.325	0.899	0.35	2.44	0.12	0.00396	1.59	0.08	0.00258
			0.375	0.851	0.30	2.14	0.11	0.00402	1.34	0.07	0.00251
			0.425	0.804	0.26	1.93	0.10	0.00410	1.17	0.06	0.00249
			0.475	0.756	0.24	1.76	0.09	0.00417	1.04	0.05	0.00248
Bird aspect ratioo: β	0.33		0.525	0.708	0.21	1.61	0.08	0.00423	0.95	0.05	0.00248
			0.575	0.660	0.20	1.49	0.07	0.00428	0.87	0.04	0.00249
			0.625	0.613	0.18	1.38	0.07	0.00432	0.80	0.04	0.00251
			0.675	0.565	0.17	1.29	0.06	0.00434	0.76	0.04	0.00255
			0.725	0.517	0.15	1.20	0.06	0.00436	0.72	0.04	0.00259
			0.775	0.470	0.14	1.13	0.06	0.00436	0.68	0.03	0.00265
			0.825	0.422	0.14	1.06	0.05	0.00435	0.66	0.03	0.00272
			0.875	0.374	0.13	0.99	0.05	0.00434	0.64	0.03	0.00280
			0.925	0.327	0.12	0.93	0.05	0.00431	0.62	0.03	0.00289
			0.975	0.279	0.12	0.87	0.04	0.00427	0.61	0.03	0.00299

Overall p(collision) = Upwind 7.8% Downwind 5.1%

Average 6.5%

Table 7.2.12: Output from NatureScot / Band model collision probability spreadsheet for hen harrier

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.52	m	0.025	0.575	5.39	20.62	0.86	0.00107	20.08	0.84	0.00105
Wingspan	1.2	m	0.075	0.575	1.80	7.05	0.29	0.00220	6.51	0.27	0.00204
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.08	5.01	0.21	0.00261	4.35	0.18	0.00227
			0.175	0.860	0.77	4.29	0.18	0.00313	3.49	0.15	0.00254
Bird speed	12	m/sec	0.225	0.994	0.60	3.85	0.16	0.00361	2.92	0.12	0.00274
RotorDiam	170	m	0.275	0.947	0.49	3.11	0.13	0.00356	2.22	0.09	0.00254
RotationPeriod	6.00	sec	0.325	0.899	0.41	2.61	0.11	0.00354	1.77	0.07	0.00239
			0.375	0.851	0.36	2.29	0.10	0.00358	1.49	0.06	0.00233
			0.425	0.804	0.32	2.04	0.08	0.00361	1.28	0.05	0.00227
			0.475	0.756	0.28	1.84	0.08	0.00363	1.12	0.05	0.00223
Bird aspect ratioo: β	0.43		0.525	0.708	0.26	1.67	0.07	0.00365	1.00	0.04	0.00219
			0.575	0.660	0.23	1.52	0.06	0.00365	0.90	0.04	0.00216
			0.625	0.613	0.22	1.40	0.06	0.00365	0.82	0.03	0.00214
			0.675	0.565	0.20	1.29	0.05	0.00363	0.76	0.03	0.00214
			0.725	0.517	0.19	1.19	0.05	0.00361	0.71	0.03	0.00214
			0.775	0.470	0.17	1.11	0.05	0.00357	0.66	0.03	0.00215
			0.825	0.422	0.16	1.03	0.04	0.00353	0.63	0.03	0.00217
			0.875	0.374	0.15	0.95	0.04	0.00348	0.60	0.03	0.00219
			0.925	0.327	0.15	0.89	0.04	0.00342	0.58	0.02	0.00223
			0.975	0.279	0.14	0.82	0.03	0.00335	0.56	0.02	0.00228

Overall p(collision) = Upwind 6.6% Downwind 4.4%

Average 5.5%

Table 7.2.13: Output from NatureScot / Band model collision probability spreadsheet for curlew

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.6	m	0.025	0.575	5.84	21.15	0.81	0.00102	20.60	0.79	0.00099
Wingspan	1	m	0.075	0.575	1.95	7.23	0.28	0.00209	6.69	0.26	0.00193
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.17	5.17	0.20	0.00248	4.51	0.17	0.00217
			0.175	0.860	0.83	4.45	0.17	0.00300	3.64	0.14	0.00245
Bird speed	13	m/sec	0.225	0.994	0.65	4.01	0.15	0.00347	3.07	0.12	0.00266
RotorDiam	170	m	0.275	0.947	0.53	3.30	0.13	0.00349	2.40	0.09	0.00254
RotationPeriod	6.00	sec	0.325	0.899	0.45	2.83	0.11	0.00354	1.99	0.08	0.00248
			0.375	0.851	0.39	2.48	0.10	0.00358	1.68	0.06	0.00243
			0.425	0.804	0.34	2.21	0.09	0.00362	1.46	0.06	0.00238
			0.475	0.756	0.31	2.00	0.08	0.00365	1.28	0.05	0.00235
Bird aspect ratioo: β	0.60		0.525	0.708	0.28	1.81	0.07	0.00366	1.15	0.04	0.00232
			0.575	0.660	0.25	1.66	0.06	0.00367	1.04	0.04	0.00230
			0.625	0.613	0.23	1.53	0.06	0.00368	0.95	0.04	0.00229
			0.675	0.565	0.22	1.41	0.05	0.00367	0.88	0.03	0.00229
			0.725	0.517	0.20	1.31	0.05	0.00365	0.82	0.03	0.00230
			0.775	0.470	0.19	1.22	0.05	0.00363	0.78	0.03	0.00231
			0.825	0.422	0.18	1.13	0.04	0.00359	0.74	0.03	0.00233
			0.875	0.374	0.17	1.06	0.04	0.00355	0.70	0.03	0.00237
			0.925	0.327	0.16	0.98	0.04	0.00350	0.68	0.03	0.00241
			0.975	0.279	0.15	0.92	0.04	0.00344	0.66	0.03	0.00246

Overall p(collision) = Upwind 6.6% Downwind 4.6%

Average 5.6%

Table 7.2.14: Output from NatureScot / Band model collision probability spreadsheet for common kestrel

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.37	m	0.025	0.575	4.49	15.43	0.77	0.00096	14.89	0.74	0.00093
Wingspan	0.8	m	0.075	0.575	1.50	5.32	0.27	0.00200	4.78	0.24	0.00179
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.90	3.87	0.19	0.00242	3.21	0.16	0.00201
			0.175	0.860	0.64	3.39	0.17	0.00297	2.58	0.13	0.00226
Bird speed	10	m/sec	0.225	0.994	0.50	3.09	0.15	0.00348	2.15	0.11	0.00242
RotorDiam	170	m	0.275	0.947	0.41	2.55	0.13	0.00350	1.66	0.08	0.00228
RotationPeriod	6.00	sec	0.325	0.899	0.35	2.18	0.11	0.00355	1.34	0.07	0.00217
			0.375	0.851	0.30	1.91	0.10	0.00358	1.11	0.06	0.00208
			0.425	0.804	0.26	1.70	0.08	0.00361	0.94	0.05	0.00200
			0.475	0.756	0.24	1.53	0.08	0.00362	0.81	0.04	0.00193
Bird aspect ratioo: β	0.46		0.525	0.708	0.21	1.38	0.07	0.00363	0.72	0.04	0.00188
			0.575	0.660	0.20	1.26	0.06	0.00362	0.64	0.03	0.00183
			0.625	0.613	0.18	1.15	0.06	0.00360	0.57	0.03	0.00180
			0.675	0.565	0.17	1.06	0.05	0.00357	0.53	0.03	0.00177
			0.725	0.517	0.15	0.97	0.05	0.00352	0.49	0.02	0.00176
			0.775	0.470	0.14	0.90	0.04	0.00347	0.45	0.02	0.00176
			0.825	0.422	0.14	0.83	0.04	0.00341	0.43	0.02	0.00177
			0.875	0.374	0.13	0.76	0.04	0.00333	0.41	0.02	0.00179
			0.925	0.327	0.12	0.70	0.04	0.00324	0.39	0.02	0.00182
			0.975	0.279	0.12	0.64	0.03	0.00314	0.38	0.02	0.00187

Overall p(collision) = Upwind 6.4% Downwind 3.8%

Average 5.1%

Table 7.2.15: Output from NatureScot / Band model collision probability spreadsheet for merlin

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.3	m	0.025	0.575	4.49	14.62	0.73	0.00091	14.08	0.70	0.00088
Wingspan	0.62	m	0.075	0.575	1.50	5.05	0.25	0.00190	4.51	0.23	0.00169
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.90	3.71	0.19	0.00232	3.05	0.15	0.00191
			0.175	0.860	0.64	3.27	0.16	0.00286	2.46	0.12	0.00216
Bird speed	10	m/sec	0.225	0.994	0.50	3.00	0.15	0.00337	2.06	0.10	0.00232
RotorDiam	170	m	0.275	0.947	0.41	2.48	0.12	0.00340	1.59	0.08	0.00218
RotationPeriod	6.00	sec	0.325	0.899	0.35	2.11	0.11	0.00343	1.27	0.06	0.00206
			0.375	0.851	0.30	1.84	0.09	0.00345	1.04	0.05	0.00195
			0.425	0.804	0.26	1.63	0.08	0.00346	0.87	0.04	0.00185
			0.475	0.756	0.24	1.46	0.07	0.00346	0.74	0.04	0.00177
Bird aspect ratioo: β	0.48		0.525	0.708	0.21	1.31	0.07	0.00344	0.65	0.03	0.00169
			0.575	0.660	0.20	1.19	0.06	0.00342	0.57	0.03	0.00163
			0.625	0.613	0.18	1.08	0.05	0.00338	0.50	0.03	0.00158
			0.675	0.565	0.17	0.99	0.05	0.00333	0.46	0.02	0.00154
			0.725	0.517	0.15	0.90	0.05	0.00327	0.42	0.02	0.00151
			0.775	0.470	0.14	0.83	0.04	0.00320	0.38	0.02	0.00149
			0.825	0.422	0.14	0.76	0.04	0.00312	0.36	0.02	0.00148
			0.875	0.374	0.13	0.69	0.03	0.00302	0.34	0.02	0.00148
			0.925	0.327	0.12	0.63	0.03	0.00292	0.32	0.02	0.00150
			0.975	0.279	0.12	0.57	0.03	0.00280	0.31	0.02	0.00152

Overall p(collision) = Upwind 6.0% Downwind 3.4%

Average 4.7%

Table 7.2.16: Output from NatureScot / Band model collision probability spreadsheet for peregrine

			Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1					Upwind:			Downwind:		
NoBlades	3										
MaxChord	4.5	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.51	m	0.025	0.575	5.84	21.91	0.84	0.00105	21.36	0.82	0.00103
Wingspan	1.13	m	0.075	0.575	1.95	7.48	0.29	0.00216	6.94	0.27	0.00200
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.17	5.32	0.20	0.00256	4.66	0.18	0.00224
			0.175	0.860	0.83	4.56	0.18	0.00307	3.75	0.14	0.00252
Bird speed	13	m/sec	0.225	0.994	0.65	4.09	0.16	0.00354	3.15	0.12	0.00273
RotorDiam	170	m	0.275	0.947	0.53	3.30	0.13	0.00349	2.40	0.09	0.00254
RotationPeriod	6.00	sec	0.325	0.899	0.45	2.74	0.11	0.00343	1.90	0.07	0.00237
			0.375	0.851	0.39	2.39	0.09	0.00345	1.59	0.06	0.00230
			0.425	0.804	0.34	2.12	0.08	0.00347	1.37	0.05	0.00224
			0.475	0.756	0.31	1.91	0.07	0.00348	1.19	0.05	0.00218
Bird aspect ratioo: β	0.45		0.525	0.708	0.28	1.72	0.07	0.00348	1.06	0.04	0.00214
			0.575	0.660	0.25	1.57	0.06	0.00348	0.95	0.04	0.00210
			0.625	0.613	0.23	1.44	0.06	0.00346	0.86	0.03	0.00207
			0.675	0.565	0.22	1.32	0.05	0.00343	0.79	0.03	0.00205
			0.725	0.517	0.20	1.22	0.05	0.00340	0.73	0.03	0.00204
			0.775	0.470	0.19	1.13	0.04	0.00336	0.69	0.03	0.00204
			0.825	0.422	0.18	1.04	0.04	0.00331	0.65	0.02	0.00205
			0.875	0.374	0.17	0.97	0.04	0.00325	0.61	0.02	0.00206
			0.925	0.327	0.16	0.89	0.03	0.00318	0.59	0.02	0.00209
			0.975	0.279	0.15	0.83	0.03	0.00311	0.57	0.02	0.00212

Overall p(collision) = Upwind 6.3% Downwind 4.3%

Average 5.3%

Document history

Author	Paul Bradshaw	17/11/2021
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Client Details	
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Appendix 7.3

Outline Bird Protection Plan

Contents

Glossary

Refer to Chapter 7: Ornithology in Volume 2 of the EIAR for the Glossary.

List of Abbreviations

Refer to Chapter 7: Ornithology in Volume 2 of the EIAR for the List of Abbreviations.

A7.3.1 INTRODUCTION

Purpose of this Document

A7.3.1.1 This is a Technical Appendix to Chapter 7: Ornithology of the Environmental Impact Assessment Report (EIAR) for the proposed Quantans Hill Wind Farm (the 'Proposed Development') and should be read in conjunction with that Chapter.

A7.3.1.2 This document sets out the proposed approach to avoid / minimise impacts on breeding birds during construction of the Proposed Development in the form of an outline Bird Protection Plan (BPP). These measures are referred to in Chapter 7 and the assessment assumes that they will be implemented and followed.

A7.3.1.3 The aims of the BPP are summarised as follows:

- To set out the approach and methods to ensure that construction works associated with the Proposed Development (including enabling works such as tree felling/clearance) follow best practice in relation to avoiding / minimising impacts on breeding and non-breeding birds;
- Demonstrate how works would be managed with respect to the legislation protecting all wild birds, their nests, eggs and young and, particularly, the species that are relevant to the study area that may be at risk from the works; and
- Outline any additional measures that would be applied in relation to monitoring and mitigation during the operational phase of the Proposed Development.

A7.3.1. There is the potential for the use of the area by breeding birds to change with time. Therefore, information from pre-construction surveys and any ongoing and future monitoring will be taken into account prior to the BPP being finalised and implemented.

Consultation and Approval

A7.3.1.4 The outline BPP would be developed into a more detailed document in advance of the commencement of construction works. It is intended that following completion of the pre-construction surveys, prior to construction commencing enabling works, an updated version of the BPP will be provided for review and comment by NatureScot and Dumfries & Galloway Council (DGC).

Relevant Legislation & Guidance

A7.3.1.5 All breeding birds are legally protected in Scotland, under the Wildlife & Countryside Act 1981 (as amended). There is a requirement to ensure that all works required to construct the Proposed Development, proceed lawfully with respect to this legislation.

A7.3.1.6 The proposed approach and measures outlined in this document are based on current best practice guidance, including consideration of the following publications:

- NatureScot (2019). Good Practice during Wind Farm Construction (4th Edition). A joint publication by Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency, Forestry Commission Scotland, Historic Environment Scotland, Marine Scotland Science, AEECoW;
- Ruddock, M. & Whitfield, D.P. (2007). A Review of Disturbance Distances in Selected Bird Species. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage;
- Whitfield, D.P., Ruddock, M., & Bullman, R. (2008). Expert opinion as a tool for quantifying bird tolerance to human disturbance. Biological Conservation, 141, 2708-2717.
- NatureScot (2016). Dealing with construction and birds. Guidance document produced by Scottish Natural Heritage (March 2016); and
- NatureScot (2016). Wind farm proposals on afforested sites - advice on reducing suitability for hen harrier, merlin and short-eared owl (January 2016).

Summary of Relevant Legal Framework

A7.3.1.7 The information provided here is primarily derived from the NatureScot website. The original legislation should be referred to for definitive guidance. Copies of the original, i.e. as enacted, and revised versions of UK and Scottish Government legislation are available online from http://www.legislation.gov.uk.

EU Birds Directive

A7.3.1.8 The Birds Directive is a legal act of the European Union which was produced in response to commitments made under the Bern and Bonn Conventions. Despite the UK's exit from the European Union the domestic legislation that has been derived from, or modified by, the provisions of the Birds Directive remain in effect. The Birds Directive mandates protection against deliberate disturbance of birds, particularly during the breeding period. This includes a high level of protection for species listed on Annex I of the Directive as well as certain general provisions for all naturally occurring birds in the wild.

A7.3.1.9 The main provisions of the Birds Directive relevant to the Proposed Development include:

- The maintenance of the populations of all wild bird species across their natural range (Article 2) with the encouragement of various activities to that end (Article 3);
- The identification and classification of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species; and
- The establishment of a general scheme of protection for all wild birds (Article 5).

A7.3.1.10 Full consideration of the potential implications of the Proposed Development on the maintenance of bird populations across their natural range and specifically in relation to SPAs has been given in the assessment (further detail is provided in Chapter 7: Ornithology). This document focuses on the implications of Article 5 and specifically how the legal protections afforded to all wild birds, and the enhanced protections to certain scarce species, will be followed during the construction of the Proposed Development.

Wildlife & Countryside Act 1981

A7.3.1.11 In the UK, the provisions of Article 5 of the Birds Directive are implemented through the Wildlife & Countryside Act 1981**Error! Bookmark not defined.** (as amended).

A7.3.1.12 With the exception of birds listed in Schedule 2, and for certain specified purposes under licence, the WCA makes it an offence to intentionally or recklessly:

- kill, injure or take a wild bird;
- take, damage, destroy or interfere with a nest of any wild bird whilst it is in use or being built (or at any time for a nest habitually used by any bird listed in Schedule A1);
- obstruct or prevent any wild bird from using its nest;
- take or destroy an egg of any wild bird;
- disturb any wild bird listed on Schedule 1 whilst it is building a nest or is in, on, or near a nest containing eggs or young, or whilst lekking;
- disturb the dependent young of any wild bird listed on Schedule 1.

A7.3.1.13 Those birds listed on Schedules A1 and 1A receive additional protection which makes it an offence to intentionally or recklessly:

- at any time take, damage, destroy or interfere with any nest habitually used by any wild bird included in Schedule A1; and
- at any time harass any wild bird included in Schedule 1A.

A7.3.1.14 In summary, to comply with the WCA, there should be no disturbance of breeding birds listed on Schedule 1, no interference with the nests of species listed on Schedule A1 at any time, nor disturbance/ harassment of birds listed in Schedule 1A at any time.

A7.3.1.15 There should also be no direct physical interference with any wild birds, or their nests, whilst they are in use or being built or while they have dependent young. It is not, however, an offence to physically interfere with old nests - except for birds listed in Schedule A1.

National and Local Status for Key Species

A7.3.1.16 Table A7.3.1 below provides a summary of the conservation and statutory designations applicable to certain key species of national conservation concern and/or special legal protection that have been recorded breeding/wintering within or near to the Proposed Development Area. Also provided is a summary of the local (i.e. in the context of the Proposed Development Area) status of the species considered in this document.

A7.3.1.17 This is not a complete list of all species that breed, or are likely to breed, within or near to the Proposed Development. Details of all species that have been recorded as breeding within the Proposed Development Area during the baseline surveys is provided in Technical Appendix 7.1. As noted above, all wild birds, their nests, eggs and young are protected under the WCA. This outline BPP includes consideration of all birds, including common and widespread species, which could be affected by the proposed works.

Table A7.3.1: Summary of National Status and Legal Protection of Key Bird Species of Conservation Concern relevant to the Proposed Development Area

Species	Key Statutory / Conservation Designations	Summary of Proposed Development Area Presence / Status
Whooper swan (*Cygnus Cygnus*)	Birds Directive Annex I [i] WCA Schedule 1 [ii] UK Amber List (BoCC4) [iii] Scottish Biodiversity List [iv]	Occasional over-flights of the Proposed Development Area during passage periods / winter months, no recorded use of the Proposed Development Area, occasional use of carse land along the Water of Deugh.
Black grouse (*Lyrurus tetrix*)	UK Red List (BoCC4) [iii] Scottish Biodiversity List [iv] UK BAP Priority Species [v]	Intermittent lek activity, with low numbers of males, within the Proposed Development Area. Lek sites at risk from disturbance, particularly during spring. Nest sites and young at risk during the breeding season, if present.
Red grouse (*Lagopus lagopus scotica*)	UK Amber List (BoCC4) [iii] UK BAP Priority Species [v]	Breeds within the Proposed Development Area at a relatively low density, in areas of suitable habitat.
Osprey (*Pandion haliaetus*)	Birds Directive Annex I [i] WCA Schedule 1 [ii] UK Amber List (BoCC4) [iii] Scottish Biodiversity List [iv]	Breeding in the surrounding region, not within or near the Proposed Development Area. Occasionally passing through the Proposed Development Area during passage periods and during the breeding season.
Hen harrier (*Circus cyaneus*)	Birds Directive Annex I [i] WCA Schedules 1, 1A [ii] UK Red List (BoCC4) [iii] Scottish Biodiversity List [iv]	Not breeding within the Proposed Development Area or the surrounding area, occasionally hunting within the Proposed Development Area during the winter. No evidence of any winter roosts within or near to the Proposed Development Area.
Red kite (*Milvus milvus*)	Birds Directive Annex I [i] WCA Schedules 1, 1A [ii] UK Green List (BoCC4) [iii]	Breeding in the surrounding area, and potentially within the Site[1] (not within the Proposed Development area), regularly hunting
	Scottish Biodiversity List [iv]	within the Proposed Development Area, year-round. No evidence of any winter roost sites near to the Proposed Development.
Oystercatcher (*Haematopus ostralegus*)	UK Amber List (BoCC4) [iii]	Does not breed within the Proposed Development area but may breed close to the site entrance area.
Golden plover (*Pluvialis apricaria*)	Birds Directive Annex I [i] UK Green List (BoCC4) [iii] Scottish Biodiversity List [iv]	Does not breed within the Site. Occasional flocks passing through the area on passage.
Dotterel (*Charadrius morinellus*)	Birds Directive Annex I [i] WCA Schedule 1 [ii] UK Red List (BoCC4) [iii] Scottish Biodiversity List [iv]	Does not breed within the Proposed Development Area, small flocks regularly occur on Cairnsmore of Carsphairn, outside of the Proposed Development area, during passage periods.
Curlew (*Numenius arquata*)	UK Red List (BoCC4) [iii] Scottish Biodiversity List [iv] UK BAP Priority Species [v]	Breeding within the Site mostly outside of the Proposed Development area.
Common snipe (*Gallinago gallinago*)	UK Amber List (BoCC4) [iii]	Breeding within the Site and within the Proposed Development area.
Barn owl (*Tyto alba*)	WCA Schedule 1 [ii] UK Green List (BoCC4) [iii] Scottish Biodiversity List [iv]	Breeding in the surrounding area, likely to be hunting over suitable habitats within the Proposed Development Area, year-round.
Short-eared owl (*Asio flammeus*)	Birds Directive Annex I [i] UK Amber List (BoCC4) [iii] Scottish Biodiversity List [iv]	Potentially breeding within the Proposed Development Area in areas of suitable habitat. Breeding activity sporadic, in response to small mammal prey population cycles.
Merlin (*Falco columbarius*)	Birds Directive Annex I [i] WCA Schedule 1 [ii] UK Red List (BoCC4) [iii] Scottish Biodiversity List [iv]	Not breeding within the Proposed Development Area, potentially breeding in the surrounding area, occasionally hunting within the Proposed Development Area.
Peregrine (*Falco peregrinus*)	Birds Directive Annex I [i] WCA Schedule 1 [ii] UK Green List (BoCC4) [iii] Scottish Biodiversity List [iv]	Breeding in the surrounding area, not within the Proposed Development Area, occasionally hunting within the Proposed Development Area.
Common kestrel (*Falco tinnunculus*)	UK Amber List (BoCC4) [iii] Scottish Biodiversity List [iv]	Breeding within the Site and within the Proposed Development area.

I. EU Directive 2009/147/EC on the conservation of wild birds (codified version of Council Directive 79/409/EEC, as amended).

II. Species listed on Schedules 1, 1A and A1 to The Wildlife & Countryside Act 1981 (as amended).

III. Eaton, M. A., Aebischer, N. J., Brown, A. F., Hearn, R. D., Lock, L., Musgrove, A. J., Noble, D. G., Stroud, D., & Gregory, R. D. (2015). Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108: 708-746.

IV. The Scottish Biodiversity List (SBL) is a list of flora, fauna and habitats considered by the Scottish Ministers to be of principal importance for biodiversity conservation. The publication of the Scottish Biodiversity List satisfies the requirements of Section 2(4) of The Nature Conservation (Scotland) Act 2004.

[1] i.e. the redline boundary as shown on Figure 7.1.

V. The UK List of Priority Species and Habitats was published in 2007 after adoption by the Governments of all four UK administrations as part of the UK contribution to the Convention on Biological Diversity (1992). The 'UK Post-2010 Biodiversity Framework' succeeded the UK BAP in 2012 and set out the strategy for England, Wales, Scotland and Northern Ireland, and the UK as a whole, to meet internationally agreed biodiversity targets. However, the 2007 UK BAP priority species and habitats remain relevant in the nature conservation / biodiversity policies.

Nesting Periods and Indicative Protection Zones

A7.3.1.18 Table 7.3.2 provides a summary of the distances and periods over which the relevant bird species are considered to be particularly vulnerable to impacts from construction works. This information is provided for general guidance only. Specific protection zones and other mitigation requirements for all species breeding within or near to works areas will need to be determined by a suitably experienced ornithologist on a case-by-case basis.

A7.3.1.19 NB all wild birds, not only the species listed here or on Schedule 1 to the WCA, are legally protected during the nesting period.

Table 7.3.2: Summary of Indicative Disturbance Protection Zones and Main Nesting Periods for Selected Species[2] (NB all breeding seasons are inclusive of the stated months)

Species	Indicative Protection Zone & Breeding Season (peak breeding stage periods for raptors/owls)	Notes
Black grouse	500-750 m (lek site), April to September. Incubation: 25-27 days Fledging: 10-14 days Chicks are precocial, downy	Black grouse are particularly sensitive to disturbance at their lek sites and at a relatively large distance. Ruddock & Whitfield (2007) reported that black grouse are likely to show a static response to disturbance, by a person on foot, between 500 to 750 m from a lek site. Lekking activity mainly around dawn and dusk, therefore the presence of a lek would not necessarily represent a constraint in terms of disturbance during the day, between the times of two hours after sunrise and two hours before sunset. The peak lekking period is April to May.
Red kite	150-300 m, March to July Nest building: Mid-March to late April Egg laying: April Incubation: April to May Hatching: May Young in nest: May to June Fledging: June to July	Red kites that nest close to human habitation may be relatively tolerant to pedestrians near to nest sites but the degree of sensitivity can range widely depending on the circumstances of the nest site and the individual responsiveness of individual birds. Ruddock & Whitfield (2007) reported an upper limit alert distance of 150 - 300 m, based on a survey of expert opinion.
Curlew	250 m, March to mid-August. Incubation: 27-29 days Fledging: 32-38 days Chicks are precocial, downy	Evidence from monitoring of wind farm construction sites in Scotland indicates that curlew are sensitive to disturbance during construction. Territories re-established during March-April. Nest sites predominantly in habitats with taller vegetation (e.g. moorland, heath, grassland). Egg-laying mid-April to June, young in nest from mid-May to July with chicks leaving nest soon after hatching.
Common snipe	250 m, April to July. Incubation: 18-20 days Fledging: 19-20 days Chicks are precocial, downy	Territories re-established during March-April. Nest sites predominantly in habitats with taller vegetation (e.g. moorland, heath, grassland). Egg-laying late-March to June, young in nest from late-April to mid-August with chicks leaving nest soon after hatching.
Short-eared owl	300-500 m, March to mid-August Egg laying: Late April (varies with vole population and weather) Incubation: Late April to late May Hatching: Mid-May Young in/near nest: Late May to late June Fledging: Late May to June; occasionally August / September for second clutches	Limited information is available for disturbance distances for this species. Whitefield *et al.* 2008 reported an upper limit to static responses to disturbance (person on foot) at 300-500 m.
Merlin	500 m, April to mid-August. Incubation: Early May to mid-Jun. (28-32 days) Young in nest: Late May to early Aug. (28-31 days)	Behavioural responses to sources of disturbance are likely to vary according to stage in the breeding season and the prior exposure of individuals which may increase tolerance. Ruddock & Whitfield (2007) reported an upper limit to static responses to disturbance (person on foot) at 300-500 m.
Kestrel	250 m, March to mid-August. Incubation: 28-29 days Fledging: 32-37 days Chicks are altricial, downy	Territories re-established during March-April. Nest site on wide range of features including crags, old nest of other species particularly crows, large ruined buildings. Egg-laying late April to mid-May, incubation late April to early June, young in nest late May to early July, fledging early June to early August.
Peregrine	500-750 m, March to mid-August. Egg laying: March to April Incubation: Apr. to May (28-35 days) Young in nest: May to Jun. (c. 40 days)	Ruddock & Whitfield (2007), based on data from an expert questionnaire on the upper limit of static or passive disturbance, recommended a disturbance management zone of 500 – 750 m from the nest.

[2] Primary sources are:

- Snow, D., & Perrins, C.M. (Eds) (1998). The Birds of the Western Palearctic, Concise Edition. Oxford University Press, Oxford.
- Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). Raptors: a field guide to survey and monitoring (3rd Edition). The Stationery Office, Edinburgh.
- Ruddock, M. & Whitfield, D.P. (2007). A Review of Disturbance Distances in Selected Bird Species. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.
- Whitfield, D.P., Ruddock, M., Bullman R. (2008). Expert opinion as a tool for quantifying bird tolerance to human disturbance. Biological Conservation, 141 (2008) 2708–2717.
- Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). Raptors: a field guide to survey and monitoring (3rd Edition). The Stationery Office, Edinburgh.

A7.3.2 OUTLINE BIRD PROTECTION PLAN

Introduction

A7.3.2.1 The purpose of the outline BPP is to set out, in sufficient detail for the purposes of EIA, how the potential effects on breeding birds arising from the construction and operation of the Proposed Development will be avoided or minimised so that the works can proceed lawfully and following current best practice.

A7.3.2.2 The measures proposed in the outline BPP will be subject to further review and consultation with NatureScot before any works occur. This is to ensure that any relevant information that emerges, subsequent to the EIAR being submitted, is taken into consideration and that the proposed measures follow current best-practice.

A7.3.2.3 There is the potential for the use of the area by breeding birds to change with time. Therefore, information from pre-construction surveys and any ongoing and future monitoring within the Proposed Development Area will be taken into account prior to the BPP being finalised and implemented.

A7.3.2.4 The decommissioning of the Proposed Development is anticipated to occur c. 35 years after the wind farm becomes operational. There is the potential for what is currently considered to be best practice to change over this period. It is also possible that the range of bird species that need to be considered will be different. It is therefore proposed that the methods of the pre-decommissioning surveys for breeding birds and the proposed BPP (or equivalent as required at that time) would be reviewed, in consultation with the relevant authorities, not more than 12 months before decommissioning works are due to commence.

Ecological Clerk of Works

A7.3.2.5 The Applicant will appoint suitably experienced and qualified Ecological Clerk of Works (ECoW) for the duration of the pre-works, construction and site restoration phases. The appointment of the individual(s) covering the ECoW role will be agreed in advance in agreement with DGC (in consultation with NatureScot). The ECoW will have authority on site to immediately halt any works that were adversely affecting nesting birds or that would contravene any other ecological / environmental protections or commitments.

A7.3.2.6 The ECoW will have responsibility for checking that the BPP measures, as outlined in this document, are properly implemented and adhered to. Also, that the potential presence of nesting birds is regularly monitored during the works and that appropriate action is taken should any nests be at risk of disturbance (e.g. active nest sites not previously identified during the pre-works surveys).

A7.3.2.7 The ECoW will provide monthly reports on the progress of the works in relation to the implementation of the environmental protection measures (including measures under the BPP) and a final report at the end of the construction and site restoration works. Copies of these reports will be provided to NatureScot and DGC.

Pre-Construction Surveys

A7.3.2.8 A detailed survey method statement will be developed in agreement with DGC (in consultation with NatureScot) well in advance of works commencing for the Proposed Development (i.e. at least 12 months in advance). All survey methods will follow current best practice and surveys will be completed by suitably experienced ecologists/ornithologists.

A7.3.2.9 The surveys will be completed at the appropriate time of year and not more than 12 months prior to the commencement of construction.

A7.3.2.10 The pre-construction surveys will include all suitable breeding habitats within appropriate buffer zones related to the focal species (or group of species) and their potential zone of disturbance from the works including a margin for error. For example, surveys for lekking black grouse would be completed in all areas of suitable habitat within at least 1 km of the proposed works.

A7.3.2.11 Pre-construction surveys will be completed within all potentially suitable breeding habitats for the following species / groups and areas (NB a desk study will be completed to confirm the appropriate suite of species prior to the surveys being undertaken):

- Black grouse - within 1 km of the Proposed Development;
- Red kite - up to 2 km of the Proposed Development;
- Curlew - within 1 km of the Proposed Development;
- Common snipe - within 1 km of the Proposed Development;
- Barn owl - within 1 km of the Proposed Development;
- Short-eared owl - up to 2 km of the Proposed Development;
- Merlin - up to 2 km of the Proposed Development;
- Kestrel - within 1 km of the Proposed Development; and
- Peregrine - up to 2 km of the Proposed Development.

A7.3.2.12 The results of the pre-construction surveys will be used to inform the detailed BPP for the construction phase of the Proposed Development. The results would also form the baseline data against which the results of the monitoring surveys during the operational phase can be compared against, discussed below.

A7.3.2.13 The results of the pre-construction bird surveys will be submitted to NatureScot and DGC along with the detailed BPP.

Works Extents & Timing

A7.3.2.14 The extent of ground works required for the construction of the wind farm will be kept to the minimum necessary.

A7.3.2.15 Initial groundworks (e.g. initial turf strip ahead of construction) will be programmed, where possible, outside of the most sensitive periods of bird breeding season (see Table 7.3.2).

A7.3.2.16 Ideally, initial groundworks would start before the onset of the main nesting period for moorland waders and songbirds (e.g. before April) and avoid starting within that period. Where such works have to occur within the main breeding season they will only be carried out following a suitably thorough survey and assessment of the area by the ECoW.

ECoW Role during Construction Phase

A7.3.2.17 The ECoW(s) will attend site as required throughout the construction period to oversee the effective implementation of all environmental mitigation, including measures relevant to birds, and to help ensure works proceed in compliance with the BPP and the legislation protecting nesting birds.

A7.3.2.18 Prior to any personnel working within construction area they will be fully briefed by the ECoW on the potential for nesting birds to be present in the area, their status and legal protection, relevant details of the BPP and what actions they need to take should any nesting birds be encountered or suspected as present during their work.

Breeding Bird Survey / Nest Check Methods during Construction

A7.3.2.19 The ECoW, with support from ornithological surveyors, will undertake / co-ordinate a rolling programme of surveys and checks for nesting birds ahead of and during construction works throughout the breeding season. This is to provide up-to-date information in all areas where works are being undertaken that could impact on all nesting bird species (i.e. including common ground-nesting songbirds).

A7.3.2.20 Methods to determine whether breeding is occurring and, if so, the nest site location (or likely location) vary between the focal species. The BPP will detail the methods for each species, the following is a summary of the proposed approach.

A7.3.2.21 Experienced ornithological surveyors will walk, and scan from suitable vantage points, the works area and buffer zone. The presence of breeding behaviour will be determined based on audio and/or visual evidence, which will vary in relation to the focal species.

A7.3.2.22 An appropriate level of survey / search effort by experienced ornithological surveyors will be undertaken in order to confirm the presence of active nest sites. It is acknowledged that locating nest sites of many bird species (including common moorland species) can be a time-consuming task. However, where breeding is suspected though a nest has not been confirmed a conservative approach will be taken and the area classified as an active breeding site, until such time as breeding status can be confirmed and appropriate mitigation may be implemented as required.

A7.3.2.23 In open moorland all areas of works, and extending to c. 50 m beyond, will be systematically walked and scanned to detect signs of all ground-nesting songbirds. Where waders are seen or suspected to breed (based on the result of the pre-construction surveys) the area of search will be extended to include c. 250 m beyond the area of works.

A7.3.2.24 Surveys of the works areas and wider surrounding habitats (i.e. out to c. 1 km from the works areas) for breeding Schedule 1 species at risk of disturbance at distance (e.g. red kite, merlin, short-eared owl) would also be completed throughout the construction programme during the relevant breeding season for the focal species. Protection zones for some species may need to vary in response to different stages of the breeding season.

A7.3.2.25 Additionally, the ECoW would be in direct communication with the DGRSG surveyor responsible for monitoring breeding peregrine and red kite in the wider area so that timely updates on breeding activity can be passed on. This is particularly important in relation to pairs using / suspected to be using nest sites that are at risk of noise or visual disturbance from the works.

Breeding Bird Protection Zones

A7.3.2.26 Appropriate protection zones will be established for any breeding sites / nest sites confirmed during the pre-construction checks and during the works. Physical marking of the edge of protection zones, in the vicinity of works, will be appropriate in some cases (e.g. use of warning signs) but this will be kept to the minimum necessary.

A7.3.2.27 Nest protection zones will vary depending on the species (see Table 7.3.2) and the specific circumstances. The exact extents will be determined by the ECoW on a case-by-case basis, with input from an ornithologist where needed. This will depend on a number of factors including local topography (e.g. the extent to which the nest site is visually screened from the works), species and the type and level of potential disturbance from the works.

A7.3.2.28 Where breeding is proven, or is suspected though no nest site location is confirmed, the area will be protected so that no construction works takes place until monitoring confirms the absence of an active nest site, e.g. birds have fledged the nest or no activity indicative of on-going nesting is observed after a number of monitoring visits (e.g. allowing for the potential for some species to raise more than one brood within a breeding season).

A7.3.2.29 Only the ECoW will confirm when breeding has been completed and when the protection zone can be removed and works can commence.

A7.3.2.30 During the bird breeding season there will be a watching brief in place for construction works to help ensure that the relevant BPP measures are correctly and consistently applied and also to react to any new evidence of breeding birds that may be affected by construction works. This will be the responsibility of the appointed ECoW.

Monitoring during Wind Farm Operation

A7.3.2.31 An operational breeding bird monitoring plan (as part of the detailed BPP) would be developed, in consultation with NatureScot, prior to the start of construction works.

A7.3.2.32 It is proposed that breeding bird surveys would be undertaken over the same areas and for the same suite of species listed for the pre-construction surveys.

A7.3.2.33 Surveys would be completed for at least the first 10 years of the development (i.e. annually for the first 3 years, then 5th and 10th years) and then the need for further monitoring would be reviewed.

A7.3.2.34 Annual surveys for red kite would continue for a period following the Proposed Development becoming operational. The methods and duration of the operational monitoring would be discussed and agreed in consultation with NatureScot in advance of the Proposed Development becoming operational. The operational monitoring surveys would include continuing to gather data on ranging, breeding success and productivity. The surveys would be co-ordinated with the DGRSG to avoid any unnecessary duplication and disturbance.

A7.3.2.35 The Applicant would also consider funding (part-funding) studies to improve understanding of breeding red kite ranging behaviour in the vicinity of the proposed wind farm (e.g. focal flight activity surveys and use of satellite GPS tags). Such studies could inform other red kite protection measures that may be implemented (see below).

Bird Carcass Monitoring during Wind Farm Operation

A7.3.2.36 Systematic bird carcass searches would be completed after the wind farm becomes operational. The methods and duration of this monitoring would be discussed and agreed in consultation with NatureScot prior to the wind farm becoming operational. The carcass searches would be within a 100 m radius area of each turbine and would be focused on periods of elevated activity and collision risk. The monitoring would be preceded by trials to determine values for site-specific biases that affect estimates of bird mortality, such as scavenger removal rates and search accuracy.

A7.3.2.37 For incidents where dead birds are found near to wind turbines (either during formal carcass searches or as incidental records by personnel involved in turbine maintenance or wind farm operational management) the following protocol would be followed:

- Location of the carcass would be recorded (minimum 6 figure OS Grid reference).
- Carcass position relative to the nearest wind turbine (e.g. distance and direction).
- Species, sex, age (if known), presence of any rings, tags.
- Preceding weather conditions.
- The carcass is then placed in an appropriate container and taken as quickly as possible to a suitably experienced veterinary surgeon to complete a necropsy.
- The species, sex, age is confirmed by the veterinary surgeon and the likely cause of death is determined, where possible.
- The findings and other details of the incident are reported to NatureScot.

Breeding Red Kite Protection & Conservation

A7.3.2.38 The potential effects of the Proposed Development on red kite, in particular would be monitored as part of the pre- and post-construction breeding bird surveys (as outlined above).

A7.3.2.39 It is also proposed that further measures would be implemented to reduce the risk to red kite from turbine collision. This would include the employment of a suitably experienced and independent ornithologist to manage and assist with the annual monitoring of red kite activity and carcass searches and to ensure that information collated is interpreted effectively and put to best use. This person would have the authority to implement additional red kite protection measures subject to monitoring findings. They would also assist in the monitoring for any sheep or cattle carcases within the wind arm area that might attract red kite and increase the risk of collisions occurring. All such carcases will be removed from the wind farm area and taken to an appropriate disposal site.

A7.3.2.40 Should the red kite monitoring show evidence of collision mortality occurring at a rate greater than that predicted in this assessment then further measures would be implemented to attempt further reduce collision risk. This may include the use of carefully targeted diversionary / supplementary feeding to reduce activity near to turbines that are a hazard to red kite. There would also be consideration of targeted vegetation management, near to wind turbines (within c. 100 m), that are presenting a relatively high risk of collision to reduce small mammal prey availability.

Habitat Management Plan (HMP)

A7.3.2.41 A HMP is proposed to address the effects of the construction and operation of the Proposed Development on sensitive habitats and to improve habitat quality for black grouse in suitable areas within Proposed Development Area and away from the influence of the wind turbines. See Chapter 6: Ecology & Biodiversity and Technical Appendix 6.6 for further details.

Decommissioning Works

A7.3.2.42 The wind farm would be decommissioned at the end of its operational life (up to 35-years). During this process there is the potential for disturbance to nesting / breeding birds, including species listed on Schedule 1 of the WCA. Pre-works survey and the relevant BPP measures proposed for the construction phase (see above) will apply to the works. However, these measures will be reviewed, in advance of the decommissioning, in order to take into account the results of monitoring during the operation of the wind farm, the results of the pre-decommissioning surveys and advances in best practice approaches to mitigate impacts on breeding birds that may have emerged since the wind farm was constructed.

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