BALLYGILBERT WIND FARM
Environmental Statement

Volumes 2 - Main Report

MANAGEMENT SYSTEM CERTIFICATION
ISO 9001 = ISO 14001 = OHSAS 18001
DNV

res
powering change

TABLE OF CONTENTS

1

Introduction & Proposed Development

1 Introduction & Proposed Site

Background

1.1 This Environmental Statement (ES) has been prepared by RES Limited (RES) to accompany a planning application that has been made to the Department for Infrastructure (DFI) for permission to construct, operate and decommission a wind farm known as Ballygilbert Wind Farm, hereinafter referred to as 'the Development'. The purpose of the ES is to inform DFI in the assessment of the likely significant environmental effects resulting from the Development and to establish the need for mitigation measures to reduce such effects.

1.2 The application site is located approximately 3km North west of the village of Cairncastle, Larne, Co. Antrim as shown in **Figure 1.1: Site Location** and **Figure 1.2: Planning Application Boundary.**

1.3 This chapter is supported by:

- Technical Appendix 1.1: Letter of Intention to Submit an Environmental Statement;
- Technical Appendix 1.2: Department for Infrastructure (DFI) response to Intention to Submit an Environmental Statement.

The Applicant

1.4 The application for planning permission is made by RES ('the Applicant').

1.5 RES is one of the world's leading independent renewable energy project developers with operations across Europe, the Americas and Asia-Pacific. At the forefront of renewable energy development for over 30 years, RES has developed and/or built almost 18,000 MW of renewable energy capacity worldwide. In the UK alone, RES currently has more than 1,000 MW of projects either constructed, under construction or consented. RES is active in a range of renewable energy technologies including onshore and offshore wind, solar, as well as enabling technologies such as energy storage.

1.6 RES has developed 16 onshore wind farms in Northern Ireland totalling 229 MW, which equates to 36% of Northern Ireland's onshore wind capacity. RES currently operates over 83 MW of wind capacity across Northern Ireland, has secured planning permission for a further 112 MW awaiting construction and has 92 MW in the planning system.

EIA Process

Scope of Environmental Statement

1.7 The Environmental Impact Assessment (EIA) has assessed the environmental impacts associated with the construction, operation and decommissioning the Development, comprising of 14 (three-bladed) horizontal axis wind turbines, each up to a maximum of 149.9 m to tip height, with a total installed capacity of up to 58.8 MW. The Development would include an upgraded site entrance, access tracks, crane hardstandings, control building and substation compound, electricity transformers, underground cabling, energy storage containers and drainage works. During construction and commissioning there will be a number of temporary works including enabling works compound and construction compound with car parking, temporary parts of crane hardstanding, welfare facilities and off-site road widenings into 3rd party lands on the Brustin Brae Road, Ballycoose Road and Feystown Road.

1.8 RES has undertaken informal scoping with Department of Infrastructure regarding the Development and a letter of Intention to Submit an ES was lodged, which is included in **Appendix 1.1**. An Intention to Submit response from Department of Infrastructure is included in **Appendix 1.2**. Consultation responses from consultees have been considered in the individual chapters of this ES.

1.9 An EIA has been undertaken in accordance with the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017, (the “EIA Regulations”), to identify and assess the likely environmental effects of the Development and establish an appropriate range of mitigation measures in order to reduce adverse impacts where possible. This ES contains the findings of the EIA.

1.10 The Development will represent a ‘Schedule 2’ development, as defined under the “EIA Regulations”. Development that is listed in Schedule 2 requires an EIA if it is likely to have an impact on the environment by virtue of factors such as its size, nature or location. Therefore, any potential effects of the construction, operation and decommissioning of the Development deemed to have significant environmental effects are subject to an EIA.

1.11 The scale of the Development means that there is the potential for significant environmental effects to arise. Consequently it was deemed appropriate to undertake an EIA.

1.12 EIA is a process by which information about the environmental impacts of a project is collected, evaluated and taken into account in its design and the decision as to whether it should be granted planning permission. The applicant presents the information on the project and its likely environmental impacts in an ES. This enables decision-makers to consider these impacts when determining the related planning application. The EIA process has a number of key characteristics:

- It is systematic, comprising a sequence of tasks defined both by regulation and by practice;
- It is analytical, requiring the application of specialist skills from the environmental sciences;
- It is impartial, its objective being to inform the decision-maker rather than to promote the project;
- It is consultative, with provision being made for obtaining information and feedback from statutory agencies and key stakeholders; and

- It is iterative, allowing opportunities for environmental concerns to be addressed during the planning and design of a project.

1.13 This final point is particularly important with respect to the design of the Development where a number of design iterations have taken place in response to environmental factors identified during the EIA process (**Chapter 3: Design Evolution and Alternatives**).

1.14 The EIA for the Development has been carried out in accordance with the latest regulations, guidance and advice on good practice, comprising:

- Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017;
- Environmental Impact Assessment: A guide to procedures (Department for Communities and Local Government, amended reprint 2001); and
- Guidelines for Environmental Impact Assessment (Institute of Environmental Management and Assessment, 2004).

1.15 Individual technical assessments have been undertaken in accordance with a variety of legislation, guidance and best practice. Relevant details are contained within the Legislation and Policy Framework section where applicable to each technical chapter.

The Assessment Method

1.16 Appropriate methodologies have been used to assess the effects relating to each of the environmental topics that have been investigated as part of the EIA. These methodologies are based on recognised good practice and guidelines specific to each subject area, details of which are provided within each individual technical section.

1.17 The design team employed an iterative approach to the design of the Development where the design evolved throughout the EIA process as different constraints and potentially adverse impacts were identified and evaluated. This method is considered best practice as mitigation measures can concurrently be integrated into the design throughout the EIA process. This approach allowed the design team to alleviate or remove potentially adverse impacts and incorporate measures into the design to enhance positive impacts. The final evaluation of significance assesses the residual impacts assuming all mitigation measures are applied.

1.18 Each technical chapter assesses the impacts that could arise as a result of the Development. Impacts are assessed as being either adverse, beneficial, permanent, temporary or reversible. Significance is determined by assessing the magnitude and sensitivity of each likely impact.

1.19 The ES complies with current planning policy and will be submitted in conjunction with a planning application. This report is a formal ES as required by Department for Infrastructure under the Planning (EIA) Regulations (Northern Ireland) 2017. The ES is designed to provide information for the purpose of assessing the likely impact upon the environment.

Structure of the Environmental Statement

1.20 Schedule 4 of the "EIA Regulations" states that the following must be included within the ES:

- A description of the development (description of the physical characteristics (site, design and size of the development), land-use requirements, production processes) and an estimate of expected residues and emissions resulting from the operation of the proposed development.
- An outline of the alternatives studied by the applicant and explanation of why the particular option was chosen.
- A description of the aspects of the environment likely to be significantly affected by the development (including population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage and landscape) and the inter-relationship between the above aspects.
- A description of the likely significant effects of the development on the environment (to include direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, beneficial and adverse effects of the development).
- A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.
- The data required to identify and assess the main effects that the development is likely to have on the environment.
- An indication of any difficulties (technical deficiencies or lack of know-how) encountered.
- A non-technical summary of the information contained within the ES.

1.21 This ES has been prepared in accordance with the "EIA Regulations" described above. The ES comprises the following volumes:

- **Volume 1**: Non-technical Summary (NTS) of the ES
- **Volume 2**: Main Text
- **Volume 3**: Figures (the illustrations that accompany the ES)
- **Volume 4**: Technical Appendices (technical information relating to the environmental topics such as detailed methodologies, baseline data information and data analysis).

1.22 Volume 2 is organised as follows:

- **Chapter 1**: Introduction & Proposed Development
- **Chapter 2**: Planning Policy
- **Chapter 3**: Design Evolution and Alternatives
- **Chapter 4:** Landscape and Visual
- **Chapter 5:** Archaeology and Cultural Heritage
- **Chapter 6**: Ecology

- **Chapter 7:** Ornithology
- **Chapter 8:** Fisheries
- **Chapter 9:** Geology and Water Environment
- **Chapter 10**: Acoustic
- **Chapter 11:** Traffic and Transport
- **Chapter 12:** Shadow Flicker
- **Chapter 13:** Socioeconomics
- **Chapter 14:** Summary of Effects.

1.23 Biodiversity is covered under Chapters 6, 7, 8 & 9; Human Health is covered under Chapters 10 & 12 and Climate Change is covered within Chapter 13. A summary of effects is described in Chapter 14.

1.24 Chapters 1, 3, 10, 11, 12 & 14 have been authored by RES using their in-house professionally qualified expertise in respect of these topics. The Environmental Statement has been compiled by RES, primarily by Jennifer McCorry (Senior Development Project Manager) who is a Chartered Planner (MIPI) with over 10 years' experience of assessing, planning and developing renewable energy projects.

1.25 In general, for each environmental topic, the following format has been adopted with regard to the presentation of information:

- Introduction
- Scope of Assessment
- Legislation and Policy Framework
- Consultation
- Assessment Methodology
- Baseline Assessment
- Assessment of residual impacts
- Design Evolution and Mitigation Measures
- Residual Impacts
- Cumulative Impacts
- Summary and Conclusions
- References.

1.26 A number of individual disciplines have adopted variations from this format as a result of specific assessment methodologies and appropriate reporting structure.

Planning Application

1.27 In July 2019, Department of Infrastructure confirmed that the planning application should be submitted to the Department of Infrastructure, in accordance with Section 26 of the Planning Act (Northern Ireland) 2011, regarding the Department's jurisdiction in relation to developments of regional significance.

Proposed Development

1.28 The Development comprises 14 (three-bladed) horizontal axis wind turbines, each up to a maximum of 149.9 m to tip height, with a total installed capacity of up to 58.8 MW. The Development would include an upgraded site entrance, access tracks, crane hardstandings, control building and substation compound, electricity transformers, underground cabling, energy storage containers and drainage works. During construction and commissioning there will be a number of temporary works including enabling works compound and construction compound with car parking, temporary parts of crane hardstanding, welfare facilities and off-site road widenings into 3rd party lands on the Brustin Brae Road, Ballycoose Road and Feystown Road.

1.29 The Planning Application Boundary (red line boundary) is shown on **Figure 1.2**. This boundary contains the main wind farm site, including positions of the turbines and associated infrastructure, with 50 m micrositing. The Planning Application Boundary lies fully within Land under the Applicant's Control (blue line boundary), as shown in **Figure 1.2.** The measures contained in the Outline Habitat Management Plan (Appendix 6.6) are contained within the blue line boundary.

- A detailed plan of the Development showing the position of the turbines and other infrastructure is shown on **Figure 1.3**: **Infrastructure Layout**.
- This chapter provides a description of the physical characteristics of the Development for the purpose of identifying and assessing the main environmental impacts of the proposal.
- In this chapter in order to differentiate between land take and infrastructure that will be present for the wind farm life time, and land take and infrastructure which is only required for short term works during the construction period, the term 'permanent' is used to describe the former and 'temporary' used to describe the latter. However it should be noted that the Development would have a temporary operational lifetime of approximately 30 years from the date of commissioning, after which the above ground infrastructure would be removed and the land remediated. Therefore the effects are largely long-term temporary as opposed to permanent.

- Planning permission is being sought for the Development comprising the following:
    - 14 three-bladed horizontal axis wind turbines of up to 149.9 m tip-height
    - Turbine foundations
    - Hardstanding areas at each turbine location for use by cranes erecting and maintaining the turbines
    - Electricity transformers
    - Approximately 6.95 km of new access track and 0.88 km of upgraded access track
    - Wind farm substation compound containing a control building
    - Energy Storage Containers
    - On-site electrical and control network of underground (buried) cables
    - Connection from the substation to the local grid network
    - Temporary construction compound
    - Permanent and temporary drainage works
    - Associated ancillary works
    - New site entrance from the public road.

Site Layout and Flexibility

1.30 Although the design process and evolution seeks to combine environmental and economic requirements, the Applicant would nevertheless wish some flexibility, where necessary, in micrositing the exact positions of the turbines and routes of on-site access tracks and associated infrastructure (50 m deviation in plan from the indicative design). Any repositioning would not encroach into environmentally constrained areas. Therefore, 50 m flexibility in turbine positioning would help mitigate any potential environmental effects: e.g. avoidance of unfavourable ground conditions or archaeological features not apparent from current records. See **Figure 1.3: Infrastructure Layout** for details.

Land Take

1.31 The turbines need to be spaced a suitable distance apart (taking into account the prevailing wind direction), so as not to interfere aerodynamically with one another (creating array losses). The actual land developed is limited to the substation, wind turbine towers, transformers, permanent crane hardstandings, energy storage hardstanding and the access tracks, which account collectively for about 10.1 % of the total area within the Planning Application Boundary.

1.32 The area of infrastructure created following construction of each turbine (including temporary areas) will be approximately 88,932 m^2. Of this, approximately 9240 m^2 would be temporary hardstanding (see **Table 2.1** under crane pads and laydown areas). The turbine foundation formation level is approximately 20 m diameter in area and 3.50 m below ground level. The walls of the excavation will be battered to approximately 1:2, yielding a ground level excavation area of approximately 34m diameter.

1.33 The excavation area around each turbine is significant in terms of both its scale and duration of the works and as such requires consideration. Ancillary excavation works and material storage around other parts of development, such as those for cable trenching, would have a negligible impact on environmental receptors due to the very minor scale of the excavation, or duration of the works and are not considered further in the ES.

1.34 Following completion of the turbine installation, the permanent hardstanding would be approximately 180 m^2 at each turbine site, which includes the concrete plinth to which the steel tower is attached, and a 5 m wide maintenance track/path around the base of the turbine (**Figure 1.14**). The external transformer (if required) would take an additional 28 m^2 of land at each turbine. The completed foundation is covered with soil approximately 1.5 m deep, leaving only the concrete plinth exposed at ground level, to which the steel tower is attached. Movement of livestock around the tower would be unrestricted.

1.35 Additionally, crane hardstanding areas would be constructed adjacent to each wind turbine. **Figure 1.15** shows the general hardstanding arrangement at each turbine. The permanent hardstanding of each turbine for the life of the Development is 1200 m^2, with a temporary hardstanding of 660 m^2 during construction, if required by the final choice of turbine supplier. If constructed, the temporary hardstanding areas would be reinstated following construction.

1.36 The Development would result in the construction of approximately 6.95 km of new track and 0.88 km of upgraded access track. The running width of the track would be 4.5 m on straight sections, with 0.25 m wide shoulders on each side, totalling 5 m. The permanent hardstanding area for the new track would be approximately 5809 m^2, 46,761 m^2 of upgraded access track, totalling 52,570 m^2.

1.37 The total area taken up by the control building and associated infrastructure is expected to be 1480 m^2. This is to include the building, rear compound, all associated welfare, access and parking (**Figure 1.5**).

1.38 A temporary construction compound (**Figure 1.12**) measuring 4,000 m^2 will be constructed. On completion of the wind farm construction, 750m2 of temporary construction compound will be utilised permanently for Energy Storage and the remaining 3,250m2 will be reinstated to their original form following construction.

Table 2.1 - Summary of Temporary and Permanent Hardstanding

Wind Farm Element	Temporary hardstanding[1] in m^2	Permanent Hardstanding[2] in m^2
Turbines and transformer pads	-	2,520
Crane pads and laydown areas	9,240	16,800
On-site access tracks (new)	-	5,809
On-site access tracks (upgraded)	-	46,761
Control building & substation compound	-	1,480
Energy storage hardstanding	-	750
Construction compound	3,250	-
Total hardstanding in m^2	12,490	74,120
Total Hardstanding in ha	1.25	7.41
Total Hardstanding as % of total area within the Planning Application Boundary (85.07).	1.4	8.7

1.39 Thus, in summary, the Development would require approximately 7.41 ha of hardstanding lasting throughout the life of the project. An estimated further 1.25 ha would be occupied by hardstanding on a temporary basis.

Habitat Management

1.40 An Outline Habitat Management Plan (HMP) has been developed to enhance habitats on site. Please see **Chapter 6: Ecology**, for further details.

Project Description

Wind Turbines

1.41 The wind turbine industry is evolving at a remarkable rate. Designs continue to improve technically and economically. The most suitable turbine model for a particular location can change with time and therefore a final choice of machine for the Development has not yet been made. The most suitable machine will be selected before construction, with a maximum tip height of 149.9 m.

1.42 For visual and acoustic assessment purposes, the most suitable candidate turbine available in the market place (currently of 4.2 MW nominal capacity and with an overall tip height of 149.9 m) has been assumed. Most of the dominant wind turbine manufacturers are now producing turbines that are classed as suitable for the wind

[1] Temporary hardstanding: this refers to ground which will be occupied by hardstanding / built structures during the construction of the Development. However, once the Development has been constructed this land will be reinstated and available for grazing.

[2] Permanent hardstanding: this refers to ground which will be occupied by hardstanding / built structures throughout the lifetime of the Development.

regimes typical of Northern Ireland and many are also producing turbines that meet the up to 149.9 m tip height specification being suggested for the Development. Exact tower and blade dimensions vary marginally between manufacturers. A diagram of a typical 149.9 m tip height turbine is given in **Figure 1.4.**

1.43 Turbines begin generating automatically at a wind speed of around 3 to 4 metres per second (m/s) and have a shut-down wind speed of about 25 m/s. It is proposed to install infrared lighting on a turbine(s) in a pattern that is acceptable to the Ministry of Defence (MoD) for aviation visibility purposes. Infrared lighting allows military aircraft with night vision capability to detect and avoid wind farms. Infrared lighting cannot be detected with the naked eye, thereby reducing visual impact.

1.44 Each turbine would have a transformer and switchgear. The transformer's function is to raise the generation voltage from approximately 690 volts to the higher transmission level that is required to transport the electricity into the grid. Depending on the turbine supplier, the transformer and switchgear may be located inside or outside each turbine.

Foundations and Hard Standing

1.45 The wind turbines would be erected on steel re-enforced concrete foundations. It is anticipated that the foundations would be of gravity base design, but there may be the requirement to use piled foundations where ground conditions dictate. Final base designs will be determined after a full geotechnical evaluation of each turbine location. **Figure 1.14** provides an illustration of a typical gravity base wind turbine foundation design.

1.46 During the erection of the turbines, crane hardstanding areas would be required at each turbine base **(Figure 1.15).** Typically, these consist of one main permanent area of 1200 m^2 adjacent to the turbine position, where the main turbine erection crane will be located. The other areas, totalling 660 m^2, will be temporary and used during the assembly of the main crane jib. The hardstanding will be constructed using the same method as the excavated access tracks. This involves the topsoil being replaced with suitable structural fill to finished level.

1.47 After construction operations are complete, the temporary crane pad areas, shown on **Figure 1.15**, will be reinstated. There will be a requirement to use cranes on occasion during the operational phase of the Development, so the main crane hardstanding (1200 m^2) will be retained to ease maintenance activities. This approach complies with current best practice guidance[3] which recommends crane hardstandings are left uncovered for the lifetime of the Development.

Site Tracks

1.48 The on-site access track layout has been designed to minimise environmental disturbance by maximising the use of upgraded site track and avoiding sensitive

[3] SNH, Scottish Renewables, SEPA and the Forestry Commission Scotland (2010) "*Good Practice during Wind Farm Construction*"

habitats where possible and keeping the length of track commensurate with the minimum required for operational safety. The track route also takes cognisance of the various identified environmental constraints. Approximately 6.95 km of new access tracks and 0.88 km of upgraded access tracks are proposed to access the various turbine locations totalling approximately 7.83 km in length. Typical access track designs are shown in **Figure 1.11**.

1.49 Five new watercourse crossings will be required as part of the track layout. These crossings would be designed to ensure that fish movements are not restricted (where applicable) in addition to ensuring the crossing size is adequate for potential flood flows. An example of the watercourse crossing design is shown in **Figure 1.18**.

Electrical Connection

1.50 Assuming the use of the currently available models, each wind turbine would generate electricity at 690 V and would have an ancillary transformer located either within or outside the base of the tower to step up the voltage to the required on-site distribution voltage. Each turbine would be connected to any adjacent turbines by underground cables.

1.51 The wind farm substation is proposed to be located on the central part of the site as shown in **Figure 1.3: Infrastructure Layout**. All power and control cabling on the wind farm will be buried underground in trenches located, where possible, along the route of site access tracks. These trenches will be partially backfilled with topsoil. The vegetation soil tuft will be stripped and laid beside the trench and used to reinstate the trench to the original ground level immediately after the cables have been installed.

1.52 The connection of wind farms to the electrical grid typically follows a separate consenting process and it is normally the responsibility of the network operator to progress the relevant consent, where required. The Best Practice Guidance to PPS 18 states that whilst the routing of such lines by Northern Ireland Electricity (NIE) is usually dealt with separately to the application for the wind farm, developers will generally be expected to provide details of indicative routes and method of connection.

1.53 RES considers connection to the grid system via a combination of overhead line and underground cables following the public road to either the existing Larne of Ballyvallagh Substations as the most likely options available. Although not a part of the planning application for the Development, proposed grid connection route is illustrated and the environmental effects have been assessed and these are presented in **Appendix 2.1**.

RES Control Building & Substation Compound and Energy Storage

1.54 The control building will be designed and constructed to the standard required by NIE for the accommodation of substation equipment. Where possible, local building materials and finishes will be used to ensure that the appearance is in keeping with other buildings in the area.

1.55 The control building and substation compound will contain power quality improvement equipment, including up to two auxiliary transformers. The control building will accommodate metering equipment, switchgear, the central computer system and electrical control panels. A spare parts store room, and welfare facilities will also be located in the control building. The building will be attended by maintenance personnel on a regular basis.

1.56 Following an assessment of foul treatment options through a review of Pollution Prevention Guidelines 4, it was determined that both the toilet, wash hand basin and sink should drain to a small package treatment plant located adjacent to the control building, which would follow the Controlled Activities Regulations (CAR) guidelines and be constructed and located in accordance with the relevant Building Standards and agreed with the Council.

1.57 A permanent external environmental waste storage area will be provided with a minimum of 6 m clearance from the buildings. The area will consist of a concrete plinth surrounded with a palisade fence and double gate.

1.58 Four permanent containers housing energy storage devices, inverters and other ancillary equipment will be positioned adjacent to the control building and substation compound on hardstanding used originally for the temporary construction compound. These units are a means of storing electrical energy just like a rechargeable battery, cell phone or electric car. These are means by which power can be stored and released. The application is of course of a larger scale but the basic principle is the same.

1.59 One of the basic roles of energy storage is to act as a power reserve, when electricity generation drops below demand. This reserve capacity can be called on at a moments notice to enable the necessary balancing of the emerging low carbon electrical system.

1.60 Another example of the flexibility services that energy storage could provide includes distribution, reinforcement and deferral services. These enable existing electrical network assets such as substations and overhead lines to have their capacity increased without the need for building new grid infrastructure.

1.61 All of these uses of energy storage involve charging a battery system with electricity, storing electricity for a period, or discharging electricity. Ultimately the proposed development will make a valuable contribution to a secure, low carbon and affordable electrical system.

Description of Access

1.62 The proposed access route for the delivery of large turbine components, known as abnormal indivisible loads (AILs), is shown in **Figure 11.1 – Turbine Delivery Route**. The site entrance is located at the end of and directly accessed off the Feystown Road.

1.63 **Appendix 11.1** shows a swept path analysis of all points along the turbine delivery route that require either overrun or oversail beyond the road edge.

1.64 At the end of the construction period and in consultation with DfI Roads, any reinstatement required to any street furniture which may be removed on a temporary basis will be undertaken. In the unlikely event that a replacement blade is required during the operational phase of the wind farm, any works will be undertaken following consultation with DfI Roads.

1.65 Further details are in Chapter 11: Traffic and Transport.

Typical Construction Activities

1.66 Prior to commencement of construction, detailed method statements will be prepared to address best practice working methods. As a minimum, the following best practice construction methods will be adhered to:

- Where possible and in order to minimise impacts of earthworks, excavations will be kept to a minimum with granular material being reused where appropriate
- Consideration will be given to weather conditions when stripping soil. For example, during periods of heavy rain (>25 mm in 24 hours), significant snow event (>75 mm lying) or an extended period of freezing conditions (ground penetration >100 mm), soil stripping works will be reviewed to take in account any adverse weather conditions and where deemed applicable, works will cease until site conditions prevail that are compatible with this activity
- Vegetated turves shall be stripped and stockpiled separately prior to excavation of topsoil/peat in all work areas
- Vegetated turves will be reused as quickly as possible
- Excavations will be monitored for changing soils types to prevent cross mixing of soils in stockpiles
- Topsoil shall be stripped and stored carefully for use in reinstatement works, which shall be carried out as soon as possible after sections of work are complete. Topsoil will be stripped prior to excavation of subsoil in all work areas
- Any remaining subsoil will be excavated down to a suitable bearing stratum and set-aside for later use in landscaping, backfilling around structures and verge reinstatement
- Reinstatement will be ongoing as the works are constructed to minimise the amount of time in which any material will be stockpiled
- Where required, all stockpiled material will be sited in areas with shallow peat depths, negligible peatslide risk and avoiding all 50 m watercourse buffer zones, ecological and cultural heritage constraints

- All stockpiles shall be shaped to promote run-off. Detailed SUDS drainage and silt control methods shall be designed for each stockpile
- Additionally, a "toolbox talk" will be provided by the site management team to highlight possible events causing slope instability and provide guidance on best practice when operating in areas of peat and/or increased slopes. In addition, a workforce engagement event shall be performed at least once for the project and shall be organised by the project team and be attended by RES and project contractor's workforce. The event will set and communicate the required safety culture and working practices for the project.

Access Tracks

1.67 As described in section 1.48 in areas of peat with a depth greater than 1.0 m consideration has been given to the use of floating tracks. The feasibility of a floating road construction is dependent upon a number of factors, namely: the geomorphology of the peat; topography; length of road section; wind farm layout; number of vehicle movements for each option; restoration requirements; peat re-use considerations. All parameters noted above will be assessed at detailed design stage post consent and the best practice road construction type will be inferred from the various design constraints.

1.68 The access track itself will be constructed of inert material of suitable grade to withstand the expected traffic loading. Road construction techniques and roadside ditches will be designed to minimise the effect on natural hydrology as much as possible.

1.69 The depths of the ditches will be kept to the minimum required for free drainage of the road. Individual drain lengths will be minimised to avoid significant disruption of natural drainage patterns and avoid accumulation of large volumes of water within an individual drain.

1.70 Drains will not directly flow into watercourses, but into a buffer zone. Buffer zones are used to allow filtration of suspended solids in the water and reduction of runoff velocities. This reduces the flashiness of response, encourages deposition of sediments and allows pollutants to be filtered out.

Construction of Temporary Compound and Energy Storage

1.71 A temporary construction compound will be located on the site, as illustrated in **Figure 1.3: Infrastructure Layout.** Details of the temporary compound layout are included in **Figure 1.12.** The compound will include the following:

- Temporary portable cabins for office accommodation, monitoring of incoming vehicles and welfare facilities
- \- Self-contained toilets with provision for waste storage and removal
- \- Containerised storage areas for tools, small plant and parts
- \- An area for site vehicle parking and storage of larger material items

- - A standing and turning area for vehicles making deliveries to the site
- - A bunded area for storing fuels, oils and greases.

1.72 On completion of the construction work these facilities will be removed and the areas not being used for energy storage will be reinstated.

1.73 The location of the temporary compound has been selected to avoid environmental constraints and for reasons of security, practicality and to obtain suitable ground conditions. The proposed temporary compound area will be constructed by top soil excavation in a similar manner to the access tracks, laying stone over a geotextile membrane.

1.74 During construction, temporary fencing will be erected as required, around the construction compound. This is illustrated in **Figure XX.**

1.75 On completion of the construction phase work on the wind farm, 3250m2 of the temporary construction compound will be removed and reinstated to agriculture with the remaining 750m2 utilised for Energy Storage devices.

1.76 The Energy Storage will comprise four permanent containers housing energy storage devices, associated inverters and ancillary equipment. Permanent fencing will enclose the containers. These are illustrated in **Figure 1.8: Energy Storage Compound Plan & Elevation** and **Figure 1.9: Energy Storage Container Elevation.**

Sustainable Drainage System

1.77 The drainage measures and Sustainable Drainage System (SuDS) designs have been directed by recommendations in **Chapter 9: Geology and Water Environment**

1.78 The runoff drainage system will be designed to mimic natural conditions to mitigate against increased flashiness in water courses and reduced groundwater recharge. The SuDS will protect the status of water courses and ground waters. A proposed SuDS Design Statement is included within the Water Framework Directive Assessment in **Appendix 9.1.**

1.79 Construction will be carried out according to Department of Agriculture, Environment & Rural Affairs (DAERA) and Construction Industry Research and Information Association (CIRIA) guidance for site works. Pollution control measures during the construction phase will be included in the Construction & Decommissioning Method Statement (CDMS), which will be agreed with Causeway Coast & Glens BC before starting construction work on site.

1.80 Mitigation measures to minimise the hydrological effect of constructing the access tracks have been proposed in **Chapter 9: Geology and Water Environment** of this ES.

Crane Hardstanding Construction

1.81 **Figure 1.15** shows the crane hardstanding layout configuration in plan. The hardstanding would be constructed using the same method as the excavated access tracks. This involves the topsoil and subsoil being replaced with imported stone, ensuring an adequate bearing capacity has been achieved to carry the anticipated loads. The final position of the hardstanding would be decided at detailed design stage and prior to construction and shall be based on a number of considerations, including; size of crane required, depth of excavation required, hydrological/ecological features in the vicinity, local topography (it is preferable to position the crane hardstanding on the same level, or higher level to the turbine foundation level since this eases lifting operations).

Turbine Foundation Construction

1.82 The turbine towers are fixed to a concrete foundation. The foundation proposed in **Figure 1.14** comprises a gravity base design. Each foundation typically consists of a tapered octagonal block of concrete, and formation will be approximately 3.5 m below ground level. The volume of concrete used to make each foundation is approximately 500 m^3, which is reinforced by approximately 50 tonnes of steel bar. The depth of the foundation varies for each turbine location according to the depth to suitable sub formation level. The excavation area for each foundation will be approximately 910m^2, 1,038 m^3. The foundation is typically poured in two parts, with a suitable construction joint between them. This will be detailed in the CDMS. Following the pouring and curing of the concrete, the foundation is backfilled with material which is initially excavated and meeting the density requirements, leaving only the tower plinth, typically 4.5 m – 5.5 m diameter, sitting at ground level. Surplus excavated material will be stored in appropriate areas identified in the Peat Management Plan (PMP), produced as part of CDMS prior to construction. The proposed plan will calculate generated excavated material and identify space for the excess volume of material. An Outline Peat Management Plan is provided in **Appendix 9.5**.

1.83 The exact quantities of concrete, reinforcement, depth and dimensions will vary on the final choice of turbine model. In the detailed pre-construction design of each foundation, geotechnical tests are carried out to determine the strength of the subsoil layers beneath the turbines and the soil behaviour under loading over time. This information is used to confirm a final design and incorporates factors for safety.

1.84 An earthing mat or electrode consisting of up to three interconnected concentric rings of bare stranded copper conductor is laid around the foundation of each tower and transformer, approximately 0.5 m below the finished ground level. In addition, earthing rods padded by bentonite (a water retaining clay mineral) are required at set locations around the foundation, and are positioned vertically below the earth mat. The number of rods and length is dependent upon the electrical resistivity of the soil which is confirmed during the site investigation, prior to construction.

1.85 Sulphate resistant cement, or higher cement content, within the concrete will be used if the site is identified to have waters with potentially low pH. This is so that they do not have a corrosive effect on turbine bases.

Wind Turbine Erection

1.86 Wind turbine towers, nacelles and turbine blades will be transported to the site as abnormal loads as described in **Section XX**. The tower sections and other turbine components will be stored at each turbine hardstanding until lifted into position.

1.87 The components would be lifted by adequately sized cranes and constructed in a modular fashion. Assembly, in general requires only fixing of bolts, torquing of nuts and electrical and hydraulic connections.

Cabling, Substation and Control Building

1.88 The location of the substation and control building is shown in **Figure 1.3: Infrastructure Layout**. Layout and elevation drawings for these buildings are presented in **Figures 1.5 -1.7**. All cabling between the turbines and the substation on the site will be connected using underground trenched cables. Where excavated, the top layer of soil will be removed and used to reinstate the excavation following the installation of the cables. Where cables are being laid in areas of peat, the various different layers will be separated and replaced appropriately. Cabling would generally run parallel to the adjacent site tracks. **Figure 1.16** presents a typical underground cable cross-section. In addition and in an effort to ensure that the cable trench does not act as a preferential drain, impermeable bunds will be installed perpendicular to the cable direction at suitable intervals (taking into account local ground conditions and topography).

Re-instatement

1.89 A programme of reinstatement would be implemented upon completion of construction. This would relate to the construction compound, temporary areas of the crane hardstandings, cable trenches and track shoulders where appropriate. There remains a potential to use cranes during the operational phase of the Development, therefore the main crane hardstanding will remain uncovered.

1.90 It is essential that the access track width is retained during the operation of the Development to allow occasional access if required. Therefore no works to reduce the track width, post turbine erection, are proposed.

Construction Programme

1.91 It is anticipated that the construction would take approx. 18 months. The indicative construction programme shown in **Diagram 2.1** shows the anticipated scheduling of construction activities.

Diagram 2.1 – Indicative Construction Programme

TASK	CONSTRUCTION MONTH																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Mobilisation & setup construction compound																		
Site entrance and tracks																		
Crane hardstandings																		
Turbine foundations																		
Control building & substation																		
Cable installation																		
Turbine deliveries																		
Turbine erection																		
Operational take over																		

Hours of Work

1.92 Construction work will take place between the hours of 0700-1900 Monday to Friday and 0700 – 1300 on Saturdays. Outside these hours, work at the Site shall be limited to turbine erection, testing/commissioning works and emergency works. Deliveries may occur outside these times to minimise disruption to local residents.

Construction Traffic and Plant

1.93 In addition to staff transport movements, construction traffic will consist of heavy goods vehicles (HGVs) and abnormal load deliveries.

1.94 As outlined in **Chapter 11: Traffic and Transport**, taking into account forecast vehicle numbers from construction activities (5888 trips) and forecast staff vehicle numbers (9500 private car, mini bus or land rover trips), the total number of two-way vehicle movements generated during the construction period would therefore be 15,388 journeys. Approximately 90 abnormal load deliveries would be generated for the turbine erection stage which would typically result in three deliveries per day. However, the actual number will be determined in the development of the Traffic Management Plan (TMP) which will be written in consultation with Department for Infrastructure (DfI), post-consent.

1.95 Turbine components will be supervised during their transportation using appropriate steerable hydraulic and modular trailer equipment where required. Axle loads would be appropriate to the roads and access tracks to be used. The transportation of turbine components would be conducted in agreement with the relevant roads authorities and local police. RES will notify the police of the movement of abnormal length (e.g. turbine blade delivery) and any abnormal weight (e.g. crane) vehicles and obtain authorisation from DfI prior to any abnormal vehicle movements.

1.96 Vehicle escorts will be used where necessary and the appropriate permits obtained for the transportation of abnormal loads, to ensure that other traffic is aware of the presence of large, slow moving vehicles. Where long vehicles have to use the wrong side of the carriageway, or have potential to block the movement of any vehicles travelling in the opposite direction, a lead warning vehicle will be used and escort vehicles will drive ahead to hold oncoming traffic. Vehicles will also be marked as long/abnormal loads. For return journeys, the extendible trailers used for wind turbine component delivery will be retracted to ensure they are no longer than that of a normal HGV.

Construction and Decommissioning Method Statement

1.97 A Construction and Decommissioning Method Statement (CDMS) will be prepared once planning consent has been gained. This will be submitted Department for Infrastructure (DfI) prior to any construction works taking place. This will describe the detailed methods of construction and working practices, work to reinstate the site following completion of construction activities and methods to reinstate the site post operation.

Operation and Management

Life of the project

1.98 The expected operational life of the wind farm is 30 years from the date of commissioning. At the end of this period, a decision is made whether to refurbish, remove or replace turbines. If refurbishment or replacement were to be chosen, relevant planning applications will be made. Alternatively, if a decision is taken to decommission the Development, this would entail the removal of all of the turbine components, transformers, the substation and associated buildings. Specific sections of the access tracks may remain on-site to ensure the continued benefit of improved access for the landowners. The concrete foundations will normally remain in place to avoid the unnecessary intrusion to the ground. The exposed concrete plinth may be removed to a specified depth, but the entire foundation will be graded over with topsoil and replanted appropriately to restore the land to its original conditions.

Maintenance Programme

1.99 Wind turbines and wind farms are designed to operate largely unattended. Each turbine at the Development would be fitted with an automatic system designed to supervise and control a number of parameters to ensure proper performance (e.g. start-up, shut-down, rotor direction, blade angles etc.) and to monitor condition (e.g. generator temperature). The control system would automatically shut the turbine down should the need arise. Sometimes the turbines would re-start automatically (if the shut-down had been for high winds, or if the grid voltage had fluctuated out of range), but other shut-downs (e.g. generator over temperature) would require investigation and manual restart.

1.100 The Development itself would have a sophisticated overall Supervisory Control and Data Acquisition system (SCADA) that would continually interrogate each of the turbines and the high voltage (HV) connection. If a fault were to develop which required an operator to intervene then the SCADA system would make contact with duty staff via a mobile messaging system. The supervisory control system can be interrogated remotely. The SCADA system would have a feature to allow a remote operator to shut down one or all of the wind turbines. This is monitored 24 hours a day, 7 days a week.

1.101 An operator would be employed to operate and maintain the turbines, largely through remote routine interrogation of the SCADA system. The operator would also look after the day-to-day logistical supervision of the Development and would be on-site intermittently.

1.102 Routine maintenance of the turbines would be undertaken approximately twice yearly to ensure the turbines are maintained to Industry Standard. This would not involve any large vehicles or machinery.

1.103 If a fault should occur, the operator would diagnose the cause. If the repair warranted the Development being disconnected from the grid then the operator would make contact with NIE. However, this is a highly unlikely occurrence as most fault repairs can be rectified without reference to the network utility. If the fault was in the electrical system then the faulty part or the entire Development would be automatically disconnected until the fault is rectified.

1.104 Signs would be placed on the Development giving details of emergency contacts. This information would also be made available to the local emergency services and NIE.

Decommissioning

1.105 One of the main advantages of wind power generation over other forms of energy production is the ease of decommissioning and the simple removal of components from the site. The residual impact on the site is limited to the continued presence of the foundations and access tracks. All above ground structures can be removed from the site.

1.106 If the Development obtains planning approval it is expected that a planning condition would be set to provide for the decommissioning and restoration of the site in accordance with a scheme agreed in writing with Department for Infrastructure (DfI), which would consider the long term restoration of the site at the end of the lifetime of the Development.

1.107 The Development will be decommissioned in accordance with best practice at that time and/or in compliance with any planning conditions. Current best practice includes the removal of all above ground structures (e.g. turbines, substation etc); the removal of certain underground structures where required (e.g. cables); and reinstatement of disturbed areas all of which will be subject to any necessary consents. Consideration will be given to the retention of wind farm access tracks if they utilise pre-existing farm infrastructure or are not located on sensitive habitats if such continued use could lead to the long term degradation of these habitats.

Construction and Decommissioning Management

1.108 This section details the environmental management controls that would be implemented by RES and its contractors during the construction of the Development to ensure that potential significant adverse effects on the environment are, wherever practicable, prevented, reduced and where possible offset.

1.109 A CDMS will be agreed with the relevant statutory consultees prior to construction commencing. The purpose of the CDMS is to:

- Provide a mechanism for ensuring that measures to prevent, reduce and where possible offset potentially adverse environmental impacts identified in the ES are implemented;
- Ensure that good construction practices are adopted and maintained throughout the construction of the Development;
- Provide a framework for mitigating unexpected impacts during construction;
- Provide a mechanism for ensuring compliance with environmental legislation and statutory consents;
- Provide a framework against which to monitor and audit environmental performance.

1.110 The CDMS will, as a minimum, include details of the following:

- Pollution prevention measures
- Peat slide, erosion and compaction management
- Control of contamination/pollution prevention
- Drainage management
- Control of noise and vibration
- Control of dust and other emissions to air.

Site Induction

1.111 The principal contractor would ensure that all employees, sub-contractors, suppliers and other visitors to the site are made aware of the content of the CDMS and its applicability to them. Accordingly, environmental specific induction training would be prepared and presented to all categories of personnel working on and visiting the site.

1.112 As a minimum, the following information would be provided to all inductees:

- Identification of specific environmental risks associated with the work to be undertaken on site by the inductee
- Summary of the main environmental aspects of concern at the site as identified in the CDMS
- Environmental Incident and Emergency Response Procedures (including specific Environmental Communication Plan requirements).

1.113 A conveniently sized copy of an Environmental Risk Map or equivalent would be provided to all inductees showing all of the sensitive areas, exclusion zones and designated washout areas. The map would be updated and reissued as required. Any updates to the map would be communicated to all inductees through a tool box talk given by specialist environmental personnel. Regular tool box talks would be provided during construction to provide ongoing reinforcement and awareness of environmental issues.

Pollution Prevention, Water Quality Monitoring and Emergency Response Plan

1.114 The CDMS will detail a number of measures to deal with pollution prevention, including RES' policies and procedures such as 'Environmental Requirements of Contractors', 'Water Quality Monitoring Procedure' and 'Procedure in the Event of a Contaminant Spill'.

1.115 Contractors and sub-contractors would be required to follow all pertinent Pollution Prevention Guidance. The following pollution control measures will be incorporated into the CDMS:

- Equipment shall be provided to contain and clean up any spills in order to minimise the risk of pollutants entering watercourses, waterbodies or flush areas
- Trenching or excavation activities in open land shall be restricted during periods of intense rainfall and temporary landscaping shall be provided as required to reduce the risk of oil or chemical spills to the natural drainage system
- Sulphate-resistant concrete[4] shall be used for the construction of turbine bases to withstand sulphate attack and limit the resultant alkaline leaching into groundwater
- All refuelling will be undertaken at designated refuelling points. There will be no refuelling within catchments contributing to water supply points
- Equipment, materials and chemicals shall not be stored within or near a watercourse. At storage sites, fuels, lubricants and chemicals shall be contained within an area bunded to 110%. All filling points shall be within the bund or have secondary containment. Associated pipework shall be located above ground and protected from accidental damage
- Any on-site concrete wash-out shall occur in allocated bunded areas
- Drip trays shall be placed under machinery left standing for prolonged periods
- All solid and liquid waste materials shall be properly disposed of at appropriate off site facilities
- Routine maintenance of vehicles shall be undertaken outwith the site
- There shall be no unapproved discharge of foul or contaminated drainage from the Development either to groundwater or any surface waters, whether direct or via soakaway

[4] BS EN206:1 : 2000 Concrete Part 1: Specification, performance, production and conformity and BS 8500 – 1 : 2006 Concrete – Complementary British Standard to BS EN 206 – 1 Part 1

- Sanitary facilities shall be provided and methods of disposal of all waste shall be approved by regulatory bodies
- A programme of surface water quality monitoring would be undertaken during the construction phase to provide assurances as to the absence of water quality impacts
- RES has a policy that no wind turbines, auxiliary and electrical equipment would contain askarels or Polychlorinated biphenyls (PCBs).

1.116 In the unlikely event of an environmental pollution incident, there will be an emergency response procedure to address any accidental pollution incident. For example, a procedure requiring the use of spill kits to contain the material and procedures to ensure that NIEA is notified on their Pollution Hotline number (0800 807060) within 30 minutes of an incident (unless unsafe to do so), will be applied.

General Drainage Design

1.117 As set out in **Chapter 9:** Geology and the Water Environment, buffers to watercourses have taken account of and infrastructure designed in accordance with best practice guidance.

1.118 The potential impact of preferential routing of drainage and associated erosion and sediment wash-off within the sub-catchments draining the site would be mitigated through the following measures which would be incorporated into the SuDS Design:

- Maintaining existing overland flow routes and channels. Existing natural flow paths lateral to access roads will be maintained through the use of piped crossings under road alignments at natural depressions and at regular intermediate intervals. The spacing of cross drains will be specified at detailed design stage;
- Avoiding transporting rainfall runoff in long linear drainage swales by providing regular channel “breakouts”, whereby water is encouraged to flow overland, thus maintaining existing natural hydrological patterns;
- Reducing surface water flow rates and volumes by attenuating runoff from tracks and hard standings “at source” by providing check-dams in swales, whereby the flow velocity and rate of discharge is artificially reduced to mimic natural properties;
- Providing settlement ponds at turbine hard standing areas and other main surface water discharge locations, where runoff from significant new impermeable areas is treated and attenuated before being released overland;
- All swales, crossings and other hydraulic features will be engineered to ensure that dimensions are suitable to convey predicted flows and so prevent build-up of surface water and / or flooding.

Runoff and Sediment Control Measures

1.119 The following measures would be used to mitigate any potential impacts on the water quality of the sub-catchments through peat erosion, stream acidification and metals leaching during construction. These are incorporated into the CDMS:

- Appropriate sediment control measures (silt fences, attenuation ponds, etc.) would be used in the vicinity of watercourses, springs or drains where natural features (e.g. hollows) do not provide adequate protection
- Sediment control measures (e.g. check dams, silt fences etc.) would be employed within the existing artificial drainage network during construction. These would be regularly checked and maintained during construction and for an appropriate period following completion
- Watercourses would be monitored throughout the construction period by the ECoW to identify any enhanced scouring of the catchment surface. If sediment from disturbed peat is excessively mobilised through the minor channels network these would be mitigated by temporary sediment control measures (e.g. geotextiles/straw/bales/brash)
- The extent of all excavations would be kept to a minimum and during construction activities surface water flows shall be captured through a series of cut-off drains to prevent water entering excavations or eroding exposed surfaces. If dewatering of excavations is required, pumped discharges would be passed through attenuation ponds and silt fences to capture sediments before release to the surrounding land
- Where there is a permanent relocation of peat, the ground would be reinstated with vegetation as soon as practicable
- Where practicable, vegetation over the width of the cable trenches would be lifted as turfs and replaced after trenching operations to reduce disturbance
- The movement of construction traffic would be controlled to minimise soil compaction and disturbance. Vehicle movements outside the defined tracks and hardstandings would be avoided
- Trenching or excavation activities in open land would be restricted during periods of intense rainfall and temporary landscaping would be provided, as required, to reduce the risk of sediment transport to the natural drainage system
- Construction of the track and cable crossings will cease during periods of heavy rain (>25mm in 24 hours), significant snow event (>75mm lying) or extended period of freezing conditions (ground penetration>100mm). If necessary, upstream of the crossing would be dammed and water pumped around the construction zone. The construction period would be minimised as far as practicable.

Peat Slide, Erosion and Compaction Management

1.120 Management of the risk of peat slides and storage is now recognised in literature, and a range of measures have now become standard engineering practice for construction of roads over peat.

1.121 These measures would be adopted, as appropriate, on site, ensuring that:

- Concentrated loads, such as those arising from stockpiling of material from turbine foundation excavations, would not be placed on marginally or potentially marginally stable ground
- Concentrated water flows arising from any aspect of construction or operation of the Development would not be directed onto peat slopes and unstable excavations
- Construction would be supervised on a full time basis by engineers fully qualified and experienced in geotechnical matters
- Robust drainage plans would be developed
- Work practices would be reviewed, modified as necessary and adopted to ensure that existing stability is not compromised
- Appropriate ground investigation and movement monitoring practices would be adopted.

1.122 Preliminary peat investigations on site indicated that there is minimal peat coverage on the proposed development area. Where peat exceeds 1.5m locally, infrastructure has been designed to avoid these where practicable.

1.123 In consideration of the above and the minimal peat disturbance anticipated, particularly where infrastructure is planned on steeper topography, it is considered that the risk from peat slide and instability is low. Should a detailed ground investigation provide further evidence of deep peat, consideration will be given to the production of a Peat Stability Risk Assessment.

Traffic Management Plan

1.124 As detailed in **Chapter 11: Transport and Traffic**, a Traffic Management Plan (TMP) would be developed to ensure road safety for all users during transit of development loads. The TMP would outline measures for managing the convoy and would set out procedures for liaising with the emergency services to ensure that police, fire and ambulance vehicles are not impeded by the loads. The TMP would be developed in consultation with DfI, the police and the local community and agreed before deliveries to the Development commence.

Construction Environmental Management Plan

1.125 A Construction Environmental Management Plan (CEMP) would be prepared and implemented through the CDMS to set out the measures required to protect and enhance ecology and hydrology at the Development during the construction phase, including pre-construction surveys, habitat management and biodiversity enhancement. The detail of the CEMP would be prepared and agreed with Department for Environment Agriculture & Rural Affairs (DEARA) and DFI prior to commencement of construction.

Potential Construction and Decommissioning Phase Environmental Impacts

1.126 Construction is predominantly a civil engineering operation and would be phased over an approximate 18 month period. Construction of tracks and foundations would be progressive, minimising the number of simultaneously active locations and ensuring that traffic density is kept low. Erection would span approximately nine weeks toward the end of the work programme.

1.127 A programme of site reinstatement and enhancement would be put in place to minimise the visual and ecological impacts on the land, in accordance with the Outline Habitat Management Plan (Appendix 6.6).

1.128 The Development would operate for approximately 30 years and would require only limited maintenance and inspection visits.

1.129 A detailed restoration plan / Decommissioning Method Statement would be prepared and agreed with the relevant authorities towards the end of the Development's operational life.

List of Figures and Appendices

Figures

Appendices

2

Planning Policy

2 PLANNING POLICY

Introduction

2.1. This Planning Policy chapter has been prepared by Turley on behalf of the applicant, RES Ltd. Turley are a full service national planning and development consultancy with experience of over 30 years of working in planning and property from a network of offices across the UK and Ireland.

2.2. This chapter demonstrates how energy and planning policy considerations have been addressed in the development proposal. The chapter opens by describing the high level policy context within which the project has been conceived and falls to be determined. It then assesses the project's compliance with operational planning policy on a policy by policy basis.

Scope of Assessment

Legislation and Policy Framework

UN GLOBAL POLICY

Rio Earth Summit

2.3. Since the Earth Summit in Rio de Janeiro in 1992 there has been a global trend in the search for more sustainable energy production. A number of key documents, including the Rio Declaration on Environment and Development and the Framework Convention on Climate Change, were developed as a result of the summit. The Rio Declaration (UNEP, 1992) set out 27 guiding principles for sustainable development and emphasised that long term growth needed to be grounded in the environment.

2.4. Since the 1992 Earth Summit, the subject of renewable energy has been at the forefront of UN policy with a goal to increase the uptake of renewable technologies. The main driver behind this goal has been the increasing greenhouse gas (GHG) emissions and their climate change consequences.

Kyoto Protocol

2.5. The Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC, 1998) originated from the Rio Earth Summit. The Protocol was adopted in Kyoto, Japan in 1997 and came into force in February 2005. It sets binding targets for reducing GHG emissions that apply to 37 industrialised countries (including the European Community), which have a target to reduce GHG emissions from 1990 levels by 5% over the period of 2008 to 2012. Within this, the European Community has a reduction target of 8% which is distributed across the member states. The United Kingdom's reduction target is 12.5% (European Union, 2002).

2.6. The Kyoto Protocol sets out measures by which countries can meet their reduction targets. As a result, the Protocol resulted in the creation of a 'Carbon Market' where GHG emissions are tracked and traded as a commodity. It can be seen as the main catalyst for the development and promotion of renewable technologies.

The Paris Agreement

2.7. The Paris Agreement establishes a framework for global climate action including the mitigation of and adaption to climate change, support for developing nations and the transparent reporting and strengthening of climate goals. The European Union signed The United Kingdom of Great Britain and Northern Ireland up to the Agreement on 22 April 2016 and it came into force on the 18 December 2016.

Strategic European Energy Review

2.8. The Strategic Energy Review was first published in 2007 to establish a core energy policy for all of Europe (Commission of the European Communities, 2007). An agenda was agreed in order to achieve the key energy objectives of:

- Sustainability;
- Competitiveness and security of supply;
- Reducing GHG emissions by 20%;
- Obtaining 20% of energy consumed from renewable energy sources; and
- Improving energy efficiency by 20%.

2.9. The Review was updated in 2008 (Commission of the European Communities, 2008), in order to propose an Energy Security and Solidarity Action Plan, which focused on diversification of energy supply, energy efficiency and making the best of the European Union's indigenous energy resources.

2.10. Development of renewable energy reserves, including wind, solar, hydro, marine and biomass energy are seen as the main sources of indigenous energy.

The Energy Road Map 2050

2.11. The Road Map (Commission of the European Communities) sets out a long-term vision for renewable energy sources in the European Union and it forms an integral part of the Strategic European Energy Review. The Energy Roadmap 2050 sets out the transition and cost effective pathways for key economic sectors for achieving an 80-95% reduction in EU emissions by 2050. To achieve this goal, significant investment is needed in new low-carbon technologies and infrastructure, energy efficiency and renewable energy.

2.12. The 2050 target will not be shifted into national targets via EU legislation, but allows more flexibility for Member Countries to meet their greenhouse gas emission reduction targets in the most cost effective method in regards to their own specific circumstances.

EU Directive 2009/28/EC on the Promotion of the use of Energy from Renewable Sources

2.13. In 2009, EU Directive 2009/28/EC (European Union, 2009) came into force in order to update Directive 001/77/EC in promoting the use of energy from renewable sources. Goals of the Directive are to improve the security and diversification of energy supply and to provide environmental protection and social and economic cohesion. The 2009 Directive further establishes this framework for promoting energy from renewable sources and it updates national targets relating to this goal. It also requires each member state to have a national renewable energy action plan in place and ready for adoption by 30 June 2010. The updated goals of the 2009 Directive are:

- A 20% target for electricity from renewable sources by 2020; and
- The UK to achieve 10% of electricity from renewables by 2010, and 15% by 2020.

2.14. The Directive was revised in 2016 to make the EU a global leading in renewable energy and ensure that the target of the final energy consumption being at least 27% renewables is met by 2030.

UK ENERGY POLICY

UK Climate Change Programme

2.15. The UK government developed a Climate Change Programme in 2000 (DECC, 2000) in response to its commitment at the 1992 Earth Summit at Rio de Janeiro. The Programme was updated in 2006 (DECC, 2006). It sets out the UK's policies and priorities for action to reduce greenhouse gas emissions. Broadly, the targets for the UK are as follows:

- Reducing GHG emissions to 12.5% below 1990 levels by 2008-2012; and
- Moving towards a domestic UK goal of 20% cut in CO2 emissions below 1990 levels by 2010.

UK Climate Change Act 2008

2.16. The UK government in June 2019 set out amendments to the Climate Change Act 2008 in the Climate Change Act 2008 (2050 Target Amendments) Order 2019. This is to ensure net greenhouse gas emissions in 2050 are at least 100% lower than the 1990 baseline. The targets set out in the Act, which cover all sectors of the economy, are legally binding and came into effect on 27 June 2019. The 'net zero' target represents a significant step-change in the commitment to addressing the climate crisis.

UK Renewable Energy Strategy 2009

2.17. The UK Renewable Energy Strategy, published by the Department of Energy and Climate Change (2009), forms the basis of the UK National Renewable Energy Action Plan required under the terms of the Renewable Energy Directive (2009/28/EC). The Strategy sets out the path required for the UK to meet its legally binding target, in order to ensure that 15% of our energy (across electricity, heat and transport) comes from renewable sources by 2020. This is a seven fold increase in the share of renewable energy sources in scarcely more than a decade.

2.18. It makes it clear that achievement of such a target will only be possible with strong co-ordinated efforts by central, regional and local government as well as public groups, the private sector and dedicated communities. It clearly sets out the role Government will adopt and the specific actions it will take in order to deliver the strategy.

UK National Renewable Energy Action Plan 2010

2.19. This National Renewable Energy Action Plan provides details on a set of measures that would enable the UK to meet its 2020 target (Department of Energy and Climate Change (DECC), 2010). The 2009 Renewable Energy Directive sets a target for the UK to achieve 15% of its energy consumption from renewable sources by 2020. This compares to only 1.5% in 2005.

NORTHERN IRELAND ENERGY POLICY

Strategic Energy Framework for Northern Ireland 2010

2.20. The aim of the Framework (DETI, 2010) is to set out the direction for energy policy for the region. It is an update to the 2004 Strategic Energy Framework which recognises that significant changes have taken place since the publication of the 2004 framework, setting out a goal for Northern Ireland to increase to 40% of electricity consumption from renewable sources by 2020.

2.21. The Strategic Energy Framework recognises the importance of renewable energy and onshore wind in particular in helping Northern Ireland secure its energy supply and meet European and national targets.

2.22. The Framework is committed to supporting and developing the industry.

Northern Ireland Energy Strategy 2050

2.23. In part due to the recognition that the 40% target set in the existing Strategic Energy Target has been met, the Department for the Economy has commenced work to developing a new Energy Strategy for Northern Ireland. The publication of a Call for Evidence was undertaken in 2019 and is part of an on-going public engagement process to inform and shape the strategy. The Call for Evidence is the first stage in a programme of work aimed at developing a new long-term strategy for decarbonisation of the Northern Ireland energy sector by 2050 at least cost to the consumer.

2.24. The Department for Economy has set out intentions of an Energy Strategy Options public consultation issued by the end of March 2021, with the responses from this informing a final Energy Strategy to be launched by November 2021.

2.25. The work by the Department for Economy on the emerging Energy Strategy is set in the context of their Analytical Services Unit data published on 4 June 2020 which confirms that for the 12 month period April 2019 to March 2020, 46.8 per cent of total electricity consumption in Northern Ireland was generated from renewable sources located in Northern Ireland. This represents an increase of 3.9 percentage points on the previous 12 month period (April 2018 to March 2019) and is the highest rolling 12 month proportion on record.

2.26. In terms of the volume of electricity consumption between April 2019 and March 2020, some 7,695 Gigawatt hours (GWh) of total electricity was consumed in Northern Ireland. Over the same period, some 3,604 GWh of electricity was generated from renewable sources within Northern Ireland.

2.27. Of all renewable electricity generated within Northern Ireland over the 12 month period April 2019 to March 2020, 85.4 per cent was generated from wind. This compares to 84.7 per cent for the previous 12 month period (April 2018 to March 2019).

2.28. Whilst still at consultation stage it is expected that the strategy will set out a 70% target and possible interim targets. Such provisions would be in alignment with the Republic of Ireland's aim of 70% renewable electricity by 2030 as set out within the Region's Renewable Electricity Support Scheme (RESS). It is important to note that there is no cap upon the existing 40% target until it is superseded.

2.29. Furthermore, despite the current lack of an explicit, Northern Ireland specific, post-2020 renewables target, other relevant frameworks and reference points apply, including the Climate Change Act 2008, by which the UK committed itself to reducing greenhouse gas emissions by at least 80% of 1990 levels by 2050. Included in this target is the reduction of emissions from the devolved administrations, including Northern Ireland.

Northern Ireland Executive Programme for Government

2.30. The 2011-2015 Programme for Government (OFMDFM Economic Policy Unit, 2011) underlined the Northern Ireland Executive's commitment to the principles of an open and accountable government. The Programme established a key commitment seeking the achievement of 20% of electricity consumption from renewable sources and 4% renewable heat by 2015 in Northern Ireland and introduced milestones to reach in the intervening years to meet these targets. Priorities of the Executive included:

2.31. Growing a Sustainable Economy and Investing in the Future;

- Creating Opportunities, Tackling Disadvantage and Improving Health and Wellbeing;
- Protecting Our People, the Environment and Creating Safe Communities;
- Building a Strong and Shared Community; and
- Delivering High Quality and Efficient Public Services.

2.32. The Executive reported that it will continue to work towards a reduction in greenhouse gas emissions by at least 35% on 1990 levels by 2025 (DOE).

2.33. A new draft Programme for Government Framework was consulted on during 2016 and uses an outcomes-based approach. These outcomes are things with which people can identify, such as living longer and healthier lives or attracting better jobs - and are designed to stay in place for a generation rather than a single Assembly term.

2.34. Since June 2018 and in the (then) absence of an Executive and continued absence of a final Programme for Government, the NI Civil Service Outcomes Delivery Plan (ODP) became a key strategic document, setting out the actions that departments had put in place to give effect to the objective of improving wellbeing for all by tackling disadvantage and driving economic growth. The development of the new Energy Strategy was identified as contributing to a Key Strategic Area within Outcome 1 – 'We prosper through a strong, competitive, regionally balanced economy.' Outcome 2 – 'We live and work sustainably – protecting the environment' references reductions in greenhouse gas emissions. The expansion of onshore wind capacity in Northern Ireland provides a clear route to delivering required long term reductions in greenhouse gas emissions.

Onshore Renewable Electricity Action Plan 2011-2020

2.35. The Department of Enterprise, Trade and Investment (DETI) published the Onshore Renewable Electricity Action Plan 2013-2020 (OREAP) for Northern Ireland in November 2013. The overarching aim of the OREAP is to optimise the amount of electricity sustainably generated from onshore renewable resources in order to enhance diversity and security of supply, reduce carbon emissions, contribute to Northern Ireland's target of 40% of electricity consumption to come from renewable energy sources by 2020 and to develop business and employment opportunities for Northern Ireland companies.

2.36. The OREAP states that with a lack of indigenous fossil fuel, no nuclear power stations and a wealth of potential renewable resources such as wind, the development of renewable technologies will play a vital role in the diversification of the future energy mix in Northern Ireland and could deliver significant investment and employment opportunities.

2.37. OREAP focuses on renewable assessments undertaken by DETI and concludes from such reports that onshore wind still has significant deployment potential. However, deployment rates are slower than previously modelled. The results of the Strategic

Environmental Framework (SEF) which support the plan provide "there is still capacity for additional development to be accommodated in existing locations, for example, in the northwest". Furthermore, it is maintained that clustering development in existing locations could reduce potentially significant adverse effects occurring in other undeveloped locations.

2.38. Development should also be targeted to areas where there is already access to the grid or where grid upgrades or the provision of new infrastructure has already been planned and assessed. The plan concludes that in order to manage or limit potential adverse effects, the preferred option would be to allow onshore wind developments to continue, where possible, to cluster in existing areas of development, before moving into new areas.

Sustainable Energy Action Plan 2012 - 2015

2.39. The Action Plan was published by the DETI in May 2012 with the primary aim of clearly showing what the Northern Ireland Executive was doing to promote sustainable energy in Northern Ireland. The Plan recognises the importance of decarbonising energy production in Northern Ireland and working towards the target of 40% consumption of electricity from renewable sources by 2020.

2.40. A key action of the Plan is that the Northern Ireland Executive will work closely with developers, planners and those responsible for environmental consents to ensure the need for renewable energy to address the environmental impact of climate change is recognised and that procedures are in place for consenting of renewable installations.

Everyone's Involved - Sustainable Development Strategy 2010

2.41. This Sustainable Development Strategy (OFMDFM May 2010) aims to bring viability, stability and opportunity to all of our social, economic and environmental activities and programmes. The vision for sustainable development echoes the Programme for Government. It is intended to reinforce the commitment to ensuring that the principles of sustainability reach into all activities of Government and that everyone is involved in achieving the objectives of the Sustainable Development Strategy.

2.42. The Strategy sets out the themes of economic prosperity, social cohesion, environmental protection and meeting our national and international responsibilities and there are two guiding principles that express the overarching ambitions of the Strategy:

- living within environmental limits; and
- ensuring a strong, healthy, just and equal society.

2.43. There are four principles that describe the necessary conditions for the achievement of sustainable development:

- Achieving a sustainable economy

- Promoting good governance
- Using sound science responsibility
- Promoting opportunity and innovation.

2.44. Six Priority Action Areas are then expressed providing the framework for the actions each department will take in support of achievement of sustainable development:

- Building a dynamic, innovative economy that delivers the prosperity required to tackle disadvantage and lift communities out of poverty.
- Strengthening society such that it is more tolerant, inclusive and stable and permits positive progress in quality of life for everyone
- Driving sustainable, long term investment in key infrastructure to support economic and social development.
- Striking an appropriate balance between the responsible use and protection of natural resources in support of a better quality of life and a better quality environment.
- Ensuring reliable, affordable and sustainable energy provision and reducing our carbon footprint.
- Ensuring the existence of a policy environment which supports the overall advancement of sustainable development in and beyond government.

2.45. Priority Action Area 5 is of particular relevance and a set of Strategic Objectives have been identified that will be pursued in this area. These are the biggest and most urgent challenges in this Priority Area. The objectives are as follows:

- Reduce greenhouse gas emissions;
- Increase the proportion of energy derived from renewable sources;
- Implement energy efficiency measures particularly for vulnerable groups;
- Increase energy security; and
- Adapt to the impacts of climate change.

2.46. The strategy recognises that the Private Sector has a role to play, contributing innovation, focus and responsiveness in the move towards a 'sustainability focused' society. The strategy seeks to champion pro-activity and innovation across the private sector in support of the sustainability vision, creating a pathway to accelerate implementation of new technologies and solutions.

Tomorrow's Energy Scenarios Northern Ireland 2019 (TESNI 2019)

2.47. The System Operator for Northern Ireland (SONI) launched a consultation document - Tomorrow's Energy Scenarios Northern Ireland 2019 (TESNI 2019) in September 2019. This sets out scenario planning as a means to create a range of possible energy futures that capture the impact of changes in moving to low carbon electricity for NI.

Strategic Assessment Summary:

2.48. The rationale for the project is clear. Making an energy infrastructure contribution of the scale proposed (58.8MW) will assist in the achievement of NI strategic energy targets and objectives, consistent with a wide range of International, European, UK and Regional level priorities.

2.49. The proposal will offer job creation and economic activity to the regional economy providing significant benefits to and investment in Northern Ireland.

2.50. Given the 30-year lifetime of the development it is expected that direct operational impacts equate to 30 jobs, £1.70 million direct wages and £5.71 million of direct Gross Value Added over the operational phase.

2.51. Both the construction and operational phases will generate increased tax and business rates revenue and the proposal is estimated to involve a capital spend of £39.78 million.

2.52. The amount of electricity that could be produced by the proposed development is estimated at 236.9gWh per year which is enough electricity to meet the needs of 61,900 homes each year, over 5,000 more than the current housing stock (of approximately 56,000) in the local area.

2.53. The proposed development is also estimated to reduce CO_2 emissions by 109,000 tonnes each year.

Northern Ireland Planning Policy

Regional Development Strategy 2035 Building for a Better Future

2.54. The revised RDS was prepared under the Strategic Planning (Northern Ireland) Order 1999. It is an overarching strategic planning framework for the future development of Northern Ireland to 2035 and the spatial strategy of the Executive. The Order requires Departments to have regard to the RDS in exercising any functions in relation to development and it influences investment by the private sector. It represents the top tier in the hierarchy of planning policy and guidance in Northern Ireland and aims to provide a long term policy direction with a strategic spatial perspective. It is material to decisions on individual planning applications and planning appeals and is an important consideration in determining major planning applications of strategic importance. It was agreed by the Executive on 26 January 2012 following a 12 week public consultation exercise and stakeholder meetings.

2.55. The revised RDS sets out a vision and eight aims intended to support the Programme for Government.

2.56. It also contains two types of Strategic Guidance – Regional Guidance of relevance everywhere in the region and Spatial Framework Guidance which is drafted specifically for each of five separate components based on functions and geography. The component of relevance to this project is the Rural Area.

2.57. The Regional Guidelines (RG) relevant to the project are RG4 (Promote a sustainable approach to the provision of tourism infrastructure) and RG5 (Deliver a sustainable and secure energy supply). RG4 states that tourism can make a step change in the economy and emphasises the quality of our natural assets. RG5 states that new energy generation or distribution infrastructure must be carefully sited to avoid adverse environmental effects, particularly on or near protected sites. It goes on to say that decision makers will have to balance impacts against the benefits from a secure renewable energy stream. There is a clear commitment to increasing the contribution that renewable energy can make to the overall energy mix: "There will need to be a significant increase in all types of renewable electricity installations...., including a wide range of renewable resources for electricity generation both onshore and offshore to meet the Region's needs."

2.58. RG9 (reduce our carbon footprint.....) picks up the same theme of increasing the use of renewable energies and refers to the targets set in the Strategic Energy Framework. Having stated the targets RG9 confirms that "this {meeting the 40% target} will require increasing numbers of renewable electricity installations and the grid infrastructure to support them. These must be appropriately sited to minimise their environmental impact." The same RG emphasises the need to protect and extend the ecosystems and habitats that can reduce or buffer the effects of climate change. Peat bogs are identified as sinks or stores for carbon if undisturbed.

2.59. RG11 (Conserve, protect and, where possible, enhance our built heritage and our natural environment) states that the environment is one of Northern Ireland's most important assets and emphasises the responsibility we have to protect it for the benefit of future generations. Specific objectives are set for the built and natural heritage including references to protecting archaeological sites/monuments, historic buildings/landscapes, priority species, designated habitat sites, landscape character, scenic quality and protected landscapes.

2.60. The Spatial Framework Guidance relates to each of the five key components of the Spatial Framework.

2.61. SFG13 (Sustain rural communities living in smaller settlements and the open countryside) refers to the need for development to be sensitive to the ability of landscapes to absorb development. Industries such as tourism and renewable energy are identified as being able to provide jobs and opportunities in rural areas so long as they are integrated appropriately within the rural landscape.

2.62. Section 4 of the revised RDS specifically addresses the matter of regionally significant infrastructure.

2.63. Paragraph 4.4 identifies 'Strategic Projects' capable of contributing to economic infrastructure development as including those that contribute to the achievement of renewable energy targets.

2.64. Paragraphs 4.15 to 4.18 refer specifically to renewable energy.

2.65. Paragraph 4.15 refers to the 40% SEF target and states that "this is likely to mean an increase in the number of wind farms both on and off shore..." Paragraph 4.16 refers to the need to strengthen the electricity grid. Paragraph 4.17 refers to the importance of interconnection. Paragraph 4.24 refers again to the need to increase the use of renewable energy sources to address climate change targets.

2.66. **Assessment:** Delivering a new installation for the generation of renewable energy is consistent with the imperative to meet the strategic energy targets and in line with the RDS' expectation that this will mean an increase in the number of wind farms. This ES provides sufficient information on each of the interests of acknowledged planning importance identified in the RDS to conclude that the benefits of the scheme outweigh the mitigated environmental impacts.

Planning Policy Statements

Strategic Planning Policy Statement for Northern Ireland (SPPS)

2.67. The SPPS was published by the Department of the Environment on 28 September 2015 as a statement of policy on important planning matters. Agreed by the NI Executive and judged to be in general conformity with the RDS, its provisions apply to the whole of Northern Ireland and are material to all decisions on individual planning applications.

2.68. The existing suite of Planning Policy Statements (PPS) and the remaining provisions of the Planning Strategy for Rural Northern Ireland (PSRNI) will be cancelled when all eleven Councils have adopted a new Plan Strategy (para 1.9).

2.69. A transitional period will apply until such times as a Council's Plan Strategy has been adopted. Paragraph 1.10 states:

2.70. 'A transitional period will operate until such times as a Plan Strategy for the whole of the council area has been adopted. During the transitional period planning authorities will apply existing policy contained within the documents identified below together with the SPPS. Any relevant supplementary and best practice guidance will also continue to apply.'

2.71. Paragraph 1.12 sets out the approach which will be taken where there is conflict between the SPPS and retained policy:

2.72. Any conflict between the SPPS and any policy retained under the transitional arrangements must be resolved in the favour of the provisions of the SPPS. For example, where the SPPS introduces a change of policy direction and/or provides a policy clarification that would be in conflict with the retained policy the SPPS should be accorded greater weight in the assessment of individual planning applications. However, where the SPPS is silent or less prescriptive on a particular planning policy matter than retained policies this should not be judged to lessen the weight to be afforded to the retained policy.

2.73. Paragraph 1.13 identifies retained policy as including the following PPSs relevant to this project:

- PPS 2: Natural Heritage (considered within Chapters 4, 6, 7 8 & 9)
- PPS 3: Access, Movement and Parking (considered within Chapter 11)
- PPS 3 (Clarification): Access, Movement and Parking (considered within Chapter 11)
- PPS 6: Planning, Archaeology and The Built Heritage (considered within Chapter 5)
- PPS 10: Telecommunications (Policy TEL 2 is cancelled) (considered within Chapter 3)
- PPS 15 Revised: Planning and Flood Risk (considered within Chapter 9)
- PPS 16: Tourism (considered within Chapters 4 & 13)
- PPS 18: Renewable Energy (considered within Chapters 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 & 13)
- PPS 21: Sustainable Development in the Countryside (considered within Chapters 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 & 13).

2.74. As per SPPS paragraph 1.12, in this period before the Council adopts its Plan Strategy, it is necessary to assess whether there is a conflict between the SPPS and any retained policy. Paragraph 1.12 provides an example of such a circumstance – where the SPPS contains a change in policy direction and/or a policy clarification in conflict with retained policy.

2.75. In his written statement dated 28 September 2015, introducing the SPPS, the Minister made the following comments:

2.76. There are a number of subject policies that are likely to be of particular interest to Assembly Members.

2.77. The first of these is Renewable Energy. Having taken into account all the comments received on the draft SPPS and following additional engagement with the Committee and others in relation to this particular policy area, the SPPS has been revised and improved.

2.78. There is a greater acknowledgement of the contribution the renewable energy industry makes towards achieving sustainable development, as a provider of jobs and investment across the region, and an acknowledgement of wider government policy support for the use of renewable energy sources. This includes reference to DETI's Strategic Energy Framework.

2.79. Furthermore, the SPPS seeks to more closely reflect PPS 18 by making it clearer that development that generates energy from renewable resources will be permitted where the proposal and any associated buildings and infrastructure, will not result in unacceptable adverse impacts on interests of acknowledged importance.

2.80. In relation to how the wider environmental, economic and social benefits are to be assessed the SPPS clarifies that planning authorities will give such considerations 'appropriate' weight in determining whether planning permission should be granted.

2.81. It is also considered appropriate that a cautious approach in designated landscapes, as per the current best practice guidance, is reflected in strategic policy and therefore this approach has been carried forward in the SPPS.

2.82. Where appropriate, the SPPS also takes into account the recommendations of the Report of the Environment Committee's Wind Energy Inquiry.

2.83. This statement confirms that the SPPS clarifies policy on the weight to be attached to social, environmental and economic considerations in the determination of planning applications. PPS18 Policy RE1 states that 'significant' weight 'must' be attached to such considerations whereas paragraph 6.225 of the SPPS states that 'appropriate' weight should be attached:

2.84. The wider environmental, economic and social benefits of all proposals for renewable energy projects are material considerations that will be given appropriate weight in determining whether planning permission should be granted.

2.85. The change in wording means that whereas PPS18 directs the weight to be attached to the benefits, the SPPS provides the decision maker with discretion in deciding the appropriate amount of weight to be attached to the benefits. In making such a judgement, it is anticipated that the decision maker will take account of the extent of the benefits in a relative or proportionate way. Where a scheme, such as this, will deliver large scale benefits (as set out within the Socio Economic details at Chapter 13), it would be logical to suggest that the decision maker would conclude it appropriate to give significant weight to the benefits. The consequence of this is that if a scheme would deliver only small scale benefits, less weight would be attached to the benefits.

2.86. The other main provisions of PPS18 and its associated Best Practice Guidance are carried through into the SPPS including:

- The direction to take particular care when considering the potential impact of all renewable proposals on the landscape (para 6.222);
- The direction to apply a cautious approach for renewable energy projects within designated landscapes of significant value such as Areas of Outstanding Natural Beauty (para 6.223);
- The presumption in favour of renewables proposals where there will be no unacceptable adverse effect on the PPS18 set of planning considerations (6.224);
- Stating that renewable energy development on active peatland will not be permitted unless there are imperative reasons of overriding public interest (para 6.226);

- Specifying that for wind farm development a separation distance of 10 times rotor diameter to occupied property, with a minimum distance of not less than 500m, will generally apply;
- Confirming that consideration of renewables projects will take account of their contribution meeting wider environmental benefits (para 6.228);
- Confirmation that the factors considered in a planning decision will include the wider environmental benefits as well as normal planning criteria (paragraph 6.229);
- A restatement of the acknowledgement that windfarms are highly visible in the landscape yet this does not render them unacceptable, and the reference to the skill of the designer and the characteristics of the receiving landscape (paragraph 6.230);
- The requirement, where a project will result in unacceptable damage, for an indication of how such damage will be minimised, mitigated and compensated for (paragraph 6.231);
- The requirement to provide details of future decommissioning and site restoration (paragraph 6.233);
- The direction to take account of the supplementary planning guidance 'Wind Energy Development in Northern Ireland's Landscapes' and all other practice notes in assessing all wind turbine proposals (paragraph 6.234).

2.87. This chapter considers the retained policy framework having regard to the SPPS and its associated transitionary arrangements.

Planning Policy Statement 2 – Natural Heritage

2.88. PPS2 is retained policy for the purposes of the SPPS transitionary arrangements. There is considered to be no conflict with the equivalent provisions in the SPPS, therefore until the Council adopts its Plan Strategy, its provisions will apply, together with the SPPS, with no less weight attached to the retained policy.

2.89. SPPS policy on Natural Heritage is set out on pages 80 to 85. It consolidates and restates policy set out in PPS2. The Minister did not identify any conflicts or clarifications in his statement launching the SPPS. The principal focus of this section is, therefore, on PPS2.

2.90. PPS 2 was published in July 2013 and provides strategic planning policy for the conservation, protection and enhancement of the natural heritage. For the purpose of the PPS, natural heritage is defined as 'the diversity of our habitats, species, landscapes and earth science features'.

2.91. The policy lists its objectives as:

- To seek to further the conservation, enhancement and restoration of the abundance, quality, diversity and distinctiveness of the region's natural heritage;

- To further sustainable development by ensuring that biological and geological diversity are conserved and enhanced as an integral part of social, economic and environmental development;
- To assist in meeting international (including European), national and local responsibilities and obligations in the protection and enhancement of the natural heritage;
- To contribute to rural renewal and urban regeneration by ensuring developments take account of the role and value of biodiversity in supporting economic diversification and contributing to a high quality environment;
- To protect and enhance biodiversity, geo-diversity and the environment; and
- To take actions to reduce our carbon footprint and facilitate adaptation to climate change.

2.92. The policy at paragraph 3.3 notes that in taking decisions, the Department should ensure that appropriate weight is attached to designated sites of international, national and local importance; priority and protected species; and to biodiversity and geological interests within the wider environment.

2.93. At section 5 the PPS lists the policy context and statutory framework, addressing international, national and local contexts.

2.94. The Development lies partly within the Scawt Hill Area of Special Scientific Interest (ASSI) which is declared primarily for its geological features. There are also a number of other ASSI's in the area surrounding the site including: Feyston ASSI, Glenarm Woods ASSI, Glenarm Woods Part 2 ASSI, Ballygalley Head ASSI, Little Deer Park ASSI, Straidkilly Wood ASSI and Knock Dhu Sallagh Braes ASSI. The Garron Plateau Special Area of Conservation (SAC) is with 7.0km of the development and the Antrim Hills Special Protection Area (SPA) lies within 2.9km of the Development.

International Sites

2.95. In relation to international sites, such as SACs, Policy NH1 - European and Ramsar Sites – International, sets out the relevant planning policy requirements.

2.96. The policy indicates that planning permission will only be granted for a development proposal that, either individually or in combination with existing and/or proposed plans or projects, is not likely to have a significant effect on an SAC or SPA. In line with the legislative framework it goes on to state:

2.97. Where a development proposal is likely to have a significant effect (either alone or in combination) or reasonable scientific doubt remains, the Department shall make an appropriate assessment of the implications for the site in view of the site's conservation objectives. Appropriate mitigation measures in the form of planning conditions may be imposed. In light of the conclusions of the assessment, the Department shall agree to the development only after having ascertained that it will not adversely affect the integrity of the site.

2.98. The final part of the policy describes the type of exceptional circumstances where proposals which could adversely affect the integrity of an international site may be permitted.

2.99. **Assessment:** Chapters 6, 8, and 9 of this ES assess the impact of the project on designated sites. They demonstrate that, following mitigation, there will be no significant effect on the qualities of the Garron Plateau SAC or Antrim Hills SPA and that the project will not adversely affect the integrity of the sites. There is no need to engage the exceptional circumstances part of this policy.

European and National Species

2.100. In relation to European and National species protected by law, Policy NH2 sets out the relevant planning policy requirements. In relation to European protected species, the policy states that planning permission will only be granted for a development proposal that is not likely to harm a European protected species. It goes on to identify exceptional circumstances. In relation to National protected species, the policy states that planning permission will only be granted for a development proposal that is not likely to harm any other statutorily protected species and which can be adequately mitigated or compensated against.

2.101. **Assessment:** Chapters 6, 7, 8 and 9 of this ES assess the impact of the project on European and National Species protected by law. They demonstrate that, following mitigation, the project will have no significant effects on and is unlikely to harm any protected species. There is no need to engage the exceptional circumstances parts of this policy.

National Sites

2.102. In relation to national sites, such as ASSIs, Policy NH3 – Sites of Nature Conservation Importance – National, sets out the relevant planning policy requirements.

2.103. The policy indicates that planning permission will only be granted for a development proposal that is not likely to have an adverse effect on the integrity, including the value of the site to the habitat network, or special interest of an ASSI. The policy indicates that a proposal which could adversely affect a site of national importance may only be permitted where the benefits of the proposed development clearly outweigh the value of the site. In such cases, appropriate mitigation and/or compensatory measures will be required.

2.104. **Assessment:** Chapters 6, 7, 8 and 9 of this ES assess the impact of the project on designated sites. They demonstrate that, following mitigation, there will be no adverse effects on the Scawt Hill ASSI. There is no need to weigh the benefits of the proposed Development, although these are clearly set out in Chapter 13.

Habitats, Species or Features of Natural Heritage Importance

2.105. Policies relevant to Habitats, Species or Features of Natural Heritage Importance are set out at Policy NH5. The policy indicates that a development proposal which is likely to result in an unacceptable adverse impact on, or damage to, habitats, species or features may only be permitted where the benefits of the proposed development outweigh the value of the habitat, species or feature. In such cases, appropriate mitigation and/or compensatory measures will be required.

2.106. This policy applies to priority habitats; priority species; active peatland; ancient and long-established woodland; features of earth science conservation importance; features of the landscape which are of major importance for wild flora and fauna; rare or threatened native species; wetlands (includes river corridors); and other natural heritage features worthy of protection.

2.107. **Assessment:** Chapters 6, 7 and 8 of this ES assess the impact of the project on important habitats, species and features of natural heritage importance, including peat and active peatland. They demonstrate that, following mitigation, there will be no unacceptable adverse effects on such interests. Whilst mitigation and compensation is proposed, there is no need to weigh the benefits of the proposed development, although these are clearly set out in Chapter 13.

Areas of Outstanding Natural Beauty

2.108. Policy NH6 sets out planning policy in relation to projects in Areas of Outstanding Natural Beauty (AONB). Planning permission for new development within an AONB will only be granted where it is of an appropriate design, size and scale for the locality and three criteria are met, including: a) the siting and scale of the proposal is sympathetic to the special character of the AONB in general and of the particular locality; and b) it respects or conserves features (including buildings and other man-made features) of importance to the character, appearance or heritage of the landscape.

2.109. **Assessment:** Chapter 4 of this ES assesses the impact of the project on the Antrim Coast and Glens AONB. Consistent with the SPPS' cautious approach to protected landscapes (para 6.223) and the BPG (para 1.3.23), every effort in siting and design has been made to reduce the impact of the proposed development and aid integration into the local landscape. Whilst there are significant landscape and visual effects, as are expected (by PPS18) with a windfarm, the proposal has sought to be of an appropriate design, size and scale for the locality, recognising the character of the wider AONB and the specific locality..

2.110. The landscape and visual impact of the windfarm is not unacceptably adverse for the purposes of the SPPS and PPS18 Policy RE1 because the inherent characteristics of the landscape provide the capacity to absorb it. The effects – relative to the qualities that underpin the designation – would not undermine the overall AONB or compromise wider landscape and visual amenity to an unacceptable degree. The impacts which are identified have to be weighed against the significant benefits of the proposed development (see Chapter 13) in the planning balance.

Planning Policy Statement 3 – Access, Movement and Parking

2.111. PPS3 is retained policy for the purposes of the SPPS transitional arrangements. There is considered to be no conflict with the equivalent provisions in the SPPS, therefore until the Council adopts its Plan Strategy, its provisions will apply, together with the SPPS, with no less weight attached to the retained policy.

2.112. SPPS policy on Transportation is set out on pages 106 to 110. It consolidates and restates policy set out in PPS3 and PPS13. The Minister did not identify any conflicts or clarifications in his statement launching the SPPS. The principal focus of this section is, therefore, on PPS3.

2.113. PPS 3 (NI Planning Service, 2005) states that the orderly and effective implementation of the local development plan objectives requires provision of infrastructure and facilities, which include an adequate public road and transport network. Also the potential impact that a development may have on the efficiency of the public road network or on road safety is an important material consideration.

2.114. Policy AMP2 Access to Public Roads states:

2.115. 'Planning permission will only be granted for a development proposal involving direct access, or the intensification of the use of an existing access, onto a public road where such access will not prejudice road safety or significantly inconvenience the flow of traffic.'

2.116. **Assessment:** Chapter 11 of this ES assesses the impact of the project on the receiving road network. It demonstrates that, following mitigation, there will be no prejudice to road safety or significant inconvenience to the flow of traffic on the adjacent road network during either construction, operation or decommissioning of the project.

Planning Policy Statement 6 – Planning, Archaeology and the Built Heritage

2.117. PPS6 is retained policy for the purposes of the SPPS transitional arrangements. There is considered to be no conflict with the equivalent provisions in the SPPS, therefore until the Council adopts its Plan Strategy, its provisions will apply, together with the SPPS, with no less weight attached to the retained policy.

2.118. SPPS policy on Archaeology and Built Heritage is set out on pages 37 to 44. It consolidates and restates policy set out in PPS6. The Minister did not identify any conflicts or clarifications in his statement launching the SPPS. The principal focus of this section is, therefore, on PPS6.

2.119. PPS 6 (NI Planning Service, 1999) sets out the Department's planning policies for the protection and conservation of archaeological remains and features of the built heritage. Archaeological sites and monuments, whether scheduled or otherwise, and their settings is a material consideration due to the desire to preserve these features. The contents of PPS 6 will be taken into account when preparing development plans and will be considered when determining planning applications.

2.120. Policy BH 1 of PPS 6 states the following:

"Development which would adversely affect such sites of regional importance or the integrity of their settings will not be permitted unless there are exceptional circumstances."

2.121. And Policy BH 2 states:

"Development proposals which would adversely affect archaeological sites or monuments which are of local importance or their settings will only be permitted where the Department considers the importance of the proposed development or other material considerations outweigh the value of the remains in question."

2.122. Policy BH 3 states:

"Where the impact of a development proposal on important archaeological remains is unclear, or the relative importance of such remains is uncertain, the Department will normally require developers to provide further information in the form of an archaeological assessment or an archaeological evaluation."

2.123. Policy BH 4 states:

"Where it is decided to grant planning permission for development which will affect sites known to contain archaeological remains, the Department will impose conditions to ensure that appropriate measures are taken for the identification and mitigation of archaeological impacts of the development…"

2.124. Policy BH6 states:

'The department will not normally permit development which would lead to the loss of, or cause harm to, the character, principal components or setting of parks, gardens and demesnes of special historic interest. Where planning permission is granted this will normally be conditional on the recording of any features of interest which will be lost before development commences.'

2.125. Policy BH11 states:

- 'The department will not normally permit development which would adversely affect the setting of a listed building. Development proposals will normally only be considered appropriate where all the following criteria are met:
- The detailed design respects the listed building in terms of scale, height, massing and alignment;
- The works proposed make use of traditional or sympathetic building materials and techniques which respect those found on the building; and
- The nature of the use proposed respects the character of the setting of the building'

2.126. PPS6 paragraph 2.6 states that development plans, where appropriate, will designate areas of significant archaeological interest (ASAIs). Such designations seek to identify particularly distinctive areas of the historic landscape in Northern Ireland. They are likely to include a number of individual and related sites and monuments and may also be distinguished by their landscape character and topography. Local policies or proposals for the protection of the overall character and integrity of these distinctive areas will normally be included in development plans.

2.127. **Assessment:** The proposed Development footprint is located outside the current ASAI designation with the exception of an existing track to be upgraded to access the site, and a short section of new proposed track.. Chapter 5 of this ES assesses the impact of the proposal on archaeology and cultural heritage. It demonstrates that the Development will have no physical impact on any known cultural asset and sets out a mitigation strategy for the identification of previously unknown archaeological remains for which there is no surface expression. The assessment concludes that there will be no significant impacts on protected interests having considered the potential impact on the scheduled monuments (Giant's Tomb, Giants' Grave, and Knockdhu Fort), Listed Building (RC Feystown Church) and Park (Glenarm Registered Park). It outlines potential moderate adverse impacts which are at the lowest end of the scale of possible significant effects to the Standing Stone and Cairn on Scawt Hill and concludes that the Development will have a minor adverse effect on the setting of the ASAI.

Planning Policy Statement 10 – Telecommunications

2.128. PPS10 is retained policy for the purposes of the SPPS transitionary arrangements. There is considered to be no conflict with the equivalent provisions in the SPPS, therefore until the Council adopts its Plan Strategy, its provisions will apply, together with the SPPS, with no less weight attached to the retained policy.

2.129. SPPS policy on Telecommunications and Other Utilities is set out on pages 94 to 96. It consolidates and restates policy set out in PPS10. The Minister did not identify any conflicts or clarifications in his statement launching the SPPS. The principal focus of this section is, therefore, on PPS10.

2.130. PPS 10 (NI Planning Service, 2002) states that large, prominent structures such as wind turbines can cause disruption to analogue television services by obstructing or reflecting the wanted signals. Policy TEL2 Development and Interference with Television Broadcasting services further states that:

2.131. 'The Department may refuse planning permission for development proposals which would result in undue interference with terrestrial television broadcasting services.'

2.132. In its justification for this statement the Department advises that it:

'Will wish to be satisfied that the potential for interference has been fully taken into account in the siting and design of large and prominent buildings and structures, since it will be more difficult, costly and sometimes impossible to correct after the event. Developers of wind turbines and any other structure which by virtue of its size, height or finishes is likely to result in undue interference are therefore encouraged seek expert advice on this matter before submitting their proposals.'

2.133. It further states that:

'Only in extreme cases where there is evidence that no practical remedy exists to overcome or otherwise mitigate problems of undue interference would the Department be justified in refusing planning permission.'

2.134. Paragraph 6.35 of PPS10 states that:

2.135. 'In any development, significant and irremediable interference with other electrical equipment of any kind can be a material planning consideration. Electromagnetic interference may be caused by a radio transmitter or by unwanted signals emitted by other electrical equipment. The Radio communications Agency has statutory powers for dealing with this type of interference under the Wireless Telegraphy Act 1949 (see Annex B).

2.136. **Assessment:** The proposals will have no significant effect on PPS10 interests.

Planning Policy Statement 15 – Planning and Flood Risk

2.137. PPS15 is retained policy for the purposes of the SPPS transitionary arrangements. There is considered to be no conflict with the equivalent provisions in the SPPS, therefore until the Council adopts its Plan Strategy, its provisions will apply, together with the SPPS, with no less weight attached to the retained policy.

2.138. SPPS policy on Flood Risk is set out on pages 61 to 68. It consolidates and restates policy set out in PPS15. The Minister did not identify any conflicts or clarifications in his statement launching the SPPS. The principal focus of this section is, therefore, on PPS15.

2.139. Revised PPS15 was published in September 2014 and contains policies relevant to the development of any proposal site in relation to flood risk:

2.140. Policy FLD 3 states:

Beyond coastal flood plains and the flood plains of rivers the Department will not permit development which is known to be at risk from flooding, or which would be likely to increase the risk of flooding elsewhere. An exception to this policy will only be permitted where an application is accompanied by measures to mitigate the risk of flooding and it is demonstrated that such measures will not increase flood risk elsewhere, will not result in an adverse impact on visual amenity or the character of the local landscape; and will not result in an adverse impact on features of importance to nature conservation, archaeology or the built heritage.

2.141. **Assessment:** Chapter 9 of this ES assesses the impact of the project from a drainage and flood risk perspective. It demonstrates that, after mitigation, the project site is not at risk of flooding and will not increase flood risk elsewhere. It is, therefore, policy compliant.

Planning Policy Statement 16 - Tourism

2.142. PPS16 is retained policy for the purposes of the SPPS transitional arrangements. There is considered to be no conflict with the equivalent provisions in the SPPS, therefore until the Council adopts its Plan Strategy, its provisions will apply, together with the SPPS, with no less weight attached to the retained policy.

2.143. SPPS policy on Tourism is set out on pages 97 to 100. It consolidates and restates policy set out in PPS16. The Minister did not identify any conflicts or clarifications in his statement launching the SPPS. The principal focus of this section is, therefore, on PPS16.

2.144. PPS 16 was published in June 2013. This statement sets out the Department's planning policy for tourism development and also for the safeguarding of tourism assets. It seeks to facilitate economic growth and social well-being through tourism in ways which are sustainable and compatible with environmental welfare and the conservation of important environmental assets. It embodies the Government's commitment to sustainable development and to the conservation of biodiversity.

2.145. The objectives of PPS16 are to:

- Facilitate sustainable tourism development in an environmentally sensitive manner;
- Contribute to the growth of the regional economy by facilitating tourism growth;
- Safeguard tourism assets from inappropriate development;
- Utilise and develop the tourism potential of settlements by facilitating tourism development of an appropriate nature, location and scale;
- Sustain a vibrant rural community by supporting tourism development of an appropriate nature, location and scale in rural areas; and
- Ensure a high standard of quality and design for all tourism development.

2.146. Policy TSM 8 sets out the criteria for the safeguarding of tourism assets. It indicates that planning permission will not be granted for development that would in itself or in combination with existing and approved development in the locality have an adverse impact on a tourism asset such as to significantly compromise its tourism value.

2.147. **Assessment:** The information within this ES, in particular at Chapters 4 and 5 assesses the impact of the proposals on the receiving environment, considering its visibility and connection to tourist assets within the study area.

2.148. Paragraph 1.3.80 of the Best Practices Guidance refers to wind energy development not necessarily being incompatible with tourism and leisure interests.

2.149. Having regard to the conclusions of the Shanti McAllister and Orion assessments in respect of landscape/visual impact and cultural heritage insofar as both of these considerations contribute to the area's tourism assets and on the basis that the proposal would not deter visitors from utilising the tourism assets in the area, it is concluded that the proposed development complies with PPS16 Policy TSM8.

Panning Policy Statement 18 – Renewable Energy

2.150. PPS18 is retained policy for the purposes of the SPPS transitionary arrangements. There is considered to be conflict with the equivalent provisions in the SPPS, only insofar as the SPPS changes the direction to attach 'significant' weight to the benefits associated with renewable energy projects and provides the decision maker with discretion in deciding the 'appropriate' amount of weight to be attached to the benefits. This is discussed in paragraphs 58 to 60 above. Therefore until the Council adopts its Plan Strategy, in terms of the 'weighting direction' the provisions of the SPPS apply, with less weight being attached to the retained policy. In all other respects, it is anticipated that no less weight will be attached to the retained policy in PPS18 Policy RE1.

2.151. PPS18, of August 2009, is the key planning policy for renewable energy in Northern Ireland. Paragraph 3.1 of PPS18 states that its aim is to facilitate the siting of renewable energy generating facilities in appropriate locations to achieve Northern Ireland's renewable energy targets and to realise the benefits of renewable energy. This is a permissive policy context. In a speech on 2 September 2009 to the Irish Wind Energy Association (IWEA) the Minster of the Environment stated "nothing illustrates the promotive nature of PPS18 more so than the opening up of AONB's to wind energy development for the first time. This is in stark contrast to the previous policy where there was a general presumption against wind farm development in AONB's".

2.152. Within this permissive policy context PPS18 sets out the Department's objectives relevant to renewable energy and its proposed planning policies that will help deliver these objectives.

2.153. The applicable policy objectives of PPS18 are:

- to ensure that the environmental, landscape, visual and amenity impacts associated with or arising from renewable energy development are adequately addressed; and
- to ensure adequate protection of the Region's built and natural, and cultural heritage features.

2.154. Policy RE 1 - Renewable Energy Development sets out a presumption in favour of renewable energy development provided it will not result in unacceptable adverse impact on five criteria. These include criteria around the need to protect and conserve the environment, visual amenity, human health and residential amenity, and public access to the countryside.

2.155. The policy specifically adopts a mitigation/compensation led approach and emphasises the 'significant' weight to be attached to the wider benefits of renewable energy projects. Paragraph 4.1 of the justification and amplification states that:

2.156. "Where any project is likely to result in unavoidable damage during its installation, operation or decommissioning, the application will need to indicate how this will be minimised and mitigated, including details of any proposed compensatory measures, such as a habitat management plan or the creation of a new habitat.

2.157. The wider environmental, economic and social benefits of all proposals for renewable energy projects are material considerations that will be given significant weight in determining whether planning permission should be granted.

2.158. This direction on where significant weight should be attached in the balancing exercise required by the policy is probably unique in the UK and Ireland and must be rooted in the Executive's agenda for renewable energy. The policy goes on to establish a set of seven additional criteria specifically for wind energy proposals including protection of visual amenity, consideration of cumulative impact, landslide risk, electromagnetic interference, roads, and residential amenity. The overall wording and thrust of the policy suggests that some degree of adverse impact may be acceptable.

2.159. Reference is made within this policy to the protection of active peatland, advising that development on this type of habitat will not be permitted unless there are imperative reasons of overriding public interest. The policy also states that for wind farm development a separation distance of 10 times rotor diameter to occupied property, with a minimum distance not less than 500m, will generally apply. The policy note also advises that turbines should be set back at least fall over distance plus 10% from the edge of any public road; public right of way; or railway line so as to achieve maximum safety.

2.160. **Assessment:** The wider environmental, economic and social benefits (Chapter 13) of the proposal are identified in this ES. Retained policy in PPS18 Policy RE1 requires that significant weight is attached to these factors but since there is conflict with the SPPS, greater weight is to be attached to the equivalent provision in the SPPS. The equivalent provision in the SPPS states that 'appropriate' weight should be given to the benefits. Appropriate weight must be relative to the scale of the benefits. In this case the social, environmental and economic benefits of the project are large in scale, proportionate to the scale and significance of the project. It follows that when considering the appropriate weight to attach to the benefits, the decision maker should attach significant weight.

2.161. This approach is evident in the PAC's consideration of the following appeals whereby the substantial environmental, economic and social benefits of the proposal were attributed significant weight (PAC Refs: 2012/A0070, 2015/A0102, 2015/A0168, 2015/A0169, 2015/A200).

2.162. This ES demonstrates that there are limited adverse effects after mitigation and these are confined to landscape and visual effects, as are expected (by PPS18) with a windfarm.

2.163. Tested in the round, with the appropriate weighing of the benefits as still directed by the policy, the proposal is considered to meet the requirements of PPS18.

2.164. More specifically, the project does not propose development on active peat and there are no dwellings within the minimum distance of 500m. Planning Appeals Commission commentary and interpretation in respect of the 10 rotor diameter distance is outlined in the following appeal cases PAC Refs: 2012/A0070, 2013/A0220, 2014/A0285, 2015/A0200, 2017/A0050, 2018/A0199 where in summary a degree of latitude can be applied to separation distances and the 10 times rotor diameter need not rigidly apply. No turbines are located within falling distance of any roads or rights of way and the fall distance has also been applied to the Ulster Way.

PPS18 Best Practice Guidance (BPG)

2.165. PPS18 BPG is to continue to be treated as a material consideration during the transitionary (or after) as per paragraph 1.14 of the SPPS.

2.166. The guidance document (NI Planning Service, 2009b) provides background information on a variety of renewable energy technologies and is intended to be read in conjunction with PPS 18. Section 1 is specific to wind energy. Paragraph 1.3.4 of the guidance document states that "Each planning application will be considered on its own merits, and the argument that granting permission might lead to another application will not be sufficient grounds for refusal."

2.167. The guidance document (NI Planning Service, 2009b) provides background information on a variety of renewable energy technologies and is intended to be read in conjunction with PPS 18.

2.168. The guidance document further details the issues relevant to planning applications for onshore wind energy. These include nature conservation, landscape and visual impact, hydrology and geology, archaeology and built heritage, noise, aviation, and health and safety issues (e.g. public access, shadow flicker and ice throw).

2.169. **Assessment:** The policy assessment in relation to PPS18 has had regard to the guidance contained within the BPG.

Wind Energy Development in Northern Ireland's Landscapes – Supplementary Planning Guidance (SPG)

2.170. This SPG is to continue to be treated as a material consideration during the transitionary (or after) as per paragraph 1.14 of the SPPS.

2.171. The SPG (NIEA, 2010) sets out the background to Northern Ireland's landscapes, describes the approach and general principles that should be applied to potential wind energy developments, and it provides guidance related to specific sensitivity of each of the 130 Landscape Character Areas (LCAs) in Northern Ireland to wind energy development. It is intended to help developers in identifying appropriate sites for wind energy generation.

2.172. **Assessment:** The SPG has been taken into account in the assessment of landscape and visual impact in Chapter 4.

Planning Policy Statement 21 – Sustainable Development in the Countryside

2.173. PPS21 is retained policy for the purposes of the SPPS transitional arrangements. Although referred to in the Minister's statement launching the SPPS, as far as renewable energy proposals are concerned there is considered to be no conflict with the equivalent provisions in the SPPS. Therefore until the Council adopts its Plan Strategy, the renewable energy related provisions of PPS21 will apply, together with the SPPS, with no less weight attached to the retained policy.

2.174. The aim of PPS 21 (NI Planning Service, 2010) is to manage development in the countryside in a manner consistent with achieving the strategic objectives of the Regional Development Strategy for Northern Ireland, which also strikes a balance between the need to protect the countryside from unnecessary or inappropriate development, while supporting rural communities.

2.175. Policy CTY 1 (Development in the Countryside) states that there are a range of types of development which in principle are considered to be acceptable in the countryside and that will contribute to the aims of sustainable development. Non-residential developments such as renewable energy projects are considered an acceptable type of development when they are in accordance with PPS 18.

2.176. **Assessment:** On the basis that the proposals meet the requirements of PPS18, the project is also acceptable in respect of PPS21.

Local Policy Context

2.177. Section 6(4) of the Planning Act (NI) 2011 (the Act) requires that the determination of proposals must be in accordance with the prevailing local development plan unless material considerations indicate otherwise.

2.178. Section 45(1) of the Act provides meaning on the weight to be afforded to the plan in determining planning applications subject to this part and section 91(2); 'Where an application is made for planning permission, the Council, or as the case may be, the Department, in dealing with the application must have regard to the local development plan, so far as material to the application, and to any other material considerations..'

2.179. The site falls within Mid and East Antrim Borough Council. The following Local Plans are of relevance.

Larne Area Plan 2010

2.180. The purpose of the Larne Area Plan (LAP) is to set out the broad land use framework for the physical development of the district. It aims to create urban and rural environments which will make a positive contribution to an improvement in the quality of life in the Borough. Whilst significantly dated (published in March 1998) it remains the extant plan for the area. References to applicable policy are outlined below with relevant references to those superseded by strategic policy direction where relevant.

2.181. The LAP contains policies and provisions relating to development in the countryside, the protection of Areas of Significant Archaeological Interest (ASAIs), wind turbine development within the AONB and the protection of tourism resources.

2.182. The application site falls outside of any defined settlements in the Plan and as such falls within the countryside. The Development falls within:

- an Area of Outstanding Natural Beauty (Antrim Coast and Glens)
- an Area of Constraint on Mineral Development.
- The following designations are relevant:
- an Area of Special Archaeological Interest;
- Scawt Hill and Sallagh Braes ASI, incorporating Scawt Hill ASSI; and
- Feystown ASSI.

2.183. Policy MAN EN1 of the LAP states that the Planning Authority will protect ASAIs from inappropriate development. It states that the designation of the overall setting in which a number of individual and related monuments are located, or an area of historic landscape, as an ASAI, is intended to protect the individual sites or monuments and their setting from inappropriate development.

2.184. The archaeological designation refers to an upland area known as Knockdhu and is designated due to the concentration of prehistoric and archaeological sites located here. The area is also shown as a Countryside Policy Area in the Larne Area Plan however; the policy provisions of PPS21 take precedence over this designation, as noted in the preamble on page 2 of PPS21 (June 2010).

2.185. Specific to Energy page 41 of the LAP states:

2.186. 'As part of an international drive to combat acid rain and reduce the emission of greenhouse gases there is a greater awareness of the environmental consequences of energy production and a growing emphasis on both energy conservation and renewable energy sources.

2.187. Government Policy in relation to energy is aimed at ensuring that the needs of society for energy are satisfied while at the same time ensuring that environmental damage is kept to a minimum. Consequently the Department will support initiatives aimed at reducing the demand for energy from fossil fuels

2.188. Much of the Area is within the Antrim Coast and Glens AONB and as such would not be considered suitable for the location of wind turbines'.

2.189. However the provisions of the more recent regional policies of the PPS18 and SPPS take precedence over this statement with respect of wind turbine development within the AONB.

2.190. Policy COU 1 of the LAP states that the Planning Authority will protect, conserve and enhance sensitive landscapes, accommodate the needs of the farming community and protect vulnerable areas from development pressure. Policy NV 4 of the LAP designates a Countryside Policy Area (CPA) for the Antrim Coast and Glens AONB. Regional policy provisions superseded these policies.

2.191. Policy COU 3 states that in assessing development proposals, the Department will apply the principles contained in the Antrim Coast and Glens AONB Design Guide. However the noted guide deals essentially with the design of buildings and does not consider wind turbine development.

2.192. Policy T1 outlines that the tourism resources of the area comprised in the landscape and the natural and manmade environment, will be protected from inappropriate forms of development. It outlines that that the Countryside Policy Area (CPA) applicable in the Antrim Coast and Glens AONB will help to protect such areas from development which is not considered to be essential. This policy is superseded by more recent regional policies of PPS16.

Emerging Local Development Plan

2.193. The Council has prepared a timetable for the preparation of its Local Development Plan (LDP) for the Borough up to 2030 and published its Mid and East Antrim Borough Council Local Development Plan 2030 draft Plan Strategy (dPS) in September 2019.

2.194. The dPS contains several policies which, directly and indirectly control the feasibility, viability and location of renewable energy infrastructure and particularly wind turbines. These policies are:

- Draft Policy CS1 – Sustainable development in the Countryside (cross refers to Draft Policy RE1)
- Draft Policy CS2 – Special Countryside Areas
- Draft Policy CS3 - Areas of Constraint on High Structures
- Draft Policy CS5 – Antrim Coast and Glens Area of Outstanding Natural Beauty
- Draft Policy RE1 – Renewable Energy Development; and
- Draft Policy TOC1 – Telecommunications Development and Overhead Cables

2.195. The draft plan also proposes an extension of the Knockdhu Area of Significant Archaeological Interest (ASAI).

2.196. The above policies have been the subject of objections and it cannot be assumed such policies will be carried forward to an adopted Plan Strategy. Indeed the plan has yet to be independently examined against the tests of soundness or found sound, as required under Section 10 (6) of the 2011 Act.

2.197. The SPPS is clear in setting out the transitional arrangements, in that a transitionary period will operate until the adoption of a Plan Strategy. Therefore, until the adoption of the Plan Strategy for the relevant council areas the planning authority (in this case DfI) will apply existing regional policies and those contained in the SPPS.

2.198. The SPPS at para 5.73 considers that proposals should only be refused on the basis of prematurity where:

2.199. "….development proposals which are individually so substantial, or whose cumulative effect would be so significant, that to grant planning permission would prejudice the outcome of the plan process by predetermining decisions about the scale, location or phasing of new development with out to be taken in the LDP context…."

2.200. Guidance on weight to be afforded to the provisions of an emerging development plan is also set out the in Joint Ministerial Statement 2005 (JMS) which remains a relevant consideration. Whilst the JMS is still material, the contents of the SPPS would be afforded greater weight, where there is conflict identified. In this instance there is not direct conflict with the SPPS. It is our view that the proposed development would not prejudice the delivery of policies within the emerging Plan Strategy as it:

- would not prejudice the ability of the Plan Strategy to retain conformity with the RDS
- would not result in an adverse impact on an environmental asset, as demonstrated within this ES;
- would not undermine the rationale behind a proposed Special Countryside Area designation proposed in the emerging plan as the draft policies make provision for exceptions.

2.201. Furthermore, the SPPS is clear at paragraph 6.221 that "moratoria on applications for renewable energy development whilst LDPs are being prepared or updated are not appropriate". For this reason, the proposed development can be determined under existing regional policies and the SPPS.

2.202. **Assessment:** Most aspects of local planning policy have been superseded by subsequent regional planning policy. On the basis of the conclusions of the detailed assessments within this ES, there is no conflict with applicable local planning policy.

Other Guidance

Antrim Coast and Glens Area of Outstanding Natural Beauty Management Plan 2008 - 2018

2.203. The Antrim Coast and Glens AONB Management Group, in partnership with the Causeway Coast and Glens Heritage Trust produced a management plan for the AONB. The Management Plan helps everyone with a stake in the landscape respond in ways that enhance the landscape and ensure the AONB remains an area everybody can identify with and enjoy and allow it to continue contributing crucially to the economy of the area.

2.204. The management plan covers a 10-year period and is accompanied by an Action Plan which details how the goals will be attained. The Management Plan and Five Year Action Plan were published for the period 2008 –2018. The purpose of the Management Plan is to state what elements of the AONB are special, characteristic and valued and to devise objectives and mechanisms by which change can occur whilst maintaining the intrinsic character of area.

2.205. The Management Plan identifies a number of objectives around the themes of land, coast and sea - biodiversity, geodiversity and landscape; built heritage – the built and historic environments; and sustainable communities – community, planning, the economy and tourism.

2.206. The Five Year Action Plan that accompanies the AONB Management Plan provides some additional detail as to how Objectives will be achieved. In relation to the management objective of protecting landscape and seascape character and restoring key areas of visual prominence where they are currently degraded the Action Plan refers to existing planning policy, guidance and landscape character assessments for information.

Overall Policy Compliance

2.207. Making an energy infrastructure contribution of the scale proposed (58.8 MW) will assist in the achievement of strategic energy targets and objectives, consistent with a wide range of International, European, UK and Regional level priorities. The rationale for the project in relation to the delivery of renewable is clear.

2.208. There is a strategic qualified national presumption in favour of developing renewable energy projects of this type.

2.209. The established approach to decision making advocated in policy is to balance the wider environmental, economic and social benefits of the project against the environmental impacts, attaching significant weight to the former.

2.210. The SPPS changes this approach insofar as the PPS18 direction to attach significant weight to the benefits is replaced by adiscretion for the decision maker to determine the appropriate weight to be attached to the benefits. This must mean that the large scale social, environmental and economic benefits associated with this project are attached significant weight. In weighing the acceptance of the proposals the following must be considered:

- The proposal will offer job creation and economic activity to the regional economy providing catalytic benefits to investment within Northern Ireland.
- Given the 30 year lifetime of the development it is expected that direct operational impacts equate to 30 jobs, £1.70 million direct wages and £5.71 million of direct Gross Value Added over the operational phase.

- Both the construction and operational phases will generate increased tax and business rates revenue and the proposal is estimated to involve a capital spend of £39.78 million.
- Based on rateable values of £13,293 per MW— it is calculated that the proposed development will increase rateable value by £0.8 million each year, or by £23.45 million over the project horizon.
- The amount of electricity that could be produced by the proposed development is estimated at 236.9gWh per year which is enough electricity to meet the needs of 61,900 homes each year , over 5,000 more than the current housing stock (of approximately 56,000) in the local area.
- The proposed development is also estimated to reduce CO_2 emissions by 109,000 tonnes each year.

2.211. The landscape and visual impact of the windfarm is not unacceptably adverse for the purposes of the SPPS and PPS18 Policy RE1 because the inherent characteristics of the landscape provide the capacity to absorb it. The effects – relative to the qualities that underpin the designation – would not undermine the overall AONB or compromise wider landscape and visual amenity to an unacceptable degree.

2.212. With the discretion to attach significant weight to the wider environmental, economic and social benefits arising from the proposal, and having regard to how the project demonstrates that it will have limited adverse impacts, the project is considered to meet the requirements of planning policy because there are no unacceptable adverse effects which are not outweighed by the local and wider environmental, economic and social benefits of the proposed development.

Appendix

- 2.1 Potential Grid Route

References

Department for Regional Development (NI) (DRD) Regional Development Strategy 2035 (March 2012)

Department of the Environment (NI) (DoE) A Strategic Planning Policy Statement for Northern Ireland Planning for Sustainable Development (SPPS)

Department of the Environment (NI) (DoE) Best Practice Guidance to Planning Policy Statement 18: Renewable Energy (BPG, PPS18), (August 2009)

Department of the Environment (NI) (DoE) Larne Area Plan 2010

Department of the Environment (NI) (DoE) Planning Policy Statement 1: General Principles (PPS1), (March 1998)

Department of the Environment (NI) (DoE) Planning Policy Statement 2: Natural Heritage (PPS2), (July 2013)

Department of the Environment (NI) (DoE) Planning Policy Statement 3: Access, Movement and Parking (PPS3), (February 2005)

Department of the Environment (NI) (DoE) Planning Policy Statement 6: Planning, Archaeology and The Built Heritage (PPS6), (March 1999)

Department of the Environment (NI) (DoE) Planning Policy Statement 10: Planning & Telecommunications (PPS10), (April 2002)

Department of the Environment (NI) (DoE) Planning Policy Statement 15: Planning and Flood Risk (PPS15), (September 2014)

Department of the Environment (NI) (DoE) Planning Policy Statement 16: Tourism (PPS16), (June 2013)

Department of the Environment (NI) (DoE) Planning Policy Statement 18: Renewable Energy (PPS18), (August 2009)

Department of the Environment (NI) (DoE) Planning Policy Statement 21: Sustainable Development in the Countryside (PPS21), (June 2010)

Department of the Environment (NI) (DoE) Supplementary Planning Guidance: Wind Energy Development in Northern Ireland's Landscapes (SPG), (August 2010)

Causeway Coast & Glens Heritage Trust - Antrim Coast and Glens Area of Outstanding Natural Beauty Management Plan 2008 – 2018 (2008)

Mid and East Antrim Borough Council - Mid and East Antrim Borough Council Local Development Plan 2030 draft Plan Strategy (September 2019)

Joint Ministerial Statement – Development Plans and Implementation of the Regional Development Strategy (January 2005)

3

Design Evolution & Alternatives

3 Design Evolution & Alternatives

Introduction

3.1 In this chapter a description is given of the site selection process and design strategies that have been adopted in order to arrive at the Development described in **Chapter 1: Introduction & The Proposed Development**. Firstly, the general design principles adopted by RES are outlined and potential key issues which have affected the design are identified. Thereafter, a description is given of how the turbine layout and infrastructure design has evolved in response to constraints identified through the EIA process.

3.2 **Figures 3.1 – 3.3** are referenced in the text where relevant.

Current land use and site context

3.3 The location of the Development is shown in **Figure 1.1: Site Location**. The 'Planning Application Boundary' (red line) and 'Land Under Applicant Control' (blue line) are shown on **Figure 1.2**: **Planning Application Boundary**. The 'Land Under Applicant Control' formed the Preliminary Site Boundary, hereinafter referred to as 'the Site'.

3.4 The Site is located approximately 3km North west of the village of Cairncastle, Larne, Co. Antrim. The Site is positioned on an upland plateau formed by Ballygilbert Hill, Black Hill and Scawt Hill in the southern part of the Antrim Coast and Glens Area of Outstanding Natural Beauty (AONB) and is accessed via the Feystown Road.

3.5 The Site is currently used for sheep and cattle grazing and predominantly comprises semi-improved agricultural land. The Ulster Way passes along the plateau. The lands are well managed with extensive stoned farm tracks providing access to agricultural fields which are bounded by mature hedgerows and stone walls.

Key Issues and Constraints

3.6 The design of a wind farm is optimised in order to produce a layout that maximises the use of the land available for wind power generation balanced against the overall environmental impact of the development. The optimal layout of a wind farm depends on a range of technical, economic and environmental criteria. There following are site specific factors determining the viability of a wind farm:

- Wind Speeds/Energy Yields: Sufficiently high wind speeds to ensure energy production from the wind turbines that would yield an adequate return on investment
- Planning: A site which complies with planning policy and in particular, avoids unacceptable effects on areas designated by statutory agencies; maintains appropriate distances from dwellings to avoid unduly impacting local amenity and; avoids impeding or interfering with major electromagnetic transmission and airport communication systems

- Area of Site: A site must have sufficient area to accommodate the number of wind turbines required for economic viability
- Access: Adequate vehicular access to a site using existing roads wherever possible to minimise the amount of civil works, particularly during the construction phase
- Local Terrain and Topography: Terrain and topography affect wind flow across a site and need to be considered in relation to turbine performance, specification and life-span
- Ground Conditions: A site must have suitable ground conditions for the construction of wind turbine foundations, erection of the machines and the provision of access tracks and cables.

3.7 There are additional factors which also influence the scale and viability of a wind farm including:

- Turbines must be separated by specific distances both perpendicular to, and in line with, the prevailing wind direction to minimise turbulent interaction between the wind turbines (i.e. wake effect). This needs to be considered to balance turbine performance with energy extraction, and to protect the life-span of the turbines. Spacing requirements vary between turbine manufacturers and are also subject to wind conditions;
- Wind turbines have to be located at a distance sufficiently far from occupied residential property to ensure adherence to relevant noise criteria and to ensure that shadow flicker impacts are minimised;
- The implications of locating turbines near environmentally sensitive features and areas (ecology, archaeology, hydrology etc.) need to be carefully considered; and
- Landscape and visual design considerations need to be taken into account.

3.8 The apportioning of weight to each element is a site-dependent consideration and results in bespoke design approaches and strategies for each site.

3.9 For this Development, the upland nature of the Site creates a number of sensitivities that need to be carefully addressed through appropriate design of the wind farm. The following sections identify potential issues and outline how these have been addressed through appropriate design.

3.10 The basis of the design process is the evaluation of the various constraints that have been identified through the environmental surveying that was undertaken between 2013 and 2019. The constraints identified through these surveys, along with other technical constraints and appropriate buffers are presented in **Figure 3.3**: **Combined Constraints and Infrastructure** and are discussed in sections 3.38 – 3.59.

Potentially significant effects

3.11 Following consultation and baseline characterisation of the Site, the following key environmental issues have been identified:

- Landscape and visual
- Archaeology and cultural heritage

- Ecology
- Ornithology
- Fisheries
- Geology and the water environment
- Noise and shadow flicker
- Traffic and transport.

3.12 The issues listed above have been considered during the iterative design process with the aim of designing out significant effects. Where it is not possible to mitigate these effects through design, the issues are considered further as part of the Environmental Impact Assessment process (EIA) which is described in this Environmental Statement (ES).

Consultation

3.13 Prior to and during the production of this ES, RES and the Consultant project team consulted with various stakeholders and, where appropriate, incorporated the outcome of this into the various chapters of this ES.

3.14 Throughout the EIA process, continual scoping has occurred to ensure that the ES fully, but concisely, addresses all potentially significant issues.

3.15 A summary of the telecommunications and aviation consultations are provided in **Table 3.1**. Details of consultation undertaken in the preparation of each of the technical chapters of this ES (chapters 4 to 13) are presented in the relevant chapter.

Table 3.1 – Summary of Consultation

Consultee	Date of Consultation	Nature and Purpose of Consultation
OFCOM	18/06/2013 17/07/2013	OFCOM were consulted to establish the identity of telecom infrastructure owners in the vicinity of the Development.
BT	19/07/2013 08/08/2019	BT were consulted to establish the location of any telecommunication links they manage.
Eircom NI	19/07/2013	Eircom NI were consulted to establish the location of any EMI links they manage.
Atkins Global	19/07/2013 08/08/2019	Atkins Global were consulted to establish the location of any radio links they manage.
Arqiva	11/10/2019	Arqiva were consulted to establish the location of any transmission links they manage.
JRC	19/07/2013 08/08/2019	JRC were consulted to establish the location of any radio links they manage.
Northern Ireland Water	08/08/2019	NIW were consulted to establish the location of any links they manage.
Telefonica	08/08/2019	Telefonica were consulted to establish the location of any telecommunication links they manage.
United Utilities	09/08/2019	UU were consulted to establish the location of any telecommunication links they manage.
Belfast International Airport	21/11/2019	Consultation regarding any issues airport may have with the Development.
Belfast City Airport	12/09/2019	Consultation regarding any issues airport may have with the Development.
Ministry of Defence DIO	09/08/209	Consultation regarding any safeguarding issues they may have with the Development.

Public Consultation

3.16 RES is committed to finding effective and appropriate ways of consulting with all its stakeholders, including local residents and community organisations, and believes that the views of local people are an integral part of the development process. RES began the engagement process eight months prior to the submission of the planning application, to facilitate a constructive consultation process which helped RES to understand and address any concerns as the project developed.

3.17 A public exhibition was held on 11th September 2019 which included detailed maps and information about the proposals, including: a map of the proposed layout; photomontages representing how the proposed layout would appear from a range of viewpoints, and; Zone of Theoretical Visibility (ZTV) diagrams. (A ZTV is a map-based diagram illustrating where and how many wind turbines, or wind farms, would theoretically be visible from all parts of a given area. The methods for preparing ZTVs and their uses within the EIA process are described in **Chapter 4: Landscape**

and Visual Impact Assessment. RES staff where available to answer questions and feedback was encouraged.

3.18 A Pre-Application Community Consultation (PACC) Report has been produced and is available for viewing at the locations listed in **Chapter 1: Introduction & Policy Context**.

Alternatives

3.19 RES considers a range of potential options when selecting and designing wind farm sites. The following sections outline the broad design alternatives that have been considered in terms of the EIA Regulations.

Do-Nothing Alternative

3.20 The “do-nothing” scenario is a hypothetical alternative considered as a basis for comparing the potential significant effects of a development proposal. In the case of the Development the “do-nothing” scenario would be to have the Site continue to be managed for sheep and cattle grazing by the landowners. It is likely that current land management activities, including agricultural improvements would continue.

Alternative Sites

3.21 RES has a robust site selection methodology, using a Geographical Information System (GIS) to aid identification of potential wind farm sites.

3.22 The Development site meets the criteria listed in section 3.28 of this chapter. The GIS model was used to identify potential constraints which could restrict development, or would need to be addressed in the design process.

Alternative Layout Designs

3.23 There have been several iterations of the turbine and infrastructure layouts. From the outset the following design principles have been employed when making design decisions:

- Mitigation by design should be the principle method of reducing potential environmental impacts
- Utilisation of existing infrastructure should be implemented whenever possible to avoid unnecessary development
- All site infrastructure should be designed as efficiently as possible to reduce the overall extent of development whilst maximising the renewable energy generation potential.

3.24 A key tool in the design process is the combined constraints drawing which integrates all potential constraints that need to be considered in the design process. The finalised combined constraints map is shown as Figure 3.3.

3.25 The combined constraints drawing is iteratively updated as new information from surveys, site visits and consultation is received. The following surveys informed the combined constraints drawing:

- Breeding and wintering bird survey
- Ornithological vantage point survey
- National Vegetation Classification (NVC) Phase 2 survey
- Terrestrial fauna surveys
- Fisheries survey
- Peat probing
- Hydrology assessment
- Archaeology and cultural heritage surveys
- Landscape field survey
- Aviation
- Transport and traffic reconnaissance trip
- Technical and engineering site walkovers.

3.26 The final site layout for the Development (Figure 1.2: Infrastructure Layout) balances the need to optimise the energy yield whilst paying due regard to environmental and technical sensitivities. Wind farm design is an iterative process and is influenced by potential environmental effects identified throughout the EIA process: policy recommendations; environmental, technical, engineering and landscape design considerations; and as a result of feedback from consultees.

3.27 The following sections describe the evolution of the turbine and infrastructure layouts.

Design Evolution

Turbine Layout

3.28 There were two principle iterations of the turbine layout, shown in **Figure 3.1: Turbine Layout Evolution**, which were developed at the following stages in the project process:

- Initial feasibility stage, when turbines were located based on preliminary constraints only;
- Revised Turbine Layout, prior to baseline environmental surveys being completed;
- EIA baseline data stage, when baseline surveys were complete and constraint information gathered;
- Further environmental assessment and refinement, when more detailed assessment was carried out on specific issues highlighted and final refinements were made to the layout.

Initial Feasibility Stage

3.29 At the beginning of the development process an initial layout was produced to show the maximum potential extent of the development within the space available and in accordance with the design principles, prior to baseline surveys had been completed. The layouts were informed by the following constraints:

- Preliminary watercourse buffers
- Slope
- Known private water supply locations
- 10 x rotor diameter separation from housing (1000m) / Double the minimum separation distance of 500 m).
- 164.9 m buffer (tip height + 10%) to public roads (including the Ulsterway walking route), in accordance with the Best Practice Guidance to PPS 18[1]. The Ulsterway was buffered based on mapping information and a GPS survey carried out – both were buffered to ensure adequate setback.

3.30 This initial feasibility layout was reviewed by the Landscape Consultant. A Zone of Theoretical Visibility diagram (ZTV) and wirelines were produced for a provisional 17-turbine layout and the potential landscape and visual issues that would need to be considered if a wind farm were to be proposed on this site were considered in broad terms based on previous experience of assessing wind farms in other this part of the Study Area. This included a preliminary analysis of the site in its wider landscape context, including its location within the Antrim Coast and Glens AONB and its potential relationship with other wind turbines.

3.31 The feasibility appraisal recommended to review the proposed layout and with that in mind the turbines numbers were reduced.

Primary Turbine Layout

3.32 Prior to detailed site assessments being undertaken by external consultants, RES technical analysts undertook site visits to check that there were no physical characteristics on site that may impact upon the turbine performance such as topography.

3.33 RES engineering and construction undertook site visits with ecological and geology/hydrology consultants to review the turbine locations and to agree principles for the design of the onsite infrastructure based on the constraints determined to date.

3.34 Following this 3 Turbines were omitted, and this necessitated other changes to maximise the efficiency of the turbines and to create a balanced layout.

3.35 The revised layout was informed by the original constraints with the following amendments:

- Hydrological buffer 70 m;

[1] Best Practice Guidance to Planning Policy Statement 18: Renewable Energy, DOE Planning & Environmental Policy Group, August 2009.

- Hydrological buffer 30 m;
- Archaeological features - Knockdhu Area of Significant Archaeological Interest (ASAI)

3.36 The removal of 3 Turbines enabled some refinements to the layout.

- T15, T16, T17 were removed from the ASAI – limited infrastructure is proposed within the ASAI, access to the site is via the existing agricultural track to ensure limited works.
- T1 was removed to reduce the extent of the development.

3.37 The resulting 14 turbine layout with 117.0 m rotor diameter produced a more compact layout as detailed below.

Revised Turbine Layout

Combined Constraints

3.38 To ensure that all requirements were captured a combination of desktop and site-based surveys were undertaken to refine constraints. Detailed environmental and technical surveys were carried out to characterise the baseline environmental conditions on the Site and associated study areas, as described in more detail in chapters 4 to 13 of this ES. Any constraints to development resulting from the baseline surveys were used to build up the combined constraints drawing.

Landscape & Visual

3.39 As mentioned above a Landscape Consultant was involved throughout the design process to provide advice regarding the scale of the Development and turbine heights and geometry.

3.40 At an early stage of the iterative design process the number of turbines was reduced from 17 to 14. Whilst this had little effect on the theoretical zone of visibility over the 30 km Study Area is has resulted in a number of benefits in landscape and visual terms, namely:

- The geographic extent of the Development was reduced at both the northern and southern ends of the upland plateau on which it was located and the most marked reduction in theoretical visibility was from locations within 5 km of the Development, particularly to the north within the centre of Glenarm and to the south around Knockdhu, Sallagh Braes and Agnew's Hill;
- The position of 'T1' turbine was moved from its outlying location to the north of 'T2' and 'T3' and was instead located to the west of these turbines, creating a more coherent edge to the Development that better reflected the rounded shape of the underlying upland edge;
- Turbines 'T15', 'T16 and 'T17' were removed from the layout, thus removing any turbines from Ballycoose Hill where they would have been

more clearly visible from the Knockdhu car park located to the south of the Development.

- The turbines in the final layout that is presented in this ES are evenly spaced in relation to each other and to the site topography which has resulted in a simpler layout with fewer variations in tip heights in relation to contour AOD levels;
- There are fewer instances where 'stacking' of turbines occurs. Stacking is where two or more turbines will appear directly in front of each other in a view and will therefore result in a 'heavier' or more solid, and hence more prominent appearance;
- Reducing the geographical spread of turbines across the upland plateau also means that the Development is viewed as a feature that is subordinate to the wider landscape which is visible from key viewpoints within the AONB and in approaches to it.

3.41 Discussion with other members of the EIA project team was also carried out as part of the iterative design process. The archaeological consultant in particular has provided input into the selection of Provisional Viewpoints to ensure that cultural heritage sites are adequately represented. Chapters 4: Landscape & Visual and Chapter 5: Archaeology & Cultural Heritage of the ES provide detailed information with regards to these areas.

Aviation

3.42 Wind turbines can potentially interfere with aviation operators by either physically affecting the safeguarding of an aerodrome by the close proximity of the turbines or through interference with the Air Traffic Control (ATC) radars that direct aircraft in flight. RES consulted with all relevant organisations which could be affected by the Development.

3.43 NATS En Route (NERL) supplies air traffic service to all En Route aircraft navigating UK airspace. RES has consulted the published NATS safe-assessment maps which have been produced to indicate if a wind farm development will impact NERL infrastructure. The Development lies outside the safeguarding areas which identify need for further consultation with NERL and therefore the Development will have no impact on NERL infrastructure.

3.44 The Defence Infrastructure Organisation (DIO) consultation response stated that, as a condition of any planning permission granted, the Applicant must notify UK DVOF & Powerlines at the Defence Geographic Centre with the following information prior to development commencing: Precise location of development; Date of commencement of construction; Date of completion of construction; The height above ground level of the tallest structure; The maximum extension height of any construction equipment; Details of aviation warning lighting fitted to the structure(s).

3.45 As detailed above in **Table 3.1**, pre-submission consultation was undertaken with airports located within 50 km of the Development. The only two airports are Belfast International Airport (BIA) and Belfast City Airport BCA).

3.46 BIA is located over 33.5 kilometres to the south west of the Development. Initial assessments revealed no line of sight visibility to the air traffic control radar and no impact on the airport safeguarding areas.

3.47 BCA is located 32.5 kilometres to the south of the Development. Initial assessments revealed no line of sight visibility to the air traffic control radar and no impact on the airport safeguarding areas. Confirmation of this was provide by the airport.

Ecology - Vegetation

3.48 The Development is situated on an upland massif which rises between the Antrim Coast (in the east) and Feystown (in the west). It is a few kilometres south of Glenarm and lies approximately a kilometre north of Sallagh Brae. The proposed access track and associated infrastructure is roughly oriented north to south along a series of low hills, each representing a separate land parcel. The southernmost land parcel, which will host the site entrance and the first 2 kilometres of access track surrounds the summit of Ballycoos (361m). This parcel consists primarily of poor semi-improved (acid) grassland with the tight sward associated with heavy sheep grazing. The ecology of the area is impoverished with the various field signs indicating badger usage of the area the only feature of note.

3.49 The route of the infrastructure then traverses an old stone wall (with associated mitigation to protect common lizards which were recorded from site) as it moves north and into the second land parcel (Scawt Hill (378m). The topography is complex in this part of the site and the resulting vegetation mosaic is thus more diverse; although heavy grazing pressure (and local land drainage) have combined to limit the conservation value of the habitats present. However, interesting pockets remain in a few places. The iterative design process has allowed the majority of more interesting pockets of fen/flush and degraded blanket bog to be avoided during the emplacement of infrastructure. This has restricted most of the impacts to areas of poor acid grassland, poor marshy grassland/(poor) rush pasture and wet heath/degraded blanket bog. Acid grassland is by far the most abundant habitat, but it is only part of a larger mosaic containing all of the other habitats mentioned above. This complex habitat mosaics present in this land parcel (and the third land parcel containing Ballygilbert Hill (370m)) are the result (in part) of the myriad of water features present on site and how these pool and flow overland before coalescing into streams and watercourses. Considerable effort has been expended during the design process to weave the infrastructure around the watercourse buffers and larger GWDTEs present on site (in order to maintain the overland flow upon which these habitats depend). One of the larger fen/flushes on site (near T10) will form the core of one of the proposed Habitat Management Areas on site (in order to compensate for habitat loss associated with construction/operation of the proposed windfarm). In addition, surveys for smooth newt were conducted in this area, however none were recorded.

3.50 The third and fourth land parcels contain the hill from which the site derives its name, Ballygilbert. The most significant feature of this part of the site is the presence of a pocket of blanket peat which forms a small plateau immediately to the east of the summit ridge (between Black Hill and the aforementioned Ballygilbert Hill). This small area forms the source of at least three watercourses which flow from the site and also contains a number of small pools. Part of the bog is fenced off, possibly in an effort to prevent livestock from falling into and drowning in the numerous pools present.

3.51 The final (and most) northerly of the five land parcels encompasses the northern slopes of Black Hill. This area is more uniform in both aspect and habitat diversity; it consists primarily of poor (heavily grazed) acid grassland. Apart from a few pockets of wet heath, poor flush and poor rush pasture, this area has less ecological diversity.

Terrestrial Fauna

3.52 Aside from detailed botanical and habitat surveys (as well as surveys for common lizard, smooth newt and badgers) detailed bat surveys were also undertaken across the entire site, during the 2019 survey season (with over 400 nights of survey). Overall activity levels were negligible to low (with no bats recorded on greater than 50% of nights surveyed). Significant activity levels (BAI of 5 of higher) were noted on a single night at T5 (in spring) and T4 (during summer); as a result a precautionary Bat Monitoring & Mitigation Plan (BMMP) has been recommended. Once implemented in full this will ensure that there is no significant impact to the local bat population. In addition, a detailed and significant HMP (Habitat Management Plan) has been agreed, the implementation of which will result in a ‘Net Gain’ in biodiversity terms as a result of the proposed windfarm.

Water Environment and Fisheries

3.53 The hydrology consultant recommended watercourse buffers of 50 m and 10 m depending on the catchment size of the watercourse, which were agreed as appropriate by the fisheries consultant.

Public Roads and Walking routes

3.54 165 m buffers were applied to nearby public roads in line with the Best Practice Guidance to PPS18 which recommends a setback distance of at least tip height plus 10% between turbines and roads, this set back distance has also been applied to the Ulsterway Walking route which runs through the site.

Finalising Turbine Layout – EIA Baseline Stage – Final Layout

3.55 Prior to detailed site assessments being undertaken by external consultants, RES technical analysts undertook site visits to check that there were no physical characteristics on site that may impact upon the turbine performance such as topography and the proximity.

3.56 RES engineering and construction undertook site visits with ecological and geology/hydrology consultants to review the turbine locations and to agree principles for the design of the onsite infrastructure based on the constraints determined to date.

3.57 Using design principles agreed with environmental, engineering and technical disciplines, the infrastructure layout was developed and used to undertake baseline assessments.

3.58 During the course of the baseline surveys changes were made to the turbine layout the revised turbine layout is illustrated in Layout 2 – Figure 3.1: Turbine Layout Evolution.

3.59 A 50 m micro siting radius was applied to each of the turbines. The extent of this was then reduced such that the micro siting avoids any of the combined constraints. The final micro siting areas are included in Figure 1.2: Infrastructure Layout.

Infrastructure Design Evolution

3.60 The infrastructure design has evolved through the EIA process as illustrated in **Figure 3.2: Infrastructure Design Evolution**, Designs 1 to 2.

Engineering considerations

3.61 The following general principles were taken into consideration when designing the supporting infrastructure:

- Avoidance of environmental and technical constraints (as shown in Figure 3.3)
- Design of the track layout to follow natural contours as far as possible, to avoid unnecessary amounts of excavation and reduce adverse hydrological impacts using the following methods:
- Maximise the use of existing track locations via upgrades;
- Minimisation of the overall length of access track;
- Minimisation of the number of watercourse crossings, as far as possible
- Watercourse buffers of 70 m and 30 m
- Avoidance of steep slope areas to minimise earthworks (except where existing farm access tracks where in situ);
- Incorporation of measures to improve the visual appearance of the scheme, including reinstatement of temporary infrastructure following the construction period;
- Sympathetically locating control room building / substation / energy storage facility within the site surroundings.

3.62 A number of amendments were made to the design of the infrastructure between Design 1 and Design 2 on (as shown on Figure 3.2) for engineering reasons and these are summarised below:

- Removal of Track at T14 to avoid an area of sensitive habitat;
- The configuration of substation, associated car parking and temporary construction compound / energy storage facility was refined;
- Minimization of land take by combining bell mouths at junctions / turning heads with areas of temporary crane hard standing to reduce the extent of infrastructure.

3.63 Key adjustments in response to constraints made through the design evolution are summarised in the following sections.

Vegetation

3.64 The engineering considerations minimised impact on sensitive habitats by utilising the existing track locations via upgrades where possible. This minimised the length of new track and where new access track is proposed, it is predominantly located in agricultural fields and coniferous shelterbelts of low ecological value.

Water Environment

3.65 The number of watercourse and drainage crossings has been minimised through the principle of avoidance at the layout design stage, and a number of culverts have been sited to coincide with existing culverts which will be upgraded. Proposals submitted in conjunction with this assessment indicate:

- One crossing of a significant watercourse
- Four crossings of minor watercourses, the majority of which comprise existing track-side drains.

3.66 The location and nature of watercourse crossings were reviewed with the hydrology and fisheries consultants as detailed in **Chapter 8: Fisheries and Chapter 9: Geology & Water Environment.**

Site Entrance Location

3.67 The site entrance is located at an existing access to farm lands on the south side of the Site along the Feystown Road. The existing access will be upgraded to provide suitable access. As specified in DCAN 15, visibility splays measuring 120m x 4.5m are provided in both directions.

3.68 Following construction, the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state.

Control Building and Substation

3.69 The buildings will located to the southern part of the site along which is to the lower slope of the site and is set back from the public road. Visibility will be limited from out with the site. The building will be orientated to be accessed from the south.

3.70 The buildings will be traditional in nature with rendered walls and tiled roofs, common characteristics of many rural buildings. The appearance of the buildings has been selected to reflect the rural character of the area to maximise the integration of the buildings within the wider landscape.

Temporary Construction Compound / Energy Storage

3.71 The temporary construction compound is required to be located close to the main bulk of the construction works and the energy storage facility is co-located adjacent to the Control Building and Substation.

3.72 Energy storage containers will utilise the southern portion of the temporary construction compound on a permanent basis with the remainder of the temporary construction compound being removed and returned to farmland.

Final Infrastructure Layout

3.73 The final infrastructure layout is shown in Design 2 of Figure 3.2: Infrastructure Design Evolution. Once finalised, the Planning Application Boundary was redrawn, ensuring sufficient space within the boundary for all features including SUDS.

3.74 The final infrastructure layout and combined constraints is shown in Figure 3.3: Combined Constraints & Infrastructure.

Residual Design Considerations

Electromagnetic Interference / TV

3.75 RES has consulted with all organisations operating microwave links which could be affected by the Development and these are listed in **Table 3.1** above. No existing links cross the Site and as such there will be no interference experienced.

Ice Throw

3.76 Under certain climatic conditions, ice can build up on turbine blades which may be thrown from the blades during blade rotation or fall when blades are stationary.

3.77 The International Energy Association (IEA) has recommended an empirical formula to calculate the maximum distance that ice may be thrown from an operating turbine based on turbine geometry. For the proposed turbine envelope this ice throw risk distance has been calculated and used in the wind farm design to locate turbines away from public roads and therefore the potential for ice throw to affect members of the public is considered to be low.

Summary

3.78 The final layout of the Development reflects the need to optimise the energy yield whilst minimising potential effects on environmental sensitivities. Wind farm design is an iterative process and the design has been influenced by potential environmental effects identified through the EIA process. The proposed layout has evolved in response to policy recommendations, environmental, technical, engineering and landscape and visual design considerations and as a result of feedback from key consultees.

List of Figures (Appendix 3)

4

Landscape & Visual

4 Landscape and Visual Impact Assessment

Executive Summary

4.1 This chapter is a Landscape and Visual Impact Assessment (LVIA) of the proposed Ballygilbert Wind Farm (hereinafter referred to as 'the Development'). An LVIA is a formal part of the Environmental Impact Assessment (EIA) process and the methodology used to prepare this chapter is defined by the requirements of the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017 (hereinafter referred to as the 'EIA Regulations') and best practice guidance publications relating both to the LVIA process in general and in specific relation to wind farm developments (refer to Technical Appendix 4.1 for further details).

4.2 The Development comprises 14 turbines with overall heights to blade tip of 149.9m (refer to paragraphs 4.22 – 4.26 for further details). Turbine hub heights of 91.5 m and rotor diameters of 117 m have been used for the purpose of preparing visualisations (see Figures 4.5 onwards). The turbines would be located along an upland plateau formed by Ballygilbert Hill, Black Hill and Scawt Hill approximately 3 km to the north west of Cairncastle village, Larne, Co. Antrim. The Study Area for this LVIA covers an area that extends to a 30 km radius from the Development and is further described from paragraph 4.78.

The Purpose of this Chapter

4.3 The objectives of an LVIA are to:

- Present an objective analysis of the landscape and visual character of a defined area (i.e. the '*baseline conditions*' within the '*Study Area*' for this LVIA) in so far as they relate to the Development;
- Identify the potential effects of the Development on these baseline conditions including direct, indirect, permanent, temporary and cumulative effects;
- Clearly distinguish between *landscape effects* and *visual effects* which although closely related are also distinct from each other. The former relates to the effects on the physical landscape as a resource in its own right. The latter relates to the effects on specific views and general visual amenity as experienced by people ('*visual receptors*');
- Propose appropriate mitigation measures to address likely significant effects, where possible, and to assess any residual effects that would remain following the implementation of these measures;

- Present all information clearly and objectively with a well-reasoned methodology that is in accordance with best practice guidance and in a manner that will inform the decision making process.

Statement of Authority

4.4 This LVIA has been prepared by Shanti McAllister Landscape Planning & Design Ltd (hereinafter referred to as SMc Ltd) on behalf of the applicant, RES Ltd (hereinafter referred to as RES). Shanti McAllister is an independent consultant and Chartered Landscape Architect with over 19 years' experience of preparing LVIAs for major development proposals including a large number of wind farms in Northern Ireland.

4.5 All information presented in this LVIA has been prepared in accordance with a methodology that is derived from a suite of best practice guidance (see Technical Appendix 4.1). A summary of the LVIA process and the key elements of this methodology are provided from paragraph 4.33 and are described in full detail in Technical Appendix 4.2. The identification and objective analysis of the landscape and visual effects of the Development is made using professional expertise and impartial judgement. The conclusions of the LVIA are based on whether or not the Development is likely to result in significant effects on the landscape and visual elements of the Study Area. The appropriate weight to be attached to these effects, when weighed against the other effects analysed in the ES, is the responsibility of the relevant planning authority, which in this case is the Department for Infrastructure.

Feasibility Appraisal and Design Iterations

4.6 The Development that is being assessed in this LVIA has evolved through an iterative design process that has been informed by a careful analysis of the constraints and opportunities presented by the site location and the characteristics of the Development itself. This process is further detailed from paragraph 4.27 of the LVIA and in Chapter 3: Design Evolution and Alternatives.

Establishing Baseline Conditions and Analysing Effects

4.7 The Baseline Assessment has considered statutory landscape designations covering the Study Area contained within current planning policy in Northern Ireland. The primary policy guidance on the assessment of landscape and visual effects of wind farm development is the Strategic Planning Policy Statement for Northern Ireland (SPPS) which should be read in conjunction with Planning Policy Statement 18: Renewable Energy (PPS 18) and its accompanying Best Practice and Supplementary Planning Guidance (BPG and SPG). In addition there are a number of guidance documents and extant Development Plans, which contain relevant statutory planning designations. These are analysed in the Baseline Assessment where applicable. It is noted that changes in planning policy and updates to development plans are expected to take place over the coming months and years as Planning Policy Statements, supplementary guidance and existing Development Plans become superseded by emerging Local Development Plans. These must be primarily informed by the SPPS. Mid and East Antrim Borough Council published a Draft Plan Strategy for the Local Development Plan in September 2019 which sets out the Council's strategic intentions for development within the Borough and representations submitted in response to this are currently being considered by the Council. It is understood that the next stage will be for the Draft Strategy, representations and counter representations to be forwarded to the DfI for Independent Examination. For the purpose of this ES it is considered that the Draft Plan Strategy is at too early a stage to be afforded weight. The SPPS notes that decisions should continue to be taken in line with the SPPS and relevant PPSs until such time as a Plan Strategy for the whole Council area has been adopted and the timescale for this is, as yet, unknown.

4.8 The Baseline Assessment also considers non-statutory landscape classifications and the information gleaned through driving and walking surveys of the Study Area to amplify and enhance the understanding of its landscape and visual character.

4.9 A total of 30 final viewpoints have been selected for consideration in this LVIA as a result of the viewpoint selection process which identified parts of the Study Area and key groups of visual receptors that may potentially be affected by the Development. A detailed description of this process and a full list of Provisional Viewpoint Locations (PVPs) are provided in Technical Appendix 4.4. Detailed descriptions of the final Viewpoints are an integral part of the Visual Impact Assessment section of the LVIA (starting at paragraph 4.148). The locations of final Viewpoints are indicated on all map-based Figures (Figures 4.1 – 4.13) and visualisations to accompany the detailed written analysis of these Viewpoints are provided in Figures 4.14 – 4.42.

Overall Significance of Landscape and Visual Effects

4.10 The Development conforms to the general principles laid out in policy and best practice guidance. Both the SPPS and PPS 18 are broadly supportive of renewable energy developments as a means of mitigating against the effects of climate change and the BPG further states that, given their importance, is it important for society at large to accept wind farms as a feature of the Region for the foreseeable future. Both the SPPS and PPS18 refer to the socio-economic benefits of wind energy development which are analysed is Chapter 13. The BPG notes that some locations may be highly visible but that this does not necessarily render them unacceptable. The latter judgement depends on the degree of effect and sensitivity of the receiving landscape. The BPG also notes that groups of turbines can normally appear acceptable as single isolated features in open, undeveloped landscapes and this principle can be applied to the Development's position within its landscape and visual context. Beyond 5 km the BPG notes that wind farms are likely to be visible as part of the wider landscape and prominent only in clear visibility, becoming less prominent as viewing distances increase.

4.11 The general principles contained within the SPG are also broadly supportive of wind energy developments in this type of landscape. The Development is located in accordance with seven of the 9 landscape and visual character issues that the SPG notes should be considered for wind energy developments within the Antrim Plateau region within which the Development is located. The Development maintains adequate separation distances from other wind farms and is of a form and layout that reflects the large scale and strong horizontal form of the uplands on which it is located as per the SPG's design principles.

4.12 However, the SPPS also requires that a cautious approach should be taken to siting renewable energy developments in designated landscapes where they would result in detrimental effects on the value of these landscapes. In this respect it is necessary to consider policy principles set out in Planning Policy Statement 2 (PPS 2) relating to AONBs and more detailed advice set out by the SPG in relation to specific Landscape Character Areas (LCAs) and also to the AONB Management Plan and Northern Ireland Regional Landscape and Seascape Character Assessments (NIRLCA and NIRSCA).

4.13 PPS 2 states that permission will only be granted in AONBs where the Development would be sympathetic to the character of the AONB in general and also of the particular locality. In broad terms this character lies in the tranquillity, cultural associations, distinctiveness, conservation interest, visual appeal and amenity value of the AONB. PPS 2 defers to the descriptions of LCAs and AONB Management Plans for further information on these elements. It is noted that the LCAs which combine to form the AONB are assessed by the SPG as being of much the same sensitivity to wind energy development as LCA 124 within which the Development would be located and many upland parts of these LCAs are described as being theoretically suitable locations. The sites of Elginny Hill and Rathsherry wind farms, which are located in the adjoining LCA 117 Central Ballymena Glens to the north of LCA 124, are specifically identified by the SPG as being particularly highly sensitive but have nevertheless been subject to planning consents.

4.14 The purpose of the Antrim Coast and Glens AONB Management Plan[1] is to define special characteristics and identify mechanisms by which changes and developments can take place whilst maintaining the AONB's special character. The special characteristics that are identified in the Management Plan include the area's relative isolation from the rest of the country and its visual links with the Scottish coastline; the distinctive character of each of the nine Glens and the sequence of cliffs, headlands and bays along the coastline which are framed by the Antrim Plateau landscape which is located inland and above these parts of the landscape and overlooking this coastal landscape/ seascape (see paragraph 4.89 onwards for further detail).

4.15 In some respects the Development is in conformance with the Management Plans recommendations which use the NILCA to assess the character and qualities of individual LCAs within the AONB. LCA 124 where the Development is located is the only LCA which is described as already having wind farms and radio masts as

[1] '*Antrim Coast and Glens Area of Outstanding Natural Beauty Management Plan 2008 – 2018*' (June 2008) Causeway Coast and Glens Heritage Trust

prominent features of its existing character. In this respect the Development would not introduce a completely new visual character element although it would create a new physical landscape character element in on part of the LCA. Wind energy was not one of the types of development identified as a perceived threat to the qualities of the AONB during the public consultation stage of the Management Plan (perceived threats were quarrying, second homes in the countryside and agricultural intensification). Climate change is noted as an issue but the Management Plan identifies no clear mechanisms for mitigating its effects. This does not reflect the policy background provided by the SPPS and PPS 18 where wind farms are identified as a key and necessary response.

4.16 Landscape in general is a palimpsest meaning that it reflects historical changes and continues to be formed and re-formed with evidence of previous alterations being evident alongside current land uses. The Management Plan identifies this palimpsest as being a key characteristic of the AONB by noting that it is a landscape which has been shaped by over 9,000 years of human occupation. This is evidenced by field patterns, agricultural buildings and cultural heritage sites. In this respect the Development reflects the continuing trend of human activity influencing landscape character and utilising the availability of natural resources. It would be a long term but nevertheless temporary addition to the landscape and visual character of the site and the wider Study Area. When the wind farm ceases to operate the site will be returned to its current form. The Development may also assist the aims of the Management Plan to restore characteristic features of the AONB that are present on the site such as stone walls which have become degraded or lost via the process of agricultural intensification and which could, in places, be restored as part of the construction process.

4.17 However, in other respects the Development is not in strict conformance with the Management Plan which refers to wind farms as one of several types of vertical features which would have a significant impact on skylines and summits which are sensitive to change. Prominent hills and iconic features of landscape and cultural importance are noted as being characterised by a general lack of visual intrusion from vertical features such as pylons and telecommunications towers and this does apply to the site and adjacent uplands. However, it is noted that these principles also apply to other existing and consented wind farms located around the edges of the AONB. The AONB notes that many parts of the uplands are relatively inaccessible which does not encourage tourists to prolong their visits or explore parts of the AONB aside from those which are easily accessible. Waymarked trails are noted as being generally poorly signed but this is not the case on this site where the Ulster Way is accessible and well signed and is therefore likely to attract relatively more visitors. However, the Development would pose no restriction to the continued use of the Ulster Way. Furthermore, research into the effects of wind farms on tourism revealed relatively high support and positivity towards renewable energy developments and found that the majority of tourists questioned would not be deterred from visiting a location because of the presence of a wind farm[2].

4.18 SPG guidance does recommend that the creation of a cluster in this LCA may be appropriate but it also specifically advises against locating a wind farm in this particular part of the LCA which it describes as the northern finger of uplands and of utmost sensitivity because it provides the setting both for Glenarm and the coastal areas to the east. The Development would have a significant direct physical effect on the LCA within which it is located. The Development would also have indirect but significant effects on the setting of other LCAs and SCAs located within approximately 15 km because the upland plateau on which it is located forms a key character component of both the LCA within which it is located and also provides the setting for adjacent areas. Much of the landscape within 15 km is also located within the AONB boundary and landscape sensitivity is heightened by this fact.

4.19 Furthermore, the coastline is particularly sensitive and the Development would be located at the southern end of the AONB on the first upland area that would be visible on approaches from Belfast both along the scenic coastal drive and inland approaches from Larne/ Carrick direction.

4.20 Existing and consented wind farms are typically located along the south western and western edges of the AONB and are more closely associated with the lowlands around the A26 road corridor in the same part of the Study Area. The cluster of wind farms at Gruig/ Altaveedan are not highly visible from within the AONB. Rathsherry/ Elginny Hill are more visible but with approximately 16 km of 'undeveloped' lowlands in between. Nevertheless, the Development is located near the outer edge of the AONB and therefore visibility from within the AONB as a whole is not widespread. There is also a consented wind farm at Ballykeel located within the AONB approximately 5.5 km to the south of the Development and there are single turbines located throughout the Study Area including 11 known turbines located within 5 km of the Development. Whilst the Development would be highly visible from many parts of the Study Area within 15km and visual effects where they occur are often significant, vertical man-made structures are already a typical landscape character element within the AONB as well as the wider Study Area. Further analysis of relevant planning policy and guidance is contained from paragraph 4.56.

4.21 In relation to residential amenity there are no properties in proximity to the Development where views could be considered overbearing or dominant. The majority of properties located along the Feystown Road, which would be in closest proximity (approximately. 1 km) are orientated to take advantage of panoramic views to the south and south west. The rising side slopes of the upland plateau on which the Development would be located physically contain views to the rear of most properties from the north to south east and prevent views to the coastline.

[2] Failte Ireland (2012) '*Visitor Attitudes on the Environment – Wind Farms*' and Northern Ireland Tourist Board (August 2011) '*Windfarms and Offshore Windfarms*'

Description of the Development

4.22 The site is located on an upland plateau. The current land use is grazing for sheep divided in part by stone walls and post and wire fences. The Ulster Way crosses the plateau. The Development itself comprises 14 wind turbines with a maximum blade tip height of 149.9 m located between approximately 311 m – 371 m AOD. A detailed description of the Development is provided in Chapter 1 of the ES, including the turbines, infrastructure, sub-station and electrical cable connections to the local grid network, energy storage compound, site access arrangements, site layout, construction methods and anticipated programme of construction work.

4.23 The construction period will be approximately 18 months and the visual effects of construction traffic and work on site will be short term and experienced only in close range views. Construction traffic will use existing tracks and newly constructed site access tracks as described in Chapter 1 and associated figures. The site entrance will utilise and upgrade an existing gateway located to the west of the Development off Feystown Road.

4.24 During the operational phase of the Development, anticipated to be 30 years, the landscape and visual effects would primarily relate to the presence of the turbines themselves as described and analysed in the following section of this LVIA. Day-to-day site activity would be minimal and there would be no further discernible changes to the landscape or visual character of the site resulting from site maintenance activities.

4.25 In addition to the turbines, there will be a sub-station and control building and energy storage compound located to the west of Turbine T14 which is the lowest turbine in the layout at 311.48m AOD. This compound will be positioned on lower lying ground in between Scawt Hill and Craigy Hill and would be largely screened from view from the surrounding landscape by the site topography.

4.26 Following the cessation of the sites function as a wind farm, all above-ground structures would be dismantled and removed from site (unless further consent is given to extend the operational life of the wind farm or replace the turbines) in accordance with a decommissioning and restoration plan which will be agreed with the local planning authority prior to decommissioning.

Feasibility Appraisal, Design Evolution and Iteration

4.27 The Development assessed in this LVIA has evolved through an iterative design process that has been informed by a careful analysis of the constraints and opportunities presented by the site location and the characteristics of the Development itself. This process is further detailed in Chapter 3: Design Evolution and Alternatives. The 14-turbine option that is presented in the EIA is the result of this iterative design process.

4.28 At an early stage of the iterative design process the number of turbines was reduced from 17 to 14. This has resulted in a number of benefits in landscape and visual terms, namely:

- The geographic extent of the Development was reduced at both the northern and southern ends of the upland plateau on which it was located and the most marked reduction in theoretical visibility was from locations within 5 km of the Development, particularly to the north within the centre of Glenarm and to the south around Knockdhu, Sallagh Braes and Agnew's Hill;
- The position of 'T1' turbine was moved from its outlying location to the north of 'T2' and 'T3' and was instead located to the west of these turbines, creating a more coherent edge to the Development that better reflected the rounded shape of the underlying upland edge;
- Turbines 'T15', 'T16 and 'T17' were removed from the layout, thus removing any turbines from Ballycoose Hill where they would have been more clearly visible from the Knockdhu car park located to the south of the Development.
- The turbines in the final layout that is presented in this ES are evenly spaced in relation to each other and to the site topography which has resulted in a simpler layout with fewer variations in tip heights in relation to contour AOD levels;
- There are fewer instances where 'stacking' of turbines occurs. Stacking is where two or more turbines will appear directly in front of each other in a view and will therefore result in a 'heavier' or more solid, and hence more prominent appearance;
- Reducing the geographical spread of turbines across the upland plateau also means that the Development is viewed as a feature that is subordinate to the wider landscape which is visible from key viewpoints within, and from approaches to, the AONB.

4.29 Discussion with other members of the EIA project team was also carried out as part of the iterative design process. The archaeological consultant in particular has provided input into the selection of PVPs to ensure that cultural heritage sites are adequately represented.

Consultation

4.30 Consultation and discussion between RES and the DfI/ Council has taken place through the Pre-Application Discussion (PAD) process in relation to the iterative development of turbine layouts, turbine dimensions and the selection of final viewpoints. DfI/ The Council are obliged to consult with other statutory consultees who would have an interest in the likely landscape and visual effects of the proposed wind farm and it is understood that they consulted directly with NIEA Natural Heritage: Landscape Architects (NIEA:LA) although no scoping response relating to landscape and visual issues has been received to date.

4.31 A public exhibition was held in September 2019 to present and discuss the Development with interested parties from the local and wider community. A map-based figure was presented to illustrate the theoretical visibility of the Development overlaid with the AONB boundary and the location of PVPs. Wirelines and photomontages of nine PVPs were also presented to illustrate how the Development would appear from some of the key viewpoints in the surrounding area (PVPs 6, 7, 17, 41, 43, 45, 53, 63 and 65, refer to Technical Appendix 4.4 Table 4.4.1).

4.32 General concerns were raised about the likely landscape and visual effects of the Development on the AONB and the A2 scenic coastal driving route. In order to fully address these concerns the selection and analysis of viewpoints in this LVIA includes representative close range and contextual views within the AONB and sequential views from the A2 Coast Road.

Summary of the Methodology for this Landscape and Visual Impact Assessment

Best Practice Guidance

4.33 An LVIA is a formal assessment, which is carried out as part of the EIA, a process defined by the EIA Regulations. In accordance with these Regulations the LVIA takes an objective approach to the identification of the baseline conditions within an appropriate 'Study Area'. In this instance the Study Area extends to a 30 km radius from the Development.

4.34 The LVIA methodology used by the author for wind farm projects has been developed in accordance with the EIA Regulations and the suite of available best practice guidance on the preparation of LVIAs in both general terms and specifically in relation to wind energy development. The latter is published by Scottish Natural Heritage and has been adapted by the author to suit the Northern Ireland context. A full list of this best practice guidance is provided in Technical Appendix 4.1 and a detailed description of the Methodology is provided in Technical Appendix 4.2. This LVIA must be read in conjunction with these Technical Appendices in order to be properly understood.

4.35 The criteria used to identify and analyse both the nature of landscape and visual receptors (their 'Sensitivity'), the nature of landscape and visual effects ('Magnitude') and the Signficance of these effects are all key LVIA terms which are defined in detail in the Methodology. They are also summarised in this section of the chapter for ease of reference (paragraph 4.39 onwards).

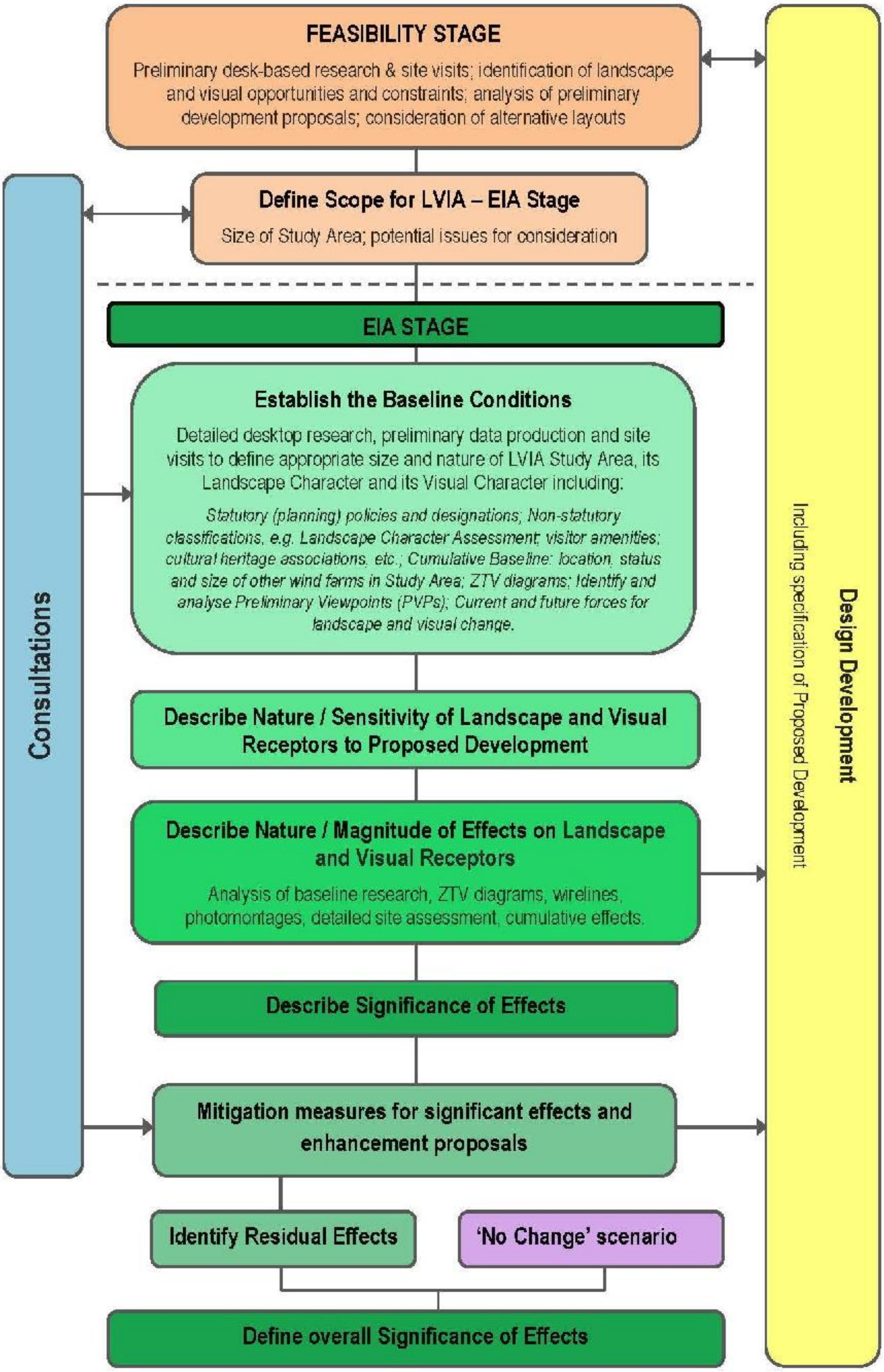
The LVIA Process

4.36 The LVIA begins with an assessment of baseline conditions combining existing desktop information, such as maps and documents, with site surveys of the Study Area carried out by an experienced Chartered Landscape Architect. A review of relevant planning policy is carried out in order to identify any elements or parts of the Study Area which are recognised for their landscape or visual qualities and any locations that may have been identified by the SPG as being more or less suitable for wind energy development. The baseline assessment also evaluates likely levels of acceptable change for various parts of the Study Area in accordance with current definitions of landscape and visual sensitivity (see paragraphs 4.42 – 4.43).

4.37 Potential landscape and visual effects on the baseline conditions are then assessed as separate but linked issues. However, it is noted that all policy guidance and publications providing information on the baseline character of the Study Area deal with landscape and visual elements in combination. To avoid repetition and present an accurate reflection of this baseline information it has been necessary for the LVIA analysis of these publications to reflect this approach. The assessment of both landscape and visual effects require a combination of quantitative and qualitative evaluation. The magnitude of landscape effects is derived from the extent to which physical changes resulting from the Development would cause changes in landscape character. Visual effects relate to changes in the composition of views and people's perception of/responses to these physical changes.

4.38 For both landscape and visual effects the Significance of effect is derived from the assessment of Landscape Value, Sensitivity and Magnitude of change and also by using objective professional judgement in relation to site circumstances. It is important to recognise that the landscape is constantly evolving and that opinions on the beneficial or adverse effects of wind farms are highly subjective. Therefore, in order to ensure that the LVIA presents information objectively, a judgement is made on the significance of effects but no judgement is made on whether these effects are beneficial or adverse.

Plate 4.1: The LVIA Process



Key LVIA Terminology and Assessment Criteria

4.39 The following terms and assessment criteria form the basis for the LVIA and are summarised below for ease of reference. They are fully described in Technical Appendix 4.2.

The Nature of Landscape and Visual Receptors

4.40 The baseline assessment element of the LVIA gathers information on the 'nature' of landscape and visual receptors which is then correlated with the nature of the Development and its anticipated 'effects' on these receptors in order to draw conclusions on the 'significance' of these effects.

4.41 This LVIA uses the term 'Landscape Sensitivity' to refer to the overall nature of landscape receptors (refer to the landscape attributes described in Technical Appendix 4.2, paragraph 4.19) and their susceptibility to the changes caused specifically by the Development.

4.42 The consideration of key landscape attributes enables a considered judgement to be made on the level of sensitivity to be apportioned to each defined LCA within the Study Area specifically related to the Development. The following criteria outline the general principles that are used to inform and guide the assessment of Landscape Sensitivity:

- ***High Landscape Sensitivity:*** A landscape where the majority of attributes are unlikely to withstand change without causing a change to overall landscape character to the extent that it would be difficult or impossible to restore. The frequency and sensitivity of landscape receptors may be high but not exclusively so;
- ***Medium Landscape Sensitivity:*** A landscape with a combination of attributes that is capable of absorbing some degree of change without affecting overall landscape character. There are unlikely to be large numbers of sensitive landscape receptors;
- ***Low Landscape Sensitivity:*** A landscape where the majority of attributes are robust and/ or tolerant of change to the extent that change or development would have little or no effect on overall landscape character. It is likely to be easily restored and the frequency and sensitivity of landscape receptors may be low but not exclusively so.

4.43 Visual effects relate to changes in the composition of views and people's responses to these changes. The nature of visual receptors is determined through the analysis of ZTV diagrams, site assessment and viewpoints representing both typically occurring views within the Study Area and views from specific locations or those likely to be experienced by specific visual receptors (for example, visitors to a specific site such as Glenarm Castle). 'Visual Sensitivity' refers to the overall nature of views and viewers (visual receptors) and their likely sensitivity to the changes in views that would be caused specifically by the Development. The following criteria outline the general principles that are used to inform and guide the assessment of visual sensitivity:

- ***High Visual Sensitivity***: may typically include residents of properties where the main view is orientated towards the Development, or people undertaking recreation where the landscape within which the Development is seen is the primary reason for attraction (e.g. walkers, cyclist and drivers on scenic routes). Receptors are more likely to be located within a designated landscape and could be attracted to visit more frequently, or stay for longer, by virtue of the view;
- ***Medium Visual Sensitivity***: may typically involve people undertaking active recreational pursuits where the wider landscape within which the Development is not seen as the primary reason for attraction (e.g. golf, water sports, theme and adventure parks, historic sites, parks and gardens). Receptors are less likely to be located within a designated landscape and could be attracted to visit more frequently or stay for longer by virtue of the facilities and features of the particular attraction rather than by the value of the view;
- ***Low Visual Sensitivity***: may typically include vehicular travellers; outdoor workers (e.g. farm and forestry workers); people in indoor workplaces and community facilities; and residents within larger settlements. Receptors are unlikely to be within a designated landscape and are most likely to be present at a given viewpoint by virtue of some other need or necessity unrelated to the appreciation of the landscape or visual value.

The Nature of Landscape and Visual Effects

4.44 This LVIA uses the term 'Magnitude' to cover assessment of the degree of change that would result from the introduction of the Development into the baseline landscape and visual context.

4.45 The nature of landscape effects is dependent on the degree of change that would result from the introduction of the Development in terms of size or scale, geographical extent, duration and reversibility of the proposed change and whether the effects would be experienced directly or indirectly (refer to Technical Appendix 4.2 paragraph 4.28 for further detail). The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of landscape effects:

- ***High Landscape Magnitude***: The Development would be immediately apparent and would result in substantial loss or major alteration to key elements of landscape character to the extent that there is a fundamental and permanent, or long-term, change to landscape character. The change may occur over an extensive area;
- ***Medium Landscape Magnitude***: The Development would be apparent and would result in loss or alteration to key elements of landscape character to

the extent that there is a partial long-term change to landscape character. The change may occur over a limited area;

- ***Low Landscape Magnitude***: The Development would result in minor loss or alteration to key elements of landscape character to the extent that there may be some slight perception of change to landscape character. The change may be temporary and occur over a limited area;
- ***Negligible Landscape Magnitude***: The Development would result in such a minor loss or alteration to key elements of landscape character that there would be no fundamental change.

4.46 The nature of visual effects is dependent on factors including, for example, the prominence of the Development in the view; the number of turbines that would be visible and the geographical extent of turbines in relation to the extent of the view; the angle and relative elevation of the viewpoint in relation to the Development; and the context within which the Development will be seen (refer to Technical Appendix 4.2 paragraph 4.33 for further detail). The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of visual effects:

- ***High Visual Magnitude***: The Development would be a dominant and immediately apparent feature that would affect and change the overall character of the view and to which other features would become subordinate;
- ***Medium Visual Magnitude***: The Development would form a visible and recognisable new element within the overall view and would be readily noticed without changing the overall nature of the view;
- ***Low Visual Magnitude***: The Development would form a component of the wider view that might be missed by the casual observer. Awareness of the Development would not have a marked effect on the overall quality of the view;
- ***Negligible Visual Magnitude***: The Development would be barely perceptible, or imperceptible, and would have no marked effect on the overall quality of the view.

The Significance of Landscape and Visual Effects

4.47 The EIA Regulations require the LVIA to identify and assess the acceptability of significant effects. Best practice guidance recognises that the significance of effects is not absolute and is related specifically to the Development. It is also dependent on the relationship between sensitivity and magnitude.

4.48 This LVIA uses the following criteria to inform and guide the assessment of the Significance of Landscape Effects:

- ***Significant Landscape Effects:*** Effects that would occur when the majority of landscape attributes are deemed to be highly sensitive and the magnitude of change would alter landscape character to the extent that it would become defined, or considerably influenced, by the presence of the Development;

- ***No Significant Landscape Effects (Not Significant)***: Effects would not be significant when the majority of landscape attributes are not deemed to be highly sensitive and where the Development would have little, or no, effect on existing landscape character. This would also occur where the Development can be integrated into the existing Study Area without the loss of key landscape attributes. Where the magnitude of effect is higher but the number and sensitivity of landscape attributes decreases, so landscape character would become less defined by the Development and more so by other landscape attributes.

4.49 This LVIA uses the following criteria to inform and guide the assessment of the Significance of Visual Effects:

- ***Significant Visual Effects***: Effects that would occur when the majority of visual receptors are deemed to be highly sensitive and the magnitude of change would alter visual character to the extent that it would become defined, or considerably influenced, by the presence of the Development;
- ***No Significant Visual Effects (Not Significant)***: Such effects would occur when the majority of visual receptors are not deemed to be highly sensitive and where the Development would have little or no effect on existing views. The Development would be likely to constitute a minor component of the wider view, which might be missed by the casual observer, and awareness of the Development would not have a marked effect on the overall quality of the view. Where the Development is easily noticeable but the number and sensitivity of visual receptors decreases, so overall visual character would remain less defined by the Development and more so by other elements of the existing view.

Cumulative Landscape and Visual Effects

4.50 The purpose of the cumulative impact assessment is to measure the incremental effect of the Development on the Cumulative Baseline rather than to assess the combined effects of all, or some, of the Cumulative Baseline with the Development[3]. The magnitude of cumulative change is dependent on a number of factors, including the presence of other wind farms and the degree to which these already influence landscape and visual character and the distance between the Development and other wind farms (see Technical Appendix 4.2, paragraphs 4.61 and 4.66 for further detail).

4.51 There are existing and consented wind farms as well as single turbines in other parts of the 30 km Study Area and these are considered to form part of its baseline character which informs the assessment of landscape and visual effects, particularly

[3] Scottish Natural Heritage (March 2012), 'Assessing the Cumulative Impacts of Onshore Wind Energy Development s' paragraphs 7 and 55, paraphrased from the GLVIA para 7.12

the analysis of effects on viewpoints for this LVIA. Proposed wind farms are also considered but may be afforded less weight when assessing the incremental effects of the Development because their status is less certain. The additional cumulative effects of the Development when considered with other wind farms and single turbines in the cumulative baseline are assessed from paragraph 4.252.

4.52 Cumulative landscape effects relate to the incremental degree of change to the existing landscape character or physical fabric of the Study Area that would result from the introduction of the Development over and above that of the Cumulative Baseline. The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of Cumulative Landscape Effects:

- ***High Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in substantial incremental loss of, or major alteration to, key elements of landscape character to the extent that there would be a fundamental and permanent, or long-term, change to landscape character. The change may occur over an extensive area;
- ***Medium Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in the incremental loss of, or alteration to, key elements of landscape character to the extent that there would be a partial long-term change to landscape character. The change may occur over a limited area;
- ***Low Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in minor incremental loss of, or alteration to, key elements of landscape character to the extent that there may be some slight perception of change to landscape character. The change may be temporary and occur over a limited area;
- ***Negligible Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in such a minor incremental loss of, or alteration to, key elements of landscape character that there would be no fundamental change to landscape character.

4.53 The significance of cumulative landscape effects is dependent on landscape sensitivity, the magnitude of cumulative change, and the relationship between these two factors. The following criteria outline the general principles that are used to inform and guide the assessment of the significance of cumulative landscape effects:

- ***Significant Cumulative Landscape Effects***: Effects that would occur when the majority of landscape attributes are deemed to be highly sensitive and the incremental effects of the Development would alter landscape character to the extent that it would become defined or considerably influenced by the presence of wind farms, taking account of cumulative baseline conditions;
- ***No Significant Cumulative Landscape Effects (Not Significant):*** Such effects would occur when the majority of landscape attributes are not

deemed to be highly sensitive and where the Development would have little or no incremental effect on the existing landscape character. Where the Development can be integrated into the existing cumulative baseline, without the loss of key landscape attributes, cumulative landscape effects would also be deemed as Not Significant. This level of significance would also occur where the Development may have a greater magnitude of effect but its incremental effects would not cause the landscape character to become more defined by wind farms than it currently is, or to become more defined by wind farms than by other landscape attributes

4.54 Cumulative visual effects relate to the degree to which wind energy developments feature in particular views or sequences of views, and the resulting effects of this upon visual receptors. This LVIA considers simultaneous and sequential cumulative visual effects that may arise within the Study Area and in relation to the selected viewpoints. The LVIA principally considers the degree to which the Development would contribute to wind energy development becoming a significant or defining characteristic of visual character. The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of cumulative visual effects:

- ***High Cumulative Visual Magnitude***: The Development would increase the scale of wind turbines in the landscape to a level at which the view would become dominated by wind farms;
- ***Medium Cumulative Visual Magnitude***: The Development would result in a noticeable increase in turbines but this increase would not result in wind farms being the dominant feature of the view;
- ***Low Cumulative Visual Magnitude***: The Development would be visible but would constitute a component of the view that might be easily missed by the casual observer and would not contribute to the overall prominence of wind farms within the view;
- ***Negligible Cumulative Visual Magnitude***: The Development would be barely perceptible, or imperceptible, and would have no effect on the perception of wind turbines within the view.

4.55 The following general principles are used to inform and guide the assessment of the Significance of Cumulative Visual Effects:

- ***Significant Cumulative Visual Effects***: Effects that would occur when the majority of visual receptors are deemed to be highly sensitive and the addition of the Development to the cumulative baseline would result in the view becoming defined, or considerably influenced, by wind turbines;
- ***No Significant Cumulative Visual Effects (Not Significant)***: Such effects would occur when the majority of visual receptors are not deemed to be highly sensitive and where the Development would have little or no incremental effect on existing views. The Development is likely to

constitute a barely perceptible, or imperceptible, component of the wider view, which might be missed by the casual observer. Awareness of the Development would not have a marked effect on the overall quality of the view. Where the Development may still be a noticeable addition to views containing wind farms in the cumulative baseline but it would not cause the overall visual character of the view to become defined by wind turbines rather than by other elements of the existing view the overall effects would also be deemed to be Not Significant.

Baseline Assessment

Legislation and Planning Policy

4.56 The primary policy guidance on the assessment of landscape and visual effects of wind farm development is the Strategic Planning Policy Statement for Northern Ireland (SPPS) which should be read in conjunction with Planning Policy Statement 2 (PPS 2), Planning Policy Statement 18 (PPS 18) it's Supplementary Planning Guidance (SPG) and Best Practice Guidance (BPG)[4]. Further changes in planning policy and updates to development plans are expected to take place over the next few months and years as Planning Policy Statements, supplementary guidance and existing Development Plans become entirely superseded by the SPPS and emerging Local Development Plans.

Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development

4.57 The SPPS sets out strategic subject policies, including renewable energy, and is intended to provide core principles to underpin the delivery of the new two-tier planning system where the new local councils have primary responsibility for the implementation of development control. However, for the transitional period whilst Local Development Plans are being prepared, the existing suite of Planning Policy Statements, supplementary and best practice guidance and relevant provisions within the *'Planning Strategy for Rural Northern Ireland'* will remain in place.

4.58 The aim of the SPPS is to facilitate for sustainable development based on three overarching principles of supporting rural regeneration; promoting economic growth and environmental sustainability. The latter principle includes for the protection of landscape character as well as a reduction in greenhouse gas emissions, and the mitigation and adaptation to the effects of climate change is a key principle in the SPPS and the promotion of renewable energy systems is one of the means by which the planning system will achieve this principle.

[4] Department of the Environment Northern Ireland (September 2015) 'Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development' , (2013) 'Planning Policy Statement 2: Natural Heritage); (2009) 'Planning Policy Statement 18: Renewable Energy' and (August 2010) 'Wind Energy Development in Northern Ireland's Landscapes, Supplementary Planning Guidance to Accompany Planning Policy Statement 18 'Renewable Energy'; (2009) 'Best Practice Guidance to Planning Policy Statement 18: Renewable Energy'

4.59 'Subject Polices' for Renewable Energy are covered in paragraphs 6.214 - 6.234 of the SPPS and the SPG remains in place. The SPPS retains the European Landscape Convention's definition of 'landscape' to mean "*an area, as perceived by people, whose character is the result of the action and interaction of natural and / or human factors*"[5]. The SPPS also recognises that Northern Ireland has significant renewable energy resources and that the renewable energy industry makes an important contribution to sustainable development and investment in the region. Renewable energy also reduces our dependence on imported fossil fuels and benefits our overall health, well-being and quality of life. "*The aim of the SPPS in relation to renewable energy is to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environment in order to achieve Northern Ireland's renewable energy targets and to realise the benefits of renewable energy without compromising other environmental assets of acknowledged importance.*" (SPPS paragraph 6.218).

4.60 The strategic regional objectives are to ensure that environmental, landscape and visual amenity impacts are adequately addressed, and that natural and cultural heritage features are adequately protected. However, the SPPS also expects that the emerging Local Development Plans will support a diverse range of renewable energy developments whilst taking account of both local circumstances and the wider recognised benefits of renewable energy. Whilst the SPPS advises that a cautious approach should be applied to proposals within designated landscapes which are of significant value, and their wider settings where it may be difficult to accommodate renewable energy developments without detriment to the regions cultural and natural heritage assets it also notes that *"It will not necessarily be the case that the extent of visual impact or visibility of wind farm development will give rise to negative effects; wind farm developments are by their nature highly visible yet this in itself should not preclude them as acceptable features in the landscape. The ability of the landscape to absorb development depends on careful siting, the skill of the designer, and the inherent characteristics of the landscape such as landform, ridges, hills, valleys, and vegetation.*" (SPPS paragraphs 6.230 - 231). Whilst the Development would be located within a designated landscape this is not unusual in a Northern Ireland context. The extent of its visibility from within the AONB boundary would be limited to 7.5 km – 10 km (see paragraph 4.155) and it would have limited cumulative effects. Furthermore, it would be in accordance with the more strategic aims of the SPPS related to the mitigation of climate change.

Planning Policy Statement 2: Natural Heritage

4.61 Policy NH6 of PPS 2 states that permission will only be granted for new development in AONBs where it is of an appropriate design, size and scale for the locality and meets three criteria including; siting that is sympathetic to the special character of

[5] Definition of landscape used in the European Landscape Convention (2000, Article 1.a) Council of Europe and 'Northern Ireland's Landscape Charter' (January 2014) NIEA

the AONB in general and also the particular locality; it respects or conserves features of importance to this character and; it respects vernacular styles and materials. PPS 2 also notes that "*the quality, character and heritage value of the landscape of an AONB lies in their tranquillity, cultural associations, distinctiveness, conservation interest, visual appeal and amenity value*" (PPS 2, paragraph 5.15). It refers to LCAs and AONB Management Plans for further information.

4.62 The substation and associated buildings would be located at a relatively low elevation on site to minimise visibility. The buildings would be designed to reflect the local vernacular placement of agricultural buildings within the landscape and the manner in which the Development as a whole reflects the special character of the AONB in included in the analysis of the AONB Management Plan from paragraph 4.89. Detail of the appropriateness of the proposed design, scale and size of the Development in relation to its location is provided by the SPG to PPS 18 which is analysed from paragraph 4.69.

Planning Policy Statement 18: Renewable Energy

4.63 The aim of PPS 18, which is broadly aligned with that of the SPPS, is "*to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environment in order to achieve Northern Ireland's renewable energy targets and realise the benefits of renewable energy*" (PPS 18, section 3.1). Policy RE1 states that proposals must demonstrate that they "*would not have an unacceptable impact on visual amenity or landscape character through: the number, scale, size and siting of turbines; that the development has taken into consideration the cumulative impact of existing turbines, those which have permissions and those that are currently the subject of valid but undetermined applications*". It is noted that the more recently published EIA Regulations do not require consideration of proposed wind farms due to the unknown nature of their status. Therefore, whilst this LVIA acknowledges the proposed Carnalbanagh wind farm because of its relative proximity to the Development the potential incremental effects of the Development on Carnalbanagh are afforded relatively little weight in the assessment of cumulative effects.

Best Practice Guidance to accompany PPS 18

4.64 The BPG provides technical information and potential considerations in relation to planning applications for wind energy projects. It refers to the SPG for guidance on the landscape and visual analysis process and advice on the indicative type of development that may be appropriate but is not prescriptive. The BPG notes that "*There are no landscapes into which a wind farm will not introduce a new and distinctive feature. Given the Government's commitment to addressing the important issue of climate change and the contribution expected from renewable energy developments, particularly wind farms, it is important for society at large to accept them as a feature of the Region for the foreseeable future.*" However, it also notes that the locations of developments should be carefully considered in order to reduce their impact and aid integration into the local landscape even though they may be highly visible. (BPG section 1.3.18 - 19).

4.65 The BPG reiterates the SPPS in its recognition that visibility doesn't necessarily equate with levels of acceptability and notes that there are three considerations when considering the capacity of a landscape to accommodate wind farm development (BPG 1.3.21):

- The degree of impact the development will have on the existing character of the landscape;
- The sensitivity of the character of the landscape; and
- The extent to which this impact can be modified and reduced by design.

4.66 The BPG also refers to the inherent characteristics of a landscape, such as landform and vegetation, the careful siting and skilful design of developments all playing an important role in the ability of a landscape to absorb development. Turbine layouts must also be appropriate to the local landform and landscape characteristics; groups of turbines can normally appear acceptable as single isolated features in open, undeveloped landscapes whereas rows of turbines may be more appropriate where there are formal field boundaries within flatter agricultural landscapes. Wind farms should not appear visually confusing in relation to the character of the landscape and should ideally be separate from surrounding features to create a simple image (sections 1.3.22 & 1.3.26).

4.67 In relation to visual impact the BPG notes that wind farms in an open landscape setting are likely to be prominent features at distances below 2 km, and relatively prominent at up to 5 km. Between 5 – 15 km they are more likely to be seen as part of the wider landscape and prominent only in clear visibility. Beyond 15 km they are only likely to be seen in clear visibility and as a minor element in the landscape (section 1.3.25).

4.68 It is noted that Scottish Natural Heritage's best practice guidance in relation to the siting and design of wind farms has been updated since the BPG was published and no longer refers to specific distances in relation to visual prominence (see Technical Appendix 4.1, paragraph 4.3). Their research has found that other factors such as weather conditions, time of day/year, angle of view, and composition of other elements in the view, all contribute to the assessment of visual effects and visual prominence.

Supplementary Planning Guidance to accompany PPS 18

4.69 The SPG is intended to provide broad strategic guidance on appropriate locations for wind energy development based on the definition of LCAs within the Northern Ireland Landscape Character Assessment (NILCA). It advises that the detailed assessment of the nature of a wind farm's effects on landscape character should be dealt with on a case-by-case basis via an LVIA. The SPG itself is non-prescriptive with regards to turbine heights and groupings. Its assessment of landscape sensitivity is intended to provide broad guidance but not to exclude development. Rather it places an onus on developers to demonstrate, via the EIA process, that wind farms can be developed without unacceptable effects on LCAs as a whole.

4.70 The SPG recommends a 20-30 km radius Study Area for medium or large commercial height turbines, which has informed the selection of a 30 km Study Area for this Development. The SPG includes recommendations that are specific to the potential effects of wind energy developments on the character of individual LCAs. The SPG as it relates to the Development is analysed starting at paragraph 4.106.

4.71 The assessment of Landscape Value and Sensitivity for some LCAs is altered from the SPG if detailed site survey in relation to Development has revealed variations in particular areas. This is in accordance with the SPG, which states that, "*It should be noted that within many LCAs there is considerable variation in sensitivity level across the area, reflecting the fact that the LCAs are broad character or identity areas. The overall sensitivity level is therefore the level that prevails over most of the LCAs geographic area. Localised areas of higher or lower sensitivity may also exist and these are generally identified in the sensitivity descriptions within each LCAs assessment sheet. The overall sensitivity level of a LCA is indicative of the relative overall sensitivity level of each LCA. A high sensitivity level does not necessarily mean that there is likely to be no capacity for wind energy development within the LCA and conversely a low sensitivity level does not mean that there are no constraints to development*" (SPG section 2.3).

Emerging Council Policy

4.72 Changes in planning policy and updates to development plans are expected to take place over the coming months and years as Planning Policy Statements, supplementary guidance and existing Development Plans become superseded by emerging Local Development Plans, which will be primarily informed by the SPPS. For the purpose of this LVIA it is considered that the draft Local Development Plan Strategy is at too early a stage to be given weight. The SPPS (at paragraph 1.10) sets out transitional arrangements where this is the case to ensure continuity of planning policy and decision making and notes that decisions should be taken in line with the SPPS and relevant PPSs until such time as a plan strategy for the whole council area has been adopted. Mid and East Antrim Borough Council published a Draft Plan Strategy for the Local Development Plan in September 2019 which sets out the Council’s strategic intentions for development within the Borough and representations submitted in response to this are currently being considered by the Council. It is understood that the next stage will be for the Draft Strategy, representations and counter representations to be forwarded to the DfI for Independent Examination. The SPPS notes that decisions should continue to be taken in line with the SPPS and relevant PPSs until such time as a Plan Strategy for the whole Council area has been adopted and the timescale for this is, as yet, unknown.

Analysis of the Developments Effects on Planning Policy

4.73 The Development is located within the Antrim Coast and Glens AONB, which is an environmental asset of acknowledged importance. With the exception of Glenarm demesne this is the only statutory landscape designation that applies to the Development. The Development's location is not contrary to the relevant planning policies described in the preceding paragraphs because they do not preclude such Development from designated areas. However, they do require them to be appropriately located in relation to the AONB, the key characteristics of which are described within the AONB Management Plan. This is a non-statutory document providing information on the special qualities of the AONB and the aims and objectives for its long term management (the Developments effects on the AONB are analysed starting at paragraph 4.89).

4.74 The SPPS, which is the overarching policy document, recognises that renewable energy is a beneficial type of development provided it is appropriately located. The SPPS also reiterates the European Landscape Convention's definition of landscape as being a result of both natural and human factors. The SPPS is supportive of renewable energy developments as a means of mitigating against the effects of climate change but advises that a cautious approach should be taken to taken to siting renewable energy developments in designated landscapes where such developments would result in detrimental effects on the value of these landscapes. In this respect it is necessary to consider policy principles set out in Planning Policy Statement 2 (PPS 2) relating to AONBs and more detailed advice set out by the SPG in relation to specific Landscape Character Areas (LCAs) and also to the AONB Management Plan and Northern Ireland Regional Landscape and Seascape Character Assessments (NIRLCA and NIRSCA).

4.75 PPS 2, Policy NH6 notes that the special qualities of AONB's include tranquillity cultural associations, distinctiveness, conservation interest, visual appeal and amenity value. PPS 2 states that permission will only be granted in AONBs where the Development would be sympathetic to the character of the AONB in general and also of the particular locality. In broad terms this character lies in the tranquillity, cultural associations, distinctiveness, conservation interest, visual appeal and amenity value of the AONB. PPS 2 defers to the descriptions of LCAs and AONB Management Plans for further information on these elements. It is noted that the LCAs which combine to form the AONB are assessed by the SPG as being of much the same sensitivity to wind energy development as LCA 124 within which the Development would be located and many upland parts of these LCAs are described as being theoretically suitable locations. The sites of Elginny Hill and Rathsherry wind farms, which are located in the adjoining LCA 117 Central Ballymena Glens to the north of LCA 124, are specifically identified by the SPG as being particularly highly sensitive but have nevertheless been subject to planning consents.

4.76 PPS 18 and its Best Practice Guidance (BPG) are generally promotive of wind energy development in appropriate locations and note that the capacity of a landscape to accommodate such development is dependent on the existing character of the landscape. The BPG further states that, given their importance, is it important for society at large to accept wind farms as a feature of the Region for the foreseeable future. The BPG notes that some locations may be highly visible but that this is not necessarily unacceptable. The latter judgement depends on the degree of effect and sensitivity of the receiving landscape. Of relevance to this Development the BPG also notes that groups of turbines can normally appear acceptable as single isolated features in open, undeveloped landscapes such as the proposed site. Beyond 5 km they are likely to be visible as part of the wider landscape and prominent only in clear visibility, becoming less prominent with distance.

4.77 The general principles contained within the SPG to PPS 18 are also broadly supportive. The Development is located in accordance with seven of the 9 landscape and visual character issues that the SPG notes should be considered for wind energy developments within the Antrim Plateau region. The Development also maintains adequate separation distances from other wind farms and is of a form and layout that reflects the large scale and strong horizontal form of the uplands on which it is located as per the SPG's design principles.

Baseline Landscape Character Assessment and Analysis of Effects

The Site and the Study Area

4.78 The Study Area for this LVIA extends to a radius of 30 km from the centre of the Development (the extent of the Study Area is indicated on all map based figures in Section 4, Volume 3 of the ES). Much of the eastern part of the Study Area is open sea, the character of which is described in the Northern Ireland Regional Seascape Character Assessment (NIRSCA, see paragraph 4.133). The northern and central parts of the Study Area are formed by the Antrim Coast and Glens AONB (see below). The western and southern parts of the Study Area are formed by relatively low lying rural/ agricultural landscapes surrounding the larger settlements within the Study Area.

4.79 The largest settlement is the port town of Larne located at the mouth of Larne Lough just beyond the south eastern edge of the AONB and approximately 8 km to the south east of the Development. The primary vehicular approach to Larne is along the A8 trunk road from Belfast which has recently been upgraded to a dual carriageway and which provides direct access to the ferry port. It has a strong physical presence within the rural landscape between Belfast and Larne. On the opposite side of Larne Lough, at the northern end of Islandmagee is Ballylumford Power Station which, in combination with Larne port creates an industrialised character to this part of the Study Area. There are a series of overhead power lines extending from the power station to the south and south west towards Belfast and Carrickfergus. Whilst the southern edge of the AONB provides a backdrop to this landscape the character and extent of the AONB, including the site of the Development, cannot be appreciated from this part of the Study Area. The presence of the Development as a landscape feature would not become apparent until one is positioned in the more elevated rural landscape to the west of Larne when travelling northwards along the B148 towards Ballygally.

4.80 Urban settlement also characterises the outer edges of the Study Area between 17 – 30 km from the Development where there are other large and medium-sized towns: Ballymena to the west; Antrim to the south west; Ballyclare and Newtownabbey to the south and Carrickfergus and Whitehead to the south east. There are a series of smaller towns and villages located along the coastal edge of the AONB and to the north of the Development, each at the base of one of the Glens which give the AONB its name. These include Glenarm approximately 4 km from the Development, Carnlough (7 km), Cushendall (15 km) and Cushendun (22 km). The landscape character of these villages is an integral part of the AONB's character.

4.81 The nearest settlement to the Development is the small village of Cairncastle which is located approximately 3 km to the north west and the larger coastal village of Ballygally beyond this (approximately 4 km away). The varied profile of the upland plateau on which the Development would be located and the highly distinctive basalt cliffs at Sallagh Braes with Knockdhu at its northern tip create a highly distinctive physical backdrop to both of these settlements.

4.82 In regional terms the Study Area is located within the Antrim Plateau which, as described in the SPG, is formed by a variety of upland landscapes interspersed with valley, glens and bogs which have been formed through the erosion of various layers of geology to create distinctive variations. The eastern fringes of the Antrim Plateau, where the Development would be located, are described as a bold escarpment which forms a series of striking headlands with precipitous cliffs overlooking the coast road. In between the headlands there is a sequence of hidden bays which form the entrances the highly distinctive-shaped 'Glens of Antrim' of which there are 9 in total. Glenarm is the most southerly of these Glens and the first which visitors arrive at when travelling from Belfast along the coast road.

4.83 The proposed site is located on the south eastern edge of the AONB which is characterised by a series of similar upland plateaus interspersed with narrow lowland glens and pastoral landscapes. To the north of the plateau on which the Development is located are Glenarm and Glencloy which have small villages at their coastal edges (Glenarm village and Carnlough). To the north west of the coast the land rises to form broad uplands which frame these villages and form the sides of the glens. To the south of the Development there is a series of hills and summits which combine to form the Larne Basalt Moorlands and the southern edge of the AONB. These include particularly distinctive profiled hills and basalt cliffs at Knockdhu, Sallagh Braes, Agnew's Hill and Slemish. The latter is a key landscape feature of the western edge of the AONB particularly from the rural lowlands surrounding Ballymena and Broughshane. Sallagh Braes forms a distinctive backdrop to the coastal landscape between Larne and Ballygally.

4.84 The proposed site is located on an upland plateau formed by Black Hill, Ballygilbert Hill and Scawt Hill which overlooks open sea to the east and a broader moorland landscape to the west. The 14 turbines would be positioned in two rows between the summits of Black Hill at the northern end of this plateau (at 318 m AOD) and Ballycoose Hill at the southern end (361 m AOD). The proposed turbines would have a lateral spread from north to south of approximately 2.8 km. Turbine T14 at the southern end of the layout would be located approximately 0.6 km from the highest of the three summits (Scawt Hill) and T1 at the northern end of the layout would be located approximately 0.8 km from the summit of Black Hill. The turbines, which would have an overall blade tip height of 149.9 m, would have base heights between approximately 311.48 m AOD (T14) and 371.30 m AOD (T4).

4.85 There is evidence of long-standing human influence on the site in the form of a number of cultural heritage sites although these are not prominent visual features and are not easy to distinguish without some knowledge of cultural heritage sites. There is also a waymarked section of the Ulster Way long distance footpath across the plateau which has a series of information signposts along its route drawing attention to the significance of the site in terms of rare mineral deposits. The land is currently used for grazing sheep.

4.86 Human influence and activity shapes the wider landscape as well. Aside from the towns and villages and interconnecting roads between these it is evidenced by large areas of coniferous forestry on uplands throughout the AONB and agricultural practices across most rural parts of the Study Area. This includes extensive sheep grazing on the uplands surrounding and including the Development site. The industrial character of the landscape around Larne port and Ballylumford power station is also a key characteristic of the coastal area within 10 km of the Development. In terms of wind energy the landscape within 5 km of the Development already features a number of existing single turbines and these are also a characteristic feature of the rural landscape in the wider Study Area, particularly around Islandmagee and Ballyclare. There are also three clusters of existing wind farms located in close proximity to the western boundary of the AONB: Altaveedan, Corkey and Gruig are located approximately 25 km to the north west; Rathsherry and Elginny Hill are located on the uplands near Broughshane and Ballymena approximately 17 km to the west; Elliot’s Hill and Wolf Bog are located approximately 17 km to the south west and there are four further wind farms/ commercial single turbines located to the south and south west at a greater distance. Full details of these wind farms, along with consented and proposed schemes are included in the cumulative baseline section of this chapter (paragraph 4.252) and Technical Appendix 4.5. The presence of existing wind turbines is, however, considered to form part of the existing landscape and visual character of the Study Area and is also considered in the analysis of effects in this respect. Whilst there are currently no existing commercial wind farms in close proximity to the Development the presence of a relatively large number of single turbines within 5 km of the Development means that wind turbines per se are not a new or unusual landscape character element in this part of the Study Area, or in the wider landscape.

Landscape Designations

4.87 The European Landscape Convention (2000) requires member states to recognise that all landscapes can have value, and that the perception of value may vary from person-to-person. Statutory designations are one of the criteria used to assess the significance of effects on landscape character and visual amenity in an objective manner. Whilst it is recognised that all landscapes have some subjective importance, particularly for those who live and work in them, or use them for leisure, designation gives an indication of a landscape's 'value to society'. Landscapes are designated by statute, and policies for their protection, use, and management are included in Development Plans, usually following a consultation process (which seeks to reach a consensus opinion, thereby reducing subjectivity). The national, regional and local designations that have been identified as being relevant to the landscape and visual character of this Study Area are described in the following paragraphs and illustrated in Figures 4.1 - 4.2.

4.88 Statutory landscape designations are contained within the current planning policy and guidance which cover the Study Area. The primary designated landscape within the Study Area is the Antrim Coast and Glens AONB and policy guidance in relation to this designation is contained within the SPPS, PPS 2, PPS 18 and SPG which are described in the preceding paragraphs. The nature of the AONB and the effects of the Development on this landscape are analysed below. Other statutorily designated landscapes within the Study Area are analysed in subsequent paragraphs.

Antrim Coast and Glens Area of Outstanding Natural Beauty

4.89 AONBs are the principal landscape conservation designation in Northern Ireland. The designation gives statutory recognition to the high scenic quality and distinctive landscape character of an area and the need to ensure that sensitive conservation measures take place to preserve these qualities alongside measures to allow public access and enjoyment of the area. The needs of local communities, including their social and economic well-being, is a key management objective, although development deemed to be detrimental to environmental quality is not permitted within AONBs. The landscape around AONBs performs an important function by providing context, particularly in view to and from the AONB and from key approach routes.

4.90 The Antrim Coast and Glens AONB is regarded as the primary designation to be considered in this LVIA because it is of regional importance. The majority of the AONB is located within the Study Area. The Development is located near the south eastern edge of the AONB overlooking the coast. A large proportion of representative viewpoints in this LVIA are also located within the AONB.

4.91 A Management Plan and Five Year Action Plan were published for the period 2008 – 2018 and, since no updates are known to have been made since, these documents continue to be the main points of reference for the AONB's management aims and objectives. The purpose of the Management Plan is to state what elements of the AONB are special, characteristic and valued and to devise objectives and mechanisms by which change might occur whilst maintaining the intrinsic character of area. The AONB is covered by a number of Landscape Character Areas (LCAs) and the NILCA is referred to because it provides a more detailed description of the physical and visual character of different parts of the AONB than that which is described in the Management Plan itself. The Development is located within LCA 124: Larne Basalt Moorland (see paragraph 4.109 for further detail). It is noted that PPS 18 was only in draft form at the time of Management Plan's publication and the SPG is not expressly referred to but the SPG is currently the primary point of reference for landscape character in relation to wind energy developments and is therefore referred to in this LVIA in preference to the NILCA. The key landscape characteristics of the AONB, including their potential sensitivity to the Development, and the potential nature, or Magnitude of effects on this AONB are described below. The sensitivity, magnitude and significance of visual effects on receptors located within the AONB are described and analysed in the assessment of Visual Effects. The AONB boundary is shown on all map based figures that accompany the LVIA (Figures 4.1 – 4.13).

4.92 The AONB Management Plan highlights the following as key characteristics that make the area special[6]:

i. Its physical isolation from the rest of Northern Ireland and its visual links with Scotland which are a reminder of the areas proximity to the Scottish islands and mainland. The Development would have no physical effect on this characteristic;

ii. The nine hidden glens which each have their own character or "personality". The Development is not located within a Glen and is physically remote from most glens due to its position at the south eastern part of the AONB. It would have little to no visibility from the majority of the Glens. It would however have some visibility from Glenarm and approaches to Glenarm village which are analysed as part of the assessment of landscape character effects on LCA 124 and in relation to visual effects;

iii. The high ground above these glens – the Antrim Plateau - which historically limited access to the Glens and which has distinct vegetation across different parts resulting from variations in the underlying geology. The Development is located within the Antrim Plateau. This is an extensive upland area and the Development would have a direct physical effect on only one part. It would be visible from surrounding elevated parts of the Plateau, particularly within 10 km to the south and west, and would therefore have an indirect effect on the landscape character of these parts. It becomes far less apparent in views from the Plateau at greater distances

6 'Antrim Coast and Glens Area of Outstanding Natural Beauty Management Plan 2008 – 2018', Causeway Coast and Glens Heritage Trust, page 3

and particularly those located to the north. Representative Viewpoints of relevance are Viewpoints 1, 2, 4 - 6, 23, 25 and 27 (refer to paragraph 4.163 onwards);

iv. The coastline which forms a dramatic sequence of cliffs, headlands and bays at the foot of each Glen as well as the adjacent seascape which includes Rathlin Island located off the north eastern corner of the mainland and open views to Scotland. The Development would have no direct or indirect physical effects on the coastline around Rathlin which is beyond the LVIA Study Area and from where the Development would not be visible. It would also have no effects on the coastline to the north of Garron Point. It would however be located in close proximity to the coastline at the south eastern edge of the AONB and would affect the physical character of the landscape which frames views from this part of the A2 Coast Road and scenic drive. It would also be a prominent feature in views from Ballygally village. Category D Viewpoints (Viewpoints 19 – 22) have been selected to inform the nature of effect on sequential views from the A2 and Viewpoints 14, 15 and 18 have been selected to inform the nature of effects on the coastal settlements of Glenarm and Ballygally;

v. The long history of human settlement in the area which is evidenced by groups of farmsteads or 'clachans' scattered throughout the valleys and sides of Glens with associated vernacular buildings, hedgerows, gateposts and ladder field patterns, archaeological sites including earthworks, tombs, stone enclosures, churches and castles. The Development is indicative of continued human use of the physical landscape and its resources;

vi. Today's population is concentrated mainly in settlements along the coastline and on the farms scattered throughout the countryside. The relative isolation of settlement in the AONB has created local communities with unique local traditions and cultures. Many of the coastal villages are old fishing communities including Cushendall, Carnlough and Glenarm which are all located in this Study Area. As described above the Development would be a prominent feature in views from the coastal village of Ballygally and, to a lesser extent, Glenarm. It would not be visible or characteristic of the setting of other coastal villages but it would be clearly visible from farmsteads located in the rural landscape in the south western part of the Study Area. The physical landscape effects of this are analysed below and the visual effects are analysed by Category E Viewpoints (from paragraph 4.230).

4.93 The Management Plan identifies a number of forces for change as listed below. Wind farms are not one of these factors. Whilst the creation of a wind farm could in theory affect the existence of historic features and vernacular buildings the Development would not have this effect. The Development's effects on wildlife habitats is beyond the remit of this LVIA and is analysed in Chapter 8 of this ES:

- The disappearance of old buildings and historic features from the landscape;
- Threats to wildlife habitats;
- Rapidly increasing house prices;
- New development that is altering the character of settlement.

4.94 The Plan then sets out mechanisms to maintain the area's special character and address threats and negative forces for change. This includes responses to community perceptions of the AONB. The overall vision is that the "*characteristic rolling plateau cut by deeply incised glens, its rugged coastline, and the remote 'jewel' of Rathlin is protected and treasured for its beauty and tranquillity*[7]". This overall vision includes the need to maintain vernacular field boundaries and farming practices that have created this character. Archaeological remains should be conserved and made more accessible for public enjoyment as should the distinctive cultural heritage of the communities within the AONB. The Development would have the potential to contribute to these aims via mitigation and enhancement measures to repair existing field boundaries and ensuring that farming practices on the site can continue below the operational turbines. The cultural heritage baseline and the potential effects of the Development on this baseline are analysed in Chapter 5.

4.95 A diversified rural economy and varied business activities, including low impact tourism is seen in the Management Plan as the means to achieve the overall vision so that communities have access to job, services and housing whilst working to conserve the AONB's unique features. This aspect is beyond the remit of the LVIA but the Development's affects and positive contribution to the rural economy of the AONB is analysed in Chapter 13 of this ES.

4.96 In relation to community perceptions wind energy developments are not identified by the Management Plan as being a threat to the AONB. Rather it is the intensification of agriculture and the expansion of quarries that are identified as key concerns alongside the lack of jobs outside the agricultural sector. As above, the Development's economic contribution is analysed in Chapter 13. In landscape terms the Development would have no physical effects on the AONB aside from temporary (albeit relatively long term) alterations to the underlying ground resulting from the construction/ erection of the turbines and associated site access tracks and infrastructure. However, unlike quarrying, the landform of the site as a whole would be largely unchanged. Existing low-intensity grazing of the site would continue, thus maintaining the existing land cover and this is recognised in the Management Plan as being an important tool for maintaining the largely pastoral landscape within the AONB.

[7] AONB Management Plan page 8

4.97 The extraction of minerals from parts of the Plateau is noted in the Plan as being a key feature of the AONB which highlights the underlying geology and early human exploitation of the landscape as a resource. Scawt Hill is noted as being a particularly unique location because it is one of the largest known plugs of the mineral dolerite. In addition, the hills and volcanic plugs located along the Plateau are noted as being prominent and iconic features of the AONB and are therefore of great importance in terms of its landscape character. These areas are characterised by a general lack of visual intrusion from pylons and other vertical structures except at Slieveannorra at the north western boundary. Whilst the Development reflects the long-standing cultural characteristic of human's harnessing the natural resources in the AONB it differs from mineral extraction activities particularly because it would result in the erection of a series of vertical structures in part of the AONB where this is not currently a characteristic feature.

4.98 Furthermore skylines and summits are noted as being sensitive to change and there are references throughout the Management Plan to the importance of coastal views and the relationship between the landscape and seascape. Wind farms are noted as being one of several types of development that would have a significant impact on skylines and one of the objectives for the future management of land, coast and sea is the protection of the character of the landscape and seascape including the restoration of key areas of visual prominence where their character has become degraded[8]. The Development would be prominently located on an upland plateau in close proximity to, and overlooking, the coastline. It would be a prominent landscape element in seaward views as well as sea-based views towards the land and would therefore have a significant effect on the landscape character on the character of the coastline between the southern edge of the AONB and Garron Point located at the centre of the eastern coastal edge of the AONB.

4.99 The Management Plan notes that climate change is an issue that will affect biodiversity but that addressing these impacts will be difficult because of its "*global origin and a limited understanding of likely changes and of measures to adapt to its effects.*[9]" No consideration is given to the potential physical effects, such as coastal erosion and changes to agricultural practices that may be related to more unpredictable weather and the manner in which these are likely to alter the physical appearance of the AONB. However the Management Plan does note (on page 22) that management of the AONB will take account of external pressures such as climate change and that the features that define the character of the AONB will be retained and their condition enhanced. This LVIA provides an outline of the likely effects of climate change in paragraph 4.262 where it is noted that the trend of developing cleaner renewable energy sources will continue and become more environmentally acceptable given the predicted effects of climate change and the necessity to tackle these effects. In this context, whilst the Development would have significant effects

[8] AONB Management Plan pages 17 and 22

[9] AONB Management Plan page 18

on both the landscape and visual character of the AONB it would also play a role in mitigating negative effects of climate change on the physical appearance of the AONB and would offer a sustainable solution of the management of the site and contribute to the local economy (as noted on page 22 of the Management Plan).

4.100 The Management Plan notes that the tourist industry is increasingly important to the AONB's economy and this is largely related to landscape value but it also notes that many tourists tend not to pass through the area along the Causeway Coastal Route rather than stopping for longer periods within the AONB. One of the reasons for this is identified by the Plan as being limited access to the countryside aside from the road network. Therefore one of the long term management aims is to encourage tourism that draws benefit from the natural features of the area. The Development is, however, located on a site which is relatively accessible for walkers because it is located on the Ulster Way and there are a number of information boards along the footpath identifying the site's geologically unique features. It is also in close proximity to the Linford car park at the base of Knockdhu which is currently a popular stopping point for fans of the 'Game of Thrones' television series and also to Glenarm village which is a stopping point/ hub along the Causeway Coastal Route. In this respect the existing character of the Development site contributes to the Management Plan's objective to make the AONB a tourism destination of international importance known for its scenic beauty. The Development would be located in part of the AONB that receives potentially higher numbers of tourists as visual receptors. The potential visual effects on this group of receptors is analysed in greater detail in relation to Viewpoints 1 – 7 and are deemed, overall to be significantly affected by the Development. However, it is noted that the Development would not impeded the use of the Ulster Way and also that Game of Thrones visitors frequently seem to make only brief stops at Linford Carpark from where the Development would not be a prominent feature (see Viewpoint 3, paragraph 4.168).

4.101 The Five Year Action Plan that accompanies the AONB Management Plan provides some additional detail as to how Objectives will be achieved. In relation to the management objective of protecting landscape and seascape character and restoring key areas of visual prominence where they are currently degraded (Objective 5) the Action Plan refers to existing planning policy, guidance and landscape character assessments for information. The potential effects of the Development on planning policy has been analysed earlier in this section of the LVIA (from paragraph 4.73) and its effects in relation to supplementary guidance on landscape and visual character issues, as well as the relatively recent seascape character assessment are analysed from paragraph 4.106.

Other Statutorily Designated Landscapes in the Study Area

Register of Historic Parks, Gardens and Demesnes

4.102 The Register identifies sites that are considered to be of exceptional importance within Northern Ireland, which have historic significance, and which may also contribute to local landscape character. It is maintained by NIEA Built Heritage. Inclusion on the Register affords sites protection through the SPPS and Planning Policy Statement 6 (PPS6)[10] which requires NIEA to make comment on the protection of such sites as part of the planning consultation process. The SPPS states that permission would not be granted for development that would harm the overall character of site's integrity, overall quality or setting and its contribution to local landscape character should be maintained where possible.

4.103 There are a large number of registered sites located within the Study Area particularly on the edge of settlements. However, few are likely to have views of the Development due to screening factors such as surrounding built development, high levels of tree cover and flat topography in low lying areas. Only Glenarm Castle, Ballygally Castle, Cleggan Lodge would experience some effects on their settings. The latter is a former shooting lodge in private ownership in a woodland setting and therefore public access is not freely available. However, Viewpoint 24 is located in close proximity and represents the nature of views from this part of the Study Area, including those from residential properties (see paragraph 4.232). Given its distance of approximately 12 km from the Development the effects on landscape character are deemed to be minimal.

4.104 The two Castles are in closer proximity to the Development. Ballygally Castle is now a hotel in the centre of the village and the immediate setting of the castle gardens is heavily influenced by adjacent hotel and town parking and other built development. The potential landscape effects of the Development are therefore considered in relation to the physical setting of the village as opposed to the registered site in isolation. The Development would be located within approximately 4 km of Ballygally on the upland plateau which forms the primary backdrop to the village and, in conjunction with the village's coastal edge location, create a distinctive character. Whilst the foreground landscape is characterised by \uilt development, the uplands are currently devoid of vertical built structures and this location is the one of the first instances along the A2 Coast Road scenic driving route (see paragraph 4.146) from where the key features of the AONB can be appreciated – namely the manner in which distinctively profiled hills and cliff faces frame a thin coastal area with small settlements nestling at the base of the upland landscape. The Development would introduce a large new physical manmade element to the landscape and would therefore have a significant effect on the setting of the village. The effect on views from this location are represented by Viewpoint 18 following analysis of a number of Provisional Viewpoints (refer to the analysis of visual effects starting from paragraph 4.207).

4.105 Glenarm is an extensive demesne landscape focussed around the Glenarm River and extending to the sea. It is described by the Register as a picturesque site below heavily wooded slopes. The house, which is privately owned, is open for tours on selected dates. The wider parkland landscape is not usually accessible but the formal

[10] Department of the Environment (March 1999) 'Planning Policy Statement 6: Planning, Archaeology and the Built Environment'

walled garden and outbuildings house various visitor attractions including small shops, a café and sculpture trail which are popular with visitors to Glenarm. Potential visibility of the Development from accessible locations within the walled garden and the roads bordering the demesne was assessed as part of the viewpoint selection process (refer to PVPs 61 – 64 and 66 - 69 in Technical Appendix 4.4, Table 4.4.1). No views were identified from within the walled garden or from the northern or southern ends of the demesne where the woodland around the sloping edges of the river valley would screen views. Three locations overlooking Glenarm village and the northern edge of the Demesne have been shortlisted to represent the nature of visual effects from this part of the Study Area (refer to Viewpoints 14, 15 and 22 starting at paragraph 4.200 and Figures 4.27, 4.28 and 4.34). They demonstrate no significant effects on the physical character of the demesne landscape. Viewpoint 8 was shortlisted to represent the nature of elevated views overlooking the demesne landscape. From this location there would be clearer views of the Development and, whilst it would not be highly visible from within the registered landscape it is deemed to have a significant effect on the wider setting due to its prominence and the presence of visual receptors of high sensitivity (paragraph 4.178 and Figure 4.21).

Non-Statutory Landscape Classifications

The Northern Ireland Landscape Character Assessment

4.106 The NILCA classifies the landscape into six broad regions and 130 smaller areas of distinct and separate character called Landscape Character Areas (LCAs). The SPG accompanying PPS 18 provides further broad guidance on these regions and LCAs including the overall sensitivity of LCAs specifically in relation to wind energy developments. The descriptions of landscape and visual character in this LVIA are based on the SPG which itself reiterates information contained within the NILCA. They are also inextricably linked to the description of the key characteristics of the Antrim Coast and Glens AONB and some elements of the subsequent LCAs have already been analysed in the preceding sections. The SPG identifies nine broad landscape and visual character issues to be considered in relation to wind farm development in the Antrim Plateau region[11] only two of which are considered to be of relevance to this LVIA. All nine are summarised below with the two most relevant to this LVIA listed first:

- Of particular relevance to this LVIA is the issue of impacts on the wild character of the moorlands to the north and east which are located within the Antrim Coast and Glens. The Development would be located in this part of the Region and is therefore likely to have a significant effect on landscape and visual character in some instances. These effects are the primary focus of the analysis of both landscape and visual effects in this LVIA. The analysis of effects on landscape character focusses on the potential effects of the Development on the AONB and the LCAs which are located within the AONB

[11] section 3.3.1 of the SPG

or which form the setting to it, particularly to the south and east. The majority of representative viewpoints in this LVIA have also been chosen to illustrate the nature of visual effects in this respect;

- Also of relevance to this LVIA is the issue of impacts on long distance views from the south (also less so from the west where the Development is unlikely to be clearly visible) on transport corridors and tourist routes, especially approaches to the Antrim Coast and Glens. Category F viewpoints have been selected to represent these types of views and include Viewpoints 28 – 30. They are analysed in detail from paragraph 4.240 and illustrated by Figures 4.40 – 4.42;
- Appropriate separation distances and cluster sizes are recommended by the SPG to ensure that wind energy developments do not become overbearing or dominant in the landscape. The Development would be located approximately at least 17 km from any existing wind farms. It would also not form part of a cluster and is therefore in conformity with this recommendation. It would however be located only 5.56 km from the consented Ballykeel wind farm but there are few instances where the two wind farms would appear in the same view or be closely related to each other due to the nature of the underlying topography. Their relationship is analysed in more detail in the assessment of cumulative effects;
- Cumulative impacts caused by simultaneous, successive or sequential views of more than one wind energy development. This is similar to the issue of separation distances noted above. The Development would, in some instances, be visible with other wind farms and single turbines in the Study Area but at such distances that cumulative effects would be minimised;
- Compatibility of smaller and larger newer turbines. This is considered to relate primarily to the clustering of wind energy developments in close proximity to each other and is not considered to be of great relevance to this Development. It is also noted that the Development is located such that it would appear to be visually distinct and separate from any single turbines that are located within 5 km;
- Impacts when seen in conjunction with electricity transmission lines. There are no such lines located in proximity to the site and this is not considered to be an issue specific to this Development;
- Impacts on skylines along the bold western edge of the Plateau and the escarpment above Belfast Lough. This issue is considered to relate to the existing wind farms at Carn Hill, Wolf Bog and Elliot's Hill, Rathsherry and Elginny Hill which are located in a linear fashion in these parts of the region. The Development is not positioned in either of these parts of the Region. It is also noted that Elginny Hill and Rathsherry were both consented following publication of the SPG despite their location being specifically highlighted as unsuitable in the SPG;

- Impacts on the settings of a number of specific settlements also located to the south and west which are parts of the Study Area located beyond 20 km from the Development and from where it would either not be significantly visible or visible at all.

4.107 General and landscape type-specific principles for the layout, siting and design of wind farms are provided in section 3 of the SPG (Tables 3 and 4). Of particular relevance to the Development are:

- Adequate and appropriate spacing depends on landscape character, including pattern and rhythm, and the degree of intervisibility between wind farms. It is necessary to maintain areas of undeveloped landscape between wind farms in order to prevent a landscape becoming dominated by them. The Development maintains adequate separation distances between the nearest existing wind farms (Wolf Bog/ Elliot's Hill and Rathsherry/ Elginny Hill both located in excess of 17 km away). The latter is intervisible with the Development in views located within the Antrim Plateau but the main section of the basalt moorland and the farmland around Ballymena provide an extensive area of 'undeveloped' land in between. The Development would be physically closer to the consented Ballykeel wind farm, which is located approximately 5.5 km to the south, a distance which falls within the SPG's recommendation of between 6 km – 12 km for larger sites in open exposed landscapes. Ballykeel comprises 7 turbines and is a smaller wind farm than the Development (which at 14 turbines would be considered to be a larger wind farm). However, the two wind would not have a close visual relationship as noted above;
- The SPG notes that small turbine groupings are likely to fit best in small scale and more intricate landscapes whereas elevated landscapes with a strong horizontal form and of a larger scale, such as the Antrim Plateau are more likely to accommodate larger turbines and larger groupings, such as the Development because they tend to diminish perceived scale. Complex and varied landforms may experience undesirable flattening effects from the latter but the Development is located on a broad upland plateau and has a broadly linear layout which reflects that of the underlying topography;
- The turbine layout would not be directly comparable to any other wind farms in close proximity to it which is reflective of the principles in the SPG and, whilst there are a number of single turbines in the surrounding lowland landscapes the upland character of the site ensures that the Development would remain clearly distinct from these turbines;
- However, the SPG also notes that the settings of distinctive landscape features such as dramatic landform features like cliffs and cultural features like historic parks may be especially sensitive. Coastal cliffs are also noted as tending to be highly sensitive. For this reason viewpoints have been selected to represent the nature and potential effect on views in proximity

to Glenarm Castle demesne and other registered parks and gardens in the Study Area which may have potential views of the Development (Viewpoints 8, 15 and 24 from paragraph 4.178 and Figures 4.21, 28 & 36). Viewpoints in proximity to Knockdhu and Sallagh Braes have also been selected to represent the potential effects on these prominent cliff landscapes in proximity to the Development (Viewpoints 3 - 6 from paragraph 4.163 and Figures 4.16 – 4.19) and a series of Viewpoints located along the A2 scenic coastal route have also been selected (Viewpoint 18 and Category D Viewpoints 19 – 22, from paragraph 4.207 and Figures 4.31 – 4.34;

- Furthermore, the SPG notes that wind farms that are set back from upland edges and located in the central parts of upland landscapes will generally be regarded as less prominent and less visible from adjacent lowlands. The Development's elevated location in proximity to the coast means that it is not visible from much of the nearby parts of the coast road. It only becomes visible at greater distances to the north and south (see Viewpoints 18 – 22) The physical contrast between the broad uplands and plateaus and the intervening Glens also means that the Development is not highly visible from many settlements which are located along the coast with the exception of Ballygally (see Viewpoints 14, 15, 17, 18 and 22 from paragraph 4.200 and Figures 4.24, 4.28, 4.30 and 4.34);
- Sites characterised by heather moorland and bog are described as having a wilder character but proximity to scale indicators such as lines of forestry is noted as having the potential to increase apparent turbine heights but this is not applicable to the Development.

4.108 There are eighteen Landscape Character Areas (LCAs) and six Seascape Character Areas (SCAs) within the Study Area of which nine are located wholly or partially within the AONB. They are illustrated on Figure 4.2. The Development is located within LCA 124 Larne Basalt Moorland and would therefore have a direct physical effect on part of this area, which is described in detail below.

Landscape Character Area 124: Larne Basalt Moorland

4.109 The SPG describes the physical landscape characteristics as well as elements of visual character of LCA 124: Larne Basalt Moorland within which the Development is located. The SPG defines LCA 124's overall sensitivity to wind energy and its capacity to accommodate certain turbines groups and heights. The relevant information from the SPG is summarised and analysed in the following paragraphs.

The SPG's description of Key Landscape and Visual Characteristics and Values

4.110 This LCA is largely characterised by upland moorland located in the countryside between the coastline and Ballymena. The landform comprises distinctive large scale rounded summits reaching up to 300 – 400m AOD. They have a simple outline and an exposed open character due to the general lack of vegetation, high elevation and expansive topography. In visual terms this openness means that there are often uninterrupted and long range views into the surrounding landscape. It also means that individual features within this LCA may often be clearly visible and that large scale features may be prominent but not dominant due to the overall scale of the topography.

4.111 The crescent-shaped cliffs to the east and south of the LCA at Sallagh Braes and Agnew's Hill are prominent features when viewed from adjacent LCAs. Sallagh Braes is most dramatic when viewed from the lowlands to the east of the LCA where they provide a distinctive backdrop to Ballygally village. Agnew's Hill provides some physical and visual containment of the LCA in approaches from the south as well as creating a setting for LCAs in the south of the Study Area, namely LCA 114 Three and Six Mile Water Valleys; LCA 115 Tardree and Six Mile Water Slopes; and LCA 125 Tardree Upland Pastures. It is noted in the SPG as being particularly prominent in views from the Glenwhirry Valley which is located directly to the south and connects Larne to Ballymena via the A36 road corridor. The Development would not feature in views from this location and Agnew's Hill would also screen views of the Development from many southern parts of the Study Area beyond approximately 15 km. Slemish Mountain is also a prominent feature of this LCA and is described by the SPG as "an exceptional landmark". Due to its distinctive shape Slemish is a distinctive feature from more distant locations within the Province and panoramic views across the Province can also be appreciated from Slemish itself which is an accessible and well-visited walking destination (the nature of views from Slemish and the likely effects on the Development on visual receptors at this location are analysed in Viewpoint 25 (paragraph 4.234) and illustrated by Figure 4.34.

4.112 The landform of LCA 124 extends into a narrower ridge in the northern part of the LCA which physically separates Glenarm from the coastline and it is on this finger of uplands that the Development would be located. It would be physically distinct from the rest of the LCA and the other distinctive landform features highlighted by the SPG and referred to above.

4.113 Land cover within this LCA is largely pastoral and used for grazing sheep. The SPG describes the overall condition of this landscape as being good but notes that there are some areas of derelict pasture and collapsed stone walls dividing fields. The degraded condition is also evidenced by the encroachment of rushes and gorse in places. In addition to the overall character of this LCA being defined by these farming practices the SPG notes that man-made influences are evidenced by prominent radio masts, areas of commercial forestry and numerous narrow roads crossing the moorland areas and around the edges of summits. Wide views are common across much of the tertiary road network in this LCA and the Development would form a clearly visible feature in many views in conjunction with existing clear views of other prominent landscape features including existing wind farms at Rathsherry and Elginny Hill and single turbines throughout the LCA and surrounding landscape.

4.114 The summits themselves tend to be accessed by farm tracks and footpaths only and are rarely settled. Built development is sparse and comprises mostly of individual farmsteads and small groups of houses arranged in proximity to road corridors. It is noted that there are also a relatively large number of single turbines located around the northern and eastern edges of this LCA and in adjacent LCAs where they are clearly visible due the exposed nature of this LCA but these are not highlighted in the SPG, possibly because they have been constructed since its publication.

4.115 The SPG describes the overall condition of the LCA as being good despite the presence of some areas of derelict pasture and degraded field boundaries. Scenic quality of this LCA is described as being high because the majority of the LCA, with the exception of the southern fringes, is located within the AONB boundary.

4.116 The SPG describes the upper and central parts of the LCA as being open and remote and therefore having a wild character. The dramatic knolls and cliffs are also described as having relative wildness as a result of their scale and dominance. It is noted, however that the SPG also highlights a number of man-made influences on this LCA, including numerous roads skirting much of the area except the summits themselves which are often accessible by footpaths and farm tracks. The open nature of the moorland has also been created, and continues to be maintained by visible farming activity and there are a number of towns and villages located in relatively close proximity to this LCA. Therefore it cannot accurately be described as wild or remote, although it is certainly relatively peaceful and tranquil.

4.117 Natural heritage interests within this LCA are noted in the SPG as including earth science sites at Scawt Hill. These are highlighted by information points along the Ulster Way which passes through the site of the Development and the visual effects on walkers along this route are analysed from paragraph 4.163. Cultural heritage interests within this LCA are noted in the SPG as being concentrated around Knockdhu, the southern fringes of the LCA and at Slemish and the former is of particular relevance to this Development due to proximity and intervisibility. The effects of the Development on these cultural heritage sites are analysed in detail in Chapter 5. There are no known cultural associations within this LCA noted by the SPG.

4.118 Based on the SPG's description of the LCA it is deemed to be of High Landscape Value because the majority of the area is located within the AONB which is a statutory designation of regional importance. It has a strong sense of place and many positive characteristics, of which most are in relatively good condition although there are also some characteristics which are degraded. There are features of high scenic quality within this LCA and concentrations of archaeological and geological sites of particular interest although these are not numerous or widespread across the LCA.

The SPG's description of Landscape Sensitivity to the Development

4.119 The SPG describes this LCA as being of high to medium sensitivity overall. It notes that the large scale landform and simple land cover suggests some suitability for wind energy developments. The SPG advises that the central parts of the LCA may be of less sensitivity because they have an open plateau landform with simple uniform land cover. In these parts of the LCA there may be some topographic screening – it is presumed that this would be provided by the outlying hills and relate to views from the wider landscape rather than from within the LCA itself. The SPG further notes that forestry has already had a detrimental effect on the landscape character and value of habitats in this part of the LCA and this is also deemed by the SPG to reduce its sensitivity.

4.120 The outer hills in the LCA are noted as being especially sensitive due to their distinctive form and wide visibility. The narrow finger of land in the northern part of the LCA, on which the Development would be located, is also highlighted as being especially sensitive because it forms an important setting to both Glenarm village and the coastline. The SPG further notes that areas that can be seen from the coast and coastal glens are of the utmost sensitivity within this LCA and in other parts of the Antrim Plateau.

4.121 Whilst the AONB Management Plan reflects the SPG's advice that skylines and summits are sensitive to change and are likely to be significantly affected by vertical features such as wind farms, pylon lines and aerials, LCA 124 is the only LCA located within the AONB which the AONB Management Plan describes as having wind farms and radio masts as prominent features of its existing character. Wind farms are not mentioned as characteristic features of any of the other LCAs within the AONB boundary although the presence of pylons is referred to as a key feature of LCA 117 Larne Ridgeland which is adjacent to LCA 124.

The SPG's description of Key Location, Siting, Layout and Design Considerations

4.122 At the time of the SPGs publication there were no operational or consented wind farms within LCA 124 and the nearest wind farms were located approximately 4 km to the south west at Elliot's Hill and Wolf Bog. In this context the SPG notes that consideration could be given to forming a cluster of wind energy developments on the central plateau within LCA 124 where it would be located away from steep hillsides, distinctive summits and rocky cliffs and where commercial forestry has reduced both landscape and visual sensitivity and would also facilitate access.

4.123 The SPG also advises that any wind energy development within this LCA should be set back from steep upland and plateau edges in order to help contain visibility. Other considerations include the avoidance of adverse impacts on the settings of Slemish, Sallagh Braes and Knockdhu, on key views from lowland landscapes to the west or from the glens and coast to the north and east, or on the wild character of the area. The SPG also notes that the "*landscape interests of natural and cultural heritage features and recreational resources should be respected*".

4.124 It is noted that the baseline character of the LCA and its wider setting has altered since the SPG was published. Whilst there are still no operational wind farms within LCA 124 there are now a relatively large number of single turbines located within this LCA and visible in adjacent LCAs. There is a consented wind farm at Ballykeel in the south east of this LCA. There are also two existing wind farms located in a cluster to the north west of this LCA at Elginny Hill and Rathsherry (in LCA 117 Central Ballymena Glens) which are clearly visible from the central plateau. Therefore, whilst the Development would be located within part of the LCA that the SPG highlights as being particularly sensitive, the magnitude of effect on landscape character is somewhat reduced by the presence of similar manmade elements which are already noted as being prominent features. Furthermore, the SPG's advice to consider clustering wind farms on the central plateau would no longer serve to minimise cumulative effects or the settings of Slemish, the Glenwhirry Valley or Sallagh Braes. The open nature of the central plateau would mean that wind farms located here would be most likely to be intervisible with surrounding wind farms whereas wind farms located around the edges of the LCA, such as Ballykeel and the Development, would retain greater separation distances. The magnitude of its effect on landscape character would also be reduced by the presence of other similar features which are noted as being prominent features of the existing character.

4.125 The Development is contrary to some of the locational criteria of the SPG, namely, its location on the northern finger of land located between Glenarm and the coast. It would be clearly visible from other locations specifically noted in the SPG as being sensitive such as Knockdhu, parts of the coastline, the setting of Sallagh Braes and Slemish. However, it would not be clearly visible from Sallagh Braes itself and would be located at some distance from Slemish with a large proportion of undeveloped land in between. It would also not form a clearly identifiable feature in the setting of Glenarm. However, it would become a key element in the setting of Ballygally village where Knockdhu and Sallagh Braes are already defining elements and it would be a prominent feature along the coastline in proximity to the village. Therefore, it is likely to have a significant effect on the coastline and seascape, a factor which is alluded to in the SPG which notes that "*Due to the proximity of the Antrim coast seaward issues may be a consideration especially in parts of the landscape from where there are high level views*"[12].

4.126 There is footpath access through the site and along adjacent parts of the Antrim Plateau. The Development would not impede access along this route. It is noted that information signs along the footpath relate to the value of the underlying geology of Scawt Hill and the manner in which rare minerals found on site have been of use to industry, thus reinforcing the value of the site for reasons aside from scenic value. It is also noted that research into the effects of wind farms on tourism has been found it to be less than previously thought and that direct access to wind farm sites could provide additional tourism opportunities.

4.127 The effects of the Development on the setting of cultural heritage sites surrounding the Development are analysed in Chapter 5: Archaeology and Cultural Heritage. Views from St Patrick's Church on the Feystown Road has also been selected for analysis in this LVIA because it is a community focal point and represents views from adjacent properties along the same road (Viewpoint 9, from paragraph 4.181 and Figure 4.22).

[12] SPG page 310, Location, siting, layout and design considerations

4.128 The Development may also have a potential indirect effect on the setting of parts of a further 8 LCAs and 3 SCAs which are in proximity to it, or which contain viewpoints used in this LVIA. These LCAs are listed in Appendix 4.3 and illustrated in Figure 4.2. The SPG's description of several of these LCAs is very similar to LCA 124 in many respects including their levels of sensitivity to wind energy development. LCAs 117, 118 and 122 all are largely within the AONB whilst LCA 127, which also has a similar description, is located mostly to the south of the AONB but together they all form the Antrim Plateau.

4.129 LCA 117 Central Ballymena Glens, for example, is described as forming an important setting for Slemish and the landscape to the south as well as being of extremely high sensitivity due to its distinctive character, relative wildness and tranquillity, high scenic quality and its key role in views from surrounding ridges and major tourist routes. Distinctive outlying hills in this LCA are described by the SPG as being valuable for their scenic and perceptual qualities, and are sensitive both physically and visually for these reasons. However, the part of this LCA that is described as being the most sensitive because of their wide visibility – the prominent upland slopes on the western edge – are now in fact the location for two operational wind farms that were proposed and consented in spite of this advice from the SPG.

4.130 LCA 118 Moyle Moorlands and Forest also has a very similar overall description of its character and sensitivity as LCA 124 although the open and expansive uplands in this LCA rise to an overall greater height that those in LCA 124 (550 m AOD) and it provides the backdrop to 4 of the 9 Glens within the AONB – a greater number than LCA 124. The overall level of manmade influences is also similar to LCA 124 but the SPG notes that this LCA already features wind turbines on some summits, which is not the case for LCA 124. In fact there are 3 operational wind farms in this LCA and these are located on the outward facing westward edge of the LCA despite the SPG's recommendation that the central part of the LCA would be best suited because of its uniform land cover, simple landform.

4.131 The SPG's recommendation for LCA 122 Garron Plateau, which is located more centrally within the AONB, is that a cluster of wind farms in proximity to forestry may be appropriate to reduce both landscape and visual sensitivity, but that adverse effects on seaward views, cultural and recreational interests should be avoided in a similar manner to effects within LCA 124.

4.132 The majority of LCA 127 is not within the AONB boundary and its setting includes some very prominent manmade elements including Ballylumford Power Station, the A5 dual carriageway and a large quarry near Millbrook. However, despite this the SPG regards the overall sensitivity to be high to medium which is the same as the other LCAs which are located wholly or mostly within the AONB, and which are characterised by less built development or visual clutter. Northern and sea-facing slopes are considered to be the most sensitive. The low ridges surrounding Larne are considered to be more suitable for wind energy development although they may be overwhelmed because they are physically narrow in extent.

The Northern Ireland Regional Seascape Character Assessment

4.133 The NIRSCA identifies and provides a broad description of Seascape Character Areas (SCAs) extending up to 12 km offshore and including the narrow margin of the coastal edge and its immediate hinterland up to 5 km inshore. This document does not offer guidance but aims to provide a strategic understanding of seascape character in order to promote protective management and planning. No conclusions are made by the NIRSCA on the sensitivity of individual SCAs to wind energy developments and therefore all conclusions in this respect are made through the LVIA process.

4.134 The landward extent of SCAs may be narrow where the coastline is edged by cliffs or settlement, for example the Larne Coast and Larne Glens (LCAs 123 and 126). It may be broader where there are beaches or pastoral fields, for example at Islandmagee (LCA 128). The seaward extent of SCAs varies depending on the extent of views to open sea and visual containment by the land. The Development would be located within the immediate hinterland that defines the seascape and would therefore form part of the landscape setting for the seascape. An analysis of relevant SCAs is included in the LVIA for this reason. Coastal areas in closest proximity to the Development are appreciated most frequently from the scenic A2 Coast Road which is located nearly at sea level in many places and from here open views towards the sea are often contained on the land side by higher ground. However, the coastline/ seascape is also be appreciated in the context of the AONB from elevated southerly approaches and from parts of the Ulster Way which traverse the site of the Development and the adjacent Knockdhu (refer to Category A Viewpoints from paragraph 4.163 and Viewpoints 12 and 28 from paragraphs 4.185 and 4.241).

4.135 The NIRSCA notes that seascape, like landscape, reflects the relationship between people and place and the part that the sea plays in forming the setting to everyday life. Therefore the LVIA concludes that it is reasonable to regard the seascape as a resource in much the same way as the landscape. Both land and sea are farmed and used for the extraction of valuable goods including energy, food and minerals, such as those found on the site of the Development. Furthermore, coastal towns have developed around sea-based rather than land-based activities such as fishing and tourism and one of the defining characteristics of the Antrim Coast and Glens is the outward-looking aspect which has developed due to the area's historic inaccessibility from the landward side. The AONB Management Plan notes how the AONB has historically had a much closer relationship with Scotland than the rest of Northern Ireland.

4.136 Other key elements of seascape character, as summarised below, provide strong evidence of continued manmade influence on the character of the seascape and exploitation of the seascape for its natural resources. The Development reflects this historic and continued use of natural resources which have formed the character of the seascape and landscape:

- The presence of fishing and other industry in towns along the coastline;

- Ritual features such as chambered graves and standing stones on sites overlooking the coastline provide a strong sense of time depth;
- Construction of the Coast Road has made the seascape far more accessible and is considered to be both one of the most scenic driving routes in the world as well as one of Northern Ireland's top visitor attractions. Whilst the tourist industry is dependent upon the quality of the coastline greater access also leads to greater pressure and effects on coastal areas, both in physical and visual terms.

4.137 SCA 10 Southern Glens Coast is of most relevance to this LVIA. It is closely related to LCAs 123 Larne Glens, 124 Larne Basalt Moorlands and LCA 126 Larne Coast. When viewed from sea level the high basalt cliffs and escarpments which frame this SCA form an important element of its landward setting but its character is also defined by extensive open views towards Scotland and it is this contrast that forms the unique character of the Coast Road. There are two more expansive beach areas at Carnlough and Ballygally, and a smaller example at Glenarm. Settlement is focussed around these three villages but is sparse elsewhere. However, there are a number of defensive sites dotted along the cliffs overlooking the sea, including the promontory fort at Knockdhu. Historically landslips have created highly distinctive craggy landforms along this coastline, most notably at Sallagh Braes, but the profile of the cliffs at Knockdhu, and the hills that form the Development site are a continuation of this and are particularly evident when viewed from the sea or from sea level. The Development would be a prominent new feature of the landscape which forms the setting of SCA 10 when viewed from the Coast Road around Drain's Bay, Ballygally and between Carnlough and Garron Point where there are currently no large scale man-made vertical structures on the cliffs overlooking the coastline. SCA 10 extends further north beyond Garron Point but from this point the Development would become concealed from view by intervening cliffs and escarpments and would not influence the character of the seascape.

4.138 The northern end of SCA 11 The Gobbins is also of relevance to this LVIA. It comprises the northern tip of Islandmagee which faces out to open sea rather than the area of sea that is enclosed between the Larne and Islandmagee coastlines. Brownsbay is the only significant beach in this SCA which otherwise comprises a rugged rocky coastline with an eastward orientations and from this location there are extensive views along the coastline of SCA 10 and, similarly to SCA 10, the Development would be one of the only man-made features on the cliffs overlooking the coastline.

4.139 There are 9 LCAs and 3 SCAs within the Study Area which have not been assessed in detail because, following the Baseline Assessment and site survey, it is concluded that they are unlikely to be significantly affected by the Development. In particular, LCAs and SCAs on the periphery of the Study Area and the ZTV, and those which do not contain viewpoints have not been subject to a detailed assessment. These LCAs are also listed in Appendix 4.3. The ZTVs are illustrated in Figures 4.5 – 4.13.

Other Non-Statutory Landscape and Visual Classifications

4.140 A review of other relevant non-statutory landscape and visual classifications has also been carried out as part of this LVIA. These classifications identify landscapes or elements within the landscape that are recognised as being important by virtue of being marketed as visual attractions or identified in non-statutory documentation in the public realm, but which have no statutory protection. These classifications are illustrated on Figure 4.1. Information on them is drawn from a number of websites[13] providing relevant descriptive information which is used in conjunction with Ordnance Survey maps to plot the locations of visitor attractions and including the Ulster Way, National Cycle Network, and scenic drives in the Study Area and to aid the selection of viewpoints (Figure 4.3).

Rights of Way, Cycle Routes, and Scenic Drives

4.141 The Ulster Way is a 1000 km long circular walking route which covers the most scenic parts of Ulster. It is divided into 'Quality Sections', which provide largely off-road way-marked access for walkers in highly scenic areas, and 'Link Sections', which are mainly along roads and are not generally way-marked. There are Quality sections of the Ulster Way extending from north to south and across the centre of the Study Area including the hills to the north of Belfast above Newtownabbey and Carrickfergus and continuing northwards beyond the Study Area through the rest of the AONB. These sections of the Ulster Way would provide walkers with an appreciation of the entire Antrim Plateau and upland parts of the AONB, the seascape to the east and the rural landscape to the west. The route passes in close proximity to the operational wind farm at Carn Hill in the southern part of the Study Area and also the consented Ballykeel wind farm site. It would also pass through the centre of the Development from where there are already clear views towards two clusters of operational wind farms at Elginny Hill/ Rathsherry to the north west and Elliott's Hill/ Wolf Bog to the south west.

4.142 The Quality section of the Ulster Way, located in the northern part of the Study Area between Slieveanorra and Cushendun, also forms part of the Moyle Way which is a 42km trail across the northern-most part of the Glens of Antrim. It comprises a mixture of forest tracks and paths across remote upland moor including the summits of Slieveanorra and Trostan, the latter being the highest summit in the AONB (550 m AOD). Detail on the walking trails in the Study Area are further described in various online publications (refer to the footnote 13).

4.143 There is a Link Section of the Ulster Way connecting the coast road between Glenarm and Cushendun. Walkers along this section of the road would experience some views of the Development as well as a small number of single turbines but are far more likely to be influenced by their immediate surroundings and seaward views.

[13] www.walkni.com; www.visitcausewaycoastandglens.com; www.causewaycoastandglens.gov.uk; www.cycleni.com; www.sustrans.org.uk

4.144 A number of viewpoints have been selected to represent the experience of walkers throughout the Study Area. Category A Viewpoints 1 – 7 represent the experiences of walkers at various points along the Quality Sections of the Ulster Way including summits within the site of the Development and adjacent parts of the footpath at Knockdhu, Sallagh Braes and near Feystown. Viewpoints 23, 25 and 30 represent the nature of views from elevated locations at a greater distance from the Development. Viewpoint 23 is located on the Ulster Way/ Moyle Way near the summit of Trostan near the norther edge of the Study Area. Viewpoint 25 is located on the summit of Slemish Mountain which is a popular destination at the end of a short walk approximately 11 km to the west of the Development. Viewpoint 30 is located at the Knockagh Monument on the cliffs overlooking Carrickfergus near the southern edge of the Study Area. Walkers on Link Sections of the Ulster Way are represented by Viewpoints 15, 19, 20 and 21 which illustrate potential views from Glenarm village and the sequence of views from the Coast Road between Glenarm and Carnlough. Viewpoint 29 represents views from the National Trust maintained walking trail near Skernaghan Point, Browns Bay on Islandmagee.

4.145 The National Cycle Network provides cyclists with marked scenic routes across the province. Within this Study Area there are routes linking Ballymena with Glenarm, Larne to Carrickfergus and along much of the Coast Road. Viewpoints 8, 14, 18, 19 – 21 and 25 are located on various parts of the network and represent the visual experience of cyclists in various parts of the Study Area.

4.146 The A2 Coast Road which links Belfast with the Glens of Antrim is considered to be both one of the most scenic driving routes in the world as well as one of Northern Ireland's top visitor attractions. Visual receptors located along this route are therefore considered to be highly sensitive. Category D Viewpoints 19 – 22 have been selected to represent the sequence of views from the main section of the Coast Road from where there would be views towards the Development. Viewpoints 15 and 18 represent views from the settlements of Glenarm and Ballygally which are located elsewhere along the Coast Road. The ZTV diagrams demonstrate that views from the northern section of the Coast Road, at a distance of approximately 15 km, would be screened by the Moyle uplands above Garron Point. In the centre part of the Study Area views would be available from a short section of the road at Drains Bay and between Ballygally and Garron Point at distances of 2.5 – 15 km. In the southern part of the Study Area views from the Coast Road would be screened by the hills above Carrickfergus and built development around Larne.

Other Visitor Attractions and Destinations

4.147 There are a number of other landscape-based visitor attractions and destinations in this Study Area which were identified and used to select PVPs. The nature of effects on these are briefly described below but are analysed in greater detail in the assessment of visual effects because the nature of effects depends largely on the experience of visitors as visual receptors:

- Villages and other stopping points along the A2 Coast Road and at the foot of the Glens of Antrim including Cushendun, Cushendall, Glenariff, Garron Point, Carnlough and Glenarm. The viewpoint selection process, including analysis of the ZTV diagrams and site assessment work, demonstrated that visual receptors in coastal areas beyond Garron Point would experience no views of the Development. A number of PVPs were identified along other parts of the A2 Coast Road and the majority of these have been shortlisted as Viewpoints in the LVIA (Viewpoints 15, 18 and Category D Viewpoints 19 – 22);
- Registered parks, gardens and demesnes including Ballygally Castle Glenarm Castle. These are described from paragraph 4.103. Several PVPs were selected in proximity to these sites and Viewpoints 8, 15, 18 and 24 have been shortlisted to represent the nature of views from, and in proximity to such sites;
- Carnfunnock Country Park is located to the north or Larne approximately 7.5 km to the south of Development. Preliminary site assessment work suggested that there would be limited views from this location due to the wooded nature of the Park itself and the eastward orientation of the car park which would provide visitors with a seaward view surrounded by trees and rising ground rather than an elevated view along the coastline to the north.
- The Gobbins is an enclosed pathway around the cliff face on the eastern side of Islandmagee. Although visitors to this unique attraction may experience views of the Development as part of their journey, there would be no views from the Gobbins itself. Two PVPs were identified on Islandmagee and VP 29 was shortlisted to represent views from the northern most point, Brownsbay, which is in closest proximity to the Development (12 km) and from where views are focussed along the Antrim coastline. PVP 21, which was selected to represent views from more the more elevated central part of Islandmagee, and which would form part of the experience of visitors to the Gobbins, was not shortlisted because it is more heavily influenced by the industrial context of Larne Lough (refer to Technical Appendix 4.4).

Baseline Visual Character Assessment and Analysis of Effects

Visual Character of the Study Area

4.148 The visual characteristics of the Study Area are intertwined with the landscape characteristics described by the various policy and guidance documents and other publications which provide baseline information about the Study Area. Therefore, many visual characteristics have already been referred to in the previous section of this LVIA (from paragraph 4.78 onwards) and are not repeated. However, they are summarised in relation to their visual as opposed to physical expressions.

4.149 The Study Area is located within the Antrim Plateau region of Northern Ireland which is formed by a variety of upland landscapes interspersed with valley, glens and bogs exposing various layers of geology to create distinctive variations in their appearance. The Plateau region is described by the SPG as a series of striking headlands and cliff faces forming a bold escarpment overlooking the Coast Road and the sea beyond. Between the headlands there is a sequence of enclosed bays which form the entrances to the highly distinctive-shaped 'Glens of Antrim' of which there are 9 in total. The key visual characteristics of the AONB, which are broadly reflective of the Plateau, are described by the AONB Management Plan (refer to paragraph 4.93 for full details) as being the visually concealed or hidden nature of the narrow Glens afforded by the surrounding uplands; the visual contrast between the broad upland plateau and the coastline which is formed by a dramatic and visually distinctive sequence of cliffs, headlands and bays at the foot of each Glen as well as the adjacent seascape. The highest quality views in the Study Area are those where the special character of the AONB can be best appreciated by the most sensitive visual receptors both within the AONB and in approaches to it.

4.150 Glenarm, the southernmost Glen, would be in closest proximity to the Development and would also be the first which visitors arrive at when travelling from Belfast along the coast road. Therefore, in visual terms, the approach to Glenarm may also be described as one of the primary gateways to the AONB where visitors start to experience the AONB within its setting and appreciate its unique visual characteristics.

4.151 The distinctively profiled hills, basalt cliffs and escarpments at Knockdhu/ Robin Young's Hill, Sallagh Braes, Agnew's Hill and Slemish are also notable features. Slemish is a visually prominent feature of the western edge of the AONB and is easily identifiable from the rural lowlands surrounding Ballymena and Broughshane but also in much more distant views across the Province in clear weather conditions because of its distinctive domed summit which rises to 437 m AOD. Sallagh Braes escarpment forms a distinctive backdrop to the coastal landscape between Larne and Ballygally village.

4.152 The Development would be located on the eastern fringes of the Plateau and, more specifically, on the south eastern edge of the Antrim Coast and Glens AONB in LCA 124 Larne Basalt Moorland. In relation to the LCA boundary it would be located on the visually distinct northern finger of uplands which are formed by Ballycoose Hill at the southern end (361 m AOD), Scawt Hill then Ballygilbert in the middle (approximately 378 m AOD) and Black Hill at the northern end (381 m AOD). Knockdhu/ Robin Young's Hill (approximately 384 m AOD) and Sallagh Braes (approximately 340 m AOD) would be located to the south of these hills and the profile of this series of uplands in conjunction with each other are a highly distinctive feature in southerly approaches to the AONB from other parts of the Antrim Plateau.

4.153 The visual effects of the Development on the baseline visual character of the Study Area are included in both the analysis of the Zone of Theoretical Visibility below and then in greater detail in relation to views and visual receptors in the analysis of Viewpoints (starting at paragraph 4.157).

The Zone of Theoretical Visibility

4.154 ZTV diagrams have been produced at radii of 15 km and 30 km to illustrate visibility for both the maximum blade-tip and hub-height dimensions being considered for the Development (Figures 4.5 - 4.8). Blade tip visibility illustrates any parts of the Study Area where at least one blade tip would theoretically be visible without taking account of screening provided by contour variations within 50m intervals or land cover elements such as trees and hedgerows. It shows the highest potential levels of theoretical visibility but not necessarily the most realistic because blade tips may be counted even where they protrude only a small amount above a skyline and this type of visibility will change continuously as the turbines rotate. Hub height ZTV diagrams represent a more realistic illustration because they show theoretical visibility of all points of the turbines to the hub/ nacelle, and therefore also include the upper parts of the turbine blades as a minimum. Reverse ZTVs (Figure 4.9 and 10) have been produced to clearly illustrate areas where there would be no theoretical blade tip or hub height visibility of the Development. These diagrams are the starting point for the baseline visual assessment and were also used to assist the selection of PVPs. They illustrate the theoretical visibility and non-visibility of the Development as a standalone wind farm, unrelated to any others in the Study Area. They indicate comparatively low levels of theoretical visibility across the Study Area as a whole and, in particular, from land-based parts of the Study Area as opposed to views from open sea. For this reason, ZTV diagrams have been produced to illustrate the difference between Study Area-wide visibility and land-based visibility. The latter include the sea immediately adjacent to the coastline but exclude areas of open sea where sensitive visual receptors are unlikely to be located:

- Within a 15 km radius from the Development, 74.19 % the Study Area as a whole is likely to have some theoretical blade tip visibility of the Development and 64.22 % of this visibility would be of 11 - 14 turbine blade tips (refer to Figure 4.5, page 1 of 2). This reflects the prominent location of the Development on the south eastern edge of an upland plateau. Much of this visibility would be in sea-based views because of its adjacency and elevated nature above the coast - there would be clear and wide visibility of the Development from nearly all parts of the sea within a 15 km radius of the Development. To the north, south and west much of the Study Area within this 15 km radius also forms part of the Antrim Plateau. The underlying topography is largely characterised by broad open upland areas so there are frequently uninterrupted views towards the site of the Development. Areas with less or no visibility indicated on the ZTV diagram can be clearly identified as the narrow glens of Glencloy and Glenarm, although the ZTV indicates that the Development would have theoretically high visibility from the southern facing side slopes of both, and particularly the latter, because it is within 5 km of the north and western sides of the Development. Other areas within the 15 km ZTV where there is less or no theoretical visibility indicated are the side slopes of the uplands to the north, south and west, and also the narrow coastal areas directly to the east of the Development where the acute angle of view and the rising cliff faces would screen views. However, the ZTV suggest theoretically clear views from coastal areas to the south around Ballygally, Larne and Islandmagee and also to the north between Carnlough and Garron Point. The greater distance of these locations from the Development means that the cliff faces and rounded profile of the plateau on which the Development would be located would not be screening factors. However, when land-based visibility is considered, only 37.64% of the Study Area would experience any type of blade tip visibility, and only 28.82% of this would be of 11 – 14 turbines (refer to Figure 4.5, page 2 of 2). If sea-based visibility is excluded, 62.36% of the Study Area would experience no theoretical blade tip visibility of the Development;

- Within a 15 km radius from the Development overall visibility would reduce to 69.27 % if hub height visibility is considered and visibility of 11-14 turbines would reduce to 52.21 % (refer to Figure 4.6, page 1 of 2). However, when land-based visibility is considered, only 32.82% of the Study Area would experience any type of blade tip visibility, and only 21.95% of this would be of 11 – 14 turbines (refer to Figure 4.6, page 2 of 2). If sea-based visibility is excluded, 67.18% of the Study Area would experience no theoretical hub height visibility of the Development;
- Within a 30 km radius from the Development blade tip visibility would reduce to 57.32 % of the Study Area and 51.20 % represents visibility of 11 - 14 turbines (refer to Figure 4.7, page 1 of 2). Visibility from the upland plateau would not extend beyond that indicated on the 15 km ZTVs except to the south east. This suggests that the western and southern side slopes of the plateau would screen views from the surrounding lowlands. However, the ZTV diagram suggests clear visibility would be available further within the AONB boundary on south-facing upland areas around the summit of Trostan located approximately 20 km to the north west, and above Glendun at a distance of approximately 27 km. Clear visibility would also extend to the hills around Carrickfergus and Larne. These form part of the elevated southern approach towards the AONB from where wider views across the AONB may also be appreciated. To the south west there is a band of clear visibility shown to extend along the main road corridor between Ballymena toward Carnlough and on the south-facing side of the uplands above this. The majority of this visibility would be in the eastern half of the Study Area and be entirely sea-based (39.71 %). If sea-based visibility is excluded the

theoretical blade tip visibility of the Development would reduce drastically to only 17.61% (refer to Figure 4.7, page 2 of 2);

- With a 30 km radius from the Development overall visibility would reduce further to 53.77 % if hub height visibility is considered and 46.02% of this would be visibility of 11-14 turbines (refer to Figure 4.8, page 1 of 2). The majority of this visibility would also be entirely sea-based (39.28 %). If sea-based visibility is excluded the theoretical blade tip visibility of the Development would reduce drastically to only 14.49% (refer to Figure 4.8, page 2 of 2).

4.155 The reverse ZTVs (Figures 4.9 and 4.10) clearly illustrate that many parts of the AONB located beyond 15 km to the north of the Development, and also the southern edge of the AONB would have no theoretical visibility of the Development. Coastal areas at a similar distance would also have no theoretical visibility of the Development – these include the AONB coastline to the north of Garron Point, the south eastern facing cliffs at Islandmagee and the shoreline of Belfast Lough between Islandmagee and Newtownabbey. Lower-lying side slopes and rural lowlands in the western half of the Study Area would also experience very limited theoretical visibility of the Development.

4.156 It is noted that all the ZTV diagrams illustrate theoretical visibility and that levels would be further reduced by topographical variations and land cover elements. Detailed site assessment indicates that heavy tree cover in proximity to Glenarm Castle would prevent some views of the Development. Urban settlement, vegetation and localised variations in the underlying topography would also screen views in proximity to the towns of Larne, Ballymena and Broughshane. The Development is also likely to be difficult to discern with the naked eye in long distance views such as elevated viewpoints at the summit of Trostan to the north west of the Development and Knockagh monument to the south.

Table 4.1 - Zone of Theoretical Visibility of the Development

ZTV Diagram	**No. of turbines theoretically visible (blade tip)**	**% of whole Study Area with visibility * % of land based visibility (excluding views from the sea beyond the immediate coastline)**		
15 km blade tip ZTV Figure 4.5	**1 - 3 turbines**	**2.44 %**	***2.27%**	**Total % of 15 km Study Area with theoretical blade tip visibility = 74.19 %** • *= 37.64% %
	4 - 7 turbines	**3.72 %**	***3.45%**	
	8 - 10 turbines	**3.81 %**	***3.10%**	
	11 - 14 turbines	**64.22 %**	***28.82%**	
	0 turbines	**25.81 %**	***62.36%**	

15 km hub height ZTV Figure 4.6	1 - 3 turbines	3.63 %	*3.34%	Total % of 15 km Study Area with theoretical hub height visibility = 69.27 % *= 32.82 %
	4 - 7 turbines	5.11 %	*3.94%	
	8 - 10 turbines	8.32 %	*3.59%	
	11 - 14 turbines	52.21 %	*21.95%	
	0 turbines	30.73 %	*67.18%	
30 km blade tip ZTV Figures 4.7	1 - 3 turbines	1.80 %	*1.48%	Total % of 30 km Study Area with theoretical blade tip visibility = 57.32 % *= 17.61 %
	4 - 7 turbines	2.23 %	*1.85%	
	8 - 10 turbines	2.09 %	*1.65%	
	11 - 14 turbines	51.20 %	*12.63%	
Reverse blade tip ZTV Figure 4.9	0 turbines	42.68 %	*82.39%	
30 km hub height ZTV Figures 4.8	1 - 3 turbines	1.98 %	*1.57%	Total % of 30 km Study Area with theoretical hub height visibility = 53.77 % *= 14.49 %
	4 - 7 turbines	2.55 %	*1.94%	
	8 - 10 turbines	3.22 %	*1.79%	
	11 - 14 turbines	46.02	*9.19%	
Reverse hub height ZTV, Figure 4.10	0 turbines	46.23 %	*85.51%	

Viewpoint Selection Process

4.157 The Baseline Assessment identified parts of the Study Area most likely to experience visibility of the Development and contain key receptors due to the theoretical levels of visibility indicated by the ZTV diagrams and the potential sensitivity of either the location and / or the visual receptors likely to be present in these areas. These include:

- Locations within the Antrim Coast and Glens AONB as well as views towards the AONB from the surrounding landscapes which form the AONB's setting. AONBs contain various visitor amenity sites and attractions and are likely to attract visitors by virtue of their designation. Visual receptors located within AONBs are therefore deemed to be potentially highly sensitive. The majority of the AONB lies within the Study Area and PVPs were identified throughout the AONB in close proximity and at greater distances to ascertain the range of views that may be available. The majority of VP locations shortlisted for detailed analysis are located within the AONB boundary at distances ranging from 0 – 13 km from the Development. Viewpoint 23 is the most distant location (that was shortlisted approximately 19 km to the north west) because it is the highest summit within the AONB and therefore likely to be a particular visitor attraction. However, it demonstrates that the Development would not be clearly visible from elevated parts of the AONB at this sort of distance. Other PVPs identified in similar locations within the AONB have not been shortlisted for more detailed analysis for this reason;

- Locations from which the Development would be seen within the wider landscape context of the Study Area. These types of views occur in other upland locations on the Antrim Plateau located to the north and south of the Development, including the southern edges of the Plateau. They are not within the AONB boundary but are located on the hills above Carrickfergus and Larne which form one of the key approaches the AONB;
- Locations from public rights of way, scenic drives and cycling routes where viewers are likely to be present for the primary purpose of appreciating scenic views. Such locations include: the Ulster Way network of footpaths across the Antrim Plateau, and across the site itself, as well as other elevated sections located in the northern and southern parts of the Study Area; the National Cycle Network which largely hugs the coast but which also includes a route between Ballymena and Glenarm in the western part of the Study Area and a route which traverses the hills between Larne and Carrickfergus in the south eastern part of the Study Area; the A2 scenic coastal driving route which covers the entire coastal section of the Study Area as well as an upland section across the glens to the north;
- Residential properties and the rural road network in close proximity to the Development where viewers may be static and obtain views for prolonged periods of time and where the Development may form a key element in such views;
- Areas of settlement where viewers may also be static and obtain views for long periods of time and where the site of the Development is likely to form a key element in the landscape setting of these settlements.

4.158 These locations guided the selection of Provisional Viewpoints (PVPs). The initial desk-based selection of PVPs, including the selection criteria, is described in Technical Appendix 4.4 and illustrated on Figure 4.4. Seventy one PVP locations were identified and analysed through the production of a preliminary ZTV diagram. Draft wireline diagrams for all these locations were prepared and checked by site visits to confirm the nature of receptors and potential visibility of the Development. These draft wirelines were used as working documents and are not reproduced in this LVIA.

Final Viewpoint Selection

4.159 Following the initial assessment described above 30 Viewpoints were shortlisted for inclusion in the LVIA. They include a proportionate number of locations which are intended to be representative of typically occurring views within the Study Area, views experienced by key visual receptors, and also views from specific locations that merit inclusion in the LVIA by virtue of their contribution to the landscape and visual qualities of the Study Area. PVPs were not shortlisted if they were found to provide no actual view of the Development. The reasons for this usually arose from differences between theoretical and actual visibility which is explained in Technical Appendix 4.2 (ES Volume 2). Other viewpoints were not shortlisted if a more typical view was demonstrated elsewhere, where no safe stopping place was available to take photographs or where the viewpoint location would not be easily accessible to the public.

4.160 A detailed description of the methodology for viewpoint selection is included in Technical Appendix 4.2 starting at paragraph 4.24. A summary analysis of all PVP locations and the rationale regarding shortlisting is provided in Technical Appendix 4.4, Table 4.4.1. The locations of final viewpoints are indicated on all map-based figures which accompany this LVIA chapter (Figures 4.1 - 4.13). Wirelines and photomontages of each viewpoint have also have been presented in Figures 4.14 - 4.42. These are intended to assist in the understanding of, but not to replace, the detailed written descriptions of effects on viewpoints which are contained in the subsequent paragraphs of this chapter. It is important to recognise the limitations of visualisations and this is further described in Technical Appendix 4.2, paragraphs 4.42 - 4.49. They should not be relied upon as the primary means to determine visual effects and it is expected that all locations will be visited by the decision-maker and any interested third parties in order to be fully understood.

4.161 In the analysis of visual effects cognisance is also taken of the SPPS and PPS 18: BPG. These policy and guidance documents note that whilst wind farms are, by their nature, highly visible and are likely to be relatively prominent at distances of up to 5 km, this does not necessarily preclude them from being acceptable features (refer to paragraphs 4.57 and 4.64). The choice of viewpoints is intended to represent the manner in which the Development is experienced when travelling around the Study Area and not just from locations in close proximity where it may be expected to be clearly visible.

4.162 For ease of analysis the shortlisted viewpoints have been categorised as follows so that the different types of views, receptors, and specific areas they represent can be accurately described and understood without unnecessary repetition:

A. Views from the Ulster Way within and in close proximity to the site;
B. Views from the rural road network, including representation of residential properties, within approximately 5 km of the site;
C. Views from settlements within approximately 5 km of the site;
D. Sequential views from the A2 Coast Road;

E. Other representative views within the AONB;
F. Longer range views located outwith the AONB.

Category A: Views from the Ulster Way within and in close proximity to the site

Description of Existing and Predicted Views

4.163 Category A includes Viewpoints 1 - 7 which are illustrated in Figures 4.14 – 4.20. They have been selected to represent the sequence of views available along parts of the Ulster Way and Moyle Way which run along the Antrim plateau, including the site of the Development and adjacent hills and summits.

4.164 Viewpoint 1 (see Figure 4.14) is located at the trig point on the summit of Black Hill near the northern end of the Development site. From this elevated location there are clear views in a linear fashion along the sequence of summits within and adjoining the Development site. This arrangement of uplands defines the coastal edge of the AONB and its setting to the south. Published walking guides for this area[14] describe the views from the summit of Black Hill as being extensive along the ridge of hills which form the site and highlights Scawt Hill's profile as being distinctive and visible from miles around. They also note the excellent views of the Antrim coastline, the North Channel and Glenarm Bay which can be appreciated from this location with views extending as far as the Scottish coastline and Ailsa Craig on a clear day. The Development would visible at close range to the south of this Viewpoint (Turbine 5 would be the nearest to this Viewpoint located approximately 251 m to the south west. Turbines 1 – 4 would be located to the north of this Viewpoint. The turbines would be arranged in a broadly linear fashion reflecting the underlying topography. However, because of the close-range nature of this Viewpoint, the highly varied topography on site would be clearly visible in a manner which would not be appreciated in views located at a greater distance and from where the bases of the turbines would appear to be more uniformly located. There are views to the open sea but the coastline itself is not visible from this location or most other parts of the Ulster Way on site because the path route is often set back from the cliff edge. There are however clearer views of the contrast between these cliffs and the coastline from the promontory of Scawt Hill, which has a particularly distinctive profile when viewed from Black Hill. From this location turbines 9 and 11 would be located in front of Scawt Hill. There would be an uninterrupted view towards the distinctive crescent-shaped escarpment at Sallagh Braes between turbines 11 and 14.

4.165 The wider Antrim Plateau characterises the full extent of views stretching far to the north and south which allows the expansive nature of this landform to be appreciated. The distinctive rounded profile of Agnew's Hill is clearly visible at the southern edge of the Plateau and frames the extent of views in this direction. There are also elevated views across lower parts of the Plateau to the west, the extent of which is marked by the highly distinctive dome-shape of Slemish and the range of

[14] 'Your Guide to Walking in the Causeway Coast and Glens' Northern Ireland Tourist Board & 'Larne Country Walks' published on walkni.com

hills overlooking the pastoral lowlands between the edge of the AONB and Ballymena. The wind farms at Elginny Hill and Rathsherry are distinctive features on this upland edge. There are also small clusters and individual single turbines located in the lowlands to the west of this Viewpoint. Extensive pastoral lowlands characterise the appearance of views beyond a distance of approximately 15 km but, in clear weather conditions views stretching as far as the Sperrin Mountains in the west of the Province may be obtained. Whilst individual features in long range views are hard to discern, the overall character of these expansive views across rural lowlands framed by ranges of uplands in both the foreground and in the far distance is evident.

4.166 Viewpoint 2 is located at the southern end of the Development site on the slightly lower summit of Ballycoose Hill. The visual character is similar to that described for Viewpoint 1 but the Development would be visible in its entirety to the north (Turbine 14 would be the nearest at approximately 554 m). The promontory at Scawt Hill would be similarly prominent and distinctive as in Viewpoint 1 (it would be visible to the right hand side of the view represented in Figure 4.15) and the location of Viewpoint 1, Black Hill, is clearly visible in front of Turbine 1. The pastoral nature of the rural lowlands to the west and the position of a cluster of existing single turbines are represented in the photomontage in Figure 4.15. Other summits located in the far north of the AONB are also illustrated in the photomontage from this Viewpoint location.

4.167 There are a number of information posts along the section of the Ulster Way traversing the site which highlight its unique underlying geology and the presence of some rare mineral deposits. Aside from the Ulster Way the current land use on site is extensive sheep grazing.

4.168 Viewpoint 3 is located in the Linford car park between Ballycoose Hill and Knockdhu. It is also the starting point for walkers seeking to access Knockdhu, Sallagh Braes and the waymarked trail across the Development site and is highlighted in the aforementioned walking guides as such. It is currently a stopping point for visitors to the many filming locations for the Game of Thrones series which are located throughout the Province (the cliffs below Knockdhu are the primary attraction at this location). It is noted that filming operations themselves create temporary visually detractive elements. Additional man-made structures such as tracks and compound areas are erected to facilitate filming operations and traffic increases significantly during these times. From locations in proximity to this viewpoint there are highly scenic views of Ballygally in its coastal setting overlooked by Knockdhu and the range of uplands on which the Development would be located. The Development itself would be only partially visible from this location due to the acute angle of view and rising ground of Ballycoose Hill to the immediate north. The hub and blades of turbine 14 (located 1.43 km from this viewpoint) and the blade tips of turbines 12 and 13 would be visible as a small physically contained element in the northern part of the view available from this location. However, the primary focus of views is likely to be eastwards to the coastline and south eastwards to the imposing escarpment of Knockdhu.

4.169 Viewpoint 4 represents views from the adjacent promontory fort near the summit of Knockdhu located approximately 1.9 km to the south of T14 which is the nearest turbine. It has been selected to represent views from this specific part of the Ulster Way which is likely to be the end destination for many visitors to the car park represented by Viewpoint 3 and those on-route to Sallagh Braes from the same starting point. The simple land cover on these uplands in comparison with the more vegetated pastoral lowlands both to the east and west is clearly visible from this location as is the visual separation between the northern finger of uplands on which the Development would be located and the rest of the upland plateau which LCA 124 comprises of. The overall character of the landscape evident from this Viewpoint is similar to that described for Viewpoints 1 - 3. There are attractive views across the village of Cairncastle towards the coastline around Ballygally but, to the south, views into the rest of the AONB are less prominent than the foreground or views in a westerly direction. The distinctive profile of Scawt Hill continues to be visible as in the previous viewpoints in this sequence of views along the Ulster Way. From this location the Development would be physically distinct from Scawt Hill but it would be visible in its entirety and would occupy a prominent location on the ridge to the left/ south west.

4.170 Viewpoints 5 and 6 represent views from the Ulster Way around Sallagh Braes with the latter representing views from the mid-section of the walk overlooking the escarpment. The walking guide describes this part of the Ulster Way as taking in "*some of the best walking that Co. Antrim has to offer*" and Sallagh Braes as "*a spectacular basalt amphitheatre*"[15]. This is certainly a highly distinctive landscape where the contrast between the uplands, the cliff faces and the coastline below can be fully appreciated at close range. The character of the foreground landscape is very different to that in Viewpoints 1 – 4 where the land cover is relatively smooth grassland grazed by sheep. This makes distinctive variations in the underlying topography and geology very noticeable. Around Viewpoints 5 and 6 the land cover is boggy heathland which has a rougher texture, in contrast with the rugged but smooth-topped Knockdhu escarpment which frames views to the north. Visual receptors at this location may have reached their destination via Viewpoint 4 and will have gained clear views of the Development from this point. However, in proximity to Viewpoint 5 there would be virtually no appreciation of the Development. Only the blade tips of turbines 8 and 9 would be visible but at a distance of 4.31 km and to such limited extent that they are unlikely to be noticeable. From Viewpoint 6 there would be visibility of ten blade tips at a distance of approximately 3.89 km but only for a short period of time on the route and away from the main focus of views which is likely to be seaward.

4.171 Viewpoint 7 has been selected to represent views on the lower slopes of the northern finger of uplands on which the Development would also be located and is approximately 1.67 km to the north west of T1. The Development is only partially

[15] Walking Tour 9 in 'Your Guide to Walking in the Causeway Coast and Glens' NITB

visible from this particular location and the nearest turbines T1 – T3 are screened by foreground topography. It would become less visible on the lower part of the footpath near Feystown Road but far more prominent on more elevated sections of the path and from the summit of Crockandoo where there would be clear uninterrupted views along the plateau and sequence of summits that form the Development site. There would also be extensive and attractive views westwards across the rest of the Larne Basalt Plateau including the upper parts of Glenarm where the contrast between the pastoral character of the Glen and the simple upland plateau can be clearly appreciated. The walking guide notes that the church and graveyard in Glenarm demesne also become visible at the top of Crockandoo. The Feystown Road corridor, clearly visible in the foreground, skirts around the edge of these uplands. The wider extent of views from this location is framed by Slemish to the west, Agnew's Hill to the south and other upland parts of the AONB to the north. There is a single turbine visible in the middle distance in front of Agnew's Hill and another small group of single turbines located on lower ground to the west. Elginny Hill and Rathsherry wind farms would be visible features to the north/ right hand side of Slemish Mountain (this is beyond the angle of view illustrated in Figure 4.20).

Sensitivity of Visual Receptors: High

4.172 The majority of visual receptors present at locations represented by this series of viewpoints would be walkers on quality sections of the Ulster Way. Viewpoint 3 would include other tourists travelling through the AONB and stopping off at the Linford Car Park in order to appreciate the views of Knockdhu and its wider context. All are considered to be highly sensitive to changes in the nature and composition of their views.

4.173 The AONB Management Plan notes that many of the summits and upland areas within the AONB are inaccessible or poorly signed. However, the footpaths in proximity to the Development that are represented by this sequence of viewpoints are one of the exceptions to this. The Ulster Way in this part of the AONB is well signposted and the footpath is relatively well defined. There are also a number of shorter sections of the route described as self-contained walks in the walking guides available online (refer to footnote 14). The section of the path that crosses the site also features information signs relating to the geological significance of the landscape. The Linford carpark has a signboard relating to Game of Thrones. Both are likely to attract a greater number of walkers/ visitors because of this provision in addition to the fact that they are easily accessible.

4.174 The principal land use on many parts of the uplands through which the Ulster Way passes is extensive sheep grazing so farmers are also considered to be potential visual receptors. However, because the farming practices are not intensive this group of receptors is therefore likely to occur in in smaller numbers than the main receptor groups. They are also present for purposes other than the purpose of scenic enjoyment and are unlikely to be deterred from visiting the locations represented by these viewpoints in response to the Development. Therefore they are deemed to be of low sensitivity.

Magnitude of Visual Effect: High overall

4.175 All Viewpoints in this category represent elevated upland locations from where panoramic far-reaching views can be obtained. In all cases the Development would impinge upon only one part of the view and views in other directions would be uninterrupted. These wider views already include a cluster of wind farm located on the western edge of the AONB and a small number of existing single turbines so wind energy development is already an established visual element. However, the Development would become the dominant feature in the composition of views at Viewpoints 1 and 2 which are located within the site boundary and from where the viewer would experience the turbines at very close range. It would become less dominant, but would still be regarded as prominent in Viewpoints 4 and from the summit of Crockandoo in proximity to Viewpoint 7. It would not be clearly visible from Viewpoint 5 and is deemed to have a negligible magnitude of effect on this Viewpoint for this reason. The Development would only be partially visible from Viewpoints 3 and 6. In the latter two viewpoints it would not alter the overall composition of views to any great extent but the magnitude of effect is deemed to be Medium because views from these locations would only be appreciated in relatively close sequence with the other viewpoints from where the magnitude of effect is deemed to be High.

Significance of Visual Effect: Significant overall

4.176 Although Viewpoints 3, 5 and 6 would experience no significant effects, the effects on all other Viewpoints in this category are deemed to be Significant. Furthermore, because viewpoints in this category are likely to be experienced as a sequence by the same visual receptors their perception of the Development is likely to be of a high magnitude and, because they are also deemed to be highly sensitive to these changes, the overall significance of effect on views from the Ulster Way in close proximity to the Development is deemed to be Significant.

Category B: Views from the rural road network, including representation of residential properties, within approximately 5 km of the site

Description of Existing View and Predicted Views

4.177 Category B includes Viewpoints 8 - 13 which are illustrated in Figures 4.21 – 4.26. They have been selected to represent views from the rural road network including approaches to the site from the north, west and south. Because of the Development's location on an upland promontory overlooking the coast there are no road-based approaches to the site from an easterly direction. Views from the A2 Coast Road are included in Category D Viewpoints. This is not a densely populated Study Area but there are detached rural properties located in proximity to this road network and views from these properties are also considered to be represented by this category of viewpoints.

4.178 Viewpoint 8 is located to the north west of the Development. It is on the B97 which provides access through Glenarm into the village at the base of this Glen. It is a relatively well trafficked road because it links the primary A42 between Ballymena and Carnlough with the network of tertiary roads around Glenarm and the central southern part of the AONB. Viewpoint 8 represents the nature of views as the road corridor climbs out of Glenarm village and where the Development would be visible at relatively close range. Views from this location are physically constrained by rising ground to the south and west and are characterised most strongly by views across the base of the Glen, including Glenarm Castle demesne which is located on the opposite side of the view to the Development, and also north eastwards towards the sea which is framed on either side by the side slopes of Glen. Glenarm Castle is clearly visible at the base of the Glen with the seascape in the background. The foreground landscape is characterised by the road corridor and adjoining verges. The land descends into the Glen and is characterised by farmland and estate woodland associated with Glenarm Castle. The opposite side of the glen is also clad with estate woodland. There are some rural properties located on the rising east side of the road with similar views to that represented by this viewpoint. On the opposite side of the glen there is a similarly open farmland landscape with individual rural properties located in a linear fashion along the road corridor in much the same way as the Munie Road corridor.

4.179 The Development would be prominently located to the right hand side/ south east of the view at a distance of approximately 3.50 km at it nearest point. The base of most of the turbines would be located beyond the skyline which is formed by the foreground landscape (i.e. the side slopes of Glenarm) but Ballygilbert Hill on which the middle grouping of six turbines (turbines 6 – 10 looking from left to right) would be located is visible beyond this. Views of some of the turbines are shielded by roadside vegetation at this location and this is typical of the nature of views from this part of the road corridor in general. Roadside vegetation becomes denser as the road descends into the village but less so as the road corridor rises to the south west.

4.180 Preliminary site assessment found no significant views would be obtained from within the demesne itself or from most other parts around the immediate boundary. The road corridor descends more steeply to the coast and Glenarm village beyond the area represented by this viewpoint and locations where the Development would appear less prominent were identified (see PVP 61 which is located lower down Munie Road with a clearer view of Glenarm Demesne and PVPs 62 and 66 - 68 located on the boundary and within the demesne itself). Much of Munie Road is elevated on the east-facing side of the Glen, becoming more elevated still as it crosses the uplands around Lisles Hill. The types of views available from these latter locations are represented by Viewpoints 16 and 26.

4.181 Viewpoint 9 is located at St Patrick's Church on the Feystown Road immediately to the west of the site boundary at a distance of approximately 1.2 km from the Development. The road runs along the full length of the uplands on which the Development would be located, linking Glenarm to Ballygally, and is the closest part of the road network to the site. There are a number of rural properties located along and adjacent to the western section of this road and this Viewpoint has been selected to represent the nature of these views as well as the specific function of the church and graveyard as a community gathering place. The cultural heritage value of the church and the potential effects of the Development on this are analysed in Chapter 5of this ES. There are no properties on the southern section of the road which passes between Ballycoose and Knockdhu – the nature of these views is represented by Viewpoint 3.

4.182 The rising upland slopes of the Development site provide a backdrop to properties along this section of Feystown Road which are generally orientated to take advantage of the extensive elevated views westwards across the southern part of the AONB looking in the opposite direction to the Development. In the land at the base of these slopes there are areas of rough grazing, pastoral fields divided by stone walls, earth banks or fences and shelter belts of coniferous trees. To the west the foreground and middle distance have a similar character with wide views across the upper parts of Glenarm and other parts of the Central Ballymena Glens LCA. These views are framed to the far south and west by other upland parts of the Larne Basalt Moorlands and to the north by the Garron Plateau. Within this expansive view the volcanic plug of Slemish Mountain to the west and Agnew's Hill to the far south are both distinctive features of the skyline. There are a number of single turbines present, mostly in the lowland parts of the view, and the existing wind farms at Rathsherry/ Elginny Hill are visible to the north of Slemish at a distance of approximately 15.28 km.

4.183 Viewpoint 10 is located at the Aughaboy – Drumcrow Road junction approximately 2.48 km to the west of the Development. It has been selected to represent the nature of views from the network of tertiary roads in this part of the Study Area which skirt around the northern and eastern facing side slopes of the mass of uplands that form the Larne Basalt Moorland and which overlook Glenarm from this type of elevated position. From such locations the distinction between the main section and the northern finger of uplands which combine to form the LCA, and on which the Development would be located, can be clearly appreciated because the southern end of Glenarm dissects the two. To the north (beyond the right-hand side of the view illustrated in Figure 4.23) there are scenic and highly distinctive views along the length of this glen towards the coast. The uplands which divide Glenarm from Glencloy frame this part of the view and are also one of the key characteristics of the AONB. There are a relatively large number of rural properties located along these road corridors compared to more upland parts of the moorland and most are orientated to take advantage of these scenic views to the north and north east.

4.184 Viewpoint 11 is located between the main and northern part of the Larne Basalt Moorlands approximately 2.53 km to the west of the Development. The Development would be located on the uplands which are focus of views when travelling in a north easterly direction along this road corridor. This viewpoint has been selected to represent views from this part of the Study Area, within the upland plateau where the Development would be visible within the context of wider views to the north and west where there are a number of other wind farm developments. The existing wind farms at Elginny Hill and Rathsherry would be clearly visible on elevated approaches to this viewpoint from the south. There are also a number of single turbines, the nearest of which, Single Turbine 8, is clearly visible in the foreground of this view. There would be other single turbines located at a greater distance to the north west/ right-hand side on this viewpoint on the side slopes at the southern end of Glenarm.

4.185 Although it is in close proximity to Viewpoint 10, Viewpoint 11 has a much more distinctly upland character which is similar to that of the site itself (and also to Viewpoint 27 which is analysed under Category E). The majority of the landscape that is visible at close range and middle distance comprises large areas of extensive sheep grazing land interspersed with coniferous forestry. There are fewer residential properties in this part of the landscape and the main visual receptors are mainly expected to comprise of farm workers and general road users as well as visitors travelling through the AONB.

4.186 Viewpoint 12 is located approximately 5 km to the south east of the Development on the tertiary road network. It has been selected to represent typical views from southerly approaches near the outer edge of the AONB from the lower-lying pastoral landscapes between Larne and Ballygally. It has been selected in preference of similar viewpoints from the nearby B148 Ballymullock Road (PVP 8) because traffic on this road is busier, fast moving and there are few available stopping places to safely photograph the view. It has also been selected in favour of PVP 42 Ballytober Road, which is one of a number of minor roads between the B148 and Viewpoint 12, because these roads are less frequently trafficked and therefore have lower numbers of potential visual receptors. Views of a similar nature would also be obtained to a lesser extent from the Old Glenarm Road which is located on lower ground to the east of Brustin Brae Road and from where views are intermittently screened by higher levels of roadside vegetation and rising ground.

4.187 The landscape around Viewpoint 12 is highly scenic and visually distinctive. The rolling pastoral lowlands are bordered by the seascape to the east and the Antrim Plateau to the west. The latter provides a distinctive backdrop to the rural landscape below in the form of a continuous sequence of upland ridges, plateaus, summits and escarpments. This sequence begins to the south of Larne where the first notable summit is Agnew's Hill. In proximity to this viewpoint the unique escarpment of Sallagh Braes is visible in the left-hand side of the view illustrated in Figure 4.25 and Scawt Hill is visible, once again, as a distinctive promontory to the left of centre. To the right of centre and also as one continues northwards towards Ballygally the wireline included in Figure 4.25 shows that there would be visibility of the sequence of rounded uplands which form the coastal edge of the AONB. This includes the sides of all the other glens on the eastern edge of the AONB including Glenarm, Glencloy and Glenariff. The single turbine located prominently near Straidkilly Point between Glenarm and Carnlough is a distracting but small component of the overall view which in general features no vertical elements above the skyline. The primary quality of the views represented by this viewpoint is the unique sense of place which is created but the expansive and distinctive nature of the uplands in contrast with the rural side slopes and coastal lowlands alongside views to the open sea.

4.188 Viewpoint 13 is located at the end of the Sallagh Road where it meets Ballycoose Road which in turn leads to the Linford Car Park (Viewpoint 3). There would be no clear views of the Development from this end of the road because of the acute angle of view and the steeply rising side slopes of Ballycoose Hill directly to the north. Only the very blade tips of turbines 11, 9 and 3 would be visible but these are unlikely to be noticeable features of the view. This location has been selected to demonstrate the manner in which the rising side slopes of the uplands on which the Development is located would effectively screen close range views located around their base. Visual receptors located directly to the east of these uplands would experience extremely limited views of the Development for this reason. Views of a similar extent may be experiences from lower sections of the Ballycoose Road to the west of Cairncastle and also from the A2 heading northwards from this village.

4.189 The overall character of the Sallagh Road is defined by the Sallagh Braes escarpment which is located directly to the west of the road corridor and which creates a unique sense of place for this short section of road along which a number of rural properties are located. These properties are generally orientated to take advantage of coastal views with Sallagh Braes as their backdrop. There would be clearer views of the Development from the southern part of Sallagh Road because they are at a greater distance from the uplands and therefore have a less acute angle of view. These sorts of views are represented by Viewpoint 12.

Sensitivity of Visual Receptors: Medium to High

4.190 Visual receptors within this category will include general road users who would normally be regarded as being of relatively low sensitivity. However, because of their location with the AONB, and because a high proportion of road users are likely to include residents of rural properties located along these road corridors as well as tourists within the AONB, they are generally deemed to be of high sensitivity with some exceptions. For example, road users in proximity to Viewpoint 8 are considered to be of medium sensitivity because, although a high proportion are likely to be tourists, they are located on the secondary rather than tertiary road network where traffic levels are likely to be higher and faster moving with less opportunities available to stop and appreciate static views. They are more likely to be transient receptors on route to other destinations including the settlements which are linked by these roads. This would also be the case in relation to Viewpoint 11. There are no marked footpaths or other amenities in close proximity to this viewpoint so these are anticipated to be transitory visual receptors travelling between other destinations within the AONB. This may include other viewpoint locations already analysed such as starting points for walks on the Feystown Road, Linford car park and Sallagh Braes. Furthermore, in relation to Viewpoint 8 the Development would not be located within the landscape forming the main focus of views. These are in a seaward direction and, as the road corridor descends, the prominence of the Development will decrease further. However, in relation to Viewpoint 12 road users are considered to be of high sensitivity because, although some will be located on the secondary road network, many will be located on quieter tertiary roads and all will experience the Development within their main focus for long periods of time and as an incongruous element that detracts from the integrity of the skyline which has a highly distinctive profile and which is otherwise uninterrupted by vertical elements.

4.191 Residents of properties are generally regarded as being of high sensitivity. Those in in proximity to viewpoints 8, 10 and 12 will experience elevated and relatively close range views (at a distance of 2.48 km – 5.08 km) in the direction of the Development. Residents of properties in proximity to Viewpoint 9 are also deemed to be of high sensitivity and will experience the Development at close range in approaches to their properties. However, the primary orientation of properties and the most attractive parts of views from the Feystown Road are located to the west, which is in the opposite direction to the Development. There are few residential receptors in proximity to Viewpoint 11 which is located with the upland part of the Larne Basalt Moorland LCA. Although there is a small linear cluster of properties further to the south of this viewpoint – located around the Loughdoo – Mullaghsandel Road junction - views from these properties towards the Development would be constrained by Robin Young's Hill and the uplands above the escarpment at Sallagh Braes. All the road corridors represented by Viewpoint 12 features rural residential properties located at relatively low densities alongside them. Therefore, residents of these properties are one of the main visual receptor groups. They will be located within the AONB and are therefore deemed to be of high sensitivity for this reason and particularly where properties are located a distance from the busier road corridors where the landscape is highly tranquil. Residents on Ballycoose Road in proximity of Viewpoint 13 would, however, experience virtually no views of the Development despite their relative proximity to the site. They are still located within a highly distinctive and scenic part of the AONB and are therefore deemed to be of Medium sensitivity.

4.192 Visitors to St Patrick's Church at Viewpoint 9 are deemed to be of medium sensitivity. The site of the Development provides an attractive backdrop to the church and the Development would be a more dominant feature in views approaching the church than in views from the Feystown Road in general. However, such visual receptors are not regarded as being present at this location for the sole purpose of scenic enjoyment and, with the exception of visiting the graveyard will often be located inside the building.

4.193 Farming is one of the primary land uses within the AONB. Therefore farm workers will be visual receptors in many of the viewpoints within this category. However, much of the farmland in close proximity to the site is used for extensive sheep grazing rather than more intensive farming practices and this group of receptors is therefore unlikely to occur in high numbers. They are also present for purposes other than the purpose of scenic enjoyment and are unlikely to be deterred from visiting the locations represented by these viewpoints in response to the Development. Therefore they are deemed to be of low sensitivity.

Magnitude of Visual Effect: High to Medium overall

4.194 The magnitude of effect from rural roads varies from Medium to High. Only one representative viewpoint in this category would experience a lesser effect – There would be a medium to low magnitude of effect on Viewpoint 13 because the Development would not be clearly visible from this particular location. Furthermore, views would be largely orientated in other directions – either eastwards to the sea or west towards the escarpment at Sallagh Braes - or filtered by foreground vegetation.

4.195 In the types of views represented by Viewpoint 8 the Development would be prominent but would not be located within the main focus of views, which is northward down the glen and towards the sea. It would also not occupy a large proportion of the available view. As the road descends into the Glen views become more constrained by the demesne woodland and further orientated away from the Development. As the road becomes more elevated views also become gradually orientated away from the Development and it would then be appreciated within the wider visual context (these latter views are represented by viewpoints in Categories C and E). The effect on views represented by Viewpoint 8 is therefore deemed to be of Medium magnitude.

4.196 The uplands on which the Development would be located are in close proximity to Viewpoint 9 and they form the backdrop to views from Feystown Road. However, the primary focus of views along this long stretch of Feystown Road is to the west, including the north and south west. These views are extensive and panoramic in nature. There is one cluster of existing wind farms and a number of single turbines present in these views. Between the Development and the road corridor/ properties along the road, there rising side slopes of the site provide some visual separation between the turbines, which would large be located slightly beyond and below the skyline, and the pastoral foreground. For these reasons the Development is regarded as being prominent rather than the dominant feature of views from Feystown Road. However, the magnitude of effect is still deemed to be high due to its proximity.

4.197 The Development is deemed to have a high magnitude of effect from the types of views represented by Viewpoint 10 because, whilst the Development would be located to eastern edge of the primary focus of views, the extent of views is not as wide as from other parts of the road network in this category. Views to the south and west are contained by rising ground immediately to the south of the roads in proximity to this viewpoint. Therefore the Development would be a prominent and relatively close range feature where large scale vertical features are not currently a defining feature of the composition of views. The Development would occupy much of the skyline that contains close range views to the east and all 14 turbines would be clearly visible either in their entirety or largely so (i.e. the rotors and upper parts of the turbine towers would be clearly visible but the bases may located below and beyond the skyline).

4.198 In proximity to Viewpoint 11 the Development would be a prominent feature on the skyline which becomes the focus of views from this part of the road corridor as it descends from the more elevated part of the plateau around the upper part of Loughdoo Road towards Feystown Road (see Viewpoint 9). However, it would form a visual component of the upland landscape whilst being visually distinct and separate from the more pastoral landscape around the upper fringes of Glenarm. From this location the turbines would be set back from the northern-most edge of the skyline as it starts to slope down into Glenarm. Whilst it would be a relatively large component of the view illustrated in Figure 4.24 its geographical extent would be small compared to the wider view that is experienced on the ground. The Development would also appears in conjunction with both an existing single turbine located in the foreground, and in the context of sequential views of other wind farms in the wider Study Area. Therefore the magnitude of effect is deemed to be medium.

4.199 With the exception of views from the Old Glenarm Road where intermittent screening is more frequent the Development would be located in the centre of views from the roads represented by Viewpoint 12. These views would also be available continuously and repeatedly for long sections of journeys in a northerly direction along these roads. The majority of the proposed turbines would be visible either in their near entirety or there would be visibility of the upper parts of the rotors and blades. The base of the turbine towers would be screened by the edge of the escarpment giving the impression that the Development may be more extensive than it actually appears. Whilst the Development would not become the most dominant feature in these views (this would remain the overall expansive nature of the landscape) it would be a dominant feature. The location of the turbines either side of the distinctive promontory of Scawt Hill would visually detract from the integrity of this skyline which is one of the most distinctive and valuable elements of views from this part of the Study Area and one of the key features of the AONB. For this reason the magnitude of effect on Viewpoint 12 is deemed to be high.

Significance of Visual Effect: Significant Overall

4.200 There are examples of views with a negligible to medium magnitude in this category (VPs 8 and 13) and one example of a close range viewpoint location where there would be very limited visibility of the Development (VP 13). However, the majority of viewpoints in this Category would have visual receptors ranging from medium to high sensitivity experiencing a high magnitude of change to the nature of their views resulting from the Development. Therefore there is deemed to be a significant effect on views from the rural road network within 5 km of the Development and residential properties located along this road network.

Category C: Views from settlements within approximately 5 km of the site

Description of Existing View and Predicted Views

4.201 Category C includes Viewpoints 14 - 18 which are illustrated in Figures 4.27 – 4.31. Much of the Study Area and the AONB in particular is not densely populated. The majority of small towns and villages are located along the coast where there would be limited views of the Development. Larger towns, with the exception of Larne, are located towards the southern edges of the Study Area in closer proximity to Belfast and the motorway network and outwith the ZTV. However, there are number of settlements in closer proximity to the Development and the nature of views from these settlements is represented by the viewpoints in this category. The ZTV diagrams indicated that there would be few views of the Development from Larne, which is the largest and nearest large town. PVP 47, which is located on the coastal walkway next to the A2 on the northern edge of the town, was initially selected because it was one of the few locations likely to have potential views of the Development but both the wireline and site assessment confirmed that this would not be the case.

4.202 Viewpoints 14 and 15 both represent the nature of views from the village of Glenarm which is located approximately 4 - 5 km to the north of the Development. The village is one of several coastal villages located at the base of one of the glens of Antrim and therefore functions as both a nodal point and a gateway into the rest of the AONB for visitors. Its coastal location with the rising slopes of the glen to the south mean that the views are largely focussed within the village itself and towards the sea and coastline. It is one of the smaller of the coastal villages and has a relatively well-preserved Georgian streetscape due to its association with the castle estate. Glenarm Castle is an attractive demesne landscape at the foot of the Glen. It has a walled garden and a number of outbuildings which have been converted as visitor attractions. There are very few available views of the Development from the village itself or from the roads immediately surrounding it. PVPs 66 -68 were identified within the grounds of the estate but none indicated clear views of the Development.

4.203 Viewpoint 14 is located on the Straidkilly Road at the outskirts of Glenarm. It is an elevated tertiary road providing an alternative access into the village than the Coast Road (see Viewpoint 22). It has been shortlisted because it is one of the only locations where there would be visibility of the Development from Glenarm. The immediate foreground landscape is relatively poor quality rough pasture. However, the coastal landscape in the middle of this view is highly scenic and would be the main focus of views from this location. Here the village’s historic streetscape can be clearly appreciated next to the extensive demesne woodland which covers the slopes at the base of the glen. The pastoral fields terminating abruptly with coastal cliff faces on the opposite side of the Glen provide an attractive backdrop to these views.

4.204 The Development would be partially visible behind the skyline to the right-hand side/ south of the village at a distance of approximately 5.11 km. The nacelles and upper parts of the rotors of 6 of the 14 turbines would be clearly visible and the blade tips of a further 4 would appear intermittently above the skyline as the blades rotated. It would not encroach on the main areas of visual quality within this view and would instead appear to be visually detached, because of its location beyond the skyline. Furthermore, views of this nature would only be experienced for a short section of the road when rounding Straidkilly Point, emerging from the woodland which covers much of this hillside, and entering the village. The same view is unlikely to be experienced by adjacent properties which are located at a lower elevation.

4.205 Viewpoint 15, located at Glenarm Marina approximately 4.28 km to the north of the Development, is far more representative of views from Glenarm village and castle demesne (refer also to PVPs 66 – 68 in Technical Appendix 4.4). The primary focus of views from the base of the glen is the sea and coastline around Glenarm Bay. The rising side slopes of the glen which are located to the south provide the setting for the village but the upland plateau beyond this is not a prominent feature. The Development, which would be located on this plateau, would be barely visible. The wireline in Figure 4.28 illustrates scant visibility of the very tip of turbine 2 but this would in reality be screened by other elements in the foreground and middle distance.

4.206 Viewpoint 16 is located approximately 6.08 km to the south west of the Development on the side slopes of the uplands at the southern end of Glenarm. It overlooks the small village of Carnalbanagh which is clustered around the Glenview - Carnalbanagh Road crossroads. The uplands in this part of the Study Area form the lower side slopes of the main Antrim Plateau and have a rural character with pastoral fields, hedgerows stone walls and trees being common throughout. They are also more populated than the upper parts of the plateau. There is a network of tertiary roads in proximity to this viewpoint which are relatively well trafficked because there are rural properties scattered along the roads and in small clusters at crossroads such as this. The types of views represented here may be experienced in sequence with the types of views represented by Viewpoints 25 at Slemish Mountain and 8 on Munie Road, i.e. by visitors travelling between Ballymena and the surrounding countryside Ballymena through the central southern part of the AONB towards Glenarm village. From these south eastern facing slopes there are expansive views across the lower pastoral slopes in the foreground to the eastern edge of the uplands which define the AONB and which provide a backdrop to views. This includes the northern finger of the Larne Basalt Moorland on which the Development would be located as well as Glenarm to the north (visible just beyond the far left hand side of the view illustrated in Figure 4.29) and towards Slemish which is a prominent landmark feature on the skyline approximately 5.5 km to the south west. This Viewpoint is surrounded by higher ground on all sides and for this reason, although views are relatively broad in terms of linear or horizontal extent, there are no views beyond approximately 5 – 6 km in any direction. Therefore, although the Development would be visible at relatively close range it would also be one of the furthest visual components in the types of views represented by this viewpoint.

4.207 Viewpoint 17 has been selected to represent views from the outskirts of Cairncastle which is the closest settlement to the Development (approximately 3.45 km to the east). Cairncastle is a very small settlement clustered around the B148 Drumnagreagh Road – Cairncastle Road crossroads. The B148 runs along the base of the range of uplands on which the Development would be located and the Cairncastle Road links the coastal village of Ballygally (see Viewpoint 18) to the Feystown Road (see Viewpoints 3 and 13). This viewpoint is not representative of views from the centre of the village which would be limited in extent. The village occupies a relatively enclosed position on the lower slopes between Ballycoose Hill and Knockdhu which form a highly distinctive backdrop to the village. The acute angle of view created by the rising slopes of these hills directly behind the village tends to contain views which are more frequently orientated eastwards towards the sea in a similar manner to that described for Viewpoint 13 (see paragraph 4.188). Visual receptors located directly to the east of these uplands would experience extremely limited views of the Development for this reason. This Viewpoint is more representative of Cairncastle Road to the east and west where there are properties located more disparately along the outskirts of the village. If travelling in a westerly direction towards the Development the turbines would be partially visible beyond the skyline to the right-hand/ north side of the view illustrated in Figure 4.30. The nacelles, rotors and hubs of seven of the turbines would be clearly visible, the blades of a further 4 turbines would also be clearly be visible and the very blade tip of T1, located to the right of T4, is unlikely to be perceptible to the casual observer. Turbines T5 and T12 would be screened from view by the escarpment and the promontory of Scawt Hill, which is clearly visible from this direction as are the adjacent promontories at either end of the Sallagh Braes escarpment. In combination these create a highly distinctive backdrop to the village and its outskirts. The primary quality of the views represented by this viewpoint is its unique sense of place which is created by the expansive and distinctive nature of the uplands in contrast with the rural side slopes alongside views to the open sea.

4.208 Viewpoint 18 has been selected to represent views from the southern part of the A2 Coast Road in proximity to Ballygally and Drains Bay on the outskirts of Larne. They are located near the south eastern edge of the AONB and are the gateway settlements to visitors arriving at the AONB on this scenic driving route from a southerly direction. This particular location has been selected in preference of Drains Bay because there would are clearer and more frequent views from the coastline around Ballygally Bay. Drains Bay is a smaller settlement arranged in a tight linear fashion along the road corridor and there may be some glimpsed views of a similar nature to those illustrated by Viewpoint 18. However, the views are often constrained by the road corridor itself or screened by the woodland in Carnfunnock Country Park and the promontory at Ballygally Head. Views from Ballygally are more consistent and similar views may be obtained from most parts of the seafront promenade, and roads leading westwards from the village towards Cairncastle.

4.209 The landscape around this viewpoint is highly scenic and visually distinctive. The village occupies a sheltered location around arranged around the crescent-shaped bay and beach bay in the foreground. The village is bordered by rolling pastoral lowlands and the Antrim Plateau beyond. The lower slopes have a well-managed pastoral character similar to that described in Viewpoint 12. The uplands provide a distinctive backdrop to all views from the Coast Road in the form of a continuous sequence of upland ridges, plateaus, summits and escarpments. This sequence begins to the south of Larne where the first notable summit is Agnew's Hill. In proximity to this viewpoint the unique escarpment of Sallagh Braes and Knockdhu are visible in the left-hand side of the view illustrated in Figure 4.31 but it is the sequence of summits and uplands which form the site of the Development that form the majority of the backdrop to the village and which are the focus of views when driving northwards along the Coast Road. Scawt Hill is clearly identifiable as a distinctive promontory in the centre of the view and remains as such from this part of the Coast Road between Ballygally Head and exiting the village.

4.210 The Development would be located approximately 4.65 km to the north west of Viewpoint 18. The turbines would be clearly visible partially behind the skyline which forms the main backdrop to the village. Turbine 14 would be located to the left-hand side/ south of Scawt Hill and Turbine 13 would be largely concealed by it. The other turbines would be located to the south/ right-hand side. The majority of these (eight turbines in total) would be clearly visible but only the upper blade tips of the others would appear above the skyline and they are unlikely to be easily perceptible to the casual viewer.

4.211 To the right of centre and also as one continues northwards along the Coast Road there would be visibility of the continuing sequence of rounded uplands which form the coastal edge of the AONB. This includes the sides of all the other glens on the eastern edge of the AONB including Glenarm, Glencloy and Glenariff. The single turbine located prominently near Straidkilly Point between Glenarm and Carnlough is a distracting but small component of the overall view which in general features no vertical elements above the skyline. The primary quality of the views represented by this viewpoint is its unique sense of place which is created but the expansive and distinctive nature of the uplands in contrast with the rural side slopes and coastal lowlands alongside views to the open sea.

4.212 A more constrained view of these uplands is also be obtained at the entrance to Drains Bay for a short section of the road corridor where the Development would be visible on the skyline above the road corridor but without the pastoral side slopes being visible in between. It is therefore likely to appear abruptly as a prominent component of the view feature but only for a very short period of time when travelling along this road corridor. Residents of properties located to the west of the road corridor may experience more prolonged views similar to those represented by Viewpoint 18.

Sensitivity of Visual Receptors: Overall High to Medium

4.213 Visual receptors within this category will include the range of different groups likely to be present within and around these settlements. Residents within smaller settlements in close proximity to the Development are deemed to be of high sensitivity where the Development would form a key visual component of views from these settlements where the character of these views is already largely defined by the landscape setting. Such receptors are likely to experience such views regularly and consistently for relatively prolonged periods of time in much the same way as residents of rural properties. Residents around Viewpoints 16 – 18 are therefore deemed to be of high sensitivity. However, residents in proximity to Glenarm - Viewpoints 14 and 15 - are deemed to be of moderate sensitivity because the Development would be a lesser component of views that the coastal setting of these settlements.

4.214 The coastal settlements of Glenarm and Ballygally are also tourist hubs and visitors are highly likely to be present in proximity to Viewpoints 14, 15 and 18 to appreciate the scenic qualities of the AONB. They are deemed to be of high sensitivity for this reason. Viewpoint 14 is also located on a link section of the Ulster Way so walkers may also be present and are also deemed to be of high sensitivity.

4.215 General road users who would normally be regarded as being of relatively low sensitivity. However, because of their location with the AONB, and because a high proportion of road users are likely to include residents who will experience views on a daily basis, they are generally deemed to be of medium sensitivity. Such receptors are likely to be present at all viewpoint locations within this category.

4.216 There is farmland surrounding the smaller villages in this category. There is also a primary school, church and a number of small commercial business properties in proximity to Viewpoint 16 and a church and public house in proximity to Viewpoint 17. These visual receptor groups are deemed to be of low sensitivity because they will be present for purposes other than the purpose of scenic enjoyment and are unlikely to be deterred from visiting the locations represented by these viewpoints in response to the Development.

Magnitude of Visual Effect: Medium overall

4.217 The Development would be a visible feature of views from Viewpoint 14 as one approached the village of Glenarm but would quickly become less visible as the road descends into the village and, at Viewpoint 15 there would be very limited visibility (only one blade tip would be visible in the wireline but this is unlikely to be easily perceived) by most visual receptors. Therefore, the overall magnitude of effect on Viewpoint 14 would be low and this would further decrease to negligible at Viewpoint 15.

4.218 The Development would be prominently located on the uplands to the far left-hand/ north side of the available view at Viewpoint 16 at a distance of approximately 6.08

km at it nearest point. All turbines would be clearly visible in their entirety although the base of approximately half of the turbines would be concealed beyond the skyline. They would cover the majority of the skyline formed by this area of uplands and would continue to be visible in much the same manner as one travels in any direction along the road corridors in proximity to this viewpoint. However, they would not be a completely new element of the view or the most dominant visual component – the latter would be both the wide extent of the view overall and the distinctive profile of Slemish Mountain which is located in the opposite direction. There are already two single turbines located on the lower slopes in the middle distance and the existing wind farms at Elginny Hill/ Rathsherry would be visible from more elevated parts of the road network. There would be clear separation between the lower pastoral landscapes and the uplands on which the turbines would be located and there would be no encroachment of the turbines into parts of the view including the distinctive profile of Slemish or the views northwards into the wider AONB. For these reasons the magnitude of effect on Viewpoint 16 is deems to be medium.

4.219 The Development would only be partially visible from Viewpoint 17 and views from this part of the Study Area are more generally orientated in the opposite direction. However, the location of the turbines either side of Scawt Hill would visually detract from the integrity of this skyline which is one of the most distinctive and valuable elements of views from this part of the Study Area and one of the key features of the AONB. Residential properties located in the foreground of the view illustrated in Figure 4.30 are likely to experience clearer views than from road corridor where partial screening is provided by foreground vegetation. However, this type of screening would also prevent views from the centre of the village in many instances. For these reasons the magnitude of effect on Viewpoint 17 is deemed to be medium.

4.220 Half of the total number turbines (a total of 7) would be clearly visible in their near entirety from Viewpoint 18, a further 4 (turbines 14, 12, 10 and 7) would be visible from the nacelle upwards. The remainder would not be clearly visible but nevertheless the Development would be a prominent component of views at a distance of approximately 4.65 km at its nearest point. With the exception of views from Drains Bay where intermittent screening is more frequent the Development would be located in the centre of views from the roads represented by this viewpoint. These views would also be available continuously in journeys through the village on the Coast Road, from the beach, many parts of the seafront and views from the backs of properties, including the Ballygally Castle hotel. Whilst the Development would not become the most dominant feature in these views (this would remain the overall expansive nature of the landscape) the location of the turbines either side of the distinctive promontory of Scawt Hill would visually detract from the integrity of this skyline which is one of the most distinctive and valuable elements of views from this part of the Study Area and one of the key features of the AONB. For this reason the magnitude of effect on Viewpoint 18 is deemed to be high.

Significance of Visual Effect: Instances of both Significant and Not Significant

4.221 The magnitude of effect on viewpoints in this category range from low and negligible (Viewpoints 14 and 15) to high (Viewpoint 18) and this relates to the prominence of the Development within these views, the proportion of the view occupied in relation to views of the wider landscape and also the location of the Development in relation to parts of the view which are likely to for the main focus of views. All viewpoints in this category would have visual receptors ranging from medium to high sensitivity to the Development. Although in relatively close proximity to the Development the settlements of Glenarm and Cairncastle would actually experience the lowest magnitude of effects because the Development would not be clearly visible from these settlements. Furthermore, where visibility does occur the Development would not impinge upon the main features of the view, the main orientation of views or be visible for prolonged periods of time. However, from Ballygally and Carnalbanagh there would be significant effects because the Development would appear as a prominent new visual component within an area which is the main focus of scenic views of the AONB. A high proportion of visual receptors at these locations would also be of high to medium sensitivity to changes to their views and the Development would introduce a large, geographically extensive vertical element to parts of the views where such features do not currently exist.

Category D: Sequential views from the A2 Coast Road

Description of Existing View and Predicted Views

4.222 Category D includes Viewpoints 19 - 22 which are illustrated in Figures 4.32 – 4.34. The coastal edge of the AONB is one of its key characteristics and the A2 Coast Road is one of the primary tourist attractions in Northern Ireland. Viewpoints considered in Category C demonstrate that there are very few parts of the Coast Road either to the north or south of Ballygally (see Viewpoint 18) where there would be views of the Development, including the section of the Coast Road directly to the east of the uplands on which the Development would be located. The ZTV diagrams indicate that views to the north would largely be restricted beyond Garron Point. Category D Viewpoints have been selected to represent the typical nature of sequential views towards the Development if travelling in a southerly direction towards the Development. Visibility starts at Garron Point located approximately 12.53 km to the north, and ends at Glenarm, located approximately 5.04 km to the north.

4.223 The viewpoint selection process identified a further area of visibility on a short section of Torr Road located approximately 25 km to the north (see PVP 72, Technical Appendix 4.4). This is a narrow tertiary road located on the cliffs above the coast where elevated views would generally be oriented out towards the open sea towards Scotland. If walking or driving along this road (it is also part of the Ulster Way) south facing views include the uplands on which the Development would be located. The provisional wireline that was prepared as a working drawing suggests that the Development would be partially visible on the skyline near the edge of the cliffs overlooking the sea in this part of the view. Initial site assessment found that, whilst it would likely be a visible element in clear weather conditions it is unlikely to be easily discernible to the naked eye under most weather conditions. Furthermore the undulating topography of the road corridor means that the Development would be frequently screened from view, the main focus of which would be orientated towards open sea from this part of the coast road. PVP 72 has not been shortlisted for these reasons.

4.224 The road corridor along this part of the coast tends to be tightly defined by the sea and coastline to the east and rising ground, often steeply to the west. A stone wall often encloses the coastal side of the road corridor but there are laybys located frequently to allow visitors to stop and appreciate the coastal views and to allow traffic to pass where necessary. The extent of the landscape that is visible around the road corridor broadens in proximity to the towns and villages which are located at the base of each of the glens and usually overlook more sheltered coastal bays. There are also some smaller clusters of houses along the road corridor and around Garron Point. Views from the road itself are transitory and aligned linearly in a north –south direction. There is often little visibility of the uplands directly adjacent to the road corridor because they rise so steeply. Therefore, people travelling in a southerly direction would experience continuous views in much the same direction for much of their journeys and, although heavily influenced by the open sea, are more likely to be focussed on the coastline.

4.225 The uplands which frame either side of Glenarm and overlook the coast are a key element located in the centre of views from this section of the Coast Road. The pastoral side slopes terminating abruptly in cliff edges are both distinctive and attractive components of views. There are also more distant views of the coastline of Islandmagee and the mouth of Larne Lough which are beyond the AONB boundary. The chimney at Ballylumford Power Station is a distant but discernible feature of views from Viewpoints 19 and 20 but becomes concealed by foreground cliffs in Viewpoints 21 and 22. There is a single turbine located very prominently on the skyline overlooking the sea to the south of Glenarm and a mobile phone mast loosely disguised as a large tree on the headland to the north of Glenarm. With the exception of some rural properties these are the only two man-made vertical structures visible on the skyline in views from this section of the Coast Road. They are prominently located in proximity to the coastal edge of the landscape and are visually distracting for these reasons.

Sensitivity of Visual Receptors: High

4.226 The majority of visual receptors in this category are deemed to be highly sensitive to changes in their views. Whilst a proportion of road users will be of lower sensitivity because they will be general road users, a large proportion will be tourists using the route because it is a renowned scenic drive and many road users will also be residents of the towns and villages along this coastline.

Magnitude of Visual Effect: Medium to Negligible

4.227 The Development would be prominently located on the same skyline as the existing single turbine 1 which is already a prominent though small component of views from the Coast Road. Although positioned further back from the cliff edge the Development would be a substantially larger component and would be positioned on the skyline which forms the main focus of land-side views from the Coast Road around Viewpoints 19 and 20. It would be nearly continuously visible in this manner if travelling between these two locations but would become significantly less visible on arrival at the edge of Carnlough town. It would not be visible at all from within the town itself (Viewpoint 21) where views would be at sea-level and completely screened by the preceding uplands. Visibility would resume when leaving Carnlough and rounding Straidkilly Point but to a far lesser extent. The position of the Development in relation to the coastline would also change – it would now be located further back from the upland edge and be only partially visible on the uplands which, in proximity to Viewpoint 22, appear to be located further inland.

4.228 The geographical spread of the turbines in relation to the overall extent of the views from viewpoints in this category is relatively minor because much of the view from the Coast Road is characterised by open sea. However, rising ground immediately adjacent to the Coast Road constrains land-side views and channels them in a north-south direction. The location of the Development on the skyline overlooking the coast means that it would occupy an increasingly large proportion of the uplands which forms the focus of land-side views when travelling in a southerly direction along the Coast Road and also when stopping at the many available laybys between Viewpoints 19 and 20 located between 12.53 km - 9.71 km from the Development. In Viewpoints 19 and 20 Turbine 3 would appear to be a slight outlier which would be more prominently located than the other turbines. These would appear to be arranged in two relatively dense linear groups. The Development is likely to be a visually prominent feature in views which are largely devoid of other vertical skyline structures. In Viewpoint 20 the turbine layout becomes more evenly distributed but still prominent.

4.229 The magnitude of effect on views in proximity to Viewpoints 19 and 20 would be high. This would reduce to negligible at Viewpoint 21 and low to negligible around Viewpoint 22 where there would be glimpsed but not prolonged visibility from some parts of the Coast Road and very minimal visibility from within the village of Glenarm itself (see Category C, Viewpoint 15). The Development would not alter the overall composition of views from these locations.

Significance of Visual Effect:

4.230 The overall sensitivity of visual receptors is deemed to be high and the magnitude of effect on Viewpoints 19 and 20 is also deemed to be high. Therefore the Development is deemed to have a significant effect on the types of views represented by Viewpoints 19 and 20. However, in the types of views represented by Viewpoints 21 and 22, the magnitude of effects decreases substantially and the Development is not deemed to have a significant effect on these types of views despite the fact that they are located in closer proximity to the Development.

Category E: Other representative views within the AONB

Description of Existing View and Predicted Views

4.231 Category E includes Viewpoints 23 - 27 which are illustrated in Figures 4.35 – 4.39. They have been selected to represent a range of other views from within the AONB that are not represented by the preceding viewpoint categories.

4.232 Viewpoint 23 is the most distant viewpoint located approximately 19 km to the north west of the Development it has been selected to represent specific views from the summit of Trostan which is the highest within the AONB and accessible via the Ulster Way. Trostan is located within the central part of the AONB and there are 360 degree views towards other parts of the upland plateau in all directions, open sea further to the east and the uplands that form the edge and setting to the AONB to the west. One of the key characteristics of this part of the view is the recurring pattern of wind energy developments located around the western and southern edges of the AONB. There are a number of existing wind farms visible at distances ranging from approximately 6 km to 39 km from this Viewpoint: the cluster of wind farms comprising Gruig, Corkey and Altaveedan are the nearest wind cluster located to the north and west; Elginny Hill and Rathsherry are located approximately 12 km to the south west; Elliott's Hill and Wolf Bog are located approximately 26 km to the south east and Carn Hill is approximately 39 km to the south.

4.233 Viewpoints 24 and 26 are located within different parts of the pastoral landscape on the eastern facing side of the uplands overlooking the A42 road corridor. There are a number of rural properties located along the tertiary road network on these slopes. Those at a more elevated position around Viewpoint 24 will experience expansive views of other pastoral lowland areas framed by rising uplands beyond. Slemish Mountain is a prominent landmark in the southern central part of this view which also extends further south beyond that which is illustrated in Figure 4.37. The Development would be visible as a relatively distant feature of views at the opposite edge of the skyline in the far north east at a distance of approximately 13.03 km. From this direction the turbines would have a generally well-spaced linear layout that reflects the underlying topography of the uplands on which it would be located. The distance of this viewpoint from the Development means that it would be a subservient component of the view that is dominated by the richly vegetated foreground landscape and overall expanse of the available view as well as the dominant profile of Slemish which is the main attraction within this view.

4.234 Viewpoint 26 would also be located to the west of the A42 corridor but at a lower elevation and in closer proximity to the Development which would be approximately 7.37 km to the south east. The foreground landscape has a transitional character with some pastoral elements merging into more open moorland. The Development would occupy a low skyline position within the main focus of views from this tertiary road and the small cluster of houses to the right hand side. However, it would be far less visible from the primary road corridor below which undulates and changes direction frequently and which is often enclosed by higher ground on both sides.

4.235 Viewpoint 25 is located on the summit of Slemish Mountain on the western side of the AONB approximately 11.42 km from the development. It is similar to Viewpoint 23 in so far as is offers a 360 degree view across the rest of the AONB and also, from this location, more extensively to the landscape beyond the AONB to the west but not towards the coastline. Also similarly to Viewpoint 23 there are existing wind farms visible in other parts of the view and at varying distances from this location. Slemish is a prominent landmark and relatively easy to access and climb so it is likely to attract a greater number of visual receptors than the summit of Trostan.

4.236 Viewpoint 27 is located with the same part of the AONB – the Larne Basalt Plateau LCA - approximately 5.46 km to the south west of the Development. The turbines would be visible in their entirety (only the lower parts of the northern turbines would be partially concealed by the skyline) but the surrounding landscape is large and broad in scale so the Development would not appear out of scale with the nature of the view. However, it would be a prominent and continuously visible component of views from the majority of the road corridor and Ulster Way in this part of the Study Area within a landscape that is currently relatively devoid of manmade vertical structures.

Sensitivity of Visual Receptors: Medium to High

4.237 Visual receptors at most of the viewpoints in this category will include walkers on the Ulster Way or other footpaths who are deemed to be of high sensitivity. Viewpoints 24, 26 and 27 have also been selected to represent views from tourists and general road users on the tertiary road network in the wider Study Area and these groups are deemed to be of high and medium sensitivity respectively. Residents of rural properties in proximity to Viewpoints 25 and 26 are also considered to be highly sensitive to changes in the composition of their views which will often be orientated in the direction of the Development.

Magnitude of Visual Effect: Medium overall

4.238 There would be a low magnitude of effect on Viewpoint 23. From this location the Development would be positioned on the skyline to the right-hand side/ west of the seascape which would occupy distant views to the east. It would be visible but it is unlikely to be easily discernible at this distance particularly in anything other than clear weather conditions. It would also appear as a small element in a very wide, expansive view in which there are other, often larger clusters of existing wind farms both in closer proximity and more distant from this viewpoint. From this position it would appear to be located in accordance with an already established pattern if wind energy development around the outer edges of the AONB although it would be the only one located in close proximity to the seascape. Even taking account of this the magnitude of effect is deemed to be low.

4.239 The effect on the other viewpoints in this category is deemed to be of a medium magnitude. In most cases the Development would be visible rather than prominent (this would only be the case for Viewpoint 27 which is in closest proximity to the

Development) and would appear as a simple linear element occupying a small proportion of the overall extent of the views available from these locations.

Significance of Visual Effect: Overall not significant

4.240 The Development is only deemed to have a significant effect on one of the locations in this category – Viewpoint 27. The Development would be prominently located only 5.46 km from this viewpoint and there would be continuous views of a similar nature from a relatively long section of the road corridor and Ulster Way footpath in proximity to this viewpoint. However, the Development is deemed to have no significant effects on the other four viewpoints in this category. Visual receptors would those with both medium and high sensitivity but the wide nature of all these views combined with the distances from the Development means that its prominence would be reduced. There would also be views towards other existing wind farms and turbines in other parts of these views, or in close sequence, so the Development would not introduce a completely new visual component. In the case of Viewpoints 24 and 26 the Development is not located within the main part of the view and, in relation to Viewpoints 23 and 25 the extent of the view is so wide that individual elements, particularly those located some distance way, assume less importance than the overall quality and composition of the wider views.

Category F: Longer range views located outwith the AONB boundary

Description of Existing View and Predicted Views

4.241 Category F includes Viewpoints 28 - 30 which are illustrated in Figures 4.40 – 4.42. The majority of the Study Area with visibility of the Development is located within the AONB and the only areas beyond the AONB boundary with theoretical visibility of the Development are the landscape around Ballymena and Broughshane to the west and the Larne/ Carrickfergus hills and Islandmagee to the south. Initial site assessment of PVPs 33 and 34 revealed no actual views in the former. The three viewpoints in this category have been selected to represent views from the landscape to the south of the AONB.

4.242 Viewpoint 28 is located approximately 12.76 km to the south of the Development in the rolling pastoral hills between Larne and Carrickfergus. The uplands which define the southern edge of the AONB frame views across the farmland in the foreground and middle distance which has a network of secondary and tertiary roads and rural settlement scattered throughout. Agnew's Hill is the most prominent feature of this skyline. There are also some glimpsed views of the seascape to the far right/ north east of this view. There are a number of single turbines present in wider view including two directly below Agnew's Hill and a further three located in the middle distance slightly to the left-hand side of the Development's position as it is illustrated in the photomontage in Figure 4.40 as well as a line of electricity pylons on the skyline to the far east/ right-hand side. Initial site assessment could not identify a safe stopping location on the nearby B100 which is the main route between Carrickfergus and Millbrook, Larne but this location represents similar views.

4.243 Viewpoint 29 is located on the northern most tip of Islandmagee where seaward views are framed along the western side by the sequence of hills and summits which form the Antrim Plateau and glens. It is located approximately 12.03 km to the south east of the Development. Views from other parts of Islandmagee are either orientated eastwards to open sea of westwards across Larne Lough where they are unique but generally characterised by a range of visual components including both natural and manmade features. Ballylumford Power Station, industrial development around Larne Lough and settlement on the shores of Larne, Islandmagee and Whitehead are all dominant features but views into the AONB are not. This part of Islandmagee is therefore relatively unique and comparatively tranquil compared to other PVPs identified in this part of the Study Area. This is the car park and starting point for a walk to the National Trust owned Skernaghan Point. The Causeway Coast and Glens Walking Guide describes the key features of views from this walk as clear views to Agnew’s Hill, Sallagh Braes and Scawt Hill.

4.244 Viewpoint 30 is located at the Knockagh Monument on the escarpment overlooking Carrickfergus approximately 21.99 km to the south of the Development. It is one of the most elevated viewpoint locations near the southern edge of the Study Area and has been selected for this reason. The main focus of views from this location is across Belfast lough to the south east but there would also be elevated views on approaches to the monument looking inland across the uplands to the north west of Carrickfergus and towards the AONB. Carn Hill wind farm is a prominent foreground feature to the west of this viewpoint. The larger cluster of wind farms at Elliott’s Hill and Wolf Bog would be partially visible in the distance beyond. Agnew’s Hill would be a prominent feature of the skyline to the far north east.

Sensitivity of Visual Receptors: Low to High

4.245 Visual receptors would include visitors and walkers at Viewpoint 29 who are deemed to be of high sensitivity because their views will be almost solely orientated towards the AONB in its coastal setting. Walkers and visitors to the Knockagh Monument would be located at a greater distance from the AONB, in a foreground landscape that is in poor condition and where the focus of views is wider and more elevated. They are therefore deemed to be of medium sensitivity.

4.246 Residents in proximity to Skernaghan Point may have similar views but many will also be located in the more sheltered Browns Bay where views towards the Development would be prevented by foreground topography. They may experience similar views when travelling to and from these properties but from the properties themselves views in this direction will not always be obtained. They are therefore deemed to be of medium to high sensitivity. Residents of rural properties in proximity to Viewpoint 28 are also deemed to be of medium sensitivity. Farmers and road users in proximity to all viewpoints in this category are deemed to be of low sensitivity.

Magnitude of Visual Effect: Low to Medium

4.247 The Development would be partially visible beyond the profile of Knockdhu on the skyline in the distant part of views from Viewpoint 28. Turbine 3 would appear as a slightly more prominent outlier but only the upper parts of the rotors of the other turbines would be visible. These would appear as two linear clusters, the central one being slightly denser than the northern-most one. However, the preceding foreground and middle distance forms the main components of this view and Agnew's Hill to the left-hand side/ south west is the main point of focus on the skyline. The Development would be more distant still and will not be an easily discernible feature. It will not alter the overall profile or appearance of this part of the skyline and the magnitude is therefore deemed to be low.

4.248 From Viewpoint 29 the Development would be clearly visible on the skyline either side of Scawt Hill at a distance of approximately 12.03 km and would be the only vertical man-made element in this part of the view with the exception of the prominently placed single turbine near Glenarm. The magnitude of effect is deemed to be medium because it would occupy only a small part of the skyline at some distance but would still be a relatively prominent feature. It would also visually detract from the integrity of Scawt Hill distinctive profile and is likely to be more noticeable for this reason.

4.249 In proximity to Viewpoint 30 the Development would be partially visible beyond the distinctive profile of Agnew's Hill. However, it would not impinge upon this profile and, at a distance of 21.99 km, it would be hard to discern with the naked eye. The magnitude of effect is therefore deemed to be low.

Significance of Visual Effect: Not Significant from Viewpoints 28 and 30 but Significant from Viewpoint 29

4.250 There would be no significant effects on Viewpoints 28 or 30 where the sensitivity of visual receptors is deemed to range from medium to low, the Development would not be clearly visible and the overall magnitude of effect is also low. However, at Viewpoint 29 visual receptors are deemed to be highly sensitive and the magnitude of effect is deemed to be medium. The Development would have a significant effect on this Viewpoint in particular but not from the rest of Islandmagee.

4.251 In summary Table 4.2 demonstrates that the overall significance of visual effects varies considerably throughout the Study Area. Whilst there are 10 representative viewpoints within 5 km of the Development that would experience significant visual effects, there are also eight viewpoints from which effects are deemed to be Not Significant. Similarly, between 5 and 15 km from the Development there are 5 representative viewpoints that would experience significant visual effects and 5 from which effects are deemed to be Not Significant. Only two viewpoints have been selected to represent the nature of views beyond 15 km and neither would experience significant effects. This reflects the relatively high sensitivity of visual receptors that would be located within the AONB versus receptors located beyond the AONB boundary but it also reflects the highly variable nature of the underlying topography of the AONB and the manner in which this provides different levels of screening in different parts of the Study Area.

4.252 However, even in instances where the overall change to the composition of the view caused by the Development would be limited (because expansive panoramic views are often available) the analysis of visual effects must consider not only changes to the composition of views but also the likely responses to these changes by visual receptors. The fact that the majority of the Study Area, and therefore the majority of Viewpoints and visual receptors are also located within the AONB means that the overall sensitivity of visual receptors is high and the value of the landscape is frequently the primary attraction for these receptors. The coastal location of the Development site also means that visual receptors are likely to be more sensitive to changes in the composition of views. The absence of other similar structures in this part of the AONB, and the unique profile of the uplands which form the site (Scawt Hill in particular) means that the magnitude of effect is often high to medium and the visual character of this part of the AONB is likely to become considerably influenced by the Development. Overall visual effects are therefore deemed to be significant.

Table 4.2: Summary of Visual Effects on Viewpoints

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
Category A: Views from the Ulster Way within and in close proximity to the site						
1	**Black Hill trig. point, Ulster Way through site** **Figure 4.14**	**0.25 km to T5**	**Dominant**	**High**	**High**	**Significant**
2	**Ballycoose Hill** **Figure 4.15**	**0.55 km to T14**	**Dominant**	**High**	**High**	**Significant**
3	**Linford Carpark, Feystown Road** **Figure 4.16**	**1.43 km to T14**	**Visible**	**High**	**Medium**	**Not Significant**
4	**Knockdhu at Fort** **Figure 4.17**	**1.90 km to T14**	**Prominent**	**High**	**High**	**Significant**

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
5	Sallagh Braes at start of walk Figure 4.18	4.31 km to T14	Not Visible	High	Negligible	Not Significant
6	Sallagh Braes mid-section Figure 4.19	3.89 km to T14	Visible	High	Negligible	Not Significant
7	Ulster Way at Crockandoo near Feystown Road Figure 4.20	1.67 km to T1	Visible to Prominent	High	Medium	Significant
Category B: Views from the rural road network, including representation of residential properties, within approximately 5 km of the site						
8	Munie Road overlooking Glenarm Castle Figure 4.21	3.50 km to T1	Prominent	Medium to High	Medium	Significant
9	St Patrick's Church, Feystown Figure 4.22	1.29 km to T5	Prominent	Medium to High	High	Significant
10	Aughaboy Road at junction with Drumcrow Road Figure 4.23	2.48 km to T12	Prominent	Medium to High	High	Significant
11	Loughdoo Road on approach to Knockdhu car park Figure 4.24	2.53 km to T14	Prominent	Medium to High	Medium	Significant
12	Brustin Brae Road at Knowehead between Larne & Ballygally Figure 4.25	5.08 km to T14	Prominent	High	High	Significant
13	Sallagh Road at Ballycoose Road junction	1.53 km to T14	Not Visible	High to Medium	Medium to Low	Not Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
	Figure 4.26		becoming more visible at opposite end of road			
Category C: Views from settlements within approximately 5 km of the site						
14	Straidkilly Road, Glenarm Figure 4.27	5.11km to T1	Visible becoming not visible past this part of the road	High to Medium	Low	Not Significant
15	Glenarm Marina Figure 4.28	4.28 km to T1	Not Visible	Medium	Negligible	Not Significant
16	Carnalbanagh Village Figure 4.29	6.08 km to T12	Prominent	High to Medium	Medium	Significant
17	Cairncastle Road on outskirts of village Figure 4.30	3.45 km to T14	Visible becoming less visible in closer proximity	Medium to Low	Medium	Not Significant
18	Ballygally beach car park Figure 4.31	4.65 km to T14	Prominent	High to Medium	High	Significant
Category D: Sequential views from the A2 Coast Road						
19	Garron Point car park Figure 4.32	12.53 km to T1	Prominent	High	High	Significant
20	A2, Garron Road between Carnlough and Garron Point Figure 4.33	9.71 km to T1	Prominent	High	High	Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
21	Carnlough Village at Harbour Figure 4.34	7.72 km to T1	Not Visible	Medium	Negligible	Not Significant
22	A2 Coast Road near Glenarm Figure 4.34	5.04 km to T1	Visible or Not Visible depending on location on this part of the road	Medium to High	Low to Negligible	Not Significant
Category E: Other representative views within the AONB						
23	Summit of Trostan near Ulster Way/ Moyle Way Figure 4.35	19.00 km to T1	Visible	High	Low	Not Significant
24	Longmore Road at Knockcaughran Hill overlooking B42 Figure 4.36	13.03 km to T5	Visible	High	Low	Not Significant
25	Slemish Mountain Figure 4.37	11.42 km to T12	Prominent	High	Medium	Significant
26	Slane village off A42 Figure 4.38	7.37 km to T1	Visible	Medium to High	Medium	Not Significant
27	Starbog Road near Capanagh Wood Figure 4.39	5.46 km to T14	Prominent	Medium to High	Medium	Significant
Category F: Longer range views located outwith the AONB boundary						
28	Cross Hill near Ralloo village between Carrickfergus and Millbrook Figure 4.40	12.76 km to T14	Visible	Medium to Low	Low	Not Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
29	Brownsbay, Islandmagee Figure 4.41	12.03 km to T14	Prominent	High to Medium	Medium	Significant
30	Knockagh monument Figure 4.42	21.99 km to T14	Visible	Medium to Low	Low	Not Significant

The Cumulative Baseline and Analysis of Effects

4.253 The Cumulative Baseline refers to all existing, consented and proposed wind farms within the 30 km Study Area. There are a total of 18 wind farms considered to be part of the Cumulative Baseline for this LVIA, of which 13 are existing, 3 are consented and 2 are proposed. There are also a total of 11 existing or consented single turbines located within 5 km of the Development which have also been included in the Cumulative Baseline. Full details of all wind farms included in the Cumulative Baseline are provided in Technical Appendix 4.5.

4.254 In many instances other wind farms in the cumulative baseline are located in visually and / or physically distinct clusters. This often reflects landscapes, ground conditions and wind speeds that are favourable for wind energy development. It also reflects a general principle that is implemented by planning authorities to consolidate and group new and established developments together as a means to achieve sustainable development and mitigate potential adverse cumulative effects on scenic landscapes which can result from a sporadic approach to siting new developments. The SPG's recommendation for LCA 124, as with other LCAs within the AONB, suggests that a creation of a new cluster in the central part of this LCA would be the best way to accommodate wind energy development whilst minimising the cumulative effects of developing several wind farms within the same LCA. However, to date, no wind farms have been constructed or consented within this LCA and therefore the Development would, if consented maximise separation distances from groups of existing and consented wind farms. There is a proposed wind farm at Carnalbanagh which would, if consented, be located within this LCA and would decrease the separation between the Development and the Elginny Hill/ Rathsherry cluster.

Table 4.3: Summary of Cumulative Baseline

Wind Farm (see Technical Appendix 4.5 for full details)	No. of turbines
Existing Wind Farms	Total no. of turbines = 73
Altaveedan	9
Ballymena Wind Park	2
Brett Martin Single Turbine Ltd	1
Carn Hill	6
Connaught Road	2
Corby Knowe	3
Corkey	10
Corkey Extension	1
Elginny Hill	10
Elliot’s Hill	10
Gruig	10
Rathsherry	9
Consented Wind Farms	Total no. of turbines = 16
Wolf Bog	5
Ballykeel	7
Castlegore	4
Proposed Wind Farms	Total no. of turbines = 11
Carnalbanagh	7
Whappstown	4
Consented Wind Farms	Total no. of turbines = 11
Single Turbines within 5 km of the Development	11
Total no. of turbines in Study Area	111

Cumulative Landscape Effects

4.255 The Study Area comprises of a series of broad and expansive upland ranges of hills which are separated from each other by lowland landscapes which are often pastoral in character. The majority of wind farms within the Study Area are located in a linear fashion on the westward facing slopes along the western edge of the AONB some distance from the Development. The scale of these uplands and the separation distances between these wind farms ensure they are not the dominant characteristic of the Study Area or the AONB. The Development would be located in relatively close proximity to the consented Ballykeel wind farm which is within the southern edge of the AONB approximately 5.5 km from the Development but the undeveloped upland landscape in between would ensure that the two wind farms would be physically distinct from each other. From elevated close range viewpoints the consented wind farm at Ballykeel would be visible in different parts of the same view as the Development and in elevated southern approaches to the AONB from a Belfast direction it would appear in front of the Development. The Development itself would increase the physical influence of wind farms within this part of the AONB boundary from these approaches and this is deemed to have a significant effect on the landscape character of this part of the Study Area. However, from all other parts of the Study Area cumulative landscape effects are not deemed to be significant. Whilst it would introduce wind turbines into a part of the Study Area where there are currently none it would also be located on an elevated upland landscape in accordance with general advice provided in the SPG that this type of landform can accommodate larger turbines and the broader the upland the greater the capacity where larger horizons tend to diminish the perception of height.

Cumulative Visual Effects

4.256 Existing and consented wind farms form the majority of the cumulative baseline that is considered in this LVIA. There are 13 existing and 3 consented wind farms in the Study Area and these are described as an integral part of the baseline views in the assessment of Viewpoints starting at paragraph 4.163. There are a further 2 proposed wind farms of which one, Carnalbanagh, is likely to be visible either simultaneously or in sequence from Viewpoint locations to the west of the Development. The EIA Regs. 2017 do not require account to be taken of proposed wind farms and they are afforded less weight in the assessment of cumulative visual effects. A full list of wind farms which have been considered in the cumulative baseline is provided in Technical Appendix 4.5, Table 4.5.1 and has been used in conjunction with the analysis of Cumulative ZTV diagrams and Viewpoints to reach a number of conclusions in relation to cumulative effects.

4.257 Three Cumulative ZTV diagrams have been produced. The first illustrates the combined effect of other existing and consented wind farms within the Study Area and the incremental effect of the Development on this cumulative baseline (Figure 4.11). The second diagram illustrates the effects of the Development when considered in addition to the consented Ballykeel wind farm (Figure 4.12). Thirdly, Figure 4.13 illustrates the theoretical visibility of other proposed wind farms and the incremental effect of the Development on the level of visibility of proposed wind farms across the Study Area. These ZTVs are calculated using theoretical blade tip visibility in order to consider the highest possible levels of visibility and cover a radius of 30 km from the centre of the Development unless otherwise stated. Refer to the

LVIA methodology in Technical Appendix 4.2 for further details. Similarly to the baseline ZTVs which have been prepared for the Development as a standalone wind farm (see paragraph 4.154) the cumulative ZTVs indicate comparatively low levels of theoretical visibility from land-based parts of the Study Area as opposed to views from open sea. For this reason, ZTV diagrams have been produced to illustrate the difference between Study Area-wide visibility and land-based visibility. The latter include the sea immediately adjacent to the coastline but exclude areas of open sea where sensitive visual receptors are unlikely to be located.

4.258 Figure 4.11 shows the cumulative ZTV for the Development in conjunction with all existing and consented wind farms in the Cumulative Baseline. It clearly illustrates the conclusion that has already been made in relation to cumulative landscape effects – that clusters of wind farms are a characteristic feature on westward facing uplands and these are visible in the western part of the Study Area where the Development would tend not to be visible. There are few discernible parts of the Study Area (1.66 %) where the Development would increase overall theoretical visibility and this would reduce further to 1.44% of sea-based visibility is excluded (see Figure 4.11, page 2 of 2). Existing and consented wind farms are already theoretically visible across 87.19% of the Study Area, reducing to the 44.96% when considering only land-based parts of the Study Area whereas the Development would be visible across a total of only 17.61% of the same parts of the Study Area.

4.259 The ZTV suggests that the areas of additional theoretical visibility will be located at relatively close range along coastal areas to the south east of the Development although site assessment suggests that visibility from these parts of the Study Area are likely to be limited to a few blade tips only and the Development is unlikely to be visually prominent. The ZTV also suggests additional theoretical visibility from elevated ground in the far north of the Study Area at distances of approximately 25 km but at these distances the Development would appear as a minor feature within panoramic views and would not be prominent.

4.260 Figure 4.12 shows the cumulative ZTV in conjunction with Ballykeel wind farm which is the closest wind farm to the Development, located approximately 5.5 km to the south and which would be theoretically visible across 42.78% of the Study Area. This would reduce further to 9.31% if sea-based parts of the Study Area are excluded (see Figure 4.12, page 2 of 2). When considered alongside only the consented Ballykeel wind farms the Development would increase overall theoretical visibility by 17.10% of the Study Area, reducing to 10.67% of land-based parts. The ZTV diagrams presented in Figure 4.12 show that Ballykeel and the Development would often appear as visually distinct wind farms despite being in relatively close proximity to each other and this is primarily due to the screening effects of the Antrim Plateau uplands which are located between them. This is reflected in the Viewpoints selected for this LVIA where there Ballykeel wind farm does not appear as a prominent feature. The ZTV shows that, in the southern part of the Study Area there is more frequently visibility of Ballykeel as a standalone development and in the northern part of the Study Area the Development is more likely to be viewed as such. In instances to the north or south where the two are likely to be viewed simultaneously in the same view there is likely to be sufficient undeveloped land in between them to ensure that they are still perceived as being visually separate and also sufficient distance between both wind farms and the viewpoints in question that they appear as minor elements within the wider view (for example refer to Viewpoints 23, Figure 4.23 and Viewpoint 28, Figure 4.40). There would be no visibility of either wind farm in 40.12% of the Study Area, but this increases significantly to 80.02% if sea-based visibility is excluded where the majority of visibility of both wind farms would be experienced.

4.261 Figure 4.14 shows the cumulative ZTV in conjunction with the two other proposed wind farms in the Study Area. Whappstown wind farm which would form part of the cluster of wind farms with Wolf Bog, Elliott's Hill and Castlegore located approximately 16 km to the south west of the Development. It is rarely visible from locations within this Study Area and does not appear within the same field of view as any of the representative Viewpoints used in this LVIA (refer to Technical Appendix 4.5.1). It also includes Carnalbanagh wind farm which would be located approximately 6.7 km to the west of the Development. This wind farm would be seen in the same field of view from many representative viewpoints located within and around the AONB to the north and west of Development but rarely in the same manner from southerly approaches towards the AONB or from sea-based areas of the ZTV. When considered alongside these proposed wind farms the Development would increase overall theoretical visibility of proposed wind farms by 34.85 %. However, much of this additional visibility would be located in open sea and, if this area of the ZTV is excluded from the calculation, the additional visibility of the Development would decrease significantly to only 7.54 %. The other proposed wind farms would be theoretically visible across 36.28% of the whole Study Area and 23.88% of land-based areas demonstrating that neither are as visible from sea-based parts of the Study Area as the Development but, conversely, the Development is significantly less visible from land-based parts of the Study Area.

Table 4.4: The Development's Cumulative Zone of Theoretical Visibility

Cumulative ZTV Diagram (30 km radius, blade tip)	No. of turbines theoretically visible	% of Study Area with visibility * % of land based visibility (excluding views from the sea beyond the immediate coastline)		
Existing and Consented Wind Farms Figure 4.11	0 turbines visible	11.15%	*53.60 %	
	Visibility of other wind farms where there is no visibility of the Development	31.53% *28.79 %	Total % of 30 km Study Area where other wind farms are	

Cumulative ZTV Diagram (30 km radius, blade tip)	No. of turbines theoretically visible	% of Study Area with visibility * % of land based visibility (excluding views from the sea beyond the immediate coastline)		
	Visibility of the Development together with other wind farms	55.66% *16.17 %	theoretically visible = 87.19 % *44.96 %	Total % of 30 km Study Area where the Development is theoretically visible = 57.32 % *17.61 %
	Additional visibility of the Development	1.66% *1.44 %		
Ballykeel Wind Farm Figure 4.12	0 turbines visible	40.12%	*80.02 %	
	Visibility of Ballykeel where there is no visibility of the Development	2.56% *2.37 %	Total % of 30 km Study Area where Ballykeel is theoretically visible = 42.78% % *9.31 %	
	Visibility of the Development together with Ballykeel	40.22% *6.94 %		Total % of 30 km Study Area where the Development is theoretically visible = 57.32 % *17.61 %
	Additional visibility of the Development	17.10% *10.67 %		
Proposed Wind Farms Figure 4.13	0 turbines visible	28.87%	*68.58 %	
	Visibility of other wind farms where there is no visibility of the Development	13.81% *13.81 %	Total % of 30 km Study Area where other wind farms are	

<table>
<tr><th>Cumulative ZTV Diagram
(30 km radius, blade tip)</th><th>No. of turbines theoretically visible</th><th colspan="3">% of Study Area with visibility
* % of land based visibility (excluding views from the sea beyond the immediate coastline)</th></tr>
<tr><td rowspan="2"></td><td>Visibility of the Development together with other wind farms</td><td>22.47%
*10.07 %</td><td>theoretically visible
= 36.28 %
*23.88 %</td><td rowspan="2">Total % of 30 km Study Area where the Development is theoretically visible
= 57.32 %
*17.61 %</td></tr>
<tr><td>Additional visibility of the Development</td><td>34.85%
*7.54 %</td><td></td></tr>
</table>

4.262 Of the 30 Viewpoints which have been selected to represent typical views of the Development within the Study Area only two – Viewpoints 16 and 25 - would experience significant cumulative effect resulting from the Development being visible in conjunction with the proposed Carnalbanagh wind farm. However, it is noted that proposed wind farms are afforded less weight in the EIA Regulations than existing or consented projects. A number of single turbines have also been included in the cumulative baseline. These would often appear in the same field of view but in distinctly separate parts of the landscape with adequate separation distances between them and the Development. In the majority of instances, across all parts of the Study Area, the Development would not appear within the same field of view as other wind farms in the cumulative baseline. In the majority of viewpoints the Development is viewed as a completely distinct element. Any other wind farms that are visible from the same viewpoints are located at some distance around the southern and western edges of the AONB where the viewer must look to other parts of the views. From Category D viewpoints, which illustrate the sequential nature of views from the A2 Coast Road, no other wind energy developments except the prominently located Single Turbine 1 would be visible. The only instances where the Development would appear behind another wind farm would be in Viewpoints 28 and 30 which are respectively located 12.75 km and 21.98 km to the south. From both of these locations the consented Ballykeel wind farm would be located in front of the Development, which itself would be only partially visible beyond. The lower parts of the turbines would be screened by the rising ground directly in front of the Development. Furthermore at these distances, and given the wide extent of the available views from these locations in comparison with the small proportion that would be occupied by Ballykeel and the Development, the latter would not be a noticeable addition to the views.

Table 4.5: Summary of Cumulative Visual Effects on Viewpoints

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of cumulative visual effect	Significance of cumulative visual effect
Category A: Views from the Ulster Way within and in close proximity to the site						
1	Black Hill trig. point, Ulster Way through site Figure 4.14	0.25 km to T5	Dominant	High	Negligible	Not Significant
2	Ballycoose Hill Figure 4.15	0.55 km to T14	Dominant	High	Negligible	Not Significant
3	Linford Carpark, Feystown Road Figure 4.16	1.43 km to T14	Visible	High	Negligible	Not Significant
4	Knockdhu at Fort Figure 4.17	1.90 km to T14	Prominent	High	Negligible	Not Significant
5	Sallagh Braes at start of walk Figure 4.18	4.31 km to T14	Not Visible	High	Negligible	Not Significant
6	Sallagh Braes mid-section Figure 4.19	3.89 km to T14	Visible	High	Negligible	Not Significant
7	Ulster Way at Crockandoo near Feystown Road Figure 4.20	1.67 km to T1	Visible to Prominent	High	Negligible	Not Significant
Category B: Views from the rural road network, including representation of residential properties, within approximately 5 km of the site						
8	Munie Road overlooking Glenarm Castle	3.50 km to T1	Prominent	Medium to High	Negligible	Not Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of cumulative visual effect	Significance of cumulative visual effect
	Figure 4.21					
9	St Patrick's Church, Feystown Figure 4.22	1.29 km to T5	Prominent	Medium to High	Negligible	Not Significant
10	Aughaboy Road at junction with Drumcrow Road Figure 4.23	2.48 km to T12	Prominent	Medium to High	Negligible	Not Significant
11	Loughdoo Road on approach to Knockdhu car park Figure 4.24	2.53 km to T14	Prominent	Medium to High	Low	Not Significant
12	Brustin Brae Road at Knowehead between Larne & Ballygally Figure 4.25	5.08 km to T14	Prominent	High	Negligible	Not Significant
13	Sallagh Road at Ballycoose Road junction Figure 4.26	1.53 km to T14	Not Visible becoming more visible at opposite end of road	High to Medium	Negligible	Not Significant
Category C: Views from settlements within approximately 5 km of the site						
14	Straidkilly Road, Glenarm Figure 4.27	5.11km to T1	Visible becoming not visible past this part of the road	High to Medium	Negligible	Not Significant
15	Glenarm Marina Figure 4.28	4.28 km to T1	Not Visible	Medium	Negligible	Not Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of cumulative visual effect	Significance of cumulative visual effect
16	Carnalbanagh Village Figure 4.29	6.08 km to T12	Prominent	High to Medium	Medium	Significant
17	Cairncastle Road on outskirts of village Figure 4.30	3.45 km to T14	Visible becoming less visible in closer proximity	Medium to Low	Negligible	Not Significant
18	Ballygally beach car park Figure 4.31	4.65 km to T14	Prominent	High to Medium	Negligible	Not Significant
Category D: Sequential views from the A2 Coast Road						
19	Garron Point car park Figure 4.32	12.53 km to T1	Prominent	High	Negligible	Not Significant
20	A2, Garron Road between Carnlough and Garron Point Figure 4.33	9.71 km to T1	Prominent	High	Negligible	Not Significant
21	Carnlough Village at Harbour Figure 4.34	7.72 km to T1	Not Visible	Medium	Negligible	Not Significant
22	A2 Coast Road near Glenarm Figure 4.34	5.04 km to T1	Visible or Not Visible depending on location on this part of the road	Medium to High	Negligible	Not Significant
Category E: Other representative views within the AONB						
23	Summit of Trostan near Ulster Way/ Moyle Way Figure 4.35	19.00 km to T1	Visible	High	Medium	Not Significant
24	Longmore Road at Knockcaughran Hill overlooking B42	13.03 km to T5	Visible	High	Low	Not Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of cumulative visual effect	Significance of cumulative visual effect
	Figure 4.36					
25	Slemish Mountain Figure 4.37	11.42 km to T12	Prominent	High	Medium	Significant
26	Slane village off A42 Figure 4.38	7.37 km to T1	Visible	Medium to High	Negligible	Not Significant
27	Starbog Road near Capanagh Wood Figure 4.39	5.46 km to T14	Prominent	Medium to High	Low	Not Significant
Category F: Longer range views located outwith the AONB boundary						
28	Cross Hill near Ralloo village between Carrickfergus and Millbrook Figure 4.40	12.76 km to T14	Visible	Medium to Low	Low	Not Significant
29	Brownsbay, Islandmagee Figure 4.41	12.03 km to T14	Prominent	High to Medium	Negligible	Not Significant
30	Knockagh monument Figure 4.42	21.99 km to T14	Visible	Medium to Low	Negligible	Not Significant

Information Gaps

4.263 There are no known gaps in the information that has been used in this LVIA. However, the DTM data which has been used to produce the ZTVs, wirelines and photomontages does not appear to reflect the complexity of the topography around the summit of Scawt Hill. Whilst this has no discernible effect on overall visibility it is particularly noticeable in the viewpoint figures where Scawt Hill appears in front of proposed turbines. In some instances the wireline diagrams indicate a certain level of visibility but, when overlaid with the viewpoint photographs, it becomes apparent that the screening effect of Scawt Hill will be greater. This relates to Viewpoint 12 (Figure

4.25), Viewpoint 17 (Figure 4.30), Viewpoint 18 (Figure 4.31) and Viewpoint 29 (Figure 4.41). In all cases this is clearly indicated on the figures in question.

Future Baseline – The 'No Change' Scenario

4.264 Under the "no change" scenario, were the Development not to be constructed, it is anticipated that the site would be continued to be used in much the same manner as it currently is. However, the existing landscape and visual character of the site and the wider Study Area will continue to be influenced by human activity which is constantly changing the landscape and it is important that the implications of these changes are considered and understood so that the intrinsic qualities of the landscape are retained and enhanced rather than destroyed or compromised. The key trends are identified in the NILCA, SCA and RLCA and are also implied by the baseline character of the Study Area at present:

- There are existing wind farms within and surrounding the Study Area. Based on the number of consented wind farms in the baseline it is likely that more wind farms will be developed within the Study Area and across the Province. Some of these are likely to be intervisible with the Development and they will continue to influence the overall landscape and visual character of the Study Area. It is likely that the current trend of developing cleaner renewable energy sources will continue and become more environmentally acceptable given the predicted effects of climate change and the necessity to tackle these effects;
- Climate change is likely to have the biggest implications on the landscape and its users in the future. Broadly, it is characterised by a general increase in unpredictable weather conditions which will inevitably impact upon all areas of life. River levels are likely to rise and there will be an associated loss of buildings in the flood plain. There will be a loss of habitats associated with the erosion of river banks and lough shores which support unique combinations of plants and animals. Migrant species, in particular birds, may also be affected and warmth-loving species will gradually replace those currently adapted to colder climates. Flooding will become more frequent and cause damage to the interiors and structures of buildings;
- Demographic change is creating the need for a large number of additional dwellings in the countryside which creates pressures on infrastructure. In particular the rural landscape at the edge of existing settlements will continue to experience pressure for built development and ribbon development along road corridors that link these settlements together. In the open countryside the presence of derelict buildings signifies a loss of traditional built vernacular and a loss of biodiversity and vegetation associated with a decline in the management of rural field boundaries and farmland;

- Continued expansion of the road network is likely to occur alongside built development. Improvements to existing secondary roads are also likely (e.g. straightening, widening and increased signage) will have cumulative negative impacts on local landscape character by eroding local patterns and causing the loss of roadside trees, hedgerows, stonewalls and bridges;
- There is an ongoing trend towards the amalgamation of small farms with the associated loss of traditional buildings and vernacular features, loss of hedgerows and trees to create larger fields. This is having a detrimental impact on the general quality and condition of the rural landscape character. There is also a trend, however, for farmers to diversify into more traditional farming techniques, husbandry of traditional breeds, and the provision of tourist attractions and accommodation. This often has positive landscape impacts. Current forestry grant schemes encourage farmers to plant more broadleaved trees for amenity and wildlife benefits and in the future this should strengthen the character of farmed landscapes. However, converting fields to coniferous plantations or selling it for housing development will continue to be a detrimental force, particularly if wetter weather renders areas of rough grazing land unviable for livestock;
- Commercial forestry on a large scale is detrimental to landscape character as it conceals the intricate pattern of the landscape and often occupies visually prominent positions in upland areas. Peat cutting alters the undulating topography and creates abrupt and artificial changes in level. This activity, particularly as it has become mechanised, also destroys natural vegetation and habitats. Where land becomes too wet to farm forestry is likely to become an attractive alternative. This may provide the opportunity to continue the current shift from coniferous plantations to broadleaved forestry which will in turn have a potentially positive impact on landscape character, visual amenity and ecological function;
- Agriculture is one of Northern Ireland's major industries. Pasture is likely to remain the dominant agricultural land-use but warmer temperatures will also enable spring cereal crops to be grown as well as an increase in the use of pesticides. This has the potential to alter the appearance of agricultural parts of the Study Area in the future.

Mitigation and Enhancement Proposals

Mitigation Proposals

4.265 Mitigation proposals in response to landscape and visual effects include:

- The exterior surfaces of the turbines will be painted in a recessive, non-reflective light grey colour to minimise their visual prominence against the sky in most weather conditions;

- Ancillary facilities, such as the control building, substation and energy storage compounds, have been designed in a manner that is sensitive to the immediate landscape character with regards to location, scale, colour, and choice of materials. These facilities have also been sited positioned on lower lying ground in between Scawt Hill and Craigy Hill and would be largely screened from view from the surrounding landscape by the site topography;
- The site entrance will utilise and upgrade an existing gateway located to the west of the Development off Feystown Road rather than be newly formed.

Enhancement Proposals

4.266 The Development could contribute to the AONB Management Plan's aims to maintain vernacular field boundaries and farming practices that have created the area's special character and also to the Plan's aim to conserve and enhance the accessibility of archaeological remains for public enjoyment. The construction phase of the project could include repairs to existing field boundary walls where these are being retained. There will also be potential to improve the Ulster Way in terms of repairs/ enhancements to footpaths and stiles, signage for cultural heritage features on site which are currently not highlighted, etc. During the operational phase of the Development farming practices on the site can continue below the operational turbines which will ensure the longer term maintenance of associated vernacular features.

Residual Effects

4.267 Potential landscape and visual effects were addressed through a comprehensive feasibility study and through iterative design development. This resulted in the Development as it is now proposed and therefore potentially significant effects have been avoided prior to the LVIA being carried out as part of the EIA. Beyond this, the proposed mitigation measures will help to minimise the effect of certain aspects of the Development. However, there would be no resulting change in the overall significance of effects. Therefore the residual effects are the same as those already identified.

Overall Significance of Landscape and Visual Effects

4.268 The Development conforms to the general principles laid out in policy and best practice guidance. Both the SPPS and PPS 18 are broadly supportive of renewable energy developments as a means of mitigating against the effects of climate change and the BPG further states that, given their importance, is it important for society at large to accept wind farms as a feature of the Region for the foreseeable future. The BPG notes that some locations may be highly visible but that this is not necessarily unacceptable. The latter judgement depends on the degree of effect and sensitivity of the receiving landscape. Of relevance to this Development the BPG also notes that groups of turbines can normally appear acceptable as single isolated features in open, undeveloped landscapes such as the proposed site. Beyond 5 km they are likely to be visible as part of the wider landscape and prominent only in clear visibility, becoming less prominent with distance.

4.269 The general principles contained within the SPG are also broadly supportive. The Development is located in accordance with the majority of landscape and visual character issues that the SPG notes should be considered for wind energy developments within the Antrim Plateau region. The Development also maintains adequate separation distances from other wind farms and is of a form and layout that reflects the large scale and strong horizontal form of the uplands on which it is located as per the SPG's design principles.

4.270 Whilst the SPPS requires a cautious approach for wind farms located in designated areas such as this AONB it is noted that all the LCAs which combine to form the AONB are assessed by the SPG as being of much the same sensitivity to wind energy development as LCA 124 within which the Development would be located and many upland parts of these LCAs are described as being theoretically suitable locations. For example, the sites for Elginny Hill and Rathsherry wind farms are specifically identified by the SPG as being particularly highly sensitive but have nevertheless been subject to planning consents. The Development's location on an upland plateau within the AONB means that, in southerly approaches to the AONB, it would form a gateway feature and therefore its effects on both the physical character of the underlying plateau and its visual effects in respect of this function would be significant. However, as one continues to travel along the scenic Coast Road and further into the AONB the landscape and visual effects of the Development would diminish in significance.

4.271 The receiving landscape is undeniably beautiful but it is also highly accessible and therefore heavily influenced by human activity. LCA 124 where the Development is located is the only LCA which is described as already having wind farms and radio masts as prominent features of its existing character. In this respect the Development would not introduce a completely new visual character element although it would create a new physical landscape character element in one part of the LCA. Human activity is in fact one of the strongest defining characteristics of the coastal landscape – the presence of the Coast Road being one of the best examples of this influence because it has enabled the growth of settlements within the Antrim Glens and is the means by which visitors can explore the coastline.

4.272 Landscape in general is a palimpsest meaning that it reflects historical changes and continues to be formed and re-formed with evidence of previous alterations being evident alongside current land uses. This palimpsest is a key characteristic of the AONB where the landscape which has been shaped by over 9,000 years of human occupation. This is evidenced by field patterns, agricultural buildings and cultural heritage sites. In this respect the Development reflects the continuing trend of human activity influencing landscape character and utilising the availability of natural resources. It would be a long term but nevertheless temporary addition to the landscape and visual character of the site and the wider Study Area. When the wind farm ceases to operate the site will be returned to its current form. The Development may also assist the aims of the AONB Management Plan to restore characteristic features that are present on the site such as stone walls which have become degraded or lost via the process of agricultural intensification and which could, in places, be restored as part of the construction process.

4.273 However wind farms are also one of several types of vertical features which have been identified by the AONB Management Plan as having a potentially significant effect on skylines and summits which are sensitive to change. Prominent hills and iconic features of landscape and cultural importance within the AONB are often characterised by a general lack of visual intrusion from vertical features such as pylons and telecommunications towers and this does apply to the site and adjacent uplands. However, it is noted that these principles also apply to other existing and consented wind farms located around the edges of the AONB. Many parts of the uplands are relatively inaccessible which does not encourage tourists to prolong their visits or explore parts of the AONB aside from those which are easily accessible. Waymarked trails within the AONB are often poorly signed but this is not the case on this site where the Ulster Way is accessible and well signed and is therefore likely to attract relatively more visitors. However, the Development would pose no restriction to the continued use of the Ulster Way. Furthermore, research into the effects of wind farms on tourism revealed relatively high support and positivity towards renewable energy developments and found that the majority of tourists questioned would not be deterred from visiting a location because of the presence of a wind farm.

4.274 SPG guidance recommends that the creation of a cluster in this LCA may be appropriate but it also specifically advises against locating a wind farm in this particular part of the LCA which it describes as the northern finger of uplands and of utmost sensitivity because it provides the setting both for Glenarm and the coastal areas to the east. The Development would have a significant direct physical effect on the LCA within which it is located and it would also have indirect but significant effects on the setting of other LCAs and SCAs located within approximately 15 km because the upland plateau on which it is located forms a key character component of both the LCA within which it is located and also provides the setting for adjacent areas. Much of the landscape within 15 km is also located within the AONB boundary and landscape sensitivity is heightened by this fact. Furthermore, the coastline is particularly sensitive and the Development would be located at the southern end of the AONB on the first upland area that would be visible on approaches from Belfast both along the scenic coastal drive and inland approaches from Larne/ Carrick direction.

4.275 Existing and consented wind farms are typically located along the south western and western edges of the AONB and are more closely associated with the lowlands around the A26 road corridor in the same part of the Study Area. The cluster of wind farms at Gruig/ Altaveedan are not highly visible from within the AONB. Rathsherry/ Elginny Hill are more visible but with approximately 16 km of 'undeveloped' lowlands in between. Nevertheless, the Development is located near the outer edge of the AONB and therefore visibility from within the AONB as a whole is not widespread. There is also a consented wind farm at Ballykeel located within the AONB approximately 5.5 km to the south of the Development and there are single turbines located throughout the Study Area including 11 known turbines located within 5 km of the Development. Whilst the Development would be highly visible from many parts of the Study Area within 15km and visual effects where they occur are often significant, vertical man-made structures are already a typical landscape character element within the AONB as well as the wider Study Area.

4.276 The Development would arguably be more appropriate as a standalone feature in its proposed location than in close proximity to any of the existing clusters of wind farms along the western edge of the AONB because this would lead to greater encroachment of these clusters into the AONB and more significant cumulative effects. It is also noted that, across Northern Ireland, wind farms are not uncommon features around the outer edges of AONBs. On the contrary, this pattern of development is typical.

4.277 The Development would have significant landscape and visual effects in some instances. Whether or not this outweighs the ever increasing importance of addressing climate change through the production of reliable renewable energy is a judgement that is beyond the scope of this chapter but it is an issue that should be afforded significant weight in the decision-making process in the context that three councils across Northern Ireland have recently declared a climate change emergency. With this in mind, the Development's location on a site that is, in many respects suitable in terms of its landscape and visual character, despite its AONB status, is pertinent.

5

Archaeology & Cultural Heritage

5 Archaeology and Cultural Heritage

Introduction

5.1 This chapter of the ES assesses the likely significant effects of the Proposed Development in terms of Archaeology and Cultural Heritage, and incorporates an assessment of baseline conditions and potential effects provided by a Cultural Heritage Baseline Appraisal, which is included in Appendix 5.1. A number of heritage visualisations of the Proposed Development have also been produced to inform the assessment provided in the baseline assessment and in this chapter, and these are provided in Appendix 5.2.

5.2 These vary in scope from buried archaeological remains up to late 20th century industrial structures. Cultural heritage can be broadly divided into the following two categories:

Archaeology

- Scheduled Ancient Monuments (SAMs) (statutory); and
- Archaeological finds and site (non-statutory).

Built Heritage

- Conservation Areas (statutory);
- Listed Buildings (statutory);
- Registered Parks and Gardens
- Non-designated built heritage assets (non-statutory).
- Registered Historic Battlefields, Shipwrecks, World Heritage Sites and Locally Listed Buildings are not considered within this Chapter because there are no such designations within, or adjacent to the Application Site.

5.3 This Chapter describes the methods used to establish baseline conditions currently existing on the Application Site; the methodology used to determine potential effects and the mitigation measures required to prevent, reduce or offset (where possible) any significant adverse effects; and the likely residual effects after these measures have been implemented.

Scope of Assessment

Legislation and Policy Framework

Legislation

5.4 The Historic Monuments and Archaeological Objects (Northern Ireland) Order 1995 protects the fabric of Scheduled Monuments, but does not afford statutory protection to their settings. Relevant policies relating to the protection of the setting of scheduled monuments are contained within national and local development plans and are set out below.

5.5 The Planning (Northern Ireland) Order 1991 sets out provisions relevant to the protection of listed buildings and conservation areas and their setting. The following sections are relevant to the study site.

5.6 Section 45 states that:

"In considering whether to grant planning permission for development which affects a listed building or its setting, and in considering whether to grant listed building consent for any works, the Department shall have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses"

Regional Planning Policy

Planning Policy Statements (PPS)

5.7 In March 1999 the Planning Service (an agency within the Department of the Environment for Northern Ireland) published Planning Policy Statement 6 (PPS 6), 'Planning, Archaeology and the Built Heritage'.

5.8 Planning Policy Statements set out the policies of the DoE on particular aspects of land use planning and apply to the whole of Northern Ireland. Their contents will be taken into account in preparing development plans and are a material consideration in determining individual planning applications and appeals.

5.9 PPS 6 sets out the DoE's planning policies for the protection and conservation of archaeological remains and built heritage.

5.10 Section 3 of PPS 6 relates to archaeological sites and monuments and provides guidance for property owners, developers, their professional advisors and others on the preservation and investigation of archaeological remains.

5.11 The Department's relevant policies on this topic are set out below:

Policy BH1 – The preservation of archaeological remains of regional importance and their settings.

The department will operate a presumption in favour of the physical preservation in situ of archaeological remains of regional importance and their settings. These comprise monuments in state care, scheduled monuments and other important sites and monuments which would merit scheduling. Development which would adversely affect such sites of regional importance or the integrity of their settings will not be permitted unless there are exceptional circumstances.

Policy BH2 – The protection of archaeological remains of local importance and their settings.

Development proposals which would adversely affect archaeological sites or monuments which are of local importance or their settings will only be permitted where the department considers the importance of the proposed development or other material considerations outweigh the value of the remains in question.

Policy BH3 – Archaeological Assessment and Evaluation

Where the impact of a development proposal on important archaeological remains is unclear, or the relative importance of such remains is uncertain, the department will normally require developers to provide further information in the form of an archaeological assessment or an archaeological evaluation. Where such information is requested but not made available the department will normally refuse planning permission.

Policy BH4 – Archaeological Mitigation

Where it is decided to grant planning permission for development which will affect sites known to contain archaeological remains, the department will impose conditions to ensure that appropriate measures are taken for the identification and mitigation of the archaeological impacts of the development, including where appropriate the completion of a licensed excavation and recording of remains before development commences.

Policy BH6 - The Protection of Parks, Gardens and Demesnes of Special Historic Interest

The department will not normally permit development which would lead to the loss of, or cause harm to, the character, principal components or setting of parks, gardens and demesnes of special historic interest. Where planning permission is granted this will normally be conditional on the recording of any features of interest which will be lost before development commences.

Policy BH11 - Development Affecting the Setting of a Listed Building

The department will not normally permit development which would adversely affect the setting of a listed building. Development proposals will normally only be considered appropriate where all the following criteria are met:

- *The detailed design respects the listed building in terms of scale, height, massing and alignment;*
- *The works proposed make use of traditional or sympathetic building materials and techniques which respect those found on the building; and*
- *The nature of the use proposed respects the character of the setting of the building.*

5.12 PPS 6 also includes policy statements on Northern Ireland's World Heritage Sites. However, this topic is not relevant to the scope of this particular assessment.

5.13 Planning policy relating to renewable energy is set out in PPS 18: Renewable Energy. The relevant policies are presented below.

5.14 Policy RE 1: Renewable Energy Development states:

Development that generates energy from renewable resources will be permitted provided the proposal, and any associated buildings and infrastructure, will not result in an unacceptable adverse impact on:

[…]

(c) Biodiversity, nature conservation or built heritage interests;

[…]

Where any project is likely to result in unavoidable damage during its installation, operation or decommissioning, the application will need to indicate how this will be minimised and mitigated, including details of any proposed compensatory measures, such as a habitat management plan or the creation of a new habitat. This matter will need to be agreed before planning permission is granted.

The wider environmental, economic and social benefits of all proposals for renewable energy projects are material considerations that will be given significant weight in determining whether planning permission should be granted.

The publication best practice guidance to planning policy statement 18 'renewable energy' will be taken into account in assessing proposals.

Strategic Planning Policy Statement for Northern Ireland (SPPS)

5.15 The SPPS is a statement of the Department's policy on important planning matters that should be addressed across Northern Ireland (SPPS paragraph 1.3). Paragraph 1.5 of the SPPS notes that the provisions within the SPPS apply to the whole of Northern Ireland and must be taken into account in the preparation of Local Development Plans, and are also a material consideration in all planning applications and appeals.

5.16 All local councils in Northern Ireland are in the process of developing new local plans which conform with the SPPS. Once these are all completed and adopted, they, together with the SPPS, will replace the Planning Policy Statements, which will be cancelled (SPPS paragraph 1.9).

5.17 Paragraphs 1.10 to 1.12 of the SPPS set out that until the adoption of the new local plans by the eleven local councils in Northern Ireland, the existing adopted local plans and Planning Policy Statements will continue to apply alongside the SPPS. However, where a policy within an existing local plan or PPS conflicts with that set out in the SPPS, the policy in the SPPS Should be accorded greater weight in the decision making process (SPPS paragraph 1.12).

5.18 SPPS policy in relation to archaeology and built heritage is set out in paragraphs 6.1 to 6.30 of the SPPS. It sets out the aim of the SPPS in relation to archaeology and built heritage in paragraph 6.3:

"The planning system has a key role in the stewardship of our archaeological and built heritage. The aim of the SPPS in relation to Archaeology and Built Heritage is to manage change in positive ways so as to safeguard that which society regards as significant whilst facilitating development that will contribute to the ongoing preservation, conservation and enhancement of these assets."

5.19 Paragraph 6.4 sets out the regional strategic objectives for archaeology and built heritage as to:

- *secure the protection, conservation and, where possible, the enhancement of our built and archaeological heritage;*

- *promote sustainable development and environmental stewardship with regard to our built and archaeological heritage; and*
- *deliver economic and community benefit through conservation that facilitates productive use of built heritage assets and opportunities for investment, whilst safeguarding their historic or architectural integrity.*

5.20 The SPPS goes on to set out policy in relation to the determination of planning applications in relation to different types of archaeological and built heritage assets in paragraphs 6.6 through 6.25. Key elements of the policies set out in this section are reproduced below for ease of reference:

World Heritage Sites

6.6 Development that would adversely affect the Outstanding Universal Value of a World Heritage Site (WHS) or the integrity of its setting must not be permitted unless there are overriding exceptional circumstances.

Archaeology

6.8 Archaeological remains of regional importance include monuments in State Care, scheduled monuments and Areas of Significant Archaeological Interest (ASAIs). Such sites (or constituent parts of them) benefit from statutory protection. Development which would adversely affect such sites or the integrity of their settings must only be permitted in exceptional circumstances. The scheduling programme is an ongoing process and there are archaeological remains of regional importance yet to be scheduled. In order to make sure that the most up to date information is taken into account when determining applications, this policy approach should also apply to such sites which, whilst not scheduled presently, would otherwise merit such statutory protection.

6.9 Development proposals which would adversely affect archaeological remains of local importance or their settings should only be permitted where the planning authority considers that the need for the proposed development or other material considerations outweigh the value of the remains and/or their settings.

6.10 Planning authorities should seek all necessary information from applicants in making well informed planning judgements, particularly where the impact of a development proposal on archaeological remains is unclear, or the relative significance of such remains is uncertain. Should an applicant fail to provide a suitable assessment or evaluation on request, the planning authority should adopt a precautionary approach and refuse planning permission.

6.11 Where a planning authority is minded to grant planning permission for development which will affect sites known or likely to contain archaeological remains, it should ensure that appropriate measures are taken for the identification and mitigation of the archaeological impacts of the development. Where appropriate, this may involve the preservation of remains in situ, or a licensed excavation, recording examination and archiving of the archaeology by way of planning conditions.

Listed Buildings

6.12 Listed Buildings of special architectural or historic interest are key elements of our built heritage and are often important for their intrinsic value and for their contribution to the character and quality of settlements and the countryside. It is important therefore that development proposals impacting upon such buildings and their settings are assessed, paying due regard to these considerations, as well as the rarity of the type of structure and any features of special architectural or historic interest which it possesses.

6.13 Development involving a change of use and / or works of extension / alteration may be permitted, particularly where this will secure the ongoing viability and upkeep of the building. It is important that such development respects the essential character and architectural or historic interest of the building and its setting, and that features of special interest remain intact and unimpaired. Proposals should be based on a clear understanding of the importance of the building/place/heritage asset, and should support the best viable use that is compatible with the fabric, setting and character of the building. Applicants should justify their proposals, and show why alteration or demolition of a listed building is desirable or necessary.

Historic Parks, Gardens and Demesnes

6.16 Planning permission should not be granted for development that would lead to the loss of, or cause harm to, the overall character, principal components or setting of Historic Parks, Gardens and Demesnes.

Conservation Areas

6.18 In managing development within a designated Conservation Area the guiding principle is to afford special regard to the desirability of enhancing its character or appearance where an opportunity to do so exists, or to preserve its character or appearance where an opportunity to enhance does not arise. Accordingly, there will be a general presumption against the grant of planning permission for development or conservation area consent for demolition of unlisted buildings, where proposals would conflict with this principle. This general presumption should only be relaxed in exceptional circumstances where it is considered to be outweighed by other material considerations grounded in the public interest. In the interests of protecting the setting of designated Conservation Areas, new development in proximity needs to be carefully managed so as to ensure it respects its overall character and appearance. Important views in and out of the Conservation Area should be retained.

Areas of Townscape Character (ATC)

6.21 In managing development within ATCs designated through the LDPs process, the council should only permit new development where this will maintain or enhance the overall character of the area and respect its built form.

Non-Designated Heritage Assets

6.24 The effect of an application on the significance of a non-designated heritage asset such as an unlisted vernacular building, or historic building of local importance should be taken into account in determining the application. In weighing applications that affect directly or indirectly non-designated heritage assets, a balanced judgement will be required having regard to the scale of any harm or loss and the significance of the heritage asset. Councils may wish to bring forward bespoke local policies for such buildings.

Enabling Development

6.25 Enabling Development is a development proposal that is contrary to established planning policy and in its own right would not be permitted. Such a proposal may however be allowed where it will secure the long term future of a significant place and will not materially harm its heritage value or setting. Enabling development typically seeks to subsidise the cost of maintenance, major repair, conversion to the optimum viable use of a significant place where this is greater than its value to its owner or market value.

5.21 The SPPS also provides policy in relation to renewable energy developments in paragraphs 6.214 through 6.234. Paragraph 6.224 makes specific reference to how effects of renewable energy developments to the historic environment should be weighed (emphasis added for clarity):

6.224 Development that generates energy from renewable resources will be permitted where the proposal and any associated buildings and infrastructure, will not result in an <u>unacceptable adverse impact</u> on the following planning considerations:

- *public safety, human health, or residential amenity;*
- *visual amenity and landscape character;*
- *biodiversity, nature conservation or <u>built heritage interests</u>;*
- *local natural resources, such as air quality, water quality or quantity; and,*
- *public access to the countryside.*

Local Planning Policy

5.22 Local planning policy is provided by the Larne Area Plan 2010, until the adoption of the emerging Local Development Plan to 2030. The 2010 plan contains the following policy relating to archaeology and cultural heritage:

Policy MAN EN1

The department will protect areas of significant archaeological interest from inappropriate development.

The designation of the overall setting in which a number of individual and related monuments are located, or an area of historic landscape, as an Area of Significant Archaeological Interest, is intended to protect the individual sites or monuments and their setting from inappropriate development. An upland area containing a number of prehistoric and later archaeological sites and monuments in the *townlands of Dunteige, Ballycoos, Drains Bog, Linford, Loughduff, Sallagh and Ballyhackett and known as Knockdhu, is designated as an Area of Significant Archaeological Interest. (map 1)*

Policy MAN EN2

The Department will protect sites and the settings of monuments in state care or which may be taken into state care. Proposals for development in the vicinity of these monuments which would be likely to have an adverse effect on the sites or their settings will not be permitted. Particular attention will be paid to the impact of the proposal on:-

1. *the area of historic landscape in which the site or monument functioned*
2. *critical views of and from the site or monument*
3. *the access and public approaches to the site or monument*
4. *the understanding and enjoyment of the site or monument by visitors.*

Larne Borough has at present two monuments in state care, Olderfleet Castle on Curran Point, Larne, the remains of a tower house and Ballylumford Dolmen, a portal tomb.

Policy MAN EN4

The Department will protect the following historic parks, gardens and demesnes in Larne Borough:-

Garron Point, Glenarm Castle, Carnfunnock, Drumalis, Magheramorne, Red Hall, Kilwaughter.

Country Houses set in landscaped parkland or within demesnes are an important part of the landscape in Larne Borough. The Department has identified a number of these parks, gardens and demesnes which are considered to represent a significant historic and landscape resource.

Other parks, gardens and demesnes retain only some elements of their original form. In the event of development being approved within these, the co-operation of developers in arranging the evaluation and recording of particular features or landscaped areas may be sought, so that knowledge of this part of our landscape heritage is not lost.

Consultation

5.23 Consultations were held with the Northern Ireland Environment Agency in order to agree the scope of the assessment work, and also the key elements of the historic environment that would require consideration. The liaison comprised:

- Email correspondence to agree the area around the application site that should be examined for potential indirect impacts; agreed to be 5km.
- A site meeting and walkover in August 2019, to review the application site, visit key monuments, and discuss approach and key views.

- Following on from the site meeting, a number of key heritage viewpoints were agreed, which required visualisation, in addition to the visualisations being produced for the LVIA. These have been produced and formed part of the baseline for the assessment of potential effects to the historic environment in this chapter.

Assessment Methodology

Methodology for assessment of archaeological potential

5.24 The archaeological potential of the application site has been assessed with reference to:

- Map regression based on Ordnance Survey maps and tithe/enclosure maps and apportionments;
- Examination of material currently held in the Historic Environment Record of Northern Ireland (HERoNI), for the study site and for a 2km search radius from the study site boundary;
- Consultation of the schedule of ancient monuments and lists of listed buildings and other designated heritage assets held by the Historic Environment Division of the Department for Communities of Northern Ireland;
- Available aerial photography
- Site inspection; and
- The results of previous archaeological surveys and investigations where available and relevant.

Methodology for assessment of setting

5.25 This assessment will consider the potential effects of development within the study site on the significance of heritage assets, through effects to their settings. This will include any heritage assets within the study site, and those in the surrounding area, whose setting may be affected.

5.26 Heritage assets and potential impacts will be assessed using best practice, including that set out in the HED’s Guidance on Setting and the Historic Environment (2018 HED). This defines setting as:

5.27 *The term ‘setting’ applies to the physical space that is part of – and contributes to – the significance and distinctive character of a heritage asset, and through which the asset may be seen, experienced, understood and enjoyed.*

5.28 The guidance goes on to set out a three stage process for the assessment of the setting of heritage assets, and of development impacts to the significance of heritage assets through changes to their setting:

- Stage 1: identify the heritage assets that might be affected.

- Stage 2: define the setting by establishing how the surroundings contribute to the significance of the heritage assets in the ways they are understood, appreciated and experienced.
- Stage 3: assess how any change would impact upon that setting.

5.29 As part of stage 1, set out above, the heritage assets which require assessment have been selected with reference to the heritage data for the study site and surrounding area provided by the HED and held by the Northern Ireland Environment Agency. A basic search radius of 5km from the study site boundary was used to establish which heritage assets required assessment for impacts, which is usually sufficient to ensure all assets which require consideration are properly assessed.

5.30 Section 5 of this assessment will describe the heritage assets which may be affected by the proposed development and will assess the relationship of the study site to those assets.

5.31 Not all designated heritage assets within this radius will require full assessment for impacts; where a designated heritage asset has been excluded, a clear justification will be provided, for example if the asset is sufficiently far, and well screened from the study site. Also, not all assets will require the same level of assessment; more complex and/or significant assets which may be subject to a higher level of impact will require more detailed consideration than those of less significance, or which are not highly affected by the proposed development.

Methodology for the assessment of impacts

5.32 The assessment of the overall impact of the proposed wind farm on the significance of heritage assets is evaluated by taking into account both the heritage significance of the heritage asset and the magnitude of the predicted effect on that significance. As is set out in policy in relation to the determination of renewable energy developments with regard to effects to heritage assets (SPPS paragraph 6.224 and PPS 18 policy RE1; see section 3 below for details), it is important to understand whether a development would result in an unacceptable adverse impact on the significance of built heritage interests. To understand whether an effect to a heritage asset is unacceptable, it is necessary to understand the degree of effect a development would have on the significance of a heritage asset, as well as of the level of importance of the heritage asset in question.

Significance of heritage assets

5.33 The importance or value of cultural heritage resources is set out in Table 5.1 below, in order to inform this process.

Table 5.1: Criteria for appraisal of level of importance of heritage assets

Importance / value	Description
Very High	World Heritage Sites
High	Scheduled Monuments and archaeological sites of demonstrable schedulable quality & importance;

Table 5.1: Criteria for appraisal of level of importance of heritage assets	
Importance / value	Description
	Protected Wreck Sites Listed buildings graded A and B+ Designated registered parks and gardens Registered Historic Landscapes of high interest Conservation Areas
Medium	Local Authority designated sites and their settings; Listed buildings graded B; Undesignated sites of demonstrable regional importance
Low	Sites with specific and substantial importance to local interest groups; Sites whose importance is limited by poor preservation and poor survival of contextual associations.
No importance	Sites with no surviving archaeological or historical component.

Assessment of effects

5.34 To ensure the planning balance is appropriately informed, as required by the planning policy discussed in paragraph 5.20 and 5.215.32, where an adverse effect is identified, it will be categorised as either Major Adverse, Moderate Adverse, Minor Adverse or Slight Adverse. Where effects would not be adverse these will be categorised as either Negligible or as resulting in no change. This spectrum of effects is summarised in Table 5.2, below, along with brief descriptions of the terms used.

5.35 Assessments of the level of effect on the significance of heritage assets is based upon the extent to which factors that contribute to the significance of the assets would be affected by the proposed development. This process is not quantitative but relies upon professional judgement at each step. However, the factors considered in informing these judgments and in arriving at the various rankings of value and magnitudes of impacts are observable facts (i.e. numbers of assets, spatial relationships, designations, impacts).

Table 5.2: Criteria for appraisal of degree of adverse effect on heritage assets	
Level of effect	Description
Major Adverse	Total or substantial loss of the significance of a heritage asset. Harm to a heritage asset through effects to its setting, such that the significance of the asset would be totally lost or substantially reduced (e.g. the significance of a designated heritage asset would be reduced to such a degree that its designation would be questionable; the significance of an undesignated heritage asset would be reduced to such a degree that its categorisation as a heritage asset would be questionable).

Table 5.2: Criteria for appraisal of degree of adverse effect on heritage assets

Level of effect	Description
Moderate Adverse	Moderate harm to a heritage asset, such that the asset's significance would be materially affected/considerably devalued, but not totally or substantially lost.
Minor Adverse	Low level of harm to the significance of a heritage asset. This could include the removal of fabric that forms part of the heritage asset, but that is not integral to its significance (e.g. the demolition of later extensions/additions of little intrinsic value). Some harm to the heritage asset's setting, but not to the degree that would result in a meaningful devaluation of its significance.
Slight Adverse	A slight effect to the significance of a heritage asset. An example would be limited disturbance of an archaeological asset, but which does not actually damage the archaeological interest of the asset in any way. A limited degree of effect through changes to setting, but the degree of effect would not be readily discernible, or meaningfully affect appreciation.
Negligible	A change to a heritage asset or its setting that involves no loss of significance or any harm.
No Impact	No change to a heritage asset or its setting.

Zone of Theoretical Visibility

5.36 This assessment has been informed by a model Zone of Theoretical Visibility (ZTV) for the surrounding area. The site visit confirmed that the ZTV model produced for the study site represents a reasonable representation of potential intervisibility, with several areas indicated as tentatively intervisible, which in practice were well screened.

Photos

5.37 A Landscape and Visual Impact Assessment (LVIA) has also been produced for the study site, in conjunction with this assessment. Any viewpoints taken as part of the LVIA used to illustrate effects within this assessment are cross referenced using the same viewpoint numbers as in the LVIA.

5.38 A series of Heritage View Points (HVPs) have also been produced, to provide additional input to the views provided in the LVIA. The HVPs have been agreed with the NIEA during the consultation process and are numbers HVP1 through HVP6. The HVPs are provided under a separate cover in Appendix 5.2, and should be read in conjunction with this assessment.

Understanding the significance of adverse effects

5.39 Due to the higher protection provided to heritage assets of higher importance, the significance of an adverse effect to the planning balance will vary depending on the importance of the asset in question (as defined in Table 5.1, above), as well as the level of adverse effect identified (as defined in Table 5.2). Table 5.3, below, takes into account these two factors to define the significance of any identified adverse effect.

Table 5.3: Criteria for determining significance of effect

Level of Importance (Table 1)	Degree of adverse effect (Table 2)				
	Major	Moderate	Minor	Slight	Negligible
Very High	Very Large	Large	Moderate / Large	Minor	Negligible
High	Large	Moderate / Large	Moderate/ Minor	Minor	Negligible
Medium	Moderate / Large	Moderate/ Minor	Minor	Slight	Negligible
Low	Moderate/ Minor	Minor	Slight	Negligible	Negligible

5.40 The categories of significance of effect defined in Table 3, above, have been devised with reference to best practice as set out in ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties (ICOMOS 2011) as well as the Design Manual for Roads and Bridges volume 11 (Standards for Highways).

5.41 The categories of significance of effect are not meant to be proscriptive, but are rather meant to allow the professional judgement of the assessor to be articulated clearly and consistently across different types of effects to heritage assets of varying nature, quality and significance, allowing for nuance where necessary. In recognition of this, where there are two options within a category of significance of effect, the assessor will provide evidence for one or the other of the options. For example, if an asset of high importance is subject to a moderate degree of adverse effect, the significance of that effect may be Moderate or Large, depending on the nature of the effect and of the asset in question. Ultimately, the most appropriate categorisation of the significance of effect must be chosen, using professional judgement which is informed by a thorough understanding of the significance of the heritage asset and the nature of the effect.

5.42 Where the significance of effect is assessed as being Moderate or higher, this is considered to be a significant effect as referred to in the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017.

Baseline Assessment

Introduction

5.43 This chapter is informed by a Cultural Heritage Baseline Assessment (CHBA), which considered the potential effects the Proposed Development would have on the historic environment. It considered both indirect effects, which would result from changes to the setting of heritage assets in the wider area, as well as potential direct physical impacts on buried archaeological remains. The CHBA is provided as an appendix to this chapter, in Appendix 5.1.

5.44 The assessment of potential indirect effects provided in the CHBA comprised a comprehensive assessment of the potential indirect impacts the proposed development could have on the significance of designated heritage assets in the wider area due to changes to their settings. The baseline assessment comprised a staged assessment process, consisting of a detailed consideration of 156 designated built and archaeological heritage assets in the wider area around the application site, followed by the detailed assessment of 55 designated heritage assets, which are provided in Appendix 1 of the CHBA (see Appendix 5.1). This process has found that in most cases, the degree of effect which would result from the proposed development would be no more than slight, and in all but two, no more than minor adverse. The assessment of indirect effects was informed by a site visit and walkover, visualisations of the proposed development within the LVIA (see Chapter 4), as well as additional visualisations produced to inform the assessment of heritage impacts, which are provided in Appendix 5.2. The LVIA visualisations are referenced by viewpoint (VP) number. Likewise, the visualisations produced for heritage assessment are referenced by heritage viewpoint (HVP) number.

5.45 The assessment of designated heritage assets provided in the CHBA highlighted a number of assets that required more detailed assessment due either to their proximity to the proposed development, their sensitivity, or the complexity of the issues surrounding their assessment which meant that they would benefit from fuller assessment. A total of eight such assets were identified, as follows:

- ANT 029:019 – Giant’s Tomb scheduled monument
- ANT 030:004 – Standing Stone scheduled monument
- ANT 035:002 – Giant’s Grave scheduled monument
- ANT 035:005 – Knockdhu Fort
- ANT 035:053 – Cairn on Scawt Hill
- Knockdhu Area of Significant Archaeological Interest (ASAI)
- HB06/02/084 – RC Feystown Church
- AN/033 – Glenarm Registered Park

5.46 The CHBA recommended that all of these heritage assets should be considered in detail in the EIA. Therefore, these assets are described in detail below, together with the effects the Proposed Development would have on their significance. The potential for indirect effects to the remaining heritage assets in the wider study, which could result from the Proposed Development, was considered in detail in the CHBA. It was concluded that the Proposed Development would have no more than a slight effect on the remaining heritage assets in the wider area, which would not comprise significant environmental effects. As such, it is not necessary to consider these effects in detail within this chapter. However, the CHBA is provided in

Appendix 5.1, where detailed assessments of all the remaining heritage assets can be found if needed.

5.47 The CHBA also considered the potential for the Proposed Development to result in direct physical impacts to buried archaeological remains. A summary of the potential for buried archaeological remains within the application site is provided below, and the potential effects of the proposed development are also considered below.

Cultural Heritage Baseline

ANT 029:019 – Giant's Grave scheduled monument

5.48 The Giant's Grave wedge tomb is situated approximately 1km to the west of the nearest proposed turbine, and is situated in a small field under pasture. The tomb is well-preserved, with complete sides of orthostats making up the outer wall. The tomb is oriented SW to NE, with the entrance at the southern end. Despite its preservation, the tomb is not readily appreciated from the wider area, as it is overgrown, and affected by some partial collapse (see plate 5.1, below).

Plate 5.1 – Looking east towards tomb (ANT: 029:019) from Feystown Road

5.49 However, at close range the tomb is readily discernible, including appreciation of its archaeological preservation (see plate 5.2, below). The tomb measures approximately 9.5 m long and 6.5 m wide at the southern end and 3.5 m wide at the northern end. It is well preserved, with a number of stones still standing and in situ. It may date to the Neolithic period, but excavations in 1870 found Bronze Age pottery, indicating that the site has been used over a long period. The tomb is situated in a small enclosed field, surrounded by hedges to the east, north and south, and farm buildings to the east, which comprises the immediate setting of the tomb. The extant hedges make the monument difficult to experience from the wider area, although it can be seen from the Feystown Road to the west, albeit not in any detail (see plate 5.1 above). More widely it is situated in a landscape which contains a number of archaeological remains with which it has a contextual relationship.

Plate 5.2 – Looking SW towards tomb (ANT 029:019)

5.50 The tomb is of High importance (as defined in Table 5.1), and as is evidenced by its designation. The importance of the tomb is primarily derived from the preservation of important archaeological remains within the scheduled monument, and the immediately surrounding area, which will contain a number of finds of archaeological interest and high research value. The preservation of the tomb also allows appreciation, at close quarters, of the original orientation of the tomb, and appreciation of the entrance at the southern end, which the tomb would have been designed to draw attention to. As such the immediate setting of the tomb contributes to its significance by providing this appreciation of its archaeological interest, and also the on-going preservation of the monument. The contextual relationship the tomb has with other monuments in the wider area is also contributes to its importance, as this has the potential to provide important insights into human activity in the early prehistoric period, although this can be difficult to appreciate on a purely visual basis. The visual relationship of the monument with the wider setting is of lesser importance, when compared to the more core aspects of its importance.

ANT: 030:004 – Standing Stone scheduled monument

5.51 The standing stone is mushroom-shaped, made of basalt, and measures 1.67m high by 0.8m wide and 0.9m thick. It is very weathered and stands in a circular depression containing exposed bedrock, which has been created by sheep rubbing against the stone. The shape of the stone suggests that it has not been formed by natural processes. It is located 200m from the nearest proposed turbine.

5.52 The standing stone is likely to be a remnant of the prehistoric landscape, and served as a marker for routes, meetings and/or funerary activity. Such features can also contain evidence of ritual activity. The stone is situated on the Ulster Way footpath, which provides a strong appreciation of its function as a roadside marker over the centuries. There are also commanding views to the east towards the sea and Ballygally, highlighting the stone’s function as a marker. The significance of the stone is primarily derived from its archaeological and historic interest, which is best appreciated along the Ulster Way, in which its preservation and function can be appreciated and understood.

ANT 035:002 – Giant’s Grave scheduled monument

5.53 The Giant’s Grave is located on a small eminence on a west facing slope approximately 1.1km to the west of the nearest proposed turbine. The wedge tomb is orientated SW to NE, and has an antechamber situated at the entrance at the south-western end of the grave (see plate 5.3, below), with outer walling also surviving, most notably on the northern side of the tomb (see plate 5.4, below). Therefore while the grave was clearly designed to look out towards the falling topography towards the west, the approach from the west towards the entrance is also important to understanding and appreciating the heritage interest of the tomb.

5.54 The tomb’s significance is primarily derived from its archaeological and architectural interest, both of which preserve additional evidence of high research value. The setting of the tomb also contributes to its significance, by providing an appreciation of the archaeological, architectural and historic interest of the tomb. The immediate vicinity of the tomb provides the best appreciation of this interest, which is difficult to discern from further afield in the surrounding area. The views from the tomb to the west provide appreciation of the deliberate topographic positioning of the tomb to take in a prominent prospect across a valley, while views along the alignment of the tomb to the east provide appreciation of the function and design of the tomb, reflected by the entrance.

Plate 5.3 – Looking ENE along alignment of wedge tomb ANT 035:002

Plate 5.4 – Looking S at northern outer walling of wedge tomb ANT 035:002

ANT 035:005 – Knockdhu Fort

5.55 Knockdhu Fort comprises a promontory fort on protruding tongue of an east facing scarp of the Antrim plateau. The key surviving earthwork on the fort is a triple rampart along the western boundary of the fort, which effectively cuts off the promontory, and uses the natural topography to provide a defensive fort (see plate 5.5, below). There are a number of other, more subtle features present, which are not as readily discernible, and aerial photographic and lidar analysis of the fort has revealed a number of additional hut circles within the fort, highlighting the potential for the fort to contain additional archaeological evidence of high research value (McNeary 2014). The fort is located 2.2km south from the southernmost proposed turbine.

Plate 5.5 – Looking east towards triple rampart which forms the western boundary of Knockdhu Fort (ANT 035:005)

5.56 It has been speculated that the fort had both defensive as well as trade based functions. Its exposed position makes it unlikely to have been a place of permanent settlement, and it is rather more likely to have been used as a refuge in times of unrest and a regular marketplace at other times, given local evidence of prehistoric holloways and mining activity in the vicinity (Hodges 1975). The significance of the fort is primarily derived from its archaeological interest, as well as historic interest as a key feature in the locality for many centuries.

5.57 The best experience of the archaeological interest of the fort is close to the western boundary, near to the triple ramparts, which are well-preserved and readily appreciated at close range. The Ulster Way provides a good dynamic experience of this feature, and as such is an important part of its setting. The ramparts also allow appreciation of the fact that the fort took advantage of a natural promontory.

5.58 Views from within the fort provide a clear understanding of its strategic positioning and defensive capabilities, evidenced by the commanding views provided across the wider landscape, with views far along the coast and out to sea. This strategic vantage point can still be appreciated clearly today (see plate 5.5).

5.59 Views of the fort from the wider area primarily provide views of the promontory as a topographic feature, although it is possible to see the ramparts, for example from the Ulster Way on Ballycoos Hill looking south. This reinforces understanding of the prominence of the fort and its central role in local life over millennia (see plate 5.6).

Plate 5.6 – Looking south along the Ulster Way towards Knockdhu in the distance; on a clear day the ramparts are just visible even at a distance

ANT 035:053 - Cairn on Scawt Hill

5.60 This cairn is situated approximately 0.45 km to the east of the nearest proposed turbine, atop of Scawt Hill, along the Ulster Way, which affords commanding views to the north, east and west and of the Irish Sea. It comprises a low, flat-topped, grassy round cairn, measuring approximately 17m in diameter and 0.8m in height. Its position at the summit of Scawt Hill is prominent and provides commanding and wide views across a varied landscape (see plate 5.7).

Plate 5.7 – Looking SSE towards cairn (ANT 035:053) with Knockdhu promontory in background

5.61 The cairn is of High importance (as defined in Table 5.1), as is evidenced by its designation. The importance of the cairn is primarily derived from the preservation of important archaeological remains within the monument, which will contain a number of finds of archaeological interest, including possible information of burial and ritual traditions. The prominent setting of the cairn, atop of Scawt Hill, is also a notable aspect of its importance, as is its contextual relationship with the other cairns to the north and south. This has the potential to provide notable insights into human activity in the early Prehistoric period, although this can be difficult to appreciate on a purely visual basis.

5.62 The immediate setting of the cairn is experienced via the Ulster Way, a footpath which runs adjacent to the cairn, and then on northwards along the high ridge. There are a number of views of the cairn from the wider area, including from other parts of the Ulster Way, and from Knockdhu Fort from the south, however it can be difficult to pinpoint this monument among natural topography from a distance. More widely it is situated in a landscape which contains a number of archaeological remains with which it has a contextual relationship, including other recorded cairns to the south within the Knockdhu ASAI (such as the scheduled cairn: ANT 035:003) and to the north (ANT 030:005).

5.63 The cairn is set just to the east of the summit of Scawt Hill, which provides commanding views to the east, overlooking the Irish Sea. This position provides a commanding prospect from the cairn, but also makes the cairn a prominent feature in the local landscape, which is visible from various points along the Ulster Way and elsewhere.

5.64 The archaeological interest of the cairn is best appreciated in the near vicinity, where its form and surviving stone elements can be seen. The more distant views also make an important contribution by providing an appreciation of the prominence of the cairn, which would have been a key motivation for its placement at this location.

Knockdhu Area of Significant Archaeological Interest (ASAI)

5.65 The Knockdhu ASAI is a designation covering a sizable area (approximately 650 ha), situated approximately 200 m to the south of the nearest proposed turbine. The ASAI is centred on a valley, the alignment of which runs close to the route of the Feystown Road, which runs roughly east-west through the centre of the ASAI, before turning north and forming the western boundary. The ASAI is dominated by the prominent hills in the east of the area, in particular the promontory hill of Knockdhu in the south-eastern part of the ASAI.

5.66 The ASAI contains a rich archaeological resource, representing human activity within the area for several thousand years. The remains include nine scheduled monuments (these can be seen in Figures 2 and 3):

- 035:030 – Megalith
- 035:001 – Cross-incised boulder: Penal Altar
- 035:002 – Wedge Tomb: Giant’s Grave
- 035:061 – Flint Quarry
- 035:031 – Standing Stone
- 035:003 – Round Cairn
- 035:004 – Earthworks
- 035:035 – Souterrain
- 035:005 – Promontory Fort: Knockdhu

5.67 In addition, a scheduled multi-period settlement is situated adjacent to the western boundary of the ASAI (034:054), which comprises a 17th century settlement overlaying a Neolithic settlement, with evidence of Bronze Age and other activity as well. Also, the ASAI contains many other undesignated archaeological remains which also add to its archaeological interest. Of particular significance is the preservation of a diverse range of elements noting early activity. These encompass settlement sites, ritual/burial sites and industrial and mining within the area. The date range spans from the Neolithic to the Post-Medieval periods. There is an absence of any significant modern disturbance and, as such, the ASAI will contain many important remains which can cast light on how land use and technology evolved over time and which have high research value.

5.68 The setting and experience of the ASAI is largely confined to area designated within the ASAI, which is designed to include many features and their environs. Within the ASAI a number of features are visible and a key means of experiencing these is from the car park, which provides key views of the Knock Dhu Fort and the Irish Sea, and from the Ulster Way, which allows a good prospect of the Fort's ramparts in the south of the ASAI and runs past a number of features, including the scheduled earthworks and cairn in the centre of the ASAI, before climbing up the hills and moving north along the ridge. The ASAI is more difficult to experience from further afield, as the features it contains mostly comprise earthworks and megaliths which are difficult to pinpoint from a distance. The exception to this is the Knock Dhu Fort, which is topographically very prominent with many views afforded from the east, although a good view of the ramparts is mostly limited to those from the Ulster Way, looking eastwards from the west.

5.69 The ASAI is considered to be of High importance (as defined in Table 1), due to the number of highly graded archaeological monuments contained within the area. The importance of the ASAI is primarily derived from the significant archaeological remains it preserves. This includes the important group value these remains have, as a group of diverse features which provide evidence of early activity and have a high level of archaeological interest. The ASAI and the features therein also have a contextual relationship with many other archaeological features in the wider area, such as the Wedge Tomb to the northwest of the application site (ANT 029:019), and the cairn and standing stone to the north of the ASAI (ANT 035:053 and ANT 030:004 respectively). Views within the ASAI are also of importance, in particular in allowing appreciation of the Knock Dhu Fort's ramparts as well as its strategic position along the coast. Key views in this regard are from the small car park in the centre of the ASAI, as well as views towards the fort along the Ulster Way, and from the fort to the surrounding area.

HB06/02/084 – RC Feystown Church

5.70 St Patrick's Church, Feystown is a relatively simple and modest undecorated single-storey structure, which is common to many Irish Catholic churches set in a rural context. The church is positioned at the south end of an informal row of five buildings on the east side of Feystown Road. These comprise, from south to north, three residential chalet bungalows, a two-storey former school building and a two-storey house. The church's long axis is aligned north-south, parallel with Feystown Road and is finished in a white-painted render with a dark slate-cladded roof.

5.71 The Northern Ireland Buildings Database records St Patrick's Church (HB06/02/084) as being statutorily designated at B2 on 10th May 2005. The extent of the designation comprises the Church, gates, gate piers and walling.

5.72 St Patrick's Church was built in 1828. The chancel and vestry extension was added in 1878, the graveyard wall was built following the graveyard's extension in 1910. The porch was constructed in 1918 and rebuilt in 1920. Major renovation works were carried out 1961-2. These included new windows, doors, floors and the addition of a bellcote at the north end of the roof apex.

5.73 The listing description provides the following description of the church:

"Small, plain, single storey gabled and stuccoed R.C. church of 1828, with vestry projection and chancel of 1878 and porch of c.1920. The church (…) is surrounded by a graveyard. (…) To the N gable of the church there is a small gabled entrance porch. To both the E and W faces of the porch there is a panelled timber double door. To the gable of the porch there is a pointed arch window with relatively modern looking stained glass. The porch has a slated roof with parapet. The main N gable of the church has a high-level roundel window, also with stained glass. The W elevation of the main body of the church has five pointed arch windows with glazing as before and label moulding with decorative stops. To the far right the façade is recessed (this is actually the W face of the chancel). (…) To the far left there is a gabled vestry projection, [which] (…) has a rendered chimneystack and slated roof, the roof of the lean-to is slated also. (…) High on the S gable there is a large three-quarter statue of St Patrick as a young man by Angela, Lady Antrim [added in 1971]. The statue faces in the direction of Slemish Mountain where Patrick is believed to have worked as a shepherd whilst in captivity. (…) The entire façade is rendered and painted (white, with black at plinth level). The main roof is slated and has parapets. To the N parapet there is a bellcote with slated hipped roof and metal cross finial. (…) The surrounding graveyard contains headstones dating back to 1829. The graveyard is bounded by a low, partly harled, partly exposed rubble wall. To the W (to the roadside) is the main gateway with simple round, conical capped pillars and wrought iron gates. The gates, which have simple, slightly crude, spearhead decoration, are now in poor condition".

5.74 The church has architectural and historic interest, as well as artistic interest from the ornamentation provided within the church and in some elements of the exterior. The church is designated at Grade B2, described by Annex C of PPS 6 as buildings of local interest which are designated on the basis of a relatively narrow range of criteria. However, to reflect the statutory protection all listed buildings receive, the building is considered to be of medium importance, as defined in Table 5.1.

5.75 The setting of the church comprises three key elements. Firstly, the graveyard adjacent to the church; secondly, the experience of the church on a short stretch of the approach along the Feystown Road, and thirdly the experience of the church from the wider area.

5.76 The graveyard provides a strong appreciation of the church's architectural interest, as well as of its communal value and of the wider rural landscape setting of the church (see plate 5.8, below).

5.77 The roadside setting provides appreciation of the church's local prominence and of its contextual relationship with nearby small settlements from which it derives parishioners. The wider setting provides a limited appreciation of the buildings architectural and historic interest, as it is of modest scale, and the prominence the church enjoys is quite localised as a result of its scale.

Plate 5.8 – Looking SSE towards Feystown Church from graveyard

AN/033 – Glenarm Registered Park

5.78 Glenarm Registered Park is located an average of 2km to the west of the proposed turbines, except for the northern end of the park, which extends to Glenarm, 4.2km to the northwest of the study site (see Figure 2). The Register of Parks, Gardens and Demesne of Special Historic Interest in Northern Ireland provides an extensive description of the park, selected elements of which are provided below for ease of reference:

A remarkable demesne, noted for its great beauty and large extent, occupies much of the lower reaches of the picturesque valley of the Glenarm River, extending some five miles from the sea and about half a mile wide. The original castle, built by the Bysets in the 13th century, was broken down in 1597 and a new castle (HB 7/2/1) was begun by Sir Randal 'Arranach' MacDonnell, later 1st Earl of Antrim, from c.1603 on the opposite bank of the river, away from the village. The building was enlarged into a double pile house in 1636, but in 1642 'Lord Antrim's pleasant house' was destroyed by invading Scots armies. It remained a gutted ruin for over a century, but the demesne continued to be used by the family, particularly during the hunting season. Around the 1660s Alexander, later the 3rd Earl of Antrim, added a wing to the ruined house to accommodate the family, while at this period created two enclosed deer parks, namely the Small Deer Park and the Grand Deer Park, the latter occupying much of the present demesne and large enough to accommodate deer hunting.

[…]

In 1750 Ballymagarry was burnt 'by the carelessness of servants' and the fifth Earl resolved to move to Glenarm. An engineer from Cumbria, Christopher Myers, was engaged to rebuild the house, the old walls of which were 'entire and for the most part sound' in 1740. The house was refashioned in 1756 with a fusion of Baroque and Palladian styles, its front fenestration being punctured by rows of Venetian windows and joined by curving colonnades to pavilions with pyramidal roof (that closest to the river contained a banqueting house). The new house and its surrounding demesne were depicted on two panoramic oil paintings of c.1770, presently in the house. At this time the formal demesne extended up the hillside, while around the building lay a network of walled courts and gardens. These included a circular grass sweep in front of the house with a 'statue of Hercules of esteemed workmanship' in the centre [as described by Milton] and a walled garden to the north of the house with espaliers on the walls and a glasshouse in the centre.

[…]

5.79 The principle building of the park is the Grade A listed castle building, which dates to the 18th century, but has had numerous alterations throughout the 19th century. The park contains numerous historic buildings and archaeological assets of interest, which are listed below:

Table 5.4: Listed Buildings in Glenarm Registered Park

HB reference	Address	Date	Grade
HB06/02/001 A	Glenarm Castle	1820 - 1839	A
HB06/02/102	Former Rectory	1840 - 1859	B1
HB06/02/021	Town Lodge	1840 - 1859	B1
HB06/02/001 Q	Gardener's house at Glenarm Castle	1860 - 1879	B1
HB06/02/001 L	1 Castle Lane	1860 - 1879	B1
HB06/02/001 H	Barbican Bridge	1820 - 1839	B1
HB06/02/001 B	Former coach house, courtyard buildings and gate screen	1860 - 1879	B1
HB06/02/001 C	Greenhouse and Store at Glenarm Castle	1860 - 1879	B1
HB06/02/001 G	Barbican Lodge	1820 - 1839	B1
HB06/02/001 M	Former Bull's House	1860 - 1879	B2
HB06/02/001 O	Castle Farm	1840 - 1859	B2
HB06/02/001 N	Cottage in Glenarm Castle Estate ('Lord Antrim's Cottage')	1920 - 1939	B2
HB06/02/001 J	Ice house	1820 - 1839	B2
HB06/02/001 D	4-5 and 6 Castle Demesne	1860 - 1879	B2
HB06/02/001 E	South courtyard	1820 - 1839	B2

5.80 The park also contains three scheduled ancient monuments (listed below) as well as numerous non-designated buried archaeological remains.

Table 5.5: Scheduled Monuments in Glenarm Registered Park			
COUNTY	**SMNO**	**TOWNLAND**	**EDITED_TYP**
ANT	029:009	GLEBE	Church and graveyard, 'Glore Church'.
ANT	029:014	GREAT DEER PARK	Mound
ANT	029:044	GLENARM DEMESNE	Henge

5.81 As such the park has high architectural, historic, archaeological and artistic interest, and is considered to be a heritage asset of High importance as defined in Table 5.1.

5.82 The park comprises an area of more formal gardens and landscaping in the north of the park, near to Glenarm Castle, and the large area of remnant deer park which occupies much of the land to the south of the castle.

5.83 The setting of the northern part of the park is dominated by the castle, and views of this, and between the castle and the walled garden. Key views are looking south from the southern elevation of the house, and west towards the walled garden. Views of the house from the south and west are also key, and provide appreciation of the architectural interest of the park. The southern part of the park comprises largely areas of woodland, but with pockets of open space, often with historic buildings or archaeological areas.

5.84 The setting of the park is largely contained within the designated area, which provides the best experience of all of the key areas of interest of the park's significance. The Munie Road, which runs along the western boundary of the park, also provides a key means of appreciating the wider deer park landscape as it runs on higher ground and, where views are not blocked by woodland, provide occasional views into the parkland which provide appreciation of the historic interest of the park.

5.85 The northern part of the park provides the best appreciation of the park's architectural, historic and artistic interest, as this is where the key buildings within the park are situated. The southern part of the park, and the views along the Munie Road provide a good appreciation of the historic landscape which surrounds the key buildings, and of the extent of the park, which is a reflection of the importance of the castle and its residents over the centuries.

Archaeological Heritage Assets

5.86 The CHBA provided a detailed desk-based assessment of the archaeological potential of the Application Site. The CHBA:

- Assessed the potential for the Application Site to contain buried archaeological remains from each period based on available evidence;

- Assessed impacts the Proposed Development would have on the identified buried archaeological remains;
- Assessed the significance of any identified impacts; and
- Set out any appropriate mitigation measures which could be deployed to reduce the significance of the effect.

5.87 The resources reviewed to inform the assessment of potential comprise the following:

- The Northern Ireland Sites and Monuments Record (NISMR);
- Historic Environment Record of Northern Ireland (HERoNI);
- Historic mapping available from record offices and the Northern Ireland Historic Map Viewer;
- The results of previous archaeological investigations where relevant from the HERoNI and from the online database of Irish Excavation Reports (if available); and
- A site walk over.

5.88 In reviewing the available evidence, the CHBA concluded that the Application Site is unlikely to contain the remains of settlement activity from any period reviewed, which is a reflection of the exposed nature of the Application Site, which would have been an unfavourable location for settlement on a permanent basis. The Application Site is, however, located in a prehistoric landscape with a number of funerary and potential ritual remains of interest, and there are recorded non-designated buried remains of a cairn and potential oval enclosure within the Application Site. As such, the CHBA concluded that there is a known potential for the presence of these remains within the study site, and a moderate potential for similar associated remains to also be present, which are as yet undiscovered.

5.89 Known buried archaeological remains within the study site comprised the recorded remains of the non-designated cairn (ANT 030:005) and an oval enclosure to the east of the turbines (ANT 035:044). The southernmost part of the Application Site is located in the Knockdhu ASAI, which contains a number of non-designated heritage assets in addition to the scheduled remains.

5.90 The cairn comprises buried remains only, with no surviving above ground remains. As such these remains would not meet the criteria for scheduling and are not of high significance. Present evidence suggests that these remains will be of local interest. Similarly the recorded oval enclosure to the east of the turbines (ANT 035:044) is likely to be of local interest. Given the absence of evidence of recorded earthworks of high interest within the majority of the Application Site (outside of the ASAI), despite numerous field visits and investigations in the locality over the years, it is considered that any as yet undiscovered buried remains are likely to be of low interest (as defined in Table 5.1).

5.91 The remains in the southern part of the Application site, which are within the ASAI are more varied, with some scheduled remains present, alongside non-designated buried remains. Below is a table which lists the archaeological heritage assets which are within the Application Site and the ASAI.

Table 5.6: List of archaeological heritage assets within the ASAI and the southern part of the Application site

SMR reference no.	Summary Description	Period	Designation
ANT035:001	CROSS-INCISED BOULDER - PENAL ALTAR: THE MASS ROCK, THE PRIEST'S GRAVE or THE HEADLESS CROSS	POST-MED	Scheduled
ANT035:002	WEDGE TOMB: GIANT'S GRAVE	NEO/B.A.; PREHISTORIC	Scheduled
ANT035:045	A.P. SITE - mound?	UNCERTAIN	Non-designated
ANT035:061	PREHISTORIC FLINT QUARRY	PREHISTORIC	Scheduled
ANT035:064	CAIRN?	PREHISTORIC; UNCERTAIN	Non-designated
ANT035:065	MOUND	UNCERTAIN	Non-designated
ANT035:067	HOUSE SITE AND ENCLOSURE	UNCERTAIN	Non-designated
ANT035:069	CURVILINEAR BANK	UNCERTAIN	Non-designated
ANT035:075	HUT SITE	UNCERTAIN	Non-designated
ANT035:076	HUT SITE	UNCERTAIN	Non-designated
ANT035:077	BARROW	PREHISTORIC; BRONZE AGE	Non-designated
ANT035:081	HUT SITE	UNCERTAIN	Non-designated

5.92 The ASAI is of High importance, as has been noted above, and the designated archaeological remains it contains are also of High importance. The non-designated buried remains within the ASAI are of low to medium importance (as defined by Table 5.1).

5.93 There is some potential for the ASAI to contain additional non-designated buried archaeological remains. However, any such remains would comprise buried remains only, as they have not been noted, despite numerous surveys undertaken in the ASAI. As such any as yet undiscovered non-designated buried remains are likely to be of no more than low importance.

Summary of Cultural Heritage Receptors

5.94 A table summarising the cultural heritage resources and their significance is provided below.

Table 5.7: Summary of Identified Receptors and their Significance/Sensitivity

Ref.	NIEA/LPA reference if applicable	Description	Assessment of significance/ sensitivity
SM1	ANT 029:019	Giant's Grave scheduled monument.	High
SM2	ANT: 030:004	Standing Stone scheduled monument.	High
SM3	ANT 035:002	Giant's Grave scheduled monument.	High
SM4	ANT 035:005	Knockdhu Fort	High
SM5	ANT 035:053	Cairn on Scawt Hill	High
ASAI1	-	Knockdhu Area of Significant Archaeological Interest (ASAI)	High
LB1	HB06/02/084	RC Feystown Church Grade B2 Listed	Medium
RP1	AN/033	Glenarm Registered Park	High
A1	ANT 030:005 ANT 035:044	Recorded non-designated archaeological heritage assets within northern part of the Application Site	Low
A2	-	As yet undiscovered buried archaeological remains within northern part of Application Site.	Low
A3	ANT035:045 ANT035:064 ANT035:065 ANT035:067 ANT035:069 ANT035:075 ANT035:076 ANT035:077 ANT035:081	Recorded non-designated archaeological heritage assets within ASAI and the Application Site	Low/Medium
A4	-	As yet undiscovered buried archaeological remains within northern part of Application Site.	Low

Assessment of Development Effects

Construction Phase Effects

Assessment of Direct Physical Effects to Buried Archaeological Remains

5.95 The proposed development comprises a wind farm, with 14 turbines measuring up to 149m in height. These turbines will be set on foundations measuring 30m by 30m in area. The turbines will be accessed using a modest track, the southern part of which will make use of existing routes, which will be improved. There will also be additional construction phase impacts during the erection of the turbines, to stabilise them, and transport the turbine parts to the study site and put them into place, as well as from the installation of any compound which is constructed. The development would be sparsely distributed throughout the Application Site, with a low below ground impact relative to the area.

5.96 There will also be a cable route leading from the turbines to connect them to the grid. The cable route trench would make use of existing road routes and would usually measure approximately 1m wide by 1m in depth.

5.97 These activities have the potential to result in the localised removal of any archaeological remains which may be present where any impact is planned. The Proposed Development's impacts have been designed to avoid all recorded buried archaeological heritage assets, and as such there would be no direct physical impacts on recorded archaeological remains either in the northern part of the Application Site (reference A1 in Table 5.7) or in the southern part of the Application Site, which includes part of the ASAI (reference A3 in Table 5.7).

5.98 Given the potential for the presence of as yet undiscovered buried remains of local/low interest within the Application Site (references A2 and A4 in Table 5.7), these impacts could result in a **minor** to a **moderate significance** of effect, depending on the nature of the remains in question, and whether the localised impacts would result in a substantive loss of remains (see Table 5.3).

Indirect Effects

5.99 The construction phase of the Proposed Development would be short lived, taking less than one year, and the effect of this on the setting of heritage assets in the wider area would be temporary. Furthermore, any effects in terms of the prominence and visibility of the turbines would be less than is the case during the operational phase. As such, the indirect construction phase effects of the Proposed Development do not need detailed assessment, and are adequately covered by the assessment of operation phase effects below.

Operational Phase

Assessment of Indirect Effects due to Changes to Setting of Heritage Assets

ANT 029:019 – Giant's Grave scheduled monument

5.100 The proposed wind turbines would be visible in the wider area (see HVP5), and so would change the setting of the tomb. However, the turbines would not interfere with the view along the alignment of the tomb, the experience of its entrance nor affect appreciation of the archaeological and architectural interest provided by the immediate setting. Likewise, the archaeological evidence and contextual relationship the tomb has with other archaeological assets in the surrounding area would all be unaffected. On this basis the degree of effect of the proposed development on the tomb is considered slight adverse, as the turbines would be noticeable in the wider area, however they would not distract from appreciation of its archaeological interest.

5.101 The significance of this effect would be **minor adverse**, which is not considered a significant effect.

ANT: 030:004 – Standing Stone scheduled monument

5.102 The effect of the proposed development on the setting of the stone is shown in HVP4. The landscape to the west would be changed considerably, reducing the local prominence of the stone as a marker. However, the ability to appreciate its function and key views east would be preserved, and views along the Ulster Way only moderately affected.

5.103 While the proposed development would not directly affect the key aspects of the significance of the stone, the proximity of the turbines would detract locally from its prominence as a marker in the landscape, which is part of its historic interest. As a result, the degree of effect would be moderate adverse.

5.104 Given the level of importance of the stone, the significance of this effect has the potential to be either moderate or large adverse (see Table 5.3). As there would be no loss of archaeological evidence or damage to the monument, no archaeological interest would be lost. Also, while the legibility of the prominence and function of the stone would be affected, appreciation of these would not be prevented or impeded, and could still be appreciated readily. Furthermore, the effects of the development are also reversible in the medium term. On this basis it is considered that the significance of this effect would be **moderate adverse**. While this is a significant effect as noted in the EIA regulations, it is the lowest level of significant effect on the spectrum of effects noted in Table 5.3.

ANT 035:002 – Giant's Grave scheduled monument

5.105 The effect of the proposed development on the setting of the tomb is shown in HVP2. The proposed turbines would be visible when looking along the alignment of the tomb towards the NE, with turbine 14 being close to the centre of the alignment.

5.106 To understand how this effect would affect the significance of the tomb, it is important to further consider how the alignment of the tomb relates to its significance. Firstly, wedge tombs are, with few exceptions, aligned NE to SW, with the opening at the south-western end, in the direction of the setting sun. In the case of the Giant's Grave, this alignment is accentuated by the local topography, which provides a commanding view across the valley towards the south west from the tomb. While there are many theories as to the reason behind the orientation of wedge tombs, what is clear from the consistent SW to NE orientation across this class of monument, throughout the island of Ireland, is that having the entrance orientated towards the south west was of ritual significance. The tomb would likely have been covered by a cairn when it was built, and the sites and monuments record for the Giant's Grave notes that some remnants of an elongated cairn were present at the time of the field visit (date of this comment is 1940; HERoNI record reference ANT 035:002). The entrance would have been visible on the south-western side of the cairn.

5.107 The presence of the turbines would not affect the views from the tomb towards the setting sun to the south west. When in the setting of the tomb, the presence of the turbines may lead to momentary distraction when looking toward the entrance, however the turbines would be at some distance and would not preclude or prevent appreciation or understanding of the tomb's alignment, or of its archaeological interest. It is on this basis that it is concluded that the Proposed Development would result in a minor adverse degree of effect to the overall significance of the tomb.

5.108 Given the level of importance of the tomb, the significance of this effect has the potential to be either moderate or minor adverse (see Table 5.3). As there would be no loss of archaeological evidence or damage to the monument, no archaeological interest would be lost. Also, the archaeological interest of the tomb would still be appreciated, and the understanding provided by its setting unaffected. Furthermore, the effects of the development are also reversible in the medium term. On this basis it is considered that the significance of this effect is considered to be **minor adverse**, which is not considered to be a significant effect.

ANT 035:005 – Knockdhu Fort

5.109 The proposed turbines would be visible from the fort when looking north, and would change the context of views from the Ulster Way towards the fort, from close to Scawt Hill. Finally the turbines would be visible when returning from the fort towards the visitor car park. The experience of the archaeological interest of the ramparts, however, would be unaffected. The effect of the proposed development on views from the fort has been illustrated in HVP1 and also in LVIA VP3.

5.110 The overall effect of this change to the setting of the fort would be to temporarily distract from existing appreciation of the archaeological interest of the fort and also, to a small extent, from strategic views when looking north from the fort. However, the proposed development would not impede or preclude the understanding or appreciation of the fort's archaeological interest, which is provided by its setting. It would still be possible to see and understand the contextual relationship between the fort and the surrounding landscape, and also the other designated heritage assets present in the wider area.

5.111 Therefore while the proposed development would introduce a distraction to the setting of the fort, it would not preclude the appreciation or understanding provided by the fort's setting. Furthermore, no archaeological evidence from the fort would be lost. Therefore, when considering the other elements of the significance of the fort which would be unaffected, the effect of the Proposed Development would comprise a minor adverse degree of effect to the overall significance of the fort.

5.112 Due to the high significance of the fort, the significance of this degree of effect has the potential to be minor or moderate. Given the fact there would be no loss of archaeological evidence or understanding, and also the medium term reversibility of the proposed development, it is considered that the significance of this effect is **minor adverse**.

ANT 035:053 - Cairn on Scawt Hill

5.113 An illustration of the effect of the proposed development on views to the west from the immediate setting of the cairn is provided in HVP3. Views to the east would be unaffected. View long views of the cairn from the surrounding area would also be affected (see HVP1).

5.114 The proposed turbines would be visible in views to the north, west and south, and would be dominant structures in the local landscape. They would also change views from the cairn as well as views of the cairn from the surrounding landscape. The key result of this is that the cairn would no longer be as prominent a feature in the local landscape, which would detract from one of its function as a local marker. While its legibility as a marker would not be impeded, understanding of this aspect of its past function would be affected.

5.115 As the cairn's prominence in the local landscape is an important aspect of its significance, the effect to the legibility of the prominence of the cairn by the proposed development would result in a moderate adverse degree of effect (Table 5.2).

5.116 Due to the high significance of the cairn, the significance of this degree of effect has the potential to be moderate or large. However, as there would be no loss of archaeological evidence or damage to the monument, and appreciation of the archaeological interest would not be lost. Given this, and also the reversibility of the development in the medium term, the significance of this effect is considered to be **moderate adverse**. While this is a significant effect as noted in the EIA regulations, it is the lowest level of significant effect on the spectrum of effects noted in Table 5.3.

Knockdhu Area of Significant Archaeological Interest (ASAI)

5.117 The proposed turbines would be visible from a number of areas within the ASAI, including from the Ulster Way. However the proposed development would not be visible from the car park in the centre of the ASAI nor in key views out to the Irish Sea, or of the Knockdhu Fort either from the car park or the Ulster Way. It would, however, be noticeable from the Ulster Way when travelling north through the northern part of the ASAI (see LVIA VP2, VP3 and VP6 as well as HVP1). As such the key views of the Knockdhu Fort and out to the Irish Sea, would not be materially affected. The proposed development would also not interfere with key views within the ASAI, which provide appreciation of the group value of the remains.

5.118 The effect of seeing the proposed development as noted above would not affect any of the key aspects of the importance of the ASAI. Specifically the proposed development would not result in any direct physical loss of any identified archaeological remains within the ASAI. There would therefore be no loss of the currently designated evidential value or archaeological interest, and the research potential of the ASAI and the remains therein would be preserved, as would appreciation of its group value.

5.119 Furthermore the proposed development in the distance, while noticeable, would not prevent an understanding of the strategic placement of the fort, or of the other visible features within the ASAI.

5.120 Therefore the effect of the proposed development would result in a change to the wider setting of the ASAI, but one which would not materially affect key aspects of its importance or archaeological interest, or the importance of any of the identified archaeological features therein. When considering the other elements of the significance of the ASAI which would be unaffected, the overall result would be a minor adverse degree of effect to the significance of the ASAI.

5.121 The significance of this degree of effect has the potential to be minor or moderate, given the high significance of the ASAI. Given the fact there would be no loss of known archaeological evidence or understanding, and also the medium term reversibility of the proposed development, it is considered that the significance of this effect is **minor adverse**.

HB06/02/084 – RC Feystown Church

5.122 The proposed development would be visible from the church and would change its setting. The turbines would be noticeable from the churchyard, but would not impede appreciation of the architectural and historic interest of the church which is provided there, nor of the rural character of the surrounding parish. The effect of the proposed development on the experience of the churchyard has been illustrated in LVIA VP9.

5.123 The turbines would be visible on the approach to the church on the Feystown Road, in particular from the south, where they would distract from the local prominence of the church, but again would not impede appreciation of that prominence or understanding of the communal value the building has with the locality. Furthermore, the building is not designed to be a prominent marker across a wide landscape; rather its prominence is local and relative to the parish which is serves.

5.124 Finally, the turbines would be visible in views of the church from the wider area, but these views provide a limited appreciation of the church's heritage values, which would not be impeded.

5.125 The significance of the church is primarily derived from its architectural, historic and artistic interest, as well as its contextual relationship with the surrounding parish. The proposed development would not affect any of these key elements of the church's significance. The proposed development would change the setting of the church, and would distract from the experience of the church's architectural interest in the churchyard and along the Feystown Road to a minor degree, but would not prevent or impede appreciation of those values.

5.126 Given this, and the fact that all other aspects of the building's significance would be unaffected, the degree of effect is assessed at minor adverse, with a **minor adverse** significance of effect.

AN/033 – Glenarm Registered Park

5.127 The proposed turbines would not be visible from the castle, nor from the northern part of the setting of the park. The ZTV indicates that it is theoretically possible that the tips of some of the northern turbines could be intervisible with the western boundary of the walled garden, at the north-western edge of the park. However, the ZTV is a "safe" representation of the potential visibility of the turbines and does not account for slight variations in local topography or intervening hedgerows, trees or buildings. The hub height ZTV (a more reliable indicator of potential visibility at significant distances) indicates that none of the hubs would be visible at all within this part of the park, and that any views would only be of the very tips, screened by intervening landscape features within the registered park and elsewhere. Therefore the proposed development would not affect the appreciation of the key heritage values of the park, which is provided by the northern part of the park.

5.128 The turbines would be largely screened from nearly all of the southern part of the park. However, in some locations the turbines would be visible across the valley in the distance, as has been noted in relation to the grade B1 listed 1 Castle Lane (see CHBA Appendix 1 in Appendix 5.1), and as is shown in LVIA VP8.

5.129 These occasional views of the turbines would result in some distraction from appreciation of the historic interest of the southern part of the deer park which is provided in these views. But the presence of the turbines would not prevent or impede appreciation in any way. The proposed development would not affect the architectural, historic, artistic or archaeological interest of the park, nor would it affect the experience provided by the northern part of the park, which provides the key appreciation of the park's architectural and historic interest. Furthermore, the turbines would be screened from the majority of the park, due to the presence of substantive and mature trees.

5.130 However, the turbines would be visible in a few places from along the Munie Road, which is an important means of appreciating the wider landscape setting and historic interest of the deer park which covered most of the park south of the main house, including in views of the grade B1 listed 1 Castle Lane.

5.131 These occasional views of the turbines would result in some distraction from appreciation of the historic interest of the southern part of the deer park which is provided in these views. But the presence of the turbines would not prevent or impede appreciation in any way.

5.132 Given this, and the fact that all other aspects of the park's significance would be unaffected, the degree of effect is assessed at minor adverse.

5.133 The significance of this degree of effect has the potential to be minor or moderate, given the high significance of the park. Given the fact that the effect is limited to more peripheral elements of the park's setting, that none of the key buildings or features within park would be affected, and also the medium term reversibility of the proposed development, it is considered that the significance of this effect is **minor adverse**.

Summary of Effects

5.134 The effects of the Proposed Development on the cultural heritage baseline, as assessed above, are summarised in Table 5.8, below.

Table 5.8: Summary of effects of Proposed Development on Cultural Heritage Receptors

Ref.	NIEA/LPA reference if applicable	Description	Level of Importance (Table 5.1)	Degree of Effect (Table 5.2)	Significance of Effect (Table 5.3)
SM1	ANT 029:019	Giant's Grave scheduled monument	High	Minor Adverse	Minor
SM2	ANT 030:004	Standing Stone scheduled monument	High	Moderate Adverse	Moderate
SM3	ANT 035:002	Giant's Grave scheduled monument.	High	Minor Adverse	Minor
SM4	ANT 035:005	Knockdhu Fort	High	Minor Adverse	Minor
SM5	ANT 035:053	Cairn on Scawt Hill	High	Moderate Adverse	Moderate
ASAI1	-	Knockdhu Area of Significant Archaeological Interest (ASAI)	High	Minor Adverse	Minor
LB1	HB06/02/084	RC Feystown Church Grade B2 Listed	Medium	Minor Adverse	Minor
RP1	AN/033	Glenarm Registered Park	High	Minor Adverse	Minor
A1	ANT 030:005 ANT 035:044	Recorded non-designated archaeological heritage assets within northern part of the Application Site	Low	No impact	No effect

Table 5.8: Summary of effects of Proposed Development on Cultural Heritage Receptors					
Ref.	**NIEA/LPA reference if applicable**	**Description**	**Level of Importance (Table 5.1)**	**Degree of Effect (Table 5.2)**	**Significance of Effect (Table 5.3)**
A2	-	As yet undiscovered buried archaeological remains within northern part of Application Site	Low	Moderate to Major if present	Minor to Moderate
A3	ANT035:045 ANT035:064 ANT035:065 ANT035:067 ANT035:069 ANT035:075 ANT035:076 ANT035:077 ANT035:081	Recorded non-designated archaeological heritage assets within ASAI and the Application Site	Low/Medium	No impact	No effect
A4	-	As yet undiscovered buried archaeological remains within northern part of Application Site	Low	Moderate to Major if present	Minor to Moderate

Design Evolution and Mitigation Measures

Mitigation Responses to Direct Physical Effects

5.135 As has been noted above, the Proposed Development has been designed to avoid all recorded archaeological heritage assets, and so no known buried archaeological remains would be impacted by the Proposed Development.

5.136 It is possible that additional, as yet unknown remains may be present within the planned areas of impact, which could be impacted (potential cultural heritage receptors A2 and A4). Depending on the extent of the impact and the nature of the buried remains the significance of this impact has the potential to be minor or moderate (Table 5.3).

5.137 In response, a programme of archaeological works can be implemented ahead of the development to detect and record any remains prior to any impact. The recording of archaeological remains serves to realise the research value of those remains, and enhance understanding and appreciation of the more significant remains in the wider area which would not be affected. While this benefit does not undo or fully outweigh the loss of any remains, it would serve to partially compensate for the loss, and would reduce any residual significance of effect to minor adverse to slight adverse. As such, such a programme of archaeological works would ensure that no significant effects would arise as a result of direct physical effects to buried archaeological remains.

5.138 Such a programme of archaeological works could be secured as a condition to planning consent and implemented ahead of development.

Mitigation Measures in Response to Indirect Effects

5.139 Given the scale of the proposed turbines, there is little scope for additional mitigation beyond the embedded mitigation undertaken by the design process, which sought to minimise the visibility of the turbines as much as possible, while also seeking to ensure the scheme remains viable.

5.140 However, in relation to the cairn on Scawt Hill (SM5) and the Standing Stone (SM2), both of which are nearest to the proposed turbines and which would be subject to higher effects, there is potential for some compensatory measures to be implemented. In both cases, the effect of the Proposed Development would be to detract from the prominence and/or the local landmark function of the heritage asset in question, which is why the adverse effect assessed is higher in relation to these assets. In response, information boards could be produced for these assets, and placed along the Ulster Way. They could be based on known information, with some additional research and collation of known information, and would enhance appreciation and understanding of the archaeological interest of the assets. This would also serve to partially restore appreciation of the local prominence of these features, and would provide a clear heritage benefit to these assets. Such measures could also be considered for the ASAI, which would further broaden the benefit. These measures could be agreed in dialogue with the NIEA and secured as a condition to planning consent.

Residual Impacts

5.141 The mitigation measures set out above would serve to reduce the significance of effect which would result from direct physical impacts of the proposed development.

5.142 The measures set out in response to indirect effects to the cairn on Scawt Hill (SM5) and the Standing Stone within the Application Site (SM2) would serve to partially compensate for the effects of the Proposed Development. The introduction of information boards would enhance appreciation and understanding of the monuments, and, as is noted above, would also provide an opportunity for research and the collation of information about these assets, which would also enhance their archaeological interest. However, such measures would not reduce the visual prominence of the Proposed Development, and so would not fully mitigate any effects. Nonetheless, archaeological research and the provision of information which enhances understanding is a clear benefit to the significance of these heritage assets. Furthermore, this benefit relates directly to the effect the Proposed Development would have.

5.143 Therefore, while the moderate effect of the proposed development on the cairn (SM5) and stone (SM2) would remain, the provision of additional information in the form of public information boards would provide a minor benefit.

5.144 The residual effects of the Proposed Development are set out in Table 5.9, below.

Table 5.9: Summary of effects of Proposed Development on Cultural Heritage Receptors

Ref.	Level of Importance (Table 5.1)	Degree of Effect (Table 5.2)	Significance of Effect (Table 5.3)	Mitigation measures	Residual Significance of Effect
SM1	High	Minor Adverse	Minor	None possible	Minor
SM2	High	Moderate Adverse	Moderate	None possible	Moderate
SM3	High	Minor Adverse	Minor	None possible	Minor
SM4	High	Minor Adverse	Minor	None possible	Minor
SM5	High	Moderate Adverse	Moderate	None possible	Moderate
ASAI1	High	Minor Adverse	Minor	None possible	Minor
SM1 SM2 SM3 SM4 SM5 ASAI1	High	Minor Beneficial	Minor Beneficial	Research and provision of information boards to enhance appreciation and understanding	Minor Beneficial
LB1	Medium	Minor Adverse	Minor	None possible	Minor
RP1	High	Minor Adverse	Minor	None possible	Minor
A1	Low	No impact	No effect	None required	No effect
A2	Low	Moderate to Major if present	Minor to Moderate	Programme of archaeological works	Slight to minor
A3	Low/Medium	No impact	No effect	None required	No effect
A4	Low	Moderate to Major if present	Minor to Moderate	Programme of archaeological works	Slight to minor

Cumulative Impacts

Baseline

5.145 This application has collated existing and proposed developments that could result in cumulative effects within a 30km radius from the Application Site. This comprises the Cumulative Baseline, which is set out in full in Chapter 4 of the EIA. This baseline has been used to assess whether there is potential for cumulative effects to result to the identified cultural heritage receptors as a result of the combined effects of the Proposed Development and one or more developments recorded in the Cumulative Baseline).

Direct Physical Impacts

5.146 There are no proposed developments which would result in any additional physical impacts to the identified or potential buried archaeological remains within the Application Site. As such, the Proposed Development would not result in any cumulative effects to buried archaeological remains.

Indirect Effects

5.147 The Cumulative Baseline was reviewed in relation to the heritage assets in the wider area which would be subject to indirect effects as a result of the Proposed Development, to determine whether any cumulative effects would result. The Heritage Viewpoints provided in Appendix 5.2, provide descriptions of other extant and potential developments together with a visualisation of the Proposed Development, for ease of reference. Potential effects are discussed in relation to each asset below.

ANT 029:019 - Giant's Grave scheduled monument

5.148 The viewpoint provided in HVP5 confirms that some single turbines as well as the wind farms at Elginny Hill and Rathsherry are theoretically visible from the immediate setting of the monument. However, the scheme at Elginny Hill is located 15km to the west, and was not noticeable during the site visit undertaken to inform the CHBA in Appendix 5.1. Likewise, the single turbines were not noticeable during the site visit. A proposed turbine scheme is being considered at Carnalbanagh, however this is 7.2km to the WSW of the Application Site, and at such a distance would not affect appreciation of the monument in any meaningful way.

5.149 As such, the assessment of the effect of the Proposed Development to this heritage asset provided in Table 5.9 would not be affected by cumulative effects.

ANT 030:004 - Standing Stone scheduled monument

5.150 The viewpoint provided in HVP4 confirms that a single blade tip from the consented Ballykeel wind farm (6km to the south of the Application Site) would theoretically be visible from the Ulster Way, in the setting of the standing stone. In addition, a number of single turbines are present in the wider area, but all are further than 5km to the south east.

5.151 The turbines at Ballykeel are mostly screened and at 6km distant would not be discernible from the setting of the stone. As such this would not have any effect. The single turbines to the south east are occasionally visible in the distance, however they are seen in the context of a varied landscape, which includes modern settlements, housing and other landscape features. As such they do not affect appreciation of the stone's heritage interest, and merely form part of the wide and varied prospect provided by the views out towards the Irish Sea. Therefore, while these distant turbines are visible in the distance, their presence has a negligible effect, that is an element within the setting that does not affect the significance of the heritage asset.

5.152 As such, the presence of these developments in the wider landscape would not change the assessment of the effect of the Proposed Development on the significance of the standing stone which is provided in Table 5.9.

ANT 035:002 - Giant's Grave scheduled monument

5.153 The viewpoint provided in HVP2 confirms that some single turbines as well as the wind farm at Elginny Hill are theoretically visible from the immediate setting of the monument, from where the Proposed Development will also be visible, albeit not in the same view. However, the scheme at Elginny Hill is located 15km to the west, and was not noticeable during the site visit undertaken to inform the CHBA in Appendix 5.1. Likewise, the single turbines were not noticeable during the site visit.

5.154 A proposed turbine scheme is being considered at Carnalbanagh, however this is 7.2km to the WSW of the Application Site, and at such a distance would not affect appreciation of the monument in any meaningful way.

5.155 As such, the assessment of the effect of the Proposed Development to this heritage asset provided in Table 5.9 would not be affected by cumulative effects.

ANT 035:005 - Knockdhu Fort

5.156 During the site visit undertaken to inform the CHBA, two small single turbines were noted from Knockdhu Fort. As can be seen in the viewpoint provided in HVP1, there are in fact three small turbines, which may be visible together with the Proposed Development in views towards the north from the fort and the immediate vicinity.

5.157 The small turbines were only noticeable by a careful examination of the surroundings, and did not materially affect appreciation of the fort's archaeological interest or setting. As can be seen in HVP1, the presence of the single turbines is barely noticeable and would not magnify or affect the level of effect assessed in this chapter and provided in Table 5.9.

5.158 HVP1 also notes that the wind farms at Elginny Hill and Carn Hill are theoretically visible from the fort. However, Elginny Hill is located 15km to the west and Carn Hill is 20.7km to the south and neither were not noticeable during the site visit, and did not affect the setting of the fort. As such the presence of these developments would not affect the assessment of effects provided in Table 5.9.

5.159 Finally, HVP1 notes that the proposed turbine scheme at Carnalbanagh, could be visible in the view. However this is 7.2km to the WSW of the Application Site, and at such a distance would not affect appreciation of the monument in any meaningful way. As such, the construction of this scheme would not materially affect the level of effect assessed in this chapter and provided in Table 5.9.

ANT 035:053 - Cairn on Scawt Hill

5.160 The cairn on Scawt Hill has extensive views in all directions. The view towards the west, including the Proposed Development is provided in HVP3. HVP3 notes that the wind farm at Elginny Hill is visible in the same view west from the cairn in which the Proposed Development would be present, together with three single turbines. It also notes that existing developments at Ballymena, Carn Hill and Wolf Bog are theoretically visible from the cairn in other directions.

5.161 However, Elginny Hill is located 15km to the west and during the site visit was not noticeable at that distance. Carn Hill is 20.7km to the south, Ballymena is 19.7km to the west, and Wolf Bog is 16.1km to the southwest of the Application Site and none of these were noticeable during the site visit, and they did not affect the setting of the cairn. As such the presence of these developments would not affect the assessment of effects provided in Table 5.9.

5.162 The small turbines were only noticeable by a careful examination of the surroundings, and did not materially affect appreciation of the cairn's archaeological interest or setting. As can be seen in HVP3, the presence of the single turbines is barely noticeable and would not magnify or affect the level of effect assessed in this chapter and provided in Table 5.9.

5.163 Finally, HVP3 notes that the proposed turbine scheme at Carnalbanagh, could be visible in the view. However this is 7.2km to the WSW of the Application Site, and at such a distance would not affect appreciation of the monument in any meaningful way. As such, the construction of this scheme would not materially affect the level of effect assessed in this chapter and provided in Table 5.9.

5.164 Likewise, the consented wind farm at Bally Keel is situated 6km to the south of the Application Site, and in practice much of this development would be substantively screened by intervening topography. It may be theoretically possible to see a few turbines from the cairn (see LVIA VP1 for representative view), however in practice at this distance the wind farm at Bally Keel would not be readily discernible, and would not materially affect the experience or appreciation of the cairn. As such, the construction of this scheme would not affect the level of effect assessed in this chapter and provided in Table 5.9.

5.165 In addition, in views towards the south east a number of single turbines are visible from the cairn. However these turbines are seen in the context of a varied landscape, which includes modern settlements, housing and other landscape features. As such they do not affect appreciation of the cairn's heritage interest, and merely form part of the wide and varied prospect provided by the views out towards the Irish Sea. Therefore, while these distant turbines are visible in the distance, their presence has a negligible effect, that is an element within the setting that does not affect the significance of the heritage asset.

Knockdhu Area of Significant Archaeological Interest (ASAI)

5.166 As has been noted above, during the site visit undertaken to inform the CHBA, two small single turbines were noted from Knockdhu Fort. As can be seen in the viewpoint provided in HVP1, there are in fact three small turbines, which may be visible together with the Proposed Development in views towards the north from the fort and the immediate vicinity.

5.167 The existing single turbines were only noticeable by a careful examination of the surroundings, and did not materially affect appreciation of the fort's archaeological interest or setting. As can be seen in HVP1, the presence of the single turbines is barely noticeable and would not magnify or affect the level of effect assessed in this chapter and provided in Table 5.9.

5.168 HVP1 and LVIA VP6 note that the wind farms at Elginny Hill and Carn Hill are theoretically visible from within the ASAI. However, Elginny Hill is located 15km to the west and Carn Hill is 20.7km to the south and neither were not noticeable during the site visit, and did not affect the setting of the fort. As such the presence of these developments would not affect the assessment of effects provided in Table 5.9.

5.169 Finally, HVP1 notes that the proposed turbine scheme at Carnalbanagh, could be visible in the view from the fort, and LVIA VP6 suggests potential visibility from the car park. However this is 7.2km to the WSW of the Application Site, and at such a distance would not affect appreciation of the ASAI in any meaningful way. As such, the construction of this scheme would not materially affect the level of effect assessed in this chapter and provided in Table 5.9.

HB06/02/084 - RC Feystown Church Grade B2 Listed

5.170 The viewpoint provided in LVIA VP9 confirms that some single turbines as well as the wind farm at Elginny Hill are theoretically visible from the immediate setting of the church, although not in the same view as the Proposed Development. However, the scheme at Elginny Hill is located 15km to the west, and was not noticeable during the site visit. Likewise, the single turbines in the wider area were not noticeable during the site visit. The proposed turbine scheme at Carnalbanagh, however this is 7.2km to the WSW of the Application Site, and at such a distance would not affect appreciation of the church in any meaningful way.

5.171 As such, the assessment of the effect of the Proposed Development to this heritage asset provided in Table 5.9 would not be affected by cumulative effects.

AN/033 - Glenarm Registered Park

5.172 The Proposed Development would only be visible from the park in elevated views from the Muncie Road, looking across the southern part of the park. This is illustrated by LVIA VP8. In theory, three single turbines and the consented scheme at Bally Keel would also be visible to the south in the same view as the Proposed Development. However, in practice the views of the schemes to the south are screened by intervening vegetation over a considerable distance, such that they would not be discernible.

5.173 As such, the assessment of the effect of the Proposed Development to this heritage asset provided in Table 5.9 would not be affected by cumulative effects.

Summary and Conclusions

Summary

5.174 This chapter has assessed the potential effects that the Proposed Development would have on the historic environment. It has considered potential direct physical impacts, indirect effects resulting from changes to the setting of heritage assets in the wider area, and the potential cumulative effects due to the presence of other extant or proposed developments.

Potential for Direct Physical Impacts

5.175 The potential for buried archaeological remains to be present within the Application Site was assessed by a review of the available evidence undertaken within the CHBA, which confirmed that the study site is unlikely to contain the buried archaeological remains of settlement activity from any period reviewed. However, the Application Site is located in a prehistoric landscape with a number of funerary and potential ritual remains of interest, and there are recorded non-designated buried remains of a cairn and potential oval enclosure within the Application Site (A1) and known remains are also recorded within the ASAI, which occupies the southernmost part of the Application site (A2). These remains, and the potential for as yet undiscovered buried remains of interest, have been considered and it is concluded that they are likely to be of no more than of local interest.

5.176 The Proposed Development has been designed to avoid all recorded archaeological remains, and will therefore have no physical effects on the identified receptors A1 and A3. There is potential for localised impacts to result to as yet unknown buried archaeological remains (A2 and A4), which could result in a minor to moderate effect. In response a programme of archaeological works is proposed, which would record any remains prior to construction, and would realise the research value of the remains. With the benefit of such a programme works, the significance of any effects to buried archaeological remains would be at most minor adverse.

Potential Indirect Effects due to Changes to the Setting of Heritage Assets

5.177 The assessment provided in this chapter was informed by a comprehensive assessment of the potential indirect impacts the Proposed Development could have on the significance of designated heritage assets in the wider area due to changes to their settings, which was provided by the CHBA provided in Appendix 5.1.

5.178 The assessment of designated heritage assets provided in the CHBA highlighted a number of assets that required more detailed assessment due either to their proximity to the proposed development, their sensitivity, or the complexity of the issues surrounding their assessment which meant that they would benefit from fuller assessment.

5.179 A total of eight such assets were identified, as follows:

- ANT 029:019 – Giant's Tomb scheduled monument
- ANT 030:004 – Standing Stone scheduled monument
- ANT 035:002 – Giant's Grave scheduled monument
- ANT 035:005 – Knockdhu Fort
- ANT 035:053 – Cairn on Scawt Hill
- Knockdhu Area of Significant Archaeological Interest (ASAI)
- HB06/02/084 – RC Feystown Church
- AN/033 – Glenarm Registered Park

5.180 The CHBA recommended that all of these heritage assets should be considered in detail in the EIA, and as a consequence these were considered in detail by this chapter.

5.181 The potential for indirect effects to the remaining heritage assets in the wider study, which could result from the Proposed Development, was considered in detail in the CHBA. It was concluded that the Proposed Development would have no more than a slight effect on the remaining heritage assets in the wider area, which would not comprise significant environmental effects. As such, it is not necessary to consider these effects in detail within this chapter. However, the CHBA is provided in Appendix 5.1, where detailed assessments of all the remaining heritage assets can be found if needed.

5.182 Due to their proximity to the Proposed Development, and the scale of the Proposed Development, the cairn on Scawt Hill, and the Standing Stone on the Ulster Way would be subject to moderate adverse degrees of effect, due to the loss of perceived prominence that would result from the Proposed Development. However, in both cases, the Proposed Development would not result in the loss of archaeological information, nor would it prevent understanding or appreciation of their archaeological and historic interest. As such, it is considered that the significance of the effect on both of these assets would be moderate adverse. This is considered to be a significant effect, but it is at the lowest end of the scale of possible significant effects outlined in Table 5.3. This relatively low level of significant effect, which is also medium term and reversible, should be capable of being made acceptable, provided sufficient benefits flow from the proposed development, and be made to accord with policy.

5.183 The remaining designated heritage assets would be subject to no more than a minor adverse effect, and are therefore the impacts of the proposed development are not considered to result in significant effects in relation to these remaining assets. In all cases, the effects are medium term and reversible, and in no instance would the proposed development directly affect a key aspect of the significance of any of these assets.

5.184 In response to these indirect effects, some compensatory measures are proposed, comprising information boards key heritage assets affected, and placed along the Ulster Way. They would be based on known information, with some additional research, and would enhance appreciation and understanding of the archaeological interest of the assets. This would also serve to partially restore appreciation of the local prominence of these features, and would provide a clear heritage benefit to these assets. While such measures would not fully mitigate the effects of the Proposed Development, they would nonetheless constitute a clear benefit to their significance, which would be considered alongside the adverse effects. Such measures would be easily secured by means of a planning condition, or similar mechanism, following the grant of planning consent.

Cumulative Effects

5.185 The potential for cumulative effects has been considered for each of the heritage assets assessed by this chapter. The assessment of potential cumulative effects has been made with reference to the cumulative baseline provided in Chapter 4 of the ES, together with information provided in the heritage viewpoints and LVIA.

5.186 The potential for cumulative effects was considered in detail, and it was found that the developments within the cumulative baseline are sufficiently far that they would not affect the significance of the heritage assets considered within this chapter. As a result, it is concluded that the presence of the developments within the cumulative baseline would not result in a materially higher level of effect to the identified heritage assets than what would result from the Proposed Development on its own.

Conclusion

5.187 In conclusion, the potential effects of the Proposed Development on the historic environment around the Application Site have been assessed, and it has been found that, with the benefit of imbedded mitigation measures, and some additional measures secured via planning condition, it would be possible to implement the proposed development in accordance with the requirements set out in policy RE1 of PPS 18 and paragraph 6.224 of the SPPS.

References

General

The Northern Ireland Sites and Monuments Record (NISMR);

Historic Environment Record of Northern Ireland (HERoNI);

Northern Ireland Historic Map Viewer;

Online database of Irish Excavation Reports (if available); and

Bibliographic

CIfA 2014. Code of Conduct (Chartered Institute for Archaeologists [CIfA] [revised edition] 2014)

CIfA 2017. Standard and Guidance for Historic Environment Desk-Based Assessment

Department for Communities 2018. Guidance on Setting and the Historic Environment

Department for Communities 2019. Register of Parks, Gardens and Demesne of Special Historic Interest in Northern Ireland

Hodges, R. 1975. Knockdhu Promontory Fortress: An Interpretation of its Function in the Light of some Preliminary Fieldwork. Ulster Journal of Archaeology. Vol. 38. 1975.

ICOMOS 2011. Guidance on Heritage Impact Assessments for Cultural World Heritage Properties

McNeary, R. 2014. Lidar Investigation of Knockdhu Promontory and its Environs, County Antrim, Northern Ireland

Orion Heritage 2020. Ballygilbert Wind Farm, Mid and East Antrim, Northern Ireland – Cultural Heritage Baseline Appraisal

List of Figures and Appendices

Figures

Appendices

6

Ecology

6. Ecology

Introduction

6.1 This chapter constitutes the ecology and nature conservation assessment for the Environmental Impact Assessment of a proposed wind farm at Ballygilbert near Larne, hereinafter referred to as 'the Development'. The site occupies an extensive ridge and adjacent slopes, rising to a maximum height of 381m at Black Hill (IGR D329107), oriented north to south and sub-parallel to the local coastline of the Irish Sea. The initial studies within the site "Blue Line[1]," which encloses an area that is approximately 5.9 km in length and varies between approximately 1.2 and 2.3 km in width, identified extensive areas of valued habitat types, as outlined in the Preliminary Ecological Assessment for the site. This early study described the habitats of 25 field units, with an area of approximately 770ha. The Blue Line was subsequently re configured, and now encloses 20 field units, with an area of approximately 570ha. The present proposal is for the construction of fourteen turbines and associated infrastructure within four of these field units, with an access road that will require land take in a further three field unit; fields have been numbered 1-7 from north to south for the purposes of description. This study addresses the potential impacts of the proposal to erect fourteen turbines and associated access tracks and infrastructure on the habitats and species in this reduced study area, as shown in **Figure 6.3 – (Phase 1) Habitat survey map**.

6.2 Blackstaff Ecology Ltd was commissioned by RES UK and Ireland Ltd to undertake an Ecological Impact Assessment (EcIA) for this proposed wind farm. The ecological surveys used to describe the baseline conditions on site and to inform the EcIA were carried out during 2019 and 2020. Full details can be found in **Chapter 2: The Proposed Project**.

6.3 The chapter is supported by:

- Appendix 6.1 – NIEA Consultation Response
- Appendix 6.2 - Quadrat Data, Target Notes & Plant Species List
- Appendix 6.3 – Static Bat Detector Results & Deployment Photos
- Appendix 6.4 - Badger Survey Report
- Appendix 6.5 - Herpetofauna Survey Report
- Appendix 6.6 – (outline) Habitat Management Plan
- Figure 6.1 - Designated Sites (within 5km)
- Figure 6.2 - Habitat Map (Preliminary Ecological Assessment)
- Figure 6.3 - Phase I Habitat Map

[1] The Blue Line used in the chapter refers to the Land Under Applicant Control.

- Figure 6.4 - Target Notes and Quadrat Locations
- Figure 6.5 –Turbine Quadrat Locations
- Figure 6.6 - Automated Static Bat Detector Locations
- Figure 6.7a – Bat Transects Results (Spring)
- Figure 6.7b – Bat Transects Results (Summer)
- Figure 6.7c – Bat Transects Results (Autumn)
- Figure 6.8 – Badger Survey Results (Confidential)
- Figure 6.9 - Herpetofauna Results
- Figure 6.10 – Habitat Management Areas

Statement of Authority

6.4 Initial vegetation surveys and habitat assessments were carried out by Dr Brian Sutton, with badger, viviparous lizard and bat surveys carried out by Traci Adams. Quadrat surveys in support of the habitat survey were carried out by Dr Sutton, Dr Erfan Fadaei and Traci Adams. Karl Hamilton carried out a Phase 1 habitat survey of the reduced study area. Bat detector deployments and bat data analysis were completed by Philip Leathem, who also produced the figures to accompany the impact assessment. An initial site appraisal was carried out by Cormac Loughran, as well as a number of surveys for smooth newt, bats and input into the layout design. The chapter was reviewed and impact assessment were also completed by Cormac Loughran and Dr Brian Sutton.

6.5 The author of this chapter is Dr Brian Sutton, who was awarded a PhD in Environmental Science by the University of Ulster. Prior to working at Blackstaff Ecology, he worked as a member of the Habitat Survey Team of the Environment and Heritage Service (now NIEA) for 2 years. During this time, he carried out habitat surveys of, principally, designated sites or candidate designated sites across Northern Ireland. In so doing he gained experience of most of the habitat types that are present in the Province. Following this, he worked as a consultant ecologist for AECOM Ltd for 15 years, carrying out habitat and faunal surveys for a wide range of governmental and private clients. Projects undertaken were at a range of scales, from small private developments to major infrastructure projects.

6.6 This report has been reviewed (and all surveys planned) by Cormac Loughran, a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). Cormac has worked professionally as a Consultant Ecologist for over 16 years. He holds an MSc (Distinction) in Environmental Management from the University of Ulster and has extensive experience in a broad range of flora & fauna surveys. He has undertaken and/or coordinated a wide range of ecological surveys and associated impact assessments for over 20 renewable energy projects. Cormac is also an experienced field naturalist and prior to his consultancy work, he worked as a ranger on a number of important nature reserves. As a result, he also has considerable habitat management experience across a broad range of habitats in including broadleaved woodland, wetland, grassland and wet & dry heathland.

6.7 Dr Erfan Fadaei has a BSc (Hons) in Zoology from the University of Manchester and a PhD in deer ecology and management from Queen's University Belfast. Erfan has several years' experience conducting a range of faunal surveys and habitat surveys using Phase 1 and NVC methodologies. He currently works as an ecologist with Blackstaff Ecology Ltd and is a qualifying member of CIEEM.

6.8 Dr Traci Adams has a BSc (Hons) in Zoology (1st class) from the University of Manchester and an MSc in Ecological Management and Conservation Biology from Queen's University, Belfast. She has gained experience within the ecology and nature conservation sector over the past 2 years through volunteering both abroad and in the UK with organisations such as WildlifeSense, The National Trust, Belfast Hills and Lagan Valley Regional Park. Her experience within the Ecological Consultancy sector began in May 2019 when she commenced work with Blackstaff Ecology. Traci has conducted numerous bat transects on single turbine and windfarm developments, as well as working on several bat reports for Blackstaff Ecology.

6.9 Karl Hamilton acquired an honours degree in Environmental Biology from the Queen's University of Belfast in 2001 and has since worked on a number of ecological projects including a PhD at the Queen's University of Belfast studying the Feeding Ecology of the Kestrel (2001 – 2003, to be completed); senior reserve warden / biodiversity officer for the Wildfowl & Wetlands Trust (2003 – 2010) where he was tasked with monitoring site flora and fauna (birds, mammals, aquatic and terrestrial invertebrates, botany) as well as managing a wide range of habitats including mesotrophic and calcareous grasslands, freshwater lagoons, fen, saline lagoons, saltmarsh, intertidal mudflats with seagrass beds and woodland. This included sourcing and establishing native plants of local provenance as well as managing and monitoring invasive non-native species.

6.10 Philip Leathem is a GIS/Ecological Technician who has worked in the environmental sector for the past 6 years. Philip's role as a technician includes the maintenance, monitoring and deployment of a suite of automated bat detector units (SM2 Bat+, SMZC's and Anabat Express') which are used during static (bat) monitoring. In addition to the above role, Philip is also a GIS Technician and has considerable experience in the production of Figures for Environmental Statements.

Legislation & Planning Policy

International Treaties, Conventions & Directives

Bonn Convention of the Conservation of Migratory Species of Wild Animals (June 1979)

6.11 The Convention requires the protection of the endangered migratory species listed and encourages separate international agreements covering particular species. An agreement covering the conservation of bats in Europe came into force in January 1994. It deals with the need to protect bats and their feeding and roosting areas.

Bern Convention on the Conservation of European Wildlife and Natural Habitats (September 1979)

6.12 The Convention carries obligations to conserve wild plants, birds and other animals, with emphasis on endangered and vulnerable species and their habitats. The provisions of the Convention underlie the EC Habitats Directive as well as the UK's wildlife legislation.

UN Biodiversity Convention (The Rio Convention) (June 1992)

6.13 The Convention provides a framework for international action to protect species and habitats. The UK's overall goal under the Convention is to conserve and enhance biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms.

Convention on Biological Diversity (93/626/EEC) (CBD)

6.14 The Convention requires contracting parties, in accordance with its conditions and capabilities, to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes. It also requires contracting parties to integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectorial and cross sectorial plans, programmes and policies.

EC Council Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) (The Habitats Directive)

6.15 Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the EU Habitats Directive) is transposed into law in Northern Ireland by the Conservation (Natural Habitats, etc.) Regulations 1995 (as amended), the Habitats Regulations.

6.16 The Habitats Directive covers habitats and non-avian species of fauna of nature conservation importance and in danger of disappearance, for which the European Commission (EC) has responsibility in view of the proportion of their global range. Habitats are listed and detailed on Annex I of the Directive.

6.17 To conserve these habitats, listed on Annex I of the directive, and species, listed and described on Annex II, a European network of Special Areas of Conservation (SAC) is being established.

6.18 As the Habitats Directive encapsulates a presumption in favour of maintaining Annex I habitats in good conservation status wherever they occur, prior assessment is therefore required to determine whether any areas of habitat within a development site meets the criteria for recognition as Annex I habitat types.

6.19 The Directive also requires appropriate assessment of any plan or project not directly connected with or necessary to the management of a Natura 2000 site, but likely to have significant effects upon a Natura 2000 site, either individually or in combination with other plans or projects.

Annex 1 Habitats

6.20 Blanket Bog (H7130) is listed in Annex 1 of the EU Habitats Directive as a habitat of European interest. Blanket bog occurs as residual, patchy elements of habitat mosaics, or as more extensive areas dominated by *Eriophorum vaginatum* that support little *Sphagnum*. The significant presence of extensive *E. vaginatum*, with patchy and/or localised *Sphagnum* suggests that active peat is at least locally present.

6.21 The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats listed in Annex 1 at a favourable conservation status, introducing robust protection for those habitats of European importance.

Domestic Legislation

Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended)

6.22 The Regulations give effect to requirements relating to the designation of protected sites under the Birds Directive and Habitats Directive. The Regulations provide for the protection and management of European Sites and place obligations on all competent authorities to have regard to the requirements of the Habitats Directive. The Regulations also provide for the protection of species of European importance.

Environment (Northern Ireland) Order 2002

6.23 The Order provides for the designation, management and protection of Areas of Special Scientific Interest (ASSIs). ASSIs may be designated for important geology and land forms as well as for wildlife and habitats. The legislation repeals Part VI of the Nature Conservation and Amenity (Northern Ireland) Order 1985.

Nature Conservation and Amenity Lands (Northern Ireland) Order 1985 (as amended)

6.24 The Order provides for the establishment of National Nature Reserves (NNRs), Nature Reserves (NRs) and Marine Nature Reserves (MNRs). It also provides for the designation and formulation of proposals for National Parks and Areas of Outstanding Natural Beauty (AONBs).

The Wildlife (Northern Ireland) Order 1985 (as amended)

6.25 The Order prohibits the intentional killing, taking or injuring of certain wild birds or wild animals; or the intentional destruction, uprooting or picking of certain wild plants. It also allows for the establishment of Wildlife Refuges (akin to Nature Reserves) for the special protection of certain species of rare plants or animals.

The Environmental Liability (Prevention and Remediation) Regulations (Northern Ireland) 2009

6.26 The Regulations implement Directive 2004/35/EC and require those carrying out certain activities to prevent, limit and remediate significant environmental damage to protected species, natural habitats, ASSIs, surface water, ground water and land. Operators of activities such as discharges to water sources and water impounding are liable for any significant environmental damage, regardless of whether they intended to cause the damage or were negligent.

Wildlife and Natural Environment Act (Northern Ireland) 2011

6.27 The Act makes provision about biodiversity; amends the Wildlife (Northern Ireland) Order 1985 and Part 4 of the Environment (Northern Ireland) Order 2002; abolishes game licences and game dealers' licences; prohibits hare coursing events and amends the Game Preservation Act (Northern Ireland) 1928.

Planning Policy

Regional Development Strategy (RDS) 2035: Building a Better Future

6.28 The Strategy takes account of European and national policies which would have an influence on the future development of Northern Ireland. The Strategic Planning (Northern Ireland) Order 1999 requires Northern Ireland Departments to have regard to the Regional Development Strategy in exercising any functions in relation to development. There are two types of Strategic Guidance: Regional Guidance (RG) and Spatial Framework Guidance (SFG). RG applies to everywhere in the region and is presented under the three sustainable development themes of Economy, Society and Environment.

6.29 RG 9-RG 12 (Environment) have been adjusted to meet obligations under the Habitats Regulations. Of relevance to the Development is RG 11: Conserve, protect and, where possible, enhance our built heritage and our natural environment. This Strategy Guidance refers to the need to:

> *'Sustain and enhance biodiversity in line with the objective of the Northern Ireland Biodiversity Strategy to halt the loss of indigenous species and habitats. By protecting existing, or creating new, ecological or wildlife corridors particularly in our cities and towns we can provide valuable help to arrest the decline in biodiversity.'*

and

> *'Identify, establish, protect and manage ecological networks. Ecological networks, including the protection of priority species, are needed to maintain environmental processes and help to conserve and enhance biodiversity. A well-established ecological network, including designated sites, should provide the habitats needed for ecosystems and species populations to survive in an increasingly human dominated landscape. Such networks could*

also be of amenity value if linked to the green infrastructure provided by walking and cycle routes to heritage and other recreational interest.'

Strategic Planning Policy Statement for Northern Ireland (SPPS)

6.30 In addition to reiterating the statement made in PPS18 (below) the SPPS States:

'Active peatland is of particular importance to Northern Ireland for its biodiversity, water and carbon storage qualities.'

and

'Renewable energy reduces our dependence on imported fossil fuels and brings diversity and security of supply to our energy infrastructure. It also helps Northern Ireland achieve its targets for reducing carbon emissions and reduces environmental damage such as that caused by acid rain.'

Planning Policy Statement 18: Policy RE1

6.31 Policy RE1 States:

'The wider environmental, economic and social benefits of all proposals for renewable energy projects are material considerations that will be given significant weight in determining whether planning permission should be granted'.

'Development that generates energy from renewable resources will be permitted provided the proposal, and any associated buildings and infrastructure, will not result in an unacceptable adverse impact on:

(a) public safety, human health, or residential amenity;

(b) visual amenity and landscape character;

(c) biodiversity, nature conservation or built heritage interests;

(d) local natural resources, such as air quality or water quality; and

(e) public access to the countryside.

Where any project is likely to result in unavoidable damage during its installation, operation or decommissioning, the application will need to indicate how this will be minimised and mitigated, including details of any proposed compensatory measures, such as a habitat management plan or the creation of a new habitat. This matter will need to be agreed before planning permission is granted.

Any development on active peatland will not be permitted unless there are imperative reasons of overriding public interest.'

Planning Policy Statement 2 - Policy NH5

6.32 Policy NH 5 - Habitats, Species or Features of Natural Heritage Importance, states:

'Planning permission will only be granted for a development proposal which is not likely to result in the unacceptable adverse impact on, or damage to known:

- priority habitats;
- priority species;
- active peatland;
- ancient and long-established woodland;
- features of earth science conservation importance;
- features of the landscape which are of major importance for wild flora and fauna;
- rare or threatened native species;
- wetlands (includes river corridors); or
- other natural heritage features worthy of protection.

A development proposal which is likely to result in an unacceptable adverse impact on, or damage to, habitats, species or features may only be permitted where the benefits of the proposed development outweigh the value of the habitat, species or feature. In such cases, appropriate mitigation and/or compensatory measures will be required.

PPS 21 Sustainable Development in the Countryside

6.33 PPS 21 aims to:

'Manage development in the countryside in a manner consistent with achieving the strategic objectives of the Regional Development Strategy for Northern Ireland 2025." Objectives include to "Conserve the landscape and natural resources of the rural area and to protect it from excessive, inappropriate or obtrusive development and from the actual or potential effects of pollution," and to "Promote high standards in the design, siting and landscaping of development in the countryside.'

Northern Ireland Biodiversity Strategy

6.34 A strategy that has been published by the DoE entitled, Valuing Nature – A Biodiversity Strategy for Northern Ireland to 2020 (01 July 2015) describes 20 targets arising from the 2010 Convention on Biological Diversity (CBD) which was held in Noyoga, Japan during October 2010. A key decision at the Convention was the adoption of a new ten-year strategic plan to guide international and national effort to save biodiversity. The strategic plan, or the Aichi Target, adopted by the meeting is the overarching, internationally agreed, framework on biodiversity. The 20 Aichi Targets form the basis for the Implementation Plan for the NI Biodiversity Strategy. The CBD fully adopted the ecosystem services approach that stresses the need to look at maintaining the functionality of ecosystems as key to protecting biodiversity and delivering benefits for humanity.

Sustainable Development Strategy for Northern Ireland

6.35 The Strategy sets out the Government agenda for ensuring that sustainable practice becomes an integral part of development policy in Northern Ireland. The following six principles of the strategy continue to echo those developed from the previous strategy, and are as follows;

- Living within Environmental Limits;
- Ensuring a Strong, Healthy, Just and Equal Society;
- Achieving a Sustainable Economy;
- Promoting Good Governance;
- Using Sound Science Responsibly;
- Promoting Opportunity and Innovation.

6.36 The strategic objective most relevant to this development is: Ensuring reliable, affordable and sustainable energy provision and reducing our carbon footprint.

UK and Northern Ireland Biodiversity and Habitat Action Plans

6.37 The UK Biodiversity Action Plan (UKBAP) and equivalent Northern Ireland Habitat Action Plan, as well the internal NIEA Guidance Document, have been consulted regarding what constitutes 'active' blanket bog.

6.38 The UKBAP indicates that 'active' peatlands include the EU Habitats Directive priority habitat 'active' blanket bog, the definition of 'active' being given as 'still supporting a significant area of vegetation that is normally peat forming'. The UKBAP indicates that the principal vegetation (NVC) types covered and so defined as Blanket bog are M1, M2, M3, M15, M17, M18, M19, M20 and M25, together with their intermediates.

6.39 The Northern Ireland Habitat Action Plan (NIHAP) provides a similar definition of the habitat type, The NI HAP notes the EC Habitats Directive definition of what constitutes 'active' bog, and notes the following in respect of relevant NVC types: -

> *'Within Northern Ireland, blanket bog encompasses a range of plant communities that are similar to those identified in the National Vegetation Classification (NVC) of Great Britain (Rodwell, 1991). NVC descriptions and codes are given to associations of plants that are characteristic of particular environmental and management conditions. Plant communities that are typical of natural blanket bogs include the bog pool communities M1 to M3, M17 Scirpus cespitosus - Eriophorum vaginatum blanket mire, M18 Erica tetralix - Sphagnum papillosum raised and blanket mire and M19 Calluna vulgaris - Eriophorum vaginatum. A number of additional NVC communities are characteristic of the extensive areas of blanket bog which have been subject to some disturbance such as drainage or peat-cutting. These include M15 Scirpus cespitosus - Erica tetralix wet heath, M20 Eriophorum vaginatum blanket and raised mire, M25 Molinia caerulea - Potentilla erecta mire, together with their intermediates. Other wetland plant communities, such*

as flush M10 Carex dioica - Pinguicula vulgaris mire and poor-fen M6 Carex echinata-Sphagnum recurvum/auriculatum mire, are often closely associated with blanket bog. For the purposes of this plan, these are treated as an integral part of the blanket bog habitat.'

6.40 The UKBAP, NIHAP and European Commission (2007) Interpretation Manual of European Union Habitats has been utilised in the current report to determine whether peatlands are 'active' and hence require consideration in policy and impact assessment terms.

Guidance on Species/Habitats of Conservation Concern

Red Data Book

6.41 Vascular plant species that are rare and/or threatened on an all-Ireland or European scale have been identified as Red Data Book (RDB) species (Curtis & McGough, 1988).

Northern Ireland Species of Conservation Concern

6.42 NIEA has produced a list of Northern Ireland Priority Species (NIPS) and Species of Conservation Concern (SOCC), which includes Biodiversity Action Plan species, not all of which are Red Data Book species. Rarity is also a criterion for inclusion in the list. NIEA is also in the process of identifying vascular plant species that are of conservation concern as the NI response to the adoption by the UK of the Global Strategy for Plant Conservation (Palmer, 1994). The proposed list will be comprehensive and include species that are near-threatened as well as those protected by the Wildlife Order or listed as NIPS and SOCC. This process of evaluation of the current list of species of conservation concern is on-going.

Local Biodiversity Action Plans (LBAPs)

6.43 Local Authorities have been able to employ Biodiversity Officers, with financial aid from NIEA, since 2004. Their duties include raising awareness of biodiversity issues within local areas, and the development of LBAPs as a means of conserving and enhancing biodiversity at a local scale.

NIEA Internal Guidance Note on Active Peatland

6.44 The Northern Ireland Environment Agency (NIEA) provides internal guidance to their personnel indicating the site conditions, and which NVC types, may indicate that blanket bog is 'active'. In terms of NVC communities, the Guidance states: -

'The list below indicates the NVC classifications that could be active. In these habitats, the full details of quadrats surveyed will be needed to aid identification of active peatland. They should be provided within the environmental statement (ES).

NVC classifications which are likely to be found in active peatland:

- M1 Sphagnum auriculatum bog pool community
- M2 Sphagnum cuspidatum/recurvum bog pool communities

- M3 Eriophorum angustifolium bog pool community
- M17 Scirpus cespitosus - Eriophorum vaginatum blanket bog
- M18 Erica tetralix- Sphagnum papillosum raised and blanket mire
- M19 Calluna vulgaris-Eriophorum vaginatum blanket mire
- M20 Eriophorum vaginatum blanket mire
- M25 Molinia caerulea-Potentilla erecta mire'

6.45 Other criteria from the Guidance, including site-specific characteristics which could indicate the presence of 'active' peat include:

- Sphagnum is present
- If the surface is spongy underfoot
- Deep peat is present (>0.5m)
- Intact peat is present or the hydrology is still intact
- E. vaginatum/angustifolium is present in significant quantities with some Sphagnum
- The typical range of blanket bog and raised bog species is present as indicated within the interpretation manual
- There is a hummock and pool topography

6.46 Consideration of this Guidance is essential in the design and layout of wind energy projects to ensure compliance with Planning Policy.

Scope of Assessment

Ecological Impact Assessment

6.47 The assessment is based mainly on a study area within the scheme Red Line boundary surrounding the proposed Development and associated infrastructure. This study area is considerably smaller than the area enclosed by the LUAC (Blue Line). The entire area within the Red Line was surveyed to establish the main habitat types present, and the results were presented as a Preliminary Ecological Assessment. The reduced survey area described in the present report takes into account the results of this earlier survey and avoids considerable areas of habitats of conservation value identified at that time. Surveys for bats were extended to 200m outside the Planning Application Boundary, as required by NIEA guidance. Sites designated for their nature conservation features within a radius of 2km of the site boundary (**Figure 6.1**) were also considered to assess potential remote effects on valuable ecological site-based receptors.

6.48 The aim of EcIA is therefore to describe and assess potential significant effects upon ecological receptors within the application site and zone of ecological influence within the wider environment, as applicable. This is achieved by informed decision-making in accordance with published methodologies and after collecting a range of primary survey data across the site of the proposed development. Identification and evaluation of likely significance of effects associated with the Development during construction, operation and decommissioning phases permit recommendation of appropriate mitigation measures to avoid and/or reduce the predicted adverse effects of the proposed development on the recorded ecological receptors identified as part of the baseline survey.

6.49 The baseline survey, characterisation of the environment and the likely significance of effects of the Development on ornithology, fisheries (aquatic ecology) and the water environment are reported upon in **Chapter 7: Ornithology, Chapter 8: Fisheries** and **Chapter 9: Geology & Water Environment**.

Consultation

6.50 Consultation was undertaken with the statutory and non-statutory organisations listed below regarding the proposed scope of the EcIA; the location of any statutory and non-statutory designated nature conservation sites that have the potential to be impacted by the Development; identification of potential ecological receptors; the existence of any ecological records within 2 km of the Preliminary Site Boundary.

- Centre for Environmental Data & Recording (CEDaR);
- DAERA Natural Environment map viewer
- National Biodiversity Network (NBN);
- NIEA – Natural Environment Division;

6.51 CEDaR and NBN provided biological records. NIEA provided a written response.

6.52 NIEA requires the identification of the ecological baseline of the area that will be affected by the scheme and the identification of areas which are likely to be of high conservation value or particularly vulnerable to impact from the proposed scheme. NIEA requires that the EIA should cover both habitats and species of flora and fauna, especially protected species, and that it should cover both the site and its surroundings, in all seasons.

6.53 The developer will be required to consider the potential impact of the scheme on designated sites. Where there is a potential for impacts on a European protected site (SPA, SAC) the developer will be responsible for informing a HRA as mandated by Article 6 of EC Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive").

6.54 The consultation and desk study identified those ecological receptors most likely to be impacted by the proposed wind farm. Ecological receptors identified included; Northern Ireland or European priority habitat and protected species. The ecological surveys and EcIA therefore concentrate on the potential effects of the Development on these ecological receptors.

Assessment Methodology

Baseline Characterisation of the Study Area

6.55 The study methodology includes both desktop and field survey methods in order to assess the potential impact on the local ecological and nature conservation interest. Features of conservation interest and importance were recorded and their locations were one of the key criteria that affect the wind farm layout. The location of the wind farm infrastructure avoids habitats and species of conservation interest where possible, and where this is not possible, mitigation and/or enhancement measures have been incorporated into the design to balance any detrimental impact.

6.56 The habitats within the entire area enclosed by the original Red Line boundary were described in the Preliminary Ecological Assessment for the site. Habitats were surveyed across the whole Preliminary Site Boundary, hereafter referred to as 'the site.' This preliminary assessment enabled the identification of substantial areas of ecologically significant habitat, and the reduction in the area that would be required for the implementation of the scheme. As a consequence of the extensive nature of the Blue Line site (approximately 770ha), the preliminary examination of the site used a largely "broad brush" approach, which identified spatially extensive habitat types as well as many smaller features of ecological significance. However, a more detailed Phase I habitat survey was carried out by Karl Hamilton in June 2020, in order to more clearly define the limits of habitat types within the newly defined development area. In addition to this a 130 target notes and botanical quadrats were also recorded when assessing habitat type and condition.

6.57 Signs of mobile species were assessed outside the site to determine their point of origin. The study area was thus extended to take account of the potential for species to use the vicinity of the proposed development as part of wider territories or foraging areas. Watercourses within the site, and some tributaries outside the site, were surveyed for signs of otter. Specific study areas for each species are as follows;

- Bats (450m around proposed turbine locations);
- Otter & badger (planning application boundary +100m buffer);
- Common lizard & smooth newt (site);
- Marsh fritillary (site);

6.58 Sites designated at international, national and local level for their conservation value within a potential impact zone were considered. The nearest designated sites to the study area were identified, to assess the potential for remote effects of the scheme on valued habitats and species outside the immediate area.

6.59 The Fauna section of the EIA considers information gathered from the following sources:

- Consultations, with statutory and non-statutory stakeholders
- Desk study, including review of published/unpublished sources/literature

- A walkover survey of the entire study area and any other areas likely to be affected
- Specialist surveys, as detailed in paragraph 6.66 below
- Assessment of the data acquired
- Consideration of ecological interests in the scheme design and identification of mitigation to be incorporated into the design
- Impact assessment
- Proposed additional mitigation measures to address any likely significant adverse impacts

6.60 The data collection methodology adopted involved both a desktop search and field survey. The relevant statutory and non-statutory bodies were contacted to obtain ecological data for the study area. CEDaR was approached for records of species of conservation concern in the study area. Detailed surveys were undertaken to establish the baseline conditions for the various habitats and for the species groups that are likely to occur around the proposed scheme. The purpose of an ecological survey is to identify 'valued ecological receptors', those species and habitats that are especially valued in some way for their ecological function, their contribution to biodiversity or are protected by specific legislation. The following specialist surveys were undertaken:

- Phase 1 & NVC Phase 2 Habitat survey
- Bat (Chiroptera spp) survey
- Otter (*Lutra lutra*) habitat assessment
- Badger (*Meles meles*) survey
- Common Lizard (*Zootoca vivipara*) survey
- Smooth Newt (*Lissotriton vulgaris*) habitat assessment
- Marsh Fritillary (*Euphydryas aurinia*) habitat survey

Habitat Survey Methodology

Phase 1 Habitat Survey

6.61 The purpose of Phase 1 habitat survey is to identify those habitats of conservation interest that might place a constraint on the placement of the infrastructure of a proposed wind farm. The site was visited by Dr Brian Sutton on 25.07.2018, 11.08.2018, 20.08.2018 and 28.08.18. The reduced development area was surveyed by Karl Hamilton on 11.06.20 and 12.06.20. Habitats of the proposed development site were allocated to the JNCC Phase 1 Habitat (JNCC 2010) classification. Notes were made of the main plant species, and other species that are indicative of the condition and management of the habitat.

6.62 Phase 1 Habitat survey methodology is intended for the auditing of habitats and is generally accurate and of wide application. It is noted also that habitat types may frequently merge, grade from one to another, or form complex mosaics. Frequently encountered habitat mosaics in Ireland include various mixtures of grassland/pasture types, heathlands and blanket bogs. Mosaics and transitional, modified and degraded habitats can be very difficult to assign to any one Phase 1 Habitat category yet may have very different sensitivities and implications for project planning and assessment.

6.63 The 2019 surveys were carried out along transects that attempted to include the variations in habitat types that were present across this extensive site. Target notes were produced that describe the salient features of vegetation communities across the site. Target notes are to be found in **Figure 6.4**. Features that indicated the potential for active peat formation were noted, and, in particular, the extent and type of moss cover were noted, with an emphasis on the prevalence or absence of *Sphagnum* species. The presence of *Succisa pratensis,* the food plant of the marsh fritillary butterfly, which is fully protected under the Wildlife (Northern Ireland) Order, 1985, was noted where encountered. A plant species list is included in **Appendix 6.2**.

6.64 The area covered by the Phase 1 Habitat survey is illustrated in **Figure 6.3**.

National Vegetation Classification (NVC) Survey

6.65 The NVC is a system of classifying natural plant communities in Britain according to the species they contain and provides a standardised methodology for detailed environmental assessments. The methodology is repeatable and incorporates the use of quadrat sampling within which the types and relative abundance of plant species is recorded. From these results, plant community types can be classified.

6.66 The survey method employed at Ballygilbert was based on the NVC survey methodology described by Rodwell (Volumes 1 to 5, 1991 to 2000), which provides for the detailed classification and map-based survey of a wide range of plant communities found in Britain. The NVC describes communities in Britain, while often relatively depauperate communities in Northern Ireland have developed as a result of isolation from potential colonisers and under a generally more oceanic climate. Consequently, NVC types, while widely applicable to vegetation communities present in Northern Ireland, may vary significantly from those described for Britain in species composition and frequency.

6.67 Plant species were identified and recorded using the keys and nomenclature of Stace (2010) for higher plants and Atherton et al. (2010) for bryophytes (mosses and liverworts).

6.68 NVC survey requires the placement by eye of 2m x 2m squares to include either locally typical vegetation or to record the local variation in community type. All herbaceous and bryophyte species present within the square were recorded and their percentage cover noted. This approach allows subsequent analysis using the MAVIS program. Sward height and evidence of grazing pressure were recorded, and, where appropriate, peat depth was measured. Irish Grid References were recorded for all quadrats sampled.

6.69 Initially, NVC was used during the 2018 Phase I habitat survey, where Northern Ireland Priority Habitats or other habitats of conservation interest were encountered. Fifteen quadrats were placed by eye in representative vegetation communities.

6.70 The NVC survey in the vicinity of proposed turbine locations was undertaken by Dr Brian Sutton on 05.09.19, 08.09.19 and 13.09.19. In total, 53 quadrats were described from the 14 proposed turbine locations. The GPS location of each quadrat was recorded and the results mapped using geo-referenced OSNI maps. Subsequently, three turbine locations were moved as a consequence of identifying likely impacts on features of conservation interest. The revised locations of these turbines (Turbines 6, 11, 13) were surveyed by Traci Adams on 24.06.20. NVC results from the abandoned sites have been incorporated into the general NVC survey described here. All quadrat data is provided in **Appendix 6.4**.

6.71 A further 42 NVC quadrats were described by Dr Fadaei and Dr Adams on five dates in December 2019 and January 2020 along proposed turbine access routes. Although these quadrats were recorded outside the optimum growing period, most species likely to be found in the recorded habitats retain vegetative evidence of their presence and it is assessed that these quadrats allow identification of the plant communities and their conservation significance. As a consequence of the change in the proposed location of the three turbines noted above, and because parts of the original access route layout encroached on valued habitats, a number of these quadrats no longer describe communities directly affected by the proposed scheme. Conversely, a number of the quadrats describing communities in the wider development site (6.74 above) are now applicable to the habitats along the amended access routes. Where quadrats refer directly to access routes, this is noted in the following account.

6.72 In order to simplify site description, quadrats from the overall site survey, from the abandoned turbine locations and from the survey of access routes have been amalgamated in Appendix 6.4. Quadrats for the currently proposed turbine locations are presented separately in the Appendix.

6.73 NVC plant communities were mapped on a 1:10,000 OS map. A hand-held GPS was used to record the location of target notes accurately. A digital camera was used to take representative photographs of each quadrat location for future reference. Analysis of the NVC community and sub-communities that were present were made using the relevant NVC Volumes (Rodwell 1991a to 2000). For the sake of clarity this report uses a combination of common and scientific species names, although the latter are only used by Rodwell (1991a to 2000). The most important references for this work are Rodwell (1991a and 1992).

6.74 NVC survey results were used to identify valuable vegetation communities and provided input into the assessment of active blanket peat within the study area. These were included in a constraints mapping exercise, along with other environmental constraints, to evolve the final layout design and layout of the wind farm. This process is described in **Chapter 3: Design Evolution & Alternatives**.

Blanket Bog Condition Assessments

6.75 Peatland habitats within the site were assessed to determine whether there were any areas of 'active' blanket bog present. The criteria used included the following:

- criteria provided in the NIEA Guidance note (2012);
- the presence and condition of NVC communities;
- the eco-hydrological conditions found in each part of the site, particularly the presence and condition of artificial drainage;
- past and present land management practices which have the potential to damage the habitat, including: peat cutting, burning, vegetation topping, sheep grazing, etc.

Bat Surveys

6.76 NIEA recommends different types of guidance for bat surveys, depending on the type of proposal. In the case of the proposed development this includes the SNH guidance (Jan 2019) entitled '*Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation*'. Therefore, this guidance was used when arriving at the appropriate level of survey effort (for both automated and manual surveys) at the windfarm.

6.77 A desk study was undertaken in order to plan survey work and provide context for this assessment. The desk study included a review all the available information on bats relevant to the proposed wind farm and considered the various factors that influence risk to the species at a site. This included:

- The use of bespoke UAV aerial imagery (a ground truthing site visit), topographical maps and habitat survey maps (from a previous Preliminary Ecology Assessment) of the proposed site to identify features of potential value to bats.
- The collation of relevant bat information within 10 km of the proposed wind energy site, including species and roost records and the proximity of national and internationally designated sites for bats.
- Particular efforts were made to identify locations with the potential to house significant roosts, such as barns and other buildings.
- The location of other wind energy developments, including the number of turbines and their size, within the surrounding 10km in order to inform an assessment of cumulative pressure.

6.78 Collins (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition) was also considered during survey design and the subsequent survey effort.

6.79 It was noted that:

- Habitat quality is poor for bats on the Application Site. Significant woodland, linear features such as hedgerows are not present;
- The site has an exposed aspect;
- The site is not proximal to sites designated for bats; and,

- No buildings or other structures known to support bats are extant on the site[2].

6.80 Based upon this information, and upon the factors noted in the aforementioned SNH Guidance, the site was deemed to be of ‘low quality’ for bats and the following survey standard was implemented in accordance with SNH Guidelines.

- Survey Area of up to 200m & Rotor Radius from the RLB;
- One manual survey visit/transect/season (spring/summer/autumn) using handheld broadband bat detectors.
- Ten consecutive nights of static monitoring per turbine location during each season (spring/summer/autumn) using broadband passive recorders.

6.81 All monthly transects were undertaken from 15-30 minutes prior to sunset and 3-minute listening stops were made at each proposed turbine location, as well as several habitat features. When the end of the transect was reached, the transect was walked in the opposite direction until the survey time was completed. Each transect took between 2-3 hours to complete.

6.82 The study area comprises a range of habitats including open sheep grazed pasture (acid/marshy grassland), wet heath and some relict poor fen/mire habitats. On the lower lying areas of pasture there are few hedgerows, or mature trees; there are also no well-vegetated stream corridors. The wider landscape is similar to the site with extensive areas of open moorland and sheep grazed pasture.

6.83 A detailed survey of potential roosting features within 200m of the application site boundary was carried out during 2019. The habitat survey did not identify any buildings or structures with potential roosting features. Few trees are present in proximity turbines however no mature trees suitable for use by roosting bats are extant within the application boundary. The majority are isolated hawthorn and were deemed unsuitable for roosting bats.

6.84 Overall the site is identified as being of low risk due to the presence of largely low quality (and limited opportunity for roosting) and the fact that the majority of the site has limited connectivity to the wider landscape; and the presence of largely low quality foraging habitat for bats; with even the areas normally described as moderate quality foraging habitat (i.e. rivers and streams) located in a fairly isolated upland context with no trees (or sheltered areas) and limited invertebrate prey.

Automated Bat Activity Surveys

6.85 Automated passive monitoring was also undertaken during spring (15 Apr – 15 Jun), summer (15 Jun – 15 Aug) and autumn (15 Aug – 15 Oct) 2019 (Appendix 6.3 and Figure 6.6: Static detector locations). Several (calibrated) broadband ultrasonic bat detectors (SM2BAT+ and Anabat Express) were placed to record for a minimum of ten nights at numerous locations across the site on a seasonal basis, including a number of potential turbine locations and adjacent habitat features (Appendix 6.3 (which

[2] within 200m plus rotor radius of the boundary of the proposed development.

contains photographs of each location along with a brief description)). Each static detector was programmed to automatically operate during set time periods to record bat activity between dusk and dawn each night.

6.86 The SNH 2019 guidance states that;

> *''Where developments have more than ten turbines, detectors should be placed within the developable area at ten potential turbine locations plus a third of additional potential turbine sites up to a maximum of 40 detectors for the largest developments''.*

6.87 For a 14-turbine site this would result in approximately 340 hours of static monitoring across the season for 11.33 turbines (10 plus one third of 4). At Ballygilbert, all 14 proposed turbines were monitored, which yielded a total of 400 hours of recording time. This was done in order to allow for alterations to the proposed turbine layout (which often occur during the assessment process) and to allow for equipment failure or damage.

6.88 Detectors were placed with the microphone directed at a 90^{o} angle towards the area to be monitored (e.g. the proposed turbine location). Whenever possible microphones were placed on a fence post or pole. This helps to prevent recording extraneous noises and places the microphone closer to or within the flight path of the bats; this tends to provide higher quality recordings.

6.89 AnalookW and Kaleidoscope Pro UK was used to undertake analysis of data collected during automated passive monitoring. Bat activity was measured using the number of files containing a bat call or bat call sequence irrespective of length, for a complete night of recording. Passive monitoring enables determination of species composition and temporal activity patterns between different times of year and different times of night at a fixed-point location. Bat activity indices (for all survey types) are provided in the survey results, included in Appendix 6.3.

6.90 Photographs were taken during each deployment, to check for disturbance, and as a record of work undertaken. Volume 4: Appendix 6.3 also contains photographs of each location along with dates and a description of the area (i.e. habitat feature or proposed turbine location).

Otter Survey

6.91 An otter survey was conducted, extending to 25m outside the Application Site on 01, 08, 14 and 27 January 2020, using the methodology described in the NIEA survey requirements (NIEA 2017[3]). The survey area was thoroughly searched for both direct and indirect evidence of otters. Such evidence included: prey remains, spraints, footprints, slides and dens. The locations of any features were noted using a handheld GPS. Where excavations were discovered the survey detailed; the direction of tunnelling; and the degree of use at the time of the survey. Where trails were found, these were followed to the edge of the recording area.

[3] https://www.daera-ni.gov.uk/sites/default/files/publications/daera/otter-survey-specifications.pdf

Badger Survey

6.92 A badger survey was conducted, extending to 25m outside the Application Site on 01, 08, 14 and 27 January 2020, using the methodology described in Harris et al (1989[4]) and with reference to the NIEA survey requirements (NIEA 2017[5]). The survey area was thoroughly searched for both direct and indirect evidence of badger activity. Such evidence included: badger hairs; mammal pathways of suitable dimension; gaps of suitable dimension in fences or hedgerows; snuffle holes indicating foraging activity; tracks; latrines; and excavations of suitable dimensions to host badgers. The locations of any features were noted using a handheld GPS. Where excavations were discovered the survey detailed;

- The number of entrances present;
- The shape of tunnel entrances;
- The width of the tunnel entrance at its widest point (visible);
- The direction of tunnelling; and
- The degree of use at the time of the survey, i.e. active or inactive.

6.93 Intact stone walls and (wire) mesh fencelines, which have the potential to act as territory boundaries, were walked to search for territory markers such as latrines and scratch marks. In more open habitats, such as heath, bracken and grassland, a grid of transects was walked and any badger signs noted. Where badger trails were found, these were followed to the edge of the recording area.

Viviparous Lizard Survey

6.94 On assessing the habitats present on the application site it was considered that there is a moderate likelihood of viviparous lizards being present. Therefore, in order to ensure that the proposed development complies with legislation and planning policy, a survey for this species was carried out. The work was carried out during September 2019 and aimed to establish whether lizards are present within the construction corridor and surrounding area.

6.95 The methodology includes both visual searches and the use of artificial refugia. Surveys were carried out during the following optimal periods;

- Early spring - middle hours of the day (c.11am-3pm);
- Late spring – mid morning (c.9-11am) and late afternoon (c.4-6pm), and/or;
- Summer – short periods in morning (c.7-9am) and evening (6-8pm); hot weather can produce totally negative results;
- Autumn similar to spring timings.

6.96 During the visual searches a transect was walked slowly, scanning sunny sides of vegetation while keeping the sun behind you or to your side. Particular attention was paid to vegetation interfaces (i.e. habitat edges, where bracken meets heather or

[4] Harris, S., Creswell. P., and Jefferies, D.J., 1989. Surveying badgers. Mammal Society, London.
[5] https://www.daera-ni.gov.uk/sites/default/files/publications/daera/bat-survey-specifications.pdf

grassland) as these are often places where reptiles bask (as they seldom venture far from dense cover for protection).

6.97 The walked transects also made use of natural basking spots, however artificial refugia in the form of 58 number rubber backed carpet tiles (500x500mm) were also placed around most of the proposed turbine locations (see Figure 6.9, Volume 4: Appendix 6.5). The transect also took account of suitable habitat within or adjacent to the construction corridor. The following was applied to the emplacement of refugia;

- Choose sunny locations away from public view and livestock;
- Press refugia down close to the ground;
- Use deep cover or edge of dense vegetation;
- Do not deploy on bare ground/sparse cover;
- Lift and replace refugia carefully taking care not to squash retreating animals.

6.98 Surveys were carried out during suitable weather conditions (as above), and focussed during September. The surveys were 2-3 hours in duration and three visits were made (with the first visit at least a week after the refugia were laid).

Smooth Newt Survey

6.99 The habitats on site were considered for the presence of smooth newt *Lissotriton vulgaris* breeding habitat. Aerial photography was reviewed for the presence of ponds or other water bodies within 200m of all proposed infrastructure. In addition to this, the area (within 200m of all infrastructure) was surveyed during the habitat survey.

6.100 An assessment of the potential for smooth newt to be present on the site was undertaken. Any suitable waterbodies/drainage channels which were identified during both the Phase 1 habitat surveys of the Site were subject to a newt habitat suitability assessment. OSNI aerial photographs were also reviewed, as were bespoke images of the site which were taken from a height of 120 m above the ground and which have 5 cm resolution per pixel.

6.101 The presence of a series of small ephemeral ponds and a small lochan (on vector mapping and aerial photographs) was noted, therefore a smooth next survey was undertaken. The methodology was in accordance with the NIEA survey specification (in force at the time of survey).

6.102 Due to the absence of natural refugia (other than tussocks of *Juncus effusus)* several artificial refugia were placed around the ponds (but within 100m). This was completed to fulfil the NIEA requirement that;

> "*The survey must establish whether newts are present, and if applicable, their status in the water-body and surrounding potential terrestrial refugia sites. The survey must include any suitable terrestrial habitat within 200m of the water body.*"

6.103 The techniques employed during the survey were:

- Refuge Search - all suitable and accessible terrestrial refugia (logs, rocks, moss hummocks, and artificial refugia) within 200m of the pond were searched;
- Egg Search - any submerged and emergent vegetation was searched for the presence of newt eggs.
- Netting - a long-handled pond net was used to search within the pond for newts; this was undertaken at an approximate rate of 15 minutes searching per 50m of pond to ensure thorough coverage.
- Torchlight Survey - this element of the survey was undertaken after dusk to search for newts within the pond using a high-powered hand-held torch.

6.104 All work was carried out under licence from NIEA and all surveys took place during May/June 2020.

Marsh Fritillary Survey

6.105 On assessing the habitats present on the site it was considered that there is reasonable likelihood of devils-bit scabious *Succisa pratensis* being present on the site. This is the food plant or LHP (Larval Host Plant) of the marsh fritillary butterfly *Euphydryas aurinia*. This is a protected species listed on Schedules 5 and 7 of the Wildlife (NI) Order 1985 (as amended) and included on Annex 2 of the EU Habitats Directive (92/43/EEC).

6.106 Therefore, in order to ensure that the proposed development complies with legislation and planning policy, an appropriate survey for devils-bit scabious was carried out during September 2019, the aim of which was to establish the frequency and abundance of this species across the site.

Ecological Impact Assessment

6.107 The assessment of the impact of a scheme on a species or habitat must consider the conservation value of the species or habitat. This assessment of the potential impact of the Development on the conservation interest of the construction area and associated access routes adopts the Guidelines for Ecological Impact Assessment in the UK (CIEEM 2018).

6.108 The objective of the EIA process, in relation to the natural environment, is to undertake sufficient assessment to identify and quantify any significant impacts on the natural environment likely to arise from turbine construction, operation and eventual decommissioning. Following identification of the final infrastructure layout, the baseline ecological (or biodiversity) conditions in the Site are described, based on information provided by consultees, background sources of information and the results of dedicated surveys carried out for the scheme.

6.109 As a means of achieving this objective, ecological constraints on development of the scheme at international, national, regional and local levels are identified and assessed. This includes the main ecological features that should be avoided or that could affect the design of the scheme or delay progress.

Sensitivity Criteria

6.110 Potential significant impacts are assessed according to the ecological value of a site, which is derived from the criteria outlined below. The sensitivity (importance) of a receiving habitat is defined by its position in a hierarchy of site importance and conservation value. This hierarchy extends, highest to lowest, from International, National, Regional, Local, to negligible importance. This range of values is expressed in the protection afforded a site by international and national legislation, and in planning policy at a more local level (**Table 6.1**).

6.111 The biodiversity value of a site, is measured by such factors as:

- animal or plant species, subspecies or varieties that are rare or uncommon, either internationally, nationally or more locally;
- endemic species or locally distinct sub-populations of a species;
- ecosystems and their component parts, which provide the habitats required by the above species, populations and/or assemblages;
- habitat diversity, connectivity and/or synergistic associations (e.g. networks of hedges and areas of species-poor pasture that might provide important feeding habitat for rare species);
- notably large populations of animals or concentrations of animals considered uncommon or threatened in a wider context;
- plant communities (and their associated animals) that are typical of valued natural/semi-natural vegetation types, including examples of naturally species-poor communities;
- species on the edge of their range, particularly where their distribution is changing because of global trends and climate change;
- species-rich assemblages of plants or animals; and
- typical faunal assemblages that are characteristic of homogeneous habitats.

6.112 The secondary value of a site can be as part of a corridor or a series of stepping stones that facilitate the migration, dispersal and genetic exchange of wild species, or as a buffer zone that protects a valued site from adverse or beneficial environmental impacts.

Magnitude of Effect

6.113 This relates to the magnitude of the impacts on the features during the construction, operation and decommissioning phases. The magnitude of ecological impacts is assessed by considering the change in the ecology of a site that will arise because of the direct and indirect effects of a development on that ecology. Factors to be considered when considering the magnitude of an impact are outlined in **Table 6.2**. The criteria for determining the magnitude of impact are listed in **Table 6.3**. Both direct and indirect impacts, and the duration of these impacts are examined.

Significance Criteria

6.114 This relates to the significance of impacts on species and habitats of conservation importance, based on their presence as determined by survey. Factors to be considered when assessing the ecological significance of impacts are outlined in **Table 6.4**. Taking the factors in **Table 6.4** into account the significance of an impact may be broadly categorised according to **Table 6.5**.

Table 6.1: Criteria for assessing ecological sensitivity/importance at a geographic scale

Value/Importance	Criteria
Internationally important sites (very high conservation value)	World Heritage Sites identified under the Convention for the Protection of World Cultural & Natural Heritage, 1972. Biosphere Reserves identified under the UNESCO Man & Biosphere Programme. Wetlands of International Importance designated as Ramsar Sites under the terms of the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the Ramsar Convention) formulated at Ramsar, Iran, in 1971. Special Protection Areas (SPAs) designated in accordance with the 1979 European Communities Directive on the Conservation of Wild Birds (79/409/EEC): The Birds Directive. This Directive requires member states to take measures to protect birds, particularly rare or endangered species as listed in Annex I of the Directive, and regularly occurring migratory birds. Special Areas of Conservation (SACs and cSACs) designated in accordance with the 1992 European Commission Habitats Directive 92/43/EEC (1992): The Habitats Directive. This Directive requires member states to establish a network of sites that will make a significant contribution to conserving habitat types and species identified in Annexes I and II. Other sites maintaining habitats and/or species listed under the Birds and/or Habitats Directives (see above). Sites hosting significant populations of species annexed under the Bonn Convention. Sites hosting significant populations annexed under the Bern Convention. Biogenetic Reserves (UNESCO Man and the Biosphere Programme).
Nationally important sites (high conservation value)	Areas of Special Scientific Interest are the principal national designation for sites of nature conservation interest. They are notified under Section 28 of the Environment (NI) Order 2002 and are chosen by virtue of any of their flora, fauna, geological, or physiographic features to represent the best national and regional example of natural habitat, physical landscape features or sites of importance for rare or protected species. National Nature Reserves (NNRs) and Marine Nature Reserves (MNRs) are designated under the Environment Order. Sites maintaining UK Red Data Book species that are listed as being either of unfavourable conservation status in Europe, of uncertain conservation status or of global conservation concern. Sites maintaining species listed in Schedules 1, 5 and 8 of The Wildlife (NI) Order 1985, as amended.
Regionally important sites (medium conservation value)	Sites that reach criteria for Local Nature Reserve but do not meet ASSI selection criteria. Sites of Local Importance for Nature Conservation (SLNCIs) are recognised by Planning Service and are intended to complement the network of nationally and regionally important sites. SLNCIs receive special consideration in relation to local planning issues. Sites supporting viable areas or populations of priority habitats/species identified in the UK Biodiversity Action Plan or smaller areas of such habitat

Value/Importance	Criteria
	that contribute to the maintenance of such habitat networks and /or species populations. Sites maintaining habitats or species identified in Regional Biodiversity Action Plans based on national rarity or local distribution. Other sites of significant biodiversity importance (e.g. sites relevant to Local Biodiversity Action Plans).
Local (lower conservation value)	Sites not in the above categories but with some biodiversity interest. Examples of lands of lower ecological value include; intensive agricultural lands and coniferous forestry.
Negligible conservation value	Sites with little or no local biodiversity interest.

Table 6.2: Factors to be considered when assessing magnitude of ecological impacts

Parameter	Description
Extent	The area over which an impact occurs.
Duration	The period required for a feature to recover or be replaced following an impact. Duration of an activity may have a shorter duration than the impact of the activity.
Reversibility	A permanent impact is one from which recovery is unlikely within a reasonable timescale. A temporary impact is reversible either through natural recovery or because of mitigation.
Timing and frequency	In some cases, an impact may only occur if it occurs during a critical season or part of a species' life-cycle, and may be avoided by careful scheduling of work activities. Frequency of an activity may also affect the magnitude of its impact by reinforcement of the impact.

Table 6.3: Criteria for assessing magnitude of ecological impact

Significance	Description
Severe adverse	The development fails to satisfy the subject environmental objective and results in major fundamental deterioration of the environment at national and international levels of importance. Proposed development activities will result in a major alteration to the baseline ecological conditions, resulting in fundamental change and major environmental deterioration. Large adverse impacts are attributed to any significant adverse impact on habitat and species (or other valued ecological receptors) identified as being of International significance. Highly significant impact, warrants refusal of planning permission.
Major adverse	The proposal (either on its own or in-combination with other proposals) may adversely affect the site, in terms of coherence of its ecological structure and function, that enables it to sustain the habitat, complex of habitats and/or the population levels of species of interest.
Moderate adverse	The site's integrity will not be adversely affected, but the effect on the site is likely to be significant in terms of its ecological objectives. If it cannot be clearly illustrated that the proposal will not have an adverse effect on integrity, then the impact should be assessed as a major adverse.
Minor adverse	Neither of the above applies, but some minor adverse impact is evident. (In the case of Natura 2000 sites a further appropriate assessment may be necessary if detailed plans are not yet available).
Negligible	Very minor alteration to one or more characteristics, features or elements.
Neutral	No observable impact in either direction.

Table 6.4: Factors to be considered when assessing ecological significance of impacts

Factor	Defining criteria
Site integrity	Extent to which site/ecosystem processes will be removed or changed. Effect on the nature, extent, structure and function of component habitats. Effect on the average population size and viability of component species, size and viability of component species.
Conservation status	Habitats: conservation status is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area. Species conservation status is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area. Conservation status may be evaluated for any defined study area at any defined level of ecological value. The extent of the area used in the assessment will relate to the geographical level at which the feature is considered important.
Probability of expected outcome	Known or likely trends and variations in population size/habitat extent. Likely level of ecological resilience.

Table 6.5: Significance of impacts

Significance	Description
Severe adverse	The proposal (either on its own or with other proposals) is likely to adversely affect the integrity of a European or nationally designated site, in terms of coherence of its ecological structure and function, across its whole area, that enables it to sustain the population levels of species of interest, or is likely to adversely affect the numbers, distribution or viability of a species or population of conservation concern. A major change in a site or feature of local importance may also enter this category.
Major adverse	The integrity of a European or nationally designated site will not be adversely affected, but the effect on the site is likely to be significant in terms of its ecological objectives. If, in the light of full information, it cannot be clearly illustrated that the proposal will not have an adverse effect on integrity, then the impact should be assessed as very large adverse.
Moderate adverse	The proposal may adversely affect the integrity of a locally important conservation site, or may have some adverse effect on the numbers, distribution or viability of a species or population of conservation concern.
Minor adverse	None of the above applies, but some minor negative impact is evident. (In the case of Natura 2000 sites a further appropriate assessment may be necessary if detailed plans are not yet available).
Neutral	No observable impact in either direction.
Minor beneficial	The development partly satisfies the subject environmental objective and partly contributes to the environmental context. Proposed development activities will result in minor improvements to baseline ecological conditions and should result in minor environmental gains. Slight beneficial impacts can be attributed to benefits to any valued ecological receptors. Environmental gains which can easily be achieved through standard practices.
Moderate beneficial	The development satisfies the subject environmental objective and contributes to the environmental context. Proposed development activities will result in recognisable improvements to baseline ecological conditions and will result in notable environmental gains. Moderate beneficial impacts can be attributed to benefits to any valued ecological receptors where improvements are expected to be significant.

Significance	Description
	Environmental gains which require detailed design consideration – potentially employed to offset slight/moderate adverse impacts elsewhere.
Major beneficial	The development satisfies the subject environmental objective and results in a major contribution to the environmental context. Proposed development activities will result in quantifiable improvements to baseline ecological conditions and will result in significant environmental gains. Large beneficial impacts are only attributed to substantial benefits to valued ecological receptors identified as being of National or International importance and where such benefits will result in the consolidation and/or expansion of areas of habitats or ensure the security and/or expansion of viable populations of species. Environmental gains which require very detailed design consideration – potentially employed to eliminate and offset potential significant adverse impacts elsewhere.

6.115 Cumulative impacts may also arise. Other projects that have been included in the cumulative impact assessment are:

- Wind farm projects which have received planning consent; and
- Other development projects with valid planning permissions, and for which formal EIA is a requirement or for which non-statutory EIA has been undertaken. Other projects should be included as appropriate, subject to consultation with DOE Planning and other statutory bodies. The cumulative impacts of different projects are assessed against the significance criteria outlined in **Table 6.6**.

Table 6.6: Criteria for assessing the significance of cumulative effects

Significance	Effects
Severe	Effects that the decision-maker must consider as the receptor/resource is irretrievably compromised.
Major	Effects that may become key decision-making issue.
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Effects that are locally significant.
Not Significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

Baseline Conditions

Consultation and Desk Study Results

6.116 A copy of relevant consultee responses is provided in **Appendix 6.1**. The results of the desk study detail designated nature conservation sites and/or ecological records of protected species or species of natural heritage importance within 2km of the Planning Application Boundary.

Plants of additional conservation interest

6.117 The food plant (devil's-bit scabious *Succisa pratensis)* of the marsh fritillary butterfly *Euphydryas aurinia* is present locally at a low density along a stream bank in field 3 and is occasional as a component of marshy grassland in fields 1 and 2. The insect is fully protected in Great Britain and Northern Ireland under the Bern Convention (Annexe II) and EC Habitats and Species Directive (Annexe II). The Wildlife (Northern Ireland) Order 1985 Schedule 5 protects the species at all times and Schedule 7 makes it an offence to sell live or dead specimens.

6.118 No examples of bog myrtle *Myrica gale* (food plant for the larvae of the argent and sable moth *Rheumaptera hastate*, a UK priority species) were found on the site.

Site Overview

6.119 The site is located in the vicinity of Scawt Hill, Co Antrim. The site occupies a broad ridge and adjacent slopes, rising to a maximum height of 381m at Black Hill (IGR D329107), oriented north to south and sub-parallel to the local coastline of the Irish Sea. The site "Blue Line" area under the control of the applicant encompasses an area of approximately 570ha that is approximately 4.3 km in length and varies between approximately 1.2 and 2.0 km in width. The reduced survey area that encompasses the four fields that are the proposed location of the turbines, substation and internal access tracks is approximately 3.0km long and around 1.3km wide and occupies an area of approximately 400ha.

6.120 The Site includes three marked summits and numerous minor hillocks and intervening, mainly small-scale, valleys. The eastern limit of the Site follows the edge of the Antrim Plateau, from which the ground falls steeply towards the east. The slopes along the western side of the Site are gentler and fall away into the Glenarm River valley. The entire site is enclosed, with large fields, in some cases over 1 km wide, usually separated by stone walls. Fields generally represent separate management units, and vegetation may vary markedly between adjacent fields. The presence of well-marked field boundaries therefore provides a convenient and meaningful means of sub-dividing the site to facilitate habitat description. Fields have therefore been numbered 1-7; locations are mapped in **Figure 6.3.**

6.121 The dominant habitats are grassland types that have been modified considerably by intensive grazing, mostly by sheep, although cattle were observed on the lower land to the south of the site. Species-poor acid grassland is dominant over higher ground, with extensive areas dominated by mat-grass *Nardus stricta*.

6.122 Lower gradient slopes or hollows, and the mid to lower western slopes of the site are often occupied by marshy grassland, with sharp-flowered rush *Juncus acutiflorus* the dominant species. Marshy grassland is generally also species-poor, with a low density and diversity of wetland forbs. The most frequent forb is often white clover *Trifolium repens*; creeping buttercup *Ranunculus repens* and meadow buttercup *R. acris* are locally frequent. Wetland herbs most frequently encountered are marsh thistle *Cirsium palustris,* marsh willowherb *Epilobium palustris* and lesser spearwort

Ranunculus flammula. In places, rush-dominated marshy grassland grades into a sharp-flowered rush/purple moor-grass *Molinia caerulea* community. This community is species-poor and is excluded from the purple moor-grass and rush pasture Priority Habitat on that account (DAERA 2018)[6].

6.123 Fields to the south of the developable area, through which the proposed access to the public road network will pass, mainly support species-poor, heavily grazed semi-improved grassland, with isolated stands of tall ruderal herbs such as creeping thistle *Cirsium arvense* and common nettle *Urtica dioica*.

6.124 There are limited areas of species-rich lowland acid grassland and fen. Residual areas with communities typical of blanket bog are locally present on flatter ground.

6.125 The following account will provide brief descriptions of the occurrence and distribution of Phase I habitat types, followed by a more detailed differentiation of habitats, based on NVC Phase II quadrat data, across the site as a whole. A further section describes the Phase II NVC survey of, specifically, proposed turbine locations. TN denotes a target note, the locations of which are to be found in Figure 6.4. The appendix also contains site photographs, quadrat data and a list of plant species found during the surveys. Site photographs are also referenced in the relevant Target Notes.

Phase I Habitat Types

6.126 The broad habitat types differentiated by Phase I methodology are described below.

B1 Acid grassland

6.127 Mat-grass-dominated species-poor acid grassland is characteristic of much of the higher ground in the site, and the species may be almost monocultural over extensive areas (Fields 1-4). The grassland may occasionally have a more heathy aspect, but is universally species-poor.

6.128 Restricted areas of relatively-species-rich acid grassland are scarce, occurring in restricted areas of Field 5. Sedge-rich patches also occur along a stream bank in Field 5.

B5 Marshy grassland

6.129 Rush-dominated marshy grassland occurs as a broad belt along much of the western edge of the site (Fields 1-3). This area is generally dominated by sharp-flowered rush *Juncus acutiflorus,* although purple moor-grass *Molinia caerulea* is locally important in Field 1. This rush-pasture is generally species-poor, supporting sparse wetland and ruderal forbs, but devil's-bit scabious is sparsely present.

[6] DAERA 2018: Habitat Guide. Purple moor-grass and rush pasture.

6.130 Elsewhere, rush pasture dominates a valley and basin in the central part of Field 3 and more or less isolated patches of rush-dominated species-poor grassland are dispersed in damper areas across the site.

6.131 Fields in the south of the site are occasionally dominated by rush species (Field 4), but rush pasture is found in a patchwork with semi-improved grassland (Fields 6). These areas of rush pasture support a restricted range of common forbs but are invariably species-poor.

B6 Poor semi-improved grassland

6.132 Much of the southern part of the site (Fields 5-7) supports semi-improved grassland, generally dominated by perennial rye-grass *Lolium perenne*. Field 7 has occasional stands of soft rush *Juncus effusus,* common nettle and creeping thistle. Other forbs in this field are limited mainly to white clover *Trifolium repens* and creeping buttercup *Ranunculus repens*.

6.133 Soft rush is more extensive in some fields and forms a mosaic with semi-improved grassland in Field 5. The acidophilous origins of the grassland is more marked in Field 6, where mat grass is present and may be widespread

C3.1 Tall ruderal

6.134 Dispersed stands of creeping thistle and common nettle are present in semi-improved grassland fields towards the south of the site.

E1.7 Wet modified bog

6.135 Field 4 includes shallow hollows within a broader area of heathy acid grassland that is likely to represent a transition from former extensive blanket bog. Desiccated *Sphagnum* in the hollows may be residual elements of the former bog that have survived on a slightly wetter substrate. possibly cut-over in the past, that supports poor blanket bog communities on deep peat.

6.136 A broad basin in Field 3 supports abundant *Sphagnum* species, although these were largely in a desiccated state at the time of survey. *Calluna* is generally patchy but is locally dominant.

6.137 A cut-over basin at the southern end of Field 2 is saturated, with occasional pools along cut edges. Hollows are often dominated by bog asphodel *Narthecium ossifragum*, which occasionally forms extensive lawns. *Sphagnum* spp are locally abundant. The western edge grades into relatively species-rich fen.

E1.8 Dry modified bog

6.138 Patches of dry, *Calluna*-dominated modified bog occur in Field 3 along the edge of the channel that drains the wet modified bog noted in Field 2. Field 3 also supports patches of hare’s-tail cottongrass modified bog.

E3 Fen

6.139 Wetter areas, for example on flatter ground below exposed bedrock, occasionally support a slightly more diverse, though never species-rich fen habitat. Restricted areas of fen occur in Fields 1, 3 and 4.

F2.1 Marginal vegetation

6.140 Edges of a wet basin in Field 2 support relatively species-rich wetland vegetation.

GI Standing water

6.141 A number of small pools are present in cutover bog in Field 2.

G2 Running water

6.142 Minor streams drain westwards towards the Glenarm River.

Phase II NVC Habitat Surveys

6.143 The NVC communities identified during the survey are listed below:

- M6 *Carex echinata-Sphagnum fallax/denticulatum* mire
- M10 *Carex dioica – Pinguicula vulgaris* mire
- M10a *Carex viridula ssp. Oedocarpa - Juncus bulbosus* mire
- M15 *Trichophorum cespitosum-Erica tetralix* wet heath
- M17 *Trichophorum cespitosum-Eriophorum vaginatum* blanket mire
- M18 *Erica tetralix-Sphagnum papillosum* raised and blanket mire
- M19 *Calluna vulgaris-Eriophorum vaginatum* blanket mire (modified)
- M20 *Eriophorum vaginatum* blanket and raised mire
- M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture
- M25 *Molinia caerulea – Potentilla erecta* mire
- MG6 *Lolium perenne - Cynosurus cristatus* improved permanent grassland
- MG7 *Lolium perenne* reseeded grassland
- S9 *Carex rostrata* swamp
- U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland
- U5 *Nardus stricta-Galium saxatile* grassland
- U6 *Juncus squarrosus-Festuca ovina* grassland

Field Units

Field 1

6.144 An extensive field (approximately 0.5km x 1.3km) that supports markedly uniform, low diversity vegetation communities. Much of the field is dominated by mat-grass grassland (Photograph 1) with purple moor-grass locally important towards its western side, and with rushy grassland on flatter ground (TN 1-3). Q1-Q7 along the access routes connecting T1-T4 illustrate the dominance of U5 *Nardus stricta-Galium saxatile* grassland. Although *Nardus* is generally the markedly dominant species, occasional quadrats (Q5, Q6) have lower cover values, but are always grass-dominated and are species-poor.

Field 2

6.145 An extensive field (approximately 0.5km x 1.3km) that generally supports mat-grass-dominated species-poor acid grassland on higher ground (TN 4, 5). U5 *Nardus stricta-Galium saxatile* grassland is the dominant community here (Q8, Q9), but U6 *Juncus squarrosus-Festuca ovina* grassland (Q10) also occurs along the access track route. Rush-dominated marshy grassland becomes increasingly dominant on lower slopes towards the western boundary of the site (TN 5-8, Photograph 2). A cut-over basin mire adjacent to the boundary with Field 3 is partially fenced, perhaps to prevent stock entering hazardous, saturated ground with occasional pools (TN 9, Q11, Q12). Edges of the basin support a relatively species-rich marginal vegetation (TN 10, Q13). The mire topography may reflect the residual effects of past cutting of formerly more extensive blanket mire.

Field 3

6.146 An extensive field (approximately 0.9km x 1.3km), with the overall ridge feature divided by a north-south trending central valley. The western side of the ridge falls away with moderate slopes towards the west, while the eastern site boundary falls away steeply. Higher ground is generally dominated by species-poor acid grassland, often dominated by mat-grass (TN 11-13, Q14-Q15, Q17-20), although species-poor heathy acid grassland is occasionally present (TN 14). Some areas are closer to U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (Q16), but *Nardus* is always at least frequent in this area. The central valley is more diverse, with a broad, rush-dominated channel (M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, Q25), dry at the time of survey, (Photograph 20) draining a depression that is also rush-dominated (TN 15-17). *Eriophorum vaginatum* is locally frequent (Q24), with low cover values of *Sphagnum*-species, possibly a legacy of former widespread blanket bog communities. This community, with *E. vaginatum* and *J. acutiflorus* equally frequent, suggests a development of M23 from M20 *Eriophorum vaginatum* blanket and raised mire. A rushy flush is present at the edge of a shallow valley (TN 18). Patches of modified bog M19 *Calluna vulgaris-Eriophorum vaginatum* blanket mire occur along the channel edge (TN 19, Q21; TN 20), where *Sphagnum* is locally frequent to abundant (TN 21, Q22) and there are occasional pools (Q24). *Calluna* is generally patchy (Q22) but is locally dominant. These modified bog habitats have a heath-like aspect, approaching M15 *Trichophorum cespitosum-Erica tetralix* wet heath although occurring on deep peat. A swathe of M20, generally *E. vaginatum*-dominated blanket bog vegetation is present to the east of the channel (Q 24, Q24a). Locally, communities approaching M18 *Erica tetralix-Sphagnum papillosum* raised and blanket mire are present here (Turbine 6, Q1). A further, more restricted area of M20 occurs near the southern boundary of the field (Q23). The western slopes are generally rush-dominated (TN 12, 22-24), rarely with significant forb diversity (TN

25) although a flushed area is relatively species-rich (TN 18). Devil's-bit scabious is sparsely present.

Field 4

6.147 This extensive field (approximately 1.0km x 1.3km) occupies part of the undulating ridge with two marked summit areas, including Scawt Hill. Most of this eastern part of the field supports species-poor, often almost monocultural, *Nardus*-dominated acid grassland (TN 24, 27, 28, Photograph 3). Occasional heathy variants are more species-rich (TN 30, Photograph 4). Central parts of the field are also generally dominated by U5 *Nardus stricta-Galium saxatile* grassland (Q26-29), but heavy grazing pressure is reflected by locally high cover values of *Juncus squarrosus* (U6 *Juncus squarrosus-Festuca ovina* grassland, Q30-Q32). U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland may be frequent in grass-dominated stands that tend to be heavily grazed (Q33-35, Turbine 13, Q1, 2). There have been localised attempts at improvement, resulting in areas of MG6 *Lolium perenne-Cynosurus cristatus* improved permanent grassland (Q36). Grassland that is so heavily grazed that differentiation is not possible (Q36a) may be included in this community. A shallow basin near the southern edge of the field, possibly cut-over in the past, supports poor blanket bog communities on deep peat (TN 29, 31, Photograph 5). Much of the ground towards the west of the field supports rushy, species-poor marshy grassland (TN, 32, Photograph 6, TN 42), although a rushy flush supports greater species diversity (TN 33). Two shallow basins near the southern limit of the field support mainly heathy or marshy acid grassland, with patchy *Sphagnum* cover (TN 34, 35). Locally, vegetation in these basins approach the appearance of M17 *Trichophorum cespitosum-Eriophorum vaginatum* blanket mire blanket bog (Q37), but it is restricted in area and constituent *Sphagnum* is frequently desiccated. More typically, M6 *Carex echinata-Sphagnum fallax/denticulatum* mire basin mire with high frequency of *Carex echinata* is also present (Q38).

Field 5

6.148 This field consists mainly of rushy, species-poor semi-improved grassland (TN 36), but acid grassland on the slope above a stream near its northern boundary includes relatively species-rich patches of U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (TN 37, Photograph 7, Q39).

Field 6

6.149 The site ridge rises to the summit of Ballycoos (361m). Vegetation consists primarily of species-poor semi-improved grassland and rush pasture (TN 38-40, Photograph 8). There are rare restricted patches of sedge-rich, though still species-poor, modified U5 *Nardus stricta-Galium saxatile* grassland (Q40).

Field 7

6.150 Field 7 comprises the southern end of the ridge that extends the entire length of the site. The eastern slope of the ridge is steep, while the western slope is gentler and becomes relatively flat towards its western end. The field is dominated by species-poor semi-improved grassland, with patchy stands of soft rush *Juncus effusus*, common nettle and creeping thistle (TN 41, Photograph 9).

Phase II NVC Survey - Turbine Locations

Turbine 1

6.151 The proposed location for Turbine 1 (T1) is towards the northwest corner of Field 1. The Turbine 1 centre point is located on a small bedrock knoll (Quadrat Q1) within an area that is generally dominated by species-poor mat-grass *Nardus stricta*-dominated NVC U5 *Nardus stricta-Galium saxatile* acid grassland. The dominance of *Nardus*, reaching 95% cover (Q4, Q6) in places indicates that the grassland here has been subjected to intense grazing pressure, as sheep find this species unpalatable and other grass species are preferentially grazed. More open parts of the grassland support a greater range of vascular plants and mosses (Q3), where an increase in perennial rye-grass *Lolium perenne* suggests that there may have been some localised attempts at improving the foraging potential of the habitat. The thin peat in this area has resulted in the formation of a number of small-scale flushes, which are of greater conservation interest (Q5). Quadrat 2 includes elements of both *Nardus* grassland and flush vegetation. Species found in flushes include common butterwort *Pinguicula vulgaris*, which, while not rare, appears to be scarce across the site. However, the flushes may be an impoverished variation of M10 *Carex dioica – Pinguicula vulgaris* mire, are often of low diversity (Q5) or support a range of mainly small sedges, and low cover of com mon herbs and mosses.

Turbine 2

6.152 The proposed location for T2 is towards the northern edge of Field 1. It is located on a gentle to moderate slope that is dominated by variably diverse, but mainly species-poor, *Nardus*-dominated U5 acid grassland. *Nardus* cover is high, up to 100% (Q2, Q4), where few other species emerge through the sward or are concealed beneath the grass mat. Elsewhere, restricted gaps in the sward allow small populations of common vascular species to survive (Q1). A restricted area of relatively level ground supports M10a *Carex viridula* ssp. *oedocarpa-Juncus bulbosus* mire with high cover of bulbous rush *J. bulbosus* and yellow sedge *C. viridula* (Q3). The mire is relatively species-rich but cover of other vascular species, apart from *Nardus*, and common mosses is low.

Turbine 3

6.153 The proposed location for T3 is towards the north-eastern corner of Field 1. The Turbine 3 centre point is on a bedrock or boulder outcrop on a gentle slope that is mainly dominated by U5 species-poor acid grassland. *Nardus* cover is often very high, with up to 95% cover (Q3). There has clearly been some agricultural improvement, with *Lolium* either frequent (Q1) or dominant (Q2) in MG7 *Lolium perenne* reseeded grassland.

Turbine 4

6.154 The proposed location for T4 is towards the southern edge of Field 1. Hare's-tail cottongrass *Eriophorum vaginatum* dominates the proposed location. Species composition is typical of species-poor M20 *Eriophorum vaginatum* blanket and raised mire, with occasional ericoids and low cover of acidophilous forbs and mosses (Q1, Q3). This habitat is widespread over much of this part of the site (Q3) and occurs in a large-scale mosaic with *Nardus*-dominated U5 species-poor acid grassland. *Nardus* is frequent within the mire habitat and there is a gradient of *Nardus* cover in the vicinity of Turbine 4 (Q2), with cover nearly complete in places (Q4).

Turbine 5

6.155 The proposed location for T5 is near the southern edge of Field 2. The proposed site is located on the moderate western slope of the site, where there is an extensive, broad band of marshy grassland with M23 rush-pasture dominated by *J. acutiflorus*. Rush cover is up to 100% (Q4), with low cover of a limited range of mainly acidophilous vascular plants and mosses (Q1-Q4).

Turbine 6

6.156 The proposed location for T6 is near the northern edge of Field 3. The proposed site is located within a mosaic of M18, M20 mire, U5 *Nardus* grassland and M23 rush communities. There is considerable variation over short distances (Q2). The M18 community is characterised by generally low cover values of *Calluna, E. vaginatum* and *Sphagnum papillosum* (Q1).

Turbine 7

6.157 The proposed location for T7 is on the gentle western slope of Field 3. The proposed location is in *Nardus*-dominated species-poor U5 acid grassland, within a broader acid grassland-M23 *Juncus acutiflorus* rush pasture mosaic. *Nardus* dominates most of the slope in the immediate vicinity of Turbine 7, reaching cover values of around 80% in places (Q1, Q4). Purple moor-grass *Molinia caerulea* is the only other grass species that attains significant cover, reaching 40% in Q3. Forbs and mosses are generally sparse. Q2 is an example of the *J. acutiflorus*-dominated component of the local mosaic. *Molinia* is the most important graminid and forbs and mosses are scarce.

Turbine 8

6.158 The proposed location for T8 in Field 3 on the ridge that lies along the central part of the site. It is at the boundary between tall soft rush M23 *Juncus effusus*-dominated marshy grassland and more open M20 *E. vaginatum*-dominated blanket bog communities. Rush-dominated communities are species-poor; rush cover is high (Q1, Q5) and is complete over much of the habitat. Openings in the rushes provide opportunities for generally restricted areas of species-poor U5 acid grassland, dominated by *Nardus*, to survive (Q2). Adjacent blanket bog communities on peat around 1m deep have high cover values for *E. vaginatum* (Q3, Q4). Other graminoid species are sparse, and the habitat supports a range of common acidophilous forbs at low densities. Ericoids are sparse and *Sphagnum* species are patchy and generally provide little cover.

Turbine 9

6.159 The T9 location is on the broad ridge in Field 3 that supports species-poor U5 acid grassland dominated by *Nardus*. Cover values for this species may reach 90% (Q3). Hard rush *Juncus squarrosus* occasionally forms a significant component of the vegetation (Q2), but other graminoids are generally sparse. A bedrock high to the west of the turbine location also has a high cover of *Nardus,* but also supports a significant proportion of well-grazed *Lolium* (Q4).

Turbine 10

6.160 The proposed location of T10 is on a moderate slope towards the west of Field 3 that is generally dominated by species-poor U5 *Nardus* grassland (Q1, Q2, Q4). *Molinia* is frequent and is locally dominant in an M25 mire community (Q3). Both forbs and mosses are scarce throughout.

Turbine 11

6.161 U5 *Nardus* grassland dominates a wide swathe of the slope and ridge crest on which the proposed site of T11 is located in Field 4. The T11 location is slightly more open than much of the grassland in this area, but the U5 grassland remains species-poor (Q1). Heavy grazing pressure is indicated by the high values of *J.squarrosus* in Q2 and Q3, resulting in the development of species-poor U6 acid grassland.

Turbine 12

6.162 The proposed location of T12 is on a level to gently sloping, rather uniform U5 acid grassland area dominated by *Nardus* with occasional *J. acutiflorus* tussocks, towards the western side of Field 4. This acid grassland is slightly more diverse than many of the *Nardus*-dominated communities on the site, with low cover values for a limited range of common sedges, forbs and brown mosses.

Turbine 13

6.163 Gently sloping, dry, heavily grazed, notably species-poor, U4 acid grassland characterises the location of T13 in the central part of Field 4. Graminids are generally dominant on thin soils. Elsewhere in the general vicinity of the proposed location, the presence of much *Lolium* provides evidence of localised improvement.

Turbine 14

6.164 Level to gently sloping ground, generally characterised by a constant presence of *Juncus acutiflorus* M23 marshy grassland, is the proposed location for T14, near the southern edge of Field 4. Rush cover is variable, with cover of 10%-60% in the quadrats sampled. Species diversity is generally low, but there is some variability between quadrats, with greater diversity in more open areas; the quadrat (Q2) with the lowest rush cover supports moderately diverse U5 acid grassland, with *Nardus* the dominant species. This quadrat supports a limited range of common forbs, ericoids and mosses, including sparse *Sphagnum* species, but none of these achieve high cover values. A high-water table is reflected in the local prominence of bottle sedge *Carex rostrata* and the presence of a number of wetland forbs in saturated ground (Q3*)*.

Designated Nature Conservation Sites

Internationally Designated Nature Conservation Sites

6.165 The site is within 2.9km of the southern section of Antrim Hills Special Protection Area (SPA) and around 6km from the northern section of the SPA. The SPA has been designated for its breeding populations of hen harrier *Circus cyaneus* and merlin *Falco columbarius*. Any potential impacts of the scheme on the designation features or conservation objectives of the designated site will be considered in Chapter 7; Ornithology of this EIA.

6.166 The site is approximately 7.0km to the southeast of the nearest point of the Garron Plateau Special Area of Conservation (SAC). The SAC has been declared for its blanket bog, which is the largest intact bog in Northern Ireland. Nutrient poor lakes on the site conform to EU Habitats Directive Annex I types. Locally, mineral enriched flushing provides the alkaline fens priority habitat, and in hollows on the wetter more level parts of the blanket bog, the influence of mineral rich water provides the transition mires and quaking bog systems. The site supports a number of rare plant species, including Marsh saxifrage *Saxifraga hirculus*.

6.167 Annex I habitats that are a primary reason for selection of this site are:

- Active blanket bog; and
- Alkaline fens.

Annex I habitats that are present as a qualifying feature but are not a primary reason for selection of this site are:

- Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*;
- Natural dystrophic lakes and ponds
- Northern Atlantic wet heaths with *Erica tetralix*; and
- Transition mires and quaking bogs

An Annex II species that is a primary reason for selection of this site is

- Marsh saxifrage *Saxifraga hirculus*

Nationally Designated Nature Conservation Sites

6.168 The NIEA consultation response notes that the following Areas of Special Scientific Interest (ASSIs) are within 7.5km of the centre of the development site:

ASSI251: Feystown

6.169 The site is approximately 0.77km to the west of the proposed development blue line. Feystown has been designated because it supports species-rich grassland. Species present include wood cranesbill *Geranium sylvaticum*, a Northern Ireland Biodiversity Action Plan (NIBAP) species.

ASSI023 Glenarm Woods

6.170 The site is approximately 0.5km to the west of the proposed development red line. The bulk of the site is made up of semi-natural woodland, which joined together make up the largest stand of semi-natural woodland left within the Antrim region. The woodland types present range from base-rich and flushed to strongly acidic, which accounts for the high number of associated woodland plant communities. These incorporate one of the richest woodland plant assemblages in Northern Ireland, including a large number of rare and notable woodland species.

ASSI369: Glenarm Woods Part 2

6.171 The site is approximately 0.7km to the west of the proposed development red line. The site has been declared an ASSI because of its wood pasture habitat and associated species, characterised by old, open-grown trees and shrubs which have significant amounts of standing and fallen dead wood. These old open-grown trees provide a specialist habitat for rare and uncommon species of invertebrates, lichens and fungi.

ASSI083: Scawt Hill

6.172 The site lies partly within the proposed development red line. Although the ASSI has been declared primarily for its geological features, both acid and base-rich grassland types are noted as secondary features.

ASSI399: Ballygalley Head

6.173 The site is approximately 4.3km to the east of the proposed development red line. Ballygalley Head has been declared as an ASSI because of its species-rich dry grassland and associated species, which include an important grassland fungi assemblage.

ASSI323: Little Deer Park

6.174 The site is approximately 1.0km to the east of the proposed development red line. Little Deer Park has been declared as an ASSI because of its species-rich dry grassland and earth science features. The vegetation at Little Deer Park is typically grass-dominated, with an important grassland fungi assemblage.

ASSI162: Straidkilly Wood

6.175 The site is approximately 4.5km to the north of the proposed development red line. Straidkilly Wood is one of the largest and least disturbed base-rich woodlands in north-east Antrim. It is of high quality with a well-developed structure and a good range of woodland floral communities.

ASSI391: Knock Dhu Sallagh Braes

6.176 The site is approximately 0.25km to the south of the proposed development red line. Knock Dhu and Sallagh Braes has been declared an ASSI because of the variety of earth science features, habitats and species that the site supports. The complex topography of cliffs, ravines and scree and the combination of basalt and limestone rock provides a wide variety of habitats at Knock Dhu and Sallagh Braes, making it one of the most important sites in Northern Ireland for mosses, including a number of rare species.

Locally Designated Conservation Sites

6.177 No Sites of Local Nature Conservation Importance (SLNCIs) are recognised in the Larne Area Plan 2010, the extant Local Development Plan. The Plan rather lists Nature Conservation Sites notified by RSPB and Ulster Wildlife Trust. Listed sites within 500m of the scheme red line are:

- Scawt Hill Escarpments, notable for its grassland plant assemblage;
- Glenarm Nature Reserve, important for its ancient woodland and parkland, and partly within the Glenarm Woods ASSI;
- Feystown Nature Reserve, adjacent to the Feystown ASSI and supporting similar species-rich grassland;
- Ballycoos Heath, with bog habitats within the scheme red line;
- Robin Youngs Hill, notable for its plant assemblage; and
- Knockdhu Escarpment, notable for its plant assemblage.

6.178 Blanket bog at Scawt Hill and between Knockdhu and Sallagh Braes is listed in “Other Sites of Nature Coservation Significance” in the Area Plan.

6.179 The NIEA Natural Environment Map Viewer maps Local Wildlife Sites, which are equivalent in conservation interest to SLNCIs. Sites within 500m of the scheme red line are:

- Sugarloaf Hill, near the eastern edge of the northern part of the site;
- Doonameenock, approximately 0.3km to the east of the site; and
- Tummills Hill, approximately 0.5km to the east of the site.

Biodiversity Action Plan (BAP) Habitat Action Plan habitats

6.180 NIEA requires reference to be made to any potential impacts of the scheme on habitats that are the subject of Northern Ireland Habitat Action Plans (HAPs). There are significant areas of blanket bog and heath habitats within the site Red Line, but these are mostly outside that part of the site that will be affected by construction or operation of the proposed wind farm.

Blanket bog

6.181 Modified bog habitats in Field 2 retains a high-water table, supports locally abundant *Sphagnum* species and is likely to be an area of active peat. Dry heath-like habitat in Field 3 is on deep peat. However, past cutting has resulted in a lowered water table and *Sphagnum* species are generally scarce. The heath is now depauperate and peat is unlikely to be active. The heath habitat lies along the edge of an extensive area of more intact *E. vaginatum*-dominated blanket bog habitat, in a large-scale mosaic with rush-dominated marshy grassland. *Sphagnum* species are present at generally low cover values in the bog community. Heathy acid grassland

and relatively *Sphagnum*-rich (although largely desiccated at the time of survey) hollows near the southern limit of Field 4 also probably mark the location of former blanket bog.

Purple moor-grass and rush pastures

6.182 *Molinia* is a frequent constituent of bog, heath and marshy grassland communities, and *Juncus* species are important in defining the extent of much of the marshy grassland on the site. However, there are no species-rich variants of these communities, and no examples of the priority habitat were found on the site.

Rivers

6.183 Minor streams that drain parts of the site are examples of the priority habitat, since they are headwater streams that contribute to the waters of the local major stream, the Glenarm River. The streams on the site have a natural aspect but, because of their youthful stage do not support significant vegetation communities.

Species Action Plan species

6.184 Several non-avian species for which NIEA has published Species Action Plans (SAPs) occur or may occur in the study area. SAP species that are known to occur or may occur at the site include; Irish hare, all bat species (the subject of an all-Ireland SAP) and otter. Occurrence of and significance of impact on these species are discussed below.

Existing Ecological Records (NIPS)

Plants

6.185 The desk study produced historical records of a number of Northern Ireland Priority Species (NIPS), BAP or Red/Amber-listed or species of conservation concern (as defined by CEDaR). There are nineteenth century records of heath cudweed *Gnaphalium sylvaticum* and small white orchid *Pseudorchis albida* from Scawt Hill. Although not specifically searched for, it is likely that prolonged intensive grazing since that time has reduced the likelihood that these species have persisted at this site. CEDaR also records the presence of wood cranesbill *Geranium sylvaticum* at Ballygilbert. These records likely refer to the extant population at Feystown ASSI, to the west of the proposed development area.

Mammals

6.186 There are CEDaR records of Irish hare *Lepus timidus hibernicus,* pine marten *Martes martes* and red squirrel *Sciurus vulgaris* from Scawt Hill/Sugarloaf Hill. Irish hare is likely to be at least an occasional visitor to the site, while pine marten and red squirrel are more likely to be present in wooded areas outside the proposed Development area.

Species Baseline

Bats

6.187 A site visit was undertaken during April 2019 to consider the potential value of habitats and landscape features within 200m of the site (i.e. the study area). The presence of any features that could support maternity roosts and significant hibernation and/or swarming sites (both of which may attract bats from numerous colonies from a large catchment) within 200m plus rotor radius of the boundary was also considered.

6.188 The landscape surrounding the site consists of several features that have potential to provide habitat for bats, notably open moorland, acid grassland; ponds as well as several watercourses. However, overall habitat quality is poor due to a combination of the exposed nature of the site and the high grazing pressure from livestock which have resulted the site having very limited shelter and vegetation in order to provide suitable foraging conditions.

6.189 Thence, the overall foraging potential of the study area is considered 'poor' as it comprises mostly heavily grazed degraded blanket bog, heath and marshy grassland. However, the site is connected to the wider landscape by linear features (i.e. minor watercourses) that could be used by commuting bats. Habitats and landscape features that may be used by bats are illustrated on **Figure 6.3**.

6.190 The overall potential of the site was of 'low' value taking into consideration the landscape of the general area, the habitats and landscape features identified on the site, the distance from the proposed (14) turbines and the potential use of the site by bats for roosting, foraging and/or commuting.

Manual Bat Activity Surveys

6.191 The bat activity surveys aimed to determine the level of bat activity within the Site. The results provide information on species composition and qualitative information on temporal and spatial bat activity patterns, such as the location of key foraging areas and commuting routes. The full results of bat activity surveys can be found in **Appendix 6.3**, while the (5.4km) transect route and associated listening stops are illustrated on **Figures 6.7(a, b & c)**.

Table 6.7: Dates, times and weather conditions bat activity surveys (transects)

Date	Sunset	Sunrise	Start / Finish	Weather Conditions		
				Temp	Wind (mph)	Cloud
21st May 2019	2135		2120 - 2350	12ºC	1-2	60%
17th June 2019	2205		2150 - 0020	14ºC	1-2	50%
16th Sep 2019	1940		1925 - 2155	11ºC	0-1	35%

6.192 A total of 15 hours of recording time was saved across the three manual bat activity surveys. During this time, an estimated number of 12 bat passes were recorded across the survey season. A total of three dusk surveys were completed. See **Appendix 6.3** for details regarding the estimated number of bats encountered during the manual transect surveys.

6.193 Temporal patterns of bat activity most likely reflect changing weather conditions across the survey season. Bat activity was low during all transect surveys. All surveys were completed during settled periods of weather, which would yield more representative results.

6.194 The results of bat activity surveys confirmed commuting (primarily at dusk) and foraging activity within the site. The results yielded low numbers of bats which would corroborate the initial assessment of Ballygilbert as a 'low' value site for bats.

6.195 The bat species recorded during activity surveys included Pipistrelle spp., common pipistrelle, soprano pipistrelle and Leisler's bat. A summary of the bat activity survey results can be found in paragraphs 6.195 to 6.198. A visual representation of the spatial variation in bat activity for each survey can be found on **Figures 6.7 (a, b & c) Bat Transect Results**.

6.196 The spring transect only yielded three bat passes, all from *P. pipistrellus*.

6.197 The summer transect yielded only seven bat passes for the two most commonly encountered species on the site. Three of the five bat passes for *N. Leisleri* were recorded along the western edge of the site near to the proposed Habitat Management Area C (which is remote from any turbine locations), with the remaining pass recorded from over the area of peatland. The *P. pipistrellus* (2) calls were all recorded in the same area (also near the peatland).

6.198 The autumn transect also yielded low numbers with four bats recorded. The three bats (2 *N. leisleri*, 2 *P. pipistrellus* were all recorded between southeast of T8.

Automated Passive Monitoring

6.199 Automated passive monitoring was undertaken at the site across spring, summer and autumn during 2019. Monitoring took place at all turbine locations and a range of 'paired' habitat features (see **Figure 6.4 – Static Detectors**).

Table 6.8: Automated Monitoring carried out (across 10 nights) during 2019[7]

	Date of Deployment		
Location	May	July	Sept
T1, T2, T3	23rd	19th	17th
T4, T5, T6, T7, T8	23rd	9th	17th
T9, 10	6th	9th	17th
T11, T12, T13, T14	6th	19th	17th

[7] Where developments have more than ten turbines, detectors should be placed within the developable area at ten potential turbine locations plus a third of additional potential turbine sites up to a maximum of 40. (SNH 2019).

6.200 Across the three seasons (spring, summer & autumn), automated monitoring was carried out for 30 nights (estimated total hours = 3920 hours (based on an average of eight hours recording per night (although night length varies across the survey season)). Bat species recorded during automated passive monitoring included; common pipistrelle, soprano pipistrelle, pipistrelle spp., Nathusius pipistrelle, Leisler's bat, Myotis species. (*Myotis daubentonii*, *M. nattereri* and *M. mystacinus*) bat are the most difficult species to identify and are therefore collectively referred to as *Myotis* bats (Russ 1999[8] & Russ 2012[9])), as well as a few records for brown long-eared bat.

6.201 **Appendix 6.3** contains Bat Activity Indices (BAI) for the static surveys, broken down by location (see **Figure 6.6 - Static Detectors**). These indices are based on the total number of files (containing a recording) of each species, divided by the total number of survey hours for that location.

6.202 Overall, only 740 bat passes were recorded at the 14 proposed turbine locations across the entire 2019 survey season. The most commonly recorded bat was *N. leisleri*, with 481 bat passes (64.9%) of all activity at turbine locations (recorded during the automated monitoring sessions). There was 183 bat passes of *P. pipistrellus*, which accounted for 24.73%; and *P. pygmaeus* accounted for 57 (7.7%) of bat passes; taken together the pipistrelle species assemblage accounted for 32.43% of all activity. There were also 17 passes (2.3%) attributed to *Myotis spp;* the only other species recorded at the turbine locations was *P. nathusii* with two separate individual passes recorded.

6.203 Overall, during 400 nights of monitoring bat activity was either negligible or no bats were recorded (Appendix 6.3 contains a detailed breakdown of activity at each turbine during each night of monitoring). However, on two nights (09 July 2019 at T4 and 30 May 2019 at T5) the BAI (Bat Activity Index) exceeded 5.0 (i.e. >50 passes in a single night). Therefore, a BMMP (Bat Monitoring Mitigation Plan) has been recommended.

Other Mammals

Otter

6.204 The presence of this species within the site was not confirmed during otter surveys. There were no otter holts, foraging areas or field signs recorded. The watercourses within the site are small upland streams, which are devoid of any significant riparian vegetation. However, these small rivers flow downstream in to the Glenarm River which is home to otters. Therefore, there is the potential for otters to come upstream during dispersal of young animals or when travelling between the numerous minor catchments within the wider catchment.

[8] Russ, J. (1999) *The Bats of Britain and Ireland, Echolocation Calls, Sound Analysis and Species Identification*, Alana Ecology Ltd, Shropshire.
[9] Russ, J. (2012) *British Bat Calls, A Guide to Species Identification*, Pelagic Publishing, Exeter.

Badger

6.205 The results of the badger survey are presented in (confidential) Appendix 6.4.

Herpetofauna

Viviparous Lizard

6.206 Lizard *Lacerta vivipara* surveys commenced when the first thirty (500x500mm artificial refugia) were placed across the site on the 12th June 2019. This was followed up with a further twenty-eight on the 2nd September 2019). These were left in-situ for at least a week to allow the lizards to become acclimatised to their presence. This coincides with the NIEA Specific Requirements (in force at the time of survey) for this species, which states that "surveys should be carried out between March and October. With the best time for surveys to be undertaken is generally April-May and in September."

6.207 **Table 6.10** (below) outlines the results of the lizard surveys undertaken in September 2019.

Table 6.9: Results of the common/viviparous lizard surveys carried out during 2019

Date/Time	Weather	Results
11/09/19	14ºC sunny and calm	5 (4 recorded from refugia; 1 recorded along the walked transect)
23/09/19	13ºC Some cloud but mostly clear, intermittent light showers and sunny spells	No lizards recorded
25/09/19	14ºC Some cloud but mostly clear and sunny spells	No lizards recorded

6.208 A maximum total of 5 adult lizards were recorded using a total of four refugia (see **Figure 6.9**). The results of the common lizard surveys reveal a population score of 1 (low population[10]) (with 5 individuals recorded). It is likely that the habitats surrounding T3 as well as adjacent to T5 and T6 are optimal habitat for this species. Albeit, optimal habitat that is degraded via overgrazing. Whereas the habitats surrounding T1, T2 & T4 are poorer quality habitat for common lizard (i.e. improved grassland). Finally, the habitats surrounding T7, T8 & T9 are likely to be sub-optimal (due to heavy sheep grazing) but that lizards are likely to be present (at low population densities).

[10] Froglife Advice Sheet 10 Reptile Survey, an introduction to planning, conducting and interpreting surveys for snake and lizard conservation

Smooth Newt

6.209 The site is pockmarked with small permanent and ephemeral ponds. In particular there are perhaps ten small ponds in the area of peatland to the northeast of T6. Therefore, a Habitat Suitability Index (HIS) was carried out. The area was deemed 'poor' given the pH of the ponds, distance from woodland, altitude and isolation, however, a series of newt surveys were carried out as a precaution.

Table 6.10: Results of the 2020 (nocturnal) surveys for smooth newt

Date/Time	Weather	Results	Notes
25.03.20	Cool, 7ºC and clear with few clouds	No newts recorded.	No eggs were found.
29.04.20	15ºc, clear and bright, but breezy		
12.06.20	17ºC, cloudy and mild with little wind.		

6.210 During the unseasonably dry conditions which prevailed during Spring 2020 all but the small ponds within the peatland were completely dry during survey. In addition, the nocturnal surveys of the small acid ponds within the peatland did not yield any records of smooth newt. Therefore, the presence of smooth newt was not confirmed within the site during the ecology surveys. A brief survey report is included in **Appendix 6.5**.

Lepidoptera

Marsh Fritillary Survey

6.211 The presence of *S. pratensis* (the LHP of *Euphydryas aurinia*) was confirmed within the site.

6.212 Over the whole site there were a number of minor localised patches of *S. pratensis* recorded, each patch was estimated to contain between 15 and 25 plants. In view of the limited extent of suitable habitat and the distance from any known breeding colonies, the site is considered to have negligible potential for breeding marsh fritillaries. The size and extent of these patches were too small to map at any meaningful scale.

6.213 The presence of marsh fritillary larval webs was not confirmed on any of these plants. This butterfly exists in a series of linked meta-populations, forming numerous temporary sub-populations, which frequently die out and recolonise. Where unable to do this, populations do not seem to be able to persist in habitat fragments.

6.214 In addition to this marsh fritillary is typically found in either dry calcicolous grassland or damp neutral or acidophilous grassland and mires. A common factor in many occupied sites is the presence of low-intensity cattle grazing which creates the preferred sward for the butterfly. The intensive sheep grazing across much of the site has created poor sward conditions and the absence of suitable habitat which is highly unlikely to favour marsh fritillary; therefore, this species has been removed from any further assessment.

Assessment of Impacts

General

6.215 Having defined the ecological baseline characteristics of the study area, it is necessary to describe the potential resultant scheme-related changes to the baseline and to assess the impact on valued ecological resources (CIEEM 2018)[11]. The process of identifying impacts refers to aspects of ecological structure and function on which a resource feature depends. Examples of aspects of ecological structure and function to consider when predicting impacts include (CIEEM 2018):

- Available resources (Territory: hunting/foraging grounds; shelter and roost sites; breeding sites; corridors for migration and dispersal; stop-over sites);
- Stochastic processes (Flooding, drought, wind blow and storm damage, disease, eutrophication, erosion, deposition and other geomorphological processes, fire and climate change);
- Ecological processes (Population dynamics: population cycles; survival rates and strategies; reproduction rates and strategies; competition; predation; seasonal behaviour; dispersal and genetic exchange; elimination of wastes. Vegetation dynamics: colonisation; succession; competition; and nutrient-cycling);
- Human influences (Animal husbandry, cutting, burning, mowing, draining, irrigation, culling, hunting, excavations, maintenance dredging, earth shaping, ploughing, seeding, planting, cropping, fertilising, pollution and contamination, use of pesticides and herbicides, introduction of exotics, weeds and genetically modified organisms and disturbance from public access and recreation, pets and transport);
- Ecological relationships (Food webs, predator-prey relationships, herbivore-plant relationships, herbivore-carnivore relationships, adaptation and dynamism);
- Ecosystem properties (Fragility and stability, carrying capacity and limiting factors, productivity, community dynamics; connectivity; source/sink; numbers in a population or meta-population, minimum viable populations; sex and age ratios; patchiness and degree of fragmentation);
- Ecological role or function (decomposer, primary producer, herbivore, parasite, predator, keystone species).

6.216 Impacts on ecosystem structure and function are assessed by reference to the following parameters:

- Positive or negative impacts, with international, national and local policies increasingly pressing for projects to deliver positive biodiversity outcomes
- Magnitude, or size of an impact, which in the case of habitat may be coincident with extent

[11] Chartered Institute of Ecology & Environmental Management (CIEEM) (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (September 2018).*

- Extent over which an impact is felt
- Duration of time over which the impact is expected to last prior to recovery or replacement of the resource or feature
- Reversibility, or whether an impact is permanent or temporary
- Timing and frequency of an activity, which may have different impacts depending on, for example, the season during which it is carried out.

6.217 EIA legislation requires the enumeration of significant negative or positive impacts of an activity on ecological features. An ecologically significant impact is here defined as an impact on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area (CIEEM 2018). The significance of an impact depends on the importance of a receptor as defined in **Table 6.1** and on the magnitude of the impact on that receptor as defined in **Table 6.2**. Receptor impacts may be averaged against each other to assess the significance of the impact of the scheme on the site's natural environment, but in some cases a single receptor, for example an internationally important species or habitat, may be of sufficiently critical importance that the magnitude of impact on that single receptor defines the significance of the impact on the site. The following narrative assesses the significance of the impact of the Development.

Construction Phase

6.218 Activities that may be associated with construction of the Development and that may generate impacts on the natural environment near the proposed scheme include:

- Disturbance of designation features/designated sites;
- Disturbance to protected species;
- Construction of hard surfaces for access roads, turbine bases and construction platforms;
- Construction on new ground, leading to habitat and population constriction and/or fragmentation;
- Storage of materials and plant, and construction of site compounds;
- Environmental incidents and accidents (e.g. spillages, noise and emissions;
- Excavation works;
- Removal and redistribution of topsoil and subsoil;
- Provision of temporary access routes;
- Disruption or modification of drainage;
- Vegetation clearance; and
- Implementation of landscape design and habitat management.

6.219 The significance of the potential effects of the proposed scheme on valued ecological receptors during the construction phase has been assessed and outlined in the following sections.

Permanent loss of habitats due to land-take

6.220 The footprint of wind farm infrastructure will involve permanent land-take, due to the construction of around 6.95km of new access track (and 0.88km of existing tracks that will be upgraded), and the construction of substation and control building, 14 crane pads and turbine bases (see **Chapter 1, Proposed Development**).

6.221 The design of the wind farm layout has evolved in part by taking into account the location of NI Priority Habitats and the NIEA, Natural Heritage, Development Management Team Advice Note – Active Peatland and PPS18.

6.222 The location of all 14 turbines and the route of the access tracks have been chosen, as far as is possible, to minimise impacts to habitats of conservation significance.

6.223 There is likely to be a limited effect on active blanket bog. T8 is located on the margin of an extensive area of the habitat. T6 is located in a mosaic of habitats of generally low conservation interest, of which a poorly-developed M18 bog community is a part. The other proposed turbine locations are separated via an adequate buffer from areas identified as blanket bog by habitats, mainly species-poor acid grassland, of lower conservation interest.

6.224 A species-poor flush is within the footprint of T1.

6.225 **Table 6.11** lists the NVC communities and habitat condition at each turbine location.

Table 6.11: NVC community and habitat condition at each turbine location

Turbine	NVC	Habitat condition
T1	U5	*Nardus*-dominated slope, with, locally moderate cover of common sedges (*C. viridula, C. binervis*).
	M10	Localised species-poor flush
T2	U5	*Nardus*-dominated acid grassland
	M10a	Localised species-poor flush, dominated by *C. viridula*
T3	U5	Majority of location dominated by *Nardus* grassland
	MG7	Knoll with *Lolium* reseeded grassland
T4	U5 M20	Mosaic of *Nardus*-dominated acid grassland and *E. vaginatum*-dominated heathy acid grassland.
T5	M23	*J. acutiflorus*-dominated species-poor rush pasture.
T6	M18, M23, U5	Small-scale mosaic of the three communities. M18 atypical, with low *Sphagnum* cover.
T7	U5	*Nardus*-dominated mosaic with rush pasture.
	M23	*J. acutiflorus*-dominated rush pasture in mosaic with acid grassland.
T8	M20	Margin of *E. vaginatum*-dominated blanket bog.
	M23	*J.effusus*-dominated marshy grassland
	U5	*Nardus*-dominated acid grassland
T9	U5	*Nardus*-dominated acid grassland
T10	U5	*Nardus*-dominated acid grassland
	M25	*Molinia*-dominated, species poor marshy grassland on slope
T11	U5	Species-poor acid grassland with much *Nardus*
	U6	Species-poor acid grassland with much *Juncus squarrosus*
T12	U5	*Nardus*-dominated acid grassland
T13	U4	Species-poor heavily grazed acid grassland.

Turbine	NVC	Habitat condition
T14	M23	*J. acutiflorus*-dominated marshy grassland
	U5	*Nardus*-dominated acid grassland grading into marshy grassland

6.226 In summary, **Figure 6.3** shows that four of the fourteen turbines, most of the access track, as well as the substation (and both temporary construction compounds) are in areas of improved/semi-improved grassland. The significance of the effect of this impact on a low value habitat is assessed as being negligible to minor and hence is acceptable without further mitigation.

Table 6.12: Habitat loss calculations by habitat type (M^2)[12]

Habitat	Loss
Semi Improved Grassland	7860
SIG/Acid Grassland	2375
Lowland Acid Grassland	1153
Acid Grassland/Marshy Grassland	70791
Species Poor Acid Grassland	22381
Poor Flush	244
Heathy Acid Grassland	587
Wet Heath	444
Swamp	110
Total	**105945 m^2**

6.227 The loss of approximately 0.22ha of wet heath/heathy acid grassland and lowland acid grassland habitats is a permanent and direct effect of medium to high magnitude on receptors of high value and sensitivity. The loss of 0.22ha of NI priority habitat is assessed to be an adverse effect of **moderate magnitude** on receptors of high value. Since land take (and hence habitat loss) will be long term, this means that the effect is of **moderate adverse significance** and further mitigation is required.

6.228 However, under the "*Biodiversity Net Gain Good practice principles for development*" and to achieve net gain locally to the Development while also contributing towards nature conservation priorities at local, regional and national levels. There will be management implemented to both enhance existing and also create new habitat. A Outline Habitat Management Plan is presented in Appendix 6.10.

Bats

6.229 Construction activities have the potential to remove foraging habitat or reduce its value, and to disrupt flight-lines. Studies in Britain indicate that most bat activity is near habitat features. Activity declines with distance from features such as treelines and woodland edge and is generally not significant at distances greater than 50 m

[12] Calculated using a continuous 2.5m buffer around all construction structures and a 7m wide track (5m for running surface and 1m either side for drainage.

(Natural England 2014[13]). This decline occurs both when bats are commuting and when foraging, although the decline is greater when animals are commuting. The potential impact of loss of feeding habitats may vary seasonally, with greater impact during the summer, and lower impact during migration.

6.230 Low numbers of bats were recorded foraging over the site, while the main bat foraging and commuting routes have all been avoided during the emplacement of infrastructure. A few river crossings will be required during construction, and therefore this may cause some limited disruption to foraging areas. However, most bat activity will likely continue as the main areas of better foraging along the wooded escarpment edges will remain untouched during construction activities and key commuting routes will therefore be unaffected.

6.231 The other main potential impact on bat populations that may arise due to construction is the loss of roost sites. However, no roosts were identified on the site during survey, and the nearest potential roosting location is 450 m away from the nearest turbine. Therefore, this impact will not arise at the Development. The magnitude of construction activities on bats is likely to be **neutral**, and the significance of the impacts will be **neutral**.

Otter

6.232 Impacts of construction works on otters includes damage to holts, disturbance at holts, disruption of dispersion and foraging routes and displacement of foraging or breeding animals. Disturbance of otters is possible during the construction phase, but the shy species is likely to avoid areas of intense human activity, particularly when this involves significant noise. Potential indirect impacts include adverse effects on fish prey species. The species is largely crepuscular in its habits, and it is likely that much of its activity will take place outside normal working hours. However, the reaction of individual otters to disturbance is unpredictable, with some inquisitive animals drawn to investigate work sites, whilst others avoid them. The likely sporadic nature of any use by otters of the site, indicates that there is highly unlikely to be any significant impact on the species as a result of construction activities. Magnitude of impacts is likely to be **negligible to neutral** and of **neutral** significance.

Badger

6.233 Potential conflicts with badgers (arising from construction) include damage to setts, disturbance at setts, and removal of foraging areas and displacement of foraging or breeding animals. Construction works may present additional hazards to badgers, with a potential for entrapment within excavations, accidental injuries on construction plant or materials, diversion from traditional trails by plant and site compounds and exposure to oils and other toxic materials.

[13] Natural England Technical Information Note TIN051 Third edition February 2014, Bats and onshore wind turbines Interim guidance.

6.234 There are numerous of badger setts located within the Development and thus there is the potential for such disturbance to occur. Badgers have crepuscular and nocturnal foraging habits, and it is unlikely that daytime construction activities will disturb or reduce the foraging range of the local social group. However, construction of access tracks, crane bases, foundations and erection of turbines will reduce the area available for foraging.

6.235 There is also the potential risk of displacement of sensitive animals unaccustomed to high levels of anthropogenic activities. The potential magnitude of impact (without mitigation) on badgers during the construction phase is moderate adverse magnitude and significance.

6.236 However, the location of known badger setts has been identified and taken into consideration during the emplacement of site infrastructure such that there are no sett entrances are within 25m of any infrastructure. In addition, the majority of setts near to areas of infrastructure are close to existing tracks and any disturbance impact if likely to be ameliorated by this fact. As a result of this mitigation measure, the potential impacts are of **minor adverse magnitude** and **minor significance** during construction.

Common Lizard

6.237 Construction of infrastructure will remove habitat for this species and cause disturbance leading to displacement of animals over a limited area of the site. It also has the potential to impact the habitat feature/requirements that lizards need within suitable habitat; this includes areas for basking, foraging, diurnal shelter and hibernation. The recorded use of the site by this species indicates that these impacts have the potential to be of **moderate adverse magnitude** and of **moderate adverse significance**. Therefore, mitigation is required (see paragraphs 6.306 – 6.315).

Operational Phase

6.238 Characteristics of wind farms that may generate impacts on the natural environment in the vicinity of the proposed scheme include:

- Replacement of former semi-natural habitats by turbines and associated infrastructure;
- Use of a swept volume of air space by turbine rotors;
- Vehicular use of access routes; and
- Improved access to remote sites.

6.239 Many of the impacts on biological receptors noted for the construction phase are also relevant during the operational phase. However, effective land take is reduced following the construction phase, as temporary site compounds and vehicle and plant running surfaces are returned to their former vegetation cover, and disturbance pressures arising from human presence along the route are significantly reduced.

6.240 Impacts on valued ecological receptors are outlined below.

Habitats

6.241 No adverse effects on vegetation communities and habitats are anticipated during the operation of the Development. Significant positive effects, through habitat restoration and enhancement, i.e. the reinstatement of heathland and blanket bog are anticipated through implementation of the outline HMP (Habitat Management Plan) in Appendix 6.10.

Bats

6.242 The main potential impacts on bats during the operational phase arise from collision with rotors and from 'barotrauma', the often-fatal injuries that occur as a result of bats flying through air of rapidly changing atmospheric pressure in the immediate vicinity of a moving blade. The turbines have been located away from the habitat features that many species of bat use as flightlines or as a focus for foraging.

6.243 There is potential for loss of foraging area because bats may avoid a turbine site. Alternatively, there is some evidence that bats may be attracted to turbines (Kunz et al 2007[14]), possibly because insects may congregate in these locations as a response to the heat radiating from the structures (Ahlén 2003[15]). This effect is most likely to occur in calm conditions, or at low wind speeds, when collision risk for bats is likely to be at its highest.

6.244 A further possible operational impact is that ultrasound emissions from turbines may interfere with bats' echolocation capabilities. The literature addressing this effect is sparse and it is likely that impacts on Irish bat species is limited (European Commission 2010[16)]. **Table 6.13** outlines the bats likely to be at risk from wind turbines.

6.245 Seasonal variation in impacts of operational turbines on bats in Ireland is at present not fully understood. Movement of bats over long distances within a limited time period may produce a concentration of animals that are available for collision. Studies have shown that there is a peak in mortality in late summer and autumn during dispersal and migration, and that migrating species are most susceptible (Rodrigues et al 2008[17]). However, it is not known to what extent Irish bats migrate, which species, if any, are involved, whether migration is on a broad or narrow front, and whether there are discernible migration routes. It has been suggested that

[14] Kunz, T.K., Arnett, E.B., Erickson, W.P., Alexander, A.R.H., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.W. & Tuttle, M.D. (2007) Ecological impacts of wind energy development on bats: questions, research, needs and hypotheses. - Frontiers in Ecology and the Environment 5: 315-324.R.

[15] Ahlén, I. (2003) Wind turbines and bats – a pilot study. - Report to the Swedish National Energy Administration, Dnr 5210P-2002-00473, P-nr P20272-1.R.

[16] European Commission (2010) Guidance on wind energy development in accordance with the EU nature legislation. European Commission, Brussels.

[17] Rodrigues, L., Bach, L., Duborg-Savage, M-J., Goodwin, J. & Harbusch, C. (2008) Guidelines for consideration of bats in wind farm projects. – EUROBATS Conservation Series No. 3, UNEP/EUROBATS Secretariat, Bonn.

collisions during migration may be exacerbated because echolocation is not used in order to save energy (Keeley et al 2001[18]).

6.246 Late summer and autumn are also the period during which there may be increased activity associated with finding mates, and differentiating between migration and mating-related causality of mortality at turbines is problematic (Cryan and Barclay 2009[19]). Recent research into Leisler's bat in Ireland (Boston, 2008[20]) showed that this species does not migrate long distances between summer ranges and hibernation sites. Leisler's have been shown to hibernate within Ireland and do not appear to migrate in numbers on a broad front. This is likely to significantly reduce the collision risk for this species in the Irish context. However, in the absence of definitive data for all species, it is not possible to assess the likelihood, and hence the significance, of collision risk during putative migration periods. **Table 6.13** outlines the risk of collision fatalities affecting bat populations identified from the site.

Table 6.13: Level of potential vulnerability of populations of N. Irish bat species[21]

		Low collision risk	Medium collision risk	High collision risk
Relative abundance	Common species			Common pipistrelle Soprano pipistrelle
	Rarer species	Brown long-eared bat Daubenton's bat		Nathusius' pipistrelle Leisler's Bat
	Rarest species	Whiskered bat Natterer's bat		

6.247 In the absence of mitigation, bats flying along the site would be potentially in close proximity to the rotor swept areas during foraging and commuting activity. This could potentially result in bat fatalities. Therefore, under the precautionary principle (and without mitigation) this project has the potential to have a **moderate adverse** impact magnitude, of **major adverse** significance during the operational phase. As a result, detailed mitigation by design has been developed and implemented. In addition to the layout design, a detailed BMMP has been recommended.

6.248 With mitigation, and based on currently available data on all species of (Irish) bat species, the impact magnitude can be reduced to **neutral** significance during the operational phase of the Development.

[18] Keeley, B., Uogretz, S. & Strickland, D. (2001) Bat ecology and wind turbine considerations. -pp135-141 in Schwartz, S.S. (2001, ed) Proceeding of the National Avian-Wind Power Planning Meeting IV, Carmel, CA, May 16-17, 2000.
[19] Cryan, P.M. and Barclay, R.M.R. (2009) Causes of bat fatalities at wind turbines: hypotheses and predictions. Journal of Mammalogy, 90(6):1330–1340.
[20] Boston (2008) Molecular ecology and conservation genetics of the Leisler's bat (*Nyctalus leisleri*) in Ireland. Unpublished Ph.D Thesis.
[21] There is no Ireland specific section with the SNH guidance, therefore the Table 2 ('Scotland') has been adapted for use here (with Brandt's and Noctule bats removed) as this is the closest match to the bat species assemblage found locally to the Site.

Otter

6.249 The level of potential disturbance to otters is less during wind farm operation as compared with the construction phase, as the site reverts to minimal human presence. There is likely to be **neutral** impact magnitude and significance during the operational phase.

Badger

6.250 The use of access tracks will be mainly limited to single-vehicle journeys for maintenance and there will be minimal collision risk to badgers. There will be no additional impacts on badgers as a result of the operation of the Development. There is likely to be **neutral** impact on magnitude and significance during the operational phase.

Common Lizard

6.251 The use of access tracks will be mainly limited to single-vehicle journeys for maintenance, and there will be minimal traffic risk to lizards. The additional likely impacts on this species as a result of the operation of the Development will include species specific habitat management and enhancement measures. Overall, the successful implementation of these measures during the operational lifetime of the wind farm is likely to be of **minor positive** magnitude and of **beneficial** significance.

Decommissioning Phase

6.252 Impacts associated with decommissioning a wind farm bear many similarities to those arising during construction. Many of the work processes are similar and plant and vehicle movements are likely to be at a similar scale. It is assumed that decommissioning will require the removal of all above ground structures; the removal of all underground structures to one metre below ground level; and reinstatement of disturbed areas.

Habitats

6.253 Two types of activities have the potential to disrupt and damage vegetation communities and peatland habitats during decommissioning. These are:

- Removal of above-ground infrastructure; and
- Laydown of waste demolition materials or spillages or leaks of fuels from decommissioning plant.

6.254 The types of decommissioning effects are as follows:

- Disruption/damage to peatland vegetation, compaction/rutting of the peat surface and disruption of peat hydrology that supports peatland (especially blanket bog) vegetation
- Contamination of the peat surface and peatland vegetation with demolition waste materials or spilled/leaked fuels.

Species of Conservation Concern

6.255 Impacts on protected mammals and herpetofauna during decommissioning are likely to be of a similar scale and nature to those that occurred during construction and are unlikely to be significant.

6.256 Each of these impacts is described and assessed below and the unmitigated impacts, mitigation measures and residual impacts are summarised in tabular form (**Tables 6.14 & 6.16**).

Table 6.14: Significant Effects upon Valued Ecological Receptors (Prior to Mitigation)

Impact	Nature of Effect	Magnitude	Significance
Construction			
Designated Sites	Statutory: Antrim Hills SPA; Garron Plateau SAC; Feystown ASSI, Glenarm Woods ASSI, Glenarm Woods ASSI Part2, Ballygalley Head ASSI, Scawt Hill ASSI, Little Deer Park ASSI, Straidkilly Wood ASSI, Knock Dhu/Sallagh Braes ASSI. There is low potential for works to have effects on designated sites because of the distance of the scheme from sites. The scheme is downslope from Scawt Hill ASSI, the nearest designated site, and no effects are therefore likely on this site.	Neutral	Neutral
Watercourses	Access tracks will cross a number of unnamed minor streams; there is a potential for ingress of silt and construction materials into streams at crossing points. Flows in these headwater streams is likely to be low and culverting/bridging works are unlikely to release significant amounts of material into the watercourses.	Negligible	Minor adverse
Wet heath/Lowland Acid Grassland	Land take associated with construction of access tracks and turbines and associated infrastructure.	Moderate	Moderate
Bats	Disturbance of European Protected Species during construction activities	Neutral	Neutral
Badger	Temporary disturbance from construction works probable	Minor	Minor Adverse
Common lizard	Temporary disturbance from construction works and loss of habitat	Moderate	Moderate Adverse
Operational			
Designated Sites / Watercourses	Statutory sites: Water pollution or increased sediment loading are extremely unlikely during the operational phase	Neutral	Neutral
Wet heath/Lowland Acid Grassland	Heathland restoration and enhancement to be conducted in accordance with methods defined in the outline HMP	Neutral	Neutral
Bats	Potential collision of European Protected Species with turbine blades (or barotrauma) during the operational phase	Moderate adverse	Major Adverse

Impact	Nature of Effect	Magnitude	Significance
Badger	Operational Effects unlikely	Negligible to Neutral	Neutral
Common lizard	Loss of habitat for the operational lifetime of the wind farm	Negligible to Neutral	Neutral
Decommissioning			
Designated Sites / Watercourses	Statutory sites: There is potential for waterborne pollution and increased sediment loading during the decommissioning phase in the absence of mitigation	Minor	Minor Adverse
Wet heath/Lowland Acid Grassland	Removal of turbines and associated infrastructure will permit reinstatement of impacted areas of this habitat.	Moderate	Moderate Adverse
Bats	Disturbance of European Protected Species during decommissioning activities unlikely	Neutral	Neutral
Badger	Temporary disturbance from decommissioning works possible	Minor	Minor Adverse
Common lizard	Temporary disturbance from decommissioning works probable	Moderate	Moderate Adverse

Design Evolution & Mitigation

6.257 The purpose of what is broadly classed as mitigation is to maintain the conservation value of a development site as far as is possible, and to exploit opportunities to enhance the site's conservation value wherever possible. This can be achieved by (CIEEM 2018):

- avoiding negative ecological impacts - especially those that could be significant;
- reducing negative impacts that cannot be avoided; and
- compensating for any remaining significant negative ecological impacts.

6.258 The aims of mitigation can be best achieved by choosing locations that allow sites or features of conservation value to be avoided; **Chapter 3: Design Evolution & Alternatives** provides a full description of the design evolution process which includes details on avoidance measures.

6.259 The Red Line boundary of lands available to the developer encloses 25 fields, with an area of approximately 770ha. The development site comprises four fields, while the access road to the public road network crosses a further three fields that support species-poor acid grassland or semi-improved grassland. Lands within the Red Line, but outside the development site, support extensive areas of dry heath and blanket bog, as well as a number of smaller features of conservation interest such as fens and flushes. The present scheme therefore avoids using those areas that support the most extensive and most intact areas of habitat of conservation value.

6.260 Avoidance and impact reduction techniques relate to reducing the footprint of the development and any ancillary works as far as is practicable. Measures required to address ecological concerns described in this ES during the construction phase will be implemented by an Ecological Clerk of Works (ECoW) as detailed in the outline Construction Environmental Management Plan (oCEMP) in **Technical Appendix 6.7** and will be incorporated within a Construction & Decommissioning Method Statement

(CDMS), which will be submitted to and agreed with the Department at the pre-construction stage. Avoidance and impact reduction measures include:

- No turbine rotors are within 50m from the edge flight-lines such as streams and shelterbelts), which is the minimum stand-off distance from blade tip to the nearest habitat feature likely to be used by bats, (Natural England 2014).
- Consideration will be given to the provenance of fill materials for roads, in terms of the similarity of their physicochemical properties (particularly pH) to the present substrate.
- The contractor will prepare a CDMS prior to construction activities to provide a method statement for working practices that will include measures, among others, to prevent adverse impacts on rivers and other watercourses. Please also refer to the SUDS design Statement in Appendix 9.1.
- A “no access” buffer will be implemented along sensitive watercourses to prevent damage to banks and to prevent disturbance of riparian habitats, apart from the narrow corridor required during construction.
- Access of all machinery and personnel will be limited to the working area corridor.
- Site compounds and stores will be sited away from any features of conservation interest, including watercourses. Any of these features in close proximity to the works or to compounds will be fenced to prevent damage by plant or stored materials.
- Dust suppression filters and appropriate wetting of running and work surfaces will be used to prevent masking of vegetation outside construction corridors, where appropriate.
- Appropriate speed limits will be imposed to reduce the potential for dust production.
- Excavations left unattended overnight should be ramped in at least one location to allow mammals to avoid becoming trapped.
- It is also recommended that, to minimise the risk of suspended sediment entrainment in surface water run-off, the site drainage system should only be carried out during periods of low rainfall and therefore minimum run-off rates.

6.261 Of particular importance for the maintenance of habitats and associated fauna is the institution of good management practices that prevent the discharge of silt and pollutants into the local drainage system. Containment measures will include:

- Where works near or in watercourses are unavoidable, working practices will include standard methods designed to minimise sedimentation and pollution, and measures will be put in place before the works begin to ensure containment of any released sediments. These may include silt containment booms or sediment barriers, as appropriate. Land stripping will be done in stages to minimise the potential for concentrated, long-lasting pulses of silt to discharge into watercourses. All filtration systems will be monitored frequently, and they will be replaced before they become ineffective.

- Material storage compounds will be located remote from any watercourse. Surface water run-off high in suspended solids should be contained and treated prior to discharge to any watercourse. All storage tanks should be bunded and should be sited remotely from any watercourse. Works should incorporate the relevant Pollution Prevention Guidelines. Additionally, a Pollution Incident Response Plan should be put in place as part of the Construction Management Plan.
- Water should be pumped from turbine bases during construction either to areas of ground capable of absorbing the water or to settlement ponds prior to discharge. Any discharged water must be free of cementitious products.
- All tracks and drains will be maintained and monitored to ensure that surface water flow is directed as designed, and that ponding and blockages are prevented.

6.262 Further details about the proposed SuDS are included in **Technical Appendix 9.1**.

6.263 Avoiding or mitigating impacts arising from construction-initiated alterations of drainage patterns and infiltration regimes is of importance for preventing damage to both aquatic and terrestrial habitats. It must be appreciated that hydrological characteristics of peatland and the habitats that they support are inextricably linked, and that changes in hydrological regime will lead to changes in these habitats. The areas of blanket bog have been avoided by sensitive siting during the design process. The site hydrological regime is considered in detail in **Chapter 9: Geology & the Water Environment** and measures outlined there will be carried out in order to maintain the limited areas of conservation interest on the Site.

6.264 Sympathetic management of the wind farm habitats during the operational phase will provide the greatest opportunity for enhancing the conservation value of the Site and should be regarded as compensatory mitigation for the permanent land take required for the new turbines and infrastructure.

6.265 The landowner will incorporate compensation and enhancement for lizard into the habitat management plan for the site. This will include the removal of grazing the habitat management area (shown in **Figure 6.10**) for the lifetime of the Development

Habitat Specific Mitigation

6.266 Mitigation measures are required during both the construction and decommissioning phases of the Development. These consist of both generic, standard, good construction working practices and controls described in the CMS, together with site specific and activity specific measures. Only the latter, the specific mitigation measures, are described here.

6.267 Adverse effects during the construction phase that were assessed to be potentially significant and require mitigation are:

- Land take (0.22ha), resulting in loss of degraded wet heath/lowland Acid Grassland which, despite being degraded is still considered to be an NI priority habitat.

- Excavation of turbine bases and cable trenches, potentially severing hydrological routing and causing dewatering of areas of soils.

6.268 The prime mitigation to reduce to an absolute minimum any disturbance or damage to vegetation, over and above the strict controls provided in the CMS, is habitat restoration and enhancement and vigorous supervision by the ECoW of all activities and at all stages of the Development.

6.269 Habitat restoration and enhancement is described in the Outline Habitat Management Plan (OHMP) in **Appendix 6.6** to provide compensation for the loss of small areas of wet heath/degraded blanket bog.

6.270 Quantification of anticipated areas enhanced via habitat management measures indicate that approximately 57.52ha of habitat management areas will be restored or managed for the benefit of biodiversity. The overall area enhanced is a combination of 37.12ha (for restoration of grassland/heath/bog and fen (i.e. NI Priority Habitat)) plus 20.4ha given over to management for snipe and other breeding waders. This is approximately 170-times greater than the areas of NI priority habitat (wet heath/lowland acid grassland) which will be lost to the Development through land take for the footprint of 0.22ha.

6.271 In addition, the proposed habitat management prescriptions will be implemented on an area of land almost 5.5-times greater than the 10.59ha of combined habitat loss for the entire Development.

6.272 This is considered to be a significant level of compensation (considering that the majority of infrastructure is situated on habitats of lower conservation value and that a significant length of existing track is also being used. In addition, the restored and enhanced habitats will also be protected from drainage, flailing and burning, and reduced grazing throughout the 30-year lifetime of the Development.

6.273 As detailed in the OHMP, the landowner has agreed to cease their currently active land management activities, should the Development be constructed.

General principles for reinstatement of habitats

6.274 Turves of heathland vegetation and associated topsoil from construction activity represent a valuable resource that can be used in the restoration of bare areas. Turves must be cut so that they capture the root systems of mineral soil as this will ensure any viable seeds are present. Turves can be laid in blocks or in a patchwork and over time heathland will develop within gaps and will provide a mosaic of structure.

6.275 During construction the areas of heath/heathy acid grassland will be lifted and stored for reuse using large-scale turfing equipment, using a technique known as "macro-turfing", moving large, thick turves. This method has many advantages over traditional turfing, virtually eliminating problems of frost and drought damage, and because the turves are thick, most burrowing invertebrates and deep-rooted plants survive. At both locations the vegetated turves will be lifted to a depth of approximately 25-40cm, (i.e. total depth of topsoil at each location).

6.276 Under the supervision of an Ecological Clerk of Works the original soil layering will be maintains and the mixing of topsoil and subsoil layers will not be permitted to occur. For peat soils, the acrotelm and catotelm will be handled and stored separately and reinstated with the acrotelmic layer on top. For peat and mineral soils, it is especially important to keep the layer of surface soil and stripped turves of vegetation on the top of the reinstatement, the right way up.

6.277 Turves will not be stacked but placed beside each other. As described above turves will be cut to an appropriate depth to maintain plant root systems and provisions for keeping soil moist must be considered in the event of dry spells of weather where vegetation may succumb to drought or the soil may be susceptible to wind erosion. Maintaining the seed bank and existing vegetation on the surface provides the best possible start for effective restoration.

6.278 Turves will be watered during times of drought or more frequently if deemed necessary by the ECoW in order to protect the health and integrity of newly translocated turves.

Compensation of the loss of NI Priority Habitats

6.279 37.12ha of existing higher value habitats (likely derived from former heath/bog and fen) will be managed in order to restore these habitats to a more species-rich sward closer to those which once prevailed across the wider area.

6.280 The main management techniques that will be employed is the removal of all grazing and the blocking of all drains within the proposed habitat management areas. After 5 years the sward will be assessed and compared with the preconstruction baseline for the area. At this point, contingency measures such as the introduction of light sheep grazing will be considered in order to maintain the momentum towards a more species-rich sward, while slowing down successional forces towards scrub/woodland (should this occur).

6.281 The current habitats within the four proposed Habitat Management Areas consist of primarily of sheep grazed semi-improved acid grassland, degraded blanket bog, marshy grassland/swamp (i.e. with a high water-table), and acid grassland. Given the historical high grazing pressure on much of the site, the complete removal of livestock is proposed for the lifetime of the Development (unless monitoring after year 5 concludes that light grazing would be beneficial. All four Habitat Management Areas will therefore be fenced off to allow close control of all management prescriptions.

Species specific mitigation

Mitigation for bats

6.282 Under the precautionary principle, and due to the presence of several species of bat known for open-air foraging, i.e. considered at risk from turbine associated mortality (Leisler's bat; common and soprano pipistrelle, a BMMP will be implemented as follows.

6.283 The BMMP will include the use of "feathering". This shall involve pitching the blades to 90 degrees and/or rotating the blades parallel to the wind direction to reduce the blade rotation speeds below two revolutions per minute while idling. This will substantially reduce the risk of bats being struck by idling blades and will reduce the spatial extent of low-pressure vortices in the wake of the blades (i.e. will substantially reduce the potential for barotrauma to occur).

6.284 This BMMP will consist of post-construction monitoring in the form of casualty searches, undertaken during years 1-3 post construction. These will be extended for a further two seasons in the event that activity levels (as recorded during the static monitoring) are moderate/high (>50 bat passes at the turbine during a single night) or if a bat carcass is found.

6.285 Carcass searches will be conducted during the spring (15 Apr – 15 June), summer (15 Jun – 15 Aug) and autumn (15 Aug – 15 Oct) seasons, as bat activity levels have been identified as moderate-high during each period. This monitoring will entail the systematic search for bat casualties within a 150m x 150m grid centred on the turbine. Searches will commence in April and be carried out as shown in Table 6.15 (adjusted accordingly depending on weather conditions; see below). They will begin no later than 1-hour post-sunrise to minimise the potential for carcass removal by predators. Three turbines will be searched during each visit, and these will be selected at random across the year.

Frequency of searches and number of turbines to be searched

6.286 Searches will be conducted at 2 to 4-day intervals (SNH 2019). Data must be obtained from the turbine operators on whether or not the target turbine was operational on the night preceding the search, with the surveying protocol being adjusted as necessary if the turbines were either non-operational or were not rotating because of a lack of wind.

6.287 To maximise the duration of monitoring during each season, whilst maintaining low carcass removal rates, it is recommended that surveying should be split into blocks as illustrated below. This is the spring schedule, which will be repeated during summer and autumn.

Table 6.15: Summary of proposed schedule for carcasses searches (spring).

Days 1-10	Days 11-20	Days 21-30	Days 31-40	Days 41-50	Days 51-60
Initial 'sweep' then survey alternate days (d2, d4, d6, d8, d10)	No Survey	Initial 'sweep' then survey alternate days	No survey	Initial 'sweep' then survey alternate days	No survey

Bat Carcass (Mortality) Searches

6.288 Bat carcass searches will be undertaken using a specialist ECoW; and will only take place the morning after optimal conditions for bats have occurred. These are defined as;

- <5m/s ground wind speed,
- >10ºC of temperature (1 hour after dusk),
- no rain, and
- after a warm day of similar settled conditions (i.e. the dusk should have a peak in bat activity in the area).

6.289 Carcass searches will commence one hour after dawn to minimise the potential for carcass removal by predators.

6.290 This approach has been selected to maximise the likelihood of finding bat carcasses, which is essential in enabling predicted bat mortality to be accurately estimated. Bat carcasses (if found) will be collected to enable accurate species identification using DNA where required. A post-mortem will also be conducted in order to ascertain the cause of death.

6.291 Also, the recording of a bat activity across the application site will also take place using automated detectors at the turbine base paired with adjacent habitat features. The recording will be undertaken for 10-nights during Spring, Summer & Autumn. This will also allow for comparison with the date collected previously as part of the planning application.

Meteorological Data

6.292 Simultaneous daily collection of meteorological data including wind speed, temperature, and precipitation will be undertaken at the turbine location, alongside bat carcass searches to identify the effect on levels of bat activity at the turbine(s).

Operational curtailment

6.293 In the event that >1 dead bat is found (in any season) during carcass searches, curtailment of the turbine will be immediately implemented on a precautionary basis. This will involve increasing the cut-in speed to 5 m/s, which is recommended by Mathews et al (2016). As bats are nocturnal, the increased cut-in speed will only apply at night, measured from 30 minutes before sunset to 30 minutes after sunrise. The increased cut-in speed will only apply between the 15 Apr and the 15 Oct each year (i.e. the generally accepted bat activity season in NI). For the remainder of the year (i.e. 15 Oct to 15 Apr), the turbine manufacturer's cut-in speed will be used.

Search efficiency trials

6.294 In addition to the proposed operational curtailment, the efficiency of the search dogs will be assessed based on integrated efficiency trials (Mathews et al., 2016). Use of this method will allow a correction factor for search efficiency to be factored into statistical modelling of numbers of bats which may be found dead beneath the turbine.

6.295 Carcasses will be dropped from waist height at randomly selected points within the search area under the turbine, on days when the dog teams are conducting searches and prior to searches taking place. The person placing the bats will not be involved in the search and will not reveal the exact number and location of bats that have been deployed to the dog teams until the trial is concluded.

6.296 When conducting observer efficiency trials for dog search teams, care will be taken to avoid transferring human scent to the specimen, for example by using tongs or disposable gloves. To allow human scent from footprints to dissipate, an interval of at least an hour will be left between placing the bats and conducting the searcher efficiency trial.

Scavenger removal rates

6.297 In order to determine the rate at which carcasses are removed (and therefore not be available for dogs to find), scavenger removal trials will be completed.

6.298 A carcass (of similar size and colour to a bat) will be left under the turbine each season. The carcasses will be placed out around dusk, and transference of human smell will be avoided. Carcasses will not be left under the turbine if and when searches are being carried out.

6.299 The carcasses will be monitored through the use of a motion-activated remotely operated camera for up to 10 days (battery life is affected by weather and the number of times the camera is triggered and is not entirely predictable). A second visit will be made to the site to check the cameras and change the batteries to ensure we can assess the scavenging rates over a three-week period. Assessing rates over a shorter timeframe would not enable a true test of scavenging removal rates to be made (Mathews et al., 2016). Different habitat types will be selected for the trials to ensure a robust evaluation of scavenging rates can be made.

6.300 The methods used in the Matthews (2016) study involved daily visits, rather than camera traps, to check corpses for the first seven days, but the use of camera traps will be more resource efficient and should also indicate the time at which the corpse was taken as well as the species of scavenger in most cases.

6.301 Different locations will be selected for the carcasses during each visit so that scavengers do not become familiar with feeding locations, and the cameras will be repositioned accordingly.

Estimating actual mortality rates

6.302 The number of observed bat carcasses recorded during the study will be corrected taking into account the area searched, scavenger rates and searcher efficiency results. Various researchers have proposed different approaches to data correction including Korner-Nievergelt et al. (2011), Korner-Nievergelt, et al. (2011), Bispo et al. (2012), and Lintott et al. (2016).

6.303 The most up to date formula for estimating the total number of carcasses present per turbine per season will be applied to the data collected at the end of the survey season

Remedial measures

6.304 The trigger threshold for remedial measures will be linked to 'significance' in line with the CIEEM guidelines for EcIA. Remedial measures will be triggered by an impact predicted to be of significance to bats at the Local level or greater.

6.305 For geographic context, the local level is considered to represent the site boundary plus a 15km radius. A significant effect would be triggered where the level of bat mortality is considered to reduce the ability of the bat population at the Local scale to sustain a viable and stable population, as informed by monitoring.

6.306 The requirement for and design of remedial measures will depend upon the findings and conclusions of monitoring and specific measures will be developed as appropriate to mitigate and significant impact predicted (those considered significant to bat populations at the Local scale or above). Where significant impacts are predicted, potential remedial options may include, but are not limited to, the feathering of individual turbines.

Mitigation for viviparous lizard

6.307 In the case of common lizard, it has been impossible to totally avoid impacts to this species, given the layout constraints. Therefore, the next course of action is to mitigate for any potential impacts.

6.308 The results of the common lizard surveys for the Development were assessed against the Key Reptile Site Survey Assessment Categories (HGBI 1998). This revealed that parts of the Site had a low population (with five individuals recorded). However, given the location of the records, it is also likely that much of the site is sub-optimal habitat for this species. This is likely a consequence of over-grazing.

6.309 Depending on the commencement of construction on site, the works corridor will be mowed. If possible, this work will be undertaken before the end February (to avoid a conflict with the bird breeding season). If this is not possible, then mowing will take place between August and September, when common lizards are likely to be fully active. Should the latter be required, the corridor will be subjected to an active nest survey by a suitably qualified ornithologist immediately prior to the commencement of mowing operations.

6.310 Clearance of stones, tree stumps, logs, brash, rocks or piles of similar debris will be undertaken carefully and by hand. Although this is only required in a few areas where the proposed site tracks traverse low stone walls. This work will not take place during the hibernation period for common lizard (i.e. mid-October to mid-March).

6.311 Clearance of tall vegetation will be undertaken using a strimmer or brush cutter with all cuttings raked and removed the same day. Cutting will only be undertaken in a phased way which will either include:

- Cutting vegetation to a height of no less than 30mm, clearing no more than one third of the site in anyone day or;
- Cutting vegetation over three consecutive days to a height of no less than 150mm at the first cut, 75mm at the second cut and 30mm at the third cut;

6.312 Following removal of tall vegetation using the methods outlined above, the remaining vegetation will be maintained at a height of 30mm through regular mowing or strimming to discourage common lizards from returning. Ground clearance of any remaining low vegetation (if required) and any ground works will only be undertaken following the works described above.

6.313 As an additional precaution the ECoW will be present from the commencement of clearance/construction with a watching brief to ensure that no common lizards remain within the construction corridor and remain in situ until the area is cleared to ensure no species or habitat conflicts emerge affecting damage to the local lizard population.

6.314 If any common lizards are found during excavation works, all works within the affected area will cease until the ECoW has safely removed them (under licence) from the construction corridor.

6.315 Should it prove necessary during site supervision (i.e. lizards are observed returning to the construction corridor); a protective lizard barrier fence will be installed along both sides of the construction corridor in order to prevent common lizards from entering the works area.

6.316 In total, there is >500 ha (of blanket bog; dry heath and marshy grassland) adjacent to the proposed construction corridor. These areas together provide more than sufficient suitable habitat.

Residual Impacts

6.317 Residual effects relating to land management that is designed to provide ecological benefits through the establishment of grazing measures which are appropriate within peatland and associated habitats (See **Appendix 6.6** – outline Habitat Management Plan) will result in more diverse and ecologically valuable habitat than the present degraded habitats that cover the majority of the site. Continuity of effective, appropriate management should result in the area becoming more biodiverse over time. With improved land management, it is anticipated that in the long term there will be at least a neutral residual impact on fauna of conservation concern. For habitats, a beneficial impact is likely if site management results in more diverse habitats of greater conservation value

6.318 **Table 6.16** provides details of the residual impacts.

Table 6.16: Summary of Residual Impacts after Mitigation and Enhancement

Impact	Ecological Impact Significance without Mitigation	Mitigation & Enhancement	Ecological Impact Significance with Mitigation
Construction			
Designated Sites / Watercourses	Major adverse	Avoidance during infrastructure design and SuDS drainage management (Appendix 9.1). No in-stream works will be required.	Neutral
Wet heath/Lowland Acid Grassland	Moderate	Heathland restoration and enhancement according to the outline HMP.	Neutral
Temporary disturbance to bats	Neutral	No mitigation required	Neutral
Temporary disturbance to badgers	Minor	A 25m buffer has been applied to all badger setts found within 25m of the construction area. In addition, a pre-construction badger survey will be completed.	Neutral
Temporary disturbance to common lizard	Minor	Implementation of species-specific mitigation to off-set potential significant effects including phased mowing of the vegetation within the construction corridor.	Negligible to Neutral
Operational			
Designated Sites / Watercourses	Major Adverse	Application of the SuDS drainage management and CMS as detailed in Appendix 9.1	Neutral
Wet heath/Lowland Acid Grassland	Moderate	Heathland restoration and enhancement according to the outline HMP.	Beneficial
Potential collision of bats with turbine blades	Major adverse	The proposed turbine layout was designed to ensure a minimum stand-off distance of 50 m (Natural England TIN051) to all habitat edges (shelterbelts and natural watercourses) which will be maintained through the lifetime of the Development. A Bat Monitoring & Mitigation Plan (BMMP) will be implemented under the Precautionary Principle.	Neutral
Disturbance to badgers	Neutral	None required, no badger setts found within 25m of the construction area.	Neutral
Disturbance to common lizard	Minor	Implementation of species-specific enhancement to off-set potential significant effects includes; Management of 37.12 hectares of habitat which will also benefit this species.	Beneficial
Decommissioning			
Designated Sites / Watercourses	Major adverse	SuDS and standard Pollution Prevent Guidelines will be adhered to during decommissioning.	Neutral
Wet heath/Lowland Acid Grassland	Minor	Heathland restoration and enhancement according to the Outline HMP.	Beneficial
Temporary disturbance to bats	Neutral	No mitigation required	Neutral
Temporary disturbance to badgers	Neutral	None required, no badger setts found within 25m of the construction area.	Neutral
Temporary disturbance to common lizard	Neutral	No mitigation required as no impact during the decommissioning phase is considered likely.	Neutral

Cumulative Impacts

6.319 When considered in the context of the overwhelming dominance of the impact of agricultural land-use change as the primary driver controlling the extent and quality of habitats in Northern Ireland, as well as natural variation (in species populations) over time, it is credible to assume that in only very exceptional circumstances will direct effects in aggregation between wind farm sites have any potential to be cumulatively of concern let alone significant (in EIA terms). It is not unreasonable to assume that any such aggregate effects that may be of significance are likely to be readily apparent to those considering individual applications who can inform consideration of specific detailed measures to avoid unacceptable effects[22].

6.320 The potential for a cumulative impact between proposed and operational wind farms arises principally if species from the same population are using more than one of the sites. The likelihood of this can be assessed through an analysis of the species assemblage and by examining the likely range and territory size of those species.

6.321 The area over which a cumulative impact may be felt should also be considered, and in the present case, wind farms within a radius of 15km have been identified. However, Ballykeel (under construction) and Carnalbanagh (proposed) are considered to be the only wind farms likely to have the potential to have a significant cumulative effect.

6.322 The following sections assess the potential cumulative impacts, as a result of the Development with other proposed and operational wind farms, where relevant.

Habitats

6.323 In the uplands there is some concern over the potential effects of the access track network required by wind farm developments on the hydrology of peatlands which are important both because they are generated by and support highly valued specialised vegetation, and as natural carbon stores.

6.324 The Development will result in a loss of low and moderate quality habitats, which are of local conservation value. Restricted areas of habitat of higher conservation value have been avoided and their interest maintained. In the case of Ballygilbert, this additional loss of habitats is considered to be not significant because the degraded wet heath/grassland habitats is of local conservation value and is widespread both locally and throughout the region. It is therefore within the ability of the resource to absorb this loss. Those habitats that are of greater value have been avoided and there will be **no significant impact** on them.

[22] Review of Guidance on the Assessment of Cumulative Impacts of Onshore Windfarms, Phase 1 Report, ENTEC, September 2008

Bats

6.325 Outcomes which must be considered are whether the cumulative impact of wind farm developments will adversely affect the distribution of these species of European conservation concern, and whether there will be population-scale effects on any bat species. The most contentious species issue currently is the extent to which bats may be at risk of collision with turbines. There is potential for bats to forage across more than one wind farm and to be subject to at least the potential of an increased risk of collision. As yet there is no agreement on how best to address it, though specific impacts on bats have been addressed through the incorporation of precautionary stand-offs to habitat features (foraging and commuting areas), as well as the selection of windfarm sites with 'low' levels of bat activity.

6.326 The development therefore has the potential to increase bat mortality resulting from collision and barotrauma, and this impact is likely to be additive to similar impacts arising from the operation of other wind farms, at both local and regional scales. The absence of data relating to bat life cycles and to the intensity and spatial variation of activities during different parts of those life cycles means that there is difficulty in determining the significance of the cumulative impacts on bat species. It is likely that the significance of cumulative impacts will also vary between species, depending on inter alia local and regional abundance of different species, prey preferences, preferred flight height, preferred foraging habitat, degree of attraction to or deflection from turbines, extent of migratory behaviour, swarming characteristics and variability of behaviour in response to varying weather conditions. Bat behaviour and collision risk are likely to be highly site-specific during much of the annual cycle, but more generalised patterns, such as those relating to migration, may be superimposed on these local factors.

6.327 Whilst evidence is beginning to be revealed through a combination of academic research and on-going monitoring at wind farm sites, certainty with regard to cumulative effects is far from clear. This is because the effects of wind farms on bat populations is dependent on a wide variety of factors including; the turbine layout, the species of bats present, existing environmental conditions and the mitigation measures proposed at each wind farm (or individual turbine). Therefore, a clear understanding of the patterns of bat activity at individual wind farms (during the development of EIA's) is essential.

6.328 In the case of the Development a clear understanding of the patterns of bat activity at the site and surrounding area was used to inform the final layout and recommend mitigation, in the form of precautionary stand-off distances to habitat features, and the maintenance of said buffers for the 30-year lifetime of the wind farm).

6.329 The potential cumulative impact of the Development in addition to (the wind farms and single turbines (within 15km and 5km respectively)) was specifically considered in relation to bats. These included two windfarms (one under construction and one proposed. Both have 7 turbines within the farm. These are;

- Ballykeel (5.5km to south of T14);

- Carnalbanagh (6.7km to west of T12);

6.330 In addition, a further 11 single turbines are located within 5km of the Development. This gives a total of 25 turbines located within the study area for cumulative effects.

6.331 Overall, only 740 bat passes were recorded across 3920 hours of recording at the 14 proposed turbine locations (for the entire 2019 survey season). Overall, this is considered to be a low level of activity. A total of two nights (out of a total of 400 recorded (14 turbines times 30-nights (minus 20- nights where detectors were moved or damaged)) did activity exceed 50 passes (i.e. a BAI of 5). These were the night of the 9th July at T4 when 58 passes attributed to Leisler's bat were recorded and at T5 on the night of the 30th May when 56 passes of Leisler's bat were recorded. Based on this information, conditions for significant bat activity only occurred on 0.5% of nights.

6.332 The stand-off distances of the existing turbines were measured (in addition to the 14 turbines in the Development), in relation to habitat features such as watercourses and plantation edges (areas which are known to have higher levels of bat activity). None of the approved turbines encroached on the Natural England stand-off distance to the edge habitat features. Therefore, if precautionary stand-off distances were applied retrospectively to the windfarms described, the layouts would comply with the guidance (with the implementation of agreed mitigation at the respective sites listed above). The cumulative impact (of the 14 proposed Ballygilbert turbines) is not considered to alter the existing predicted impacts, therefore the cumulative impact is **not** considered to be **significant**.

Badger

6.333 It is not anticipated that the Development will have a measurable impact on local badger social groups and the wind farm will therefore not contribute to any cumulative impacts that may be detectable from the operation of other wind farms in the local area. The cumulative impact on badgers is considered to be **not significant**.

Herpetofauna

6.334 The limited distribution of these species across much of the site and the habitat improvements specifically designed to favour them, indicate that the Development will not add to any adverse cumulative effects that may arise from wind farm developments generally. The cumulative impact on the site herpetofauna is therefore considered to be **not significant**.

Trans-boundary effects

6.335 Potential trans-boundary effects of the Development on designated sites and on mobile species (i.e. bats) were assessed. The effects are considered to be the same as those described in the relevant sections (i.e. cumulative effects). Trans-boundary effects are therefore not considered to be significant. Potential trans-boundary effects of the Development on Annex 1 migratory bird species are assessed in **Chapter 7 - Ornithology**.

Conclusions

6.336 There is no regular usage of the area by otter, smooth newt or marsh fritillary butterfly, therefore no impacts to these species is likely. Mitigation for the reptiles found on site (i.e. common lizard) is proposed. This involves the provision of habitat management, as well as drift fencing and mowing/hand clearance during the construction phase. All badger setts have been buffered by the required 25m from any infrastructure.

6.337 The proposed outline HMP will ensure compensation for areas of NI Priority Habitat lost under the footprint of the Development and should also result in enhancement of the local site ecology.

6.338 The mitigation measures specified in **Table 6.16** will be adhered to, ensuring that any potential impacts to bats will be negligible. In conclusion and based on current knowledge this would appear to be a site posing little risk to bats or bat populations, however a BMMP has been recommended as a precaution.

6.339 Therefore, the potential effects of the Development on ecological receptors have been assessed and it is concluded that with the implementation of appropriate mitigation measures the effects would be reduced to a **minor adverse** or **neutral effect** that would not adversely affect the ecological integrity of the site and the wider area.

6.340 An assessment of cumulative impacts on the habitats and fauna of the area was also undertaken, and it was concluded that this is **not significant impact**.

References

6.341 References have been inserted as footnotes within the body of the document.

Abbreviations

AONB	Area of Outstanding Natural Beauty
ARGUK	Amphibian and Reptile Groups of the UK
ASSI	Area of Special Scientific Interest
BSBI	Botanical Society of the British Isles
CEDaR	Centre for Environmental Data and Recording
CIEEM	Chartered Institute of Ecology and Environmental Management
CNCC	Council for Nature Conservation and the Countryside
EC	European Commission
EcIA	Ecological Impact Assessment

EIA	Environmental Impact Assessment
HRA	Habitat Regulations Assessment
HSI	Habitat Suitability Index
IROPI	Imperative Reasons of Overriding Public Interest
JNCC	Joint Nature Conservation Committee
LHP	Larval Host Plant
LUAC	Land Under Applicant Control
MNR	Marine Nature Reserve
NBN	National Biodiversity Network
NIBG	Northern Ireland Bat Group
NIEA	Northern Ireland Environment Agency
NIPS	Northern Ireland Priority Species
NNR	National Nature Reserve
NR	Nature Reserve
PPS	Planning Policy Statement
SAC	Special Area of Conservation
SLNCI	Sites of Local Nature Conservation Importance
SPA	Special Protected Area
UW	Ulster Wildlife

7

Ornithology

7 Ornithology

Summary

Methodology

7.1 This chapter assesses the potential effects of the Development on bird communities and has been informed primarily by a programme of baseline ornithology surveys commissioned by the Applicant and completed during an initial two year period (commencing during winter 2012 and finishing in summer 2014) followed by a more recent 15 month update period (commencing in summer 2018 and finishing in August 2019). The surveys have included (as appropriate) breeding bird surveys, winter surveys, vantage point surveys and wider area surveys. All surveys have been completed in line with the current SNH guidance for bird surveys at on-shore wind farms.

Breeding Birds

7.2 Key species found within the breeding bird survey area (within 500 m of the turbines or 800 m for curlew) were snipe (eight breeding pairs) and red grouse (one or two breeding pairs). Seven species of moorland passerines were also found breeding (a relatively small number due to the general uniformity of the habitat) including skylark, meadow pipit, stonechat, whinchat, wheatear and reed bunting – with the exception of skylark and meadow pipit (both of which were widely distributed over the survey area) passerine species were locally distributed and in very small numbers. Curlews were not present within the breeding bird survey area, however two pairs were found within the wider surrounding area (within 2 km but not closer than 800 m from the turbine locations).

Winter Birds

7.3 A total of 31 bird species were recorded during the winter surveys however most of these species are very widespread in distribution locally and regionally and were recorded within the survey area in relatively small numbers. Golden plovers were recorded within the survey area on a fairly regular basis during October to April however numbers were small and the flocks were very mobile, with no particularly favoured locations.

Raptor Breeding Activity

7.4 Raptor species found breeding within the wider surrounding area (within 2 km of the turbines) were peregrine (one pair), buzzard (five pairs), kestrel (one pair) and sparrowhawk (one pair). Hen harriers were not found breeding within the survey area. For peregrines there are two alternative nest sites (used by the same peregrine pair) located within the survey area and they are 700 m (location 1) and 2 km (location 2) distant from the nearest turbine locations. Each of the locations was occupied by peregrines at least once during the baseline survey period. For other raptor species, none of the breeding locations were closer than 1 km from the turbines.

Raptor Foraging Activity

7.5 Raptor species observed foraging within the survey area (within 500 m of the turbines) were peregrine, kestrel, merlin, buzzard, sparrowhawk and hen harrier however with the exceptions of buzzard and kestrel observation rates were relatively low or very low. The buzzard observations indicate regular use of the survey area by this species for foraging and most observations were during the breeding period with markedly fewer observations during the non-breeding period. Foraging kestrels use the survey area less frequently than buzzards and principally during the latter part of the breeding season and during the autumn / post-breeding period, with minimal or negligible activity during the winter and early breeding periods.

7.6 Hen harriers occur occasionally within the survey area during the late summer and autumn period and the observations certainly relate to birds (mostly juveniles) involved in post-breeding dispersal or migratory movements and there is no indication of regular foraging activity within the survey area during the breeding season. Peregrines occur in the survey area throughout the year but activity levels are low with a slight indication of a peak during the late summer and early autumn period.

Effects on Bird Communities

7.7 For snipe, displacement of two or three breeding pairs (50% of territories within 400 m of turbines) might be expected to occur due to the Development. It is not certain that displaced snipe would be lost to the local breeding population, as there is extensive suitable habitat within the immediately surrounding area therefore it is possible that some or all of the displaced birds might be able to re-locate locally. However the possibility of some snipe being permanently lost cannot be excluded although any such losses would be significant at the local population level only. Habitat compensation measures for snipe have been included within the Habitat Management Plan (Appendix 6.10).

7.8 For red grouse and moorland passerines there are not expected to be any significant permanent displacement effects, however some temporary disturbance is possible during the construction of the wind farm when that is during the breeding season. For curlews there are not expected to be any significant adverse effects as the two territories are located significantly more than 800 m away from the turbines.

7.9 For breeding raptors there are not expected to be any significant issues in relation to potential disturbance of breeding sites as all are located beyond the likely disturbance distances for the relevant species and in the case of peregrines there are also other mitigating factors. Foraging displacement is unlikely to be significant for any of the raptor species found within the survey area.

7.10 For peregrine and hen harrier the frequency of observations within the survey area during the baseline period is judged to be insufficient to warrant use of the Collision

Risk Model and collision risk is unlikely to be significant for either species. For buzzards collision risk is equivalent to one bird every 2.0 years (range 2.1 – 1.9 years) and for kestrels is equivalent to one bird every 3.8 years (range 4.3 – 3.3 years) however for both species it is unlikely that the predicted collision risk would have a significant adverse effect on the distribution and abundance of the local populations or on the regional conservation status of the species.

Antrim Hills SPA

7.11 The results of the baseline surveys indicate that there is extremely unlikely to be any significant connectivity between the Development and the Antrim Hills SPA hen harrier and merlin populations.

Mitigation

7.12 An Ornithology Mitigation Strategy (OMS) would be completed during the construction of the wind farm where this is during the bird breeding season and would aim to avoid any significant disturbance to the relevant breeding bird species found within the vicinity of the Development. A Habitat Management Plan (HMP) would be initiated after planning consent and should include habitat enhancement measures that would be beneficial for breeding snipe. Habitat measures implemented for snipe are also likely to have a significant beneficial effect for several moorland passerine species found within the survey area.

Introduction

7.13 This chapter assesses potential effects of the Development on bird communities. The principal objectives of the chapter are:

- To outline the scope of the assessment;
- To describe the methodologies used in completing the assessment;
- To describe the baseline bird communities found within the site and in defined surrounding buffer areas;
- To describe the potential effects on bird communities and assess the significance of these effects;
- To detail any mitigation or compensation measures that may be required and to describe any residual effects remaining after the implementation of these measures.

7.14 The ornithology assessment is supported by:

- Figures 7.1 - 7.10 and Confidential Figure 7.11;
- Appendices 7.1 - 7.x.

7.15 The Figures and Appendices are referenced in the text as necessary and listed in full at the end of the chapter.

Statement of Authority of the Author

7.16 The ornithology assessment has been carried out by David Steele:

- Professional qualifications - B.Sc. (2i Honours), Zoology, University of Aberdeen (1988);
- Professional experience – 31 years working as a professional ornithologist throughout Britain and Ireland, covering a wide range of bird species and methodologies including those particularly relevant to on-shore wind farm work (raptor monitoring, moorland bird surveys and breeding wader surveys). This work has been for a range of organizations including the Royal Society for the Protection of Birds, British Trust for Ornithology, Birdwatch Ireland and Scottish Natural Heritage (Seabirds Team). For the last 17 years working as a freelance consultant and has completed the fieldwork and ornithology assessments for 17 wind farm proposals in Northern Ireland and has also completed training on collision risk modelling.

Legislation and Policy Guidance

Legislation

7.17 The ornithology assessment has been carried out with reference to the following key pieces of legislation:

7.18 The Wildlife (Northern Ireland) Order 1985 (amended) which describes general protection measures for wild birds and in particular Schedule 1 to the Order which details those species (for example raptors) that have special levels of protection;

7.19 Annex 1 of the EC Birds Directive which details those bird species which are of particular conservation concern in Europe and which should be subject to special measures concerning their habitats in order to ensure they maintain a favorable conservation status.

Policy Guidance

7.20 In line with the current policy of the Northern Ireland Environment Agency (NIEA) the assessment has been carried out with reference to the published guidance of Scottish Natural Heritage (SNH) on assessing the effects of on-shore wind farms on bird communities outside designated conservation areas[1].

Scope of Assessment

General Effects of Wind Farms on Birds

7.21 On-shore wind farms can potentially effect birds in two main ways – by displacement of birds around the turbine array (leading to indirect habitat loss) or by creating a risk of collisions with the turbines. Direct habitat loss from wind farms is usually

[1] SNH (2018): Assessing Significance of Impacts from Onshore Wind Farms Outwith Designated Areas (Guidance, February 2018)

relatively small scale compared to other sorts of developments and in most cases is unlikely to be significant for bird communities[2].

7.22 The ornithology assessment therefore focuses on assessing potential displacement effects and (where relevant) collision risk effects of the Development. The assessment considers the potential effects on the bird communities found within the site and in defined surrounding buffer areas. Where relevant, the assessment also considers the potential cumulative effects resulting from other existing, consented or proposed wind farms in the vicinity of the Development.

Bird Species Requiring Assessment

7.23 All wild birds are subject to a general level of protection through the Wildlife and Countryside Act (Wildlife Order in Northern Ireland) and the EU Birds Directive but in line with SNH guidance only some bird species should generally be of concern in relation to wind farms:

- Birds on Annex 1 of the EU Birds Directive;
- Birds on Schedule 1 to the Wildlife and Countryside Act (Wildlife Order in Northern Ireland);
- Regularly occurring migratory species;
- Species listed on the non-statutory lists of Birds of Conservation Concern (BoCC) for the UK and Ireland.

7.24 The SNH guidance recommends that assessment of the effects of a wind farm on birds will normally be limited to those species included within the above categories. Additionally, SNH are of the view that passerine species (e.g. small moorland birds such as skylarks and meadow pipits) are not significantly impacted by wind farms[3]. However, all bird species (including passerine species) need to be considered in relation to the general levels of statutory protection afforded by the Wildlife (Northern Ireland) Order[4].

Designated Conservation Sites

Antrim Hills SPA

7.25 The northern boundary of the southern section of the Antrim Hills Special Protection Area (SPA) is located to the southwest of the Development boundary and the assessment considers possible effects on the SPA, which is designated for its breeding populations of hen harrier and merlin[5].

[2] Percival, S. (2005): Birds and wind farms, what are the real issues? (British Birds 98 / 4)

[3] SNH (2014 and 2017): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Notes, May 2014 and March 2017)

[4] NIEA: The Wildlife Law and You in Northern Ireland (Northern Ireland Environment Agency Biodiversity Series Booklet)

[5] Citation for Antrim Hills Special Protection Area (Northern Ireland Environment Agency)

ASSIs

7.26 Several Areas of Special Scientific Interest (ASSIs) are located within the surrounding area of the Development. In all cases these have been designated primarily for their flora or earth science interest however peregrines have been recorded at two of the sites and are mentioned in the respective citation documents and the assessment therefore considers possible effects on the ornithological interests of these ASSIs.

Consultation

7.27 A consultation response in relation to the Development has been received from NIEA (NED)[6] Ref: **Appendix 6.1**. This included general scoping guidance for environmental impact assessment and in relation to flora and fauna (including birds).

7.28 Northern Ireland Raptor Study Group (NIRSG) provided confidential information on breeding activity by Annex-1 raptor species occurring in the vicinity of the Development – the information related to specific breeding sites and was therefore given on a personal communication basis rather than within a formal data request.

Assessment Methodology

Survey Methods

7.29 Field surveys were carried out in line with the current SNH guidance for bird surveys at on-shore wind farms[7]. The different methodologies employed during the field surveys are described below.

Breeding Bird Surveys

7.30 Breeding bird survey visits have been completed in a total of five different years as summarized in Table 7.1. All visits have been completed between late March and early July. The number of survey visits completed has varied between years. An initial two consecutive years of breeding bird surveys were completed during 2013 (three visits) and 2014 (four visits). Following a survey gap, a single visit to look for breeding birds was carried out in late June 2016. Following a further gap, surveys were re-commenced by way of two visits during the latter half of the breeding season in 2018 then this update completed by way of six survey visits during late March to early July 2019. Further details of all the survey visits (including dates, times and weather conditions) are provided in Appendix 7.1.

7.31 All surveys were completed using an adapted Moorland Bird Survey (MBS) method (also known as the "Brown and Shepherd" method)[8]. This method is suitable for surveying breeding wader species (curlew, snipe and lapwing) and also red grouse.

[6] DAERA Planning Response Ref. Appendix 6.1: Intention to submit an Environmental Statement for the proposed Ballygilbert Wind Farm

[7] SNH (2014 and 2017): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Notes, May 2014 and March 2017)

[8] Gilbert, G *et al.* (1998): Bird Monitoring Methods – a manual of techniques for key UK bird species (RSPB)

SNH do not generally recommend survey of moorland passerines for wind farm developments, however, on sites were breeding waders are present only in small numbers then it is possible to include passerines in the MBS method. The principal target species for the surveys were therefore the breeding wader species and also red grouse however passerine species were included where reasonably possible.

7.32 The surveys extended to at least 500 m around the turbine locations. All land under the Applicant's control was walked through, with additional coverage into adjacent areas by appropriate (depending on the habitat) periods of scanning with binoculars.

Curlews

7.33 In line with the requirements of NIEA and RSPB the survey area for curlew was extended to at least 800 m around the turbine locations. This additional survey coverage was achieved by three methods: (1) by scanning the additional area with binoculars during the standard MBS visits (any areas under the Applicant's control were also walked through); (2) during the vantage point surveys by scanning areas of potential curlew habitat with binoculars and telescope and also by listening for calling or singing birds and (3) by looking for curlews from public roads while moving around within the wider surrounding area of the Development.

Table 7.1 – Summary of Breeding Bird Surveys

Baseline Year	No. Survey Visits Completed	Survey Months
2019	6	Mar, Apr (x2), Jun (x2), Jul
2018	2	Jun, Jul
2016	1	Jun
2014	4	Apr (x2), May, Jun
2013	3	Apr, May, Jun

Winter Bird Surveys

7.34 Surveys for wintering and migrating birds have been contemporaneous with the breeding bird surveys and have been completed during four different winter periods as summarized in Table 7.2. Three consecutive periods of initial winter surveys were followed by a survey gap then a further period of recent update surveys. Further details of all the winter survey visits (including dates, times and weather conditions) are provided in Appendix 7.2.

7.35 All the surveys were completed using the same adapted MBS method as employed for the breeding bird surveys. The surveys extended to at least 500 m around the turbine locations. All land under the Applicant's control was walked through, with additional coverage into adjacent areas by appropriate (depending on the habitat) periods of scanning with binoculars. Birds on spring migration (for example golden plovers) were also looked for during the early season breeding bird survey visits.

Table 7.2 - Summary of Winter Bird Surveys

Winter Period	No. Survey Visits Completed	Survey Months
Oct 2018 to Mar 2019	3	Jan, Feb (x2)
Oct 2014 to Mar 2015	4	Oct, Dec, Feb, Mar
Oct 2013 to Mar 2014	5	Oct, Nov, Jan, Feb, Mar
Oct 2012 to Mar 2013	3	Dec, Feb (x2)

Vantage Point Surveys

7.36 An assessment of activity by raptors and other relatively large aerial species (e.g. migrating swans and geese) was completed from four vantage points in 21 consecutive months during the period July 2013 to March 2015. Additional survey (by way of update and using five vantage points) was then completed in 15 further consecutive months during June 2018 to August 2019. Vantage point survey effort during both the initial and the update survey periods is summarized in Table 7.3. During each survey period typically six hours were completed at each VP per month - details of individual vantage point watches are provided in Appendix 7.3.

7.37 Vantage points were selected in line with current SNH guidance within any constraints imposed by access restrictions. No turbine location was more than 2 km from a vantage point. The locations of the vantage points and the associated visibility coverage are shown in Figure 7.1. Areas of overlapping visibility (visible form two or more vantage points) are also shown in the figure. In line with SNH guidance, visibility is shown for the lower edge of the turbine rotor (which in this case is 33 m above ground level). For the assessment of collision risk, visibility at rotor height is more important than visibility at or near the ground. However it is important to note that during the vantage point surveys the observer was generally content with visibility at or near ground level.

7.38 The vantage point surveys were completed in line with the SNH method statement[9]. The surveys therefore extended to at least 500 m around the turbine locations (up to a maximum of 2 km from each vantage point). The target species were: (1) all raptor species, but with priority given to the three Annex 1 species (hen harrier, peregrine and merlin); (2) whooper swans and geese (winter and migration periods only). Other species (e.g. golden plovers, gulls, cormorants and grey herons) were recorded as secondary species. At the discretion of the observer, notes were also kept of any significant activity by smaller aerial species (e.g. feeding swallows).

7.39 Vantage point watches were carried out at different times of day and in a range of weather conditions within the constraints of the SNH method statement. Most watches were of three hours duration but some shorter or longer watches (not shorter

[9] SNH (2014): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Note, May 2014)

than one hour or longer than four hours) were also completed. A number of vantage point watches were targeted at detecting potential roosting activity by raptors. These commenced at least 30 minutes before sunset and continued till dusk (typically 30-40 minutes after sunset). A summary of these watches is provided in Appendix 7.4.

Table 7.3 - Summary of Vantage Point Surveys (Hours Completed)

Baseline Period	VP1	VP2	VP3	VP4	VP5
Mar 2019 to Aug 2019	36	36	36	36	36
Sep 2018 to Feb 2019	36	36	36	36	36
Jun 2018 to Aug 2018	18	18	18	18	18
Sep 2014 to Mar 2015	39	39	39	39	0
Mar 2014 to Aug 2014	36	36	36	36	0
Sep 2013 to Feb 2014	36	36	36	36	0
Jul 2013 to Aug 2013	12	12	12	12	0

Wider Area Raptor Surveys

7.40 Surveys for breeding activity by raptor species in the wider area around the Development have been contemporaneous with the vantage point surveys and are summarized in Table 7.4. The selection of target species for these surveys depended primarily on indications provided by the vantage point surveys in combination with: (1) an assessment of potential raptor breeding habitat within the area of interest; (2) the surveyor's previous knowledge of raptor breeding activity within the area of interest[10] and (3) personal communications with NIRSG.

7.41 Following the above criteria the principal target species for the surveys was peregrine and in line with current SNH guidance for this species the area of interest was limited to approximately 2 km radius around the turbine locations[11]. The indications provided by the vantage point surveys (in combination with consideration of the other factors mentioned above) suggested that other Annex 1 raptor species (notably hen harrier and merlin) were unlikely to be breeding within 2 km of the Development. However the vantage point surveys indicated that three non-Annex 1 raptor species (buzzard, kestrel and sparrowhawk) were possibly breeding within 2 km and these species were included in the wider area surveys as secondary species.

7.42 Surveys of potential peregrine breeding sites followed appropriate methodologies and protocols for this species[12]. The surveys were carried out from roads and other areas

[10] Steele, D *et al.* (1997): Antrim Hills Breeding Bird Survey 1997 (Unpublished Report to RSPB, October 1997)

[11] SNH (2017): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Note, March 2017)

[12] Gilbert, G *et al.* (1998): Bird Monitoring Methods – a manual of techniques for key UK bird species (RSPB)

with public access or access permissions. To avoid disturbance, all observations were made using a telescope from a safe distance. Further details of the surveys of peregrine breeding activity within the area of interest are provided in the Confidential Appendix (Appendix 7.14).

Table 7.4 – Summary of Wider Area Raptor Surveys

Baseline Year	Target Species	Secondary Species	Survey Limit
2019	peregrine	buzzard, kestrel, sparrowhawk	2 km
2018	peregrine	buzzard, kestrel, sparrowhawk	2 km
2014	peregrine	buzzard, kestrel, sparrowhawk	2 km
2013	peregrine	buzzard, kestrel, sparrowhawk	2 km

Assessing Significance of Effects

Favourable Conservation Status

7.43 The assessment of the significance of effects on bird communities primarily follows the Favourable Conservation Status (FCS) approach recommended by SNH[13]. This approach considers any potential effects on a species and assesses these in the context of the total national or regional population and distribution. An impact should be judged to be of concern where it would adversely affect the favourable conservation status of a species (or prevent a species from recovering to favourable conservation status) at the regional or national level. The conservation status of the bird species considered by the ornithology assessment refer to the current non-statutory lists of Birds of Conservation Concern (BoCC) published for the island of Ireland[14] and the UK[15].

7.44 For assessing the significance of bird populations (or any expected losses at the national or regional level) the generally accepted 1% threshold level is used, therefore if a population (or loss) exceeds 1% of the national or regional population of the species then it should be considered to be significant.

7.45 In the assessment of effects, the probability of any given effect occurring (and the probability of any likely effects being significant) are described using the scale suggested by the Institute of Ecology and Environmental Management (IEEM)[16] – the scale is given in Appendix 7.5.

[13] SNH (2018): Assessing Significance of Impacts from Onshore Wind Farms Outwith Designated Areas (Guidance, February 2018)

[14] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9: 523-544)

[15] Eaton, M *et al.* (2015): Birds of Conservation Concern 4 – the population status of birds in the UK, Channel Islands and Isle of Man (British Birds 108, December 2015)

[16] IEEM (2006): Guidelines for Ecological Impact Assessment in the United Kingdom

7.46 In line with the IEEM guidance, where relevant the assessment also considers possible local effects on bird communities. The assessment of the significance of local effects generally follows the same approach as for regional and national effects.

Cumulative Effects

7.47 Where relevant the assessment of the significance of effects also considers possible cumulative effects on bird communities from other existing, consented or proposed wind farm developments (including single turbines) in the vicinity. The assessment of cumulative effects on birds has been completed with reference to the current published SNH guidance[17].

Description of Baseline Bird Communities

Breeding Birds

Red Grouse

7.48 The status of red grouse within the survey area during the baseline period is summarized in Table 7.5. Further details of sightings are given in Appendix 7.6 and the locations of sightings are mapped in Figure 7.2. An appraisal of the incidence and distribution of the sightings indicates the presence of two red grouse territories during the earlier baseline period, declining to one territory during the recent (update) baseline period.

7.49 The sightings of red grouse are clustered predominantly within a relatively small area at the northern-most extremity of the survey area and are associated with the heather patches that occur in this area. There is a smaller cluster of sightings in the central part of the survey area, although heather is not a conspicuous element of the vegetation in this area and sightings in this area were less frequent. The birds were highly mobile (often flying long distances when disturbed) and it is certain that birds were mobile between the two clusters of sightings.

Table 7.5 – Summary of Baseline Status for Red Grouse

Baseline Period	No. Territories	No. Territories within 500m of Turbines
Update baseline period (2018 – 2019)	1	1

[17] SNH (2018): Assessing the cumulative impacts of onshore wind farms on birds (Guidance, August 2018)

Baseline Period	No. Territories	No. Territories within 500m of Turbines
Earlier baseline period (2013 - 2014)	2	2

Curlew

7.50 The status of curlews within the survey area during the baseline period is summarized in Table 7.6. Over the baseline period as a whole, curlews were found at three different locations within the wider surrounding area of the Development however no more than two locations were occupied by curlews in any year and none of the locations was closer than 930 m (initial baseline period) or 1.2 km (update baseline period) from the turbine locations. No curlews were found during the single one-off survey visit in late June 2016.

7.51 At location 1 a pair of curlews (pair 1) were found in 2014 and a pair was still present in the same area in 2019. (It is considered probable that a pair were also present at this location in 2018 but had vacated the area prior to surveys commencing in mid-June of that year). None of the sightings of this curlew pair (including numerous sightings made during the recent baseline year) has been closer than 1.2 km from a turbine location. Details of sightings of this pair are given in Appendix 7.7 and all sightings are mapped in Figure 7.3.

7.52 At location 2 a pair of curlews (pair 2) were found in 2018 and were still present in the same area in 2019. (It is not known whether curlews were present at this location in 2014). None of the sightings of this curlew pair (including numerous sightings made during the two most recent baseline years) has been closer than 1.4 km from a turbine location. Details of sightings of this pair are given in Appendix 7.7 and all sightings are mapped in Figure 7.3.

7.53 At location 3 a pair of curlews (pair 3) were found in 2014 but could not be relocated in this area in either of the two more recent baseline years. It is concluded that curlews are no longer present at this location. The sighting in 2014 was 1.0 km from the nearest turbine location. Details of the sighting of this pair are given in Appendix 7.7 and the sighting is mapped in Figure 7.3.

Table 7.6 – Summary of Baseline Status for Curlew

Location	No. Curlew Pairs	Baseline Years in which Curlew Present	Nearest Distance to Turbine Locations
Location 1	1	2014, (2018), 2019	1.2 km
Location 2	1	2018, 2019	1.4 km
Location 3	1	2014	1.0 km

Snipe

7.54 The status of breeding snipe within the survey area during the baseline period is summarized in Table 7.7. Further details of records of territorial snipe are given in

Appendix 7.8 and the locations are mapped in Figure 7.4. All the records were of birds calling from the ground ("chipping") or engaged in brief, low-level display flights with the birds subsequently seen to settle on the ground – such observations are likely to give a good indication of territory locations.

7.55 An appraisal of the incidence and distribution of the records of territorial activity indicates the presence of eight pairs of snipe during the earlier baseline period (of which five pairs were within 400 m of the turbine locations) and eight pairs during the recent (update) baseline period (of which five pairs were within 400 m of the turbine locations). The overall number of territories was the same in each baseline period however two locations for breeding snipe in the earlier baseline period (one of which was within 400 m of the turbine locations) were not occupied during the more recent (update) baseline period, indicating a possible loss of some territories and / or some local-scale variation in the locations of territories between years.

Table 7.7 – Summary of Baseline Status for Breeding Snipe

Baseline Period	Total No. Territories / Pairs	No. Territories / Pairs within 400m of Turbines
Update baseline period (2018 – 2019)	8	5
Earlier baseline period (2013 – 2014)	8	5

Moorland Passerines

7.56 The status of breeding moorland passerines within the survey area (within 500 m of the turbine locations) during the recent (update) baseline period is summarized in Table 7.8 and the locations of these species are mapped in Figures 7.5 - 7.6. Most species were present in both update years however if a species was present in only one year this is indicated in the Table. The status of passerine species during the earlier baseline period is summarized in Appendix 7.9.

7.57 A total of seven passerine species were confirmed breeding within the survey area. This is a relatively small number of species and is explained by the generally very uniform habitat – moorland and upland grasslands, grazed by sheep, mostly at relatively high elevation and lacking significant areas of trees or shrubs. An additional five passerine species were recorded as transient visitors – these were not breeding within the survey area but occasionally visited the area to feed.

7.58 Meadow pipit and skylark were the two most abundant passerine species and both were distributed very widely across the survey area. Other species were present in very small numbers only and were distributed very locally within the survey area.

7.59 Wheatears (up to ten birds in a day) were recorded widely over the survey area on spring migration however only a small number stayed to breed and these were distributed very locally within the survey area (showing an association with short grassland and rocky outcrops). A pair of whinchats were confirmed breeding during the first of the update years but were not relocated in the second year and this species may not therefore be regularly occurring within the survey area.

Table 7.8 – Summary of Baseline Status for Moorland Passerines

Species	No. of Breeding Pairs / Territories	Breeding Status / Remarks
Skylark	26	Breeding confirmed
Meadow pipit	30	Breeding confirmed
Stonechat	2	Breeding confirmed
Whinchat	1	Breeding confirmed (present in 2018 only)
Wheatear	2	Breeding confirmed
Wren	6	Breeding confirmed
Grey wagtail	0	Non-breeding transient (max. count two birds)
Starling	0	Non-breeding transient (max. count 60 birds)
Linnet	0	Non-breeding transient (max. count six birds)
Hooded crow	0	Non-breeding transient (max. count 30 birds)
Raven	0	Non-breeding transient within survey area (max. count 20 birds) however nest confirmed at Scawt Hill just outside survey area
Reed bunting	2	Breeding confirmed

Winter Birds

7.60 The status of bird species within the survey area (within 500 m of the turbine locations) during the recent (update) winter and migration baseline period and during the three earlier winter and migration periods (combined) is summarized in Table 7.9. Sightings of raptors are additional to those made during the vantage point surveys. Further details of any sightings judged to be of note are given in Appendix 7.10.

7.61 A total of 31 bird species were recorded during the winter surveys however (except for those detailed in Appendix 7.10) most of these species are very widespread in distribution locally and regionally and were recorded within the survey area in relatively small numbers. For most species, status during the more recent (update) baseline period is broadly comparable with that found during the earlier baseline period.

7.62 Golden plovers were recorded within the survey area on a fairly regular basis during October to April however numbers were small (maximum counts of 28 birds during the update baseline period and 55 birds during the earlier baseline period) and the flocks were very mobile, with no particularly favoured locations. On approximately a third of survey visits no plovers were found. The sightings in April all referred to small flocks of the northern form "*altifrons*" (which breeds in Iceland and Scandinavia)[18] and there was no indication of breeding by golden plovers within the survey area.

7.63 Snipe were recorded on most survey visits during the winter and migration seasons, however numbers were small and the birds were widely scattered within the survey area, with no indication of any particularly favoured locations where birds might congregate. Single jack snipe were recorded on several surveys and this species is probably regularly occurring within the survey area in small numbers, however there was no indication of any regular or particularly favoured location.

7.64 Feeding flocks of common gulls and black-headed gulls occurred very locally within the survey area, being restricted to the short grassland at Ballycoos (within the southern-most part of the buffer area) and not in the near vicinity of any turbine locations. The flocks were irregular in occurrence (present on only about one in five of all survey visits) and the number of birds involved was relatively small.

7.65 Small flocks of snow buntings were recorded within the survey area on a fairly regular basis (on roughly half of all survey visits) with the largest numbers (maximum 55 birds) in the mid-winter period (December to February). The flocks were highly mobile within the survey area but there was some indication of an association with anthropomorphic features in the landscape (e.g. the edges of tracks and the vicinity of supplementary feeding stations for sheep).

Table 7.9 – Summary of Baseline Status for Winter Season Birds

Species	Update Baseline Period		Earlier Baseline Period	
	No. of Surveys Species Recorded	Maximum Count	No. of Surveys Species Recorded	Maximum Count
Golden plover	2	28	8	55
Snipe	3	10	10	8
Jack snipe	1	1	3	1
Woodcock	0	-	1	1
Merlin	1	1	1	1
Kestrel	0	-	3	2
Peregrine	1	1	4	1
Buzzard	3	3	8	2
Hen harrier	0	-	2	1
Sparrowhawk	0	-	2	1
Teal	2	10	0	-

[18] Cramp, S *et al.* (1983): Handbook of the Birds of Europe, the Middle East and North Africa – Volume III, Waders to Gulls (Oxford University Press)

Species	Update Baseline Period		Earlier Baseline Period	
	No. of Surveys Species Recorded	Maximum Count	No. of Surveys Species Recorded	Maximum Count
Great black-backed gull	1	1	3	3
Lesser black-backed gull	0	-	1	10
Common gull	2	105	4	90
Black-headed gull	1	10	4	60
Skylark	2	10	8	10
Meadow pipit	3	20	8	80
Stonechat	2	1	3	1
Redwing	0	-	2	10
Fieldfare	0	-	2	50
Mistle thrush	0	-	3	30
Wren	1	3	4	6
Pied wagtail	2	1	3	4
Starling	0	-	2	5
Hooded crow	3	6	12	40
Raven	3	15	12	20
Jackdaw	1	10	6	20
Magpie	2	2	4	6
Reed bunting	0	-	3	2
Snow bunting	1	18	6	55

Vantage Point Surveys

Annex 1 Species

7.66 Activity by Annex 1 species within the survey area (up to 500 m around the turbine locations) during both the earlier and recent (update) baseline periods is summarized in Table 7.10 and discussed under the relevant species headings below. The flight-lines for these species are mapped in Figure 7.7 and Figure 7.8. Further details of the sightings of Annex 1 species are given in Appendix 7.11.

Hen Harrier

7.67 During the earlier baseline period harriers were recorded very infrequently within the survey area, with just two observations made from vantage points: a female bird in December 2014 and a male in July 2013. Two additional observations were made during the winter moorland bird surveys: a female in March 2014 and a female in December 2014 (see Table 7.10 and Appendix 7.10).

7.68 During the recent (update) baseline period there were seven harrier observations, all of which were during the months of August and September. There was one observation of an adult male harrier and six of juvenile or first-year birds. Five of the birds were foraging and two birds were engaged in direct travelling flight. The observations indicate that harriers occur occasionally within the survey area during the late summer and autumn period and the observations certainly relate to birds involved in post-breeding dispersal or migratory movements. Harriers may very occasionally visit the survey area during other times of the year (as indicated by observations during the earlier baseline period) however there is currently no indication of regular foraging activity within the survey area during the breeding season or mid-winter period.

Peregrine

7.69 During the baseline period peregrines were recorded infrequently within the survey area. There were a total of 18 observations, of which ten were during the earlier baseline period and eight during the recent (update) period. Observations were in February (1), March (3), April (2), July (1), August (2), September (6), October (2) and December (1). Five additional peregrine observations were made during the winter moorland bird surveys (see Table 7.10 and Appendix 7.10).

7.70 The observations indicate that peregrines occur in the survey area throughout the year but that activity levels are low with a slight indication of a peak during the late summer and early autumn period, which would correlate with the period of post-breeding dispersal. Overall during the baseline period peregrine observations were fewer than might perhaps be expected (in view of the relatively close proximity of a breeding territory) however this can be explained by several factors including relative prey abundance within the survey area (up to 500 m around the turbine locations) compared with the wider surrounding area and also certain other aspects of peregrine behaviour – these factors are discussed further in the assessment of effects.

Merlin

7.71 During the baseline period merlins were recorded very infrequently within the survey area and during the autumn / winter season only. There were two observations during the earlier baseline period and two during the recent (update) period. Observations were in September (1), October (2) and November (1). Two additional observations were made during the winter moorland bird surveys (see Table 7.10 and Appendix 7.10). All sightings were of birds in female-type plumage and the sightings certainly relate to birds involved in post-breeding dispersal or migratory movements.

Whooper Swans

7.72 During the baseline period there were no observations of whooper swans within the survey area (up to 500 m around the turbine locations).

Table 7.10 - Summary of Baseline Activity by Annex 1 Species

Baseline Period	No. of Sightings			
	Hen Harrier	Peregrine	Merlin	Whooper swan
Mar 2019 to Aug 2019	3	2	0	0
Sep 2018 to Feb 2019	3	4	2	0
Jun 2018 to Aug 2018	1	2	0	0
Totals (update baseline period)	**7**	**8**	**2**	**0**
Sep 2014 to Mar 2015	1	2	0	0
Mar 2014 to Aug 2014	0	3	0	0
Sep 2013 to Feb 2014	0	3	2	0
Jul 2013 to Aug 2013	1	2	0	0
Totals (earlier baseline period)	**2**	**10**	**2**	**0**

Non-Annex 1 Species

7.73 Activity by non-Annex 1 species within the survey area (up to 500 m around the turbine locations) during the recent (update) baseline period is summarized in Table 7.11 and discussed under the relevant species headings below. The flight-lines for these species are mapped in Figure 7.9 and Figure 7.10. Further details of the sightings of non-Annex 1 species during the recent (update) baseline period are given in Appendix 7.12.

Buzzard

7.74 During the recent (update) baseline period there were a total of 48 buzzard observations indicating regular use of the survey area by this species. Most observations were during the breeding period March to August. There were markedly fewer observations during the non-breeding period September to February and most observations during this period were during the autumn months of September and October, with only two observations during the mid-winter period November to February, indicting relatively low use of the survey area by buzzards during this time of year.

7.75 Most observations were of birds that were obviously engaged in foraging or related behaviours, though there were also some observations of soaring birds. The mapped flight-lines are widely distributed over the survey area however there is an indication of some concentration of flight activity along the eastern edge of the buffer area, in association with the very steep slopes and cliffs in this area (these flight-lines are mostly not particularly close to the turbine locations) and also a suggestion of some concentration over the moderately steep western slopes of the survey area.

Kestrel

7.76 During the recent (update) baseline period there were a total of 25 kestrel observations indicating moderately regular use of the survey area although less than for buzzard. All observations were of birds that were obviously engaged in foraging or related behaviours. The kestrel observations also show a more strongly seasonal pattern than buzzard – all observations within the survey area were during the period June to October and there were no observations during the winter (November to February) or early breeding season (March to May) periods.

7.77 The observations suggest that kestrels use the survey area principally during the latter part of the breeding season and during the autumn / post-breeding period, with minimal or negligible use during the winter and early breeding periods (it would be expected that kestrels would still occur in the wider surrounding area during these periods, but are presumably using a different mix of habitats). The apparent absence of kestrels from the survey area during the earlier part of the breeding season may be related to the location of the breeding site, which during the recent (update) baseline period was not particularly close (Table 7.14).

Greylag goose

7.78 During the recent (update) baseline period there was one observation of greylag geese, concerning a flock of 12 birds flying from north to south on 18th October and impinging only marginally on the eastern edge of the survey area.

Table 7.11 – Summary of Baseline Activity by Non-Annex 1 Species

Baseline Period	No. of Sightings			
	Buzzard	Kestrel	Sparrowhawk	Greylag goose
Mar 2019 to Aug 2019	24	10	7	0
Sep 2018 to Feb 2019	8	7	2	1
Jun 2018 to Aug 2018	16	8	1	0
Totals	**48**	**25**	**10**	**1**

Secondary Species

7.79 Activity by secondary species (e.g. golden plovers and gulls) and any observations of smaller aerial species (e.g. feeding swallows) within the survey area (up to 500 m around the turbine locations) during the recent (update) baseline period is summarized in Appendix 7.13. Activity by golden plovers was in keeping with the findings of the moorland bird surveys and indicated the occurrence of relatively small flocks of birds during the winter and migration seasons only.

Wider Area Surveys

Annex 1 Raptor Species

7.80 Breeding activity by Annex 1 raptor species in the wider area of the Development (within 2 km of the turbine locations) during the baseline period is summarized in Table 7.12. Breeding activity by peregrines is discussed (in general terms) under the species heading below. Further details of peregrine breeding activity are given in Appendix 7.14 (*Confidential – not for release into the public domain*) and the locations of peregrine breeding activity are mapped in Figure 7.11 (*Confidential – not for release into the public domain*).

Table 7.12 – Summary of Baseline Breeding Activity by Annex 1 Raptor Species

Baseline Year	No. of Pairs or Territories within 2km		
	Peregrine	Hen harrier	Merlin
2019	1	0	0
2018	1	0	0
2014	1	0	0
2013	1	0	0

Peregrines

7.81 During the baseline period peregrines were confirmed breeding at two different locations in the wider area of the Development (within 2 km of the turbine locations) as summarized in Table 7.13. No more than one of the locations was occupied in any one baseline year and it is considered that the two different locations (which are about 2 km apart) are alternative breeding sites within a single peregrine territory[19]. Both locations are designated ASSIs (primarily for their flora or earth science interest however peregrines are mentioned in the respective citation documents).

7.82 Location 1 is a traditional peregrine breeding site that has been monitored by NIRSG for more than 40 years[20]. The location is approximately 700 m from the nearest turbine location and was occupied in the first of the two earlier baseline years however in the second year the birds switched to location 2 (which is approximately 2 km from the nearest turbine location) and were found again at location 2 in the first of the two recent baseline years. In the most recent baseline year a pair was present in the territory (seen in the vicinity of both location 1 and location 2) but breeding was not confirmed at either of the two locations.

Table 7.13 – Summary of Baseline Breeding Activity for Peregrines

[19] Personal observations and NIRSG personal communications

[20] NIRSG personal communications

Baseline Year	Location 1	Location 2	Remarks
2019	-	-	Territory occupied but breeding not confirmed at either location
2018	Not occupied	Breeding confirmed	-
2014	Not occupied	Breeding confirmed	-
2013	Breeding confirmed	Not occupied	-

Non-Annex 1 Raptor Species

7.83 Breeding activity by Non-Annex 1 raptor species in the wider area of the Development (within 2 km of the turbine locations) during the recent baseline period is summarized in Table 7.14 and locations are mapped in Figure 7.11 (*Confidential – not for release into the public domain*). Breeding activity by the different species is discussed further under the species headings below.

Table 7.14 - Summary of Baseline Breeding Activity by Non-Annex 1 Raptor Species

Species	Baseline Period: 2018 / 2019	
	No. Pairs within 2km	No. Confirmed Breeding Attempts within 2km
Buzzard	5	3
Kestrel	1	0
Sparrowhawk	1	0

Buzzard

7.84 During the recent baseline period five pairs of buzzards were located in the wider area of the Development (within 2 km of the turbine locations) as summarized in Table 7.15. Locations are mapped in Figure 7.11 (*Confidential – not for release into the public domain*). Breeding was confirmed (fledged juveniles seen) at three of the locations and probably also occurred at the other two locations. Four pairs were associated with areas of woodland or mature trees within farmland habitats and one pair with a natural cliff. None of the pairs were closer than 1 km from the nearest turbines and three pairs were significantly more than 1 km away.

Table 7.15 - Summary of Baseline Breeding Activity for Buzzards

Buzzard Pair	Baseline Period	Breeding Status	Distance to Nearest Turbine Location
Pair 1	2018 / 2019	Confirmed	1.1 km
Pair 2	2018 / 2019	Confirmed	1.4 km
Pair 3	2018 / 2019	Probable	2.0 km

Buzzard Pair	Baseline Period	Breeding Status	Distance to Nearest Turbine Location
Pair 4	2018 / 2019	Confirmed	1.0 km
Pair 5	2018 / 2019	Probable	1.6 km

Kestrel

7.85 During the recent baseline period one pair of kestrels were present in the wider area of the Development (within 2 km of the turbine locations) however the nest location was not confirmed. The vantage point observations during the most recent year of survey (2019) gave strong indications (e.g. birds seen flying with prey) that the nest site was located to the southeast of the Development and was certainly more than 1 km from the nearest turbine locations and possibly more than 2 km away.

Sparrowhawk

7.86 During the recent baseline period one pair of sparrowhawks were present in the wider area of the Development (within 2 km of the turbine locations) however the nest location was not confirmed. The vantage point observations during the most recent year of survey (2019) gave strong indications (e.g. birds seen flying with prey) that the nest site was located to the southwest of the Development and was certainly more than 1 km from the nearest turbine locations and possibly more than 2 km away.

Assessment of Effects

Breeding Birds

7.87 The potential effects of the proposed Development on breeding birds are described under the headings below. Potential adverse effects and the significance of any likely effects are summarized in Table 7.16. The likelihood / probability of an effect occurring or being significant are described using the IEEM probability table (Appendix 7.5).

General Remarks

7.88 Results of research for breeding birds[21] have suggested that the main adverse effects of wind farms for these species are probably due to disturbance displacement during construction and that wind farm operation is unlikely to have a significant effect on local breeding bird populations. The research also suggested that there are potential beneficial effects of wind farm construction for some passerine bird species.

Red Grouse

7.89 The baseline surveys found up to two red grouse territories within the survey area but only one territory during the more recent (update) baseline period. Densities of

[21] Pearce-Higgins, J.W. et al. (2012): Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis (Journal of Applied Ecology 49)

red grouse have been found to be reduced at wind farms during construction[22] however they recovered quickly (one year after construction) therefore any displacement of birds due to construction would be temporary. There is no indication that red grouse avoid turbines[23] so birds are extremely unlikely to be displaced during the operational phase of the wind farm.

7.90 It is therefore extremely unlikely that there would be any long-term significant adverse effects on the local red grouse population. Any displacement of birds during construction would be expected to be temporary and relatively localized in nature. An appraisal during the field surveys has indicated that adequate suitable habitat that could be utilized by temporarily displaced birds is present in areas adjoining the existing red grouse locations. Also, construction work would be expected to proceed sequentially over the Development area and therefore not all of the area would be subject to disturbance at the same time, leading to an overall slight to moderate mitigating effect on disturbance.

7.91 Grouse are likely to be more sensitive to displacement effects during the breeding season (when for example nests or broods of chicks might be present). Any such effects are still expected to be temporary and relatively localised in nature, however in order to minimize potential disturbance to red grouse during the breeding season there should be appropriate pre-construction vegetation management and also monitoring of grouse activity in the vicinity of the construction works as part of an Ornithology Mitigation Strategy.

Curlew

7.92 The baseline surveys found curlews at three locations within the wider surrounding area of the Development however during the more recent (update) baseline period curlews were present at only two of these locations. The zone of potential sensitivity for displacement effects for curlew extends to 800 m from turbines[24] and during the more recent (update) baseline period curlew were not found closer than 1.2 km (pair 1) and 1.4 km (pair 2) from the turbine locations. It is therefore extremely unlikely that any displacement of curlews would occur.

7.93 Although not closer than 1.4 km from a turbine location, curlew pair 2 was sighted to within 760 m from the proposed entrance to the Development. This sighting is towards the outer limit of the zone of potential displacement (and is separated from the proposed entrance by the existing public road) and most sightings of this pair were significantly further away (average 950 m from the proposed entrance). At these distances (and also considering the existing public road in this area) it is extremely unlikely that any increased activity in the vicinity of the entrance (during

[22] Pearce-Higgins, J.W. et al. (2012): Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis (Journal of Applied Ecology 49)

[23] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[24] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

the construction phase of the Development) would result in any significant displacement of the birds.

7.94 As noted above, the territory of pair 2 is in relatively close proximity to existing public roads however during the more recent (update) baseline period vehicles were frequently observed passing along these roads (to within 60 m of feeding curlews) with no discernible adverse effects on the birds. There is also significant screening by hedgerows and the local topography in this area therefore any increase in vehicle movements along these roads (as might occur during the construction phase of the Development) is extremely unlikely to cause any significant displacement of the birds.

7.95 During the baseline period sightings of curlew pair 1 were not closer than 1.2 km from the turbine locations or any other infrastructure (including the proposed entrance to the Development) and this territory is not in the vicinity of any existing public roads.

Snipe

7.96 The baseline surveys found eight snipe territories within the survey area, with five of these located within 400 m of the turbine locations (which is the zone of potential sensitivity for displacement effects for snipe). Displacement effects might be expected to affect approximately 50% of snipe territories within the 400 m sensitivity zone[25] therefore displacement in the range of two or three snipe territories might be expected to occur.

7.97 It is not certain that displaced snipe would be lost to the local breeding population, as there is extensive suitable habitat within the immediately surrounding area (including within approximately 400 m to 800 m from the turbines) therefore it is possible that some or all of the displaced birds might be able to re-locate locally. However the possibility of some snipe being permanently lost cannot be excluded and any such losses would probably be significant at the local population level.

Moorland Passerines

7.98 Densities of two passerine species (skylark and stonechat) have been found to increase at wind farms during and after construction and there is also an indication of a possible beneficial effect for meadow pipits during construction[26]. It is suggested that vegetation disturbance during the construction of wind farms results in changes to the vegetation that are known to favour these species.

7.99 It should also be noted that SNH are of the view that passerine species are generally not adversely affected by wind farms[27] and many of the territories of passerine

[25] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[26] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[27] SNH (2006): Assessing the significance of impacts of on-shore wind farms on birds out-with designated areas (Guidance Note, July 2006)

species within the survey area are not in the near vicinity of the turbine locations or other proposed infrastructure. All of the moorland passerine species recorded within the survey area also occur in the wider immediate area and are also widely distributed locally and at a regional level. It is therefore extremely unlikely that the Development would cause any significant adverse effects on moorland passerine species at the local population level.

7.100 Although it is not expected that there would be any significant adverse effects on moorland passerines, nevertheless in order to minimize potential disturbance during the breeding season there should be appropriate pre-construction vegetation management and also monitoring of activity by passerine species in the vicinity of the construction works as part of an Ornithology Mitigation Strategy.

Table 7.16 – Summary of Potential Effects on Breeding Birds

Species / Species Group	Potential Effect	Likelihood / Significance of Effect
Red grouse	Temporary displacement of birds during construction	It is probable that some displacement of red grouse would occur during construction however this would be temporary and relatively localised in nature. It is extremely unlikely that there would be any long-term significant adverse effects on the local red grouse population Grouse are likely to be more sensitive to disturbance during the breeding season – to minimize potential disturbance there should be appropriate pre-construction vegetation management and also monitoring of grouse activity as part of an Ornithology Mitigation Strategy
Curlew	Displacement of breeding pairs	Displacement is extremely unlikely to occur and it is therefore extremely unlikely that there would be any significant adverse effects on the local curlew population
Snipe	Displacement of breeding pairs	Displacement of 2 - 3 pairs of snipe is possible. The birds might be able to relocate to suitable habitat which exists in the immediate surrounding area however some losses cannot be completely excluded and any losses would probably be significant at the local population level
Moorland Passerines	Displacement of breeding pairs	It is extremely unlikely that there would be any adverse effects on any passerine species at the local population level Nevertheless in order to minimize any potential disturbance during the breeding season there should be appropriate pre-construction vegetation management and also monitoring of grouse activity as part of an Ornithology Mitigation Strategy

Winter Birds

Golden plovers

7.101 During the baseline period golden plovers were recorded within the survey area on a fairly regular basis during October to April however numbers were small and there was no indication that golden plovers were breeding within the survey area. Golden plovers are widely distributed locally and regionally during the winter and migration seasons and even after making some allowance for turnover of flocks during the migration periods (as birds move quickly through the area and are replaced by others) there is no indication (for example sightings of large flocks) that the survey area is particularly significant for golden plovers during these times.

7.102 Due to the relatively small number of birds involved, any displacement effects on wintering and migrating golden plovers are therefore highly unlikely to be significant. There is no indication that golden plovers are particularly susceptible to collisions with turbines (a 98% avoidance rate is indicated for this species)[28] therefore any losses due to collisions with turbines are also extremely unlikely to be significant.

Other Species

7.103 The potential effects of the proposed Development on other winter bird species are likely to be similar to those described for breeding birds. Therefore the principal adverse effects for these species are also likely to be due to disturbance displacement during construction and wind farm operation is unlikely to have a significant effect on local populations of these species. All of the species found during the winter season are very widespread in distribution locally and regionally and were recorded within the survey area in relatively small numbers. Therefore in general it is not expected that the Development would cause any significant adverse effects on the local populations of wintering birds. For some species (e.g. snow bunting) that are associated with anthropomorphic habitat features there may be potential beneficial effects of wind farm construction (e.g. due to the creation of new tracks and associated habitat edges) at the local population level.

Annex 1 Raptor Species

7.104 The potential effects of the proposed Development on Annex 1 raptor species are described under the headings below. Potential adverse effects and the significance of any likely effects are summarized in Table 7.17. The likelihood / probability of an effect occurring or being significant are described using the IEEM scale.

[28] SNH (2016): Avoidance rates for the SNH onshore wind farm Collision Risk Model (SNH Guidance Note, October 2016)

Hen Harriers

Displacement Effects (Foraging)

7.105 Sightings during the baseline period indicate that hen harriers occur occasionally within the survey area (principally during the late summer and autumn period) and the sightings certainly relate to birds involved in post-breeding dispersal or migratory movements. During the baseline period there has been no indication of regular foraging within the survey area during the breeding season.

7.106 It has been estimated that avoidance of turbines can lead to a 52% reduction in harrier flight activity within 500 m of turbine locations[29] however harriers would not be completely excluded from using the area and this, in combination with the small number of birds involved and the low observation rates would suggest that any displacement effects on hen harriers visiting the survey area during the post-breeding dispersal and migratory periods are unlikely to be significant.

Collision Risk

7.107 The number of hen harrier observations within the survey area during the baseline period is judged to be insufficient to warrant use of the Collision Risk Model. The overall low observation rates within the survey area (within 500 m of the turbine locations) and the relatively high turbine avoidance rate for this species of 99%[30] would indicate that the collision risk is unlikely to be significant.

Peregrines

Displacement Effects (Foraging)

7.108 The relatively low observation rates for peregrines within the survey area (within 500 m of the turbine locations) during the baseline period (despite the relatively close proximity of a breeding territory) can be explained by several factors including relative prey abundance and also certain other aspects of peregrine behaviour.

7.109 The favoured prey species for peregrines (including for example magpies, jackdaws, woodpigeons, racing pigeons and gulls) are relatively scarce within the survey area and all these species are much more abundant within the wider surrounding area, in particular for example within the coastal farmland plain lying to the east of the survey area.

7.110 During the wider area surveys peregrines were observed foraging over the coastal farmland plain. The observed foraging flights were initiated from the nest cliff - for example both birds of the pair hunting domestic pigeons over the coastal plain on 12th June 2014 with prey capture observed to take place high in the airspace above Ballygally village, a distance of 3 km from the nest. These observations demonstrate

[29] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[30] SNH (2016): Avoidance rates for the SNH onshore wind farm Collision Risk Model (SNH Guidance Note, October 2016)

the relatively wide foraging range of peregrines and also how they often take their prey from the airspace rather than relying particularly on habitats at ground level.

7.111 Of the two alternative nest sites within the peregrine territory, location 1 (occupied in one of the four baseline survey years) is relatively close to several of the turbine locations. However none of the turbine locations are within 500 m of the nest site (closest turbine is approximately 740 m distant) and the nest cliff also faces away from the turbine locations and is completely screened by the topography, which is such that peregrines approaching the nest generally do so from the eastern side (away from the Development). Both these factors mean that peregrine flight activity in the immediate vicinity of the nest (within 500 m) does not impinge on the survey area.

7.112 The extent of any displacement of foraging peregrines around wind turbines has not been estimated by the published research, however assuming that displacement is no greater than that indicated for other raptor species and in view of the relatively low observation rates within the survey area (and the other behavioural factors described above) it is unlikely that any displacement would be significant for the local peregrine population.

Collision Risk

7.113 The number of peregrine observations within the survey area during the baseline period is judged to be insufficient to warrant use of the Collision Risk Model. Moreover, there is no indication that peregrines are particularly susceptible to collisions with turbines – the species is extremely agile and a 98% avoidance rate is indicated.[31] Along with the relatively low observation rates within the survey area (within 500 m of the turbine locations) this would indicate that collision risk for this species is unlikely to be significant.

7.114 Of the two alternative nest sites within the peregrine territory, location 1 is relatively close to the turbine locations (740 m to the closest turbine) and there might be concerns in relation to collision risk for juvenile peregrines during the fledging period when the birds are making their first short flights. However two significant factors mitigate this potential concern - the location of the nest site relative to the Development and the flight behaviour of young peregrines during the fledging period. The nest cliff faces away from the turbine locations and is completely screened by the topography and the initial flights by young birds are therefore unlikely to be in the direction of the Development. Also, flight activity by young birds during the initial fledging period is mostly within 500 m of the nest[32], so is unlikely to impinge significantly on the turbine locations.

Direct Disturbance (Nest Sites)

7.115 Of the two alternative nest sites within the peregrine territory, location 1 is in relatively close proximity (approximately 740 m) to one of the turbine locations (T14)

[31] SNH (2016): Avoidance rates for the SNH onshore wind farm Collision Risk Model (SNH Guidance Note, October 2016)

[32] Personal observations

and therefore there might be concerns in relation to potential disturbance of nesting peregrines if this location is occupied during the construction phase of the Development. However several significant factors mitigate against this potential concern, including the location of the nest site relative to the Development, the expected response of nesting peregrines to human activity in the vicinity and the likely disturbance distance for peregrines.

7.116 Importantly, the nest cliff faces away from the Development (east) and is completely screened by the topography therefore nesting peregrines will not be in direct sight of (or over-looked by) any construction activity, which will significantly reduce the risk of disturbance. Depending on certain factors (e.g. wind direction and the types of construction activity taking place) there might be some moderate levels of construction noise audible in the vicinity of the nest but this is extremely unlikely to be significant for peregrines as many of the known nest sites for this species in Northern Ireland are located within busy commercial quarries with high noise levels[33]. The distance from the nest site to the closest turbine (740 m from T14) is also towards the likely upper limit of disturbance, which is in the range of 500 - 750 m for peregrines)[34]. All the other turbine locations are >800 m distant.

7.117 Taking these factors into account it is extremely unlikely that nesting peregrines at location 1 (assuming this location is occupied by the birds) would be significantly disturbed by the construction phase of the Development. If the other alternative nest site (location 2) is occupied during the construction phase then there should be no concerns as this location (which is approximately 2 km from the nearest turbine) is well beyond any likely upper disturbance distance for nesting peregrines.

7.118 Although it is not expected that there would be any significant adverse effects on peregrines, nevertheless in the event that location 1 is occupied by breeding peregrines during the construction phase of the Development then in order to minimize any potential disturbance there should be monitoring of the nest site and also of any construction works within the adjacent part of the Development as part of an Ornithology Mitigation Strategy.

Table 7.17 – Summary of Potential Effects on Annex 1 Raptor Species

Species	Potential Effect	Likelihood / Significance of Effect
Hen harrier	Displacement	Unlikely to be significant. During the baseline period harrier observations have been predominantly during the non-breeding period and there has been no indication of regular foraging during the breeding season
Hen harrier	Collision risk	Unlikely to be significant. Hen harriers are not particularly susceptible to collisions and observation rates during the baseline period have been relatively low

33 NIRSG personal communications

34 Ruddock, M and Whitfield, D.P. (2007): A Review of Disturbance Distances in Selected Bird Species (Natural Research Ltd Report to Scottish Natural Heritage)

Species	Potential Effect	Likelihood / Significance of Effect
Peregrine	Displacement	Unlikely to be significant. Due to various aspects of the foraging behaviour and ecology of this species displacement is unlikely to be significant for the local peregrine population
Peregrine	Collision risk	Unlikely to be significant. Peregrines are not particularly susceptible to collisions and observation rates during the baseline period have been relatively low
Peregrine	Direct disturbance (nest sites)	Extremely unlikely to occur. An appraisal of the two alternative nest site locations in combination with the likely upper disturbance distance for peregrines and other relevant factors indicates that disturbance is extremely unlikely to occur Nevertheless in the event of location 1 (which is closer to the turbine locations) being occupied by nesting peregrines during the construction phase of the Development then in order to minimize any potential disturbance there should be appropriate monitoring as part of an Ornithology Mitigation Strategy

Non-Annex 1 Raptor Species

7.119 The potential effects of the proposed Development on Non-Annex 1 raptor species are described under the headings below. Potential adverse effects and the significance of any likely effects at the regional (Northern Ireland) level are summarized in Table 7.18. The likelihood / probability of an effect occurring or being significant are described using the IEEM scale.

Buzzards

Displacement Effects (Foraging)

7.120 Flight activity by buzzards has been found to decline by 41% within 500 m of turbine arrays[35]. Assuming displacement does occur then the significance of this effect needs to be assessed in the context of other habitat that is likely to be available to the birds and also in the context of the favourable conservation status[36] and very widespread distribution of this species in Northern Ireland and in the island of Ireland as a whole[37].

7.121 Buzzards forage over a very wide range of habitats including moorland habitats (such as those found within the survey area), un-intensive upland farmland habitats, woodland and commercial forestry habitats and also intensive lowland farming habitats (including arable land and improved grasslands). During the baseline period buzzards were observed foraging in association with all of the above habitats within the wider area around the Development (four of the five breeding pairs within the

[35] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[36] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9)

[37] Balmer, D. *et al*. (2013): Bird Atlas 2007-2011 (BTO Books)

wider surrounding survey area were located within agricultural habitats) and availability of foraging habitat is unlikely to be a significant constraint for the birds. Placed in this context then it is extremely unlikely that any foraging displacement would have a significant adverse effect on the distribution and abundance of the local buzzard population or on the regional conservation status of the species.

Collision Risk

7.122 The collision risk assessment for buzzards using the Collision Risk Model is detailed in Appendix 7.15 and indicates a collision risk equivalent to one bird every 2.0 years (range 2.1 – 1.9 years). The collision risk needs to be assessed in the context of breeding productivity and also the favourable conservation status[38] and very widespread distribution of this species in Northern Ireland and in the island of Ireland as a whole[39].

7.123 The all-Ireland buzzard breeding population has been estimated at 3,312 pairs (of which about half are in Northern Ireland) however the population is still expanding in size and range[40]. Breeding productivity in Northern Ireland has been estimated at an average of 1.95 young fledging per successful pair[41] and a study in the Republic of Ireland recorded an average of 2.61 young fledging per successful pair[42]. Beyond the wider surrounding survey area (where the baseline surveys located five pairs) buzzards are also very widespread in the local area of East Antrim, in both lowland and upland habitats[43]. Placed in this context, then it is extremely unlikely that the predicted collision risk would have a significant adverse effect on the distribution and abundance of the local buzzard population or on the regional conservation status of the species.

Direct Disturbance (Nest Sites)

7.124 Disturbance distances for nesting buzzards are likely to be in the region of 500 m[44]. During the baseline period five buzzard pairs were found within the wider surrounding survey area however none of the buzzard locations was closer than 1 km from the nearest turbine locations or other infrastructure and at these distances disturbance due to construction or operation of the wind farm is extremely unlikely to occur.

[38] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9)

[39] Balmer, D. *et al*. (2013): Bird Atlas 2007-2011 (BTO Books)

[40] Nagle, T. *et al*. (2014): Habitat and diet of re-colonising common buzzards *Buteo buteo* in County Cork (Irish Birds 10)

[41] Rooney, E and Montgomery, W.I. (2013) Diet diversity of the common buzzard *Buteo buteo* in a vole-less environment (Bird Study 60)

[42] Nagle, T. *et al*. (2014): Habitat and diet of re-colonising common buzzards *Buteo buteo* in County Cork (Irish Birds 10)

[43] Personal observations

[44] Personal observations

Kestrels

Displacement Effects (Foraging)

7.125 The baseline surveys have indicated some foraging activity by kestrels within the survey area however activity levels were relatively modest and kestrels were not suspected to be nesting in the close vicinity (not within 1 km and possibly not within 2 km). A relatively low turbine avoidance rate of 95%[45] indicates that kestrels may be less prone to displacement effects than most other raptors – along with the presence of extensive suitable habitat in the wider surrounding area then it is extremely unlikely that any foraging displacement would have a significant adverse effect on the distribution and abundance of the local kestrel population or on the regional conservation status of the species.

Collision Risk

7.126 The collision risk assessment for kestrels using the Collision Risk Model is detailed in Appendix 7.15 and indicates a collision risk equivalent to one bird every 3.8 years (range 4.3 – 3.3 years). Any potential collisions need to be considered in the context of the very widespread distribution of this species in Northern Ireland and in the island of Ireland as a whole – although it is an Amber-listed species of conservation concern in Ireland[46], kestrel is nevertheless one of the most widespread and abundant raptor species in Britain and Ireland (present in almost 90% of 10 km squares) and is the most widely distributed raptor species in Ireland[47].

7.127 Although not well studied in Northern Ireland, breeding productivity would also be expected to be relatively good for this species (nest sites are relatively secure and therefore are relatively less prone to predation). Beyond the wider surrounding survey area (where the baseline surveys located one pair) kestrels also occur widely in upland habitats within the local area of East Antrim however (unlike buzzards) they are generally absent from lowland farmland habitats[48]. Placed in this context, and allowing that kestrels are less abundant locally than buzzards due to habitat limitations, then it is nevertheless still unlikely that the predicted collision risk would have a significant adverse effect on the distribution and abundance of the local kestrel population or on the regional conservation status of the species.

Table 7.18 - Summary of Potential Effects on Non-Annex 1 Raptors

Species	Potential Effect	Likelihood / Significance of Effect
Buzzard	Displacement	Extremely unlikely to be significant

[45] SNH (2016): Avoidance rates for the SNH onshore wind farm Collision Risk Model (SNH Guidance Note, October 2016)

[46] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9)

[47] Balmer, D. *et al*. (2013): Bird Atlas 2007-2011 (BTO Books)
[48] Personal observations

Species	Potential Effect	Likelihood / Significance of Effect
Buzzard	Collision risk	Collision rate of one bird every 2.0 (range 2.1 – 1.9) years extremely unlikely to be significant
Buzzard	Direct Disturbance (Nest Sites)	Extremely unlikely to occur
Kestrel	Displacement	Extremely unlikely to be significant
Kestrel	Collision risk	Collision rate of one bird every 3.8 (range 4.3 – 3.3) years unlikely to be significant

Antrim Hills SPA

7.128 The potential effects of the proposed Development on the Antrim Hills SPA (for the principal listed qualifying species hen harrier and merlin) are detailed in Table 7.19. The likelihood / probability of an effect occurring or being significant are described using the IEEM scale. The results of the baseline surveys indicate that there is extremely unlikely to be any significant connectivity between the Development and the Antrim Hills SPA hen harrier and merlin populations.

Table 7.19 - Summary of Potential Effects on the Antrim Hills SPA

SPA Qualifying Species	Summary of Potential Effects	Likelihood / Significance of Effect	Remarks
Hen harrier	Reduction in the distribution and / or abundance of the SPA hen harrier population	Extremely unlikely	The results of the baseline surveys indicate that it is extremely unlikely to be any significant connectivity between the Development and the Antrim Hills SPA harrier population. This is to be expected in view of the fact that the Development is located not closer than 6 km (range 6 – 8.5 km) from recent known harrier nesting locations within the SPA[49] and is therefore located significantly beyond the likely core foraging range for hen harriers (2 – 3 km) and in addition there is no continuous connectivity in terms of harrier habitats between the Development and the SPA. Harriers (mostly juveniles) are found occasionally within the area of the Development for a relatively short period during the late summer and autumn - the observations relate to birds involved in post-breeding dispersal and / or

[49] NIRSG *pers. com.* and personal observations

SPA Qualifying Species	Summary of Potential Effects	Likelihood / Significance of Effect	Remarks
			migratory movements and (importantly) *do not relate to foraging activity by active breeding pairs located within the SPA.* It is possible (though not certain) that some of the harrier observations in the vicinity of the Development relate to birds from the SPA involved in post-breeding dispersal. However it is at least equally likely that the birds are from other areas outside the SPA and observation rates are relatively low. Therefore (and particularly because the observations relate to the non-breeding period) it is extremely unlikely there would be any significant effects on the SPA harrier population.
Merlin	Reduction in the distribution and / or abundance of the SPA merlin population	Extremely unlikely to occur	The results of the baseline surveys indicate that there is extremely unlikely to be any significant connectivity between the Development and the Antrim Hills SPA merlin population.

Local ASSIs

7.129 The potential effects of the proposed Development on Local ASSIs are detailed in Table 7.20. In all cases these have been designated primarily for their flora or earth science interest however peregrines have been recorded at two of the sites and are mentioned in the respective citation documents. The likelihood / probability of an effect occurring or being significant are described using the IEEM scale.

Table 7.20 – Summary of Potential Effects on Local ASSIs

ASSI Feature	Summary of Potential Effects	Likelihood / Significance of Effect	Remarks
Nesting peregrines	Adverse effects on nesting peregrines	Extremely unlikely	The two relevant ASSIs are alternative nesting sites (location 1 and location 2) within a single peregrine breeding territory and

ASSI Feature	Summary of Potential Effects	Likelihood / Significance of Effect	Remarks
			possible adverse effects on these locations due to the Development have been considered in detail in the relevant section of the assessment of effects.

Cumulative (Combined) Effects

Methodology

7.130 In line with the current SNH guidance[50] potential cumulative (combined) effects are assessed in the context of the total national or regional population and distribution of a species – a cumulative (combined) impact should be judged to be of concern where it would adversely affect the favourable conservation status of a species (or prevent a species from recovering to favourable conservation status) at the regional or national level.

Single Turbines

7.131 Information on single wind turbines (either consented or with applications submitted) within a three mile (4.8 km) search radius around the Development has been provided by the applicant. This information indicates a total of twelve single turbine applications within the search area. Eleven of the single turbine locations are more than 2 km away from the Development and it is considered extremely unlikely that the construction and / or operation of these turbines would result in any cumulative adverse effects on the bird communities found within the survey area.

7.132 The remaining turbine (F/2010/0208/F) is located 187 m southeast of 32 Loughdoo Road, Glenarm, approximately 1.9 km from the Development. This turbine is consented and was operational during the period of the updated ornithology baseline surveys. The turbine is in relatively close proximity to the territory of curlew pair 2 and these curlews were present in both the recent baseline update years. These birds were observed feeding in fields to within a distance of 200 m of the operational Loughdoo Road single turbine and the average distance of sightings of these curlews to the turbine was approximately 450 m. Potential cumulative effects on curlews are described below and summarized in Table 7.21.

7.133 The assessment of effects has indicated that the Development is extremely unlikely to have any significant adverse effects on curlew. The territory of curlew pair 2 is in relatively close proximity to the Loughdoo Road single turbine and the continued presence of curlew in this area (the birds were observed feeding to within 200 m of the turbine) would suggest that there are extremely unlikely to be any significant additional effects on curlew pair 2 due to the Loughdoo Road turbine. It is therefore

[50] SNH (2018) Assessing the cumulative impacts of onshore wind farms on birds (SNH Guidance Note, August 2018)

extremely unlikely that there would be any significant adverse cumulative (combined) effects on the conservation status of curlew at the regional or national level.

Table 7.21 – Summary of Potential Cumulative Effects (Single Turbines)

Single Turbine	Species	Potential Effects of the Development	Likelihood / Significance of Cumulative Effects	Remarks
F/2010/0208/F (operational)	Curlew	Extremely unlikely to be significant	Extremely unlikely to be significant	It is extremely unlikely that there would be any significant adverse cumulative effects on the local curlew population

External Wind Farms

7.134 Information on external wind farms within a 30 km search radius around the Development has been provided by the applicant. Many of these wind farms are distant from the Development and could not reasonably be considered to be within the same geographical area and several have had planning permission refused. For the purposes of the cumulative assessment only those wind farms located within 10 km radius of the Development and either consented or still under planning consideration are to be included and these are summarized in Table 7.22.

Table 7.22 - Summary of External Wind Farms within 10 km of the Development

Wind Farm	No. Turbines	Status	Distance from the Development (km)
Ballykeel Wind Farm	7	Awaiting construction	6.0
Carnalbanagh Wind Farm	7	Application submitted	7.2

7.135 Potential cumulative effects on bird communities are summarized in Table 7.23. As a general remark, it is noted that both of the external wind farms are relatively small in scale and are not particularly close to the Development (both are >5 km distant).

Snipe

7.136 The assessment of effects has indicated that the displacement of two or three pairs of snipe is possible due to the Development, although the significance of this effect would be at the local population level only. Considering the locations of the two external wind farms included in Table 7.22 then it is extremely unlikely that either wind farm would exert any additional effects (in combination with the potential effects of the Development) on breeding snipe located within the survey area (for example by restricting the options for relocation of displaced birds locally). It is therefore extremely unlikely that there would be any significant adverse cumulative (combined) effects on the conservation status of snipe at the regional or national level.

Other Bird Species

7.137 For all other bird species the assessment of effects has indicated that it is extremely unlikely or unlikely that there would be any significant adverse effects due to the Development. Allowing for this and considering the locations (and the relatively small scale) of the two external wind farms then it is extremely unlikely that either wind farm would exert any additional effects on the other bird species occurring within the survey area (for example additional displacement effects) or on the conservation status of these other bird species at the regional or national level.

Table 7.23 - Summary of Potential Cumulative Effects (External Wind Farms)

Species	Potential Effects of the Development	Likelihood / Significance of Cumulative Effect	Remarks
Curlew	Extremely unlikely to be significant	Extremely unlikely to be significant	It is extremely unlikely that there would be any significant cumulative effects on the conservation status of curlew at the regional or national level
Snipe	Displacement of 2 -3 breeding pairs is possible - probably significant at the local population level	Extremely unlikely to be significant	It is extremely unlikely that there would be any significant cumulative effects on the conservation status of snipe at the regional or national level
Hen harrier	Extremely unlikely to be significant	Extremely unlikely to be significant	It is extremely unlikely that there would be any significant cumulative effects on the conservation status of hen harrier at the regional or national level
Buzzard	Extremely unlikely to be significant	Extremely unlikely to be significant	It is extremely unlikely that there would be any significant cumulative effects on the conservation status of buzzard at the regional or national level
Kestrel	Extremely unlikely / unlikely to be significant	Extremely unlikely to be significant	It is extremely unlikely that there would be any significant cumulative effects on the conservation status of kestrel at the regional or national level

Mitigation

7.138 Proposed mitigation measures are summarized in Table 7.24 and would be implemented in full by the developer. Full details of the proposed Ornithological Mitigation Strategy (OMS) and the Habitat Management Plan (HMP) would be provided in reports prior to commencement of construction.

7.139 The Ornithology Mitigation Strategy (OMS) would be completed during the construction of the wind farm where this is during the bird breeding season (1st March to 31st August) and would aim to avoid any significant disturbance to the relevant breeding bird species found within the vicinity of the Development.

7.140 The Habitat Management Plan (HMP) would be initiated after planning consent. The HMP should include habitat enhancement measures that would be beneficial for breeding snipe. To maximize potential benefits for snipe some of these measures should if possible be within parts of the Development site that are located more than 400 m from turbines, however appropriate measures anywhere within the Development site are likely to be of significant benefit to snipe. Habitat measures implemented for snipe anywhere within the Development site are also likely to have a significant habitat enhancement effect for several moorland passerine species found within the survey area.

Table 7.24 – Proposed Mitigation Measures

Proposed Mitigation	Implementation	Target Species	Remarks
Ornithology Mitigation Strategy (OMS)	Prior to and during construction	Red grouse Moorland passerines Peregrine	To allow construction work to take place during the bird breeding season (1st March – 31st August) whilst avoiding any significant adverse effects on breeding birds
Habitat Management Plan (HMP) (Details of the HMP are in Appendix 6.6)	After planning consent	Breeding snipe Moorland passerines	The HMP for the wind farm should include measures that would be beneficial for snipe and if at all possible some of these measures should be within parts of the Development site that are located >400 m from turbines Habitat measures implemented for snipe are likely to have a significant enhancement effect for several moorland passerine species within the survey area

Residual Effects

7.141 The potential effects of the Development on birds and any residual effects after the implementation of the proposed mitigation measures are summarized in Table 7.25.

Table 7.25 - Summary of Potential Effects on Bird Communities and Residual Effects

Bird Community / Species	Potential Effect	Likelihood / Significance of Effect	Residual Effects (After Mitigation)
Red grouse	Permanent displacement of birds	Extremely unlikely to be significant	-

Bird Community / Species	Potential Effect	Likelihood / Significance of Effect	Residual Effects (After Mitigation)
Red grouse	Temporary disturbance during construction	Possible	Unlikely to be significant
Curlew	Permanent displacement of birds	Extremely unlikely to be significant	-
Curlew	Temporary disturbance during construction	Extremely unlikely	-
Snipe	Displacement of up to 2 or 3 breeding pairs	Probably significant at the local population level	Unlikely to be significant; possible beneficial effect from the HMP
Snipe (cumulative effects)	Displacement of a small number of additional snipe	Extremely unlikely to be significant at the regional or national population level	-
Moorland Passerines	Displacement	Extremely unlikely to be significant	HMP likely to have a beneficial effect
Moorland passerines	Temporary disturbance during construction	Possible	Unlikely to be significant
Winter Birds	Displacement	Extremely unlikely to be significant	-
Hen harrier	Displacement	Extremely unlikely to be significant	-
Hen harrier	Collision risk	Extremely unlikely to occur	-
Peregrine	Displacement	Extremely unlikely to be significant	-
Peregrine	Collision risk	Extremely unlikely to occur	-
Peregrine	Direct Disturbance (Nest Sites)	Extremely unlikely to occur	-
Merlin	Displacement	Extremely unlikely to be significant	-
Buzzard	Collision risk	The collision risk of one bird every 2.0 years (range 2.1 – 1.9 years) is extremely unlikely to be significant	-
Buzzard	Direct Disturbance (Nest Sites)	Extremely unlikely to occur	-
Kestrel	Displacement	Extremely unlikely to be significant	-
Kestrel	Collision risk	The collision risk of one bird every 3.8 years (range 4.3 – 3.3 years) is unlikely to be significant	-
Antrim Hills SPA	Reduction in the distribution and / or	Extremely unlikely	-

Bird Community / Species	Potential Effect	Likelihood / Significance of Effect	Residual Effects (After Mitigation)
	abundance of the SPA qualifying species (hen harrier and merlin)		
Local ASSIs	Adverse effects on the relevant ASSI feature (nesting peregrines)	Extremely unlikely	-

Conclusions

7.142 Assuming implementation of the mitigation measures then it is concluded that the Development is unlikely to have any significant adverse effects on bird communities. Furthermore, measures included for breeding snipe within the HMP are likely to have a significant beneficial effect for several moorland passerine species found within the survey area.

References

References are given in full in the footnotes to the Chapter.

List of Appendices

Appendix 7.1 – Details of Moorland Bird Survey Visits

Appendix 7.2 – Details of Winter Bird Survey Visits

Appendix 7.3 – Details of Vantage Point Watches

Appendix 7.4 - Summary of Vantage Point Watches at Dusk

Appendix 7.5 – IEEM Probability Table

Appendix 7.6 – Details of Red Grouse Sightings

Appendix 7.7 – Details of Curlew Sightings

Appendix 7.8 – Details of Snipe Sightings

Appendix 7.9 – Summary of Status of Moorland Passerines (Earlier Baseline Period)

Appendix 7.10 – Details of Winter Bird Sightings

Appendix 7.11 – Details of Records of Annex 1 Species (All Baseline Period)

Appendix 7.12 – Details of Records of Non-Annex 1 Species (Update Baseline Period)

Appendix 7.13 – Summary of Activity by Secondary Species

Appendix 7.14 – Details of Peregrine Breeding Activity (CONFIDENTIAL - not for release into the public domain)

Appendix 7.15 – Details of Collision Risk Model

List of Figures

8

Fisheries

8 Fisheries & Aquatic Ecology

Background

8.1 This chapter describes the fisheries interests of the watercourses draining the proposed Ballygilbert Wind Farm, hereinafter referred to as 'the Development', and considers the potential effects of the construction, operation and decommissioning of the development on these interests. The assessment consists of a desk-based assessment using available published and online information in combination with data and observations collected in the field. The specific objectives of the chapter are to:

- describe the fisheries baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects, including direct, indirect and cumulative effects;
- describe the mitigation measures proposed to address likely significant effects;
- assess the residual effects remaining following the implementation of mitigation.

8.2 The assessment has been carried out by Paul Johnston Associates Ltd, an independent fisheries consultancy specialising in freshwater fisheries in Ireland. This chapter was compiled by David Kelly, principal consultant and director of PJA Ltd. He holds a BSc (1st Class Hons) degree in Zoology, and a PhD in Freshwater Ecology & Fisheries; he is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM), a registered member of the Institute of Fisheries Management (MIFM), and a visiting Research Fellow at Queens University Belfast. Also involved was Paul Johnston who holds a BSc (Hons) in Zoology and a PhD in Fisheries Ecology; he is also a Fellow of the Institute of Fisheries Management (FIFM) and Chartered Environmentalist (CEnv).

8.3 The practice has completed a wide range of assignments in the areas of environmental impact assessment, fisheries development and catchment management. This includes fisheries assessments in connection with a series of onshore wind farm developments in Northern Ireland.

8.4 **Volume 3 - Figures 8.1 - 8.7** are referenced in the text where relevant.

Legislation, Policy & Relevant Guidance

Fisheries Administration

8.5 With regard to fisheries administration and legislation, the footprint of the Development lies within the jurisdiction of Inland Fisheries Division (IFD) of the

Department for Agriculture Environmental and Rural Affairs (DAERA). Under the provisions of the Fisheries Act (NI) 1966, DAERA IFD has responsibility for the conservation, protection, development and improvement of salmon and inland fisheries of Northern Ireland.

Legislation

EU Legislation

8.6 EU and local legislation relevant to fisheries and the water environment in the area of the Development includes the following:

- EC Habitats Directive (92/43/EEC);
- EU Water Framework Directive (2000/60/EC) [incorporating standards from the Fish Directive [Consolidated] (2006/44/EC) – this Directive was repealed in 2013];
- European Eel Regulation (EC) 1100/2007.

Domestic Legislation

- Fisheries (Northern Ireland) Act 1966;
- Drainage (Northern Ireland) Order 1973;
- Environment (Northern Ireland) Order 2002;
- Nature Conservation and Amenity Lands (Amendment) (Northern Ireland) Order 1989;
- Water (Northern Ireland) Order 1999;
- Water Environment (Water Framework Directive) (Northern Ireland) Regulations 2003;
- Wildlife (Northern Ireland) Order 1985;
- Wildlife and Natural Environment Act (Northern Ireland) 2011.

Policy

8.7 Policy with regard to Atlantic salmon and European eel in this region is set out in the following:

- Glens and Rathlin Local Management Area Action Plan and Update;
- Atlantic Salmon Management Strategy for Northern Ireland and the Cross-Border Foyle and Carlingford catchments to meet the objectives of NASCO resolutions and agreements, 2008–2012 (DCAL);
- North Eastern River Basin District Eel Management Plan (DEFRA).

Guidance

8.8 Specific guidance relevant to the Development includes the following:

- Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites (DCAL undated);
- Engineering in the water environment: good practice guide River Crossings (SEPA 2nd Edtn 2010);

- Culvert Design and Operation Guide (C689) (CIRIA, 2010);
- Environment Agency Policy Regarding Culverts: Technical Guidance on Culverting Proposals (EA, 1999);
- PPG1: Understanding your environmental responsibilities – good environmental practices
- GPP2: Above ground oil storage tanks;
- GPP5: Works and maintenance in or near waters;
- PPG6: Working at construction and demolition sites;
- GPP8: Safe storage and disposal of used oils;
- PPG13: Vehicle washing and cleaning;
- PPG18: Managing fire water and major spillages;
- GPP21 Pollution incident response planning;
- GPP22 Dealing with spills;
- GPP26 Safe storage – drums and intermediate bulk containers

Scope of Assessment

8.9 The fisheries assessment has involved desk study, field work, data processing and analysis and interpretation using professional judgement. The key receptors are the Glenarm River, its key tributary the Linford Water, and a series of small tributary streams which drain the area within the Land Under Applicant Control, hereinafter referred to as ‘the Site’.

8.10 Existing fisheries data and relevant conservation information on the Glenarm River was assimilated and supplemented through a bespoke fisheries survey of the Development covering the principal watercourses draining the area.

8.11 The field study consisted of walkover surveys of the principal watercourses, assessments of physical habitat conditions, measurement of basic chemistry parameters, collection of benthic invertebrate samples for assessment of biological quality, and a fish stock survey by electrofishing.

8.12 The sensitivity of each watercourse with regard to fisheries has been assessed according to a methodology for environmental sensitivity outlined in the Design Manual for Roads and Bridges, specifically with regard to effects on the water environment (DMRB, 2009). Potential effects of the construction, operation and decommissioning phases of the Development were then assessed. This assessment was based primarily on the potential effects on resident fish stocks either directly or upon their habitats.

Consultation

8.13 The principal consultee during the study was DAERA IFD as the statutory body with authority for fisheries matters in the local waters. Consultee responses are summarised in **Table 8.1**.

8.14 Consultations were also conducted with other sub-consultants on the project, notably in relation to hydrology and drainage issues which are contained within **Chapter 9: Geology and Water Environment** of this ES.

Table 8.1: Consultee Responses

Consultee		Summary of Response	Addressed in Assessment
DAERA	**Inland Fisheries Division**	**A letter was submitted September 10th 2019 to the DAERA area fisheries officer Warren Campbell seeking any comments that the Department might have regarding fisheries interests in the streams draining the proposed development. No comments were received.**	

Assessment Methodology

Baseline Characterisation

Study Area

8.15 The study area focussed on tributary streams of the Linford Water (a main tributary of the Glenarm River) and the Glenarm River which drain the area within the site to the east and north

8.16 The desk assessment includes an evaluation of fisheries in downstream reaches of the Glenarm River **(Volume 3 - Figure 8.1)**.

Desk Study

8.17 A desk study was carried out to assimilate baseline information relating to salmonid fisheries, ecological and water quality status for the study area. The following sources were consulted/used:

- DAERA Inland Fisheries Division
- Northern Ireland Environment Agency (NIEA) – Water Management Unit (WMU) (Rivers and Lakes Team) https://appsd.daera-ni.gov.uk/RiverBasinViewer/
- NIEA - Protected Areas https://appsd.daera-ni.gov.uk/nedmapviewer/
- NIEA digital datasets https://www.daera-ni.gov.uk/articles/digital-datasets

Field Survey

General Approach

8.18 An initial walkover survey was carried out to assess the significance of the streams directly draining the Development area (see Figure 8.5). This was followed by more detailed surveys of the Linford Water and Glenarm tributary streams at selected sites in the reaches draining the Development area.

8.19 The surveys at each site comprised assessments of stream quality (water chemistry, physical habitat and aquatic ecology), fisheries habitat and juvenile fish stocks.

Stream Quality

8.20 A series of survey sites was selected on the streams draining the Site. In addition, a "control" site was selected in the main channel Linford Water upstream of the inflow of the Development area drainage streams while an "impact" site was selected in the main channel Glenarm River downstream of all streams draining the Development; this "control" and "impact" design provides some indication of pre-construction baseline conditions and allows for post-construction monitoring of potential impacts should this be required. Surveys were conducted in October 2018. For each site, baseline water chemistry, physical habitat and aquatic ecology were assessed.

Water Chemistry

8.21 A series of basic water quality parameters were measured at each site using portable meters to provide an outline profile of chemical quality.

8.22 Dissolved oxygen was measured with a Hanna Oxy-Check oxygen meter, and conductivity with a Hanna HI86303 conductivity meter; temperature measurements were made with the oxygen meter.

Physical Habitat

8.23 River physical habitat (substratum type, depth, flow velocity) was assessed based on the fully quantitative method developed by DAERA Inland Fisheries Division and the AgriFood and Biosciences Institute (AFBI). In each site, surveys consisted of a 40m stream reach with 25 sampling points across five equidistant cross-sectional transects except on very narrow (<0.3m width) and overgrown streams where it was difficult to observe the riverbed; on these streams, up to 12 transects (1-3 sampling points per transect) were surveyed in each reach.

8.24 At each sampling point, flow velocity was recorded at 60% depth using a Geopacks flow meter, with water depth measured using the meter's impeller stick; substrate was visually assessed using a bathyscope with the dominant substrate type recorded according to a modified Wentworth Scale (Bain et al. 1985; **Table 8.2**).

Table 8.2: Substrate classification and scoring based on the Wentworth system (from Bain *et al*. 1985)

Substrate type	Size Class (mm)	Score
Sand/silt	<2	1
Gravel	2-16	2
Pebble	17-64	3
Cobble	65-256	4
Boulder	>256	5
Irregular Bedrock	-	6

8.25 The following physical characteristics were measured at each site:

- Stream width and depth at each transect (m)
- Substrate composition (visually estimated as per Bain et al., 1985);
- Percentage of deposited fine sediment (<2mm grain) on the river bed as per Clapcott et al. (2011), with the dominant fine sediment type (sand, silt, clays) determined by running the grain through the observer's fingers.

The classification system of Bain *et al* (1985) was used to summarise the composition of substrate in a reach based on two indices:

- Coarseness index (CI) – calculated as the mean dominant substrate score
- Heterogeneity (SD) – calculated as the standard deviation of the mean CI.

These indices show how coarse or smooth the substrate of a reach is and if it is comprised of a mixture or is dominated by a particular substrate class **(Table 8.3).**

Table 8.3: Substrate description inferred from sample data (from Bain *et al*. 1985)

Mean substrate score (CI)	Heterogeneity (SD)	Inferred substrate description
3.2	1.96	Heterogeneous, smooth and rough
5.0	0.00	Homogeneous, coarse
1.25	0.44	Nearly homogeneous, smooth
3.25	0.85	Heterogeneous, intermediate coarseness
5.05	0.69	Heterogeneous, coarse

Aquatic Ecology

8.26 Stream benthic communities are sensitive to a wide range of environmental stressors including nutrient enrichment and organic pollution, acidification, fine deposited and suspended sediments, and hydrocarbons/ oils. The relatively long lifespans and varying sensitivities of individual taxa mean that invertebrate communities can integrate stressor effects over longer timescales than may be indicated by physico-chemical parameters alone (Extence et al. 2013). As such, they are important for assessing both short and longer term effects.

8.27 In October 2018, baseline ecology of watercourses adjacent and downstream of the Development was assessed by sampling the benthic macroinvertebrate community in the riffle/ run habitat using a standard threeminute kick sample (hand held 1mm mesh pole net); the method is recommended by the United Kingdom Technical Advisory Group (UK-TAG) for assessing the condition of the quality element "benthic invertebrates" for WFD reporting (WFD-UKTAG, 2014). The sampling period corresponds to the preferred spring or autumn collection season when larger instars of taxa are better retained by the kick-net mesh

8.28 Samples were collected from riffle/run habitats, fixed in 4% formalin for 1 week, followed by preservation in 70% ethanol prior to sorting and identification.

8.29 In the laboratory, macroinvertebrate samples were spread across a 4 x 5, 20-square grid sorting tray to facilitate identification and to estimate relative abundance. Abundant taxa were counted in a subset of five squares and scaled to whole sample estimates as recommended in Murray-Bligh (2002). Less abundant taxa were counted in all grid squares.

Fisheries Habitat

8.30 An outline assessment of the tributary streams draining the Development was carried out in October 2018 and consisted of walkover surveys recording general characteristics to provide an outline assessment for these watercourses. Additional information of fish habitat classification was recorded during the fish stock survey in August 2019 and a further walkover survey of stream headwaters within the Land under Applicant Control.

8.31 The descriptive terminology used in the survey is based on the Life Cycle Unit method (Kennedy, 1984) currently used by DAERA Inland Fisheries and the Loughs Agency (see also DANI advisory leaflet No 1). In summary, habitat type is recorded as:

- Nursery (shallow rock/cobble riffle areas for juvenile fish - fry/parr);
- Holding (deeper pools/runs for adult fish);
- Spawning (shallow gravel areas for fish spawning);
- Unclassified (unsuitable for fish – shallow bedrock areas or heavily modified sections of channel).

8.32 Each stretch of a particular river is also graded 1 to 3, based on a series of criteria as set out in Annex 1 of the DANI advisory leaflet. In essence, points 1-3 are of fisheries interest (Nursery, Holding and Spawning) whereas non-fisheries interest is unclassified and would describe a substrate of fine silt, or extensive bridge invert, or engineered channel with solid bed and possibly constrained banks.

8.33 The descriptive terminology used in the survey is based on the Life Cycle Unit method (Kennedy, 1984) currently used by DAERA Inland Fisheries (see also DANI advisory leaflet No 1).

Juvenile Fish Stocks

8.34 Monitoring of fish stocks by the DAERA IFD tends not to include sampling sites in the upper reaches of tributaries in most river systems. Therefore, this part of the fisheries assessment considered the principal streams draining the Development site with the data supplemented by DAERA IFD data for the main Glenarm River.

8.35 A juvenile fish stock survey of the Linford Water and tributaries adjacent to the Development Site was carried out by electrofishing at selected locations in August 2019 (**Volume 3 - Figure 8.5**).

8.36 Electrofishing was carried out according to a semi-quantitative methodology described by Crozier and Kennedy (1994). The procedure involves two operators fishing continuously in an upstream direction for five minutes at each sampling location, using an E-Fish 500W single anode electrofishing backpack (EF-500B-SYS). The system operates on 24V input and delivers a pulsed DC output of 10 to 500W at a variable frequency of 10 to 100Hz. Output voltage and frequency are adjusted according to the electrical conductivity at the survey site.

8.37 All fish were caught using a dip net and retained for general inspection and length measurement before being returned to the water live. Any additional Age 0 salmonids observed but not captured were also recorded. This method is consistent with DAERA IFD survey and monitoring procedures.

8.38 The semi-quantitative electrofishing method has been calibrated separately for trout and salmon based on extensive studies in river reaches of known juvenile salmonid density. This has resulted in the development of an abundance classification system (Abundance Index) for salmon with five categories: Absent, Poor, Fair, Good, Excellent (**Table 8.4a**). The Abundance Index for trout has six classifications: Absent, Poor, Poor/Fair, Moderate, Good, Excellent (**Table 8.4b**).

Table 8.4: Semi-quantitative abundance categories for age 0 salmon (a) and trout (b), as developed by Crozier and Kennedy (1994); Kennedy (*unpublished data*)

(a) Salmon

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
0	0	Absent
1 - 4	0.1 - 41.0	Poor
5 - 14	41.1 - 69.0	Fair
15 - 24	69.1 - 114.6	Good
25+	114.6+	Excellent

(b)Trout

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
0	0	Absent
0 - 1	0.1 - 7.0	Poor

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
2 - 3	7.1 - 16.5	Fair
4 - 8	17 - 31	Moderate
9 - 17	32 - 59.9	Good
18+	60+	Excellent

Assessment of Effects

8.39 The assessment of effects was derived from methodologies outlined by:

- the Design Manual for Roads and Bridges specifically with regard to Road Drainage and the Water Environment, Volume 11, Section 3, Part 10 LA 113 (DMRB, 2019);
- Guidelines for Ecological Impact Assessment in the UK and Ireland (2018).

8.40 The significance of the potential effects of the Development has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect.

Sensitivity Criteria

8.41 Using the information assembled through the baseline assessment, the Fisheries Significance/Sensitivity of each watercourse was graded according to the generic methodology for environmental sensitivity outlined in **Table 8.5**, which is adapted from DMRB guidance for assessing the importance/ sensitivity of water environment features (Table 3.7; DMRB, 2019) and biodiversity resources (Table 3.9; DMRB, 2019b). **Table 8.5** details the framework applied in determining the sensitivity and this evaluation was used as the basis for the assessment of effects and the specification of any necessary mitigation requirements with regard to fisheries and the aquatic environment.

Table 8.5: Estimating the Sensitivity/Importance of Receptors (adapted from Table 3.9 DMRB, 2019b)

Sensitivity	Criteria	Typical Examples
Very High	Attribute has a high quality and rarity on a regional or national scale	WFD Class ‘High’. Site protected/designated under EC or UK habitat legislation (SAC, ASSI, salmonid water)/Species protected by EC legislation. Watercourse containing salmon and supporting a nationally important fishery or river ecosystem.
High	Attribute has a high quality and rarity on a local scale	WFD Class ‘Good’. Species protected under EC or UK habitat legislation. Watercourse containing salmon or trout and supporting a locally important fishery or river ecosystem.

Sensitivity	Criteria	Typical Examples
Medium	Attribute has medium quality and rarity on a local scale	WFD Class 'Moderate'. Watercourse containing trout and upstream of locally important fishery or river ecosystem.
Low	Attribute has low quality and rarity on a local scale	WFD Class 'Poor'. Watercourse without salmon or trout but upstream of locally important fishery or river ecosystem.
Negligible	Attribute has very low quality and rarity on a local scale	WFD Class 'Poor'/unspecified.

Magnitude of Effect

8.42 The magnitude of effect was assessed according to the criteria set out in **Table 8.6** and includes a consideration of the timescale of the effect (short, medium or long term).

Table 8.6: Estimating the Magnitude of Effect on Receptors (adapted from Table 3.71, DMRB, 2019 and Table 3.1, DMRB, 2019b)

Magnitude	Criteria	Type and Scale of Effect
Major	Results in loss of attribute and/or quality and integrity of the attribute	Loss or extensive change to a fishery. Loss or extensive change to a designated Nature Conservation Site. Major alteration to fish population levels in catchment as a whole, through fish mortality, habitat destruction or barrier to migration. Duration: long-term (>5 years).
Moderate	Results in effect on integrity of attribute, or loss of part of attribute	Partial loss in productivity of a fishery. Appreciable alteration to fish population levels in specific sub-catchment or zone. Duration: medium-term (1-5 years).
Minor	Results in some measurable change in attribute's quality or vulnerability	Minor loss in productivity of a fishery. Minor alteration to fish population levels in specific sub-catchment or zone. Duration: short-term (up to 1 year).
Negligible / No impact	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	Unlikely to affect the integrity of the water environment. No measurable alteration to fish population levels.

Significance Criteria

8.43 The correlation of magnitude against the sensitivity of the receptor determines a qualitative expression for the significance of the effect on the basis of a standard matrix shown in **Table 8.7**. The greater the sensitivity or value of a receptor or resource, and the greater the magnitude of the impact, the more significant the effect.

Table 8.7: Estimating the Significance of Potential Effects (adapted from Table 3.13, DMRB, 2019b and Table 3.8.1, DMRB, 2019c)

Sensitivity	Magnitude of Effect			
	Major	Moderate	Minor	Negligible
Very High	**Very Large**	**Large/Very Large**	**Moderate/Large**	**Neutral**
High	**Large/Very Large**	**Moderate/Large**	**Slight/Moderate**	**Neutral**
Medium	**Large**	**Moderate**	**Slight**	**Neutral**
Low	**Slight/Moderate**	**Slight**	**Neutral**	**Neutral**

8.44 The five significance categories with typical effects are shown in **Table 8.8**. Effects evaluated as being Moderate, Large or Very Large are considered to be significant for the purpose of the EIA in line with the EIA Regulations and will require mitigation. Those effects assessed as Slight or Neutral are not considered to be significant in terms of the EIA.

Table 8.8: Descriptors of the Significance of Effect Categories (adapted from Table 3.7, DMRB, 2019c).

Significance category	Descriptors of effects
Very large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Baseline Conditions

Outline

8.45 This element of the assessment consisted of:

- Desk studies to collate baseline information on fisheries, conservation designations, and ecological status of waterbodies hydrologically connected to the Development; and

- Field surveys focused on the streams draining the Development to assess baseline physical habitat conditions, biological quality, salmonid habitat, and fish distribution. Field survey work was therefore carried out both within the Site Boundary and in the immediate downstream reaches of the drainage streams connecting to the Glenarm River.

Catchment Status

Designated Sites

8.46 There are no designations relating to Fisheries and Aquatic Ecology with respect to SACs or ASSIs. However, Glenarm Woods ASSI extends along the riparian area of the main channel Glenarm River and is considered in **Chapter 6; Ecology**.

EU Water Framework Directive

Local River Catchments

8.47 The Development is located largely within the Glenarm River catchment The Glenarm River is formed by two key tributaries, the Owencloghy and the Skeagh/ Linford Water, where it flows in a northerly direction to enter the North Channel of the Irish Sea at Glenarm village (**Figure 8.3**). The Glenarm River is assigned to the North Eastern River Basin District (NERBD) under the Water Framework Directive.

8.48 The Owencloghy tributary extends to over 10km in length from its source at over 380m elevation, while the Skeagh/ Linford Water tributary also extends to over 10km from its source at over 330m elevation east of Capanagh Wood. Both tributaries then form the main stem Glenarm River, which runs for approximately 6km long, with most of the section occurring within Glenarm Estate.

8.49 A very minor watercourse drains directly to the coast on the north-east of the Development. Its source within the Development is water-logged land characterised by thick grass and moss before flowing over very steep cliffs and hillside towards the coast as field drainage, with extensive culverting in its lower reaches (see Chapter 9, Geology and Water Environment). As such, the watercourse has no fisheries interest.

8.50 Land use in the upper reaches is predominantly rough grazing for sheep with extensive conifer forestry plantation, although cattle grazing also occurs on the gentler gradients.

Ecological Status & Water quality

8.51 To achieve the ecological objectives of the Water Framework Directive (WFD), River Basin Management Plans (RBMPs) have been implemented through a series of Local Management Areas (LMAs) during the 2010 to 2015 planning cycle, now extended into the subsequent 2016 to 2021 cycle, and with provision under WFD for a third cycle from 2022 to 2027.

8.52 The Development lies entirely within the Glens and Rathlin LMA, with all of the application area located in two main waterbodies defined as Glenarm River (UKGBNI1NE040403012) and Linford Water (UKGBNI1NE040403012).

8.53 Ecological and water quality monitoring to inform waterbody status is conducted by the NIEA Water Management Unit to comply with statutory monitoring for WFD compliance. The monitoring station that informs the Glenarm River status is located in the lower river in Glenarm village (station 10479) whereas the station on the Linford Water is located several kilometres upstream of the Development (station 11310). The most recent ecological assessment for these waterbodies was carried out in 2015 and is summarised in **Table 8.9, the table** indicates the overall classification and status with regard to each of the principal parameters monitored.

Table 8.9: Classification of individual quality elements contributing to overall WFD status of relevant water bodies in Glenarm and Rathlin LMA, 2018 (Source: NIEA)

Parameter	Glenarm River (Ref 3012)	Linford Water (Ref 3048)
Benthic Invertebrates	High	High
Macrophytes	High	High
Phytobenthos	High	High
Fish	-	-
Biochemical Oxygen Demand	High	High
Temperature	High	High
Dissolved oxygen	High	High
pH	High	High
Soluble Reactive Phosphorus	High	High
Ammonia	Good/High	Good/High
Hydrological regime	High	High
Morphological conditions	Good	Good
Overall Status	**GOOD**	**GOOD**

8.54 For the current planning cycle to 2021 NIEA has developed a series of RMBPs for each River Basin District including the North Eastern RBD. These documents set out the latest assessment of pressures and impacts on the water environment, they describe the progress NIEA has made towards achieving objectives for 2015, and explain the significant water management issues that still need to be addressed.

EC Fish Directive

8.55 The EC Freshwater Fish Directive (Consolidated) 2006/44/EC (FWFD) set physical and chemical water quality objectives for salmonid waters and cyprinid waters, specifically with regard to dissolved oxygen, ammonia, pH and total zinc.

8.56 The main stem channel of the Glenarm River and its two key tributaries, the Owencloghy and Linford Water, was designated as “salmonid” under the Surface Waters (Fish Life Classification) Regulations (Northern Ireland) 1997, which implements the EC Freshwater Fish Directive.

8.57 The Fish Directive was repealed by the Water Framework Directive (WFD) at the end of 2013, and the ecological status defined in the WFD sets the same protection to waterbodies designated for fish under the original directive. Areas designated under the Fish Directive have become areas designated for the protection of economically significant aquatic species under WFD and placed on a Register of Protected Areas.

WFD Fish Monitoring

8.58 Water Framework Directive (WFD) compliant fish surveys at surveillance stations are required under national and European law. Annex V of the WFD stipulates that rivers should be included within monitoring programmes and that the composition, abundance and age structure of fish fauna should be examined (Council of the European Communities, 2000). However, there are no WFD fish monitoring stations within the Glenarm catchment, and this has been recognised as an area requiring further progress in the LMA Action Plan.

8.59 The following fish species are recorded as being present in the Glenarm River catchment:

- Atlantic salmon (*Salmo salar*);
- Brown trout and Sea trout (*Salmon trutta*);
- Eel (Anguilla anguilla);

The following species may be present although there are no substantive records:

- Three-spined stickleback (*Gasterosteus aculeatus*);
- Minnow (Phoxinus phoxinus);
- River/Brook lamprey (*Lampetra* sp);
- Sea lamprey (Petromyzon marinus). doubtful

Significant Freshwater Species

8.60 This section outlines the current status of Annexe II freshwater species and other species of conservation interest in the Glenarm River catchment.

Atlantic salmon

8.61 As an anadromous species, Atlantic salmon use both the freshwater and marine for the completion of the life cycle. The relevant conservation designations for Atlantic salmon give the species national and international significance. Atlantic salmon is listed in Annexes IIa and Va of the EC Habitat and Species Directive (Directive 92/43/EEC), Appendix III of the Bern Convention, and has a IUCN status of threatened in the Irish Red List No 5 (King et al, 2011). The species was added to the UK Biodiversity Action Plan (BAP) list in 2007 as a priority species for conservation action.

8.62 Adult salmon mature at two to four years of age with spawning occurring between November and December usually the upper reaches of suitable tributaries. Juvenile fish remain in freshwater for one or two years to attain sufficient size before becoming smolts, when they migrate to sea during April and May. The marine phase represents a period of rapid growth associated with greater food availability. Many salmon will return to freshwater in the following year as one sea-winter fish (grilse) but a proportion may remain at sea for another year to return as two sea-winter fish.

8.63 The North Atlantic Salmon Conservation Organisation (NASCO) has endorsed a precautionary approach to the conservation, management and exploitation of the salmon resource and the environments in which it lives; Northern Ireland, through the UK and EU, is a Party to NASCO.

8.64 Atlantic salmon stocks in general are in serious decline with some stocks threatened with extinction. As a conservation measure, the Fisheries Regulations (Northern Ireland 2014 saw the introduction of a series of regulations by DCAL (now DAERA) including the closure of commercial salmon fisheries and mandatory catch and release of salmon caught by anglers within the its jurisdiction.

8.65 Conservation measures are subject to annual review by the Standing Scientific Committee on Salmon (SSCS). In 2019, based on salmon stock data showing that the Glenarm river was meeting its management objective, the SSCS recommended a harvestable surplus of 24 adult fish.

Eel

8.66 The European eel the stock has been in rapid decline throughout its range since around 1980. This has led to the passing of the European Eel Regulation (EC) 1100/2007 which aims to return the European eel stock to more sustainable levels of adult abundance and juvenile eel recruitment. Member States are required to implement Eel Management Plans in each eel river basin, in this case the North Western International River Basin District.

8.67 The European eel is not listed under Annexe II but has recently been added to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species in the category of Critically Endangered (King *et al*, 2011).

8.68 There is limited data available on the distribution of eel in the Glenarm River catchment but the species is expected to be widespread where barriers to upstream migration of elvers are absent.

Brown trout

8.69 Brown trout are a priority species for conservation action in Northern Ireland, as required under the Wildlife and Natural Environment Act (Northern Ireland) 2011. Brown trout is widely distributed in the Glenarm River catchment with a significant proportion of the stock migrating to sea and returning to freshwater to spawn.

Salmon & Trout Stock Data

8.70 Annual monitoring of salmon (and trout) stocks in the Glenarm River is conducted by DAERA IFD and AFBI. Although not an index river for salmon, where salmon management is informed by fish counters that record the number of returning adults, management is based on:

- Rod catch data;

- Juvenile fish stocks.

Adult Salmon Runs and Conservation Limits

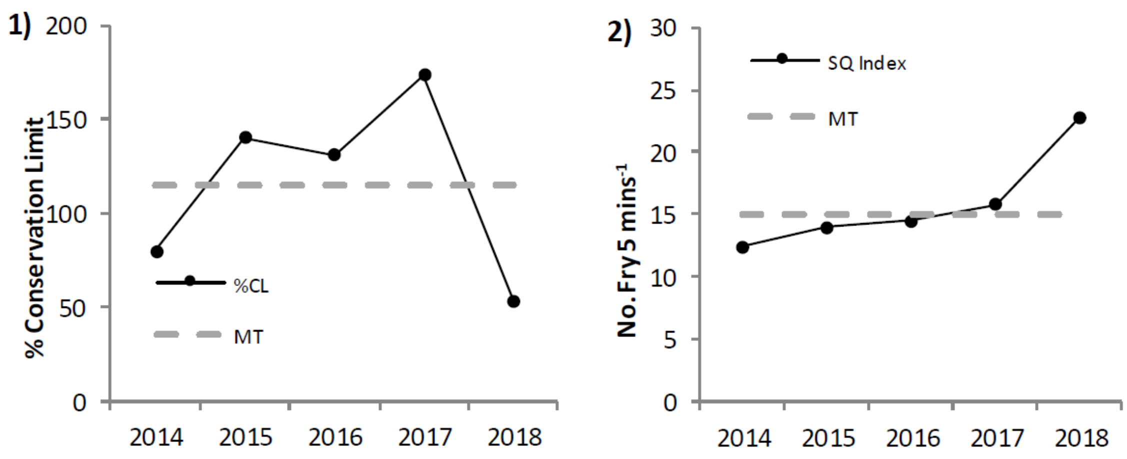
8.71 A key factor in assessing the status of salmon stocks is determination of Conservation Limits for individual river systems. The Conservation Limit for Atlantic salmon is defined by NASCO as: *the spawning stock level that produces long term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship*. In simpler terms the Conservation Limit for a river is the number of spawning salmon required to ensure that salmon are reproducing in sufficient quantities to produce the next generation of fish.

8.72 DAERA IFD operates a management regime for salmon rivers within its jurisdiction which aims to manage salmon fisheries and spawning populations in a sustainable manner. Management targets and spawning targets are set for each river catchment with egg deposition levels set according to the area and quality grading of each section of nursery habitat. 25% is deducted from the management target allowing for loss of salmon by angling (15%), and poaching and predation (10%). The remaining figure is referred to as the conservation limit/spawning target.

8.73 A management target of 0.44 million eggs for Atlantic salmon has been set for the Glenarm River, which equates to a conservation limit/spawning target of 0.38 million eggs (Kennedy et al. 2019).

8.74 **Figure 8.2** shows the adult salmon escapement against the Management Target (115% CL), and the index of juvenile salmon recruitment, for the Glenarm River. The number of adult fish – expressed as a percentage of the conservation limit – has exceeded the management target in 3 of the last 5 years while juvenile recruitment has met or exceeded the management target value of 15 fry per 5-minute electrofishing in the last 3 years.

Figure 8.2 Conservation limits in relation to management targets for (1) adult salmon escapement and (2) juvenile salmon recruitment 2014-2018 (Source: Kennedy et al. 2019)



Juvenile Fish Stocks

8.75 Fry distribution and abundance are an indication of the distribution and level of spawning by adult fish. Trends in abundance of juvenile salmon and trout are monitored by DAERA IFD/ AFBI through annual or rotational semi-quantitative electrofishing surveys according to a methodology developed by Crozier & Kennedy (1994).

8.76 The semi-quantitative electrofishing method has been calibrated separately for trout and salmon based on extensive studies in river reaches of known juvenile salmonid density. This has resulted in the development of an abundance classification system (Abundance Index) for salmon with five categories: Absent, Poor, Fair, Good, Excellent (Crozier and Kennedy, 1994). The Abundance Index for trout has six classifications: Absent, Poor, Poor/Fair, Moderate, Good, Excellent (Kennedy, unpublished).

8.77 The average numbers of trout and salmon detected at DAERA IFD monitoring sites on the Glenarm River and its Linford Water tributary in 2018, which are hydrologically connected to the Site, are indicated in **Table 8.10**. The location of these sites is shown along with average Fry Abundance Indices for salmon and trout in **Figures 8.3 and 8.4**. Note that no fry or co-ordinate data is available for a DAERA IFD site 4.

Table 8.10: Average fry abundance indices at survey sites on the Glenarm River, 2018; (Source: DAERA IFD/ AFBI)

Site ID	Grid ref		Average 5 min catch		Fry abundance index	
	Easting	Northing	Salmon	Trout	Salmon	Trout
1	328885	409145	0	10	Absent	Good
2	330026	410119	23	1	Good	Poor
3	330207	410625	30	6	Excellent	Moderate
5	330067	412246	40	10	Excellent	Good
6	330285	413758	26	16	Excellent	Good
7	330745	414543	12	14	Fair	Good
8	331015	414984	6	21	Fair	Excellent
9	331234	405973	0	19	Absent	Excellent
10	327393	407946	0	3	Absent	Poor/fair
11	332034	405400	0	2	Absent	Poor/fair
12	326303	405040	0	10	Absent	Good

8.78 This data demonstrates that there is a significant level of salmon spawning in the main channel Glenarm River directly downstream from tributaries that drain the Development (within 2 - 4.5km of boundary). Salmon fry abundance ranges Fair in the lower reaches to Good / Excellent in the middle and upper reaches of the main channel with distribution of adult fish limited by a significant waterfall, known locally as "the Leap", approximately 275m downstream of the confluence of the two main tributaries, the Owencloghy (not hydrologically connected to the Development) and the Linford Water (hydrologically connected to the Development). There is anecdotal evidence of some salmon ascending this obstruction but there is a further waterfall on the Linford Water approximately 375m upstream of the confluence and known locally as the "Bull's Eye", which is definitely impassable.

8.79 In contrast to salmon fry, trout fry are present in the main Linford Water and Owencloghy tributaries and throughout the catchment. The dataset demonstrates that trout spawning is widely distributed, with abundance generally Good to Excellent in the middle to lower Glenarm River, which is hydrologically connected to the Site. With upstream distribution of adult trout limited by the Bull's Eye" waterfall, it is clear that the trout stock upstream of this point is self-sustaining.

Angling

8.80 The Glenarm River is a spate river and offers moderate quality fishing for salmon although good stocks of resident brown and migratory sea-trout also occur. Fishing Rights in the Glenarm River are owned by Glenarm estate and leased to a private syndicate and Glenarm Angling Club.

Site Survey: Fisheries Habitat

Overview

8.81 The Development is located entirely within the Glenarm River catchment, with three small watercourses draining into the main Linford Water tributary of the Glenarm River and four small watercourses draining directly into the Glenarm River. Site drainage is described in further detail in Ch 9 Geology & Water Environment.

8.82 The fish habitat survey consisted of a walkover assessment of the main drainage streams (as shown on **Volume 3 - Figures 8.5**), and accessible reaches of the Linford Water downstream of the Linford Water tributary 1 draining the Site.

8.83 In addition, a walkover assessment of salmonid habitat was conducted within the Land under Applicant Control in the headwaters of these small watercourses, with a focus on areas of watercourse and site track intersection. The aim was to inform on potential culverting requirements for fish passage.

General Description / Observations

Linford Water tributary 1

8.84 This watercourse drains the south-western part of the Site and flows in a south-westerly direction to join with the Linford Water just upstream of McCartney's Bridge. Within the Site, and bordering the planning application boundary, it is semi-natural with extensive sheep grazing; here the stream is very narrow (<0.5m wide), steep, and shallow with low fisheries potential (**Plate 8.1**). 300m downstream of the Site boundary to Dunteige Bridge, there is extensive sheep grazing of both banks. Flow habitat comprises riffle/ runs and small pools over a moderately steep gradient;

substrate is a mixture of boulder, cobble and areas of bedrock generally indicative of grade 2 and 3 nursery (**Plate 8.2)**. Cattle were observed grazing downstream of Duntiege Bridge although this section of the river was unfenced. Juvenile stock surveys indicated that the stream supports resident trout above Dunteige Bridge (see below).

Plate 8.1: Linford Water tributary 1 within Site boundary

Plate 8.2: Linford Water tributary 1 downstream of Site boundary

Clady Burn

8.85 The Clady Burn drains the western central area of the Site where it issues from areas of blanket bog; it is one of the more significant watercourses from a size and fisheries perspective. Within the Land under Applicant Control, there are 3 small tributaries that drain to a single channel downstream of the boundary.

8.86 Adjacent but not overlapping the planning application boundary, the southern tributary is 0.3-0.7m wide, with adequate flow and a mixture of riffles and small pools; there is potential for trout presence despite none observed in clear sunlit pools (**Plate 8.3**).

8.87 The northern tributary of the Clady traverses the planning application boundary, is up to 0.8m wide with a steep section falling over a 2m elevation that would be impassable to trout, whose presence is thus highly unlikely (**Plate 8.4**).

8.88 The central tributary partly overlaps the planning application boundary, is 0.5-1.0 wide with cobble, boulder and a large amount of bedrock over a steep slope (**Plate 8.5**). Trout presence is unlikely.

8.89 In the lower reaches up to 900m downstream of the Site boundary, good quality nursery habitat is present in riffles, runs and small pools **(Plate 8.6)**. Juvenile stock surveys indicated that the stream supports resident trout.

Plate 8.3: Clady Burn southern tributary bordering planning application boundary

Plate 8.4: Clady Burn northern tributary traversing planning application boundary

Plate 8.5: Clady central tributary impassable fall

Plate 8.6: Clady Burn 900m downstream of Site boundary

Feystown Burn

8.90 The Feystown Burn drains the north-west area of the Site, running west then south-west to confluence with the Clady Burn 600m upstream of the Linford Water. Within the Site, it overlaps the Planning Application Boundary; here the stream is narrow (<0.5m wide) with a cobble/ boulder bed in an incised channel that runs across a steep gradient. The channel is overgrown with occasional open areas. Fish presence is highly unlikely (**Plate 8.7**).

8.91 There is some erosion of banks and there is extensive sheep grazing along the channel from the Development boundary. However, a series of pronounced meanders over a length of 250m above Feystown Road is associated with very good quality nursery habitat with some spawning pockets and small pools **(Plate 8.8)**. Juvenile stock surveys indicated that the stream here supports a good population of resident trout.

Plate 8.7: Feystown Burn at Site boundary

Plate 8.8: Glenarm tributary 1 above Feystown Road

Glenarm River tributary 1

8.92 This small watercourse drains an area of bog in the north-west area of the Site and flows west to confluence with the Glenarm River over 2km downstream. The stream is very narrow and shallow at the Site boundary and widens up to 1.2m at the Feystown Road 1km downstream. Flow habitat is mainly slow run with banks subject to livestock poaching, collapse, and silt deposition in the lower reaches above Feystown Road **(Plate 8.9)**.

8.93 At Feystown Road, the watercourses flows through a stone arch culvert that is silt embedded although passable to fish **(Plate 8.10)**. Juvenile trout habitat is generally poor given the shallow depth and siltation of the riverbed with juvenile stock surveys confirming the lack of fish.

Plate 8.9: Glenarm tributary 1 culvert

Plate 8.10: Glenarm tributary 2

Glenarm River tributary 2

Plate 8.11: Glenarm tributary 2 - culvert

Plate 8.12: Glenarm tributary 2

8.94 This small watercourse drains the northern edge of the Site boundary where it issues from bog before flowing west to confluence with the Glenarm River almost 3km downstream. 1.8km downstream of the Site boundary – and above Feystown Road - , the stream remains very narrow (circa. 1m wide) and shallow, with heavily vegetated banks but areas of cattle and sheep access and poaching.

8.95 A significant barrier to upstream fish passage exists at the stone culvert beneath Feystown Road, where a 2-stepped concrete apron with step heights of 28-30cm and shallow depth would prevent passage by resident fish **(Plate 8.11)**.

8.96 Below the Feystown Road, the stream narrows further with vertical banks cutting an incised channel surrounded by silage pasture **(Plate 8.12)**. While substrate is reasonable quality cobble and gravel with good depth, no fish were recovered during juvenile stocks surveys above and below the Feystown Road.

Glenarm River tributary 3

8.97 This small watercourse drains an area north of the Site boundary and was previously within the Site prior to boundary changes. Survey findings are presented for general information purposes. Just upstream of Feystown Road the gradient is steep with habitat a mixture of bedrock, very coarse cobble and pebbles, consistent with grade 2 nursery **(Plate 8.13)**.

8.98 The stream then narrows as a series of small runs with cobble and partly poached banks. Grade 3 nursery **(Plate 8.14)**. No fish were recovered upstream of Feystown Road during the juvenile stock surveys.

Plate 8.13: Glenarm tributary 3

Plate 8.14: Glenarm tributary 3

Glenarm River tributary 4

8.99 This small watercourse drains the north of the Site just below the boundary where it is very narrow with drain-like seepage habitat unsuitable for fish. 1.8km north of the Site boundary, the stream is 1m wide, approximately <6cm deep with areas of bank poaching and collapse on the true right side due **(Plate 8.15)**.

8.100 The flow remained consistently poor in 2018 and 2019 field surveys, with substrate quality consistently undermined by fine sediment infiltration, with habitat assessed as Grade 3 nursery at best. Juvenile stock surveys did not recover any fish over a 150m of channel.

Plate 8.15: Glenarm tributary 4

Site Survey: Stream Quality

8.101 Nine sites were surveyed in the watercourses draining the Development (Sites 1-9; **Volume 3- Figure 8.5**) as follows:

- Site 1 – Linford Water tributary at the Site boundary.

- Site 2 – In the Linford Water 50m upstream of the confluence of Linford Water tributary 1 – this site was selected to act as an overall “control” reach for assessing potential effects of the Development.
- Sites 3 and 4 - on the Clady and Feystown Burns were respectively 0.79km and 1.1km downstream of the Site boundary; these sites were selected to assess potential impacts on the streams.
- Sites 5-8 – on tributaries 1-4 of the Glenarm River were respectively 0.9, 1.25, 1.4, and 1.8km downstream of the Site boundary; these sites were selected to assess potential impacts on the streams.
- Site 9 – Glenarm River main channel, Glenarm village – this site was selected below the inflow of tributary 4 to act as an overall “impact” reach for assessing potential effects of the Development.

Chemical Water Quality: Basic Parameters

8.102 All streams had satisfactory dissolved oxygen levels with lower conductivity recorded in the Clady, Feystown and Glenarm tributary 1 **(Table 8.11)**. There was no obvious conductivity gradient between streams draining to the Linford and the main channel Glenarm. For example, the highest conductivities were recorded in Linford tributary 1 and Glenarm tributary 3.

Table 8.11: Water chemistry parameters measured at nine survey sites, Oct. 2018.

Site	River/ stream location	Diss. Oxygen (mg/l; % sat)	Conductivity (µS/cm)
1	Linford Water tributary 1	11.2 (98%)	306
2	Linford Water “control” reach upstream of Development drainage	11.6 (100%)	220
3	Clady Burn	11.3 (98%)	176
4	Feystown Burn	11.0 (98%)	153
5	Glenarm River tributary 1	11.1 (97%)	159
6	Glenarm River tributary 2	11.3 (99%)	200
7	Glenarm River tributary 3	11.0 (97%)	266
8	Glenarm River tributary 4	11.1 (95%)	234
9	Glenarm River “impact” reach downstream of Development drainage	11.2 (98%)	262

8.103 It should be noted that spot measurements of physico-chemical parameters provide only a snap-shot of stream water quality; consensus on overall quality should consider consider additional indicators such as those provided by stream macroinvertebrate communities (see below).

Physical Habitat Quality

8.104 Most of the sites on streams draining the Site boundary (sites 1, 3-8) were narrow, very shallow, and of moderate to low flow velocities (**Table 8.12**). Substrate was mainly of intermediate to high coarseness, dominated by cobbles, gravels and pebbles, with low riverbed cover of fine sediment. Riverbed coarseness indices were generally above or close to values in rivers with good salmonid habitat quality reported elsewhere in Northern Ireland (Johnston, 2012).

8.105 However, tributaries 3 and 4 (sites 7 & 8) had much lower coarseness; in tributary 3 (site 7) the low coarseness index was influenced by moderate cover of smooth bedrock and moderate levels of siltation. In tributary 4 (site 8), large areas of the riverbed had a layer of fine silt, which reflects the poor habitat quality caused by bank erosion, and heavy cattle grazing and poaching.

8.106 In the control site in the Linford Water (Site 2) and the impact Site in the Glenarm River (Site 9), physical habitat quality was good, with low cover of fine sediment and coarseness suited to good salmonid nursery habitat.

Table 8.12: Stream habitat quality at each site from baseline surveys, October 2018.

Site	River/ stream	Sediment cover (%) & type	Mean width (m)	Mean water depth (m)	Mean flow velocity (ms-1)	Coarse-ness index (CI)	Substrate hetero-geneity (SD)	Inferred substrate
1	Linford Water tributary	11.9; silt	1.0	0.1	0.174	3.9	0.65	Mixture; intermediate coarseness
2	Linford Water control u/s	11.6; silt	5.3	0.2	0.34	4.6	0.85	Mixture; coarse
3	Clady Burn	9.0; sand / silt	3	0.1	0.16	3.7	1.0	Mixture; inter-mediate coarseness
4	Feystown Burn	12.9; sand/ silt	1.7	0.09	0.14	3.7	0.85	Mixture; inter-mediate coarseness
5	Glenarm River tributary 1	25; silt	1.2	0.07	0.12	3.2	1.0	Mixture; inter-mediate coarseness
6	Glenarm River tributary 2	19; silt	1.1	0.06	0.12	3.7	0.6	Mixture; inter-mediate coarseness
7	Glenarm River tributary 3	30; silt	1.5	0.09	0.14	2.5	1.5	Heterogeneous; almost smooth
8	Glenarm River tributary 4	47; silt	1.2	0.06	0.13	2.6	1.4	Heterogeneous; almost smooth
9	Glenarm River impact d/s	0.4	12.5	0.2	0.34	3.9	0.65	Mixture; inter-mediate coarseness

Aquatic Ecology

8.107 Recorded ecological quality for the nine survey sites are shown in **Table 8.13**. Based on the benthic invertebrate indicator element, and the "one out, all out" philosophy, site 8 on the Glenarm River tributary 4 was classed as having "POOR" WFD-based ecological quality, whereas all other sites were classed as having "GOOD" or "HIGH" ecological quality (**Table 8.13**). The assessment generally corresponds with degraded physical habitat, low substrate complexity and high sediment cover in tributary 4, which markedly exceeded the 20% cover threshold above which benthic biodiversity can be compromised (Clapcott et. al. 2011).

8.108 Of the sites draining the Development, the Clady and Feystown Burns (Sites 3 and 4) were noteworthy; both sites were indicated as having "HIGH" ecological quality based both on their N-TAXA and WHPT-ASPT metrics.

Table 8.13: WFD-based ecological quality classes at each site derived from benthic invertebrate baseline surveys, October 2018.

Site	River/ stream	BMWP WHPT score	Number of taxa	N-TAXA WFD-based invert. class	WHPT ASPT	ASPT WFD-based invert. class
1	Linford Water tributary	124.1	18	GOOD	6.8	HIGH
2	Linford Water control u/s	154.2	22	HIGH	7	HIGH
3	Clady Burn	113.7	18	HIGH	6.3	HIGH
4	Feystown Burn	134.1	19	HIGH	7.05	HIGH
5	Glenarm River tributary 1	85	15	GOOD	5.66	GOOD
6	Glenarm River tributary 2	82.7	15	GOOD	5.5	GOOD
7	Glenarm River tributary 3	121.3	18	GOOD	6.7	HIGH
8	Glenarm River tributary 4	54.9	12	POOR	4.6	MODERATE
9	Glenarm River impact d/s	78	14	HIGH	5.6	GOOD

Site Survey: Juvenile Fish Stocks

8.109 The survey of fish stocks was conducted in late August 2019 at 8 sites located on tributaries of the Glenarm River **(Table 8.14; Volume 3 - Figure 8.6)**. Fish survey sites corresponded with Stream Quality survey sites except on the Linford Water tributary 1, where the fish survey took place 400m downstream at Duntiege Bridge; on the main Linford Water, where the survey was 350m downstream of site 2; on Glenarm tributary 3, where the survey was 700m downstream.

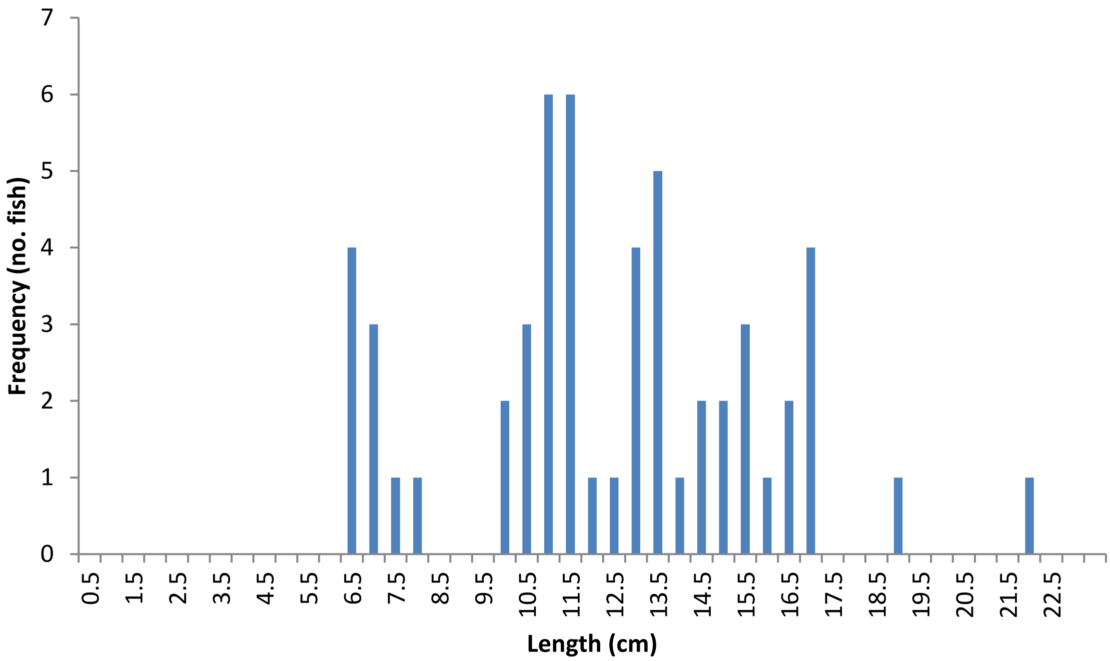
8.110 Salmon were absent at all surveyed sites. Trout were present at 4 of the 8 sites, including the Linford Water (downstream of site 2) and the three tributaries of the Linford Water that drain the Site as follows; the Linford tributary 1 (site 1); the Claudy Burn (site 3); the Feystown Burn (site 4; **Table 8.14).**

8.111 No trout or other fish species were recorded at sites 5-8, all tributaries of the Glenarm River that drain the Site.

Population Age Structure

8.112 The age structure of the trout stocks in the Linford Water and tributaries were verified by constructing composite length frequency distributions (**Figure 8.7**).

Figure 8.7: Length frequency distribution of trout caught in the Linford Water and tributaries.



8.113 The trout length frequency shows a clear separation of Age 0 fry (<10cm) from Age greater than 1 fish (>10 cm). The trout length frequency indicates that fish aged 1 or older were dominant in the streams, with fish greater than 14.0cm likely to be Age 2 or older.

Fish Distribution & Abundance

8.114 The results of the semi-quantitative survey are shown in **Table 8.14** with the numbers of trout and salmon at each site separated into age groups based on observed fish length as outlined above.

8.115 The lack of salmon in any tributary draining the Site appears to be consistent with the distribution of salmon indicated by DAERA IFD, with salmon distribution constrained to the main Glenarm River due to significant waterfall obstructions to upstream migration **(Figure 8.3)**.

8.116 Of the streams draining the Site, only the Linford Water tributary 1 and the Clady Burn contained Aged 0 trout but both these streams and the Feystown Burn had good abundance of Aged 1 or older trout. The pattern of greater abundance of older trout in the Clady and Feystown Burns is most likely due to upstream movement of resident trout in preparation for spawning in October/ November. In the main channel Linford Water, trout aged 1 or older were present in excellent numbers, again possibly related to movement upstream in preparation for spawning in autumn/ winter.

8.117 The presence of trout in several of the streams draining the Site also is consistent with DAERA IFD data showing trout throughout the main Glenarm River but also extending to the upper reaches of its two key tributaries, the Owencloghy and the Linford Water (**Figure 8.4**).

Table 8.14: Summary results of electrofishing survey indicating numbers of age 0 and older trout and salmon caught; fry abundance indices also indicated.

Site	Stream	Trout (Age)		Salmon (Age)		Fry abundance index	
		(0)	(1++)	(0)	(1++)	Trout	Salmon
400m d/s site 1	Linford Water trib.	10	5	0	0	Good	Absent
350m d/s site 2	Linford Water main channel	0	23	0	0	Absent	Absent
3	Clady Burn (Linford trib.)	2	11	0	0	Fair	Absent
4	Feystown Burn (Linford trib)	0	17	0	0	Absent	Absent
5	Glenarm tributary 1	0	0	0	0	Absent	Absent
6	Glenarm tributary 2	0	0	0	0	Absent	Absent
700m d/s site 7	Glenarm tributary 3	0	0	0	0	Absent	Absent
8	Glenarm tributary 4	0	0	0	0	Absent	Absent

8.118 The lack of any trout (or any fish species) in all of the tributaries of the main stem Glenarm river that drain the Site (sites 5-8) may be related to poor stream quality (site 8), lack of sufficient water depth (5-8), poor physical habitat quality (7 & 8), or barriers to upstream passage from the main Glenarm River. For example, the gradient in the final 0.5-1.0km sections of all 4 streams is very steep before entering the Glenarm River (**Figure 8.6**).

Assessment of Effects

8.119 Potential effects were assessed for construction, operational and decommissioning phases of the Development. Construction impacts cover the discharge of suspended solids, release of other pollutants and interruption of fish passage. Post-construction (operational) impacts include habitat loss at watercourse crossings, obstruction of fish passage and surface water run-off.

8.120 Impact assessments are primarily based on their effect on salmonids either directly or upon their habitats. However, these assessments would be equally relevant to eels and lamprey if present in these waters.

Fisheries Significance / Aquatic Ecological Sensitivity

8.121 Using the information assembled through the baseline assessment, the Fisheries Significance/Sensitivity for the main watercourses draining the area within the Site Boundary and downstream of this area are shown respectively in **Table 8.15**. A watercourse was deemed to have a High/ Very High sensitivity if its WFD class was at least Good and/or Annex II species were present (e.g. salmon).

8.122 Glenarm tributary 4 **(Volume 3 - Figures 8.5 & 8.6)** was assessed as generally of Low sensitivity because of the lack of fish, poor habitat quality and excessive riverbed siltation. All other streams draining the Site were assessed at High or Very High sensitivity due to Good/ High WFD-based ecological quality and/ or trout presence.

8.123 The downstream main channel rivers, the Linford Water and the Glenarm River, were of Very High sensitivity due to the presence of Atlantic salmon and/ or High WFD ecological quality.

Construction Phase

8.124 The potential for impacts on fisheries and aquatic habitats during the construction phase is mainly associated with ground disturbance and the entrainment of sediments in surface water drainage. There is also a potential impact from the accidental spillage of other hazardous substances (oil and fuel) used in the construction process.

8.125 Obstruction of fish passage within the Site is a potential impact at several small tributaries if culvert crossings are proposed.

Table 8.15: Sensitivity of receiving watercourses within Site Boundary and downstream to Glenarm River main channel.

River/Stream	Key Species/ receptors	WFD class	Sensitivity
	Site drainage streams		
Linford Water tributary 1	Trout present at GOOD abundance at Site boundary and downstream reaches including Linford Water.	GOOD	High
Clady Burn	Trout present at FAIR abundance with pre-spawning fish in good numbers.	HIGH	Very High
Feystown Burn	Though no fry present, pre-spawning/ older trout present in excellent numbers downstream of Site boundary.	HIGH	Very High
Glenarm tributary 1	No fish present, with stream becoming too shallow/ narrow at Site boundary	GOOD	High
Glenarm tributary 2	No fish present, with possible barrier to upstream migration at Feystown Road	GOOD	High
Glenarm tributary 3	No fish present. Was previously within the Site prior to boundary changes. Now out-side Site boundary	GOOD	Very High
Glenarm tributary 4	No fish present. Habitat poor with excessive riverbed siltation and bank poaching.	POOR	Low

River/Stream	Key Species/ receptors	WFD class	Sensitivity
Site drainage streams			
Sensitive downstream watercourses			
Linford Water main channel	Trout present in main channel with excellent abundance of pre-spawners. Potential Lamprey spp.	HIGH	Very High
Main Glenarm River	Salmon present at Good-Excellent abundance, with key spawning and nursery areas present where tributary streams draining the Site inflow. Potential Lamprey spp.	GOOD	Very High

Sediment Run-off

8.126 The release of fine sediment (grain size <2mm) is potentially a major cause of environmental impacts and is associated with clearly defined negative impacts (Newcombe and Jensen, 1996; Turley et al. 2014). Sensitive fish species such as brown trout and Atlantic salmon are highly vulnerable to suspended and deposited sediment in spawning and nursery habitats (Kemp et al. 2011). In spawning gravels, incubating salmonid eggs require good water circulation to provide oxygen and remove waste products. As deposited fine sediment content increases, gravels become embedded, resulting in restricted water circulation and reduced egg and alevin survival. After emergence, juvenile salmonids (fry) disperse downstream to suitable nursery rearing habitat generally within 100m (Kennedy, 1984), often in faster flowing riffles/ runs, where they establish feeding territories and compete for food.

8.127 Suspended sediment can lower water clarity leading to reduce prey capture efficiency and may affect respiration rates by clogging of gills (Kemp et al. 2011). Deposited sediment can reduce habitat complexity and quality by in-filling of substrate, thus reducing territory size leading to increased aggression and ultimately lower carrying capacity. Deposited fine sediment can also indirectly affect growth and survival of juvenile salmonids by reducing the quality of habitat for preferred invertebrate prey species (Suttle et al., 1994).

8.128 Adult salmonids are prone to gill-clogging and visual impairment at high levels of suspended sediment but are much less reliant on substrate complexity, tending to occupy deeper pools, particularly during the spawning season. Adult salmonids are also more mobile than sessile eggs or juvenile stages, and thus more capable of avoiding adverse local conditions (Kemp et al. 2011).

8.129 Freshwater benthic macroinvertebrates are also an important component of river ecosystems, acting both as sentinels of general water and habitat quality, and as an important food resource for higher trophic levels such as fish and birds. Pulses of fine sediment can cause behavioural drift, whereas excessive fine sediment can reduce the quality of physical habitat by smothering and blocking of interstitial spaces and water flow (Allan, 1999). As fine sediment infiltration increases, invertebrate abundance and community diversity is reduced, resulting in the replacement of sensitive taxa (mayfly, stonefly and caddis) by more tolerant types (worms, midge larvae, molluscs; Matthaei et al. 2006; Kemp et al. 2011).

8.130 Sediment release and entrainment can also increase the risk of nutrient addition and alterations in channel morphology and hydrology (Levesque and Dube, 2007). For example, excavated bank material or soils associated with the construction process could increase inputs of sediment bound phosphorus, which could negatively affect aquatic biota by causing excessive algal and macrophyte growth, and depressed oxygen levels.

8.131 Fine sediment is partly managed by the water quality objectives and standards of the EC Freshwater Fish Directive 2006/44/EC (FWFD), where a mean total suspended solids (TSS) concentration of 25 mg/L is specified for salmonid waters. While Article 6 of the Water Framework Directive has now repealed the FWFD, new standards that provide the same level of protection have been proposed (UKTAG, 2010). However, there is no national environmental standard or guideline for deposited fine sediment in the UK. Fine sediment cover above a threshold of 20% bed cover, based on recommendations in New Zealand by Clapcott et al. (2011), and published research (e.g. O'Connor & Andrew,1998; Kemp et al. 2011), provides a general indication of increasing risk for both invertebrates and salmonids.

8.132 The discharge of suspended solids during construction of the proposed Ballgilbert wind farm could result from:

- Excavations associated with construction of access tracks and turbine foundations
- Excavations associated with watercourse crossings
- Ground disturbance and subsequent erosion of the underlying soils
- Stockpiling of soils and excavated materials
- Run-off from access roads
- Landslide resulting from slippage of access roads or excavated materials.

8.133 The proposed site is hydrologically connected to watercourses of significant fisheries interest via on-site and off-site watercourses which are potential routes for suspended solids run-off. The Glenarm River and a key tributary, the Linford Water, are of particular significance due to their importance in providing spawning and nursery for salmon and trout and in supporting recreational angling. Salmon also area EC Habitats Directive Annexe II listed species.

8.134 Streams directly draining the Site, such as the Feystown Burn, Clady Burn and the Linford Water tributary 1, also support good populations of resident trout, and these would be vulnerable to suspended sediment entrainment.

Release of other pollutants

8.135 As the Site drains into tributaries of the Glenarm River and Linford Water, there is some potential for spillage or release of diesel, oil or other polluting substances, with consequences for resident fish together with invertebrate organisms that underpin the generally Good/ High ecological health observed in these streams.

8.136 During construction, with high usage of plant fuel and oil, there is an increased risk of accidental spillage and discharge to the any of the drainage streams and thence to the Glenarm River and Linford Water. Similarly, the application of ready-mix concrete in construction processes carries some risk of inadvertent discharge with the potential to impact on resident fish and invertebrate organisms in these watercourses.

Fish passage: temporary obstruction

8.137 Poor management of works adjacent to stream banks or at crossing points may lead to obstruction of the channel during periods of fish migration and spawning.

8.138 Chapter 9 (Geology & Water Environment), indicates five crossings of minor watercourses within the planning application boundary; three occur on the upper reaches of the Feystown Burn near Turbine 5 and Turbine 6, and at a small tributary north of Turbine 7; two occur on the Clady Burn, one on the northern tributary near Turbine 8 and the other just north of Turbine 14 on the southern tributary (Figure 8.7).

8.139 Both Burns have trout in their lower reaches adjacent to the Feystown road, however, walkover surveys indicated that the habitat at the three proposed watercourse crossings of the Feystown Burn was unsuitable for trout.

8.140 A waterfall (just south of Turbine 10) is a likely barrier to trout presence in the upper reaches of the Northern tributary of the Clady Burn and the habitat above this is of low quality so that trout presence is unlikely. The Southern tributary of the Clady Burn was potentially suitable for trout some 200m downstream of the proposed crossing but not at the track crossing location due to limited flow and unsuitable bed material.

8.141 Overall, trout presence is not expected at any of the five watercourse crossings within the Planning Application Boundary due to the presence of natural barriers to upstream movement or a lack of suitable habitat.

Operational Phase

8.142 The potential for any impacts will be significantly reduced during the operational phase with the construction process complete, site infrastructure in place, and a reduced requirement for any hazardous materials on-site. Potential impacts at Ballygilbert are essentially limited to surface water run-off, and loss of habitat.

Surface Water Run-off

8.143 Surface water run-off from hard surfaces (access tracks, hard stands, control buildings) could lead to sediment-laden run-off to the receiving watercourses with potential effects on fish and other forms of aquatic life as outlined above; however, the effects are expected to be less severe because no soil/ peat disturbance will occur. Any effects on fish are more likely in more distant reaches downstream from the planning application boundary (e.g. in the Clady Burn, Feystown Burn, and Linford tributary 1) because of the small size, gradient and general limited suitability of the stream sections within this area for fish.

8.144 Wash-out of areas of excavated peat (where present) during or following periods of heavy rainfall could also result in run-off of sediment to the receiving watercourses with potential increases in sediment load.

Fish Passage obstruction/ inhibition

8.145 The construction of bridges and culverts has the potential to prevent or hinder normal fish movement within the stream or upstream migrations of pre-spawning adults unless consideration is given at the design stage.

8.146 Obstructions can occur if inverts are not sufficiently embedded to below the water level or if the length and gradient over which the culvert is installed causes high flow and an inability to find flow refugia due to a lack of baffles or natural stream substrate.

8.147 An assessment of the upper Feystown and Clady Burns in the area of the planning application boundary track road suggests that there is limited potential for trout presence.

Habitat loss at stream crossings

8.148 Depending on the length of culvert used, a watercourse crossing may result in significant loss of habitat, particularly where the original channel bed is lost and cannot be restored. Removal of bed material also can result in long term loss of habitat and channel diversity. Enclosure of the channel over significant lengths restricts light penetration which inhibits growth of primary producers such as benthic algae and aquatic plants, in turn leading to reduced potential for macroinvertebrate and fish secondary production.

8.149 The five crossings on the Feystown and Clady Burn tributaries could each result in loss of a very small area of stream habitat but this is expected to have a negligible effect on primary (algae/ plants) and secondary (macroinvertebrate) production given the overall scale in relation to existing watercourse area. In addition, the lack of suitable fish habitat at these crossing indicates that this negligible loss will not impact on fish.

Decommissioning Phase

8.150 Decommissioning of the Development would have potential effects on fish stocks and aquatic habitats in the drainage tributaries and the more distant Glenarm River and Linford Water. Impacts will be similar to those predicted for the construction phase but will ultimately depend on the level of reinstatement required.

8.151 In this case the decommissioning process will involve the removal of all above ground structures, removal of underground structures to one metre below ground level, and reinstatement of disturbed areas; access tracks are likely to remain for farm use.

However, it is unlikely that any of the structures at or near to the main watercourses will be removed or modified in any way.

8.152 The effects of decommissioning on fish habitats and fish stocks are therefore likely to be similar to those of construction for sediment run-off and the release of other pollutants, although of lower magnitude.

Mitigation

Construction Phase

Sediment Run-off

8.153 Mitigation measures to control sediment run-off are described in detail in Chapter 9 (Geology & Water Environment) and summarised as follows:

Buffer Zones

8.154 During the construction phase it is important that works should be avoided within the area of sensitive watercourses, with the preservation of intact vegetated buffer zones between the development infrastructure and stream channels. To this end, buffer zones of 30m and 70m minimum width are specified in Chapter 9 for minor and major watercourses, respectively. The larger minimum buffer of 70m will apply to the Clady Burn, which is a key watercourse in its downstream reaches in terms of potential fisheries sensitivity.

8.155 Turbine bases, access roads (apart from at stream crossings) and associated infrastructure will be located out-with buffer zones.

8.156 The application of buffer zones will minimise the risk of sediment run-off from site construction works to on-site watercourses and the most sensitive downstream reaches (Linford tributary 1, Clady Burn, Feystown Burn) and more distant receiving reaches in the Glenarm River and Linford Water.

Timing of Works

8.157 DCAL (now DAERA) Inland Fisheries produced Guidelines for Fisheries Protection during Development Works (undated) which identifies the likely impact of construction and development work on fisheries habitat and outlines practical measures for the avoidance and mitigation of damage.

8.158 Although the Development will require watercourse crossings on tributaries of the Feystown and Clady Burns, these have low fisheries potential due to habitat that is unsuitable for trout (Feystown and Clady tributaries) and the presence of a nearby downstream waterfall (northern Clady Burn tributary).

8.159 Therefore, no restrictions to the timing of works at these crossings is required provided that other conditions/ precautions are applied to avoid sediment inputs.

8.160 All works at stream crossings will adhere to the measures outlined in the Guidance for Pollution Prevention: Works and maintenance in or near water: GPP 5 (Environment Agency, 2018). It is also recommended that to minimise the risk of suspended sediment entrainment in surface water run-off, the site drainage system should only be constructed during periods of low rainfall and therefore low run-off rates.

Surface Water Management

8.161 The potential for pollution of watercourses by silt-laden runoff is addressed in detail in Chapter 9: Geology & Water Environment. A surface water management plan will be developed using the principles of Sustainable Drainage, based on the on-site retention of flows and use of buffers, swales, check-dams and other silt removal techniques.

8.162 Implementation of the management plan will prevent any adverse effects on the ecology of the principal receiving watercourses during the construction phase of the project.

Water Quality Monitoring

8.163 Chapter 9 also proposes the implementation of a water quality monitoring programme to examine the effects of the infrastructure construction works on surface water quality. It is recommended that the monitoring programme be continued through the operation and decommissioning phases of the Development.

Release of other pollutants

Site Management

8.164 All precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the construction phase. This will be achieved through good site practices as described in the Good Practice Guidance notes proposed by EA/SEPA/NIEA (Environment Agency, 2014), including:

- PPG1: General Guide to the Prevention of Water Pollution;
- GPP5: Works in or near to Watercourses;
- PPG10: Working at Construction and Demolition Sites.

8.165 A Pollution Prevention Plan will be included as part of the Construction & Decommissioning Method Statement (CDMS) for the Development, to be agreed with the local planning authority at the pre-construction stage. This will incorporate a contingency plan setting out the procedure to be followed in the event of a significant spillage occurring.

Surface Water Management

8.166 The proposed surface water management plan and associated SuDS system will also facilitate the interception of diesel, oil or other polluting substances during the construction phase.

Operational Phase

Surface Water Run-off

8.167 As outlined in Chapter 9, site drainage will use the principles of SuDS, with installations to incorporate a "treatment train" of two to three stages of pollutant removal to all surface water runoff during the operational phase, as with the construction and decommissioning phases. Additional measures to prevent the release of suspended solids will include:

- Preservation of natural run-off patterns;
- Reduction of flow rates from access tracks through use of attenuating check-dams;
- Use of shallow ponds to aid settlement;
- Linear track drainage swales with regular outflow points throughout the SuDS system to limit the potential for large flows at single outflow points;
- Avoidance of peat storage within denoted watercourse buffer zones or in areas of overland water flow.

Decommissioning Phase

8.168 Mitigation measures during decommissioning will be the same as during the construction phase with regard to addressing the potential for run-off of suspended solids and other polluting substances. However, the level of mitigation will be determined by the level of reinstatement required.

Residual Effects

8.169 The potential effects of the Development on fish stocks and their habitats in the Glenarm River, Linford Water tributaries and associated streams draining the Site, are measured against proposed mitigations, as a means of assessing the residual effects of the project.

8.170 The magnitude of the potential effects and their residual significance were assessed according to the procedure outlined in the Methodology section of this chapter. It is the residual effects associated with the Development that most accurately reflect the overall predicted effects on fisheries and the aquatic environment during the construction, operational and decommissioning phases.

Construction Phase

8.171 Mitigation measures employed through the surface water management plan outlined in Chapter 9 based on SuDS technology to control drainage and silt management on the Development site will remove the potential for damage to fish or their habitat from siltation of spawning and nursery habitats. These measures in association with the Pollution Prevention Plan will also minimise the risk for release of other construction related polluting substances into the river network.

If solid invert culverts are used to cross the tributaries of the Feystown and Clady Burns where they intersect with track roads, there will be no effect on fish migrations or spawning given the lack of suitable habitat. There also will be no effect on fish migrations or spawning activity in any other stream.

8.172 The magnitude and significance of potential effects during the construction phase before mitigation are summarised for each watercourse in **Table 8.16** along with the predicted residual effects after mitigation.

8.173 For watercourses draining the immediate Development, without mitigation the effects during the construction phase are predicted to be at worst of ***Moderate Magnitude*** and of **Large/ *Very Large Significance***, depending on specific effects and the sensitivity of individual watercourses e.g. sediment run-off or the release of other pollutants to the Clady Burn as a watercourse with High WFD status and good trout abundance. However, with mitigation the effects are reduced to ***Neutral***.

8.174 This assessment also applies to the sensitive Linford Water and main Glenarm River, which occur downstream of watercourses draining the Site.

Operational Phase

8.175 Although there will be an increase in the area of hard surface due to the Development, the surface water management plan / drainage design features for the control and attenuation of storm water run-off will protect receiving watercourses from excessive inputs of sediment.

8.176 There are no stream sections of potential fisheries interest within the Site (Clady Burn and Feystown Burn tributaries) where a new track intersection is proposed. Therefore, no loss of salmonid habitat will occur. While very small areas of stream habitat will be covered due to the placement of five culverts, this will have an impact of Negligible magnitude and Neutral significance because the habitat is unsuitable for salmonid fish.

8.177 The magnitude and significance of potential effects during the operational phase before mitigation are summarised for each watercourse in **Table 8.17** along with the predicted residual effects after mitigation.

8.178 Without mitigation the effects during the operational phase are predicted to be at worst of ***Minor Magnitude*** and of Moderate/ ***Large Significance***. For example, surface water run-off could impact on all watercourses draining the Development but but with mitigation the effects are reduced to ***Neutral***.

Decommissioning Phase

8.179 The magnitude and significance of potential effects during the decommissioning phase before mitigation are summarised for each watercourse in **Table 8.18** along with the predicted residual effects after mitigation.

8.180 Without mitigation the effects during the decommissioning phase are predicted to be at worst of ***Minor Magnitude*** and of **Moderate/ Large *Significance***, depending on specific effects and the sensitivity of individual watercourses. Mitigation measures will ensure that the effects remain as ***Neutral***.

Table 8.16: Construction Phase - Magnitude and Significance of Effects without Mitigation, and Residual Effects after Mitigation.

River/ Stream	Key receptors	Sensit-ivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
Linford Water tributary 1	Trout present; WFD status Good	High	Sediment run-off	Moderate	Large	Neutral
			Release of other pollutants	Moderate	Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Clady Burn **effect applies only to tributary intersecting site access track*	Trout present; WFD status High	Very High	Sediment run-off	Moderate	Large/ Very Large	Neutral
			Release of other pollutants	Moderate	Large/ Very Large	Neutral
			Fish passage: temp. obstruction*	No change	Neutral	Neutral
Feystown Burn **effect applies only to tributary intersecting site access track*	Trout present; WFD status High	Very High	Sediment run-off	Moderate	Large/ Very Large	Neutral
			Release of other pollutants	Moderate	Large/ Very Large	Neutral
			Fish passage: temp. obstruction*	No change	Neutral	Neutral
Glenarm tributary 1	No fish present; WFD status Good	High	Sediment run-off	Moderate	Large	Neutral
			Release of other pollutants	Moderate	Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Glenarm tributary 2	No fish present; WFD status Good	High	Sediment run-off	Moderate	Large	Neutral
			Release of other pollutants	Moderate	Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Glenarm tributary 3	No fish present; WFD status High	Very High	Sediment run-off	Moderate	Large/ Very Large	Neutral
			Release of other pollutants	Moderate	Large/ Very Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral

River/ Stream	Key receptors	Sensit-ivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
Glenarm tributary 4	No fish present; WFD status Poor	Low	Sediment run-off	Moderate	Slight	Neutral
			Release of other pollutants	Moderate	Slight	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Linford Water – downstream of 3 watercourses draining the Development	Trout present; potential Lamprey spp. WFD status High	Very High	Sediment run-off	Moderate	Large/ Very Large	Neutral
			Release of other pollutants	Moderate	Large/ Very Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Main Glenarm River – downstream of 4 watercourses draining the Development	Salmon & Trout; potential Lamprey spp.; WFD status Good	Very High	Sediment run-off	Moderate	Large/ Very Large	Neutral
			Release of other pollutants	Moderate	Large/ Very Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral

Table 8.17: Operational Phase – Magnitude and Significance of Potential Effects without Mitigation, and Residual Effects after Mitigation.

River/ Stream	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
Linford Water tributary 1	Trout present; WFD status Good	High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction	No change	Neutral	Neutral
			Habitat loss at stream crossings	No change	Neutral	Neutral
Clady Burn ***effect applies only to tributary intersecting site access track***	Trout present; WFD status High	Very High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction*	No change	Neutral	Neutral
			Habitat loss at stream crossings*	Negligible	Neutral	Neutral
Feystown Burn	Trout present; WFD status High	Very High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction*	No change	Neutral	Neutral

River/ Stream	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
***effect applies only to tributary intersecting site access track*			Habitat loss at stream crossings*	Negligible	Neutral	Neutral
Glenarm tributary 1	No fish present; WFD status Good	High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction	No change	Neutral	Neutral
			Habitat loss at stream crossings	No change	Neutral	Neutral
Glenarm tributary 2	No fish present; WFD status Good	High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction	No change	Neutral	Neutral
			Habitat loss at stream crossings	No change	Neutral	Neutral
Glenarm tributary 3	No fish present; WFD status High	Very High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction	No change	Neutral	Neutral
			Habitat loss at stream crossings	No change	Neutral	Neutral
Glenarm tributary 4	No fish present; WFD status Poor	Low	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction	No change	Neutral	Neutral
			Habitat loss at stream crossings	No change	Neutral	Neutral
Linford Water - downstream of 3 streams draining the Development	Trout present; potential Lamprey spp. WFD status High	Very High	Surface water run-off	Minor	Moderate/ Large	Neutral
			Fish passage obstruction	No change	Neutral	Neutral
			Habitat loss at stream crossings	No change	Neutral	Neutral
Main Glenarm River - downstream of 4	Salmon & Trout present; potential	Very High	Surface water run-off	Minor	Neutral	Neutral
			Fish passage obstruction	No change	Neutral	Neutral

River/ Stream	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
streams draining the Development	Lamprey spp. WFD status Good		Habitat loss at stream crossings	No change	Neutral	Neutral

Table 8.18: Decommissioning - Magnitude and Significance of Effects without Mitigation, and Residual Effects after Mitigation.

River/ Stream	Key receptors	Sensit-ivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
Linford Water tributary 1	Trout present; WFD status Good	High	Sediment run-off	Minor	Slight/ Moderate	Neutral
			Release of other pollutants	Minor	Slight/ Moderate	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Clady Burn	Trout present; WFD status High	Very High	Sediment run-off	Minor	Moderate/ Large	Neutral
			Release of other pollutants	Minor	Moderate/ Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Feystown Burn	Trout present; WFD status High	Very High	Sediment run-off	Minor	Moderate/ Large	Neutral
			Release of other pollutants	Minor	Moderate/ Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Glenarm tributary 1	No fish present; WFD status Good	High	Sediment run-off	Minor	Slight/ Moderate	Neutral
			Release of other pollutants	Minor	Slight/ Moderate	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Glenarm tributary 2	No fish present; WFD status Good	High	Sediment run-off	Minor	Slight/ Moderate	Neutral
			Release of other pollutants	Minor	Slight/ Moderate	Neutral

River/ Stream	Key receptors	Sensit-ivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Glenarm tributary 3	No fish present; WFD status High	Very High	Sediment run-off	Minor	Moderate/ Large	Neutral
			Release of other pollutants	Minor	Moderate/ Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Glenarm tributary 4	No fish present; WFD status Poor	Low	Sediment run-off	Minor	Neutral	Neutral
			Release of other pollutants	Minor	Neutral	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Linford Water – downstream of 3 watercourses draining the Development	Trout present; potential Lamprey spp. WFD status High	Very High	Sediment run-off	Minor	Moderate/ Large	Neutral
			Release of other pollutants	Minor	Moderate/ Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral
Main Glenarm River – downstream of 4 watercourses draining the Development	Salmon & Trout; potential Lamprey spp.; WFD status Good	Very High	Sediment run-off	Minor	Moderate/ Large	Neutral
			Release of other pollutants	Minor	Moderate/ Large	Neutral
			Fish passage: temp. obstruction	No change	Neutral	Neutral

Cumulative Effects

Additional Developments

8.181 From a fisheries and aquatic ecology perspective, there are no other wind farm developments which have been constructed or are in the planning process within the Glenarm River catchment. As a result, there are no potential cumulative effects on fisheries/ aquatic ecology within the catchment.

Summary

8.182 This chapter outlines the potential effects of the Development on the fish stocks and fish habitats of the receiving watercourses in the Glenarm River catchment. It provides relevant baseline information on fisheries and aquatic ecological health enabling the potential effects to be identified and evaluated.

8.183 It has been determined that potential impacts are primarily related to sediment run-off and the release of other pollutants to the receiving watercourses with related effects on fish stocks and the wider stream ecosystem. Additionally, there is potential for the loss of habitat at five tributary locations where the site access tracks cross. Without mitigation it is considered that these impacts have the potential to be of Moderate Magnitude and of Very Large Significance depending on the sensitivity of individual watercourses.

8.184 A series of specific mitigation measures have been designed to avoid adverse effects on fisheries with regard to both construction and operational phases of the project.

8.185 Hydrology and site drainage issues have been considered in detail in Chapter 9 which outlines a surface water management system and drainage (SuDS) designed to control drainage and silt management on the Site.

8.186 It is concluded that, provided the mitigation measures are implemented as specified, construction and operation of the proposed development will have a neutral impact on the fish stocks and aquatic ecology of the Glenarm River and its main streams draining the Site.

References

Allan, J.D. (1999). Stream Ecology: Structure and Function of running waters. Kluwer Academic Publishers. Pp. 388.

Bain M., Finn J. and Brooke, H. (1985). Quantifying stream substrate for habitat analysis studies. N Am J Fish Manage 5, 499-500.

Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. and Death, R.G. (2011) Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand.

Chartered Institute of Ecology & Environmental Management (2018). Guidelines for ecological impact assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.

Crozier WW & Kennedy GJA (1994) Application of semi-quantitative electrofishing to juvenile salmonid stock surveys. Journal of Fish Biology 45, 159-164.

Design Manual for Roads and Bridges (DMRB, 2019). Road Drainage and the Water Environment, Volume 11, Section 3, Part 10, LA113.

Design Manual for Roads and Bridges (DMRB, 2019b). Sustainability and Environmental Appraisal: LA08 Biodiversity.

Design Manual for Roads and Bridges (DMRB, 2019c). Sustainability and Environmental Appraisal: Environmental Assessment and Monitoring, Section 2, Part 4, LA104

Environment Agency (2018) Guidance for Pollution Prevention. Works and maintenance in or near water: GPP5. http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017

Extence CA, Chadd RP, England J, Dunbar MJ, Wood PJ & Taylor ED (2011). The assessment of fine sediment accumulation in rivers using macro-invertebrate community response. River Research and Applications, 29,17–55.

Goodwin CE, Dick JTA & Elwood RW (2009) A Preliminary Assessment of the Distribution of the Sea lamprey (Petromyzon marinus LL)), River lamprey (Lampetra fluvialilis (L)) and Brook lamprey (Lampetra planeri (Bloch)) in Northern Ireland. BIOLOGY AND ENVIRONMENT: PROCEEDINGS OF THE ROYAL IRISH ACADEMY, VOL. 109B, NO. 1, 4752

Johnston PM (2012) A6 Londonderry to Dungiven Dualling - Supplementary Fisheries Report: Physical Habitat Characteristics And River Sediment Analysis. Paul Johnston Associates/AECOM.

Kemp, P, Sear, D., Collins, A, Naden, P., and Jones, I. (2011). The impacts of fine sediment on riverine fish. Hydrological Processes, 25, 11, 1800-1821.

Kennedy GJA (1984) The ecology of salmon habitat re-instatement following river drainage schemes. IFM Annual Study Course, Magee College, Londonderry, 18pp.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., Fitzpatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Levesque, L.M. and Dube, M.G. (2007). Review of the effects of in-stream pipeline crossing construction on aquatic ecosystems and examination of Canadian methodologies for impact assessment. Environmental Monitoring and Assessment, 132, 395-409.

Matthaei C.D., Weller, F., Kelly, D.W. & Townsend, C.R. (2006) Impacts of fine sediment addition to tussock, pasture, dairy and deer farming streams in New Zealand. *Freshwater Biology*, 51, 2154-2172.

Murray-Bligh, J. (2002) UK Invertebrate Sampling and analysis for EU-Star project. EUSTAR http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf

Newcombe, C.P. and Jensen, J.O.T. (1996). Channel suspended sediment and fisheries: A synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management, 16, 4, 693-727.

O'Connor WCK & Andrew TE (1998) The effects of siltation on Atlantic salmon, Salmo salar L, embryos in the River Bush. Fisheries Management and Ecology 5 (5), 393-401.5 (5), 393-401.

Kennedy, R.J., Rosell, R., Ensing, D., Gargan, P. and Boylan, P. (2019). Standing Scientific Committee - Advice on DAERA Area Salmon Stocks 2019. (Executive Summary)

Suttle, K.B., Power, M. E., Levine, J. M., and McNeely, C. (2004). How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological Applications, 14,4, 969-974.

Turley, M. D., Bilotta, G. S., Extence, C. A., and Brazier, R. E. (2014). Evaluation of a fine sediment biomonitoring tool across a wide range of temperate rivers and streams. Freshwater Biology, 59, 2268-2277.

WFD-UKTAG (2014). UKTAG River Assessment Method: Benthic Invertebrate Fauna. Invertebrates (General Degradation): Walley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT).

9

Geology & Water Environment

9 Geology and Water Environment

Introduction

Terms of Reference

9.1 This chapter considers the likely significant effects on the receiving hydrological, geological and hydrogeological environments; associated with the construction, operation and decommissioning of the proposed windfarm at Ballygilbert, near Cairncastle, Co. Antrim, hereinafter referred to as 'the proposed development'.

9.2 The impacts caused by the construction, operation and decommissioning phases of the proposed development are assessed, and mitigation measures are provided where required.

9.3 The assessment also identifies where hydrological features may constrain the layout of the proposed development.

Supplementary Assessments

9.4 This Chapter is supported by:

- Technical Appendix 9.1: Water Framework Directive Assessment;
- Technical Appendix 9.2: Flood Risk & Drainage Assessment;
- Technical Appendix 9.3: Geotechnical Assessment including Peat Slide Risk Assessment;
- Technical Appendix 9.4: Consultation Records; and
- Figures 9.1 to 9.3

9.5 Reference should be made to Chapter 1: Introduction & The Proposed Development for information regarding detailed construction proposals.

9.6 Changes to the hydrological / hydrogeological regime may create resultant effects on ecology within surface and groundwater dependent ecosystems. Therefore, this chapter is further supported by:

- Chapter 6: Ecology; and
- Chapter 8: Fisheries & Aquatic Ecology Assessment

Statement of Authority

9.7 The assessment has been carried out by McCloy Consulting Ltd.; an independent environmental consultancy specialising in the water environment, with specialist knowledge of hydrological and hydrogeological assessments.

9.8 The key staff members involved in this project are as follows:

- Iain Muir MSc MCIWEM - Environmental Consultant experienced in Environmental Impact Assessment (EIA) specialising in the water environment, undertaking hydrology, water quality and flood risk assessments; and
- Kyle Somerville BEng (Hons) CEng MIEI – Associate and Chartered Senior Engineer specialising in the fields of flood risk assessment, flood modelling, drainage and surface water management design including particular experience in pollution control from large scale onshore wind farm developments.

Scope of Assessment

9.9 This report will assess the effects of the proposed development on hydrology and surface water quality, hydrogeology and groundwater quality, and geological features. The assessment covers the construction, operational, maintenance and decommissioning phases of the proposed development.

9.10 This assessment identifies the hydrological constraints within land under applicant control; herein referred to as 'the survey boundary' and assesses the potential effects of the following:

- Existing natural and artificial drainage patterns;
- Water quality of surface water and groundwater;
- Surface and groundwater dependent ecosystems;
- Usage of surface water and groundwater including abstractions;
- Groundwater - surface water interactions;
- Aquifer systems and their vulnerability;
- Superficial and bedrock geology at the site; and
- Structural geology of the area and its environs.

9.11 In order to quantifiably assess the preceding, this report:

- Outlines relevant policy relating to the water environment;
- Summarises consultations provided in response to scoping requests;
- Provides baseline information and identifies sensitive receptors;
- Identifies potential likely effects, including potential likely cumulative effects;
- Assesses the significance of any adverse effects and resulting impacts based on the magnitude of the impact and the sensitivity of the receptors;
- Discusses management of design evolution and details mitigation measures;
- Provides a residual impact assessment; and
- Discusses the cumulative effects of the proposed development in conjunction with other proposed and existing developments in the vicinity.

Legislation and Planning Policy

9.12 Relevant Environmental Planning legislation, policy and industry best-practice guidance relevant to an assessment of hydrogeology and the water environment are summarised in **Table 9.1** and the following sections.

Relevant European and National Planning Policy

Table 9.1: Relevant European and National Planning Policy

Legislation	
EU	Water Framework Directive (2000/60/EC)
	Groundwater Directive (2014/80/EU)
	Priority Substance Daughter Directive to the Water Framework Directive (2008/105/EC)
	Environmental Liability Directive (2004/35/EC)
	Floods Directive (Directive 2007/60/EC)
	Environmental Impact Assessment Directive 2011/92/EU as amended (2014/52/EU)
	Integrated Pollution and Prevention Control Directive (2008/1/EC)
	Drinking Water Directive (98/83/EC)
	Nitrates Directive (91/676/EEC)
	Habitats Directive (92/43/EEC)
	Birds Directive (2009/147/EC) on the Conservation of Wild Birds, 1979
NI	Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011
	Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017
	Water Resources (Environmental Impact Assessment) Regulations (Northern Ireland) 2017
	The Environmental Liability (Prevention and Remediation) (Amendment) Regulations (NI) 2009
	The Groundwater (Amendment) Regulations (Northern Ireland) 2016
	Nature Conservation and Amenity Lands (NI) Order 1985
	The Private Water Supplies Regulations (Northern Ireland) 2017
	The Surface Waters (Dangerous Substances) (Classifications) Regulations (NI) 1998
	Drainage (Northern Ireland) Order 1973 / Drainage (Amendment) (Northern Ireland) Order 2005
	The Environment (Northern Ireland) Order 2002
	Fisheries (Northern Ireland) Act 1966
	Water (Northern Ireland) Order 1999
	The Water Supply (Water Quality) Regulations (Northern Ireland) 2017

Legislation	
	Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017
	Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (NI) 2015
	Groundwater (Amendment) Regulations (Northern Ireland) 2016
	The Surface Waters (Dangerous Substances) (Classifications) Regulations (NI) 1998
UK	UK TAG on the WFD (UK Environmental Standards & Conditions) 2008

Regional and Local Planning Policy

9.13 The proposed development has been reviewed in relation to local planning policy specific to geology and the water environment. A detailed planning policy and legislation review is included within **Chapter 2: Planning Policy**.

Regional Development Strategy 2035

9.14 The RDS promotes a sustainable approach to the provision of water and sewerage services and flood risk management including grey water recycling, rainwater harvesting and sustainable surface water management e.g. Sustainable Drainage Systems (SuDS).

Planning Policy Statements (PPS)

Strategic Planning Policy Statement (SPPS)

9.15 In working towards sustainable development, the aim will be to conserve both the archaeological and built heritage and natural resources (including wildlife, landscape, water, soil and air quality), taking particular care to safeguard designations of national and international importance.

PPS15 - Revised Planning and Flood Risk

9.16 Revised PPS15 sets out planning policies to "minimise flood risk to people, property and the environment", emphasising sustainable development and the conservation of biodiversity. The policy refers to the use of Sustainable Drainage Systems (SuDS) to minimise effects on the receiving water environment.

9.17 The policy that development proposals facilitating sustainable drainage would be considered favourably by the planning authority as such a sustainable drainage approach should be adopted by the Development.

9.18 Flood risk and drainage planning policy is similarly established by the Strategic Planning Policy Statement (SPPS). Transitional arrangements stated in the SPPS at paragraph 1.10 to 1.12 confirm that until a Plan Strategy is adopted, existing policies will apply together with the SPPS. Where the SPPS is silent or less prescriptive on a matter then this should not be judged to lessen the weight afforded to the retained policy.

9.19 In relation to flood risk planning policy, RPPS15 is more prescriptive on all aspects of matters for consideration, and the policy direction contained in RPPS15 is consistent with that stated in the SPPS.

PPS18 - Renewable Energy

9.20 PPS18 sets out the planning policy for development that generates energy from renewable resources and aims to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environments.

9.21 Policy RE1 of PPS18 states that, 'Development that generates energy from renewable resources will be permitted provided the proposal, and any associated buildings and infrastructure, will not result in an unacceptable adverse impact on…local natural resources, such as air quality or water quality.'

Larne Borough Council, Larne Area Plan 2010

9.22 The proposed development is located within Mid & East Antrim Borough Council (MEABC) boundary. MEABC are currently preparing a new Local Development Plan (LDP) for the Borough up to 2030. In the interim, the current area plan for MEABC is the Larne Area Plan 2010.

9.23 The Larne Area Plan 2010 contains no policy or guidance relevant to geology, hydrogeology or hydrology. Drainage policy DR2 within the policy states that "Where a designated watercourse runs adjacent to or through a development site the department will require the provision of a 5m wide working strip along at least one bank of the watercourse.

9.24 The department will monitor all new development proposals to ensure that storm water run-off can be adequately catered for and does not compound existing flood problems". The plan also states that policies regarding utilities and new infrastructure are set out in "the Rural Strategy" and that "the need for such facilities will be balanced against the objective of conserving the environment and protecting amenity".

9.25 The Larne Area Plan 2010 highlights the importance of the designation of a hierarchy of sites which are of high nature conservation importance. The scale of importance of summarised in the below table.

Mid & East Antrim Borough Council, Local Development Plan 2030 (Draft)

9.26 The Draft Local Area Plan 2030, although not yet adopted, outlines planning policy pertinent to the water environment.

9.27 CS8 sets out policy to protect main river corridors by ensuring floodplain capacity is not hindered as well considering water quality and pollution prevention to protect aquatic and riverine ecosystems.

9.28 FRD1 to FRD6 sets out policy to manage development that may be at risk from flooding or that may increase the risk of flooding elsewhere; to protect flood defence and drainage infrastructure; and to promote sustainable drainage solutions to improve water quality.

9.29 As the draft Plan Strategy is only at consultation stage it holds no material weight in decision making.

Table 9.2: Designations Summary

Scale of Importance	Designation Type	Designated By
INTERNATIONAL Nature Conservation Importance	Ramsar Sites	Convention on Wetlands of International Importance1975
	Special Protection Areas Special Areas of Conservation	European Commission Directive on the Conservation of Wild Birds (79/409/EEC) The Conservation (Natural Habitats, etc.) Regulations (NI) 1995
NATIONAL Nature Conservation Importance	Nature Reserves, National Nature Reserves, Marine Nature Reserves Areas of Special Scientific Interest	Nature Conservation and Amenity Lands (NI) Order 1985
LOCAL Nature Conservation Importance	Sites of Local Nature Conservation Importance and Earth Science Interests / Assets	Northern Ireland Council Area Plans

Guidance on Conservation of Geological Features - Earth Science Conservation Review

9.30 The Earth Science Conservation Review (ESCR) is the means whereby areas of geological interest in Northern Ireland are assessed to determine their importance to science and hence to earth science conservation.

9.31 The objective of the ESCR is to define systematically all earth science localities (geological and/or geomorphologic) in Northern Ireland. The overall aim of the process is to encourage conservation of such areas to protect them from potential threats such as landfill, changes to natural systems and coastal defence work.

Industry Guidelines

9.32 The Pollution Prevention Guidelines (PPGs), published by the Northern Ireland Environment Agency (NIEA) in conjunction with the Environment Agency for England and Wales, and the Scottish Environment Protection Agency (SEPA) are currently being replaced by updated Guidance for Pollution Prevention (GPPs). Guidance notes relevant to the proposed development include:

- NIEA Guidance for Pollution Prevention (GPPs):
    - GPP 2: Above ground oil storage tanks;
    - GPP 4 Treatment and disposal of Wastewater where there is no connection to the public foul sewer;
    - GPP 5: Works and Maintenance in or near Water;
    - GPP 8: Safe Storage and Disposal of Used Oils;
    - GPP 20: Dewatering Underground Ducts and Chambers;
    - GPP 21: Pollution Incident Response Planning;

   - GPP 22: Dealing with Spills; and
   - GPP 26 Safe Storage – Drums and Intermediate Bulk Containers.
- In the absence of revised specific guidance, works shall similarly consider the lapsed NIEA Pollution Prevention Guidance Notes (PPGs):
   - PPG 1: Understanding Your Environmental Responsibilities – Good Environmental Practice;
   - PPG 3 Use and Design of Oil Separators in Surface Water Drainage Systems
   - PPG 6: Working at Construction and Demolition Sites;
   - PPG 7: The Safe Operation of Refuelling Facilities; and
   - PPG 18: Managing Fire Water and Major Spillages.

9.33 Other relevant industry guidance includes:

- BS6031: 2009 Code of Practice for Earthworks;
- BS 5930 2015: Code of Practice for Site Investigations;
- CIRIA C532 - Control of Water Pollution from Construction Sites (2001);
- CIRIA C692 - Environmental Good Practice On-Site (2010);
- CIRIA C609 - Sustainable Drainage Systems: hydraulic/structural/water quality (2004);
- CIRIA C753- The SuDS Manual (2015);
- CIRIA C689- Culvert Design and Operation Guide (2010);
- DEFRA Construction Code of Practice for Sustainable Use of Soils on Construction Sites (2009);
- DAERA - A Guide to EIA and Planning Considerations: Environmental Advice for Planning Practice Guide - Water Features Survey (2018); ; and
- DAERA - A Guide to EIA and Planning Considerations: Wind Farms and Groundwater Impacts (2019).

Consultation

9.34 Formal consultation to form opinion and requirements with regards to the hydrological and geological environments was sought from local and regional organisations as summarised within

9.35 **Table** 9.3 and **Table 9.4**. Consultation took the form of a proposed scope of this assessment and a request for any amendment or additional requirements sought by the consultee.

9.36 A summary of the specific requests made by the various consultees is included in the following table. Site specific input provided is included in the following baseline assessment. Consultee responses are included in **Appendix 9.4**.

Table 9.3: Consultee Summary

Consultee		Summary of Response	Addressed in Assessment
DAERA	NIEA Land and Groundwater Team	Wind turbine foundations have the potential to impact on the groundwater environment; e.g. groundwater flow paths, aquifers or secondary receptors (including private water supplies). Groundwater receptors should be identified through a Water Feature Survey, the risk of potential impact assessed, and, mitigation measures should be identified where required.	9.15
	Environment, Marine & Fisheries Group Marine & Fisheries Division	States no issues / concerns to raise from an aquaculture / sea fisheries aspect. Reminds the applicant it is an offence under Article 47 of the Fisheries Act (NI) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks. States works near watercourses to be carried out in line with guidance as described in the PPG 5 (Works In, Near or Liable to Affect Watercourses).	9.151
	NIEA - Natural Environment Division	The Site is in proximity to Antrim Hills SPA. Proposals which may impact on a European site, will require a Habitats Regulations Assessment (HRA). Considers the proposal is likely to have significant environmental effects with regard to the Planning (EIA) Regulations (NI) 2015. The application site may contain priority peatland habitat. The topography, geology, soils and water environmental of the site and surrounding area should be described. ES should include the likely significant effects and proposed mitigation measures to offset any significant adverse effects.	The NIEA NED comments relate to the Ecology Chapter (Chapter 6). The Ecology chapter is inter-related with the Water and Geology chapter is crossed referenced where appropriate.

9.37 Additional pre-application consultation and data gathering to form opinion and requirements with regards to the hydrological and geological environments was sought from local and regional stakeholder organisations, including organisations who would be anticipated to be consulted by the planning authority in relation to the planning application. The consultation is intended to pre-empt any pre-application or in-application consultation that would be undertaken on notification or submission of the planning application and EIA. The informal consultation excludes NIEA:NED whose concerns are addressed separately in **Chapter 6 Ecology**.

9.38 A summary of the specific data provided by and information / concerns raised by the various stakeholders is included in the following table. Site specific input provided is included in the following baseline assessment. Stakeholder responses are included in **Technical Appendix 9.4.**

Table 9.4: Additional Consultation Summary

Consultees		Summary of Response	Addressed in Assessment
Mid and East Antrim Borough Council	Environmental Health	Stated there are no Private Water Supplies located within the enquiry area surrounding the proposed development. MEABC also confirmed that information held by the Borough Council is limited and NIEA DWI / PWS team should be consulted.[1]	9.139 to 9.141
DAERA	NIEA Private Water Supply / Drinking Water Inspectorate	There are no private water supplies registered with the inspectorate within 5km of the outlined site. There is one private drinking water supply (spring) registered with the Inspectorate within 5km of the outlined site. Stated that DWI does not hold information on private water supplies which supply single dwellings and any details should be obtained from the Environmental Health Department of Mid and East Antrim Borough Council.	
DAERA	Fisheries Inspectorate	Stated that there were no issues or concerns from an aquaculture perspective as there are no aquaculture sites in proximity to the proposed development.	9.151
DAERA	Inland Fisheries	Highlighted that the watercourse that will be mainly affected in this instance will be the Glenarm River and some tributaries, noting that sites lower in the catchment are used for monitoring of salmonid populations as they support salmonid species (Salmon and Brown/ Sea Trout). Fish populations are sensitive to reductions in water quality and fisheries habitat is susceptible to siltation from suspended solids. Consideration of potential impacts of project methodology on the aquatic environment and water quality should be considered. Disturbance to watercourses during operations may require authorisation under section 48 of the Fisheries Act (NI) 1966 (as amended) and it is an offence under section 47 of the Fisheries Act (Northern Ireland) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks.	
DAERA	Environmental Crime Department	Confirmed no records of unlicensed landfills within 2km of the proposed development.	9.80
DAERA	NIEA Water Management Unit	Conducted a search of the groundwater monitoring database and found there are no groundwater abstraction points within the search area. Provided water quality data and River Waterbody Class (2018) for waterbodies within 5km the proposed development. WMU also noted that all the information requested (except for groundwater quality), is available on the new Water Information Request Viewer.	9.129 to 9.138

[1] Personal comms. (phone call) between Sam Mills (Environmental Health Officer – MEABC) and Iain Muir (Project Consultant – McCloy Consulting) 19/06/2019.

Consultees		Summary of Response	Addressed in Assessment
Department for Infrastructure	Rivers	Confirmed there are no designated watercourses or culverts under the terms of the Drainage (Northern Ireland) Order 1973 within or bounding the site. Stated there may be undesignated rivers about which DfI Rivers is unaware. Confirmed the DfI had no record of any historical flood calls at the location of the proposed development.	9.107
Department for Economy	Geological Survey of Northern Ireland (GSNI)	GSNI database search identified two abandoned mine workings. Details on the shafts and hazards associated with adits was provided. Stated that the eastern side of the area is susceptible to landslide movement and provided detail, noting that peat is considered a compressible material and should be considered for any development. GSNI also advised that there may be groundwater abstractions in the area; however, could not provide the information and recommended that the Drinking Water Inspectorate be consulted.	9.79 to 9.87
NIEA	Water Management Unit – Pollution Prevention Team	Pollution Prevention Team provided general information in relation to pollution prevention. Recommends all necessary source control and mitigation measures to prevent pollution of the water environment during construction, operational or maintenance phase of a project are identified and employed. Highly recommends the relevant PPGs and GPPs are identified and their precepts adhered to, in particular PPG5 and PPG6. Recommends the NIEA Pollution Prevent Team be consulted about any work, to be conducted in or near a waterway, or liable to affect any waterway, to agree a Method Statement with contractors (8 weeks) prior to the commencement of any works. Risks to the water environment, potential pollution pathways, best practices principles and mitigation measures to minimise risks should be identified, incorporated in contractors' Method Statements and be in place prior to the commencement of any works. Provided examples of mitigation measures; Construction phase site drainage plans should be considered at an early, to ensure site water is minimised (e.g. utilising cut off channels) collected, channelled and treated prior to discharge. Water should be collected in cut of drains and check dams and channelled to settlement features (built and maintained according to industry bet practice) for treatment of suspended solids prior to discharge. Phased stripping and minimisation of exposed land to control suspended solid generation should be considered. Use of settlement systems for settlement of suspended solids from site drainage. These should be built and maintained according to industry best practice.	9.129 to 9.138

Consultees		Summary of Response	Addressed in Assessment
		Any works in a waterway must be conducted 'in the dry' e.g. behind coffer dams, use of over pumping, the use of temporary diversions etc. The NIEA Pollution Prevention Team do not permit machinery to enter any waterway at any time. NIEA must be consulted prior to commencement of any such works to ensure appropriate mitigation measures are in place. The Pollution Prevention Team work with contractors to ensure minimal disturbance and generation of suspended solids during the placement and removal of cofferdams/diversions etc. The NIEA do not encourage in stream settlement as a primary mitigation measure, the contractor must strive to ensure the generation of suspended solids is prevented/ minimised in the first instance. The use of downstream settlement measures is considered a secondary line of protection. Management and maintenance of mitigation measures to ensure effective functioning. Prevent pollution by fuel/oil, from leaking machinery, there must be regular inspections of machinery working near any waterway. Safe refuelling, handling and storage practices for earth stockpiles and secondary containment for chemicals, oil, fuels etc. Compliance with the requirements of Control of Pollution (Oil Storage) Regulations (NI) 2010. Emergency spill procedures should be addressed Highlights requirements of the Control of Pollution (Oil Storage) Regulations, the primary requirement being secondary containment must be provided for oil stored in above ground containers over 200L with 110% capacity.	

9.39 During consultation, the Drinking Water Inspectorate (DWI) advised that primary production sites (e.g. dairy farms) are not required to be registered with the DWI and should this information be required, contact should be made with the Agri-food Inspection Branch (AfIB).

9.40 A review of the NIEA WMU Water Information Request Viewer identified several abstractions to the south of the Site identified as 'Agriculture-Livestock'. AfIB confirmed that they did not hold any further information associated with the identified abstractions.

9.41 A copy of consultee responses is included in **Technical Appendix 9.4**.

Assessment Methodology

Baseline Characterisation

9.42 This qualitative assessment has been undertaken based on experienced professional judgement and assessment of compliance with statutory and industry guidance, including site visits for verification.

Study Area

9.43 Potential effects were considered within the survey boundary (within which the planning application boundary lies; hereafter referred to as the Site); and the wider geological and hydrogeological setting of the area.

9.44 The hydrological study area includes surface water catchments draining the area within the Site and the downstream river reaches affected by this area as defined by the relevant River Basin Management Plans, Local Management Areas (LMAs) and Catchment Stakeholder Groups.

9.45 The hydrogeological and geological study area extends to the underlying aquifer catchments and extents of the geological units.

Additional Areas Considered

9.46 Consideration has been given to potential likely significant effects in respect of the proposed turbine delivery route and access route. Details of the work comprising junction widening, passing bays and general road widening, and potential effects on the geology and water environment are summarised within **Chapter 11: Transport & Traffic**.

9.47 A potential grid connection route is described within **Technical Appendix 2.1: Assessment of Potential Grid Connection**. Although the grid route is not part of the proposed development consideration has been given to potential likely significant effects.

Desk Study

9.48 The desktop study involved collation and assessment of the relevant information from the following sources:

- Ordnance Survey raster and vector mapping in addition to aerial photography to assess land use and environs and to identify water features and watercourse catchments;
- Local authority and regulatory body consultation responses;
- NIEA river quality data and natural heritage data;
- DfI Rivers Flood Maps NI;
- NIEA Drinking Water Inspectorate and Water Management Unit data;
- Review of CEH Flood Estimation Handbook (Version 3) for details of river catchment data;
- Review of Inland Fisheries information;
- Review of detailed site topographic survey;
- The Geology of Northern Ireland – Our Natural Foundation, GSNI, Mitchell (2004);
- GSNI GeoIndex (1:10,000 bedrock and superficial geology maps);
- GSNI GeoIndex (aquifers and aquifer vulnerability);
- GSNI GeoRecords database;

- General Soil Type Map of Northern Ireland at 1:250 000 scale;
- NIEA Groundwater quality data and abstractions / discharges database; and
- NIEA Drinking Water Inspectorate and Water Management Unit data.

Determination of Sensitivity, Magnitude, Likelihood and Significance

9.49 This assessment determines the nature, scale and significance of the effects of the proposed development on the baseline (current) scenario in accordance with a methodology stated within The Institute of Environmental Management and Assessment guidance[2].

9.50 The potential impact significance is defined by the combination of the sensitivity of the receptor and the magnitude of the effect. Following this, an overall impact significance is determined by considering the potential impact significance and the likelihood of the effect occurring.

Sensitivity Criteria

9.51 The scale and sensitivity of the receiving environment (receptor) has been categorised on a scale of "Very High" to "Low". The sensitivity criteria used for this assessment are presented in **Table 9.5** and are based on:

- Vulnerability of a receptor to a particular pressure (degree of environmental response to any particular effect); and
- The importance or 'value' of the receptor e.g. an area of international importance should be considered more sensitive to effect than a local area of little or no conservation value.

Table 9.5: Evaluation of Hydrological / Hydrogeological Receptor Sensitivity Criteria

Scale / Sensitivity of the Environment (Receptor)		
International and / or Very High	Attribute has a very high quality / rarity at an international scale.	Important on a European or global level, e.g. Ramsar Sites, SAC, SPA and Habitats Directive Sites with dependence on the water environment.

2 Institute of Environmental Management and Assessment (2004) Guidelines for Environmental Impact Assessment.

Scale / Sensitivity of the Environment (Receptor)		
National and / or High	Attribute has a high quality and rarity at a national scale.	Important in Northern Ireland, e.g. ASSI or National Nature Reserve (NNR) with respect to the hydrological / geological environment. WFD classification of 'High' with the watercourse providing a nationally important resource or supporting river ecosystem. Public water supplies and highly productive aquifers or local water supplies, including private water supplies where there is no alternative to private supplies. Principal aquifer providing a nationally important resource. Source Protection Zone 2 (Outer Source Protection Zone).
Regional and / or Medium	Attribute has a medium quality and rarity at a regional scale.	Important in the context of the region, e.g. catchment scale issues, main river within the catchment, local Nature Reserves or Sites of Local Importance for Nature Conservation (SLNCI), designated geological features considered important for their educational, research, historic or aesthetic importance. WFD classification of 'Good' with the watercourse providing an important resource or supporting river ecosystem or upstream of a designated fishery. Active floodplain area. Designated fishery, catchment regionally important for fisheries. Domestic private water supplies located within vicinity of mains water supply or private water supplies used only for agricultural purposes and not drinking water. Surface and groundwater dependent terrestrial ecosystems in hydraulic continuity with the Site. Principal aquifer providing a regionally important resource e.g. industrial use with limited connection to surface water. Source Protection Zone 3 (catchment of groundwater source).
Local and / or Low	Attribute has a low quality and rarity at a local scale.	WFD classification of 'Moderate' or less with the watercourse providing a locally important resource or supporting river ecosystem. Geological features not currently identified as ASSI, ESCR that may require protection in the future. Domestic private water supplies located within vicinity of mains water supply or private water supplies used only for agricultural purposes and not drinking water. Surface or groundwater dependent terrestrial ecosystems in hydraulic continuity with the Site. Aquifer providing a locally important resource e.g. For agricultural or small-domestic supplies.

Magnitude of Effect

9.52 The magnitude of change / effect is influenced by the timing, scale, size and duration of the hazardous effect; magnitude has been categorised on a scale of "High" to "Low"; defined in **Table 9.6**.

Table 9.6: Evaluation of Magnitude of Effect Criteria

Magnitude of Effect / Description		Definition of Criteria	
High	Fundamental change resulting in loss of an attribute and /or the quality and integrity of conditions.	Water Quality	Potential high risk of pollution to surface water changing water quality status.
		Water Supply	Loss of local water supply or change in quality with respect to drinking water standards (DWS).
		Groundwater	Significant change in groundwater levels, flow regime, groundwater quality or extensive change to an aquifer.
		Surface and Groundwater Dependent Ecosystem	Loss of or extensive change to a surface or groundwater dependent ecosystem or fishery.
		Geology and Soils	Partial (greater than 50%) or total loss of a geological site or mineral deposit. Major or total loss of topsoil, soils or peatland.
Medium	Detectable change to conditions resulting in non-fundamental temporary or permanent consequential changes.	Water Quality	Potential medium risk of pollution to surface water, changing water quality status.
		Water Supply	Temporary loss of local water supply or minor change in quality of supply with respect to drinking water standards.
		Groundwater	Measurable change in groundwater levels, groundwater flow regime, groundwater quality or identifiable change to an aquifer.
		Surface and Groundwater Dependent Ecosystem	Partial loss or change to a surface or groundwater dependent ecosystem or fishery.
		Geology and Soils	Partial loss of topsoil, soils or peatland, or where the value of the area would be affected, but not to a major degree

Magnitude of Effect / Description		Definition of Criteria	
Low	Results in minor effect on attribute of insufficient magnitude to affect the use or integrity.	Water Quality	Minor deterioration in water quality unlikely to affect the most sensitive receptor or insignificant change in water quality conditions not exceeding those expected due to naturally occurring fluctuations.
		Water Supply	No change in pressure or flow to local water supply or minor change in quality of supply with respect to drinking water standards.
		Groundwater	Any measurable change in groundwater levels that does not affect groundwater flow regime, groundwater quality with regards to DWS or result in any change to an aquifer.
		Surface and Groundwater Dependent Ecosystem	Any measurable change to a surface or groundwater water dependent ecosystem or fishery.
		Geology and Soils	Small effect on a geological/ geodiversity site or mineral deposit (up to 15%). Partial loss of topsoil, soils or peatland, or where soils will be disturbed but the value of the area would not be affected.
Negligible	Results in negligible effect on attribute	Water Quality	No perceptible change in water quality.
		Water Supply	No change in pressure or flow to local water supply and negligible change in quality of supply with respect to drinking water standards.
		Groundwater	No measurable change in groundwater levels, groundwater flow regime, groundwater quality with regards to DWS. No change to an aquifer.
		Surface and Groundwater Dependent Ecosystem	No measurable change to a surface or groundwater water dependent ecosystem or fishery.
		Geology and Soils	Very slight change from geological, mineral and soil baseline conditions

Impact Significance Criteria

9.53 The magnitude of effect and receptor sensitivity are combined to evaluate and qualify if an impact is of high, moderate, low or negligible significance as outlined in

9.54 **Table** 9.7.

Table 9.7: Evaluation of Potential Effect Significance

Scale / Sensitivity of the Environment (Receptor)	Magnitude of Effect			
	Negligible	Low	Medium	High
International / Very High	Moderate	Moderate	High	High
National / High	Low	Moderate	Moderate	High
Regional / Medium	Negligible	Low	Moderate	Moderate
Local / Low	Negligible	Negligible	Low	Low

Likelihood of Occurrence Criteria

9.55 The likelihood of the potential effects occurring is assessed based on historical data, quantitative analysis and professional judgement based on relevant experience as shown in **Table 9.8**.

Table 9.8: Evaluation of Likelihood of Occurrence

Likelihood of occurrence	Criteria
Certain	Likely consequential effect in medium term and inevitable in long term (within the life of the development).
Likely	Possible consequential effect in the medium term and likely but not inevitable in the long term.
Unlikely	Unlikely that any consequential effect would arise within the lifetime of the development.
Rare	It is unlikely that any consequence would ever arise.

Determination of Overall Impact Significance

9.56 Potential Impact Significance (

9.57 **Table** 9.7**)** and Likelihood of Occurrence (**Table 9.8**) are combined to determine an Overall Impact Significance as shown in the matrix in **Table 9.9**.

Table 9.9: Evaluation of Overall Significance

Potential Significance	Likelihood of Occurrence			
	Rare	Unlikely	Likely	Certain
High	Minor	Moderate	Major	Major
Moderate	Minor	Minor	Moderate	Major
Low	Not Significant	Minor	Minor	Moderate
Negligible	Not Significant	Not Significant	Minor	Moderate

Site Characteristics & Baseline Conditions

Site Description

9.58 The proposed development is in the townland of Ballygilbert, Co. Antrim. Glenarm is c. 2.5 km to the north and Ballygally c. 3.5 km to the south-east of the site. The survey boundary has an area of approximately 5.82 km^2 (582 ha); the application ,application, the application Site has a total area of approximately 0.85 km2 (85 ha).

Topography

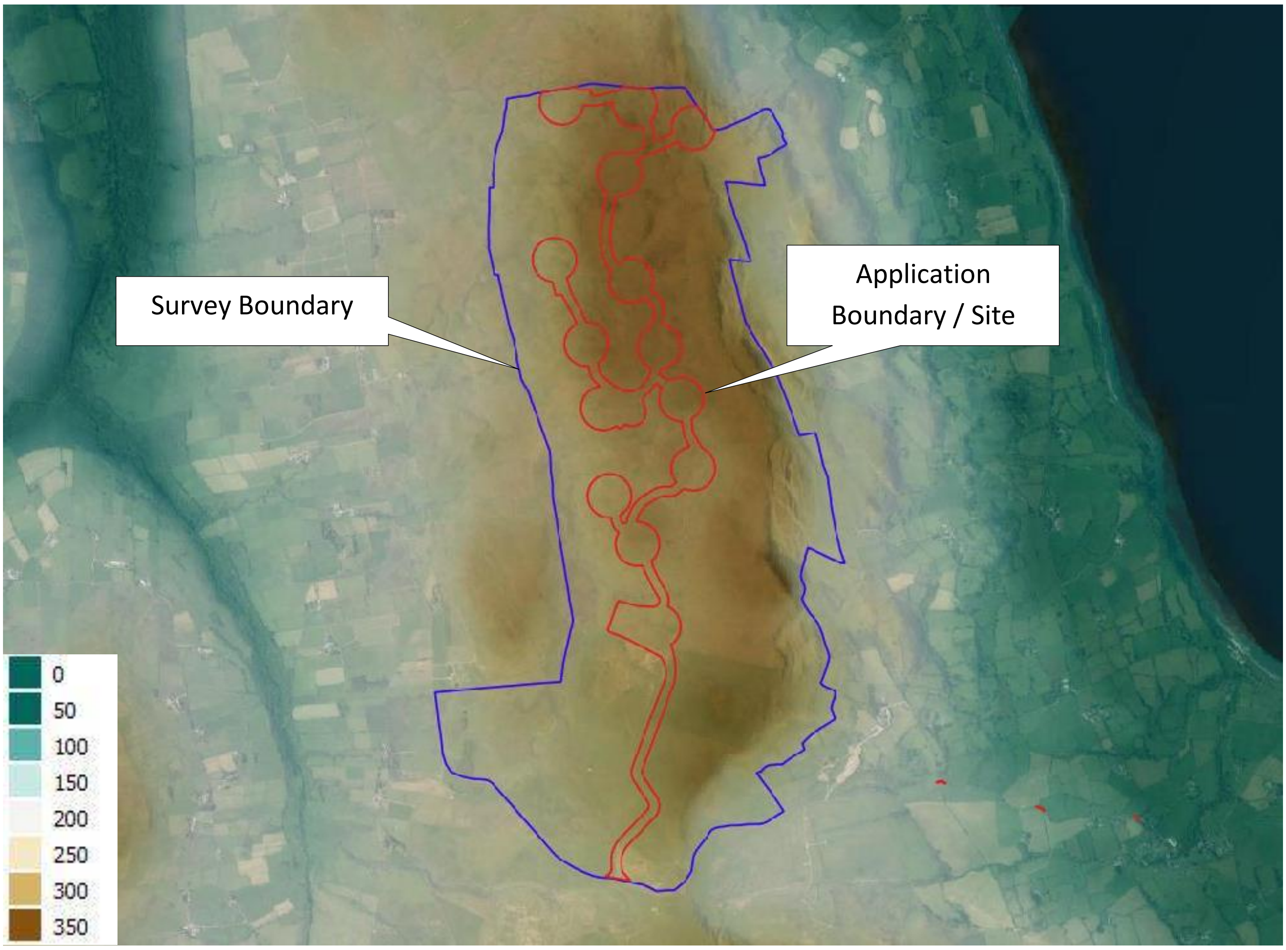
9.59 The topography of the site predominately falls from east to west, from a maximum height of approximately 378 m down towards Feystown Rd and Glenarm River to the valley bottom over approximately 3 km. The eastern boundary is characterised by a steep mountainous cliff face which drops sharply towards the A2 Coast Road.

Land Cover

9.60 The site comprises of marginally intensive agricultural grazing and grassland / rushes in the higher elevations. Sporadic peatland cover is present in upland areas in the central northern and southern half of the site. The NIEA Natural Environmental Map Viewer classifies these areas as ‘Priority Habitats’. The dominant habitats are grassland types that have been modified considerably by intensive grazing, mostly by sheep, although cattle were observed on the lower land to the south of the site. Species-poor acid grassland is dominant over higher ground. Lower gradient slopes or hollows, and the mid to lower western slopes of the site are often occupied by marshy grassland. Further detail of is provided in Chapter 6: Ecology.

9.61 The site can be accessed by farm tracks from the south via Feystown Road and the north via Dickeystown Road.

Plate 9-1: Topography



Meteorological Data Summary

9.62 The Standard Percentage Runoff (SPR) is a parameter used in runoff and flood estimation, which represents the percentage of total rainfall likely to contribute to direct runoff and storm flow. Review of the site in relation to Hydrology of Soil Types (HOST) class mapping indicates a SPR of approximately 48 - 60 %[3]. For context, SPR values in the UK range from 2% (sand or chalk with slow response / low runoff) to a maximum of 60% (peat bog with rapid response / high runoff).

9.63 Rainfall data from the Killylane climate station[4] (approx. 16 km south-west from the proposed development) recorded an annual average rainfall total of 1330 mm during the 1981 – 2010 climatic period. Based on the Meteorological Office banding of annual average rainfall (1981 – 2010), rainfall in the vicinity of the site is within the fourth highest of nine bands (1250 – 1500 mm) and is typical for elevated regions in Northern Ireland.

[3] Institute of Hydrology (1995) Report No. 126 Hydrology of soil types: a hydrologically based classification of the soils of the United Kingdom. Available at: http://nora.nerc.ac.uk/id/eprint/7369/1/IH_126.pdf

[4] Met Office, Killylane Climate. Available at https://www.metoffice.gov.uk/public/weather/climate/gcg9gvrs8 Accessed 13/06/2019

Geology

Agricultural Land Classification

9.64 DAERA published a classification index for Agricultural Land Classification (ALC) in 1997 based on a document "Agricultural Land Classification of England and Wales" published by the Ministry of Agriculture and Fisheries and Food (now Department for Environment, Food and Rural Affairs)[5] in 1988. The index classifies agricultural land into five grades based on climate, topography, soil, slope and altitude characteristics; with Grade 1 excellent quality and Grade 5 very poor quality.

9.65 Using the guidance from the ALC of England and Wales, along with available site information including site walkover observations and gradients the land the most suitable land classification for the site ranges from Grade 3b – 'moderate quality agricultural land' for the majority of the site and Grade 4 – 'poor quality agricultural land', in the south western area of the site.

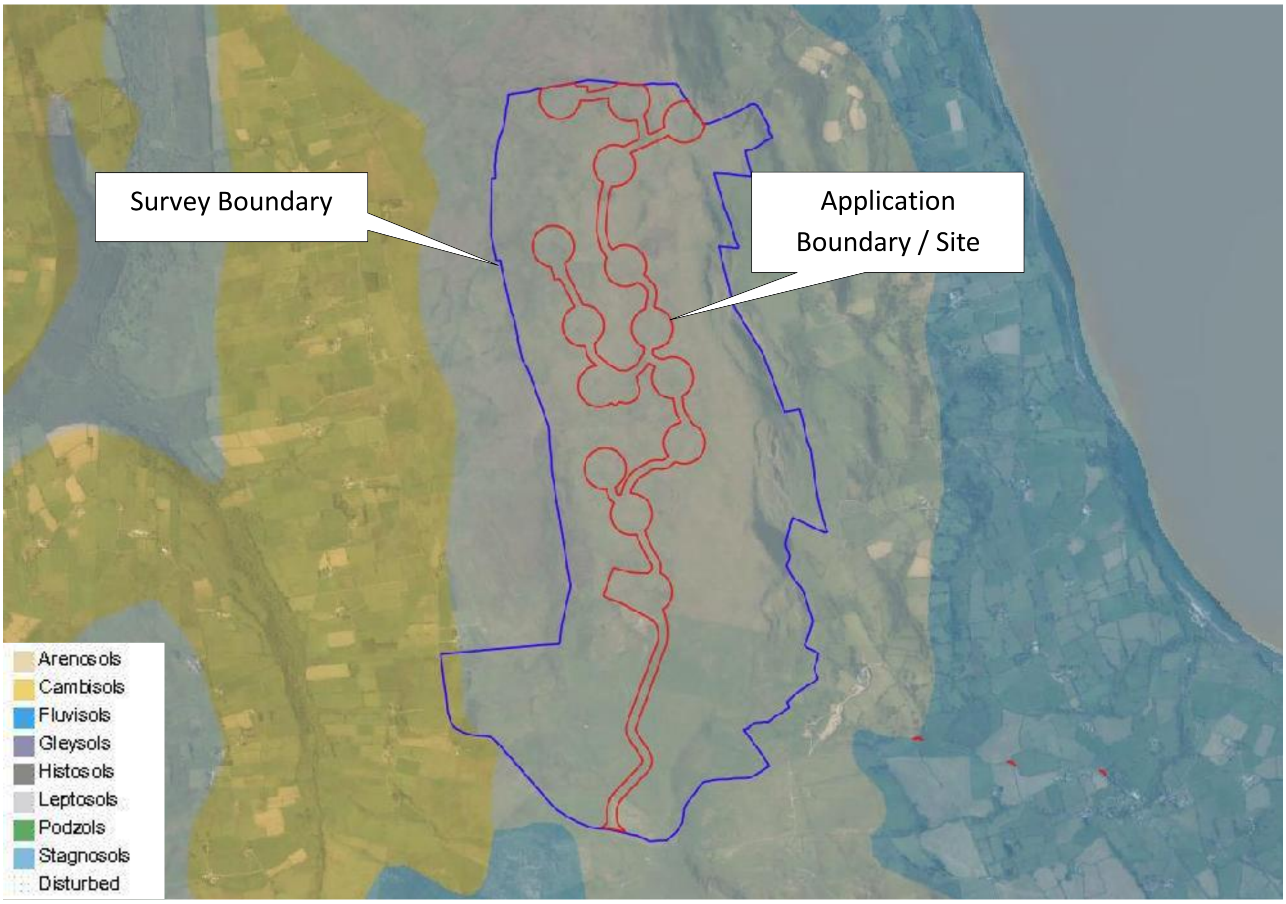
9.66 The loss or partial loss of agricultural function on the site is therefore not significant and does not inform constraints to development.

Soil Conditions

9.67 The Soil Map for N. Ireland (World Reference Base Classification) classifies the soil cover on the site as 'Leptosols', which are a very shallow soil which have an inability to hold water. Small areas around the periphery of the site are classified as 'Cambisols'; their aggregate structure and high content of weatherable minerals, means they usually can be exploited for agriculture dependent on terrain and climate.

5 Ministry of Agriculture, Fisheries and Food: Agricultural Land Classification of England and Wales (1988) http://publications.naturalengland.org.uk/file/5526580165083136

Plate 9-2: Soils

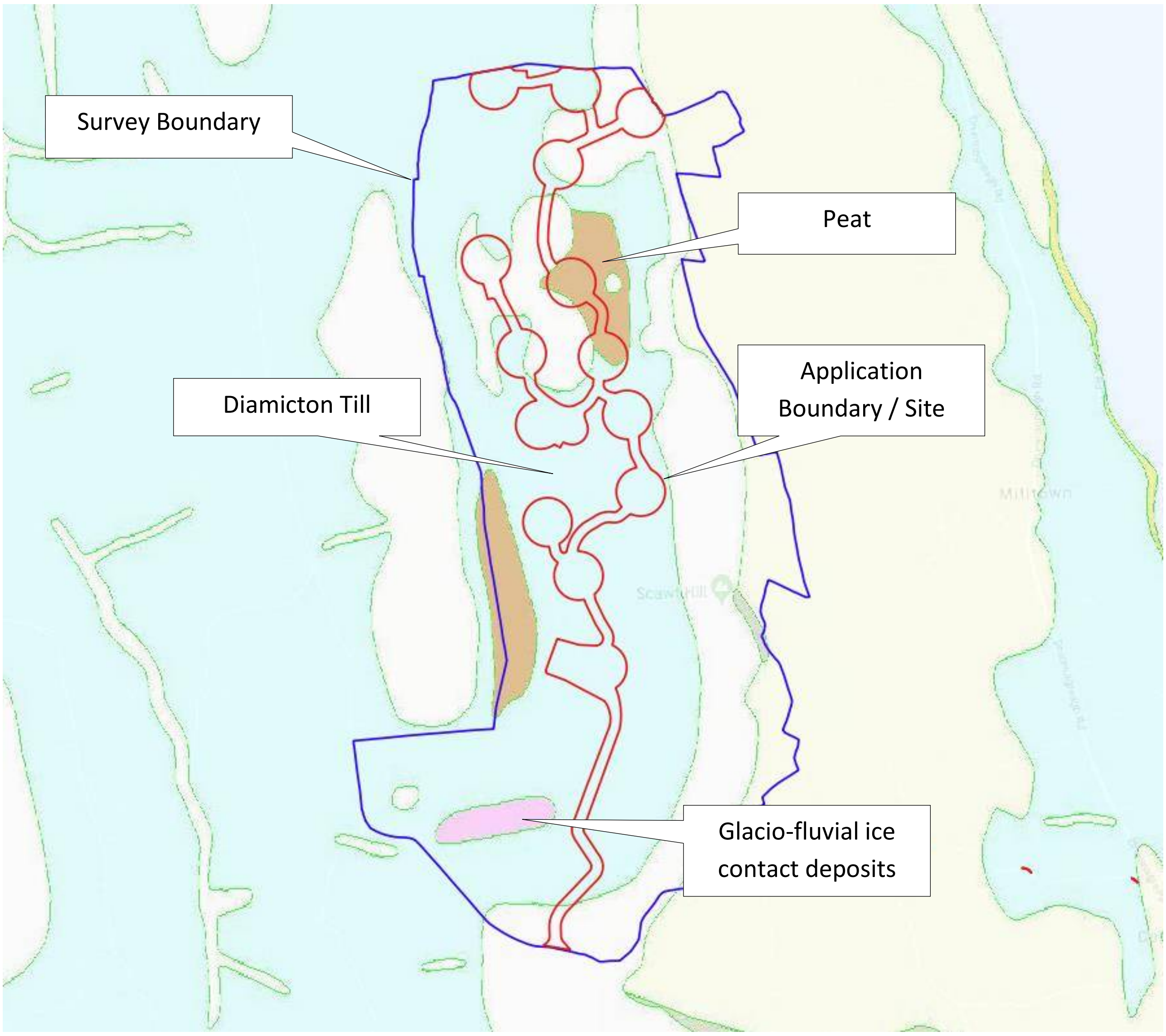


Superficial Deposits

9.68 The site has been reviewed in relation to the 1:10,000 mapping available from the GSNI GeoIndex WMS layers.

9.69 The majority of the site is underlain by diamicton till with an area of glaciofluvial ice contact deposits in the southern section of the site. Unknown/unclassified areas are evident in GSNI mapping indicating shallow soils, and site walkovers identified small areas of exposed bedrock to the west of the Site.

Plate 9-3: Superficial Deposits based on GSNI 10K Datasets



Peat

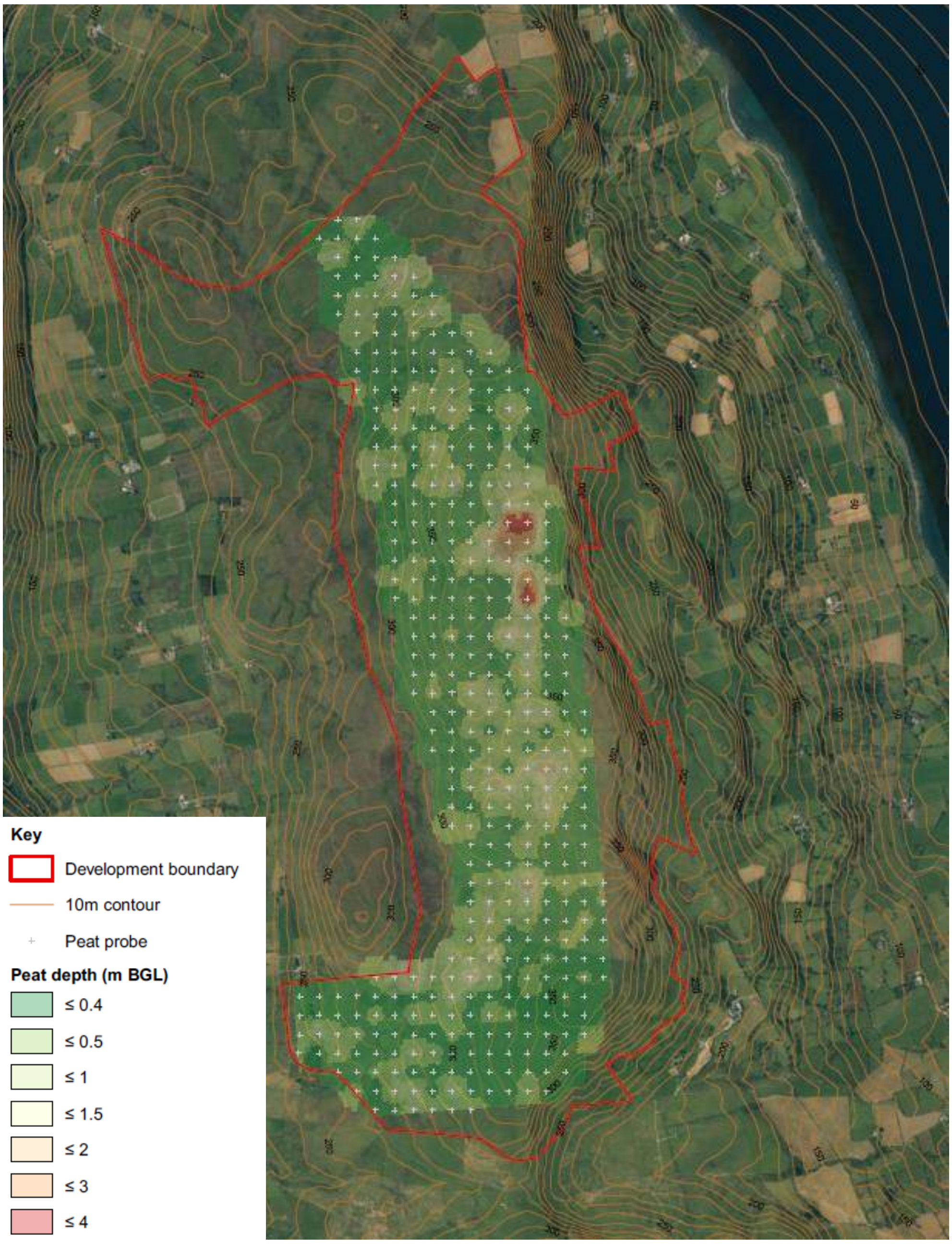
9.70 The presence of peat coverage is initially identified by GSNI 1:10,000 mapping (shown on Plate 9-3) and the NIEA Natural Environment Map Viewer, both of which indicate peat coverage within the site. A Phase 1 Geotechnical Study including Peat Slide Risk Assessment (PSRA) has been produced by a 3rd party for the applicant and is included in Appendix 9.3 and the findings of that intrusive investigation take precedent over desktop sources in relation to peat coverage at the site.

9.71 The PSRA stated that the most consistent peat coverage was found at the higher elevations of the proposed development. The deepest being in flat basins mainly on the eastern side of the development around Black Hill. Average peat depth was 0.35m with the maximum depths up to 4.00m in several discrete pockets.

9.72 The study concluded that conditions applicable to peat slide are observed to be very rare due to shallow peat depths on steeper slopes, and deep peat only being found in small localities with relatively shallow gradients.

9.73 The Phase 1 Geotechnical Study including Peat Slide Risk Assessment is included in **Appendix 9.3**. Accurate peat extent and depth mapping is shown at Figure 5 of that Appendix. An excerpt is provided in Plate 9.4.

Plate 9-4: Peat Depth (excerpt from PSRA – Appendix 9.3)



Bedrock Geology

9.74 The bedrock geology of the site has been reviewed in relation to the 1:10,000 mapping available from the GSNI GeoIndex WMS layers. The northern area of the site is underlain by the Upper Basalt Formation and the southern area by the Lower Basalt Formation. An interbasaltic formation, lithomarge of bauxitic clay and oxides and iron hydroxides indicates the contact boundary between the two formations.

9.75 The south-east section of the site around Scawt Hill, overlies a seam of chalk (Ulster White Limestone Group). Scawt Hill, the dominant feature in the landscape, is an igneous volcanic plug composed of microgabbro.

Exposed Bedrock

9.76 Site walkovers identified small areas of exposed bedrock to the west of the Site.

Faults

9.77 BGS data mapping identifies two faults within the survey boundary; one orientated in a south-west to north east, then north-south direction (within the survey boundary for approximately 1 km in total); and the second orientated south east to north west, crossing the alignment of the site access track; however, no turbines are proposed to be sited in the vicinity of them.

9.78 The locations of large regional fault systems are *inferred* from the BGS mapping. Their presence is noted in the Geotechnical Assessment (Appendix 9.3); however, they are not considered further as a source of potential local ground stability.

Mass Movement

9.79 A review of the 1:10,000 mapping on the GSNI GeoIndex indicates the steep land adjacent along the eastern site boundary of the site have historically been affected by landslip.

Plate 9-5: Solid Geology

Radon

9.80 The UK interactive radon map, based on the Indicative Atlas of Radon in Northern Ireland, indicates a portion of the site is subject to elevated radon potential. In the south and east of the site the maximum radon potential is 1-3 %, i.e. this is the percentage of homes above the action level[6].

Waste and Minerals

Waste Site Licence Exemptions and Sites

9.81 NIEA datasets informed of no waste sites situated within 1 km of the site.

[6] Government recommendations state that radon levels should be reduced in buildings where the average is more than 200 becquerels per metre cubed (200 Bq m-3). The 'action level' refers to the annual average radon concentration in a building.

Landfills

9.82 A review of the opensource NIEA authorised landfill sites dataset does not identify any features within the vicinity of the proposed development.

9.83 An information request made to the DAERA Environmental Crime Department confirmed the department is not aware of any unlicensed landfills within 1 km of the site.

Historic Quarries

9.84 A review of DAERA WMU historical land use datasets identified as mineral workings (shown as a quarry until 1971) located on Feystown Road directly adjacent to the proposed access to the development. As it is located down gradient, it is not considered to pose a potential impact to, or be affected by, the proposed development.

Active Quarries

9.85 Consultation of the GSNI GeoIndex (records from 2000) lists no active quarries within 1 km of the survey boundary.

9.86 There is 1 no. mapped trial adit[7] within the survey boundary but located outside, and at a higher elevation, than the proposed development boundary (c. 270 m north-east and c. 14 m higher) such that it is not considered to pose a potential geotechnical risk. The Phase I Geotechnical Study also highlights the abandoned adit but does not identify it as a geotechnical risk.

9.87 GSNI Mineral Branch were contacted for further information, a summary of the response is included in **Table 9.10**. The full response is included in **Appendix 9.4**.

Table 9.10: GSNI Mine Search

Accession	Name	IGR – Easting, Northing	Mineral	Notes
765	Ballygilbert Trial Adit	333504, 409928	Iron	'Pisolitic Iron Ore. Adit driven five fathoms, now abandoned.' *Antrim 30SW Field Slip Trail 1880 Notes* 'Possibility of other adits in the area 'on the south slope of Ballygilbert Hill…adits were driven on the Ore bed.' *Cole, G.A.J (1912) The Interbasaltic Rocks (Iron Ores and Bauxites of North-East Ireland 32* 'Old note says 5m adit abandoned.no tunnel nor any dump. known as 'ore hole'. a spring emerging from a rabbit size hole. No danger. Collapsed. Degree of Risk: minimal Recommendations: No Action' *Smith, A. 1983 Open file* *report no.69 interbasaltic mine workings surface hazards-Alan Smith locality no.352 notes*

[7] [7] a horizontal passage leading into a mine for the purposes of access or drainage

Mineral Occurrences

9.88 Information available on the GSNI GeoIndex and Industrial Heritage Record mapping shows there are 2 no. mineral occurrences 1.5 km to the north of the site. Bauxite and lignite are mapped in proximity to a watercourse which rises on the site and a coal mine is located approximately 800 m further east. The mineral occurrences are in the site of former mines.

Mineral Licences

Consultation of the GSNI GeoIndex indicates there is no current mining licences held for the site or vicinity. The site was previously within an historic mineral licence area.

Industrial Consents

9.89 Review of DAERA mapping identified six industrial consents within 1 km of the proposed development boundary. They are described as private sewage (5 No.) and site drainage (1 No.). All are located down gradient from the proposed development and not considered to pose a potential impact to, or be affected by, the proposed development.

Summary of Geohazards

Table 9.11: Summary of Identified Geohazards

Geohazard Type	Applicable to the Proposed Development?	Rationale / Potential Constraint	Consider Further?
Extractions	No	No active quarries were identified within 1 km from the site.	No
Adit	Yes	Located outside proposed development boundary (c. 270 m NE and c. 14 m higher from nearest proposed turbine base. GSNI reported as no danger with minimal degree of risk.	No
Land Slip	Yes	GSNI holds records of historical land slip adjacent to the eastern boundary.	No
Peat	Yes	There are peat deposits within the site boundary. The occurrence of peat is a potential constraint to development. The PSRA found that conditions applicable to peat slide are observed to be very rare due to shallow peat depths on steeper slopes, and deep peat only being found in small localities with relatively shallow gradients; but the variable nature of the topography on the relatively small scale, could lead to potentially high-risk areas being missed by the coarse nature of the survey grid. The PSRA recommended a phased site investigation be carried out to confirm the geological conditions across the development, normally be carried out post-consent and part of a pre-construction phase of works.	No
Running Sands	No	There are no sand deposits mapped within the application boundary.	No
Compressible Ground	Yes	Peat is present within the area of proposed built development. (T6, T7, T8 and T12 are in an area	No

Geohazard Type	Applicable to the Proposed Development?	Rationale / Potential Constraint	Consider Further?
		identified as peat.). The PSRA recommended a phased site investigation be carried out to confirm the geological conditions across the development, normally be carried out post-consent and part of a pre-construction phase of works.	
Landfill	No	There is no evidence (current or historic) of landfill presence within the site boundary.	No
Karst Features	No	No recorded features within the vicinity of the site.	No
Radon	Yes	The site is within an area of low radon potential.	No

Hydrogeology

Aquifer Classifications

9.90 A review of the online data available on GSNI GeoIndex indicates the bedrock aquifer underlying the site is classified as Bm(f), denoting it has moderate productivity[8] and flow controlled by fracture networks within the rock with no intergranular flow.

9.91 The GSNI Groundwater Vulnerability Map indicates that groundwater at the site has a classification of 5 (very high). The vulnerability mapping (informed by the 1:250,000 scale geological mapping) indicates the areas classed as 5 are absent of superficial deposits inferring the basalt bedrock is exposed.

9.92 The groundwater body underlying the site is the Glenariff Groundwater Body which has an overall WFD status of “Good”. The overall status relates to both the quantitative and chemical (water quality) characteristics of the groundwater body.

9.93 There are no superficial aquifers mapped within the site boundary and there are not expected to be any unmapped potential aquifers present due to the absence of any superficial sand deposits within the boundary.

9.94 The nearest superficial aquifer is c. 1 km for the north west of the site, coinciding with the Glenarm River as in flows in Glenarm forest park.

Groundwater Recharge

9.95 Within the site boundary most recharge will be direct where bedrock is at or close to surface. A proportion of recharge through overlying till deposits may also occur, especially where the deposits are thin. Point source recharge may occur in a few karstic areas with run-off from basalt catchments discharging to the underlying chalk through swallow holes; however, no specific karstic features are mapped within the boundary.

9.96 The long-term average recharge rates are approximately 387 mm/a (for Bf(l) aquifers the actual recharge rate is likely to be limited and assumed to be 100 mm/a in calculations. Average rainfall is 1305 mm/a.

[8] Geological Survey Northern Ireland (2005) WFD Aquifer Classification Scheme for Northern Ireland. Available from https://www.daera-ni.gov.uk/

Groundwater Flow

9.97 Fracture flow with occasional localised conduit flow is dominant throughout the body although some intergranular flow occurs within the greensands. Flow paths are generally considered to be short (tens to hundreds of metres) with flow mainly towards the escarpment edge. Some flow may also be occurring westwards into the adjacent river basin district at times.

9.98 Discharge from the bedrock will mainly be to the local surface water network with potentially some limited discharge to the coast.

Springs

9.99 A review of the OSNI historical maps available from PRONI[9] and the Historical Map Viewer[10] indicated there are numerous historical springs within the site boundary and immediate vicinity. GSNI do not hold records of any springs within 1 km of the site boundary.

Boreholes

9.100 GSNI and MEABC confirmed that they do not hold records of any boreholes within 1 km of the site boundary.

Groundwater Abstractions

9.101 In order to identify potential groundwater users, data was sought from a number of sources. Findings from this is summarised as follows:

- NIEA Water Management Unit carried out a search of the Groundwater Monitoring Database. In their response received 14th November 2018, they advised they found no groundwater monitoring points within 5 km of the Site.
- NIEA Drinking Water Inspectorate confirmed in their response received 9th November 2018, there are no private drinking water supplies registered with the Inspectorate within 5 km of the Site under the Private Water Supplies Regulations (Northern Ireland) 2017. A copy of this correspondence is included in **Appendix 9.4**.
- Mid and East Antrim Borough Council (MEABC) was contacted with respect to information on private water supplies which supply single dwellings. In their consultation response received 19th June 2019 the Council advised that there are no Private Water Supplies located within the enquiry area surrounding the proposed development. MEABC also confirmed that information held by the Borough Council is limited and NIEA DWI / PWS team should be consulted. The response is included in **Appendix 9.4**.
- The DAERA Abstraction and Impoundment Licencing (AIL) information available on the Water Information Request Viewer identifies five licenced groundwater-fed

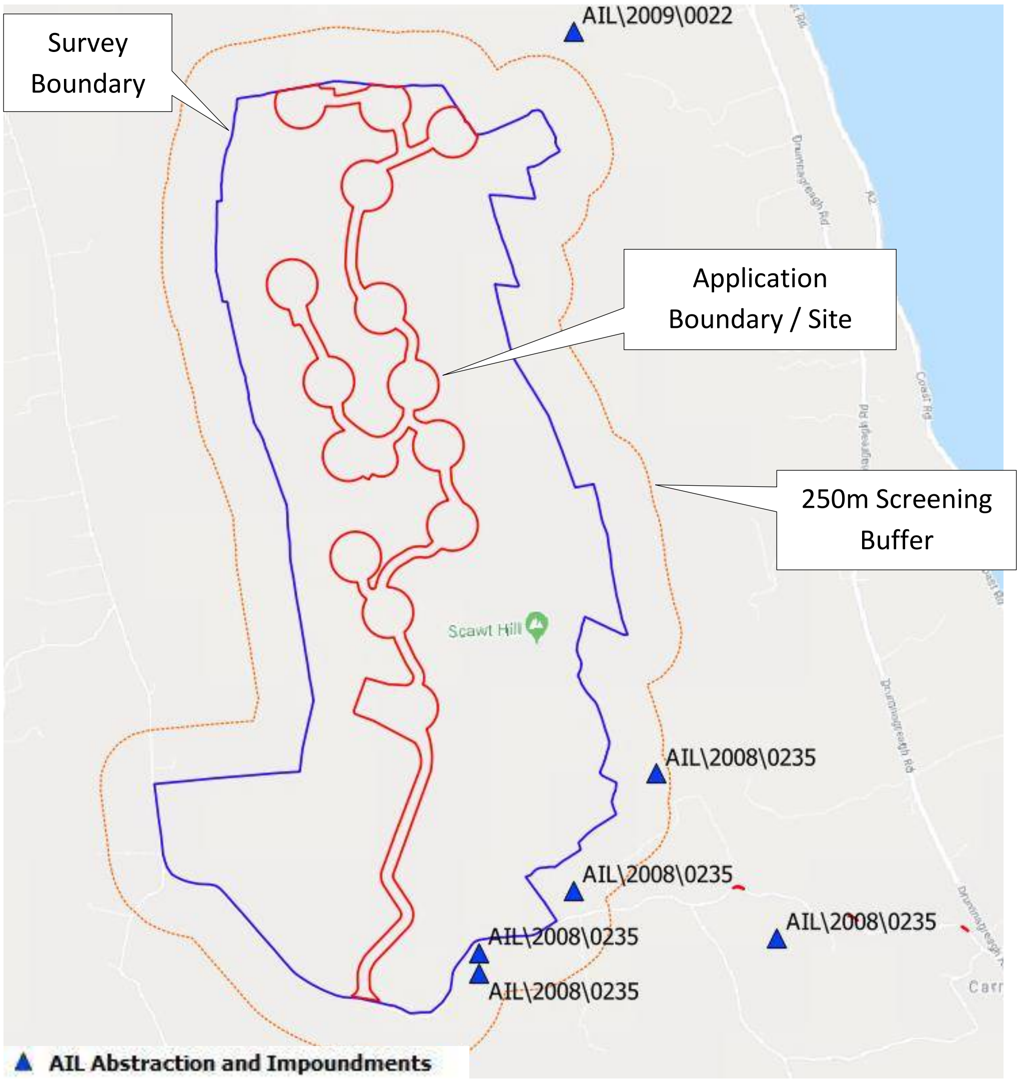
[9] PRONI Historical Maps. Available from https://apps2.spatialni.gov.uk/EduSocial/PRONIApplication/index.html

[10] Department for Communities Historical Environment Map Viewer. Available from https://dfcgis.maps.arcgis.com/apps/webappviewer/index.html?id=6887ca0873b446e39d2f82c80c8a9337

abstractions (AIL\2008\0235) on the lower slopes to the south on the site (outside the survey boundary) **Plate 9-5**. Each are denoted as groundwater abstractions for agriculture / livestock. A licenced spring-fed abstraction associated with hydro power (AIL\2009\0022) is located to the east of the proposed development on the hills above the A2 Coast Road, consistent with numerous springs recorded in the area on the historic mapping. NIEA guidance recommends applying 250 m buffer zone for a water feature used for drinking water (public or private). The potential abstraction location has been screened within a 250m buffer from the survey boundary extents, as shown on **Plate 9-5**.

9.102 Although abstractions are noted within the 250 m screening buffer from the survey boundary, no abstraction lies within 340 m of the application boundary, and as such, there is no potential to be affected by the proposed development.

Plate 9-6: Groundwater Abstraction Screening

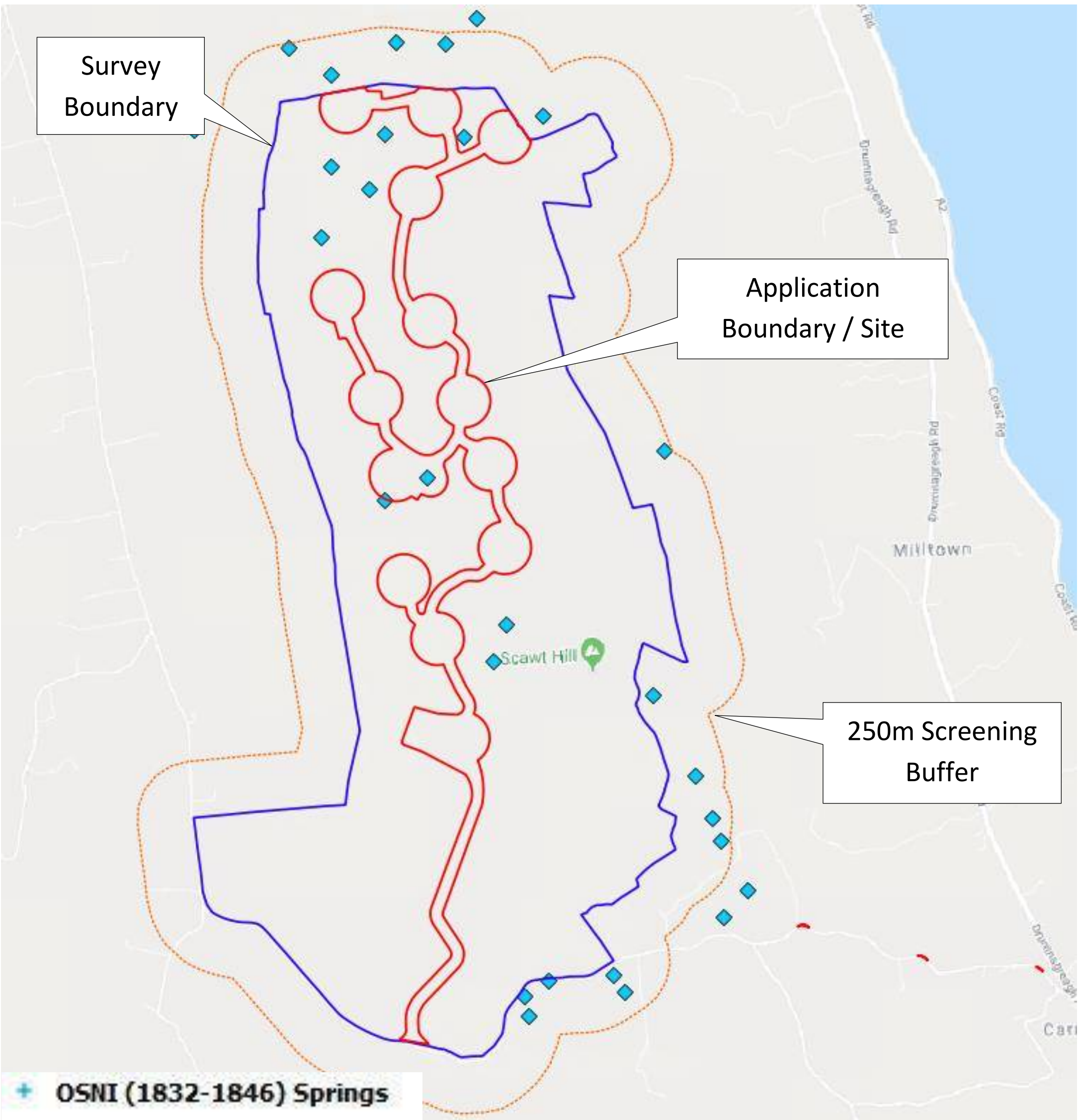


9.103 Mapping, including detailed Ordnance Survey mapping and historical mapping available through the Public Records Office (PRONI), was reviewed in order to identify present or historic mapped wells that may imply a current groundwater usage.

9.104 No wells were identified, although the historic mapping (OSNI 1832-1846) indicates numerous springs, including one denoted as 'underground', across much of the Site (**Plate 9-6**).

9.105 Presence of these receptors infers that groundwater is likely to be close to the surface across the Site. Their presence also informs sensitivity of the groundwater body and the subsequent assessment of effects and design of avoidance / mitigation.

Plate 9-7: Historic Springs identified from OSNI Historical First Edition (1832-1846)



9.106 In addition to identification of potential abstractions from records, the various consultees indicated that they do not hold a definitive database of individual properties served by a private water supply. In order to ensure a robust assessment, screening has been undertaken to identify properties potentially served by local, unrecorded water abstractions within the vicinity of the proposed development based on property and occupancy information determined by the applicant.

9.107 To a ensure a conservative assessment, a 500 m screening radius (i.e. 2 x NIEA Guidance) has been applied to the Site. Screened properties are shown on the following **Plate 9-7** and scheduled in

9.108 **Table** 9.12.

Plate 9-8: Property Screening

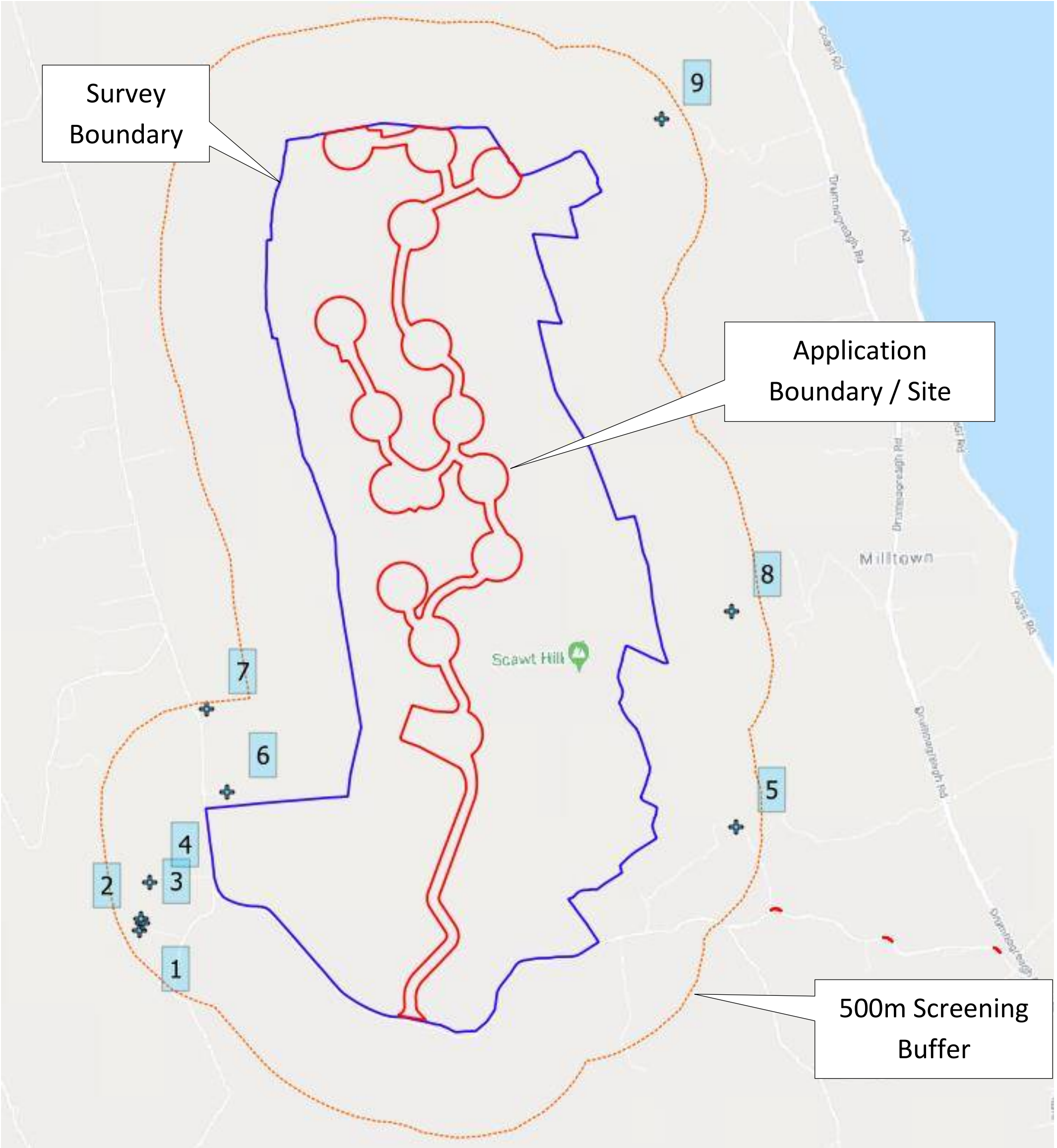


Table 9.12: Summary of Dwellings

Feature ID	Description	Significance and Rationale (for Scoping-out?)
1	Residential property	NI Water main present.
2	Residential property	NI Water main present.
3	Residential property	NI Water main present.
4	Residential property	NI Water main present.
5	Residential property	>1000m from nearest proposed turbine.
6	Residential property	NI Water main present.
7	Residential property	NI Water main present.
8	Residential property	>1000m from nearest proposed turbine.
9	Residential property	>800m from nearest proposed turbine.

9.109 The screening exercise confirms no additional properties downgradient from the application boundary that are likely to rely on private water supply abstractions; therefore, no private water supplies are likely to be affected by the proposed development.

Catchment Hydrology

Surface Water Bodies

9.110 DfI Rivers map of Designations approved by the Drainage Council (NI) indicate there are no designated watercourses within the site boundary. All watercourses within the application area are subject to riparian ownership and maintenance only.

9.111 Site reconnaissance observations indicate that the current hydrology of the site consists of a number of natural source watercourses and streams, and artificially modified drainage ditches and peat drains. The nature of the Site, which primarily occupies the ridge crest of a hill, means that there are no significant waterbodies on the upper site where development of wind turbines is proposed.

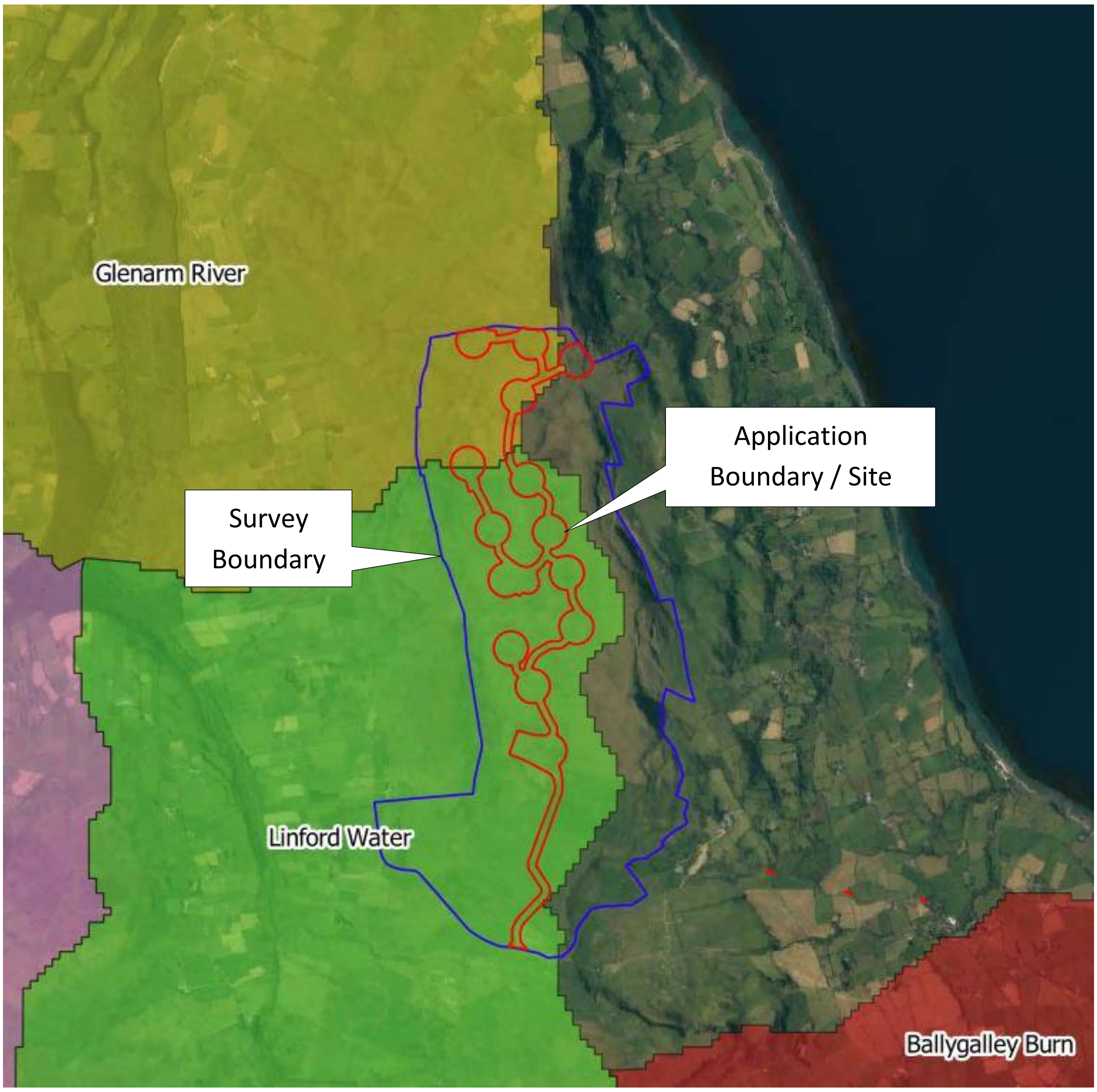
9.112 The hydrological regime of the site and discharge locations of onsite watercourses as determined by desktop studies and site walkovers are shown on Figure 9.1: Site Hydrology (included in Appendix 9.1).

9.113 NIEA River Water Body dataset boundaries show the site drains to two delineated and named waterbodies. The north and west of the site to Glenarm River water body (UKGBNI1NE040403012) which has an area of 24 km^2, and the south and west to the Linford Water (UKGBNI1NE040403048), with an area of 33 km^2. Much of the eastern side of the site drains over steep hillside and cliffs toward the coast via field drainage until it is culverted under the Coast Road to the Irish Sea.

9.114 Desktop catchment analysis, terrain models, and ground truthing, verified that all water features flowing from the north, west and south of the site, eventually, discharge to the

Glenarm River. Water flowing in an easterly direction from the survey boundary discharge to the North Channel (Irish Sea).

Plate 9-9: Watersheds and NIEA Waterbodies



9.115 Drainage within the site comprises headwaters of minor watercourse, field drains / ephemeral features. The more significant watercourses are sited at lower elevations to the south and west of the Site. Detailed site hydrology identified during site walkovers, tracing surveys, and desktop analysis of flow routes and catchments based on height data is shown on **Figure 9.1: Site Hydrology**.

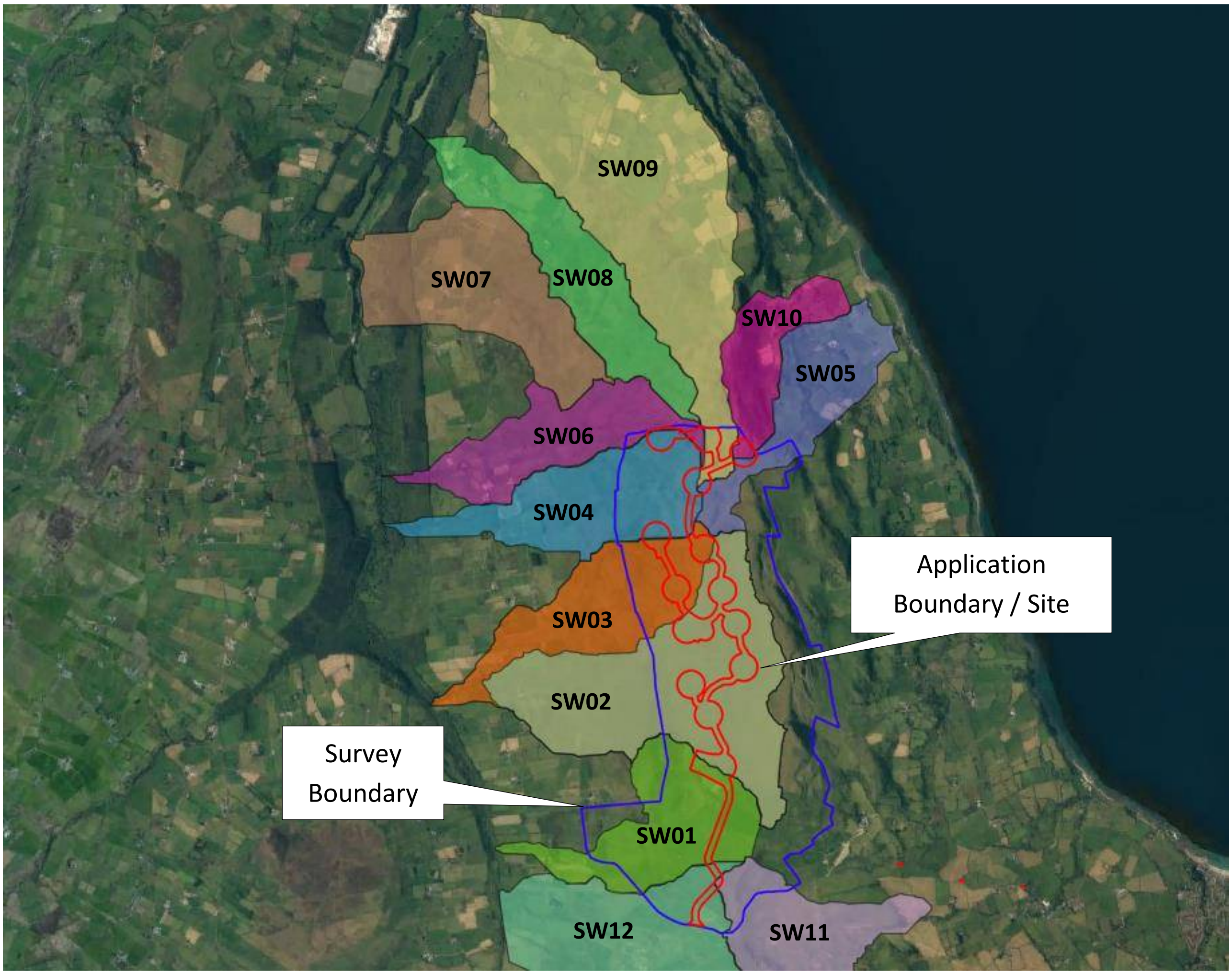
9.116 The area of lands within the Site comprises approximately 3.1% of the hydrological catchment of the Glenarm River and approximately 10.2% of the hydrological catchment of Linford Water.

Sub-catchments / Watersheds

9.117 For purposes of differentiation of effects and consistency with associated assessments (i.e. Chapter 8 – Fisheries), the hydrology in the areas where development is proposed is divided into twelve watercourse sub-catchments. Six drain to the west into the Linford

Water catchment (a tributary of Glenarm River), three drain in a north-west direction toward Glenarm River, and three drain east toward the North Channel of the Irish Sea.

Plate 9-10: Internal Catchments



Unnamed Tributary of Linford Water (Ref: SW01)

9.118 The Tributary of Linford Water has a catchment area of 1.31 km^2. The watercourse is little more than a ditch in the upper catchment but becomes more prominent as it reaches steeper ground where it develops into an incised channel (narrow channel with steeper banks) where erosion has exposed the underlying soils and superficial geology. It is crossed by access tracks and is piped under theses at several location.

Clady Burn (Ref: SW02)

9.119 The Clady Burn has a catchment area of 2.71 km^2. Within the site boundary, the upper reach of the watercourse is fed by three small discrete streams. Each of these are similar in characteristics. Their sources appear to be within the flatter boggy lands of the hill with little flow, becoming more defined as they enter the main channel which then discharges into the Feystown Burn c. 1.4 km west of the site boundary.

Feystown Burn (Ref: SW03)

9.120 The Feystown Burn has a catchment area of 1.31 km^2. The Feystown Burn and Clady Burn meeting a short distance upstream from their confluence with Linford Water. The upper section of the watercourse is a very narrow drainage channel through rough grassland, becoming more established as it reaches the flatter farmland, flowing under Feystown Road.

Southern Tributary of Glenarm River (Ref: SW04)

9.121 The Southern Tributary of Glenarm River has a catchment area of 1.44 km^2. It has several smaller (ephemeral) channels feeding it within the upper reaches. These meander through the undulating topography, but the channel itself remains relatively narrow, widening and becoming more established as it reaches, and passes under, Feystown Road c. 800 m west of the site boundary.

Unnamed Watercourses (Ref: SW05 & SW10)

9.122 These unnamed watercourses have catchment areas of 1.07 km^2 and 0.74 km^2. They flow east towards the Irish Sea coast. Thick grasses and mossy water-logged land characterise their source / upper catchments. Further downstream, channels become more defined, albeit still largely grass-covered. The lower reaches are confined to field boundary drainage until the watercourse discharges to the sea under the A2 Coast Road.

Unnamed Tributary #1 (of Glenarm River) (Ref: SW06)

9.123 This unnamed tributary of Glenarm River has a catchment area of 1.17 km^2. It drains a small section of land (c. 0.16 km^2) within the northern extent of the proposed development boundary. Sections of the upper reaches are narrow with cobble and stone-sized materials evident in the channels. The watercourse is culverted via a concrete pipe at an existing access track. Surrounding land is rough grazing / uncultivated grasses.

Unnamed Tributaries #2 & #3 (of Glenarm River) (Ref: SW07 & SW08)

9.124 These watercourses are separated from the proposed development boundary by the upper reaches of their neighbouring catchments (SW06 to the west and SW09 to the east). Although not directly connected to the proposed development, combined they drain a substantial section of the northern slopes of Scawt Hill / Black Hill that discharges to Glenarm River; so are considered here for completeness.

9.125 Like the other watercourses of the site, their upper reaches / sources are within relatively flat boggy areas of thick grasses. The channels become more established downstream, with evidence of stone and cobbled-sized materials. They are culverted under existing access tracks via plastic pipes.

Unnamed Tributary #4 (of Glenarm River) (Ref: SW09)

9.126 The Unnamed Tributary of Glenarm River has a catchment area of 3.68 km^2. A small section of the upper catchment (c. 0.36 km^2) is within the Site. In this area the watercourse flows predominantly over rough grasses. It is slow moving (appearing as standing water) at discrete depressions in the land. Some of these locations appear to have had stone material imported, possible to improve underfoot conditions for hillwalkers. On steeper downstream sections the watercourse appears ephemeral as a dry, but clearly defined, channel on the hillside.

Unnamed Watercourses (Ref: SW11 & SW12)

9.127 These unnamed watercourses are marginally encroached by the proposed development boundary. SW11 has an overall catchment area of 1.3 km^2 of which only 0.008 km^2 is located within the proposed development boundary. SW12 has an overall catchment area of 4.4 km^2, or which 0.07 km^2 is located within the proposed development boundary.

9.128 Within the proposed development boundary, the watercourses are little more than heavy vegetated depressions with some pronounced channels forming ditches around field boundaries.

Off-site Unnamed Watercourses

9.129 The construction of passing areas and road widening for abnormal long vehicles are to be located within the unnamed catchment between Linford Water to the west and Ballygalley Burn to the south. The catchment is drained by several unnamed minor watercourses whose confluence is located upstream of Halfway House Hotel on Coast Road, before discharging to the Irish Sea (North Channel). The catchment has not been assigned a WFD status.

9.130 One passing place (situated 1.7 km east of the site access) is located c. 40 m from a minor watercourse and will, therefore, be subject to good practice (in proximity to watercourses) during construction as outlined in the following sections.

9.131 The proposed haul route development will not affect existing conditions of the water environment is not considered further. Further details of the proposed haul route are provided in **Chapter 11: Transport & Traffic**

Surface Water Quality

9.132 The following section is intended to provide a qualitative appraisal of existing surface water quality in those catchments the proposed development lies within.

9.133 Following the publication of the Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015, waterbodies are given a classification based on annual average / percentile results from several individual monitoring stations.

9.134 The WFD classification is a combination of chemical, biological and hydromorphological elements; whereby, the overall status is the lowest of the combined constituents.

9.135 Approximately 35% of the Site is located within the Glenarm River catchment, approximately 42% in the Linford Water catchment (ultimately discharging into the Glenarm River), and the remainder discharges via the steep east-facing slopes toward the North Channel (Irish Sea).

Table 9.13: River Water Body Status

River Waterbody	2018 Status	2021 Target	2027 Target
Glenarm River (UKGBNI1NE040403012)	Good	Good	Good
Linford Water (UKGBNI1NE040403048)	Good	Good	Good
Irish Sea (North Channel) (UKGBNI6NE030)	Good	Good	Good

9.136 NIEA Water Management Unit were consulted for surface water quality monitoring station sites and data (from 2009 onwards) within a 5 km radius of the site. The below table provides a summary of the information provided on the monitoring sites. The complete consultation response, including raw chemical and biological data, is included in **Appendix 9.4**. Each of the above is contained within the Glens and Rathlin Local Management Area.

9.137 Linford and Glenarm Rivers were designated under the WFD as Freshwater Fish Directive protected areas due to the presence of economically significant species. The Directive 2006/44/EC has since been revoked, however NIEA:WMU continues to recognise them as protected areas containing economically significant species.

Table 9.14: NIEA WMU Water Quality Classification

River Water Body ID	Location	Local Management Area	Sitecode	Monitoring Station	Overall NI Site Class 2018	River Waterbody Class 2018
GBNI1NB030308214	Braid River (Aghacully)	Braid and Main	F10189	Braid River at Aghacully Bridge	Good	Good
GBNI1NE040403011	Ballygalley Burn	Glens and Rathlin	F11211	Ballygally Burn at Carncastle Road Bridge	Moderate	Moderate
GBNI1NE040403012	Glenarm River	Glens and Rathlin	F10479	Gelnarm River at Glenarm	Good	Good
GBNI1NE040403045	Owencloghy Water	Glens and Rathlin	F10470	Owencloghy Water at Mill Bridge	Good	Good
GBNI1NE040403048	Linford Water	Glens and Rathlin	F11310	Linford Water off Aughaboy Road	Good	Good
GBNI1NE040403061	Glencloy River	Glens and Rathlin	F10478	Glencloy Road at Glencloy Bridge	Good	Good

Project Specific Water Quality Assessment

9.138 In addition to a review of water quality data held by statutory bodies, independent water quality monitoring has been undertaken as part of this assessment to provide baseline water quality standards of water features within the application boundary prior to any development.

9.139 Sampling was carried out in November 2018. The prevailing weather conditions on the day of sampling were dry and sunny. The baseline assessment collected and assessed representative water samples from watercourses draining the site for a range of physio-chemical parameters. Monitoring locations are shown on **Figure 9.3**.

9.140 Water quality results were assessed for compliance against key parameter limits outlined in the Water Framework Directive (2000/60/EC), transposed in Northern Ireland through the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017, and the Directive 2013/39/EU is transposed through the Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015. In terms of the key indicators of water quality and / or pre-existing pollutants, chemical results obtained showed:

- pH results were within the naturally excepted range and classified 'Good', based on WFD standards for this parameter;
- Dissolved oxygen levels are classified as 'High' under the WFD;
- Orthophosphate levels were below the LOD at all sample locations;
- BOD results signified 'High' water quality in all locations based on WFD classifications;
- Alkalinity concentrations and topography characteristics classed the site as 'upland and low alkalinity';
- Ammoniacal Nitrogen concentrations ranged from 'Good' to 'Moderate'.

9.141 Water quality for watercourses draining the Site is generally consistent with the WFD status of Good for the downstream waterbody outlined previously. Therefore, preservation of the baseline water quality results within the upper reaches would be important at a local level to preserve the downstream NIEA classifications.

Surface Water Abstractions

9.142 In order to allow assessment of potential for the proposed development to affect surface water abstractions in the catchment at and up to 5 km downstream of the site, an initial screening review of the NIEA WMU Water Information Request Viewer[11] was carried out.

9.143 Two surface water abstractions are located within the vicinity of the proposed development: 1 no. associated with Fish Farms & Hatcheries (AIL\2007\0110) 1.7 km west of the Site on the Glenarm River, and a hydro power abstraction on the Linford Water (AIL\2009\0036) c. 1 km upstream from the confluence with the Owencloghy Water.

Northern Ireland Water Infrastructure

9.144 A review of Northern Ireland Water asset information did not identify any infrastructure (i.e. waste-water treatment works, intakes, reservoirs etc.) within 5 km of the proposed development. No raw or treated water infrastructure is sited within the Site.

[11] Water Information Request Viewer. Available at: https://www.daera-ni.gov.uk/articles/information-requests

Flood Risk

9.145 The proposed development was assessed in relation to Flood Maps (NI) and similar DfI Rivers datasets, which provide an indication of predicted flood extents for a 1% Annual Equivalent Probability (AEP) fluvial flood and 0.5% AEP Surface Water Flood, and for reservoir inundation. DfI Rivers have also been consulted regarding flooding; the response (Ref: IN1-19-254) is included in Appendix 9.4.

Historical Flood Extents

9.146 Flood Maps (NI) indicates no recorded incidents of historic flooding in the vicinity of the site.

Fluvial Flooding

9.147 Out of bank flooding from the upper reaches of several watercourses draining from the survey boundary toward the Glenarm River and Linford Water catchments are identified on the Flood Maps (NI) indicative predicted 1 % AEP fluvial (river) flood extents.

Pluvial Flooding

9.148 Small areas of surface water flooding are predicted by the indicative 0.5 % AEP surface water flood extent mapping at a limited number of discrete locations within the survey boundary, and generally coincide with the headwaters of watercourses.

9.149 Surface water flooding would not constrain development but would inform design of the infrastructure with a view to ensuring that surface water flow paths are maintained, and a suitable standard of protection if afforded to any development adjacent to areas predicted to be affected by flooding.

Reservoir Flooding

9.150 The risk of reservoir flooding was assessed using Reservoir Flood Mapping for Emergency Planning[12], which shows the indicative area that may flood from an uncontrolled release of water from all possible dam failure scenarios.

9.151 No flooding from these sources are identified in the vicinity of the proposed development.

Summary

9.152 Flood extents are shown on **Figure 9.1: Site Hydrology**. Mitigation of flood risk is described in subsequent sections and is addressed in detailed in **Appendix 9.2 - Flood Risk & Drainage Assessment** in the format normally requested by DfI Rivers in consultation.

[12] DfI Rivers (2017) Reservoir Flood Mapping for Emergency Planning. Available at http://riversagency.maps.arcgis.com/apps/webappviewer/index.html?id=006872dcdd7b43b89d352e0b93190e67. Accessed 12/06/2019

Eco-Hydrology & Water Dependent Habitats / Species

9.153 Consideration has been given to local surface water and groundwater dependent ecosystems and habitats dependent on, or prone to change due to variation in, surface water and groundwater patterns on the Site within **Chapter 6: Ecology**. No further consideration is given to those aspects within this chapter.

Fisheries

9.154 Detailed consideration has been given to fisheries on and downstream of the Site within **Chapter 8: Fisheries and Aquatic Ecology**.

9.155 That assessment, when considered a wider survey boundary, has determined that:

- Stream SW01 (termed in the Fisheries Assessment as Linford Water tributary 1): Trout present at GOOD abundance at Site boundary and downstream reaches including Linford Water.
- Stream SW02 (termed in the Fisheries Assessment as Clady Burn): Trout present at FAIR abundance with pre-spawning fish in good numbers.
- Stream SW03 (termed in the Fisheries Assessment as Feystown Burn): Though no fry present, pre-spawning/ older trout present in excellent numbers downstream of Site boundary.
- Stream SW04 (termed in the Fisheries Assessment as Glenarm tributary 1): No fish present, with stream becoming too shallow/ narrow at Site boundary.
- Stream SW06 (termed in the Fisheries Assessment as Glenarm tributary 2): No fish present, with possible barrier to upstream migration at Feystown Road.
- Stream SW08 (termed in the Fisheries Assessment as Glenarm tributary 3): No fish present.
- Stream SW09 (termed in the Fisheries Assessment as Glenarm tributary 4): No fish present.
- Linford Water main channel: Trout present in main channel with excellent abundance of pre-spawners. Potential Lamprey spp.
- Main Glenarm River: Salmon present at Good-Excellent abundance, with key spawning and nursery areas present where tributary streams draining the Site inflow.

9.156 The Fisheries Assessment confirms that there are no fish present, or potential fishery habitat, on the watercourse reaches within the Site in areas proximal to the proposed development.

Aquaculture

9.157 DAERA Fisheries Inspectorate confirmed no aquaculture sites in the vicinity of the proposed development and, therefore, is not considered further in this assessment.

Water Framework Directive - Fisheries Classification

9.158 Glenarm River and Linford Water were given status under the now revoked Directive 2006/44/EC 'on the quality of fresh waters needing protection or improvement in order to support fish life'; more commonly known as the Freshwater Fish Directive.

9.159 NIEA Water Management Unit data, on the NIEA River Basin Planning Mapviewer[13] designates these watercourses as protected areas containing economically significant species.

Designated Sites

9.160 Designated sites such as; Special Areas of Conservation (SAC), Special Protected Areas (SPA), Areas of Special Scientific Interest (ASSI), and similarly designated environmental receptors, have been identified as part of this assessment. Sites were identified utilising the datasets available on the NIEA Natural Environment Map Viewer and Join Nature Conservation Committee[14] website and were screened to identify:

- Terrestrial sites of geological importance on or immediately adjacent to the proposed development;
- Hydrological sites with sensitivities to the water environment that are connected to the proposed development, i.e. sites which lie in the upstream catchment of or are on downstream streamlines of the watercourses draining the proposed development;

9.161 Only sites meeting these criteria are discussed further in this assessment. Terrestrial sites with ground or surface water-dependent habitats are considered in **Chapter 6: Ecology.** Terrestrial sites with water-related reliance for birds are not considered further within this assessment and are considered in **Chapter 7: Ornithology**.

13 NIEA River Basin Viewer. Available at https://appsd.daera-ni.gov.uk/RiverBasinViewer/

14 Joint Nature Conversation Committee (2016) Protected Sites. Available at: http://jncc.defra.gov.uk/page-4. Accessed 03/07/2018

Table 9.15: Initial Screening of Geology / Water related Designated Sites

Name	Designation	Reason for designation and qualifying features relevant to this assessment	Distance from survey boundary at nearest point (km)	Considered further and rationale.
Scawt Hill ASSI	ASSI (ASSI083)	The summit of Scawt Hill marks the outcrop of an olivine dolerite plug, which intrudes the Cretaceous White Limestone and overlying Tertiary lavas of the Lower Basalt Formation. High temperature and low-pressure thermal metamorphism produced unusual calc-silicate mineral assemblages. A remarkable series of minerals have resulted, many rare and some described for the first time.	Located within survey boundary.	Yes: Important site for Earth Sciences
Linford ASSI	ASSI (ASSI341)	Linford contains excellent examples of surface karst[15] features not usually seen on the age of rocks found in the site.	150 m south	Yes: Important site for Earth Sciences
Knock Dhu and Sallagh Braes ASSI	ASSI	Knock Dhu and Sallagh Braes has been declared an ASSI because of the variety of earth science features (large, semi-circular cliff at Sallagh Braes notable for huge landslips as a result of the geology and the glacial history of the site), habitats and species that the site supports.	260 m south	No: No proposed works associated with the proposed development will affect the earth science features, habitats and species for which the site is designated.
Glenarm Woods ASSI	ASSI	The area is of special scientific interest because of its woodland flora and fauna, in addition to the physical features of the river and its associated riverine flora and fauna.	770 m west	Yes: Proposed development is located upstream and is, therefore, hydrologically connected, to the ASSI via surface water. Also considered in Chapter 6: Ecology

[15] Karst is a term used for the distinctive features that form through the interaction of water and limestone. Rain and flowing water can dissolve the rock to create the distinctive landforms.

Name	Designation	Reason for designation and qualifying features relevant to this assessment	Distance from survey boundary at nearest point (km)	Considered further and rationale.
Glenarm Woods Part 2 ASSI	ASSI	Glenarm Woods Part 2 has been declared an ASSI because of its wood pasture habitat and associated species. The site is part of the Glenarm demesne, which can be traced back to the 17th century.	1 km west	Yes: Proposed development is located upstream and is, therefore, hydrologically connected, to the ASSI via surface water. Considered in Chapter 6: Ecology
The Maidens SAC and ASSI	ASSI and Special Area of Conservation	Marine Sandbanks / Reef noted as being susceptible to the effects of diffuse pollution	Approx. 15 km	No: The site lies approximately 10 km offshore in the North Channel from the mouth of the Glenarm River; it is therefore considered that development of a scale associated with wind farm construction and operation could not feasibly affect the designated site and thus requires no further consideration within this assessment.

Scawt Hill ASSI

9.162 The summit of Scawt Hill marks the outcrop of an olivine dolerite plug which intrudes the Cretaceous Ulster White Limestone and overlying Tertiary lavas of the Lower Basalt Formation. High temperature and low-pressure thermal metamorphism at the plug contacts has produced unusual calc-silicate mineral assemblages in the limestone, and assimilation of the carbonate rock has produced a sequence of alkali basic igneous rocks just inside the old volcanic conduit. A remarkable series of minerals have resulted, many rare and some described for the first time.

9.163 When declaring the site an ASSI, the Department of the Environment (DoE now DAREA) highlighted that activities likely to damage the flora and geological features of the area included:

- Any activity or operation which involves the damage or disturbance by any means of the surface and subsurface of the land, including ploughing, rotovating, harrowing, reclamation and extraction of minerals, including sand, gravel and peat.

- Construction, removal or disturbance of any permanent or temporary structure including building, engineering or other operations.
- The storage or dumping, spreading or discharge of any material. 4. Alteration of natural or man-made features, the clearance of boulders or stones and grading of rock faces.
- Any activity or operation which involves the damage or disturbance by any means of the surface and subsurface of the land, including ploughing, rotovating, harrowing, reclamation and extraction of minerals, including sand, gravel and peat.
- The destruction, displacement, removal or cutting of any plant, seed or plant remains, other than plants listed as being noxious in the Noxious Weeds (NI) Order 1977.
- Use of vehicles or craft likely to damage the interest of the area.

9.164 Continued use of the site for agricultural activities would be encouraged provided no damaging activities are undertaken without consent, the needs of owners, occupiers and the Department (overseeing environment / heritage) can be met. Specific objectives would include retaining the geological series in an undamaged state and retaining access to the geological series.

Linford ASSI

9.165 The area is of special scientific interest because of its important physiographical features. Linford is of national importance as it contains surface karst landforms that have developed on the Cretaceous age Ulster White Limestone Formation. It is understood that surface water flow enters the site from the south and disappears into a number of active or partly active sinkholes. Flow is then underground before re-emerging some 400 m to the west to join another water course.

9.166 Specific objectives include:

- Retain all karst features and the processes that have formed them through sympathetic land management practices.
- Discourage the disposal of waste of any type within the site.
- Maintain the physiographical series in an undamaged state.
- Maintain access to the physiographical series.

Glenarm Woods ASSI

9.167 The area is of special scientific interest because of its woodland flora and fauna, in addition to the physical features of the river and its associated riverine flora and fauna (including Linford Water). These rivers have a natural and complex flow sequence reflecting their physical structure, with a mixture of runs, riffles, glides and pools along some sections, and more dynamic but localised rapids, cascades and waterfalls in others.

9.168 When declaring the site an ASSI, the Department of the Environment (DoE now DAREA) highlighted that activities likely to damage the flora and physiographical features of the area included, inter alia:

- Construction, removal or disturbance of any permanent or temporary structure including building, engineering or other operations.
- Operations or activities which would affect wetlands (including marsh, fen, rivers, streams and open water), e.g.
    - change in the methods or frequency of routine drainage maintenance;
    - modification to the structure of any watercourse;
    - lowering of the water-table, permanently or temporarily;
    - change in the management of bank-side vegetation.

Baseline Summary and Receptor Sensitivities

9.169 The baseline assessment identified the receptors which have the potential to demonstrate a sensitivity to the proposed development; the receptors and their scale / sensitivity value are summarised in **Table 9.16**. Sensitivity is based on the baseline assessment and determined in accordance with the rationale previously described in **Table 9.5**.

Table 9.16: Receptor Sensitivity

Type	Receptor	Scale / Sensitivity	Rational
Geological	Soils / Drift Deposits	Local / Low	Site with little geological value or of widespread local abundance. Loss of the land on the Site would not be considered significant in the context of the region.
	Scawt Hill ASSI	National / High	The area exhibits a remarkable series of minerals have resulted, many rare and some described for the first time.
	Linford ASSI	National and / or High	Linford contains excellent examples of surface karst features not usually seen on the age of rocks found in the site.
Hydrological	On-site significant watercourses	Local / Low	Clady Burn / Feystown Burn and the unnamed tributaries of Linford Water and Glenarm River - the fisheries assessment has confirmed the watercourse to be insignificant in terms of fisheries in the upper reaches. There are no other significant pressures on or users of the watercourse. No fluvial flooding is predicted, although surface water flooding is predicted coinciding with watercourse channels.
	On-site Minor Drainage	Local / Low	All other on-site watercourses are generally characterised by vegetated overgrown field drains / cut peat drainage / trackside drainage and have low fisheries and other ecological potential and have no other use of significant value.

Type	Receptor	Scale / Sensitivity	Rational
	Linford Water & Glenarm River	National / High	The Glenarm River and Linford Water receive all runoff from the site and are classified as having ‘Good’ status under the WFD and due to presence of Atlantic salmon.
	Glenarm ASSI	National / High	The morphological character of the watercourses included within the designation of Glenarm Woods ASSI may be affected by potential changes in flow regimes of watercourses connected to (hydrologically) to the proposed development.
Hydro-Geological	Private Water Supply	Local / Low	Domestic private water supplies and potential water supplies have been identified within a screening distance from the Site.
	Bedrock Groundwater / Aquifers	Local / Low	Aquifer with limited productivity and no significant abstractions. Potential for discrete local supply sources WFD Status of “Good”
	Shallow Groundwater / potential superficial Aquifers	Local / Low	No substantial superficial aquifers present at the site.
Terrestrial	The Proposed Development	Local / Low	Proposed infrastructure prone to damage including potential for water damage of electrical infrastructure in a flood event; potential for structural damage of access infrastructure in the event of hydraulic incapacity.
	Buildings	Local / Low	The Site is shown to be within the radon affected area. Any buildings located within this area would be subject to inclusion of protection measures.

Predicted Environmental Effects

Preamble

9.170 This section outlines and describes the potential likely effects of the proposed development on hydrological patterns and water quality on the site, and in the downstream environment, that have the potential to arise in the absence of mitigation. The following phases of the proposed development are considered;

- Windfarm construction;
- Windfarm operation and maintenance;
- Wind farm decommissioning

9.171 During each phase, some of the activities undertaken have the potential to modify hydrological regimes and affect water quality on the site and the downstream environment. Due to the nature of the site and work undertaken, the hazards and associated effects will be similar for each phase; with an increased likelihood during the construction phase.

Components Contributing to Predicted Environmental Effects

Activities Associated with Construction, Operation and Decommissioning

9.172 During construction, the proposed development comprises construction of infrastructure which would be likely to cause change to local hydrology and water quality, comprising earthworks, plant movements with associated use of lubricants and fuel oils, spoil handling and placement of aggregates and cementitious materials, and dewatering associated with construction of temporary compounds, turbine foundations, building foundations, access tracks, and cable trenches.

9.173 The operational phase of the proposed development (the designed operating life estimated to be 30 years) would cause runoff from access tracks, turbine bases and hard standings via drainage features, would require onsite welfare facilities with associated waste, and potentially necessitate storage and use of oils, fuels and lubricants on-site, each with the potential to cause adverse effects on the environment without adequate avoidance, design, or mitigation measures.

9.174 Activities associated with the decommissioning phase at the end of the operating design life are generally as per those for the construction phase i.e. earthworks, plant movements with associated use of lubricants and fuel oils, spoil handling and placement of aggregates and cementitious materials, and dewatering associated with removal of turbines, buildings, hard standing areas and buried structures followed by reinstatement and restoration of ground cover.

Likely Significant Effects

9.175 The likely effects of the proposed development on the surface and ground water environment prior to any avoidance, careful design, or additional mitigation are summarised in the following sections.

Changes in Runoff and Flow Patterns

9.176 New temporary and permanent impermeable surfaces, as well as temporary compaction of soils due to construction phase plant and site traffic movements, may cause increased rate and volume of surface water runoff due to the reduced permeable area on the Site through which rainfall can infiltrate. Impermeable surfaces will cause an increased "flashy" response to rainfall events, with increased water velocities in new and existing drainage features. As a consequence, the effect would be likely to cause temporary or permanent increases in surface water runoff rates and volumes, leading to increased flood risk and increased effects of erosion and scour in downstream watercourses. Similarly, loss of permeable areas is likely to cause reduced potential for groundwater recharge affecting aquifers.

9.177 Significant excavations, in particular linear works such as access tracks, drainage ditches and cable trenches, are likely to act as barriers to runoff resulting in ponding, or development of preferential flow routes, diverting surface water away from its current route. Consequently, temporarily or permanently redirected surface water flows may starve areas where water currently flows, or cause flooding of areas where water currently does not flow.

9.178 Works to existing surface watercourses (such as installation of culverts) have the potential to cause an obstruction to flows and may alter conveyance capacities, potentially causing temporary or permanent restrictions in watercourse channels, affecting upstream water levels and increasing flood risk.

Changes to Water Quality

Sediment / Suspended Pollution

9.179 Temporary activities required to construct windfarm infrastructure would require excavations, ground disturbance (due to excavations and plant and vehicle movements), stripping and excavation of peat and soils, and temporary spoil deposition. Exposed soils have potential to release fine sediments in surface water runoff or where excavations come in contact with surface watercourses.

9.180 Construction of hardstanding areas and access tracks would require importing, handling and placement of aggregate; which would have the potential to release fine sediments into surface water runoff. The proximity of such works to a surface watercourse will increase the risk of pollution to the wider water environment.

9.181 Temporary surface water or shallow groundwater gathering in significant excavations has the potential to be significantly polluted due to contact with excavated surfaces and aggregates. Discharge of intercepted contaminated groundwater during passive or active dewatering has the potential to pollute the wider water environment if not disposed of correctly.

9.182 Silt and suspended sediments and debris entering watercourses would have the potential to adversely modify stream morphologies, smother habitats and harm aquatic flora and fauna.

Chemical Pollution of Surface Water and Groundwater

9.183 Temporary storage and use onsite use of chemicals, fuels and oils associated with construction activities, and use of wet concrete and other cementitious material, may result in potentially harmful substances entering the water environment. Possible pathways to hydrological receptors may include; accidental spillages, improper transport and refuelling, or inappropriate storage and disposal procedures, by gradual leakage or single failure of storage tanks or refuelling mechanisms. Temporary presence of alum-based flocculants (used to remove suspended solids from surface water) has the potential to enter surface waters if unregulated.

9.184 During the operational phase of the proposed development, the permanent presence of oils and lubricants associated with turbine maintenance has a similar potential to enter and pollution the water environment.

9.185 Wastewater effluent from temporary construction phase welfare facilities and permanent substation building welfare facilities has the potential to enter surface water or shallow groundwater.

9.186 As a consequence, chemical pollutants from construction activities, storage of materials, or from coliforms from wastewater entering watercourses have the potential to adversely affect water quality, with associated effects to potable supplies, fish and aquatic ecology.

Design Evolution: Constraints and Avoidance Measures

9.187 The magnitude and significance of those effects determined as being likely to be a consequence of the proposed development can be substantially reduced or eliminated through a proactive design approach to avoid identified baseline receptors, with particular emphasis in relation to fishery habitats.

9.188 This section identifies the avoidance measures imposed and outlines the resulting magnitude and significance of residual effects. Additional mitigation is then specified to further reduce or eliminate remaining residual effects.

9.189 Detail of the design evolution highlighting considerations made with regards to hydrology and water quality management is presented in **Chapter 3: Design Evolution & Alternatives**.

9.190 The proposed development layout has evolved so that the design avoids conflict with the water and geology environment, as demonstrated in the following sections.

Water Features

9.191 As a precautionary measure and in accordance with the guidance previously advocated by NIEA Natural Environment Division, buffer (exclusion) zones to valuable water features are adopted as constraints to built development, and for incorporation as a construction buffer in relation to permissible land uses in proximity to watercourses.

9.192 Impact avoidance and design of mitigation have been developed in accordance with legislation and best practice guidance outlined in **Table 9.1** and paragraphs **9.32** and **9.33**, respectively. Mitigation for all water features aims to preserve existing water quality ratings as a minimum.

9.193 Establishment of intact vegetated buffer zones between infrastructure and water features allows:

- Protection of water quality by filtering runoff within riparian vegetation before it enters the watercourse;
- Space for natural fluvial processes such as channel shape and planform adjustment which help restore and maintain the natural dynamic balance of river systems and associated habitats;
- Establishment of vegetation to stabilise banks and reduce soil erosion;
- Access for the maintenance and inspection of watercourses and for dealing with any residual risk of pollution incidents; and
- Habitat for plants and animals to form part of a habitat network.

9.194 The sensitivity of the water feature and the associated degree of protection it is therefore afforded, is primarily dependent on;

- Environmental designations on the water feature or downstream environment;
- Fisheries or ecological potential in the water feature or in the downstream environment;
- Water feature morphology (natural substrate or artificial channel, soil/ground type);
- Water feature size, capacity to convey water and hydrological potential (flows) – proportionate to the size of the catchment drained by the water feature;
- Nature and topography of the surrounding land, i.e. wet, poorly drained soils and steep slopes (>10°) would require greater protection;
- Sensitivity of the water feature to particular types of pollution, i.e. silts / nutrient enrichment / chemical pollution.

9.195 The rationale adopted in relation to water feature buffers is informed by NIEA Natural Environment Division guidance, which has typically in response to similar development advised no infill, disturbance, construction activity or storage of materials within 50 m of natural watercourses. NIEA has indicated that justification for buffer zones applied is the responsibility on the Applicant, while any rationale for reducing the scale of the buffer zone must be demonstrated requiring the submission of detailed information using a number of additional factors e.g. soil typology, topography, size of watercourse and climatic conditions.

9.196 NIEA, in Practice Guide to EIA and Planning Considerations, outlines buffer zones for water features as per the below table;

Table 9.17: NIEA Buffer Zones for Water Features

Width of Watercourse	Width of Buffer Strip
Surface Watercourse	10 m (minimum detailed in GGP 5)
Water Feature (surface watercourse, spring, well, borehole used for Drinking Water – public or private)	250 m
Water Feature (surface watercourse, spring, well, borehole not used for water supply – but could provide preferential flow pathway)	50 m
Designated Wetland	250 m

9.197 Additional industry guidance relevant and similar in nature to the construction and operational activities for the proposed development has been reviewed and taken into account:

- Guidance for Pollution Prevention (GPPs): GGP5-Works and Maintenance in or near water;
- Pollution Prevention Guidance (PPGs);

- Best practice in relation to forestry works (in particular on upland and peat sites) recommends riparian buffer reflecting stream size, with buffers from 5 –20 m;
- Best practice in management of sediments and runoff from exposed ground in relation to agriculture recommends buffers of up to 10 m in order to protect surface waters from pollution by suspended solids, and nutrient enrichment by organic/inorganic fertilisers.

9.198 Water features considered significant for the purposes of the proposed development are shown on **Figure 9.1** and drainage drawings within **Appendix 9.1: Water Framework Directive Assessment.**

9.199 Significance has been determined following a desktop studies and verified by site walkovers, with all streamlines subject to catchment and flow analysis by GIS -flow-raster accumulation analysis.

Significant watercourses

9.200 Significant watercourses identified and requiring application of a buffer to the proposed turbines and infrastructure are largely as per OS close scale vector mapping and were subject to ground truthing on Site.

9.201 A 50 m buffer has been applied to the significant watercourses identified in the baseline assessment, i.e. significant where catchment within Site is >0.25 km^2. “Significant” watercourses located within the Site are SW01 and SW02 **(Figure 9.1)**.

9.202 Examples of the significant watercourses on the site are shown on the following **Plate 9-9**.

Plate 9-11: Significant Watercourse Examples

Location	**Mid-catchment of SW01**
Grid Ref.	**332532,408104**
Photo Ref.	**IMG_20181010_113904.jpg**
	

Minor Watercourses

9.203 Minor watercourses were given buffers of 10 m based on SEPA and SNH guidance and represent tributary channels on the site where the catchment area was less than 0.25 km^2. Specific to the Ballygilbert site, the watercourses are generally track-side drainage or larger vegetated field drains. Many are the sources / upper reaches of the more identifiable downstream channels and appear as grass-covered depressions in the land. They are distinct and easily identifiable on aerial imagery but often harder to differentiate from the surrounding land at ground level during dry conditions.

9.204 Minor watercourses will either be protected on their present alignment, or where works or diversions are required, then this shall be as enabling work adhering to strict procedures for working in or near water (described later in this assessment) with the proposed alignment then protected from the development.

9.205 Examples of minor watercourses / upper catchment sources on the site are shown on the following **Plate 9-10**.

Plate 9-12: Minor Watercourse Examples

Location	**Upper catchment of SW03 (preferential flow route / channel establishment)**	**Upper catchment of SW09**
Grid Ref.	**332971, 408573**	**333106,411535**
Photo Ref.	**IMG_20181010_120919.jpg**	**IMG_20181017_155845.jpg**
		

Other Drainage Features

9.206 All other minor drainage features (mapped or otherwise) comprising; dry or partially dry agricultural ditches, ephemeral drains, dry track drainage, grips, peat cuttings or other drainage features are considered insignificant in the context of site hydrology and habitat potential.

9.207 Such features would be managed during and following construction by means of temporary blocking (with prior settlement features upstream of and outwith the drainage channel), using filtration check dams or similar, in order to prevent residual indirect potential pollution downstream caused by connectivity to downstream waterways.

Adopted Watercourse Buffers

9.208 The significance of watercourses is shown on **Figure 9.1: Site Hydrology.** Conservative minimum hydrological buffer zones are adopted and implemented as shown in **Table 9.18.** The buffer widths adopted exceed those recommended in industry guidance; the allowance provided gives due consideration to the nature of peat soil conditions on the Site, antecedent weather, moisture and base flow and a significantly increased factor of safety in all instances given the significance of fishery interests within downstream catchments.

Table 9.18: Minimum Adopted Hydrological Buffer Zones

Water Features	Minimum Width of Buffer Strip
Significant Watercourses (catchment >0.25 km^2)	50 m
Minor Watercourses (catchment <0.25 km^2)	10 m
Other Drainage Features	Managed on-site by diversion / temporary blocking in accordance with GGPs and PPGs.

9.209 New infrastructure designed to lie outwith stated hydrological buffer zones include those elements of the works associated with significant earthworks and greatest potential for spillage or leakage of chemical pollutants, i.e.:

- All turbine bases, crane pads and associated working areas;
- Temporary and permanent spoil storage areas;
- Enabling works compound, substation and construction compound, fuel and chemical storage areas and any other platforms;
- Spoil movements and earthworks (placement of donor turves and contour ploughing) associated with proposed habitat enhancement and ecological mitigation.

9.210 New permanent access tracks are to lie outside of buffer zones; with the exception of unavoidable crossings of water features. Careful consideration has been given to the routing of access tracks in order to avoid / limit crossing of watercourses.

9.211 Areas of proposed road widening / passing places on existing roads surrounding the proposed development are to lie outwith buffer zones. Careful consideration has been given to the positioning of widened areas to avoid construction activities in the vicinity of watercourses. No widening occurs within 50m of any significant watercourse or within 10m of any minor watercourse and as such complies with the avoidance approach adopted for the main area of development.

9.212 Temporary track infrastructure (such as temporary widening and turning heads) that may encroach into buffers shall be managed through the use of additional surface water management measures, discussed in **paragraphs 9.250** through **9.253**.

Abstractions

9.213 The proposed infrastructure layout within the Site is such that no development (tracks, turbines or other significant infrastructure) is sited within 250m of any known or potential potable water abstraction identified in the previous screening assessment. No further constraint is required.

Floodplains

9.214 Baseline screening within the survey boundary identified out of bank flooding in the upper reaches of several watercourses draining toward the Glenarm River and Linford Water catchments. The proposed development has been designed to avoid these areas of indicatively modelled fluvial flooding.

9.215 Pluvial flood extends noted along watercourses on-site (shown on **Figure 9.1: Site Hydrology**) do not extend beyond the extent of the hydrological buffers established in **paragraph 9.208** and therefore do not further constrain development.

9.216 Infrastructure is designed to ensure that conveyance of surface water flooding is not impeded by means of providing drainage culverts / under track crossings where necessary.

9.217 Electrical infrastructure that would be susceptible to damage by floodwater is designed such that it does not have potential to be affected by surface water flooding.

9.218 Areas of isolated surface water flooding generally coincide with source areas of on-site water features or isolated low points. Site drainage and culverts shall allow passage of local surface flooding as considered within **Appendix 9.1: Water Framework Directive Assessment**, **Appendix 9.2 Flood Risk & Drainage Assessment**, and accompanying drainage management drawings.

Geological Features

9.219 Baseline screening within the survey boundary identified the geological features of Scawt Hill that are important on national scale and environmentally designated as ASSI (refer to

9.220 **Table** 9.15 for detail). The proposed development has been designed to avoid sensitive areas.

Designed Measures

9.221 Normal design measures associated with development of the type proposed are not considered "mitigation" in EIA terms, but are important in their effect of controlling or reducing the potential effect of the proposal on the receiving environment. Such measures are outlined in the following sections.

Site Drainage Management and SuDS Design

9.222 The proposed development will adopt a surface water management plan / site drainage design using the principles of Sustainable Drainage, promoting the principles of onsite retention of flows and use of buffers and other silt removal techniques. All drainage related mitigation measures proposed will be encompassed by a robust and proven Sustainable Drainage System (SuDS) design which will be used to control drainage and silt management on the site.

9.223 Onsite drainage design will minimise modification and disruption of the existing natural hydrology by:

- Maintaining existing overland flow routes and channels. Existing natural flow paths lateral to access roads will be maintained through the use of piped crossings under road alignments at natural depressions and at regular intermediate intervals. The spacing of cross drains will be specified at detailed design stage;
- Avoiding transporting rainfall runoff in long linear drainage swales by providing regular channel "breakouts", whereby water is encouraged to flow overland, thus maintaining existing natural hydrological patterns;
- Reducing surface water flow rates and volumes by attenuating runoff from tracks and hard standings "at source" by providing check-dams in swales, whereby the flow velocity and rate of discharge is artificially reduced to mimic natural properties;
- Providing settlement ponds at turbine hard standing areas and other main surface water discharge locations, where runoff from significant new impermeable areas is treated and attenuated before being released overland;
- All swales, crossings and other hydraulic features will be engineered to ensure that dimensions are suitable to convey predicted flows and so prevent build-up of surface water and / or flooding.

9.224 Drainage design will reduce chemical, silt and other suspended pollutant transport by providing a "treatment train" of two to three stages of pollutant removal to all surface water runoff, nominally by:

- Ensuring that drainage swales are designed to convey flows at a low velocity by using a wide, flat bottomed drain;
- Providing settlement and filtration features in all linear drainage swales (check dams, filtration dams) to reduce flow velocity and encourage settlement;
- Encouraging appropriate vegetation growth in the base of all linear drainage to provide additional filtration to flows;
- Providing settlement ponds at turbine hard standing areas and other key discharge locations in order to provide treatment to contaminated runoff prior to discharge;
- Discharging surface water runoff over undisturbed vegetated ground, hence allowing any remaining silts and other pollutants to drop out of flows before entering the watercourse (having the effect of polishing the runoff);
- Preventing the discharge of surface water runoff flows directly to existing watercourses or drainage. All discharges shall seek to be via SuDS and buffer zones which will act as a filter strip, allowing deposition of suspended solids and other pollutants;
- Providing settlement features in water channels downstream of areas of peat infilling and ditch blocking area proposed as part of habitat management and enhancement planning.

9.225 Consideration specific to the proposed infrastructure elements are documented in the detailed site-specific drainage management / SuDS design – see **Appendix 9.1: Water Framework Directive Assessment** and accompanying drainage drawings.

Watercourse Crossings

9.226 As noted previously, the number of watercourse and drainage crossings has been minimised through the principle of avoidance at the layout design stage. Proposals submitted in conjunction with this assessment indicate:

- One crossing of a significant watercourse.
- Four crossings of minor watercourses.

9.227 Culverts will be designed to accommodate track crossings and minimise length of affected channel in order to comply with Revised PPS15 policy FLD4.

9.228 Hydraulic design of crossings will be undertaken as per the guidance and requirements provided in CIRIA C689 “Culvert Design and Operation Guide” (or other standard as may be required by DfI Rivers in post-consent consultation), with primary parameters likely to include:

- Width of the culvert will be greater than the width of the active drainage channel;
- Alignment of the culvert will suit the alignment of the drainage channel, i.e. preserve the existing direction of flow;

- The slope of the culvert will not exceed the slope of the bed of the existing drainage channel.
- Detailed design of crossings will assume a hydraulic capacity requirement of 1% Annual Equivalent Probability flow as a conservative measure. Detailed hydraulic design of culverts and similar structures post permission is normal and accepted practice for wind farms in Northern Ireland.
- Fisheries shall be protected (where applicable) by adopting the guidance stated in Guidelines for Fisheries Protection during Development Works as published by Loughs Agency.

9.229 Culvert form will be informed by the site-specific fisheries assessment (**Chapter 8: Fisheries**). In this instance where there is no particular fishery habitat on the site that would be disrupted by loss of substrate, then closed (piped) culverts are suitable.

9.230 Consultation and approval will be sought from all relevant parties as required by the DAERA Surface Waters Alteration Handbook (November 2017), including and DfI Rivers in particular, at the pre-construction detailed design stage for all works in and affecting watercourses and drains, as per the requirements of Schedule 6 of the Drainage (Northern Ireland) Order 1973 and subsequent amendments. Given that all proposed culverts are of a conventional type and in a number of instances coincide with and replace existing culverts, it is anticipated that Rivers approvals for culvert works can be deferred post-determination of the planning application. Further consideration is given in Flood Risk Assessment included in **Appendix 9.2**.

Radon

9.231 The site is within an area of elevated radon potential, where 1–3 % buildings are above the action level. Radon protection measures are advised to be implemented for the permanent sub-station and control building or as may be directed by the local Building Control office suitable to the nature of the proposed enclosed space.

Effect of the Development

9.232 Magnitude and likelihood of the potential environmental effects have been determined based on criteria outlined within **paragraphs 9.49** to **9.56** taking into account the effect of avoidance measures and normal designed-in measures proposed and described in preceding sections.

9.233 The associated impact significance of these effects on the receptors affected (following the implementation of avoidance and design measures proposed) has been determined in accordance with the rationale described previously and the results are presented in summary **Table 9.19**.

Table 9.19: Potential Magnitude and Significance of Impacts to Receptors – Including effect of Avoidance & Design

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
Soils / Drift Deposits (Local / Low)	Ground Movement / Instability	Low	Negligible	Unlikely	Not Significant	The Quantitative Risk Assessment within the Peat Slide Risk Assessment has concluded that peat slide risk is not significant.
Scawt Hill AASI (National / High)	Impact on a site of important earth science interest	Negligible	Low	Rare	Not Significant	During design evolution, avoidance measures were adopted to locate the proposed development outwith a buffer zone such that the ASSI would not be adversely affected during construction, operation or decommission phases.
Linford ASSI (National / High)	Impact on a site of important earth science interest	Negligible	Low	Rare	Not Significant	The existing site entrance from Feystown Road is in proximity (c. 10 m) of the ASSI boundary. The proposal is to upgrade the entrance; however, works are unlikely to affect the ASSI (as surface water appears to flow into the karst features from the south).
Glenarm ASSI (National / High)	Impact on morphological character of watercourses	Low	Moderate	Unlikely	Minor	Watercourses included within the designation of Glenarm Woods ASSI are hydrologically connected to the upper catchments where the proposed development is to be sited. Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. The drainage strategy adopted ensures that natural catchments are mirrored and ensures that water is not lost from the catchment. Therefore, ASSI features may be susceptible to potential changes due to sediment as a result of the proposed development.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
On-site Minor Drainage (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. Design of crossings of minor watercourses at four locations within channels on-site when adopting best practice design standards as stated result in no significant localised effect in terms of restricted capacity that would cause any change to flood risk.
	Silt / suspended solid pollution of surface waters	Medium	Low	Likely	Minor	Temporary short-term construction activities within watercourses would be likely to cause a significant but temporary fundamental change in water quality in watercourses on the site.
	Chemical pollution of surface waters	Medium	Low	Likely	Minor	Spillage of oils, chemicals, or cementitious material associated with temporary construction and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in watercourses on the site.
On Site significant watercourses (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. The drainage strategy adopted ensures that natural catchments are mirrored and ensures that water is not lost from the catchment that would result in a loss of available water for abstraction.
	Silt / suspended solid pollution of surface waters	Medium	Low	Likely	Minor	Temporary short-term construction activities within the watercourse (to construct the culvert) would be likely to cause a significant but temporary fundamental change in water quality in watercourses on the site.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Chemical pollution of surface waters	Medium	Low	Likely	Minor	Spillage of oils, chemicals, or cementitious material associated with temporary construction and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in watercourses on the site.
Linford Water & Glenarm River (National / High)	Changes in runoff and flow patterns	Negligible	Low	Rarely	Not significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt "soft" rural SuDS features to ensure response to rainfall is not exacerbated. The site as a proportion of the waterbody catchment is not significant.
	Silt / suspended solid pollution of surface waters	Medium	Moderate	Likely	Moderate	Riparian buffer zones, avoidance, and control of reduced quality runoff from the temporary and permanent works would cause runoff from the site to have no effect exceeding normal seasonal or pre-existing fluctuations. Temporary short-term construction activities within upstream watercourses would be likely to cause a detectable but temporary change in water quality in the immediate downstream environment.
	Chemical pollution of the watercourse	High	High	Likely	Major	Spillage of oils, chemicals, or cementitious material associated with temporary construction, particularly at works adjacent to or within watercourses, and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in the downstream environment.
Bedrock Groundwater / Aquifers	Alteration of Groundwater	Low	Negligible	Unlikely	Not Significant	No significant excavations within the bedrock are expected. Significant dewatering with the potential for affecting groundwater levels is not anticipated.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
(Local / Low)	Chemical pollution of groundwater	Low	Negligible	Likely	Minor	Bedrock is expected to be shallow in several areas, with limited thickness of Superficial Deposits however depth to groundwater is anticipated to be significant and dominated by fracture flow.
Private water supplies	Disruption to quantity or quality of supply	Negligible	Negligible	Unlikely	Not Significant	No infrastructure is proposed within 250m of any known or potential abstraction location and as such no supply would be affected.
Tracks, turbines and associated buildings. (Local / Low)	Risk to occupants and infrastructure due to identified potential risk of flooding.	Low	Negligible	Unlikely	Not Significant	The proposed development has been designed to avoid areas potentially susceptible to pluvial ponding.
	Risk to occupants due to presence of Radon	Low	Negligible	Unlikely	Not Significant	Proposed buildings will be designed to incorporate appropriate radon / gas protection measures.

Additional Mitigation Measures – Construction Phase

9.234 Additional mitigating measures, over and above the avoidance and buffer zones previously detailed, are intended to reduce or prevent the residual significant hazards which may not be fully mitigated by the design evolution and avoidance.

Water Quality Monitoring

9.235 A water quality monitoring program will be implemented to monitor effects on the surface water quality regime during the infrastructure construction, operational and decommissioning phases of the proposed development, in order to;

- Demonstrate that the mitigation measures and surface water management is performing as designed;
- Provide validation that the in-place mitigation measures are not having an adverse effect upon the environment;
- Indicate the need for additional mitigation measures to prevent, reduce or remove any effects on the water environment, such as additional temporary settlement or filtration structures or short-term flocculant dosing to suit observed site conditions.

9.236 The monitoring would be informed by existing water quality baseline data presented in **paragraphs 9.138** through **9.141** of this assessment and baseline monitoring rounds undertaken prior to the commencement of the construction phase.

9.237 It is intended that the water monitoring extent, duration and frequency will be agreed with the Department of Infrastructure or the relevant regulating body (nominally NIEA WMU) post consent and will nominally consist of physicochemical and biological monitoring. The extent, duration and frequency of the monitoring will be proportionate to the level of activity during each phase of the proposed development and the associated perceived risks.

Pollution Prevention

Pollution Prevention Plan

9.238 A detailed Pollution Prevention Plan (PPP) will be implemented and monitored by the site manager as part of a full Construction & Decommissioning Method Statement (CDMS) for the project, to be submitted post-consent following detailed site investigations and agreed with the local planning authority. Although this will be of particular importance during construction, it will apply to potentially polluting activities during all phases of the proposed development.

9.239 The detailed PPP will be produced following consultation and agreement with NIEA, and all appropriate personnel working on the Site will be trained in its use. As a minimum, the PPP will comply with Guidance for Pollution Prevention (GPP) and Pollution Prevention Guidelines (in particular GPP 21: Pollution Incident Response

Planning) and best practice as advocated by CIRIA. The PPP will identify site-specific measures and incorporate a Pollution Incident Plan, which will include emergency contact details, details of spill kits on the Site and instructions on actions in case of spillage / emergency.

9.240 Measures to be incorporated within the PPP are identified in the following sections.

Pollution Prevention Measures

9.241 During all phases the site manager will ensure that mitigation measures as identified within this assessment are fully implemented and that activities are carried out in such a manner as to prevent or reduce effects. The following construction and decommissioning phase-specific measures will be implemented. The following sections should be read in conjunction with the construction management information provided within **Chapter 1: Introduction and Proposed Development.**

9.242 To ensure best practice on site and to help avoid pollution release to watercourses and groundwater, the following NIEA Guidance for Pollution Prevention (GPP) and Pollution Prevention Guidance (PPGs) will be adhered to:

- GPP2 Above Ground Oil Storage Tanks
- GPP 4 Treatment and disposal of Wastewater where there is no connection to the public foul sewer
- GPP 5 Works and Maintenance in or near Water
- GPP 8 Safe Storage and Disposal of Used Oils
- GPP 20 Dewatering Underground Ducts and Chambers
- GPP 21 Pollution Incident Response Planning
- GPP 22 Dealing with Spills
- GPP 26 Safe Storage of Drums and Intermediate Bulk Containers.
- PPG 1 Understanding Your Environmental Responsibilities - Good Environmental Practices
- PPG 3 Use and Design of Oil Separators in Surface Water Drainage Systems
- PPG 6 Working at Construction and Demolition Sites
- PPG 7 Safe Storage – The Safe Operation of Refuelling Facilities

9.243 Key requirement for control of chemical pollution risk are identified in the above guidance and will include the following:

Storage

9.244 All equipment, materials and chemicals on the Site will be stored away from any watercourse (i.e. outwith previously stated buffer zones). Chemical, fuel and oil stores will be sited on impervious bases in accordance with GPP2 and within a secured bund of 110% of the storage capacity, within the temporary storage compound

Vehicles and Refuelling

9.245 Standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Refuelling of vehicles and machinery will be carried out on an impermeable surface in designated areas, well away from any watercourse or drainage ditches (i.e. outwith previously stated buffer zones) and will adhere to best practice as detailed in PPG 7.

Maintenance

9.246 Onsite maintenance to construction plant will be avoided in all practicable instances, unless vehicles have broken down necessitating maintenance at the point of breakdown. Suitable measures in accordance with a Pollution Prevention Plan (PPP) will be put in place prior to commencement of maintenance in this instance.

Cement and concrete batching

9.247 Preference shall be given to construction techniques that do not require use of cementitious materials where suitable practicable alternatives exist. When concrete / cement is used, concrete batching will not be permitted on site. Wet concrete operations will not be carried out within watercourses or adjacent to watercourses. Measures to prevent discharge of alkaline wastewaters or contaminated storm water to watercourses will be outlined in a detailed PPP for the Site to be approved by NIEA before commencement of works. Wastewater spillage will be minimised by using settling tanks and recycling water.

Mess and welfare facilities

9.248 Mess and welfare facilities will be required during construction and decommissioning and will be located at the construction compound. Foul effluent disposal shall be via chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on site).

Construction Best Practice

Construction in the vicinity of Watercourses

9.249 The following procedures apply to the general construction activities either within the watercourses or in defined watercourse buffer zones:

- Due consideration will be given to the prevailing ground and weather conditions when programming the execution of the works in order to ensure that in-channel works are undertaken during periods of predicted low flow and low rainfall in order to minimise contact with water.
- Ensure that roadside drains do not discharge directly into watercourses, but rather through a riparian buffer area of intact vegetation as denoted on design drawings.

Construction of Watercourse Crossings

9.250 Construction of watercourse crossings will be programmed to coincide with periods of predicted low flow in the affected channel (determined by rainfall and would generally coincide with summer months). Construction will be strictly as per the design for each identified watercourse crossing and will fully implement all SuDS and additional mitigating measures proposed at the detailed design stage. For purposes of outline design, the proposed mitigation will include:

- Installation of silt fences parallel to the watercourse channel in the vicinity of the proposed crossing;
- Installation of small cut-off drains to prevent natural surface runoff entering area of construction activity;
- Installation of filtration or other silt entraining features within the watercourse channel immediately downstream of the works location;
- Use of damming and over pumping to allow a dry working environment where deemed appropriate.

Temporary SuDS

9.251 Temporary drainage and silt management features (SuDS) will be constructed prior to earthworks (including preliminary or enabling works) proceeding to construct any linear works (tracks / hardstanding areas / cable routes), turbine bases, and other infrastructure. Drainage will be provided to temporary works and reinstated to suit the final footprint of the completed development.

9.252 Temporary drainage measures in particular will be employed in enabling works to facilitate widening of existing tracks.

9.253 Temporary measures may include:

- Temporary silt fences erected in areas where risk of pollution to watercourses has been identified e.g. watercourse crossing locations and areas where tracks or other infrastructure lie within watercourse buffer zones.
- Placing temporary filtration silt fences within drainage channels where siltation is observed.
- Installing temporary constructed settlement features such as sumps or settlement ponds / lagoons where required.
- Upslope cut-off drainage channels approximately parallel to the proposed track alignment installed in advance of any excavated cuttings for the track or turbine hardstanding areas.
- Watercourses, drains, natural flow paths and cut-off drain outlet locations should be identified and charted, in order to ensure that piped crossings can be installed in advance of or adjacent to the track construction.

- Settlement ponds should be constructed in advance of commencing excavations for foundations and at any other locations identified as required at detailed design stage.
- Trackside drainage swales should be installed in parallel with track construction. Note that this may require that drainage swales are reformed on an ongoing basis as temporary track alignments are modified to their eventual finished design level.

9.254 Suitable prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.

Electrical Cable Laying

9.255 Due consideration will be given to the prevailing ground conditions and season when programming the execution of cable trench excavations in order to ensure works are undertaken during periods with low rainfall and elevated shallow groundwater levels in order to reduce the likelihood of runoff entering the excavations.

9.256 Excavation of cable trenches will be carried out over short distances, with frequent backfilling of trenches to minimise opportunity for the ingress of water into open trenches, temporary silt traps will be provided in longer trench runs and on steeper slopes and spoil will be stored in line with a spoil management plan, which will be produced as part of the CDMS at the pre-construction stage.

Excavations and Spoil Management

9.257 Soil and subsoil excavation and movement will be undertaken in accordance with best practice guidelines such as Good Practice Guide for Handling Soils (MAFF, 2000) in order to minimise potential for silt laden runoff from spoil and excavations. Areas of stockpiled spoil including stored peat:

- will not be permitted within previously identified watercourse buffer zones; and
- will not be permitted to obstruct the flow of overland surface water with specific drainage to spoil mounds to be provided.

9.258 Material produced from excavations on the Site will be reused where reasonably practicable in the reinstatement of the site. Excavated materials will be separated into rock material, subsoil, reusable peat and vegetated sod material and will be stored in the designated temporary stockpile zones, under the supervision of a geotechnical expert. These materials will be reused where possible to re-grade slopes, and to re-vegetate and stabilise the sides of access tracks and hard standing areas.

9.259 Spoil drainage will be designed on a bespoke basis for spoil storage areas to allow controlled dewatering and prevent washout of suspended solids to the receiving water environment. As part of the detailed CDMS a spoil management strategy will be developed by the appointed competent contractor for the development. Outline designs for drainage arrangements for temporary spoil areas are shown on the Drainage Management Drawings within **Appendix 9.1: Water Framework Directive Assessment.**

Ditch Blocking and Earthworks for Habitat Enhancement

9.260 It is proposed that very localised ditch blocking be carried out for the purposes of habitat enhancement / restoration. Details are provided in the Outline Habitat Management Plan (OHMP) in Appendix 6.6.

9.261 Ditch blocking downgradient of areas of earthworks will have an additional beneficial effect by providing settlement to reduced quality runoff from lands upgradient.

Dewatering of Excavations

9.262 The majority of the turbine base foundations will be on bedrock or other hard strata above bedrock (to be confirmed by detailed site investigation prior to detailed design); therefore, deep excavations within bedrock and the associated bedrock aquifer are not anticipated and dewatering below the bedrock aquifer groundwater table is therefore not anticipated.

9.263 Shallow groundwater (e.g. in areas of glacial sand and gravel) or rainfall runoff collected in excavations will be discharged via settlement ponds or filter strips prior to entry to the receiving water environment.

9.264 Any settlement lagoons or filter strips associated with dewatering will be regularly inspected, particularly after periods of heavy rainfall and prior to periods of forecast heavy rainfall. Maintenance (to clear blockages or remove silt) will be carried out in periods of dry weather where practicable. Maintenance requirements are further considered in **Appendix 9.1: Water Framework Directive Assessment.**

Dust Management

9.265 Loose track material generated during the use of access tracks and the construction compound will be prevented from reaching watercourses by maintenance to surface water drainage systems installed at aggregate based hard standing areas. In dry weather dust suppression methods such as by dust suppression bowser will be employed.

Borrow Pits

9.266 For the avoidance of doubt, no borrow pits are proposed at the site, therefore associated pollution risks associated with rock extraction activities are not a consideration.

Maintenance of Pollution Prevention Measures

9.267 All SuDS and additional pollution prevention measures installed will be subject to a regular maintenance regime for the life of the construction phase in order to maintain functionality of all features. This will comprise:

- Unblocking of drains;
- Maintenance of access road and other hard standing surfaces;
- Replacement of filtration features;
- Removal of silt build-up from settlement and filtration features.

Mitigating Measures - Operational Phase

9.268 Mitigation of the effects of the wind farm development will comprise the following:

- Ensure best practice is adhered to on the Site and avoid pollution release to watercourses by incorporating NIEA Pollution Prevention Guidance notes into management policy.
- In the event that permanent welfare facilities are installed as part of control building / substation facilities, foul effluent will be disposed of through the use of sealed cesspools or chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on the site).
- Cyclical maintenance of permanent SuDS drainage features installed during the construction phase, including unblocking of drains, maintenance of access road and other hard standing surfaces, and removal of silt build-up from settlement features. An outline maintenance programme is included in **Appendix 9.1: Water Framework Directive Assessment.**

Mitigating Measures and Residual Effects

9.269 The following table details the assessed impact magnitude, likelihood and associated significance as a function of the matrix stated previously of all receptors identified as previously having an unmitigated impact significance greater than 'not significant'.

Table 9.20: Mitigated Effects

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
Glenarm ASSI (National / High)	Impact on morphological character of the watercourses included within the designation of Glenarm Woods ASSI	Negligible	Low	Rare	Not Significant	Surface water management and pollution control and in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions in terms of sediment leaving the site exceeding natural or pre-existing conditions.
On-site Minor Drainage (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. Design of crossings of minor watercourses at four locations within channels on-site when adopting best practice design standards as stated result in no significant localised effect in terms of restricted capacity that would cause any change to flood risk.
	Silt / suspended solid pollution of surface waters	Low	Negligible	Unlikely	Not Significant	Surface water management and pollution control and in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of surface waters	Low	Negligible	Unlikely	Not Significant	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
On Site significant watercourses (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. The drainage strategy adopted ensures that natural catchments are mirrored and ensures that water is not lost from the catchment that would result in a loss of available water for abstraction.
	Silt / suspended solid pollution of surface waters	Low	Negligible	Unlikely	Not Significant	Surface water management and pollution control and in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of surface waters	Low	Negligible	Unlikely	Not Significant	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.
Linford Water & Glenarm River (National / High)	Changes in runoff and flow patterns	Negligible	Low	Rarely	Not significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. The site as a proportion of the waterbody catchment is not significant.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Silt / suspended solid pollution of surface waters	Low	Moderate	Unlikely	Minor	Riparian buffer zones, avoidance, and control of reduced quality runoff from the temporary and permanent works would cause runoff from the site to have no effect exceeding normal seasonal or pre-existing fluctuations. Surface water management and pollution control in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of the watercourse	Low	Moderate	Unlikely	Minor	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.
Bedrock Groundwater / Aquifers (Local / Low)	Alteration of Groundwater	Low	Negligible	Unlikely	Not Significant	No significant excavations within the bedrock are expected. Significant dewatering with the potential for affecting groundwater levels is not anticipated.
	Chemical pollution of groundwater	Low	Negligible	Likely	Not Significant	Bedrock is expected to be shallow in several areas, with limited thickness of Superficial Deposits however depth to groundwater is anticipated to be significant and dominated by fracture flow.

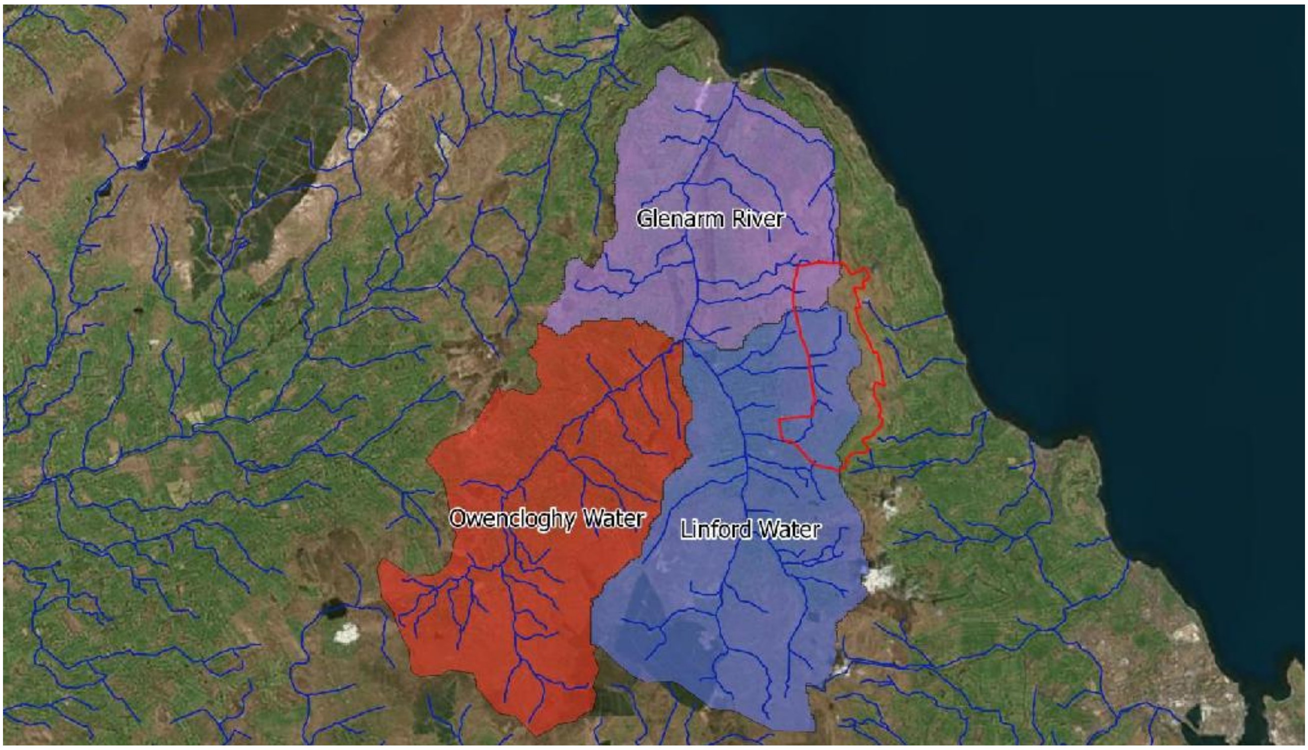
Cumulative Effects

9.270 An assessment has been undertaken of the cumulative effect on geology and the water environment of the Development in conjunction with other known wind farms and other significant developments in planning, construction or operation at the time of the application.

9.271 The assessment aims to determine potential for cumulative impact within the hydrological, hydrogeological and geological setting of the site caused by an accumulation of similar developments.

9.272 The hydrological and hydrogeological setting of the site for the purposes of the assessment is the downstream Glenarm River (including Linford Water and Owencloghy Water tributaries) as identified on the NIEA Water Framework Directive interactive catchment mapping website and shown on the following **Plate 9-11**. No other significant wind farm development is planned or operational within that setting and as such potential for cumulative effect is discounted.

Plate 9-13: Hydrological Setting



9.273 If considering a wider setting, then as no likely significant residual water environment or geological effects are predicted arising from the Development, there is no potential significant cumulative effect to water or the geological environment in conjunction with any other pre-existing or future development.

Summary and Conclusions

9.274 This assessment identifies the potential geological, hydrological, and hydrogeological impacts, including surface and groundwater quality of the Development. It summarises the relevant legislation and guidance and provides appropriate baseline information, enabling the potential effects to be identified.

9.275 Aspects of the design, construction and operation of the Development that may potentially impact on the receiving geological and water environment have been identified and the pathways for impacts assessed. It has been determined that without mitigation the Development would be likely to cause adverse impacts of moderate significance primarily driven by the sensitivity of fisheries interests on and shortly downstream of the Site. As such, informed by the baseline assessment and pathways identified, mitigation integrated as part of outline design and proposed during construction phase includes:

- Avoidance of water features based on baseline constraints mapping;
- Design of site elements to minimise impact on the geological and water environment;
- Implementation of a comprehensive surface water management plan comprising the use of SuDS (drainage) and silt management in order to prevent pathways for pollution;
- Construction phase pollution prevention procedures in accordance with NIEA requirements and guidance.

9.276 Monitoring of the effect of the Development on the water environment and fisheries habitat will be provided by the Applicant through physicochemical and biological water quality monitoring. Implementation of the mitigation proposed eliminates or reduces the potential significance to all receptors to “not significant”.

9.277 There is no likelihood of significant cumulative impacts over and above any pre-existing effect caused by existing or consented wind development.

10

Noise

10 Acoustic Assessment

Introduction

10.1 This chapter contains an assessment of the acoustic impact of the proposed Ballygilbert Wind Farm (hereafter referred to as the proposed development). The report assesses wind farm operational noise and construction noise at the nearest residential properties.

10.2 This chapter is supported by the following:

- Figure 10.1 – Predicted Noise Footprint due to Proposed Wind Farm;
- Figure 10.2 – Predicted Cumulative Noise Footprint;
- Technical Appendix 10.1 - Assessment of Energy Storage Facility;
- Technical Appendix 10.2 – Scope of Assessment;
- Technical Appendix 10.3 – Calculating Standardised Wind Speed;
- Technical Appendix 10.4 – Propagation Height & Valley Effect;
- Technical Appendix 10.5 – Background Noise Survey Photos;
- Technical Appendix 10.6 – Instrumentation Records;
- Technical Appendix 10.7 – Charts;
- Technical Appendix 10.8 – Suggested Planning Conditions; and
- Glossary.

10.3 Figures and Technical Appendices are referenced in the text where relevant.

Statement of Authority

10.4 This assessment has been undertaken by RES, with at least one in-house Member of the Institute of Acoustics involved in its production. RES has undertaken acoustic impact assessments in every single one of its UK wind farm development applications since 2000. RES has also carried out noise assessments and reported to several local planning authorities on operational wind energy projects, including taking measurements on newly constructed wind farms to ensure compliance with planning conditions.

10.5 Additionally, RES has been project co-ordinator for several Joule[1] projects, leading European research into wind turbine noise, was involved in producing the guideline 'The Assessment and Rating of Noise from Wind Farms'[2] for the DTI in 1996, acted as peer reviewer for the 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'[3], and contributed to the RenewableUK work on Amplitude Modulation[4]. Publications include:

- 'An Investigation of Blade Swish from Wind Turbines', P Dunbabin, Proceedings of the 1996 International Congress on Noise Control Engineering (Internoise '96), 30 July – 2 August 1996, Book 1, pp 463 – 469;

[1] DGXII European Commission funded projects in the field of Research and Technological Development in non-nuclear energy

[2] 'The Assessment and Rating of Noise from Wind Farms', The Working Group on Noise from Wind Turbines, ETSU Report for the DTI, ETSU-R-97

[3] 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise', Institute of Acoustics, May 2013

[4] 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects', RenewableUK, 2013

- 'An Automated System for Wind Turbine Tonal Assessment', R Ruffle, Proceedings of the 1996 International Congress on Noise Control Engineering (Internoise '96), 30 July – 2 August 1996, Book 6, pp 2997 – 3002;
- 'Wind Turbine Measurements for Noise Source Identification', ETSU W/13/003914/00.REP, 1999, Dr P Dunbabin, RES et al;
- 'A Critical Appraisal of Wind Farm Noise Propagation', ETSU W/13/00385/REP, 2000 Dr J Bass, RES;
- 'Aerodynamic Noise Reduction for Variable Speed Turbines', ETSU/W/45/00504/REP, 2000, Dr P Dunbabin, RES;
- 'Fundamental research in amplitude modulation - a project by RenewableUK', Dr J Bass et al, Fourth International Meeting on Wind Turbine Noise, Rome, April 2011;
- 'Investigation of the 'Den Brook' Amplitude Modulation methodology for wind turbine noise', Dr J Bass, Acoustics Bulletin Vol 36 No 6 November/December 2011;
- 'How does noise influence the design of a wind farm?', Dr M Cassidy, Fifth International Conference on Wind Turbine Noise, Denver, 2013;
- 'Propagation of Noise from Wind Farms According to the Good Practice Guide', A Birchby, Sixth International Conference on Wind Turbine Noise, Glasgow, 2015;
- 'Addressing the Issue of Amplitude Modulation', Dr M Cassidy, Sixth International Conference on Wind Turbine Noise, Glasgow, 2015;
- 'A Method for Rating Amplitude Modulation in Wind Turbine Noise', Institute of Acoustics Noise Working Group, August 2016; and
- 'Pre-construction Site Prediction Tool for Wind Farm AM – Do We Now Know Enough?', A Birchby, Seventh International Conference on Wind Turbine Noise, Rotterdam, 2017.

Wind Turbine Noise

10.6 In the context of other sources of environmental noise, the noise levels produced by wind turbines are generally low and have greater dependence upon wind speed. The combination of these two factors implies that a degree of masking would often be provided by background noise.

10.7 As described by the Department of the Environment in Best Practice Guidance to Planning Policy Statement 18[5]:

"There are two quite distinct types of noise source within a wind turbine. The mechanical noise produced by the gearbox, generator and other parts of the drive train; and the aerodynamic noise produced by the passage of the blades through the air. Since the early 1990s there has been a significant reduction in the mechanical noise generated by wind turbines and it is now usually less than, or of a similar level to, the aerodynamic noise. Aerodynamic noise from wind turbines is generally unobtrusive – it is broad-band in nature and in this respect is similar to, for example, the noise of wind in trees."

[5] 'Best Practice Guidance to Planning Policy Statement 18: Renewable Energy', PPS18, August 2009

Construction Noise

10.8 The sources of construction noise, which are temporary, would vary both in location and duration as the different elements of the wind farm are constructed and would arise primarily through the operation of large items of plant.

10.9 Noise would also arise due to the temporary increase in construction traffic near the site. This level would also depend on the particular construction phase of the proposed development.

Scope of Assessment

10.10 Noise can have an effect on the environment and on the quality of life enjoyed by individuals and communities. The effect of noise, both in the construction and operational phase, is therefore a material consideration in the determination of planning applications.

Operational Noise

10.11 The main focus of the assessment of operational noise presented here is based on the most relevant type of noise emission for modern wind turbines: aerodynamic noise, which is broadband in nature. Mechanical noise, which can be tonal in nature, is also considered albeit less relevant to modern wind turbines. Implicitly incorporated within this assessment is the normal character of the noise associated with wind turbines (commonly referred to as 'blade swish') and consideration of a range of noise frequencies, including low frequencies.

10.12 An acoustic assessment considering the operation of the proposed Energy Storage Facility can be found in **Technical Appendix 10.1**.

10.13 Low frequency content of the noise from wind farms shall be considered through the use of octave band specific noise emission and propagation modelling, however it is considered that specific and targeted assessment on low frequency content of noise emissions from the proposed wind farm is unjustified. Details for scoping out low frequency noise from the acoustic assessment, as well as infrasound, sleep disturbance, vibration, amplitude modulation and wind turbine syndrome can be found in **Technical Appendix 10.2**.

10.14 A summary of the findings of a comprehensive study into wind turbine noise and associated health effects can be found in **Technical Appendix 10.2**.

Construction Noise

10.15 The acoustic impact assessment of construction noise from the wind farm presented here is based on RES's experience of constructing wind farms and calculated for the operation of the primary large items of construction equipment. Additionally, consideration is given to the increased noise levels due to increased traffic flows during the construction phase to and from the site.

10.16 Whilst noise would also arise during decommissioning of the proposed development (through turbine deconstruction and breaking of the exposed part of the concrete bases) this is not discussed separately as noise levels resulting from it are expected to be lower than those during construction due to the number and type of activities involved. The impact of decommissioning can therefore be considered in light of the conclusions of the construction noise assessment.

Legislative Framework & Guidance

Operational Noise

10.17 Within Northern Ireland, noise from wind farms is defined within the planning context by Planning Policy Statement 18: Renewable Energy[6]. Best Practice Guidance to Planning Policy Statement 18: Renewable Energy[5] refers to the use of the Department of Trade and Industry's 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97). In relation to noise from wind farms the Planning Policy states:

"The report, 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97), describes a framework for the measurement of wind farm noise and gives indicative noise levels calculated to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development."

10.18 It is therefore considered that the use of ETSU-R-97, as a criterion for assessment of wind farm noise, fulfils the requirements of Planning Policy Statement 18.

10.19 The methodology described in ETSU-R-97 was developed by a working group comprised of a cross-section of interested persons including, amongst others, environmental health officers, wind farm operators and independent acoustic experts.

10.20 ETSU-R-97 makes it clear from the outset that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that arise through the development of renewable energy resources. The principle of balancing development needs against protection of amenity may be considered common to any type of noise control guidance.

10.21 The basic aim of ETSU-R-97, in arriving at the recommendations contained within the report, is the intention to provide:

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

10.22 An article published in the Institute of Acoustics Bulletin (IoA Bulletin) Vol. 34 No. 2, March/April 2009[7], recommends a methodology for addressing issues not made explicit by, or outside the scope of, ETSU-R-97, such as in relation to wind shear or noise propagation modelling. Whilst this article does not represent formal legislation or guidance it was authored by a group of independent acousticians experienced in wind farm noise issues who have undertaken work on behalf of wind farm developers, local planning authorities and third parties and as such is a good indicator of best practice techniques. The assessment presented herein adopts the recommendations made within this article.

---

[6] 'Planning Policy Statement 18: Renewable Energy', PPS18, August 2009

[7] 'Prediction and Assessment of Wind Turbine Noise', Bowdler et al, Acoustics Bulletin Vol 34 No 2 March/April 2009

10.23 A Good Practice Guide (IoA GPG) to the application of ETSU-R-97 for the assessment and rating of wind turbine noise[3], issued by the Institute of Acoustics in May 2013 and endorsed by the Northern Ireland Executive, along with the governments in England, Scotland and Wales, provides guidance on all aspects of the use of ETSU-R-97 and reaffirms the recommendations of the Acoustics Bulletin article with regard to propagation modelling and wind shear. The assessment presented herein adopts the recommendations of the Good Practice Guide.

10.24 Supplementary guidance notes were published by the Institute of Acoustics in July and September 2014, and these provide further details on specific areas of the IoA GPG[8]. The assessment presented herein adopts the recommendations made within these supplementary guidance notes.

10.25 ETSU-R-97 has been applied at the vast majority of wind farms currently operating in the UK and provides a robust basis for assessing the noise impact of a wind farm when used in accordance with the IoA GPG. It is the only relevant guidance referenced in [Country] planning policy for rating and assessing operational wind farm noise. Based on planning policy and guidance, as outlined above, a wind farm which can operate within noise limits derived according to ETSU-R-97 shall be considered acceptable. This approach has been agreed with Mid & East Antrim Borough Council.

Construction Noise

10.26 In Northern Ireland, advice on construction noise assessment is referred to in 'The Control of Noise (Codes of Practice for Construction and Open Sites) Order (Northern Ireland) 2002'[9]. This legislation points to BS 5228: Part 1:1997 for guidance on appropriate methods for minimising noise from construction and open sites in Northern Ireland.

10.27 Since the 1997 version of BS 5228 has been superseded by BS 5228-1:2009 'Code of practice for noise and vibration control on construction and open sites - Part 1: Noise'[10] this has been identified as being the appropriate source of guidance on appropriate methods for minimising noise from construction activities, and is adopted herein.

10.28 The Pollution Control and Local Government (NI) Order 1978 provides information on the need for ensuring that best practicable means are employed to minimise noise[11].

---

[8] 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise - Supplementary Guidance Notes', Institute of Acoustics, July & September 2014

[9] 'The Control of Noise (Codes of Practice for Construction and Open Sites) Order (Northern Ireland) 2002', The Department of the Environment, November 2002

[10] 'Code of Practice for Noise and vibration control on construction and open sites - Part 1: Noise', British Standards Institution, BS 5228-1:2009

[11] 'Pollution Control and Local Government (NI) Order 1978', published by Her Majesty's Stationary Office, 1978

Consultation

10.29 Details of the consultation undertaken are outlined in **Table 10.1**.

Table 10.1 - Acoustic Assessment Consultation

Consultees	Date of Consultation	Nature and Purpose of Consultation
Mid & East Antrim Borough Council	17/06/2019	Report "Planned Acoustic Assessment at the Proposed Ballygilbert Wind Farm" (ref. 03128-001011-01) sent to Environmental Health Officer (EHO).
Mid & East Antrim Borough Council	20/06/2019	Call with EHO to confirm assessment received and that two of the proposed survey locations had changed. Further detail on new locations then provided by email
Mid & East Antrim Borough Council	25/06/2019	EHO noted that two of the proposed survey locations were close to farm buildings. EHO also thought a further location to the west might be useful in confirming that data from Feystown survey is still appropriate or providing redundancy. EHO would like to discuss inferred locations at a later date.
Mid & East Antrim Borough Council	26/06/2019	Comments made by EHOs on site during setup of meters at four survey locations. Data from one location to be reviewed at interim visit. Fifth location (giving a second data point to the west) to be investigated.
Mid & East Antrim Borough Council	28/06/2019	Report "Noise Survey Locations for the Acoustic Assessment of the Proposed Ballygilbert Wind Farm" (ref. 03128-001026-01) sent to Environmental Health Officer (EHO).
Mid & East Antrim Borough Council	17/07/2019	Report "Noise Survey Locations for the Acoustic Assessment of the Proposed Ballygilbert Wind Farm" (ref. 03128-001026-02) sent to Environmental Health Officer (EHO) detailing fifth survey location. Summary of data from interim site visit provided.
Public	11/09/2019	Public exhibition held in Ballygally
Mid & East Antrim Borough Council	30/10/2019	Discussion of survey results including comparison between survey locations and with previous Feystown survey. Proposed inferred locations and daytime lower limit.

Methodology

Operational Noise

10.30 To ensure adequate assessment of the potential impacts of the operational noise from the proposed wind farm the following steps have been taken, in accordance with relevant guidance detailed above:

- The baseline noise conditions at each of the nearest residential properties to the wind farm are established by way of representative background noise surveys;
- The noise levels at the nearest residential properties from the operation of the proposed development are predicted using a sound propagation model considering: the locations of the wind turbines; the intervening terrain; and the likely noise emission characteristics of the wind turbines;
- With due regard to relevant guidance or regulations the acoustic assessment criteria are derived; and
- The evaluation of the acoustic impact is undertaken by comparing the predicted noise levels with the assessment criteria.

Establishing Baseline Conditions

10.31 Similar to other assessments of noise impacts (most notably BS 4142[12],which ETSU-R-97 identifies as forming the basis of its recommendations), the ETSU-R-97 methodology requires the comparison of predicted noise levels due to turbine emissions (which vary with hub height wind speed) with noise limits based upon the noise levels already existing under those same conditions (i.e. the baseline conditions).

10.32 Since background noise levels depend upon wind speed, as indeed do wind turbine noise emissions, it is important when making reference measurements to put them in that context. Thus, the assessment of background noise levels at potentially sensitive residential properties requires the measurement of not only noise levels, but concurrent wind conditions, covering a representative range of wind speeds. These wind measurements are made at the wind turbine site rather than at the residential properties, since it is this wind speed that would subsequently govern the wind farm's noise generation. Often the residential properties themselves will be sheltered from the wind and may consequently have relatively low background noise levels.

10.33 To establish the baseline conditions, sound level meters and associated apparatus are set-up to record the required acoustic information at a selection of the nearest residential properties geographically spread around the proposed wind farm site and which are likely to be representative of other residential properties in the locale.

10.34 Wind speed and direction are recorded as 10 minute averages for the same period as for the noise measurements, and are synchronised with the acoustic data to allow correlations to be established. The wind speed that is adopted for use is the same wind speed as that which drives the turbine noise levels.

[12] 'Method for Rating Industrial Noise affecting Mixed Residential and Industrial Areas', British Standards Institution, 1997

10.35 The adoption of this wind speed was recommended within the article published in the IoA Bulletin and the subsequent IoA GPG. The methodology used to calculate standardised 10 m wind speed is described in **Technical Appendix 10.3**.

10.36 Prior to establishing the baseline conditions the acoustic data is filtered as follows:

- For each background noise measurement location, the measured noise data is divided into two sets, as specified by ETSU-R-97 and shown in **Table 10.2**:

Table 10.2 - Definition of Time of Day Periods

Time of Day	Definition
Quiet daytime	18:00 - 23:00 every day 13:00 - 18:00 Saturday 07:00 - 18:00 Sunday
Night-time	23:00 - 07:00 every day

- Rainfall affected data is systematically removed from the acoustic data set. To facilitate this, a rain gauge is deployed at the wind farm site to record 10 minute rainfall data and identify potentially affected noise data. Both the 10 minute period containing the bucket tip and the preceding 10 minute period are removed from the dataset as recommended in the IoA GPG to account for the time it takes for the rain gauge tipping bucket to fill.
- Periods of measured background noise data thought to be affected by extraneous, i.e. non-typical, noise sources are identified and removed from the data set. Whilst some 'extraneous' data may actually be real, it tends to bias any trend lines upwards so its removal is adopted as a conservative measure.
- In practice this means close inspection of the measured background noise levels, comparison with concurrent data measured at nearby locations and consideration of both directional and temporal variation.

Modelling Noise Propagation

10.37 Whilst there are several sound propagation models available, the ISO 9613 Part 2 model has been used[13], this being identified as most appropriate for use in such rural sites[14]. The specific interpretation of the ISO 9613 Part 2 propagation methodology recommended in the aforementioned IoA Bulletin and the subsequent IoA GPG has been employed.

10.38 To make noise predictions it is assumed that:

- the turbines are identical;
- the turbines radiate noise at the power specified in this report;
- each turbine can be modelled as a point source at hub-height;
- each residential property is assigned a reference height to simulate the presence of an observer.

[13] 'Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation', International Organisation for Standardisation, ISO 9613-2:1996

[14] 'A Critical Appraisal of Wind Farm Noise Propagation', ETSU Report W/13/00385/REP, 2000

10.39 The sound propagation model takes account of attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively, as recommended in the IoA Bulletin and IoA GPG. Ground effects are also taken into account by the propagation model with a ground factor of 0.5 and a receiver height of 4 m used as recommended in the IoA Bulletin and IoA GPG.

10.40 The barrier attenuations predicted by ISO 9613 Part 2 have been shown to be significantly greater than those measured in practice under downwind conditions[14]. Therefore, barrier attenuation according to the ISO 9613 Part 2 method has been discounted. In lieu of this, where there is no direct line of sight between the residential property in question and any part of the wind turbine, 2 dB attenuation has been assumed as recommended in the IoA Bulletin and the IoA GPG.

10.41 Additionally, verification studies have also shown that ISO 9613 Part 2 tends to slightly underestimate noise levels at nearby dwellings in certain exceptional cases, notably in a valley type environment where the ground drops off between source and receiver. In these instances an addition of 3 dB(A) has been applied to the resulting overall A-weighted noise level as recommended by the IoA GPG. Further detail is provided in **Technical Appendix 10.4**.

10.42 To generate the ground cross sections between each turbine and each dwelling necessary for reliable propagation modelling, ground contours at 5 m intervals for the area of interest have been generated from 50 m grid resolution digital terrain data.

10.43 The predicted noise levels are calculated as L_{Aeq} noise levels and changed to the L_{A90} descriptor (to allow comparisons to be made) by subtraction of -2 dB, as specified by ETSU-R-97.

10.44 It has been shown by measurement-based verification studies that the ISO 9613 Part 2 model tends to slightly overestimate noise levels at nearby dwellings[14]. Examples of additional conservative assumptions modelled are:

- properties are assumed to be downwind of all noise sources simultaneously and at all times. In reality, this is not the case and additional attenuation would be expected when a property is upwind or crosswind of the proposed wind turbines;
- although, in reality, the ground is predominantly porous (acoustically absorptive) it has been modelled as 'mixed', i.e. a combination of hard and porous, corresponding to a ground absorption coefficient of 0.5 as recommended by the IoA Bulletin and IoA GPG;
- receiver heights are modelled at 4 m above local ground level, which equates roughly to first floor window level, as recommended by the IoA Bulletin and IoA GPG. This results in a predicted noise level anything up to 2 dB(A) higher than at the typical human ear height of 1.2-1.8 m;
- trees and other non-terrain shielding effects have not been considered;
- an allowance for measurement uncertainty has been included in the sound power levels for the presented turbine.

Operational Noise Impact Criteria

10.45 Noise is measured in decibels (dB) which is a measure of the sound pressure level, i.e. the magnitude of the pressure variations in the air. Measurements of environmental noise are usually made in dB(A) which includes a correction for the sensitivity of the human ear.

10.46 ETSU-R-97 seeks to protect the internal and external amenity of wind farm neighbours by defining acceptable limits for operational noise from wind turbines. The test applied to operational noise is whether or not the noise levels produced by the combined operation of the wind turbines lie below noise limits derived in accordance with ETSU-R-97 at nearby residential properties.

Whilst ETSU-R-97 presents a comprehensive and detailed assessment methodology for wind farm noise, it also provides a simplified methodology:

"if the noise is limited to an $L_{A90,10min}$ of 35dB(A) up to wind speeds of 10 m/s at 10 m height, then these conditions alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary".

10.47 In the detailed methodology, ETSU-R-97 states that different limits should be applied during daytime and night-time periods. The daytime limits, derived from the background noise levels measured during quiet daytime periods, are intended to preserve outdoor amenity, while the night-time limits are intended to prevent sleep disturbance. The general principle is that the noise limits should be based on existing background noise levels, except for very low background noise levels, in which case a fixed limit may be applied. The suggested limits are given in **Table 10.3** below, where L_B is the background $L_{A90,10min}$ and is a function of wind speed. During daytime periods and at low background noise levels, a lower fixed limit of 35–40 dB(A) is applicable. The exact value is dependent upon a number of factors: the number of nearby dwellings, the effect of the noise limits on energy produced, and the duration and level of exposure.

Table 10.3 - Permissible Noise Level Criteria

Time of Day	Permissible Noise Level
Daytime	• 35-40 dB(A) for L_B less than 30-35 dB(A) • L_B + 5 dB, for L_B greater than 30-35 dB(A)
Night-time	• 43 dB(A) for L_B less than 38 dB(A) • L_B + 5 dB, for L_B greater than 38 dB(A)

10.48 Note that a higher noise level is permissible during the night than during the day as it is assumed that residents would be indoors. The night-time criterion is derived from sleep disturbance criterion referred to in ETSU-R-97, with an allowance of 10 dB for attenuation through an open window.

10.49 The wind speeds at which the acoustic impact is considered are less than or equal to 12 ms^{-1} at a height of 10 m and are likely to be the acoustically critical wind speeds. Above these wind speeds, as stated in ETSU-R-97, reliable measurements of background and turbine noise are difficult to make. However, if a wind farm meets the noise criteria at the wind speeds presented, it is most unlikely that it would cause any greater loss of amenity at higher wind speeds due to increasing background noise levels masking wind farm generated noise.

10.50 It is important to note that, since reactions to noise are subjective, it is not possible to guarantee that a given development would not result in any adverse comment with regard to noise as the response to any given noise will vary from person to person.

Consequently, standards and guidance that relate to environmental noise are typically presented in terms of criteria that would be expected to be considered acceptable by the majority of the population.

Construction Noise

10.51 To ensure adequate assessment of the potential impacts of the construction noise from the proposed wind farm the following steps have been taken:

- Baseline noise criteria are established from the appropriate guidance BS 5228-1:2009;
- Noise levels due to on-site construction activities are predicted at nearby residential properties in accordance with the BS 5228-1:2009 standard;
- Predicted noise levels due to construction traffic at the same residential properties are made using the BS 5228-1:2009 standard; and
- The combined effect of on-site construction activities with construction traffic is compared with the target level specified by BS 5228-1:2009;

Baseline Conditions

Operational Noise

10.52 The proposed development is located approximately 4 km north-west of Ballygally. The surrounding area is predominantly rural in nature and used for grazing sheep and cattle with an A-class road and the sea approximately 2 km to the east. The general noise character is typical of a rural environment with noise from farm machinery, sheep, cattle and birds, along with the occasional overhead aircraft.

10.53 Background noise measurements were undertaken by RES at five residential property locations in accordance with ETSU-R-97 as detailed in **Table 10.4** and shown in **Figure 10.1**.

Table 10.4 - Background Noise Survey Details

House ID	Measurement Period		
	Start	End	Duration (days)
H96	26/06/2019	28/08/2019	64
H105	26/06/2019	05/08/2019	41
H151	16/07/2019	28/08/2019	44
H158	26/06/2019	28/08/2019	64
H200	26/06/2019	28/08/2019	64

10.54 The background noise monitoring equipment was housed in weather-proof enclosures and powered by lead-acid batteries. The microphones were placed at a height of approximately 1.2 m above ground and equipped with all-weather wind shields which also provide an element of water resistance.

10.55 The proprietary wind shields used are designed to reduce the effects of wind-generated noise at the microphone and accord with the recommendations of the IoA GPG in that they are the appropriate size and, in combination with the microphone, are certified by the manufacturer as meeting Type 1 / Class 1 precision standards.

10.56 Noise levels are monitored continuously, and summary statistics stored every 10 minutes in the internal memory of each meter. The relevant statistic measured is the $L_{A90,10min}$ (The A-weighted sound pressure level exceeded for 90 % of the 10 minute interval).

10.57 The sound level meters were placed away from reflecting walls and vegetation. Photos of the equipment, in situ, may be seen in **Technical Appendix 10.5**. The apparatus were calibrated before and after the survey period and the maximum drift detected was 0.2 dB, which is within the required range recommended in the IoA GPG. All instrumentation has been subject to laboratory calibration traceable to national standards within the last 24 months, as recommended in the IoA GPG. Details are provided in **Technical Appendix 10.6**.

10.58 **Charts 1-3** (see **Technical Appendix 10.7** for all charts) show the measured wind rose over the background noise survey period, as measured by the LiDAR located on-site.

10.59 LiDAR (Light Detection and Ranging) is a remote sensing device that measures conditions in the atmosphere by using pulses from a LASER by applying the principle of the Doppler Effect, detecting the movement of air in the atmospheric boundary layer to measure wind speed and direction. LIDAR provides measurements at several heights, and this enables wind speed data to be obtained that describe the wind profile across a range of heights.

10.60 LiDAR has been successfully tested, by independent third parties using suitable test sites, against conventional anemometry[15,16]. From the technical reports, these tests have demonstrated that, over a range of relevant heights, the accuracy of the LiDAR is comparable to that of the conventional anemometry.

10.61 For illustrative purposes, **Chart 4** shows the measured wind rose over an extended period (17/11/2005 – 05/09/2008), as measured by a meteorological mast located 24 km from the proposed site. As previously discussed, the noise prediction model employed is likely to overestimate the real noise immission levels for locations not downwind of the turbines. **Chart 4** therefore may aid the reader as to the likelihood of over-estimation due to this factor.

10.62 The noise data has been cross-referenced with rainfall data measured at the LiDAR using a rain gauge. Any noise data identified as having been affected by rainfall has been removed from the analysis as shown in **Charts 5 to 14.**

10.63 Short-term periods of increased noise levels considered to be atypical have been removed from the dataset. The excluded data is shown in **Charts 5 to 14.**

10.64 **Charts 5 to 9** show $L_{A90,10min}$ correlated against wind speed for quiet daytime periods at each survey location. In each case, a 'best fit' line has been fitted to the data and the noise limits added. The equation of the regression polynomial has been provided in the charts.

10.65 **Charts 10 to 14** show $L_{A90,10min}$ correlated against the wind speed for night-time periods at each survey location. In each case, a 'best fit' line has been fitted to the data and

[15] "Evaluation of WINDCUBE", Albers et al, Deutsche WindGuard Consulting GmbH, Report PP 08007, 16 March 2008

[16] "Verification test for three WindCubeTM WLS7 LiDARs at the Høvsøre test site", Gottschall et al, DTU Report Risø-R-1732, May 2010

the noise limits added. The equation of the regression polynomial has been provided in the charts.

10.66 **Table 10.5** and **Table 10.6** detail the $L_{A90,10min}$ background noise levels calculated from the derived 'best fit' lines, as described above. Also shown are the background noise levels recorded at three locations in a survey undertaken for the previously proposed Feystown wind farm[17] in February – March 2013 and those recorded between 15/02/2017 and 04/03/2017 in a survey undertaken for a nearby single turbine with planning reference LA02/2017/0715/F.

Table 10.5 - Quiet Daytime Noise Levels (dB(A) re 20 μPa)

Survey Location	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H96	28.2	28.2	28.2	28.5	29.2	30.3	31.7	33.4	35.2	37.3	39.4	41.6
H105	27.0	27.0	27.1	27.6	28.5	29.7	31.1	32.8	34.7	36.8	38.9	41.2
H151	25.5	25.5	25.5	26.0	27.0	28.4	30.1	32.0	34.2	36.4	38.6	40.6
H158	28.5	29.6	30.5	31.3	32.0	32.7	33.4	34.1	35.0	36.0	37.3	38.8
H200	27.2	27.6	28.1	28.8	29.5	30.3	31.2	32.1	33.1	34.0	35.0	36.0
Feystown NM1 (H79)	28.1	28.1	28.1	28.1	29.4	30.9	32.8	34.9	37.4	40.2	40.2	40.2
Feystown NM2 (H124)	25.3	25.3	25.3	25.3	26.7	28.4	30.4	32.7	35.3	38.2	38.2	38.2
Feystown NM3 (H157)	25.2	25.2	25.2	25.2	26.2	27.6	29.3	31.3	33.6	36.3	36.3	36.3
LA02/2017/0715/F (H226)	30.1	30.1	30.1	30.1	30.1	33.1	35.8	38.4	41.0	43.5	45.9	48.3

Table 10.6 - Night-time Noise Levels (dB(A) re 20 μPa)

Survey Location	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H96	22.5	24.0	25.3	26.7	28.1	29.5	31.0	32.6	34.3	36.1	38.1	40.3
H105	25.9	25.9	25.9	25.9	25.9	26.3	27.1	28.4	30.2	32.4	35.1	38.2
H151	24.4	24.4	24.4	24.7	25.4	26.4	27.7	29.4	31.3	33.6	36.2	39.1
H158	22.9	24.4	25.8	27.0	28.2	29.3	30.4	31.7	33.0	34.6	36.4	38.4
H200	20.6	22.5	24.2	25.7	27.0	28.2	29.4	30.6	31.8	33.1	34.5	36.0
Feystown NM1 (H79)	22.5	22.5	22.5	22.5	24.4	27.0	30.1	33.5	37.0	40.2	40.2	40.2
Feystown NM2 (H124)	22.8	22.8	22.8	22.8	24.4	26.4	28.7	31.4	34.5	37.9	37.9	37.9
Feystown NM3 (H157)	23.4	23.4	23.4	23.4	24.6	26.1	28.0	30.2	32.8	35.7	35.7	35.7
LA02/2017/0715/F (H226)	26.8	26.8	26.8	26.8	26.8	30.7	34.0	37.0	39.8	42.5	45.1	47.6

10.67 The results from the Feystown survey compare well with those from the RES survey, especially those to the west of the proposed site (H105 & H151) where the Feystown monitoring positions are also located. It is therefore proposed to include data from the Feystown surveys in the assessment to provide a fuller picture of the background noise environment. The results from the monitoring for single turbine LA02/2017/0715/F are higher than the other surveys so it is proposed that this data should only be used at locations nearest to the single turbine in question.

[17] Feystown wind farm, planning application ID: F/2013/0101/F, appeal reference: 2014/A0285

Construction Noise

10.68 For the on-site construction noise assessment, Annex E of BS 5228-1:2009 provides guidance on setting environmental noise targets. Several methods of assessing the significance of noise levels are presented in Annex E and the most applicable to the construction of the proposed development is the ABC method. The ABC method sets threshold noise levels for specific periods based on the ambient noise levels.

Potential Impacts

Potential Operational Impacts

Noise Propagation Modelling

10.69 The locations of the proposed turbines are provided in **Table 10.7** and shown in **Figure 10.1**.

Table 10.7 - Location of Proposed Turbines

Turbine	Co-ordinates	
	X (m)	Y (m)
T1	332645	411490
T2	333037	411477
T3	333349	411356
T4	332953	411108
T5	332607	410651
T6	333015	410541
T7	332777	410202
T8	333167	410187
T9	333283	409907
T10	332866	409860
T11	333348	409538
T12	332901	409392
T13	333050	409135
T14	333164	408695

10.70 The locations of the nearest residential properties to the turbines have been determined by inspection of relevant maps and through site visits. More residential properties may have been identified but have not been considered critical to this acoustic assessment or may be adequately represented by another residential property. The locations considered are listed in **Table 10.8** and are also shown in **Figure 10.1**.

10.71 The distances from each residential property to the nearest turbine are given in **Table 10.8**. It can be seen that the minimum house-to-turbine separation is 999 m.

Table 10.8 - Location of Residential Properties and Distances to Nearest Proposed Turbine

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
6 LOUGHDOO ROAD	H1	332020	405782	3130	T14

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
4A LOUGHDOO ROAD	H2	332075	405835	3060	T14
63 MULLAGHSANDALL	H3	331603	405838	3256	T14
5 LOUGHDOO ROAD	H4	332304	405887	2937	T14
10 LOUGHDOO ROAD	H5	331637	406111	3001	T14
7 LOUGHDOO ROAD	H6	332193	406142	2731	T14
10A LOUGHDOO ROAD	H7	331650	406169	2945	T14
26 SALLAGH ROAD	H8	334589	406271	2812	T14
28 SALLAGH ROAD	H9	334875	406695	2632	T14
30 SALLAGH ROAD	H10	334911	406797	2580	T14
24 AUGHABOY ROAD	H11	331093	406898	2742	T14
32 SALLAGH ROAD	H12	334781	407102	2270	T14
23 AUGHABOY ROAD	H13	330686	407113	2940	T14
4 SALLAGH LANE	H14	335570	407129	2871	T14
21B AUGHABOY ROAD	H15	330885	407212	2719	T14
21A AUGHABOY ROAD	H16	330865	407237	2722	T14
3 SALLAGH LANE	H17	335202	407274	2484	T14
14 BALLYCOOSE ROAD	H18	335638	407423	2782	T14
120 BRUSTIN BRAE ROAD	H19	335935	407427	3047	T14
2 DRUMNAGREAGH ROAD	H20	335893	407434	3006	T14
8 BALLYCOOSE ROAD	H21	335736	407442	2861	T14
12 BALLYCOOSE ROAD	H22	335725	407451	2847	T14
1 DRUMNAGREAGH ROAD	H23	335950	407458	3048	T14
18 AUGHABOY ROAD	H24	330834	407461	2637	T14
DRUMNAGREAGH ROAD	H25	335882	407471	2981	T14
4 DRUMNAGREAGH ROAD	H26	335890	407481	2984	T14
3 DRUMNAGREAGH ROAD	H27	335921	407494	3007	T14
_ DRUMNAGREAGH ROAD	H28	335896	407496	2984	T14
2 BALLYCOOSE ROAD	H29	335830	407498	2922	T14
30 LOUGHDOO ROAD	H30	331734	407499	1864	T14
10 BALLYCOOSE ROAD	H31	335723	407501	2824	T14
5 DRUMNAGREAGH ROAD	H32	335930	407512	3008	T14
7 DRUMNAGREAGH ROAD	H33	335908	407513	2988	T14
4 BALLYCOOSE ROAD	H34	335808	407520	2893	T14
6 BALLYCOOSE ROAD	H35	335778	407541	2857	T14
40 BALLYCOOSE ROAD	H36	335122	407554	2266	T14
16 BALLYCOOSE ROAD	H37	335741	407571	2811	T14
6 DRUMNAGREAGH ROAD	H38	335852	407576	2912	T14
8 DRUMNAGREAGH ROAD	H39	335845	407585	2902	T14

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
18 BALLYCOOSE ROAD	H40	335772	407592	2832	T14
19 AUGHABOY ROAD	H41	330721	407598	2678	T14
10 DRUMNAGREAGH ROAD	H42	335811	407616	2858	T14
7 BALLYCOOSE ROAD	H43	335772	407640	2813	T14
28 BALLYCOOSE ROAD	H44	335549	407643	2607	T14
14 DRUMNAGREAGH ROAD	H45	335793	407650	2829	T14
32 BALLYCOOSE ROAD	H46	335476	407651	2537	T14
12 DRUMNAGREAGH ROAD	H47	335800	407653	2834	T14
26A BALLYCOOSE ROAD	H48	335582	407663	2629	T14
26 BALLYCOOSE ROAD	H49	335610	407666	2654	T14
11 BALLYCOOSE ROAD	H50	335742	407667	2775	T14
24 BALLYCOOSE ROAD	H51	335650	407668	2690	T14
30 BALLYCOOSE ROAD	H52	335521	407669	2571	T14
17 AUGHABOY ROAD	H53	330678	407682	2684	T14
15 AUGHABOY ROAD	H54	330728	407751	2613	T14
38B LOUGHDOO ROAD	H55	331658	407765	1770	T14
38 LOUGHDOO ROAD	H56	331671	407802	1740	T14
38A LOUGHDOO ROAD	H57	331661	407822	1738	T14
15 DRUMNAGREAGH ROAD	H58	336004	407842	2965	T14
14 AUGHABOY ROAD	H59	330853	407866	2455	T14
18 DRUMNAGREAGH ROAD	H61	335658	407895	2619	T14
12 AUGHABOY ROAD	H62	330880	407899	2419	T14
16 AUGHABOY ROAD	H63	330818	407910	2474	T14
20 DRUMNAGREAGH ROAD	H64	335660	407913	2616	T14
20A DRUMNAGREAGH	H65	335613	407992	2548	T14
LOUGHDOO ROAD	H66	331702	407996	1621	T14
10 AUGHABOY ROAD	H67	330913	408005	2354	T14
22 DRUMNAGREAGH ROAD	H68	335599	408028	2525	T14
24 DRUMNAGREAGH ROAD	H69	335596	408039	2519	T14
8A AUGHABOY ROAD	H70	330748	408075	2494	T14
17 DRUMNAGREAGH ROAD	H71	335733	408078	2642	T14
8 AUGHABOY ROAD	H72	330740	408122	2491	T14
25 DRUMNAGREAGH ROAD	H73	335574	408223	2456	T14
26 DRUMNAGREAGH ROAD	H74	335465	408238	2346	T14
26A DRUMNAGREAGH	H75	335432	408250	2311	T14
31 BALLYCOOSE ROAD	H76	334480	408256	1387	T14
5 AUGHABOY ROAD	H77	330539	408289	2607	T12
28 DRUMNAGREAGH ROAD	H78	335376	408372	2235	T14

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
92 FEYSTOWN ROAD	H79	332071	408420	1127	T14
28A DRUMNAGREAGH	H80	335477	408421	2329	T14
30 DRUMNAGREAGH ROAD	H81	335439	408457	2287	T14
32 DRUMNAGREAGH ROAD	H82	335410	408512	2253	T14
10 DRUMCROW ROAD	H83	331362	408561	1749	T12
4 AUGHABOY ROAD	H84	330690	408576	2357	T12
COAST ROAD	H85	335968	408653	2765	T11
35 DRUMNAGREAGH ROAD	H86	335524	408738	2318	T11
60 DRUMNAGREAGH ROAD	H87	334765	408808	1594	T11
86 FEYSTOWN ROAD	H88	331975	408817	1090	T12
6 DRUMCROW ROAD	H89	331339	408822	1663	T12
38 DRUMNAGREAGH ROAD	H90	335137	408864	1912	T11
380 COAST ROAD	H91	336012	408890	2742	T11
19 DRUMCROW ROAD	H92	330405	408917	2541	T12
21 DRUMCROW ROAD	H93	330323	409011	2606	T12
3 DRUMCROW ROAD	H94	331473	409077	1462	T12
39 DRUMNAGREAGH ROAD	H95	335631	409103	2324	T11
58 DRUMNAGREAGH ROAD	H96	334787	409123	1498	T11
56 DRUMNAGREAGH ROAD	H97	334727	409126	1439	T11
41 DRUMNAGREAGH ROAD	H98	335653	409139	2339	T11
23 DRUMCROW ROAD	H99	330160	409149	2752	T12
87 FEYSTOWN ROAD	H100	331376	409199	1537	T12
52 DRUMNAGREAGH ROAD	H101	334697	409206	1389	T11
49 DRUMNAGREAGH ROAD	H102	335289	409248	1963	T11
54 DRUMNAGREAGH ROAD	H103	334459	409278	1141	T11
51 DRUMNAGREAGH ROAD	H104	335250	409283	1919	T11
85 FEYSTOWN ROAD	H105	331453	409296	1451	T12
85A FEYSTOWN ROAD	H106	331528	409307	1376	T12
53A DRUMNAGREAGH	H107	335309	409310	1974	T11
366 COAST ROAD	H108	335803	409328	2464	T11
368 COAST ROAD	H109	335796	409346	2456	T11
46 DRUMNAGREAGH ROAD	H110	335050	409395	1708	T11
53 DRUMNAGREAGH ROAD	H111	335240	409397	1897	T11
55 DRUMNAGREAGH ROAD	H112	335666	409483	2319	T11
83 FEYSTOWN ROAD	H113	331622	409510	1284	T12
83A FEYSTOWN ROAD	H114	331645	409511	1262	T12
50 DRUMNAGREAGH ROAD	H115	334696	409560	1348	T11
79 FEYSTOWN ROAD	H116	331235	409601	1651	T10

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
79B FEYSTOWN ROAD	H117	331278	409609	1608	T10
77 FEYSTOWN ROAD	H118	331214	409647	1659	T7
78 FEYSTOWN ROAD	H119	331665	409723	1209	T10
59 DRUMNAGREAGH ROAD	H120	335342	409730	2003	T11
76 FEYSTOWN ROAD	H121	331661	409740	1208	T7
380A COAST ROAD	H122	335578	409898	2259	T11
FEYSTOWN ROAD	H123	331605	410027	1180	T5
72A FEYSTOWN ROAD	H124	331792	410033	999	T7
70 DRUMNAGREAGH ROAD	H125	334940	410046	1663	T9
70C FEYSTOWN ROAD	H126	331589	410086	1164	T5
70B FEYSTOWN ROAD	H127	331584	410115	1155	T5
71 FEYSTOWN ROAD	H128	331383	410119	1335	T5
67 DRUMNAGREAGH ROAD	H129	335326	410121	2054	T9
70A FEYSTOWN ROAD	H130	331579	410150	1144	T5
71 DRUMNAGREAGH ROAD	H131	335306	410159	2039	T9
67 FEYSTOWN ROAD	H132	331209	410245	1456	T5
68 FEYSTOWN ROAD	H133	331560	410252	1120	T5
74 DRUMNAGREAGH ROAD	H134	334854	410278	1614	T9
76B DRUMNAGREAGH ROAD	H135	334973	410310	1737	T9
76A DRUMNAGREAGH	H136	334914	410345	1689	T9
76 DRUMNAGREAGH ROAD	H137	334916	410372	1698	T9
63 FEYSTOWN ROAD	H138	331143	410660	1464	T5
78 DRUMNAGREAGH ROAD	H139	334895	410667	1693	T3
82 DRUMNAGREAGH ROAD	H140	334671	410733	1461	T3
61 LISLES HILL ROAD	H141	329543	410735	3065	T5
__ DRUMNAGREAGH ROAD	H142	335124	410784	1865	T3
_ FEYSTOWN ROAD	H143	331287	410808	1329	T5
86 DRUMNAGREAGH ROAD	H144	335057	410900	1768	T3
90 DRUMNAGREAGH ROAD	H145	334756	410923	1472	T3
88 DRUMNAGREAGH ROAD	H146	335057	410931	1760	T3
60 FEYSTOWN ROAD	H147	331313	410952	1329	T5
59 FEYSTOWN ROAD	H148	331180	410958	1460	T5
87 DRUMNAGREAGH ROAD	H149	335021	411090	1693	T3
89 DRUMNAGREAGH ROAD	H150	335035	411095	1706	T3
57 FEYSTOWN ROAD	H151	331208	411097	1468	T5
102 MUNIE ROAD	H152	329277	411292	3374	T1
96A DRUMNAGREAGH	H153	334470	411327	1121	T3
96 DRUMNAGREAGH ROAD	H154	334534	411328	1185	T3

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
98A DRUMNAGREAGH	H155	334533	411402	1185	T3
98 DRUMNAGREAGH ROAD	H156	334539	411408	1191	T3
54 FEYSTOWN ROAD	H157	331497	411423	1150	T1
100 DRUMNAGREAGH ROAD	H158	334345	411444	1000	T3
100 MUNIE ROAD	H159	329278	411453	3367	T1
97 DRUMNAGREAGH ROAD	H160	334911	411527	1571	T3
99 DRUMNAGREAGH ROAD	H161	334887	411557	1551	T3
97A DRUMNAGREAGH	H162	334908	411557	1572	T3
98 MUNIE ROAD	H163	329301	411563	3345	T1
53 FEYSTOWN ROAD	H164	331022	411574	1625	T1
101 DRUMNAGREAGH ROAD	H165	334891	411597	1561	T3
102 DRUMNAGREAGH ROAD	H166	334837	411609	1509	T3
97 MUNIE ROAD	H167	329248	411632	3400	T1
105 DRUMNAGREAGH ROAD	H168	334824	411774	1533	T3
93 MUNIE ROAD	H169	329138	411834	3524	T1
81 DICKEYSTOWN ROAD	H170	334586	411944	1370	T3
81A DICKEYSTOWN ROAD	H171	334608	411946	1390	T3
MUNIE ROAD	H172	330179	411974	2513	T1
3B CASTLE LANE	H173	330183	411978	2510	T1
3C CASTLE LANE	H174	330227	412028	2477	T1
75 DICKEYSTOWN ROAD	H175	334525	412139	1413	T3
73 DICKEYSTOWN ROAD	H176	334497	412169	1407	T3
49 FEYSTOWN ROAD	H177	330765	412180	2003	T1
71 DICKEYSTOWN ROAD	H178	334468	412185	1393	T3
87 MUNIE ROAD	H179	329389	412202	3333	T1
65B DICKEYSTOWN ROAD	H180	334130	412236	1177	T3
402 COAST ROAD	H181	334754	412253	1667	T3
_ MUNIE ROAD	H182	329395	412254	3339	T1
65 DICKEYSTOWN ROAD	H183	334126	412256	1189	T3
65A DICKEYSTOWN ROAD	H184	334129	412272	1203	T3
67 DICKEYSTOWN ROAD	H185	334002	412273	1126	T3
404 COAST ROAD	H186	334740	412277	1668	T3
406 COAST ROAD	H187	334679	412383	1680	T3
79 MUNIE ROAD	H188	329293	412385	3469	T1
67A DICKEYSTOWN ROAD	H189	334154	412396	1315	T3
77 MUNIE ROAD	H191	329313	412417	3459	T1
61A DICKEYSTOWN ROAD	H192	333584	412437	1105	T2
66 DICKEYSTOWN ROAD	H193	334306	412523	1509	T3

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
75 MUNIE ROAD	H194	329197	412542	3605	T1
64 DICKEYSTOWN ROAD	H195	334312	412560	1542	T3
61B DICKEYSTOWN ROAD	H196	333589	412564	1219	T2
75A MUNIE ROAD	H197	329200	412573	3611	T1
46 FEYSTOWN ROAD	H198	331244	412636	1810	T1
59 DICKEYSTOWN ROAD	H200	333679	412682	1365	T2
45 FEYSTOWN ROAD	H202	330856	412702	2161	T1
71 MUNIE ROAD	H203	329432	412792	3467	T1
CASTLE LANE	H204	330006	412822	2956	T1
69 MUNIE ROAD	H205	329414	412861	3510	T1
414 COAST ROAD	H206	334302	412873	1792	T3
418 COAST ROAD	H207	334283	413030	1917	T3
52 DICKEYSTOWN ROAD	H208	333738	413038	1711	T2
36 FEYSTOWN ROAD	H209	331687	413119	1890	T1
56 DICKEYSTOWN ROAD	H210	333831	413203	1900	T2
54 DICKEYSTOWN ROAD	H211	333821	413205	1898	T2
54A DICKEYSTOWN ROAD	H212	333829	413213	1908	T2
61 MUNIE ROAD	H213	329360	413270	3736	T1
60 MUNIE ROAD	H214	329708	413276	3437	T1
419 COAST ROAD	H215	334153	413283	2088	T3
41 FEYSTOWN ROAD	H216	331098	413295	2377	T1
27 DICKEYSTOWN ROAD	H217	333224	413382	1914	T2
47A TULLY ROAD	H218	329490	413421	3699	T1
51 DICKEYSTOWN ROAD	H219	333347	413421	1969	T2
58 DICKEYSTOWN ROAD	H220	333669	413467	2088	T2
4 CASTLE LANE	H221	330215	413500	3154	T1
47 TULLY ROAD	H222	329531	413513	3713	T1
49 DICKEYSTOWN ROAD	H223	333051	413536	2059	T2
49A DICKEYSTOWN ROAD	H224	333106	413569	2093	T2
39 FEYSTOWN ROAD	H225	330884	413605	2752	T1
45 DICKEYSTOWN ROAD	H226	332784	413664	2178	T1
45 TULLY ROAD	H227	329645	413680	3714	T1
29 TOWN BRAE	H228	331003	413755	2798	T1
43 DICKEYSTOWN ROAD	H229	332798	413847	2362	T1
43A DICKEYSTOWN ROAD	H230	332807	413850	2366	T1
41 DICKEYSTOWN ROAD	H231	332644	413855	2365	T1
3 CASTLE LANE	H232	330214	413908	3429	T1
2 CASTLE LANE	H233	330218	413919	3434	T1

House Name	House ID	Co-ordinates		Distance (m)	Nearest Turbine
		X (m)	Y (m)		
2A CASTLE LANE	H234	330209	413992	3492	T1
28 FEYSTOWN ROAD	H235	331225	414050	2927	T1
21 MUNIE ROAD	H236	330031	414056	3663	T1
33 DICKEYSTOWN ROAD	H237	332127	414061	2623	T1
33A DICKEYSTOWN ROAD	H238	332141	414085	2643	T1
37 DICKEYSTOWN ROAD	H239	332512	414216	2729	T1
35 DICKEYSTOWN ROAD	H240	332494	414229	2743	T1
29 DICKEYSTOWN ROAD	H241	331839	414345	2967	T1
424 COAST ROAD	H242	333332	414349	2887	T2
20 FEYSTOWN ROAD	H243	331466	414391	3131	T1
36 DICKEYSTOWN ROAD	H244	332323	414546	3073	T1
34 DICKEYSTOWN ROAD	H245	332185	414547	3091	T1
30 DICKEYSTOWN ROAD	H246	332125	414574	3128	T1
30A DICKEYSTOWN ROAD	H247	332096	414588	3146	T1
26 DICKEYSTOWN ROAD	H248	331807	414843	3456	T1

10.72 Although not finalised, the candidate turbine type for the proposed development is the Vestas V117-4.2MW turbine. This report uses the acoustic data from the manufacturer's general specification for this machine for all analysis[18]. The manufacturer has identified these values as warranted although no independent test reports are available to indicate whether any margin has been incorporated, therefore 2 dB has been added to the warranted levels as a conservative measure as recommended by the IoA GPG. Details used in this analysis are as follows:

- a hub height of 91.4 m;
- a rotor diameter of 117.0 m;
- sound power levels, L_{WA}, for standardised 10 m height wind speeds (v_{10}) as shown in **Table 10.9**;
- octave band sound power level data, at the wind speeds where it is available, as shown in **Table 10.10**;
- tonal emission characteristics such that no clearly audible tones are present at any wind speed.

Table 10.9 - A-Weighted Sound Power Levels (dB(A) re 1 pW) for the Vestas V117-4.2MW Wind Turbine

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Warranted	Plus Uncertainty
1	93.1	95.1
2	93.1	95.1
3	93.1	95.1

[18] 'Performance Specification V117 - 4.0/4.2 MW', Vestas Document ID: 0067 7063 V03, 2017-11-29

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Warranted	Plus Uncertainty
4	96.0	98.0
5	100.2	102.2
6	104.0	106.0
7	105.9	107.9
8	106.0	108.0
9	106.0	108.0
10	106.0	108.0
11	106.0	108.0
12	106.0	108.0

Table 10.10 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at Standardised 10m Height Wind Speeds for the Vestas V117-4.2MW Wind Turbine

Octave Band (Hz)	8 ms^{-1}
63	88.3
125	95.5
250	100.3
500	102.6
1000	102.4
2000	99.7
4000	94.6
8000	87.0
OVERALL	108.0

Predictions of Noise Levels at Residential Properties

10.73 **Table 10.11** shows the predicted noise immission levels at the nearest residential properties at each wind speed considered, calculated from the operation of the proposed wind farm. The property with the highest predicted noise immission level of 41.0 dB(A) is 72A FEYSTOWN ROAD (H124).

10.74 **Figure 10.1** shows an isobel (i.e. noise contour) plot for the site at a 10 m height wind speed of 8 ms^{-1}. Such plots are useful for evaluating the noise 'footprint' of a given development.

Table 10.11 - Predicted Noise Levels At Nearby Residential Properties, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	13.0	13.0	13.0	15.9	20.1	23.9	25.8	25.9	25.9	25.9	25.9	25.9
H2	14.1	14.1	14.1	17.0	21.2	25.0	26.9	27.0	27.0	27.0	27.0	27.0
H3	13.1	13.1	13.1	16.0	20.2	24.0	25.9	26.0	26.0	26.0	26.0	26.0
H4	15.8	15.8	15.8	18.7	22.9	26.7	28.6	28.7	28.7	28.7	28.7	28.7
H5	14.5	14.5	14.5	17.4	21.6	25.4	27.3	27.4	27.4	27.4	27.4	27.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H6	17.5	17.5	17.5	20.4	24.6	28.4	30.3	30.4	30.4	30.4	30.4	30.4
H7	15.1	15.1	15.1	18.0	22.1	25.9	27.8	28.0	28.0	28.0	28.0	28.0
H8	16.1	16.1	16.1	19.0	23.2	27.0	28.9	29.0	29.0	29.0	29.0	29.0
H9	14.1	14.1	14.1	17.0	21.2	25.0	26.9	27.0	27.0	27.0	27.0	27.0
H10	15.1	15.1	15.1	18.0	22.2	26.0	27.9	28.0	28.0	28.0	28.0	28.0
H11	18.0	18.0	18.0	20.9	25.1	28.9	30.8	30.9	30.9	30.9	30.9	30.9
H12	17.1	17.1	17.1	20.0	24.2	28.0	29.9	30.0	30.0	30.0	30.0	30.0
H13	18.9	18.9	18.9	21.8	26.0	29.8	31.7	31.8	31.8	31.8	31.8	31.8
H14	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H15	19.0	19.0	19.0	21.9	26.1	29.9	31.8	31.9	31.9	31.9	31.9	31.9
H16	19.1	19.1	19.1	22.0	26.2	30.0	31.9	32.0	32.0	32.0	32.0	32.0
H17	16.8	16.8	16.8	19.7	23.9	27.7	29.6	29.7	29.7	29.7	29.7	29.7
H18	16.2	16.2	16.2	19.1	23.3	27.1	29.0	29.1	29.1	29.1	29.1	29.1
H19	15.5	15.5	15.5	18.4	22.6	26.4	28.3	28.4	28.4	28.4	28.4	28.4
H20	15.6	15.6	15.6	18.5	22.7	26.5	28.4	28.5	28.5	28.5	28.5	28.5
H21	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H22	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H23	15.5	15.5	15.5	18.4	22.6	26.4	28.3	28.4	28.4	28.4	28.4	28.4
H24	19.6	19.6	19.6	22.5	26.7	30.5	32.4	32.5	32.5	32.5	32.5	32.5
H25	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H26	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H27	15.6	15.6	15.6	18.5	22.7	26.5	28.4	28.5	28.5	28.5	28.5	28.5
H28	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H29	15.9	15.9	15.9	18.8	23.0	26.8	28.7	28.8	28.8	28.8	28.8	28.8
H30	19.9	19.9	19.9	22.8	27.0	30.8	32.7	32.8	32.8	32.8	32.8	32.8
H31	16.2	16.2	16.2	19.1	23.3	27.1	29.0	29.1	29.1	29.1	29.1	29.1
H32	15.7	15.7	15.7	18.6	22.7	26.5	28.5	28.6	28.6	28.6	28.6	28.6
H33	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H34	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H35	16.1	16.1	16.1	19.0	23.2	27.0	28.9	29.0	29.0	29.0	29.0	29.0
H36	17.8	17.8	17.8	20.7	24.9	28.7	30.6	30.7	30.7	30.7	30.7	30.7
H37	16.3	16.3	16.3	19.2	23.4	27.2	29.1	29.2	29.2	29.2	29.2	29.2
H38	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H39	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H40	16.2	16.2	16.2	19.1	23.3	27.1	29.0	29.1	29.1	29.1	29.1	29.1
H41	20.2	20.2	20.2	23.1	27.3	31.1	33.0	33.1	33.1	33.1	33.1	33.1
H42	16.2	16.2	16.2	19.1	23.3	27.1	29.0	29.1	29.1	29.1	29.1	29.1
H43	16.3	16.3	16.3	19.2	23.4	27.2	29.1	29.2	29.2	29.2	29.2	29.2

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H44	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8
H45	16.3	16.3	16.3	19.2	23.4	27.2	29.1	29.2	29.2	29.2	29.2	29.2
H46	17.2	17.2	17.2	20.1	24.3	28.1	30.0	30.1	30.1	30.1	30.1	30.1
H47	16.3	16.3	16.3	19.2	23.4	27.2	29.1	29.2	29.2	29.2	29.2	29.2
H48	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8
H49	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8
H50	16.5	16.5	16.5	19.4	23.6	27.4	29.3	29.4	29.4	29.4	29.4	29.4
H51	16.7	16.7	16.7	19.6	23.8	27.6	29.5	29.6	29.6	29.6	29.6	29.6
H52	17.1	17.1	17.1	20.0	24.2	28.0	29.9	30.0	30.0	30.0	30.0	30.0
H53	20.3	20.3	20.3	23.2	27.4	31.2	33.1	33.2	33.2	33.2	33.2	33.2
H54	20.6	20.6	20.6	23.5	27.7	31.5	33.4	33.5	33.5	33.5	33.5	33.5
H55	20.7	20.7	20.7	23.6	27.8	31.6	33.5	33.6	33.6	33.6	33.6	33.6
H56	20.9	20.9	20.9	23.8	28.0	31.8	33.7	33.8	33.8	33.8	33.8	33.8
H57	20.9	20.9	20.9	23.8	28.0	31.8	33.7	33.8	33.8	33.8	33.8	33.8
H58	16.1	16.1	16.1	19.0	23.2	27.0	28.9	29.0	29.0	29.0	29.0	29.0
H59	21.1	21.1	21.1	24.0	28.2	32.0	33.9	34.0	34.0	34.0	34.0	34.0
H61	17.2	17.2	17.2	20.1	24.3	28.1	30.0	30.1	30.1	30.1	30.1	30.1
H62	20.9	20.9	20.9	23.8	28.0	31.8	33.7	33.8	33.8	33.8	33.8	33.8
H63	21.1	21.1	21.1	24.0	28.2	32.0	33.9	34.0	34.0	34.0	34.0	34.0
H64	17.2	17.2	17.2	20.1	24.3	28.1	30.0	30.1	30.1	30.1	30.1	30.1
H65	17.5	17.5	17.5	20.4	24.6	28.4	30.3	30.4	30.4	30.4	30.4	30.4
H66	21.8	21.8	21.8	24.7	28.9	32.7	34.6	34.7	34.7	34.7	34.7	34.7
H67	20.8	20.8	20.8	23.7	27.9	31.7	33.6	33.7	33.7	33.7	33.7	33.7
H68	17.7	17.7	17.7	20.6	24.8	28.6	30.5	30.6	30.6	30.6	30.6	30.6
H69	17.7	17.7	17.7	20.6	24.8	28.6	30.5	30.6	30.6	30.6	30.6	30.6
H70	21.3	21.3	21.3	24.2	28.4	32.2	34.1	34.2	34.2	34.2	34.2	34.2
H71	17.3	17.3	17.3	20.2	24.4	28.2	30.1	30.2	30.2	30.2	30.2	30.2
H72	21.3	21.3	21.3	24.2	28.4	32.2	34.1	34.2	34.2	34.2	34.2	34.2
H73	18.1	18.1	18.1	21.0	25.2	29.0	30.9	31.0	31.0	31.0	31.0	31.0
H74	18.5	18.5	18.5	21.4	25.6	29.4	31.3	31.4	31.4	31.4	31.4	31.4
H75	18.7	18.7	18.7	21.6	25.8	29.6	31.5	31.6	31.6	31.6	31.6	31.6
H76	22.1	22.1	22.1	25.0	29.2	33.0	34.9	35.0	35.0	35.0	35.0	35.0
H77	21.2	21.2	21.2	24.1	28.3	32.1	34.0	34.1	34.1	34.1	34.1	34.1
H78	18.9	18.9	18.9	21.8	26.0	29.8	31.7	31.8	31.8	31.8	31.8	31.8
H79	24.9	24.9	24.9	27.8	32.0	35.8	37.7	37.8	37.8	37.8	37.8	37.8
H80	18.8	18.8	18.8	21.7	25.9	29.7	31.6	31.7	31.7	31.7	31.7	31.7
H81	18.8	18.8	18.8	21.7	25.9	29.7	31.6	31.7	31.7	31.7	31.7	31.7
H82	19.0	19.0	19.0	21.9	26.1	29.9	31.8	31.9	31.9	31.9	31.9	31.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H83	22.2	22.2	22.2	25.1	29.3	33.1	35.0	35.1	35.1	35.1	35.1	35.1
H84	21.9	21.9	21.9	24.8	29.0	32.8	34.7	34.8	34.8	34.8	34.8	34.8
H85	17.5	17.5	17.5	20.4	24.6	28.4	30.3	30.4	30.4	30.4	30.4	30.4
H86	19.0	19.0	19.0	21.9	26.1	29.9	31.8	31.9	31.9	31.9	31.9	31.9
H87	22.2	22.2	22.2	25.1	29.3	33.1	35.0	35.1	35.1	35.1	35.1	35.1
H88	25.0	25.0	25.0	27.9	32.1	35.9	37.8	37.9	37.9	37.9	37.9	37.9
H89	23.0	23.0	23.0	25.9	30.1	33.9	35.8	35.9	35.9	35.9	35.9	35.9
H90	20.3	20.3	20.3	23.2	27.4	31.2	33.1	33.2	33.2	33.2	33.2	33.2
H91	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8
H92	21.9	21.9	21.9	24.8	29.0	32.8	34.7	34.8	34.8	34.8	34.8	34.8
H93	21.6	21.6	21.6	24.5	28.7	32.5	34.4	34.5	34.5	34.5	34.5	34.5
H94	24.2	24.2	24.2	27.1	31.3	35.1	37.0	37.1	37.1	37.1	37.1	37.1
H95	19.1	19.1	19.1	22.0	26.2	30.0	31.9	32.0	32.0	32.0	32.0	32.0
H96	23.0	23.0	23.0	25.9	30.1	33.9	35.8	35.9	35.9	35.9	35.9	35.9
H97	23.3	23.3	23.3	26.2	30.4	34.2	36.1	36.2	36.2	36.2	36.2	36.2
H98	19.1	19.1	19.1	22.0	26.2	30.0	31.9	32.0	32.0	32.0	32.0	32.0
H99	21.1	21.1	21.1	24.0	28.2	32.0	33.9	34.0	34.0	34.0	34.0	34.0
H100	23.9	23.9	23.9	26.8	31.0	34.8	36.7	36.8	36.8	36.8	36.8	36.8
H101	23.6	23.6	23.6	26.5	30.7	34.5	36.4	36.5	36.5	36.5	36.5	36.5
H102	20.1	20.1	20.1	23.0	27.2	31.0	32.9	33.0	33.0	33.0	33.0	33.0
H103	24.8	24.8	24.8	27.7	31.9	35.7	37.6	37.7	37.7	37.7	37.7	37.7
H104	20.2	20.2	20.2	23.1	27.3	31.1	33.0	33.1	33.1	33.1	33.1	33.1
H105	24.6	24.6	24.6	27.5	31.7	35.5	37.4	37.5	37.5	37.5	37.5	37.5
H106	25.1	25.1	25.1	28.0	32.2	36.0	37.9	38.0	38.0	38.0	38.0	38.0
H107	20.1	20.1	20.1	23.0	27.2	31.0	32.9	33.0	33.0	33.0	33.0	33.0
H108	18.0	18.0	18.0	20.9	25.1	28.9	30.8	30.9	30.9	30.9	30.9	30.9
H109	17.9	17.9	17.9	20.8	25.0	28.8	30.7	30.8	30.8	30.8	30.8	30.8
H110	21.9	21.9	21.9	24.8	29.0	32.8	34.7	34.8	34.8	34.8	34.8	34.8
H111	20.5	20.5	20.5	23.4	27.6	31.4	33.3	33.4	33.4	33.4	33.4	33.4
H112	19.2	19.2	19.2	22.1	26.3	30.1	32.0	32.1	32.1	32.1	32.1	32.1
H113	26.1	26.1	26.1	29.0	33.2	37.0	38.9	39.0	39.0	39.0	39.0	39.0
H114	26.2	26.2	26.2	29.1	33.3	37.1	39.0	39.1	39.1	39.1	39.1	39.1
H115	23.0	23.0	23.0	25.9	30.1	33.9	35.8	35.9	35.9	35.9	35.9	35.9
H116	24.3	24.3	24.3	27.2	31.4	35.2	37.1	37.2	37.2	37.2	37.2	37.2
H117	24.6	24.6	24.6	27.5	31.7	35.5	37.4	37.5	37.5	37.5	37.5	37.5
H118	24.3	24.3	24.3	27.2	31.3	35.1	37.1	37.2	37.2	37.2	37.2	37.2
H119	26.7	26.7	26.7	29.6	33.8	37.6	39.5	39.6	39.6	39.6	39.6	39.6
H120	20.6	20.6	20.6	23.5	27.7	31.5	33.4	33.5	33.5	33.5	33.5	33.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H121	26.7	26.7	26.7	29.6	33.8	37.6	39.5	39.6	39.6	39.6	39.6	39.6
H122	19.2	19.2	19.2	22.1	26.3	30.1	32.0	32.1	32.1	32.1	32.1	32.1
H123	26.7	26.7	26.7	29.6	33.8	37.6	39.5	39.6	39.6	39.6	39.6	39.6
H124	28.1	28.1	28.1	31.0	35.2	39.0	40.9	41.0	41.0	41.0	41.0	41.0
H125	22.6	22.6	22.6	25.5	29.7	33.5	35.4	35.5	35.5	35.5	35.5	35.5
H126	26.6	26.6	26.6	29.5	33.7	37.5	39.4	39.5	39.5	39.5	39.5	39.5
H127	26.6	26.6	26.6	29.5	33.7	37.5	39.4	39.5	39.5	39.5	39.5	39.5
H128	25.3	25.3	25.3	28.2	32.4	36.2	38.1	38.2	38.2	38.2	38.2	38.2
H129	20.5	20.5	20.5	23.4	27.6	31.4	33.3	33.4	33.4	33.4	33.4	33.4
H130	26.6	26.6	26.6	29.5	33.7	37.5	39.4	39.5	39.5	39.5	39.5	39.5
H131	20.6	20.6	20.6	23.5	27.7	31.5	33.4	33.5	33.5	33.5	33.5	33.5
H132	24.3	24.3	24.3	27.2	31.4	35.2	37.1	37.2	37.2	37.2	37.2	37.2
H133	26.6	26.6	26.6	29.5	33.7	37.5	39.4	39.5	39.5	39.5	39.5	39.5
H134	23.1	23.1	23.1	26.0	30.2	34.0	35.9	36.0	36.0	36.0	36.0	36.0
H135	22.5	22.5	22.5	25.4	29.6	33.4	35.3	35.4	35.4	35.4	35.4	35.4
H136	22.8	22.8	22.8	25.7	29.9	33.7	35.6	35.7	35.7	35.7	35.7	35.7
H137	22.7	22.7	22.7	25.6	29.8	33.6	35.5	35.6	35.6	35.6	35.6	35.6
H138	24.2	24.2	24.2	27.1	31.3	35.1	37.0	37.1	37.1	37.1	37.1	37.1
H139	22.7	22.7	22.7	25.6	29.8	33.6	35.5	35.6	35.6	35.6	35.6	35.6
H140	22.9	22.9	22.9	25.8	30.0	33.8	35.7	35.8	35.8	35.8	35.8	35.8
H141	19.6	19.6	19.6	22.5	26.7	30.5	32.4	32.5	32.5	32.5	32.5	32.5
H142	21.4	21.4	21.4	24.3	28.5	32.3	34.2	34.3	34.3	34.3	34.3	34.3
H143	25.0	25.0	25.0	27.9	32.1	35.9	37.8	37.9	37.9	37.9	37.9	37.9
H144	21.6	21.6	21.6	24.5	28.7	32.5	34.4	34.5	34.5	34.5	34.5	34.5
H145	22.8	22.8	22.8	25.7	29.9	33.7	35.6	35.7	35.7	35.7	35.7	35.7
H146	21.6	21.6	21.6	24.5	28.7	32.5	34.4	34.5	34.5	34.5	34.5	34.5
H147	25.1	25.1	25.1	28.0	32.2	36.0	37.9	38.0	38.0	38.0	38.0	38.0
H148	24.3	24.3	24.3	27.2	31.4	35.2	37.1	37.2	37.2	37.2	37.2	37.2
H149	21.6	21.6	21.6	24.5	28.7	32.5	34.4	34.5	34.5	34.5	34.5	34.5
H150	21.5	21.5	21.5	24.4	28.6	32.4	34.3	34.4	34.4	34.4	34.4	34.4
H151	24.3	24.3	24.3	27.2	31.4	35.2	37.1	37.2	37.2	37.2	37.2	37.2
H152	18.5	18.5	18.5	21.4	25.6	29.4	31.3	31.4	31.4	31.4	31.4	31.4
H153	23.6	23.6	23.6	26.5	30.7	34.5	36.4	36.5	36.5	36.5	36.5	36.5
H154	23.2	23.2	23.2	26.1	30.3	34.1	36.0	36.1	36.1	36.1	36.1	36.1
H155	23.5	23.5	23.5	26.4	30.6	34.4	36.3	36.4	36.4	36.4	36.4	36.4
H156	23.5	23.5	23.5	26.4	30.6	34.4	36.3	36.4	36.4	36.4	36.4	36.4
H157	25.7	25.7	25.7	28.6	32.8	36.6	38.5	38.6	38.6	38.6	38.6	38.6
H158	25.3	25.3	25.3	28.2	32.4	36.2	38.1	38.2	38.2	38.2	38.2	38.2

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H159	18.4	18.4	18.4	21.3	25.5	29.3	31.2	31.3	31.3	31.3	31.3	31.3
H160	21.6	21.6	21.6	24.5	28.7	32.5	34.4	34.5	34.5	34.5	34.5	34.5
H161	21.6	21.6	21.6	24.5	28.7	32.5	34.4	34.5	34.5	34.5	34.5	34.5
H162	21.5	21.5	21.5	24.4	28.6	32.4	34.3	34.4	34.4	34.4	34.4	34.4
H163	18.3	18.3	18.3	21.2	25.4	29.2	31.1	31.2	31.2	31.2	31.2	31.2
H164	22.5	22.5	22.5	25.4	29.6	33.4	35.3	35.4	35.4	35.4	35.4	35.4
H165	21.5	21.5	21.5	24.4	28.6	32.4	34.3	34.4	34.4	34.4	34.4	34.4
H166	21.8	21.8	21.8	24.7	28.9	32.7	34.6	34.7	34.7	34.7	34.7	34.7
H167	18.1	18.1	18.1	21.0	25.2	29.0	30.9	31.0	31.0	31.0	31.0	31.0
H168	21.5	21.5	21.5	24.4	28.6	32.4	34.3	34.4	34.4	34.4	34.4	34.4
H169	17.6	17.6	17.6	20.5	24.7	28.5	30.4	30.5	30.5	30.5	30.5	30.5
H170	21.8	21.8	21.8	24.7	28.9	32.7	34.6	34.7	34.7	34.7	34.7	34.7
H171	21.7	21.7	21.7	24.6	28.8	32.6	34.5	34.6	34.6	34.6	34.6	34.6
H172	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H173	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H174	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H175	22.7	22.7	22.7	25.6	29.8	33.6	35.5	35.6	35.6	35.6	35.6	35.6
H176	22.7	22.7	22.7	25.6	29.8	33.6	35.5	35.6	35.6	35.6	35.6	35.6
H177	19.1	19.1	19.1	22.0	26.2	30.0	31.9	32.0	32.0	32.0	32.0	32.0
H178	22.8	22.8	22.8	25.7	29.9	33.7	35.6	35.7	35.7	35.7	35.7	35.7
H179	17.9	17.9	17.9	20.8	25.0	28.8	30.7	30.8	30.8	30.8	30.8	30.8
H180	23.1	23.1	23.1	26.0	30.2	34.0	35.9	36.0	36.0	36.0	36.0	36.0
H181	21.9	21.9	21.9	24.8	29.0	32.8	34.7	34.8	34.8	34.8	34.8	34.8
H182	17.9	17.9	17.9	20.8	25.0	28.8	30.7	30.8	30.8	30.8	30.8	30.8
H183	23.1	23.1	23.1	26.0	30.2	34.0	35.9	36.0	36.0	36.0	36.0	36.0
H184	23.0	23.0	23.0	25.9	30.1	33.9	35.8	35.9	35.9	35.9	35.9	35.9
H185	23.6	23.6	23.6	26.5	30.7	34.5	36.4	36.5	36.5	36.5	36.5	36.5
H186	21.9	21.9	21.9	24.8	29.0	32.8	34.7	34.8	34.8	34.8	34.8	34.8
H187	21.9	21.9	21.9	24.8	29.0	32.8	34.7	34.8	34.8	34.8	34.8	34.8
H188	17.4	17.4	17.4	20.3	24.5	28.3	30.2	30.3	30.3	30.3	30.3	30.3
H189	23.4	23.4	23.4	26.3	30.5	34.3	36.2	36.3	36.3	36.3	36.3	36.3
H191	17.4	17.4	17.4	20.3	24.5	28.3	30.2	30.3	30.3	30.3	30.3	30.3
H192	24.4	24.4	24.4	27.3	31.5	35.3	37.2	37.3	37.3	37.3	37.3	37.3
H193	22.2	22.2	22.2	25.1	29.3	33.1	35.0	35.1	35.1	35.1	35.1	35.1
H194	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8
H195	22.0	22.0	22.0	24.9	29.1	32.9	34.8	34.9	34.9	34.9	34.9	34.9
H196	23.5	23.5	23.5	26.4	30.6	34.4	36.3	36.4	36.4	36.4	36.4	36.4
H197	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H198	19.5	19.5	19.5	22.4	26.6	30.4	32.3	32.4	32.4	32.4	32.4	32.4
H200	23.4	23.4	23.4	26.3	30.5	34.3	36.2	36.3	36.3	36.3	36.3	36.3
H202	16.5	16.5	16.5	19.4	23.6	27.4	29.3	29.4	29.4	29.4	29.4	29.4
H203	17.0	17.0	17.0	19.9	24.1	27.9	29.8	29.9	29.9	29.9	29.9	29.9
H204	13.6	13.6	13.6	16.5	20.7	24.5	26.4	26.5	26.5	26.5	26.5	26.5
H205	16.9	16.9	16.9	19.8	24.0	27.8	29.7	29.8	29.8	29.8	29.8	29.8
H206	21.3	21.3	21.3	24.2	28.4	32.2	34.1	34.2	34.2	34.2	34.2	34.2
H207	20.8	20.8	20.8	23.7	27.9	31.7	33.6	33.7	33.7	33.7	33.7	33.7
H208	21.3	21.3	21.3	24.2	28.4	32.2	34.1	34.2	34.2	34.2	34.2	34.2
H209	19.6	19.6	19.6	22.5	26.7	30.5	32.4	32.5	32.5	32.5	32.5	32.5
H210	20.3	20.3	20.3	23.2	27.4	31.2	33.1	33.2	33.2	33.2	33.2	33.2
H211	20.3	20.3	20.3	23.2	27.4	31.2	33.1	33.2	33.2	33.2	33.2	33.2
H212	20.2	20.2	20.2	23.1	27.3	31.1	33.0	33.1	33.1	33.1	33.1	33.1
H213	16.1	16.1	16.1	19.0	23.2	27.0	28.9	29.0	29.0	29.0	29.0	29.0
H214	13.8	13.8	13.8	16.7	20.9	24.7	26.6	26.7	26.7	26.7	26.7	26.7
H215	19.8	19.8	19.8	22.7	26.9	30.7	32.6	32.7	32.7	32.7	32.7	32.7
H216	15.4	15.4	15.4	18.3	22.5	26.3	28.2	28.3	28.3	28.3	28.3	28.3
H217	19.8	19.8	19.8	22.7	26.9	30.7	32.6	32.7	32.7	32.7	32.7	32.7
H218	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H219	20.2	20.2	20.2	23.1	27.3	31.1	33.0	33.1	33.1	33.1	33.1	33.1
H220	19.2	19.2	19.2	22.1	26.3	30.1	32.0	32.1	32.1	32.1	32.1	32.1
H221	12.7	12.7	12.7	15.6	19.8	23.6	25.5	25.6	25.6	25.6	25.6	25.6
H222	16.1	16.1	16.1	19.0	23.2	27.0	28.9	29.0	29.0	29.0	29.0	29.0
H223	19.2	19.2	19.2	22.1	26.2	30.0	32.0	32.1	32.1	32.1	32.1	32.1
H224	19.0	19.0	19.0	21.9	26.1	29.9	31.8	31.9	31.9	31.9	31.9	31.9
H225	14.6	14.6	14.6	17.5	21.7	25.5	27.4	27.5	27.5	27.5	27.5	27.5
H226	18.6	18.6	18.6	21.5	25.7	29.5	31.4	31.5	31.5	31.5	31.5	31.5
H227	14.6	14.6	14.6	17.5	21.7	25.5	27.4	27.5	27.5	27.5	27.5	27.5
H228	13.8	13.8	13.8	16.7	20.9	24.7	26.6	26.7	26.7	26.7	26.7	26.7
H229	17.7	17.7	17.7	20.6	24.8	28.6	30.5	30.6	30.6	30.6	30.6	30.6
H230	17.7	17.7	17.7	20.6	24.8	28.6	30.5	30.6	30.6	30.6	30.6	30.6
H231	17.5	17.5	17.5	20.4	24.6	28.4	30.3	30.4	30.4	30.4	30.4	30.4
H232	11.8	11.8	11.8	14.7	18.9	22.7	24.6	24.7	24.7	24.7	24.7	24.7
H233	11.8	11.8	11.8	14.7	18.9	22.7	24.6	24.7	24.7	24.7	24.7	24.7
H234	11.6	11.6	11.6	14.5	18.7	22.5	24.4	24.5	24.5	24.5	24.5	24.5
H235	13.3	13.3	13.3	16.2	20.4	24.2	26.1	26.2	26.2	26.2	26.2	26.2
H236	12.3	12.3	12.3	15.2	19.4	23.2	25.1	25.2	25.2	25.2	25.2	25.2
H237	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H238	15.7	15.7	15.7	18.6	22.8	26.6	28.5	28.6	28.6	28.6	28.6	28.6
H239	16.0	16.0	16.0	18.9	23.1	26.9	28.8	28.9	28.9	28.9	28.9	28.9
H240	15.9	15.9	15.9	18.8	23.0	26.8	28.7	28.8	28.8	28.8	28.8	28.8
H241	13.9	13.9	13.9	16.8	21.0	24.8	26.7	26.8	26.8	26.8	26.8	26.8
H242	13.8	13.8	13.8	16.7	20.9	24.7	26.6	26.7	26.7	26.7	26.7	26.7
H243	12.7	12.7	12.7	15.6	19.8	23.6	25.5	25.6	25.6	25.6	25.6	25.6
H244	14.7	14.7	14.7	17.6	21.8	25.6	27.5	27.6	27.6	27.6	27.6	27.6
H245	14.4	14.4	14.4	17.3	21.5	25.3	27.2	27.3	27.3	27.3	27.3	27.3
H246	14.2	14.2	14.2	17.1	21.3	25.1	27.0	27.1	27.1	27.1	27.1	27.1
H247	14.1	14.1	14.1	17.0	21.2	25.0	26.9	27.0	27.0	27.0	27.0	27.0
H248	13.3	13.3	13.3	16.2	20.4	24.2	26.1	26.2	26.2	26.2	26.2	26.2

10.75 Noise levels at 182 of the 244 nearest residential properties are below 35 dB(A), indicating that the noise immission levels would be regarded as acceptable and residential amenity as receiving 'sufficient protection' without further assessment requiring to be undertaken.

10.76 There are 62 properties that have predicted noise levels greater than this simplified noise criteria as indicated in **Table 10.11**. Therefore the 'full' acoustic assessment need only be considered at these.

Acoustic Acceptance Criteria

10.77 As stated previously, during daytime periods and at low background noise levels, a lower fixed limit of 35-40 dB(A) is applicable with the exact value dependent upon a number of factors: the number of noise affected residential properties; the potential impact on the power output of the wind farm and the likely duration and level of exposure. Through consideration of these factors RES have adopted a 37.5 dB(A) level. Justification is provided in the following paragraph, and the resulting criteria are shown in **Table 10.12**.

10.78 Justification for the daytime lower limit, considering each of the factors recommended by ETSU-R-97 and the guidance provided by the IoA GPG, is as follows:

- ***Number of noise affected residential properties:*** There are 62 residential properties with a predicted noise level greater than 35 dB(A) although not all of these are predominantly downwind of the proposed development. Given that the proposed scheme could generate significant social, economic and environmental benefits, this would suggest a limit towards the middle of the range;
- ***Potential impact on the power output of the wind farm:*** The proposed development site can be considered a medium scale development as it has a rated power output of 58.8 MW should the turbine type considered in the acoustic assessment be installed. A daytime lower limit at the lower end of the range would reduce the amount of energy that could be generated by such a scheme;
- ***The likely duration and level of exposure:*** The amount of the time that noise levels of greater than 35 dB(A) are predicted is limited to periods of sufficiently high

wind speed. Noise levels would also be reduced when properties are not located downwind of the wind turbines.

Table 10.12 - Permissible Noise Level Criteria in Vicinity of Proposed Development

Time of Day	Permissible Noise Level
Daytime	• 37.5 dB(A) for L_B less than 32.5 dB(A) • L_B + 5 dB, for L_B greater than 32.5 dB(A)
Night-time	• 43.0 dB(A) for L_B less than 38.0 dB(A) • L_B + 5 dB, for L_B greater than 38.0 dB(A)

Calculation of Acceptable Noise Limits from Baseline Conditions

10.79 The 'best-fit' lines of **Charts 5-14** have been used to calculate the noise limits at the RES background noise measurement locations. **Table 10.13** shows the daytime noise limits and **Table 10.14** the night time noise limits. The noise limits derived from the third party survey data are also shown for comparison.

Table 10.13 - Recommended Daytime Noise Limits (dB(A) re 20 μPa)

House Name	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H96	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H105	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.8	39.7	41.8	43.9	46.2
H151	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	39.2	41.4	43.6	45.6
H158	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H200	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.1	39.0	40.0	41.0
Feystown NM1 (H79)	37.5	37.5	37.5	37.5	37.5	37.5	37.8	39.9	42.4	45.2	45.2	45.2
Feystown NM2 (H124)	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.7	40.3	43.2	43.2	43.2
Feystown NM3 (H157)	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.6	41.3	41.3	41.3
LA02/2017/0715/F (H226)	37.5	37.5	37.5	37.5	37.5	38.1	40.8	43.4	46.0	48.5	50.9	53.3

Table 10.14 - Recommended Night-time Noise Limits (dB(A) re 20 μPa)

House Name	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H96	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H105	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.2
H151	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H158	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H200	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Feystown NM1 (H79)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.2	45.2	45.2
Feystown NM2 (H124)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Feystown NM3 (H157)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
LA02/2017/0715/F (H226)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.5	50.1	52.6

10.80 The recommendations of ETSU-R-97 state that where there are groups of properties that are likely to have a similar background noise environment, it is appropriate to use data from one representative location as the basis for assessment at the other properties. The survey results inferred to be representative for each property is shown in **Table**

10.15. The specific choice of noise survey chosen has been made considering the distance to the nearest survey location and the likelihood of experiencing a broadly similar exposure as the survey.

Table 10.15 - Assumed Representative Background Noise Survey Locations

House Name	House ID	Survey Location
6 LOUGHDOO ROAD	H1	H105
4A LOUGHDOO ROAD	H2	H105
63 MULLAGHSANDALL ROAD	H3	H105
5 LOUGHDOO ROAD	H4	H105
10 LOUGHDOO ROAD	H5	H105
7 LOUGHDOO ROAD	H6	H105
10A LOUGHDOO ROAD	H7	H105
26 SALLAGH ROAD	H8	H96
28 SALLAGH ROAD	H9	H96
30 SALLAGH ROAD	H10	H96
24 AUGHABOY ROAD	H11	H105
32 SALLAGH ROAD	H12	H96
23 AUGHABOY ROAD	H13	H105
4 SALLAGH LANE	H14	H96
21B AUGHABOY ROAD	H15	H105
21A AUGHABOY ROAD	H16	H105
3 SALLAGH LANE	H17	H96
14 BALLYCOOSE ROAD	H18	H96
120 BRUSTIN BRAE ROAD	H19	H96
2 DRUMNAGREAGH ROAD	H20	H96
8 BALLYCOOSE ROAD	H21	H96
12 BALLYCOOSE ROAD	H22	H96
1 DRUMNAGREAGH ROAD	H23	H96
18 AUGHABOY ROAD	H24	H105
DRUMNAGREAGH ROAD	H25	H96
4 DRUMNAGREAGH ROAD	H26	H96
3 DRUMNAGREAGH ROAD	H27	H96
_ DRUMNAGREAGH ROAD	H28	H96
2 BALLYCOOSE ROAD	H29	H96
30 LOUGHDOO ROAD	H30	H105
10 BALLYCOOSE ROAD	H31	H96
5 DRUMNAGREAGH ROAD	H32	H96
7 DRUMNAGREAGH ROAD	H33	H96
4 BALLYCOOSE ROAD	H34	H96
6 BALLYCOOSE ROAD	H35	H96

House Name	House ID	Survey Location
40 BALLYCOOSE ROAD	H36	H96
16 BALLYCOOSE ROAD	H37	H96
6 DRUMNAGREAGH ROAD	H38	H96
8 DRUMNAGREAGH ROAD	H39	H96
18 BALLYCOOSE ROAD	H40	H96
19 AUGHABOY ROAD	H41	H105
10 DRUMNAGREAGH ROAD	H42	H96
7 BALLYCOOSE ROAD	H43	H96
28 BALLYCOOSE ROAD	H44	H96
14 DRUMNAGREAGH ROAD	H45	H96
32 BALLYCOOSE ROAD	H46	H96
12 DRUMNAGREAGH ROAD	H47	H96
26A BALLYCOOSE ROAD	H48	H96
26 BALLYCOOSE ROAD	H49	H96
11 BALLYCOOSE ROAD	H50	H96
24 BALLYCOOSE ROAD	H51	H96
30 BALLYCOOSE ROAD	H52	H96
17 AUGHABOY ROAD	H53	H105
15 AUGHABOY ROAD	H54	H105
38B LOUGHDOO ROAD	H55	H105
38 LOUGHDOO ROAD	H56	H105
38A LOUGHDOO ROAD	H57	H105
15 DRUMNAGREAGH ROAD	H58	H96
14 AUGHABOY ROAD	H59	H105
18 DRUMNAGREAGH ROAD	H61	H96
12 AUGHABOY ROAD	H62	H105
16 AUGHABOY ROAD	H63	H105
20 DRUMNAGREAGH ROAD	H64	H96
20A DRUMNAGREAGH ROAD	H65	H96
LOUGHDOO ROAD	H66	H105
10 AUGHABOY ROAD	H67	H105
22 DRUMNAGREAGH ROAD	H68	H96
24 DRUMNAGREAGH ROAD	H69	H96
8A AUGHABOY ROAD	H70	H105
17 DRUMNAGREAGH ROAD	H71	H96
8 AUGHABOY ROAD	H72	H105
25 DRUMNAGREAGH ROAD	H73	H96
26 DRUMNAGREAGH ROAD	H74	H96
26A DRUMNAGREAGH ROAD	H75	H96

House Name	House ID	Survey Location
31 BALLYCOOSE ROAD	H76	H96
5 AUGHABOY ROAD	H77	H105
28 DRUMNAGREAGH ROAD	H78	H96
92 FEYSTOWN ROAD	H79	Feystown NM1 (H79)
28A DRUMNAGREAGH ROAD	H80	H96
30 DRUMNAGREAGH ROAD	H81	H96
32 DRUMNAGREAGH ROAD	H82	H96
10 DRUMCROW ROAD	H83	H105
4 AUGHABOY ROAD	H84	H105
COAST ROAD	H85	H96
35 DRUMNAGREAGH ROAD	H86	H96
60 DRUMNAGREAGH ROAD	H87	H96
86 FEYSTOWN ROAD	H88	H105
6 DRUMCROW ROAD	H89	H105
38 DRUMNAGREAGH ROAD	H90	H96
380 COAST ROAD	H91	H96
19 DRUMCROW ROAD	H92	H105
21 DRUMCROW ROAD	H93	H105
3 DRUMCROW ROAD	H94	H105
39 DRUMNAGREAGH ROAD	H95	H96
58 DRUMNAGREAGH ROAD	H96	H96
56 DRUMNAGREAGH ROAD	H97	H96
41 DRUMNAGREAGH ROAD	H98	H96
23 DRUMCROW ROAD	H99	H105
87 FEYSTOWN ROAD	H100	H105
52 DRUMNAGREAGH ROAD	H101	H96
49 DRUMNAGREAGH ROAD	H102	H96
54 DRUMNAGREAGH ROAD	H103	H96
51 DRUMNAGREAGH ROAD	H104	H96
85 FEYSTOWN ROAD	H105	H105
85A FEYSTOWN ROAD	H106	H105
53A DRUMNAGREAGH ROAD	H107	H96
366 COAST ROAD	H108	H96
368 COAST ROAD	H109	H96
46 DRUMNAGREAGH ROAD	H110	H96
53 DRUMNAGREAGH ROAD	H111	H96
55 DRUMNAGREAGH ROAD	H112	H96
83 FEYSTOWN ROAD	H113	H105
83A FEYSTOWN ROAD	H114	H105

House Name	House ID	Survey Location
50 DRUMNAGREAGH ROAD	H115	H96
79 FEYSTOWN ROAD	H116	H105
79B FEYSTOWN ROAD	H117	H105
77 FEYSTOWN ROAD	H118	H105
78 FEYSTOWN ROAD	H119	H105
59 DRUMNAGREAGH ROAD	H120	H96
76 FEYSTOWN ROAD	H121	H105
380A COAST ROAD	H122	H96
FEYSTOWN ROAD	H123	H105
72A FEYSTOWN ROAD	H124	Feystown NM2 (H124)
70 DRUMNAGREAGH ROAD	H125	H96
70C FEYSTOWN ROAD	H126	H105
70B FEYSTOWN ROAD	H127	H105
71 FEYSTOWN ROAD	H128	H105
67 DRUMNAGREAGH ROAD	H129	H96
70A FEYSTOWN ROAD	H130	H105
71 DRUMNAGREAGH ROAD	H131	H96
67 FEYSTOWN ROAD	H132	H151
68 FEYSTOWN ROAD	H133	H151
74 DRUMNAGREAGH ROAD	H134	H96
76B DRUMNAGREAGH ROAD	H135	H96
76A DRUMNAGREAGH ROAD	H136	H158
76 DRUMNAGREAGH ROAD	H137	H158
63 FEYSTOWN ROAD	H138	H151
78 DRUMNAGREAGH ROAD	H139	H158
82 DRUMNAGREAGH ROAD	H140	H158
61 LISLES HILL ROAD	H141	H151
__ DRUMNAGREAGH ROAD	H142	H158
_ FEYSTOWN ROAD	H143	H151
86 DRUMNAGREAGH ROAD	H144	H158
90 DRUMNAGREAGH ROAD	H145	H158
88 DRUMNAGREAGH ROAD	H146	H158
60 FEYSTOWN ROAD	H147	H151
59 FEYSTOWN ROAD	H148	H151
87 DRUMNAGREAGH ROAD	H149	H158
89 DRUMNAGREAGH ROAD	H150	H158
57 FEYSTOWN ROAD	H151	H151
102 MUNIE ROAD	H152	H151
96A DRUMNAGREAGH ROAD	H153	H158

House Name	House ID	Survey Location
96 DRUMNAGREAGH ROAD	H154	H158
98A DRUMNAGREAGH ROAD	H155	H158
98 DRUMNAGREAGH ROAD	H156	H158
54 FEYSTOWN ROAD	H157	Feystown NM3 (H157)
100 DRUMNAGREAGH ROAD	H158	H158
100 MUNIE ROAD	H159	H151
97 DRUMNAGREAGH ROAD	H160	H158
99 DRUMNAGREAGH ROAD	H161	H158
97A DRUMNAGREAGH ROAD	H162	H158
98 MUNIE ROAD	H163	H151
53 FEYSTOWN ROAD	H164	H151
101 DRUMNAGREAGH ROAD	H165	H158
102 DRUMNAGREAGH ROAD	H166	H158
97 MUNIE ROAD	H167	H151
105 DRUMNAGREAGH ROAD	H168	H158
93 MUNIE ROAD	H169	H151
81 DICKEYSTOWN ROAD	H170	H158
81A DICKEYSTOWN ROAD	H171	H158
MUNIE ROAD	H172	H151
3B CASTLE LANE	H173	H151
3C CASTLE LANE	H174	H151
75 DICKEYSTOWN ROAD	H175	H158
73 DICKEYSTOWN ROAD	H176	H158
49 FEYSTOWN ROAD	H177	H151
71 DICKEYSTOWN ROAD	H178	H158
87 MUNIE ROAD	H179	H151
65B DICKEYSTOWN ROAD	H180	H200
402 COAST ROAD	H181	H158
_ MUNIE ROAD	H182	H151
65 DICKEYSTOWN ROAD	H183	H200
65A DICKEYSTOWN ROAD	H184	H200
67 DICKEYSTOWN ROAD	H185	H200
404 COAST ROAD	H186	H158
406 COAST ROAD	H187	H158
79 MUNIE ROAD	H188	H151
67A DICKEYSTOWN ROAD	H189	H200
77 MUNIE ROAD	H191	H151
61A DICKEYSTOWN ROAD	H192	H200
66 DICKEYSTOWN ROAD	H193	H200

House Name	House ID	Survey Location
75 MUNIE ROAD	H194	H151
64 DICKEYSTOWN ROAD	H195	H200
61B DICKEYSTOWN ROAD	H196	H200
75A MUNIE ROAD	H197	H151
46 FEYSTOWN ROAD	H198	H151
59 DICKEYSTOWN ROAD	H200	H200
45 FEYSTOWN ROAD	H202	H151
71 MUNIE ROAD	H203	H151
CASTLE LANE	H204	H151
69 MUNIE ROAD	H205	H151
414 COAST ROAD	H206	H200
418 COAST ROAD	H207	H200
52 DICKEYSTOWN ROAD	H208	H200
36 FEYSTOWN ROAD	H209	H200
56 DICKEYSTOWN ROAD	H210	H200
54 DICKEYSTOWN ROAD	H211	H200
54A DICKEYSTOWN ROAD	H212	H200
61 MUNIE ROAD	H213	H151
60 MUNIE ROAD	H214	H151
419 COAST ROAD	H215	H200
41 FEYSTOWN ROAD	H216	H151
27 DICKEYSTOWN ROAD	H217	H200
47A TULLY ROAD	H218	H151
51 DICKEYSTOWN ROAD	H219	H200
58 DICKEYSTOWN ROAD	H220	H200
4 CASTLE LANE	H221	H151
47 TULLY ROAD	H222	H151
49 DICKEYSTOWN ROAD	H223	LA02/2017/0715/F (H226)
49A DICKEYSTOWN ROAD	H224	LA02/2017/0715/F (H226)
39 FEYSTOWN ROAD	H225	H151
45 DICKEYSTOWN ROAD	H226	LA02/2017/0715/F (H226)
45 TULLY ROAD	H227	H151
29 TOWN BRAE	H228	H151
43 DICKEYSTOWN ROAD	H229	LA02/2017/0715/F (H226)
43A DICKEYSTOWN ROAD	H230	LA02/2017/0715/F (H226)
41 DICKEYSTOWN ROAD	H231	LA02/2017/0715/F (H226)
3 CASTLE LANE	H232	H151
2 CASTLE LANE	H233	H151
2A CASTLE LANE	H234	H151

House Name	House ID	Survey Location
28 FEYSTOWN ROAD	H235	H200
21 MUNIE ROAD	H236	H151
33 DICKEYSTOWN ROAD	H237	H200
33A DICKEYSTOWN ROAD	H238	H200
37 DICKEYSTOWN ROAD	H239	H200
35 DICKEYSTOWN ROAD	H240	H200
29 DICKEYSTOWN ROAD	H241	H200
424 COAST ROAD	H242	H200
20 FEYSTOWN ROAD	H243	H200
36 DICKEYSTOWN ROAD	H244	H200
34 DICKEYSTOWN ROAD	H245	H200
30 DICKEYSTOWN ROAD	H246	H200
30A DICKEYSTOWN ROAD	H247	H200
26 DICKEYSTOWN ROAD	H248	H200

10.81 As recommended in ETSU-R-97, the absolute lower noise limits may be increased up to 45 dB(A) if the occupant has a financial involvement in the wind farm. However, whilst some of the nearby properties may qualify for such an increase, these limits have not been adopted in the presented results.

Acoustic Assessment

10.82 An assessment of the proposed development alone has not been undertaken as there are other wind turbines in the vicinity that are already consented or in existence and it is necessary for the criteria to be met cumulatively. An acoustic assessment considering the proposed development along with nearby consented and existing sites has therefore been undertaken.

Cumulative Effects

Cumulative Operational Noise Assessment

10.83 An assessment of the cumulative acoustic impact of the proposed development in conjunction with the existing Ballykeel wind farm[19], proposed Carnalbanagh wind farm[20] and eight nearby consented single turbine schemes, has been undertaken in accordance with the guidance on wind farm noise assessment; ETSU-R-97 and the IoA GPG.

10.84 ETSU-R-97 states:

"It is clearly unreasonable to suggest that, because a wind farm has been constructed in the vicinity in the past which resulted in increased noise levels at some properties, the residents of those properties are now able to tolerate higher noise levels still. The existing wind farm should not be considered as part of the prevailing background noise."

[19] Ballykeel wind farm, planning reference F/2013/0244/F

[20] Carnalbanagh wind farm, planning reference LA02/2017/0594/F

10.85 The locations of the turbines that make up the proposed development, along with the other turbines considered in the cumulative assessment, are shown in **Figure 10.2**. The planning references for the single turbine schemes are as detailed in **Table 10.16**.

Table 10.16 - Single Turbine Planning Details

Turbine ID	Planning Reference
A1	LA02/2017/0715/F
D1	F/2011/0073/F
E1	F/2013/0164/F
F1	F/2012/0133/F
G1	F/2010/0208/F
J1	F/2013/0111/F
K1	F/2012/0052/F
L1	LA02/2017/0296/F

10.86 The residential properties considered in the cumulative assessment are as per those detailed in **Table 10.8**. The distances to the nearest turbine included in the cumulative assessment are given in **Table 17**.

Table 17 - Distances to Nearest Cumulative Turbine

House Name	House ID	Distance (m)	Nearest Turbine
6 LOUGHDOO ROAD	H1	1568	G1
4A LOUGHDOO ROAD	H2	1523	G1
63 MULLAGHSANDALL ROAD	H3	1521	G1
5 LOUGHDOO ROAD	H4	1525	G1
10 LOUGHDOO ROAD	H5	1246	G1
7 LOUGHDOO ROAD	H6	1249	G1
10A LOUGHDOO ROAD	H7	1186	G1
26 SALLAGH ROAD	H8	2239	F1
28 SALLAGH ROAD	H9	1775	F1
30 SALLAGH ROAD	H10	1697	F1
24 AUGHABOY ROAD	H11	868	G1
32 SALLAGH ROAD	H12	1715	F1
23 AUGHABOY ROAD	H13	1061	J1
4 SALLAGH LANE	H14	959	F1
21B AUGHABOY ROAD	H15	964	G1
21A AUGHABOY ROAD	H16	980	G1
3 SALLAGH LANE	H17	1266	F1
14 BALLYCOOSE ROAD	H18	811	F1
120 BRUSTIN BRAE ROAD	H19	517	F1
2 DRUMNAGREAGH ROAD	H20	557	F1
8 BALLYCOOSE ROAD	H21	711	F1

House Name	House ID	Distance (m)	Nearest Turbine
12 BALLYCOOSE ROAD	H22	721	F1
1 DRUMNAGREAGH ROAD	H23	497	F1
18 AUGHABOY ROAD	H24	812	J1
DRUMNAGREAGH ROAD	H25	563	F1
4 DRUMNAGREAGH ROAD	H26	554	F1
3 DRUMNAGREAGH ROAD	H27	522	F1
_ DRUMNAGREAGH ROAD	H28	547	F1
2 BALLYCOOSE ROAD	H29	613	F1
30 LOUGHDOO ROAD	H30	191	G1
10 BALLYCOOSE ROAD	H31	720	F1
5 DRUMNAGREAGH ROAD	H32	512	F1
7 DRUMNAGREAGH ROAD	H33	534	F1
4 BALLYCOOSE ROAD	H34	634	F1
6 BALLYCOOSE ROAD	H35	664	F1
40 BALLYCOOSE ROAD	H36	1320	F1
16 BALLYCOOSE ROAD	H37	702	F1
6 DRUMNAGREAGH ROAD	H38	592	F1
8 DRUMNAGREAGH ROAD	H39	600	F1
18 BALLYCOOSE ROAD	H40	673	F1
19 AUGHABOY ROAD	H41	635	J1
10 DRUMNAGREAGH ROAD	H42	637	F1
7 BALLYCOOSE ROAD	H43	679	F1
28 BALLYCOOSE ROAD	H44	900	F1
14 DRUMNAGREAGH ROAD	H45	660	F1
32 BALLYCOOSE ROAD	H46	974	F1
12 DRUMNAGREAGH ROAD	H47	654	F1
26A BALLYCOOSE ROAD	H48	871	F1
26 BALLYCOOSE ROAD	H49	843	F1
11 BALLYCOOSE ROAD	H50	714	F1
24 BALLYCOOSE ROAD	H51	804	F1
30 BALLYCOOSE ROAD	H52	932	F1
17 AUGHABOY ROAD	H53	542	J1
15 AUGHABOY ROAD	H54	520	J1
38B LOUGHDOO ROAD	H55	462	G1
38 LOUGHDOO ROAD	H56	492	G1
38A LOUGHDOO ROAD	H57	514	G1
15 DRUMNAGREAGH ROAD	H58	539	F1
14 AUGHABOY ROAD	H59	552	J1

House Name	House ID	Distance (m)	Nearest Turbine
18 DRUMNAGREAGH ROAD	H61	866	F1
12 AUGHABOY ROAD	H62	562	J1
16 AUGHABOY ROAD	H63	501	J1
20 DRUMNAGREAGH ROAD	H64	872	F1
20A DRUMNAGREAGH ROAD	H65	950	F1
LOUGHDOO ROAD	H66	670	G1
10 AUGHABOY ROAD	H67	561	J1
22 DRUMNAGREAGH ROAD	H68	980	F1
24 DRUMNAGREAGH ROAD	H69	988	F1
8A AUGHABOY ROAD	H70	386	J1
17 DRUMNAGREAGH ROAD	H71	897	F1
8 AUGHABOY ROAD	H72	375	J1
25 DRUMNAGREAGH ROAD	H73	1112	F1
26 DRUMNAGREAGH ROAD	H74	1208	F1
26A DRUMNAGREAGH ROAD	H75	1242	F1
31 BALLYCOOSE ROAD	H76	1387	T14
5 AUGHABOY ROAD	H77	240	J1
28 DRUMNAGREAGH ROAD	H78	1360	F1
92 FEYSTOWN ROAD	H79	1104	G1
28A DRUMNAGREAGH ROAD	H80	1315	F1
30 DRUMNAGREAGH ROAD	H81	1367	F1
32 DRUMNAGREAGH ROAD	H82	1426	F1
10 DRUMCROW ROAD	H83	1089	J1
4 AUGHABOY ROAD	H84	557	J1
COAST ROAD	H85	1221	F1
35 DRUMNAGREAGH ROAD	H86	1519	F1
60 DRUMNAGREAGH ROAD	H87	1594	T11
86 FEYSTOWN ROAD	H88	1090	T12
6 DRUMCROW ROAD	H89	1198	J1
38 DRUMNAGREAGH ROAD	H90	1868	F1
380 COAST ROAD	H91	1428	F1
19 DRUMCROW ROAD	H92	794	J1
21 DRUMCROW ROAD	H93	888	J1
3 DRUMCROW ROAD	H94	1461	J1
39 DRUMNAGREAGH ROAD	H95	1772	F1
58 DRUMNAGREAGH ROAD	H96	1498	T11
56 DRUMNAGREAGH ROAD	H97	1439	T11
41 DRUMNAGREAGH ROAD	H98	1794	F1

House Name	House ID	Distance (m)	Nearest Turbine
23 DRUMCROW ROAD	H99	1045	J1
87 FEYSTOWN ROAD	H100	1476	J1
52 DRUMNAGREAGH ROAD	H101	1389	T11
49 DRUMNAGREAGH ROAD	H102	1963	T11
54 DRUMNAGREAGH ROAD	H103	1141	T11
51 DRUMNAGREAGH ROAD	H104	1919	T11
85 FEYSTOWN ROAD	H105	1451	T12
85A FEYSTOWN ROAD	H106	1376	T12
53A DRUMNAGREAGH ROAD	H107	1974	T11
366 COAST ROAD	H108	1910	F1
368 COAST ROAD	H109	1929	F1
46 DRUMNAGREAGH ROAD	H110	1708	T11
53 DRUMNAGREAGH ROAD	H111	1897	T11
55 DRUMNAGREAGH ROAD	H112	2103	F1
83 FEYSTOWN ROAD	H113	1284	T12
83A FEYSTOWN ROAD	H114	1262	T12
50 DRUMNAGREAGH ROAD	H115	1348	T11
79 FEYSTOWN ROAD	H116	1651	T10
79B FEYSTOWN ROAD	H117	1608	T10
77 FEYSTOWN ROAD	H118	1659	T7
78 FEYSTOWN ROAD	H119	1209	T10
59 DRUMNAGREAGH ROAD	H120	2003	T11
76 FEYSTOWN ROAD	H121	1208	T7
380A COAST ROAD	H122	2259	T11
FEYSTOWN ROAD	H123	1180	T5
72A FEYSTOWN ROAD	H124	999	T7
70 DRUMNAGREAGH ROAD	H125	1663	T9
70C FEYSTOWN ROAD	H126	1164	T5
70B FEYSTOWN ROAD	H127	1155	T5
71 FEYSTOWN ROAD	H128	1335	T5
67 DRUMNAGREAGH ROAD	H129	2054	T9
70A FEYSTOWN ROAD	H130	1144	T5
71 DRUMNAGREAGH ROAD	H131	2039	T9
67 FEYSTOWN ROAD	H132	1456	T5
68 FEYSTOWN ROAD	H133	1120	T5
74 DRUMNAGREAGH ROAD	H134	1614	T9
76B DRUMNAGREAGH ROAD	H135	1737	T9
76A DRUMNAGREAGH ROAD	H136	1689	T9

House Name	House ID	Distance (m)	Nearest Turbine
76 DRUMNAGREAGH ROAD	H137	1698	T9
63 FEYSTOWN ROAD	H138	1464	T5
78 DRUMNAGREAGH ROAD	H139	1693	T3
82 DRUMNAGREAGH ROAD	H140	1461	T3
61 LISLES HILL ROAD	H141	1916	D1
__ DRUMNAGREAGH ROAD	H142	1865	T3
_ FEYSTOWN ROAD	H143	1329	T5
86 DRUMNAGREAGH ROAD	H144	1768	T3
90 DRUMNAGREAGH ROAD	H145	1472	T3
88 DRUMNAGREAGH ROAD	H146	1760	T3
60 FEYSTOWN ROAD	H147	1329	T5
59 FEYSTOWN ROAD	H148	1460	T5
87 DRUMNAGREAGH ROAD	H149	1693	T3
89 DRUMNAGREAGH ROAD	H150	1706	T3
57 FEYSTOWN ROAD	H151	1468	T5
102 MUNIE ROAD	H152	1325	D1
96A DRUMNAGREAGH ROAD	H153	1121	T3
96 DRUMNAGREAGH ROAD	H154	1185	T3
98A DRUMNAGREAGH ROAD	H155	1185	T3
98 DRUMNAGREAGH ROAD	H156	1191	T3
54 FEYSTOWN ROAD	H157	1150	T1
100 DRUMNAGREAGH ROAD	H158	1000	T3
100 MUNIE ROAD	H159	1219	D1
97 DRUMNAGREAGH ROAD	H160	1571	T3
99 DRUMNAGREAGH ROAD	H161	1551	T3
97A DRUMNAGREAGH ROAD	H162	1572	T3
98 MUNIE ROAD	H163	1173	D1
53 FEYSTOWN ROAD	H164	1625	T1
101 DRUMNAGREAGH ROAD	H165	1561	T3
102 DRUMNAGREAGH ROAD	H166	1509	T3
97 MUNIE ROAD	H167	1091	D1
105 DRUMNAGREAGH ROAD	H168	1533	T3
93 MUNIE ROAD	H169	896	D1
81 DICKEYSTOWN ROAD	H170	1370	T3
81A DICKEYSTOWN ROAD	H171	1390	T3
MUNIE ROAD	H172	1868	D1
3B CASTLE LANE	H173	1871	D1
3C CASTLE LANE	H174	1909	D1

House Name	House ID	Distance (m)	Nearest Turbine
75 DICKEYSTOWN ROAD	H175	1413	T3
73 DICKEYSTOWN ROAD	H176	1407	T3
49 FEYSTOWN ROAD	H177	2003	T1
71 DICKEYSTOWN ROAD	H178	1393	T3
87 MUNIE ROAD	H179	1062	D1
65B DICKEYSTOWN ROAD	H180	1177	T3
402 COAST ROAD	H181	1667	T3
_ MUNIE ROAD	H182	1069	D1
65 DICKEYSTOWN ROAD	H183	1189	T3
65A DICKEYSTOWN ROAD	H184	1203	T3
67 DICKEYSTOWN ROAD	H185	1126	T3
404 COAST ROAD	H186	1668	T3
406 COAST ROAD	H187	1680	T3
79 MUNIE ROAD	H188	981	D1
67A DICKEYSTOWN ROAD	H189	1315	T3
77 MUNIE ROAD	H191	1006	D1
61A DICKEYSTOWN ROAD	H192	1105	T2
66 DICKEYSTOWN ROAD	H193	1509	T3
75 MUNIE ROAD	H194	929	D1
64 DICKEYSTOWN ROAD	H195	1542	T3
61B DICKEYSTOWN ROAD	H196	1219	T2
75A MUNIE ROAD	H197	943	D1
46 FEYSTOWN ROAD	H198	1810	T1
59 DICKEYSTOWN ROAD	H200	1330	A1
45 FEYSTOWN ROAD	H202	2161	T1
71 MUNIE ROAD	H203	1246	D1
CASTLE LANE	H204	1785	D1
69 MUNIE ROAD	H205	1264	D1
414 COAST ROAD	H206	1552	A1
418 COAST ROAD	H207	1438	A1
52 DICKEYSTOWN ROAD	H208	1048	A1
36 FEYSTOWN ROAD	H209	1642	A1
56 DICKEYSTOWN ROAD	H210	982	A1
54 DICKEYSTOWN ROAD	H211	974	A1
54A DICKEYSTOWN ROAD	H212	974	A1
61 MUNIE ROAD	H213	1476	D1
60 MUNIE ROAD	H214	1741	D1
419 COAST ROAD	H215	1189	A1

House Name	House ID	Distance (m)	Nearest Turbine
41 FEYSTOWN ROAD	H216	2123	A1
27 DICKEYSTOWN ROAD	H217	521	A1
47A TULLY ROAD	H218	1675	D1
51 DICKEYSTOWN ROAD	H219	520	A1
58 DICKEYSTOWN ROAD	H220	685	A1
4 CASTLE LANE	H221	2283	D1
47 TULLY ROAD	H222	1770	D1
49 DICKEYSTOWN ROAD	H223	368	A1
49A DICKEYSTOWN ROAD	H224	327	A1
39 FEYSTOWN ROAD	H225	2269	A1
45 DICKEYSTOWN ROAD	H226	419	A1
45 TULLY ROAD	H227	1970	D1
29 TOWN BRAE	H228	2136	A1
43 DICKEYSTOWN ROAD	H229	339	A1
43A DICKEYSTOWN ROAD	H230	330	A1
41 DICKEYSTOWN ROAD	H231	492	A1
3 CASTLE LANE	H232	2534	D1
2 CASTLE LANE	H233	2545	D1
2A CASTLE LANE	H234	2588	D1
28 FEYSTOWN ROAD	H235	1915	A1
21 MUNIE ROAD	H236	2508	D1
33 DICKEYSTOWN ROAD	H237	1021	A1
33A DICKEYSTOWN ROAD	H238	1011	A1
37 DICKEYSTOWN ROAD	H239	700	A1
35 DICKEYSTOWN ROAD	H240	722	A1
29 DICKEYSTOWN ROAD	H241	1371	A1
424 COAST ROAD	H242	495	A1
20 FEYSTOWN ROAD	H243	1740	A1
36 DICKEYSTOWN ROAD	H244	1040	A1
34 DICKEYSTOWN ROAD	H245	1151	A1
30 DICKEYSTOWN ROAD	H246	1216	A1
30A DICKEYSTOWN ROAD	H247	1248	A1
26 DICKEYSTOWN ROAD	H248	1631	A1

Turbines prefixed ‘T’ are part of the proposed development, those prefixed ‘B’ belong to Ballykeel, those prefixed ‘C’ belong to Carnalbanagh. All other prefixes denote single turbine schemes whose associated planning references can be found in Table 10.16.

Cumulative Assessment Methodology

10.87 ETSU-R-97 recommends that the derived noise limits applicable at nearby residential properties shall relate to the cumulative effects of noise from all wind turbines that may affect a particular location.

10.88 The methodology is therefore to:

- Identify appropriate overall ETSU-R-97 noise limits for each noise-sensitive receptor;
- Predict the level of noise resulting from the operation of the turbines being considered in the cumulative assessment without the proposed development;
- Subtract the predicted noise levels calculated in step 2 from the ETSU-R-97 limits identified in step 1. Such a calculation shall provide the limit remaining at each property which the proposed development should not exceed; and
- Compare the predicted noise levels due to the proposed development to the limit calculated in step 3 to determine whether the proposed development complies with ETSU-R-97.

10.89 The methodology outlined above is in accordance with the appropriate guidance on cumulative wind farm noise assessment as described in ETSU-R-97 and the IoA GPG.

Predictions of Noise Levels at Residential Properties

10.90 The existing Ballykeel wind farm consists of seven Enercon E-70 2.3 MW machines. Warranted acoustic emission data for this turbine is provided by the manufacturer and an uncertainty of 2 dB has been included. The data used is consistent with that used in the Ballykeel ES chapter[21]. Details used in this analysis are as follows:

- Hub height of 64 m;
- Rotor diameter of 70 m;
- Sound power levels, L_{WA}, for standardised 10 m height wind speeds as shown in **Table 10.18**; and
- Octave band sound power level data, at the wind speeds where it is available, as shown in **Table 10.19**.

Table 10.18 - A-Weighted Sound Power Levels (dB(A) re 1 pW) for the Enercon E-70 2.3 MW Wind Turbine

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Warranted Plus Uncertainty
1	92.8
2	92.8
3	92.8
4	92.8
5	95.6
6	100.8
7	103.4
8	105.1

[21] Ballykeel wind farm Environmental Statement, Chapter 8 - Noise

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Warranted Plus Uncertainty
9	106.5
10	106.5
11	106.5
12	106.5

Table 10.19 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at Standardised 10m Height Wind Speeds for the Enercon E-70 2.3 MW Wind Turbine

Octave Band (Hz)	8 ms^{-1}
63	89.0
125	97.6
250	100.1
500	98.7
1000	97.2
2000	93.9
4000	87.0
8000	79.4
OVERALL	105.1

10.91 The existing Ballykeel Wind Farm is conditioned to the noise limits specified in its Decision Notice. These noise limits are used to calculate the worst case predicted noise levels using the 'Controlling Property' method outlined in the IoA GPG as follows:

- Predictions are made using appropriate acoustic emission data, as specified above;
- Comparison is made between the predictions and the limits from the planning conditions in order to identify the controlling property; and
- The predictions are scaled by the minimum margin between the predictions and the conditioned noise limits at the controlling property. This yields predicted noise levels which do not exceed the conditioned noise limits at any property and are equal to the conditioned noise limit at the controlling property.

10.92 The proposed seven turbine Carnalbanagh wind farm consists of four Vestas V105 3.45 MW machines and three Vestas V105 3.6 MW machines. Warranted acoustic emission for these turbines is provided by the manufacturer and an uncertainty of 2 dB has been included. Details used in this analysis are as follows:

- Hub height of 72.5 m;
- Rotor diameter of 105 m;
- Sound power levels, L_{WA}, for standardised 10 m height wind speeds as shown in **Table 10.20**; and
- Octave band sound power level data, at 8 ms^{-1}, as shown in **Table 10.21**.

Table 10.20 - A-Weighted Sound Power Levels (dB(A) re 1 pW) plus Uncertainty for the Vestas V105 3.45 / 3.6 MW Wind Turbine

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	V105 3.45 MW	V105 3.6 MW
1	95.1	95.1
2	95.1	95.1
3	95.1	95.1
4	96.5	96.6
5	100.2	100.3
6	104.0	104.1
7	106.2	106.4
8	106.7	106.9
9	106.7	106.9
10	106.7	106.9
11	106.7	106.9
12	106.7	106.9

Table 10.21 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at 8 ms^{-1} for the Vestas V105 3.45 / 3.6 Wind Turbine

Octave Band (Hz)	V105 3.45 MW	V105 3.6 MW
63	86.0	86.2
125	96.5	96.7
250	99.1	99.3
500	101.6	101.8
1000	100.6	100.8
2000	97.9	98.1
4000	92.6	92.8
8000	76.5	76.7
OVERALL	106.7	106.9

10.93 It is assumed that the proposed Carnalbanagh wind farm would be conditioned to the noise limits proposed by the EHO[22]. The 'Controlling Property' method, as described in paragraph 10.91, is used to calculate the worst case predicted noise levels.

10.94 Details of the single turbine schemes considered are as follows:

- Turbine types and hub heights as detailed in **Table 10.22**;
- Sound power levels as shown in **Table 10.23**; and
- Octave band data as shown in **Table 10.24**.

[22] Mid and East Antrim Borough CouncilEnvironmental Services Consultation Response in respect of Planning Application LA02/2017/0594/F, dated 26 June 2018

Table 10.22 - Single Turbine Types and Dimensions

Turbine ID	Turbine Type	Hub Height (m)
A1	Vestas V52 850 kW	49.0
D1	WTN 250 kW	30.0
E1	WTN 250 kW	30.0
F1	Langerway 80 kW	23.0
G1	Vestas V27 225 kW	31.0
J1	WTN 250 kW	30.0
K1	Endurance E3120 50 kW	24.6
L1	Bonus 150 kW	22.5

Table 10.23 - A-Weighted Sound Power Levels (dB(A) re 1 pW) plus Uncertainty for Single Turbines

v_{10} (ms^{-1})	A1	D1	E1	F1	G1	J1	K1	L1
1	97.9	94.9	94.9	90.4	94.6	94.9	89.3	93.0
2	97.9	94.9	94.9	90.4	94.6	94.9	89.3	93.0
3	97.9	94.9	94.9	90.4	94.6	94.9	89.3	93.0
4	97.9	94.9	94.9	90.4	94.6	94.9	89.3	93.0
5	98.3	94.9	94.9	90.9	95.3	94.9	89.6	93.9
6	98.7	95.0	95.0	91.7	96.1	95.0	90.1	94.8
7	99.1	98.1	98.1	92.3	96.9	98.1	91.7	95.7
8	99.5	97.6	97.6	93.0	97.7	97.6	93.4	96.6
9	100.0	98.6	98.6	94.0	98.4	98.6	95.2	97.5
10	100.7	101.2	101.2	95.0	99.2	101.2	97.1	98.4
11	101.5	102.7	102.7	96.0	100.0	102.7	98.0	99.3
12	102.4	102.7	102.7	97.0	100.8	102.7	97.5	100.2

Table 10.24 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at 8 ms^{-1} for Single Turbines

Octave Band (Hz)	A1	D1	E1	F1	G1	J1	K1	L1
63	82.1	75.3	75.3	64.6	72.2	75.3	71.9	81.0
125	88.1	86.0	86.0	71.8	81.3	86.0	80.3	86.0
250	92.6	90.4	90.4	77.1	87.1	90.4	85.3	87.0
500	93.9	90.7	90.7	85.0	92.4	90.7	84.2	91.0
1000	93.1	91.8	91.8	87.4	93.9	91.8	85.5	91.0
2000	91.2	90.6	90.6	87.4	89.8	90.6	88.4	88.0
4000	86.0	85.0	85.0	87.2	77.1	85.0	86.1	85.0
8000	77.1	73.2	73.2	67.6	65.9	73.2	73.1	78.0
OVERALL	99.5	97.6	97.6	93.0	97.7	97.6	93.4	96.6

10.95 The existing and consented single turbine schemes are conditioned to the noise limits specified in their Decision Notices. These noise limits are used to calculate the worst case predicted noise levels using the 'Controlling Property' method outlined in the IoA GPG and described in paragraph 10.91 above.

10.96 The predicted noise levels at the nearest residential properties due to the operation of the sites considered in the cumulative assessment, excluding the proposed development, are detailed in Table 10.25 for day and Table 10.26 for night time periods respectively. The cumulative predicted noise levels are different for day and night as some of the sites considered are conditioned to different limits for the two periods and the predicted noise levels have been scaled to these limits.

10.97 The methodology used to calculate the cumulative predicted noise levels makes the assumption that the properties in question are downwind of all of the considered sites simultaneously, which is not the case in practice. These downwind cumulative predicted noise levels are conservative due to the reductions in noise that would be expected when a property is situated crosswind or upwind of a noise source.

Table 10.25: Cumulative Downwind Predicted Noise Levels during the Day, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	16.1	16.1	16.1	16.1	17.5	21.5	22.5	23.8	24.7	25.0	27.9	28.0
H2	16.4	16.4	16.4	16.4	17.8	21.7	22.7	24.0	24.9	25.2	28.2	28.2
H3	16.6	16.6	16.6	16.6	17.9	21.6	22.6	23.9	24.7	25.1	27.9	27.9
H4	16.4	16.4	16.4	16.4	18.0	22.1	23.1	24.4	25.2	25.5	28.4	28.5
H5	17.9	17.9	17.9	17.9	19.1	22.2	23.2	24.3	25.2	25.7	28.2	28.3
H6	17.7	17.7	17.7	17.7	19.0	22.4	23.5	24.6	25.5	25.8	28.4	28.4
H7	18.3	18.3	18.3	18.3	19.3	22.3	23.3	24.4	25.3	25.8	28.2	28.3
H8	14.3	14.3	14.3	14.3	16.6	22.0	23.0	24.7	25.6	25.7	29.4	29.4
H9	13.3	13.3	13.3	13.3	15.5	20.7	21.7	23.4	24.3	24.4	28.0	28.0
H10	13.3	13.3	13.3	13.3	15.4	20.5	21.5	23.1	24.1	24.2	27.7	27.8
H11	25.2	25.2	25.2	25.2	25.9	27.5	28.2	29.1	30.0	30.8	32.4	32.5
H12	13.7	13.7	13.7	13.7	15.6	20.2	21.2	22.8	23.7	23.9	27.3	27.3
H13	22.7	22.7	22.7	22.7	23.5	25.6	26.4	27.3	28.3	29.1	30.9	31.0
H14	16.8	16.8	16.8	16.8	18.0	21.0	22.0	23.4	24.4	24.9	27.6	27.6
H15	24.3	24.3	24.3	24.3	25.0	26.7	27.5	28.4	29.3	30.1	31.8	31.9
H16	24.1	24.1	24.1	24.1	24.9	26.6	27.4	28.3	29.2	30.1	31.8	31.9
H17	14.8	14.8	14.8	14.8	16.3	20.0	21.0	22.5	23.4	23.7	26.8	26.8
H18	15.5	15.5	15.5	15.5	16.8	19.4	20.4	21.8	22.7	23.2	25.7	25.8
H19	19.8	19.8	19.8	19.8	20.7	22.1	23.1	24.3	25.3	26.2	27.9	27.9
H20	19.0	19.0	19.0	19.0	20.0	21.5	22.5	23.7	24.7	25.5	27.3	27.3
H21	16.7	16.7	16.7	16.7	17.8	19.8	20.8	22.0	23.0	23.7	25.8	25.8
H22	16.5	16.5	16.5	16.5	17.6	19.8	20.7	21.9	22.9	23.6	25.7	25.7
H23	20.2	20.2	20.2	20.2	21.1	22.5	23.4	24.6	25.6	26.5	28.1	28.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H24	24.4	24.4	24.4	24.4	25.1	27.1	27.7	28.6	29.8	30.7	32.7	32.8
H25	18.9	18.9	18.9	18.9	20.0	21.5	22.4	23.6	24.6	25.4	27.2	27.2
H26	19.1	19.1	19.1	19.1	20.0	21.6	22.5	23.7	24.7	25.6	27.3	27.3
H27	19.7	19.7	19.7	19.7	20.6	22.0	23.0	24.2	25.2	26.1	27.8	27.8
H28	19.2	19.2	19.2	19.2	20.2	21.7	22.6	23.8	24.8	25.6	27.4	27.4
H29	18.1	18.1	18.1	18.1	19.1	20.8	21.8	23.0	24.0	24.8	26.6	26.6
H30	39.5	39.5	39.5	39.5	40.2	41.1	41.8	42.7	43.4	44.2	45.0	45.1
H31	16.6	16.6	16.6	16.6	17.8	19.9	20.9	22.2	23.1	23.7	25.9	25.9
H32	19.9	19.9	19.9	19.9	20.8	22.2	23.2	24.3	25.4	26.3	27.9	27.9
H33	19.5	19.5	19.5	19.5	20.4	21.9	22.8	24.0	25.0	25.9	27.6	27.6
H34	17.8	17.8	17.8	17.8	18.8	20.5	21.5	22.7	23.7	24.5	26.4	26.4
H35	17.3	17.3	17.3	17.3	18.4	20.2	21.2	22.4	23.3	24.1	26.1	26.1
H36	14.2	14.2	14.2	14.2	15.6	18.9	19.9	21.3	22.2	22.6	25.4	25.4
H37	16.8	16.8	16.8	16.8	18.0	20.2	21.1	22.4	23.3	24.0	26.2	26.2
H38	18.5	18.5	18.5	18.5	19.4	21.0	22.0	23.2	24.1	25.0	26.8	26.8
H39	18.3	18.3	18.3	18.3	19.3	20.9	21.9	23.1	24.1	24.9	26.7	26.7
H40	17.2	17.2	17.2	17.2	18.2	20.1	21.1	22.3	23.3	24.0	26.0	26.0
H41	24.8	24.8	24.8	24.8	25.3	27.7	28.1	28.9	30.5	31.6	34.0	34.0
H42	17.7	17.7	17.7	17.7	18.8	20.5	21.4	22.7	23.6	24.4	26.2	26.3
H43	17.1	17.1	17.1	17.1	18.2	20.0	21.0	22.2	23.2	23.9	25.9	25.9
H44	14.9	14.9	14.9	14.9	16.2	19.2	20.2	21.6	22.5	23.0	25.7	25.7
H45	17.3	17.3	17.3	17.3	18.5	20.2	21.2	22.4	23.4	24.1	26.0	26.0
H46	14.2	14.2	14.2	14.2	15.6	18.8	19.8	21.1	22.1	22.5	25.2	25.2
H47	17.4	17.4	17.4	17.4	18.5	20.3	21.2	22.5	23.4	24.2	26.0	26.1
H48	15.1	15.1	15.1	15.1	16.5	19.4	20.3	21.7	22.6	23.1	25.7	25.7
H49	17.6	17.6	17.6	17.6	18.8	20.9	21.8	23.2	24.1	24.8	27.0	27.0
H50	16.6	16.6	16.6	16.6	17.8	19.7	20.6	21.9	22.8	23.5	25.6	25.6
H51	18.0	18.0	18.0	18.0	19.1	20.9	21.9	23.2	24.1	24.9	26.8	26.8
H52	14.6	14.6	14.6	14.6	16.0	19.0	20.0	21.4	22.4	22.8	25.5	25.5
H53	25.5	25.5	25.5	25.5	26.0	28.5	28.7	29.6	31.3	32.5	35.1	35.1
H54	25.8	25.8	25.8	25.8	26.2	28.7	29.0	29.8	31.6	32.8	35.4	35.5
H55	28.4	28.4	28.4	28.4	29.1	30.3	31.0	31.8	32.7	33.5	34.8	34.9
H56	27.8	27.8	27.8	27.8	28.5	29.7	30.4	31.3	32.1	33.0	34.3	34.4
H57	27.5	27.5	27.5	27.5	28.2	29.4	30.1	30.9	31.8	32.7	34.0	34.1
H58	22.2	22.2	22.2	22.2	23.0	24.1	25.1	26.3	27.2	28.2	29.6	29.6
H59	27.5	27.5	27.5	27.5	27.9	30.4	30.5	31.4	33.4	34.7	37.4	37.5
H61	14.9	14.9	14.9	14.9	16.1	18.4	19.4	20.6	21.6	22.2	24.4	24.4
H62	27.4	27.4	27.4	27.4	27.7	30.3	30.4	31.2	33.2	34.5	37.3	37.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H63	28.1	28.1	28.1	28.1	28.4	31.1	31.1	32.0	34.1	35.4	38.3	38.3
H64	14.8	14.8	14.8	14.8	16.0	18.4	19.4	20.6	21.5	22.1	24.3	24.4
H65	14.1	14.1	14.1	14.1	15.4	17.9	18.9	20.1	21.1	21.6	23.9	23.9
H66	25.1	25.1	25.1	25.1	25.8	27.3	28.0	28.8	29.8	30.7	32.3	32.4
H67	27.3	27.3	27.3	27.3	27.7	30.3	30.3	31.2	33.2	34.5	37.3	37.3
H68	13.9	13.9	13.9	13.9	15.3	17.8	18.8	20.0	20.9	21.5	23.8	23.8
H69	16.1	16.1	16.1	16.1	17.2	19.1	20.2	21.4	22.3	23.1	25.0	25.0
H70	30.1	30.1	30.1	30.1	30.3	33.1	33.0	33.9	36.2	37.6	40.6	40.6
H71	17.0	17.0	17.0	17.0	18.0	19.8	20.7	21.9	22.9	23.7	25.5	25.5
H72	30.3	30.3	30.3	30.3	30.5	33.4	33.2	34.1	36.4	37.9	40.8	40.9
H73	15.1	15.1	15.1	15.1	16.5	18.5	19.5	20.7	21.6	22.2	24.3	24.3
H74	14.4	14.4	14.4	14.4	15.7	18.0	19.0	20.2	21.1	21.7	23.9	23.9
H75	14.2	14.2	14.2	14.2	15.5	17.9	18.9	20.1	21.0	21.6	23.8	23.8
H76	12.5	12.5	12.5	12.5	14.6	18.5	19.6	20.9	21.8	22.0	25.1	25.1
H77	31.3	31.3	31.3	31.3	31.5	34.4	34.2	35.1	37.5	38.9	42.0	42.0
H78	13.4	13.4	13.4	13.4	14.9	17.4	18.4	19.6	20.5	21.0	23.3	23.3
H79	20.7	20.7	20.7	20.7	21.6	23.8	24.7	25.5	26.4	27.2	29.1	29.2
H80	13.6	13.6	13.6	13.6	15.1	17.5	18.5	19.7	20.6	21.1	23.4	23.4
H81	13.4	13.4	13.4	13.4	14.8	17.3	18.4	19.5	20.4	21.0	23.2	23.2
H82	13.0	13.0	13.0	13.0	14.6	17.1	18.2	19.3	20.2	20.7	23.0	23.0
H83	21.7	21.7	21.7	21.7	22.3	24.8	25.3	26.1	27.7	28.8	31.3	31.4
H84	26.7	26.7	26.7	26.7	27.1	29.9	29.9	30.7	32.9	34.2	37.1	37.2
H85	14.0	14.0	14.0	14.0	15.6	17.6	18.6	19.7	20.6	21.3	23.3	23.3
H86	12.4	12.4	12.4	12.4	14.1	16.7	17.7	18.8	19.7	20.2	22.5	22.5
H87	11.7	11.7	11.7	11.7	13.5	17.5	18.6	19.9	20.7	21.0	24.0	24.0
H88	19.0	19.0	19.0	19.0	20.1	22.7	23.6	24.4	25.4	26.2	28.2	28.3
H89	20.6	20.6	20.6	20.6	21.3	24.0	24.6	25.4	26.8	27.9	30.4	30.5
H90	10.6	10.6	10.6	10.6	13.0	16.2	17.3	18.4	19.2	19.6	22.1	22.2
H91	9.8	9.8	9.8	9.8	12.7	15.5	16.5	17.6	18.4	18.7	21.2	21.2
H92	21.4	21.4	21.4	21.4	22.2	25.3	26.1	26.8	28.2	29.1	31.6	31.7
H93	20.7	20.7	20.7	20.7	21.7	24.8	25.7	26.4	27.6	28.5	30.8	30.9
H94	19.3	19.3	19.3	19.3	20.2	23.1	23.9	24.7	25.9	26.7	29.0	29.2
H95	10.2	10.2	10.2	10.2	13.2	15.9	16.9	17.8	18.6	19.0	21.4	21.3
H96	11.1	11.1	11.1	11.1	13.7	17.3	18.3	19.5	20.4	20.7	23.5	23.5
H97	11.1	11.1	11.1	11.1	13.8	17.4	18.4	19.6	20.4	20.7	23.5	23.5
H98	11.3	11.3	11.3	11.3	13.9	16.4	17.3	18.3	19.1	19.6	21.8	21.7
H99	20.3	20.3	20.3	20.3	21.4	24.4	25.6	26.3	27.2	27.9	30.0	30.4
H100	19.1	19.1	19.1	19.1	20.1	23.0	23.9	24.6	25.8	26.6	28.9	29.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H101	11.0	11.0	11.0	11.0	13.7	17.3	18.3	19.5	20.3	20.6	23.4	23.4
H102	9.7	9.7	9.7	9.7	12.5	15.5	16.6	17.6	18.3	18.7	21.1	21.1
H103	11.0	11.0	11.0	11.0	13.9	17.4	18.4	19.6	20.4	20.7	23.5	23.5
H104	10.3	10.3	10.3	10.3	12.9	15.8	16.8	17.8	18.6	19.0	21.3	21.3
H105	18.6	18.6	18.6	18.6	19.6	22.6	23.6	24.4	25.4	26.2	28.4	28.5
H106	18.3	18.3	18.3	18.3	19.4	22.4	23.4	24.2	25.2	25.9	28.1	28.2
H107	10.3	10.3	10.3	10.3	12.9	15.7	16.7	17.7	18.5	18.9	21.2	21.2
H108	9.1	9.1	9.1	9.1	11.9	14.9	16.0	17.0	17.7	18.1	20.5	20.5
H109	9.0	9.0	9.0	9.0	11.9	14.9	15.9	16.9	17.7	18.0	20.5	20.5
H110	10.3	10.3	10.3	10.3	13.1	16.3	17.3	18.4	19.2	19.5	22.1	22.1
H111	10.1	10.1	10.1	10.1	12.8	15.7	16.7	17.7	18.4	18.8	21.2	21.1
H112	10.2	10.2	10.2	10.2	13.5	15.9	16.9	17.7	18.5	19.0	21.1	21.0
H113	17.6	17.6	17.6	17.6	18.9	21.9	23.0	23.8	24.7	25.4	27.4	27.6
H114	17.6	17.6	17.6	17.6	18.9	21.9	23.0	23.7	24.6	25.3	27.4	27.6
H115	10.4	10.4	10.4	10.4	13.7	17.0	18.0	19.1	19.9	20.2	22.9	22.9
H116	18.9	18.9	18.9	18.9	20.0	22.9	24.0	24.7	25.6	26.3	28.4	28.6
H117	18.8	18.8	18.8	18.8	19.9	22.7	23.9	24.6	25.5	26.2	28.3	28.5
H118	18.9	18.9	18.9	18.9	20.0	22.9	24.0	24.7	25.6	26.3	28.3	28.6
H119	17.8	17.8	17.8	17.8	19.1	21.9	23.0	23.7	24.6	25.2	27.1	27.3
H120	9.4	9.4	9.4	9.4	13.7	16.1	17.0	17.8	18.6	19.0	21.2	21.1
H121	17.8	17.8	17.8	17.8	19.1	21.8	23.0	23.7	24.6	25.2	27.1	27.3
H122	8.5	8.5	8.5	8.5	12.2	15.1	16.1	17.0	17.7	18.0	20.4	20.4
H123	17.1	17.1	17.1	17.1	18.5	21.4	22.7	23.3	24.1	24.7	26.6	26.8
H124	16.8	16.8	16.8	16.8	18.3	21.1	22.4	23.0	23.8	24.3	26.2	26.4
H125	9.5	9.5	9.5	9.5	13.5	16.5	17.4	18.5	19.2	19.5	22.1	22.0
H126	17.0	17.0	17.0	17.0	18.5	21.3	22.6	23.3	24.0	24.6	26.5	26.7
H127	17.0	17.0	17.0	17.0	18.4	21.3	22.6	23.3	24.0	24.6	26.4	26.6
H128	17.3	17.3	17.3	17.3	18.8	21.6	23.0	23.6	24.4	24.9	26.8	27.0
H129	8.8	8.8	8.8	8.8	14.0	16.3	17.2	17.9	18.7	19.0	21.2	21.0
H130	16.9	16.9	16.9	16.9	18.4	21.3	22.6	23.2	24.0	24.5	26.4	26.6
H131	8.9	8.9	8.9	8.9	14.1	16.5	17.3	18.1	18.8	19.2	21.4	21.3
H132	17.4	17.4	17.4	17.4	18.8	21.7	23.2	23.7	24.5	25.0	26.9	27.1
H133	16.7	16.7	16.7	16.7	18.3	21.1	22.5	23.1	23.8	24.4	26.2	26.4
H134	9.2	9.2	9.2	9.2	13.8	16.6	17.5	18.4	19.2	19.5	21.9	21.8
H135	9.0	9.0	9.0	9.0	13.6	16.3	17.3	18.1	18.9	19.2	21.6	21.5
H136	9.0	9.0	9.0	9.0	13.7	16.4	17.3	18.2	18.9	19.3	21.6	21.5
H137	9.0	9.0	9.0	9.0	13.8	16.4	17.4	18.2	19.0	19.3	21.6	21.5
H138	16.9	16.9	16.9	16.9	18.5	21.3	22.9	23.4	24.1	24.5	26.4	26.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H139	8.5	8.5	8.5	8.5	15.4	17.3	18.1	18.7	19.4	19.8	21.7	21.4
H140	8.9	8.9	8.9	8.9	14.6	17.0	17.9	18.7	19.4	19.7	22.0	21.8
H141	18.1	18.1	18.1	18.1	19.2	21.2	23.1	23.4	24.1	24.7	27.0	27.2
H142	8.1	8.1	8.1	8.1	15.3	17.1	17.8	18.4	19.1	19.5	21.3	21.0
H143	16.5	16.5	16.5	16.5	18.2	20.9	22.5	23.0	23.6	24.1	25.9	26.1
H144	8.1	8.1	8.1	8.1	15.7	17.4	18.0	18.6	19.3	19.8	21.4	21.1
H145	8.6	8.6	8.6	8.6	16.3	18.0	18.7	19.4	20.1	20.5	22.3	22.0
H146	8.1	8.1	8.1	8.1	15.8	17.4	18.1	18.7	19.4	19.8	21.4	21.1
H147	16.3	16.3	16.3	16.3	18.1	20.8	22.4	22.9	23.5	23.9	25.7	25.9
H148	16.6	16.6	16.6	16.6	18.3	21.0	22.6	23.1	23.7	24.2	26.0	26.1
H149	7.9	7.9	7.9	7.9	14.6	16.5	17.3	18.0	18.7	19.0	20.8	20.6
H150	7.9	7.9	7.9	7.9	16.1	17.7	18.4	18.9	19.6	20.0	21.6	21.2
H151	16.4	16.4	16.4	16.4	18.2	20.8	22.5	23.0	23.5	24.0	25.8	26.0
H152	20.5	20.5	20.5	20.5	21.2	22.7	25.0	25.1	25.8	26.4	29.0	29.1
H153	8.5	8.5	8.5	8.5	16.3	18.0	18.7	19.4	20.1	20.5	22.2	21.9
H154	8.5	8.5	8.5	8.5	16.2	17.9	18.6	19.3	20.0	20.4	22.2	21.9
H155	8.4	8.4	8.4	8.4	18.0	19.4	20.0	20.6	21.3	21.7	23.2	22.7
H156	8.4	8.4	8.4	8.4	18.1	19.4	20.0	20.6	21.3	21.7	23.2	22.7
H157	15.5	15.5	15.5	15.5	17.8	20.3	21.9	22.3	22.9	23.3	25.1	25.2
H158	8.6	8.6	8.6	8.6	18.5	19.8	20.4	20.9	21.6	22.0	23.4	22.9
H159	20.4	20.4	20.4	20.4	21.0	22.3	24.7	24.6	25.4	26.1	28.8	28.9
H160	7.7	7.7	7.7	7.7	17.5	18.8	19.4	19.9	20.6	21.1	22.4	21.9
H161	7.7	7.7	7.7	7.7	17.7	19.0	19.5	20.0	20.7	21.1	22.5	22.0
H162	8.0	8.0	8.0	8.0	17.6	18.9	19.5	20.0	20.7	21.2	22.5	22.0
H163	19.6	19.6	19.6	19.6	20.3	21.7	24.0	24.0	24.8	25.4	28.1	28.1
H164	16.7	16.7	16.7	16.7	18.5	20.9	22.7	23.0	23.6	24.1	26.0	26.0
H165	8.0	8.0	8.0	8.0	17.8	19.1	19.6	20.1	20.8	21.3	22.6	22.1
H166	7.7	7.7	7.7	7.7	18.0	19.2	19.7	20.2	20.9	21.4	22.7	22.2
H167	20.2	20.2	20.2	20.2	20.8	22.1	24.5	24.5	25.3	25.9	28.6	28.7
H168	7.6	7.6	7.6	7.6	18.5	19.6	20.1	20.6	21.3	21.8	23.0	22.4
H169	21.8	21.8	21.8	21.8	22.3	23.4	25.9	25.8	26.6	27.3	30.1	30.2
H170	7.8	7.8	7.8	7.8	19.7	20.7	21.2	21.7	22.4	22.9	24.0	23.4
H171	7.8	7.8	7.8	7.8	19.6	20.6	21.2	21.6	22.3	22.8	24.0	23.3
H172	15.4	15.4	15.4	15.4	16.9	18.6	20.5	20.7	21.5	22.0	24.4	24.4
H173	15.4	15.4	15.4	15.4	16.8	18.6	20.5	20.7	21.4	22.0	24.3	24.4
H174	15.2	15.2	15.2	15.2	16.7	18.5	20.3	20.6	21.3	21.9	24.2	24.2
H175	7.7	7.7	7.7	7.7	20.5	21.5	22.0	22.5	23.1	23.7	24.7	24.0
H176	7.7	7.7	7.7	7.7	20.7	21.6	22.1	22.6	23.3	23.8	24.8	24.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H177	17.2	17.2	17.2	17.2	18.9	20.8	22.8	23.0	23.6	24.1	26.2	26.2
H178	7.8	7.8	7.8	7.8	20.9	21.8	22.3	22.8	23.5	24.0	25.0	24.3
H179	20.1	20.1	20.1	20.1	20.8	21.8	24.2	24.1	24.9	25.6	28.4	28.4
H180	8.1	8.1	8.1	8.2	19.3	20.4	21.0	21.5	22.2	22.7	23.8	23.2
H181	7.3	7.3	7.3	7.3	20.2	21.1	21.6	22.0	22.7	23.2	24.2	23.5
H182	20.0	20.0	20.0	20.0	20.7	21.7	24.1	24.0	24.8	25.5	28.3	28.3
H183	8.1	8.1	8.1	8.1	19.3	20.4	21.1	21.6	22.3	22.8	23.9	23.3
H184	8.1	8.1	8.1	8.1	19.4	20.5	21.1	21.7	22.3	22.9	24.0	23.3
H185	8.3	8.3	8.3	8.3	19.8	20.9	21.4	22.0	22.7	23.2	24.3	23.6
H186	7.3	7.3	7.3	7.3	20.3	21.2	21.7	22.2	22.9	23.4	24.4	23.7
H187	7.3	7.3	7.3	7.3	20.8	21.7	22.2	22.7	23.4	23.9	24.8	24.1
H188	20.7	20.7	20.7	20.7	21.3	22.2	24.7	24.5	25.4	26.1	28.9	29.0
H189	8.0	8.0	8.0	8.0	19.9	20.9	21.5	22.0	22.7	23.2	24.3	23.6
H191	20.5	20.5	20.5	20.5	21.1	22.0	24.5	24.4	25.2	25.9	28.7	28.7
H192	8.9	8.9	8.9	8.9	19.9	20.9	21.6	22.1	22.8	23.3	24.3	23.7
H193	7.9	7.9	7.9	7.9	22.8	23.6	24.0	24.6	25.2	25.8	26.6	25.8
H194	21.2	21.2	21.2	21.2	21.8	22.6	25.2	25.0	25.8	26.5	29.5	29.5
H195	7.9	7.9	7.9	7.9	22.9	23.7	24.2	24.6	25.3	25.9	26.7	25.9
H196	8.8	8.8	8.8	8.8	20.8	21.7	22.3	22.9	23.5	24.1	25.0	24.3
H197	21.1	21.1	21.1	21.1	21.7	22.5	25.1	24.9	25.8	26.5	29.4	29.4
H198	15.2	15.2	15.2	15.2	18.6	20.4	22.0	22.3	22.9	23.3	25.0	24.9
H200	8.6	8.6	8.6	8.6	21.3	22.2	22.8	23.3	24.0	24.6	25.5	24.7
H202	15.9	15.9	15.9	15.9	18.4	20.3	22.1	22.3	22.9	23.3	25.2	25.2
H203	18.6	18.6	18.6	18.6	19.6	20.6	23.0	22.8	23.6	24.3	27.0	27.0
H204	15.4	15.4	15.4	15.4	16.9	18.3	20.3	20.4	21.2	21.8	24.1	24.2
H205	18.5	18.5	18.5	18.5	19.5	20.5	22.9	22.8	23.6	24.2	26.9	26.9
H206	7.7	7.7	7.7	7.7	24.2	25.0	25.4	26.0	26.7	27.2	28.0	27.1
H207	7.6	7.6	7.6	7.6	25.1	25.8	26.3	26.8	27.5	28.1	28.8	27.9
H208	8.2	8.2	8.2	8.2	25.7	26.4	27.0	27.5	28.2	28.7	29.5	28.6
H209	13.1	13.1	13.1	13.1	19.8	20.9	22.0	22.4	23.0	23.6	24.9	24.5
H210	8.0	8.0	8.0	8.0	26.4	27.1	27.6	28.2	28.9	29.5	30.2	29.3
H211	8.0	8.0	8.0	8.0	26.5	27.2	27.7	28.2	28.9	29.5	30.2	29.3
H212	8.0	8.0	8.0	8.0	26.5	27.2	27.7	28.2	28.9	29.5	30.2	29.3
H213	17.1	17.1	17.1	17.1	18.4	19.5	21.7	21.7	22.4	23.1	25.7	25.6
H214	15.5	15.5	15.5	15.5	17.6	18.8	20.7	20.8	21.5	22.1	24.4	24.4
H215	7.5	7.5	7.5	7.5	27.2	27.8	28.3	28.9	29.6	30.2	30.8	29.9
H216	13.2	13.2	13.2	13.2	18.1	19.6	20.9	21.2	21.8	22.3	23.8	23.6
H217	8.5	8.5	8.5	8.5	33.0	33.6	34.2	34.8	35.5	36.1	36.8	35.8

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H218	15.9	15.9	15.9	15.9	17.7	18.9	20.9	20.9	21.7	22.3	24.7	24.7
H219	8.3	8.3	8.3	8.3	33.1	33.7	34.2	34.8	35.5	36.1	36.8	35.8
H220	8.0	8.0	8.0	8.0	30.1	30.8	31.3	31.9	32.6	33.2	33.8	32.8
H221	15.3	15.3	15.3	15.3	17.2	18.3	20.3	20.3	21.1	21.7	24.1	24.1
H222	15.4	15.4	15.4	15.4	17.4	18.7	20.6	20.6	21.4	22.0	24.4	24.3
H223	8.6	8.6	8.6	8.6	36.5	37.1	37.6	38.3	39.0	39.6	40.2	39.2
H224	8.5	8.5	8.5	8.5	37.6	38.2	38.8	39.4	40.1	40.7	41.3	40.3
H225	13.1	13.1	13.1	13.1	17.4	18.8	20.2	20.4	21.1	21.6	23.3	23.1
H226	8.9	8.9	8.9	8.9	35.2	35.8	36.4	37.0	37.7	38.3	38.9	37.9
H227	14.4	14.4	14.4	14.4	16.9	18.2	19.9	20.0	20.7	21.3	23.5	23.4
H228	12.5	12.5	12.5	12.5	17.6	18.9	20.1	20.4	21.1	21.6	23.2	22.9
H229	8.7	8.7	8.7	8.7	37.2	37.8	38.4	39.0	39.7	40.3	40.9	39.9
H230	8.7	8.7	8.7	8.7	37.5	38.1	38.7	39.3	40.0	40.6	41.2	40.2
H231	8.9	8.9	8.9	8.9	33.6	34.2	34.8	35.4	36.1	36.7	37.4	36.4
H232	14.3	14.3	14.3	14.3	16.5	17.7	19.5	19.6	20.3	20.9	23.3	23.2
H233	14.2	14.2	14.2	14.2	16.5	17.6	19.5	19.6	20.3	20.9	23.2	23.1
H234	14.1	14.1	14.1	14.1	16.3	17.5	19.4	19.4	20.2	20.8	23.1	23.0
H235	11.4	11.4	11.4	11.4	18.2	19.3	20.3	20.7	21.4	21.9	23.2	22.8
H236	12.1	12.1	12.1	12.1	14.9	16.4	18.1	18.3	18.9	19.5	21.5	21.4
H237	9.7	9.7	9.7	9.7	26.1	26.8	27.3	27.9	28.6	29.2	29.9	28.9
H238	9.7	9.7	9.7	9.7	26.2	26.9	27.4	28.0	28.7	29.3	29.9	29.0
H239	8.8	8.8	8.8	8.8	30.0	30.7	31.2	31.8	32.5	33.1	33.7	32.8
H240	8.8	8.8	8.8	8.8	29.7	30.4	30.9	31.5	32.2	32.8	33.4	32.5
H241	9.3	9.3	9.3	9.3	22.9	23.6	24.2	24.6	25.3	25.9	26.7	25.9
H242	7.5	7.5	7.5	7.5	33.0	33.6	34.2	34.8	35.5	36.1	36.7	35.8
H243	10.3	10.3	10.3	10.3	20.5	21.4	22.1	22.5	23.1	23.7	24.7	24.0
H244	8.7	8.7	8.7	8.7	25.9	26.6	27.0	27.6	28.3	28.9	29.6	28.7
H245	9.0	9.0	9.0	9.0	24.7	25.4	26.0	26.5	27.2	27.8	28.5	27.6
H246	9.1	9.1	9.1	9.1	24.2	24.9	25.5	26.0	26.7	27.3	28.0	27.1
H247	9.1	9.1	9.1	9.1	23.9	24.6	25.2	25.7	26.4	27.0	27.7	26.8
H248	9.4	9.4	9.4	9.4	21.1	22.0	22.7	23.1	23.8	24.3	25.2	24.4

Table 10.26 - Cumulative Downwind Predicted Noise Levels during the Night, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	16.2	16.2	16.2	16.2	17.7	21.6	22.8	23.9	24.8	25.1	28.0	28.0
H2	16.5	16.5	16.5	16.5	17.9	21.8	23.0	24.1	25.0	25.3	28.2	28.3
H3	16.7	16.7	16.7	16.7	18.0	21.8	23.0	24.0	24.9	25.2	27.9	28.0
H4	16.5	16.5	16.5	16.5	18.1	22.2	23.5	24.6	25.4	25.6	28.5	28.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H5	18.0	18.0	18.0	18.0	19.2	22.3	23.5	24.4	25.3	25.8	28.3	28.3
H6	17.8	17.8	17.8	17.8	19.2	22.6	23.9	24.8	25.6	25.9	28.4	28.5
H7	18.3	18.3	18.3	18.3	19.4	22.5	23.6	24.5	25.4	25.9	28.3	28.4
H8	14.4	14.4	14.4	14.4	16.6	22.1	23.1	24.7	25.6	25.7	29.4	29.4
H9	13.4	13.4	13.4	13.4	15.6	20.8	21.8	23.4	24.3	24.4	28.0	28.0
H10	13.4	13.4	13.4	13.4	15.5	20.6	21.6	23.2	24.1	24.2	27.8	27.8
H11	25.2	25.2	25.2	25.2	26.0	27.5	28.4	29.2	30.1	30.9	32.5	32.6
H12	13.7	13.7	13.7	13.7	15.7	20.3	21.4	22.9	23.8	23.9	27.3	27.3
H13	22.8	22.8	22.8	22.8	23.6	25.7	26.7	27.4	28.4	29.1	31.0	31.1
H14	16.8	16.8	16.8	16.8	18.1	21.0	22.1	23.4	24.4	24.9	27.6	27.6
H15	24.3	24.3	24.3	24.3	25.1	26.8	27.7	28.5	29.4	30.2	31.8	32.0
H16	24.2	24.2	24.2	24.2	24.9	26.7	27.6	28.4	29.3	30.1	31.8	31.9
H17	14.8	14.8	14.8	14.8	16.4	20.0	21.1	22.5	23.4	23.8	26.8	26.8
H18	15.6	15.6	15.6	15.6	16.8	19.5	20.5	21.8	22.7	23.3	25.7	25.8
H19	19.8	19.8	19.8	19.8	20.7	22.1	23.2	24.3	25.3	26.2	27.9	27.9
H20	19.0	19.0	19.0	19.0	20.1	21.6	22.6	23.8	24.7	25.5	27.3	27.4
H21	16.7	16.7	16.7	16.7	17.8	19.9	20.9	22.1	23.1	23.8	25.8	25.8
H22	16.5	16.5	16.5	16.5	17.7	19.8	20.8	22.0	23.0	23.6	25.7	25.7
H23	20.2	20.2	20.2	20.2	21.1	22.5	23.5	24.6	25.6	26.5	28.2	28.2
H24	24.5	24.5	24.5	24.5	25.2	27.2	27.9	28.6	29.8	30.7	32.7	32.8
H25	18.9	18.9	18.9	18.9	20.0	21.5	22.5	23.7	24.6	25.5	27.2	27.2
H26	19.1	19.1	19.1	19.1	20.1	21.6	22.6	23.8	24.8	25.6	27.3	27.3
H27	19.8	19.8	19.8	19.8	20.7	22.1	23.1	24.2	25.2	26.1	27.8	27.8
H28	19.2	19.2	19.2	19.2	20.2	21.7	22.7	23.9	24.8	25.7	27.4	27.4
H29	18.1	18.1	18.1	18.1	19.1	20.8	21.9	23.0	24.0	24.8	26.7	26.7
H30	39.5	39.5	39.5	39.5	40.2	41.1	41.9	42.7	43.4	44.2	45.0	45.1
H31	16.6	16.6	16.6	16.6	17.8	20.0	21.0	22.2	23.1	23.8	25.9	26.0
H32	19.9	19.9	19.9	19.9	20.8	22.2	23.3	24.4	25.4	26.3	27.9	27.9
H33	19.5	19.5	19.5	19.5	20.4	21.9	22.9	24.0	25.0	25.9	27.6	27.6
H34	17.8	17.8	17.8	17.8	18.8	20.6	21.6	22.8	23.7	24.5	26.4	26.4
H35	17.4	17.4	17.4	17.4	18.4	20.2	21.3	22.5	23.4	24.1	26.1	26.1
H36	14.3	14.3	14.3	14.3	15.6	19.0	20.1	21.4	22.3	22.7	25.4	25.5
H37	16.8	16.8	16.8	16.8	18.0	20.2	21.2	22.5	23.4	24.0	26.2	26.2
H38	18.5	18.5	18.5	18.5	19.5	21.1	22.1	23.2	24.2	25.1	26.8	26.8
H39	18.3	18.3	18.3	18.3	19.3	21.0	22.0	23.2	24.1	24.9	26.7	26.7
H40	17.2	17.2	17.2	17.2	18.3	20.2	21.2	22.3	23.3	24.0	26.0	26.0
H41	24.8	24.8	24.8	24.8	25.4	27.8	28.3	29.0	30.5	31.6	34.0	34.1
H42	17.7	17.7	17.7	17.7	18.8	20.5	21.5	22.7	23.6	24.4	26.3	26.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H43	17.1	17.1	17.1	17.1	18.2	20.1	21.1	22.2	23.2	24.0	25.9	25.9
H44	14.9	14.9	14.9	14.9	16.3	19.3	20.3	21.6	22.5	23.0	25.7	25.7
H45	17.3	17.3	17.3	17.3	18.5	20.3	21.3	22.5	23.4	24.1	26.0	26.1
H46	14.3	14.3	14.3	14.3	15.7	18.8	19.9	21.2	22.1	22.5	25.2	25.2
H47	17.4	17.4	17.4	17.4	18.6	20.3	21.3	22.5	23.4	24.2	26.1	26.1
H48	15.1	15.1	15.1	15.1	16.6	19.4	20.5	21.7	22.7	23.2	25.7	25.7
H49	17.7	17.7	17.7	17.7	18.9	20.9	22.0	23.2	24.1	24.8	27.0	27.0
H50	16.6	16.6	16.6	16.6	17.8	19.7	20.8	22.0	22.9	23.6	25.6	25.6
H51	18.0	18.0	18.0	18.0	19.2	21.0	22.0	23.2	24.1	24.9	26.9	26.9
H52	14.6	14.6	14.6	14.6	16.0	19.1	20.2	21.5	22.4	22.9	25.5	25.5
H53	25.5	25.5	25.5	25.5	26.0	28.5	28.9	29.7	31.4	32.5	35.1	35.2
H54	25.8	25.8	25.8	25.8	26.3	28.8	29.1	29.9	31.7	32.8	35.4	35.5
H55	28.4	28.4	28.4	28.4	29.1	30.3	31.1	31.9	32.7	33.5	34.8	34.9
H56	27.8	27.8	27.8	27.8	28.5	29.7	30.5	31.3	32.2	33.0	34.3	34.4
H57	27.5	27.5	27.5	27.5	28.2	29.4	30.2	31.0	31.9	32.7	34.0	34.1
H58	22.2	22.2	22.2	22.2	23.0	24.2	25.1	26.3	27.3	28.2	29.6	29.6
H59	27.5	27.5	27.5	27.5	27.9	30.5	30.6	31.4	33.4	34.7	37.5	37.5
H61	14.9	14.9	14.9	14.9	16.1	18.4	19.6	20.7	21.6	22.2	24.4	24.4
H62	27.4	27.4	27.4	27.4	27.8	30.4	30.5	31.3	33.3	34.6	37.3	37.3
H63	28.1	28.1	28.1	28.1	28.5	31.2	31.2	32.0	34.1	35.5	38.3	38.3
H64	14.8	14.8	14.8	14.8	16.1	18.4	19.5	20.6	21.6	22.2	24.4	24.4
H65	14.2	14.2	14.2	14.2	15.5	18.0	19.1	20.2	21.1	21.7	24.0	24.0
H66	25.1	25.1	25.1	25.1	25.8	27.3	28.1	28.9	29.8	30.7	32.3	32.4
H67	27.3	27.3	27.3	27.3	27.7	30.3	30.4	31.2	33.2	34.5	37.3	37.3
H68	14.0	14.0	14.0	14.0	15.3	17.9	19.0	20.1	21.0	21.5	23.9	23.9
H69	16.2	16.2	16.2	16.2	17.3	19.2	20.3	21.4	22.3	23.1	25.0	25.1
H70	30.1	30.1	30.1	30.1	30.3	33.2	33.0	33.9	36.2	37.6	40.6	40.6
H71	17.0	17.0	17.0	17.0	18.0	19.8	20.9	21.9	22.9	23.7	25.5	25.5
H72	30.3	30.3	30.3	30.3	30.5	33.4	33.3	34.1	36.5	37.9	40.8	40.9
H73	15.1	15.1	15.1	15.1	16.5	18.6	19.7	20.8	21.6	22.3	24.4	24.4
H74	14.4	14.4	14.4	14.4	15.7	18.1	19.2	20.3	21.2	21.8	23.9	24.0
H75	14.2	14.2	14.2	14.2	15.6	18.0	19.1	20.2	21.1	21.7	23.8	23.9
H76	12.6	12.6	12.6	12.6	14.7	18.7	19.8	21.0	21.9	22.1	25.1	25.1
H77	31.3	31.3	31.3	31.3	31.5	34.5	34.3	35.1	37.5	39.0	42.0	42.0
H78	13.5	13.5	13.5	13.5	15.0	17.5	18.7	19.7	20.6	21.1	23.3	23.4
H79	20.7	20.7	20.7	20.7	21.7	23.9	25.0	25.6	26.6	27.3	29.1	29.2
H80	13.7	13.7	13.7	13.7	15.2	17.6	18.8	19.8	20.7	21.2	23.4	23.4
H81	13.4	13.4	13.4	13.4	14.9	17.4	18.6	19.6	20.4	21.0	23.2	23.2

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H82	13.1	13.1	13.1	13.1	14.7	17.2	18.4	19.4	20.3	20.8	23.0	23.1
H83	21.7	21.7	21.7	21.7	22.4	24.9	25.6	26.3	27.8	28.8	31.3	31.4
H84	26.8	26.8	26.8	26.8	27.1	29.9	30.0	30.8	32.9	34.3	37.1	37.2
H85	14.1	14.1	14.1	14.1	15.6	17.7	18.8	19.8	20.7	21.4	23.3	23.3
H86	12.5	12.5	12.5	12.5	14.2	16.8	18.0	19.0	19.8	20.3	22.5	22.5
H87	11.7	11.7	11.7	11.7	13.7	17.6	18.9	20.0	20.8	21.1	24.0	24.1
H88	19.1	19.1	19.1	19.1	20.2	22.9	24.1	24.6	25.6	26.3	28.3	28.4
H89	20.7	20.7	20.7	20.7	21.4	24.1	24.9	25.5	27.0	27.9	30.4	30.5
H90	10.7	10.7	10.7	10.7	13.1	16.4	17.6	18.6	19.3	19.7	22.2	22.2
H91	9.9	9.9	9.9	9.9	12.8	15.7	16.8	17.7	18.5	18.8	21.3	21.2
H92	21.5	21.5	21.5	21.5	22.4	25.5	26.6	27.0	28.3	29.3	31.6	31.8
H93	20.9	20.9	20.9	20.9	21.9	25.0	26.3	26.7	27.8	28.6	30.9	31.0
H94	19.4	19.4	19.4	19.4	20.4	23.3	24.4	24.9	26.1	26.9	29.1	29.2
H95	10.3	10.3	10.3	10.3	13.3	16.0	17.2	18.0	18.7	19.1	21.4	21.4
H96	11.2	11.2	11.2	11.2	13.8	17.4	18.7	19.7	20.5	20.8	23.6	23.6
H97	11.2	11.2	11.2	11.2	13.9	17.5	18.7	19.7	20.5	20.8	23.6	23.6
H98	11.4	11.4	11.4	11.4	14.0	16.5	17.6	18.4	19.2	19.7	21.8	21.8
H99	20.4	20.4	20.4	20.4	21.6	24.7	26.2	26.6	27.5	28.1	30.1	30.5
H100	19.2	19.2	19.2	19.2	20.2	23.2	24.4	24.9	26.0	26.8	29.0	29.1
H101	11.1	11.1	11.1	11.1	13.8	17.4	18.6	19.6	20.4	20.7	23.5	23.5
H102	9.9	9.9	9.9	9.9	12.6	15.7	17.0	17.7	18.5	18.8	21.2	21.2
H103	11.1	11.1	11.1	11.1	14.0	17.5	18.8	19.7	20.5	20.8	23.5	23.5
H104	10.4	10.4	10.4	10.4	13.0	15.9	17.2	18.0	18.7	19.1	21.4	21.4
H105	18.7	18.7	18.7	18.7	19.8	22.9	24.2	24.6	25.6	26.4	28.5	28.6
H106	18.5	18.5	18.5	18.5	19.6	22.6	24.0	24.4	25.4	26.1	28.2	28.3
H107	10.4	10.4	10.4	10.4	13.0	15.9	17.1	17.9	18.6	19.0	21.3	21.3
H108	9.2	9.2	9.2	9.2	12.0	15.1	16.4	17.2	17.9	18.2	20.6	20.6
H109	9.1	9.1	9.1	9.1	12.0	15.1	16.3	17.1	17.8	18.1	20.5	20.5
H110	10.4	10.4	10.4	10.4	13.3	16.5	17.7	18.6	19.3	19.6	22.2	22.1
H111	10.2	10.2	10.2	10.2	13.0	15.8	17.1	17.8	18.6	19.0	21.2	21.2
H112	10.3	10.3	10.3	10.3	13.6	16.1	17.2	17.9	18.6	19.1	21.2	21.1
H113	17.8	17.8	17.8	17.8	19.1	22.2	23.7	24.0	24.9	25.6	27.5	27.7
H114	17.7	17.7	17.7	17.7	19.1	22.1	23.6	24.0	24.9	25.5	27.5	27.7
H115	10.5	10.5	10.5	10.5	13.8	17.2	18.4	19.3	20.0	20.3	23.0	23.0
H116	19.0	19.0	19.0	19.0	20.2	23.1	24.5	24.9	25.8	26.5	28.5	28.7
H117	18.9	18.9	18.9	18.9	20.1	23.0	24.4	24.8	25.7	26.4	28.4	28.6
H118	19.0	19.0	19.0	19.0	20.2	23.1	24.6	25.0	25.8	26.5	28.4	28.7
H119	17.9	17.9	17.9	17.9	19.3	22.1	23.6	24.0	24.8	25.4	27.3	27.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H120	9.5	9.5	9.5	9.5	13.8	16.3	17.4	18.0	18.7	19.1	21.3	21.2
H121	17.9	17.9	17.9	17.9	19.2	22.1	23.6	24.0	24.8	25.4	27.2	27.4
H122	8.6	8.6	8.6	8.6	12.3	15.2	16.5	17.1	17.9	18.2	20.5	20.4
H123	17.3	17.3	17.3	17.3	18.8	21.7	23.3	23.6	24.3	24.9	26.7	26.9
H124	16.9	16.9	16.9	16.9	18.5	21.3	23.0	23.3	24.0	24.5	26.3	26.5
H125	9.6	9.6	9.6	9.6	13.6	16.6	17.8	18.6	19.3	19.6	22.1	22.1
H126	17.2	17.2	17.2	17.2	18.7	21.6	23.3	23.6	24.3	24.8	26.6	26.8
H127	17.1	17.1	17.1	17.1	18.7	21.6	23.3	23.6	24.3	24.8	26.6	26.8
H128	17.5	17.5	17.5	17.5	19.0	21.9	23.6	23.9	24.6	25.1	27.0	27.2
H129	9.0	9.0	9.0	9.0	14.1	16.4	17.5	18.1	18.8	19.1	21.2	21.1
H130	17.1	17.1	17.1	17.1	18.6	21.5	23.2	23.5	24.2	24.7	26.5	26.7
H131	9.0	9.0	9.0	9.0	14.2	16.6	17.6	18.2	18.9	19.3	21.5	21.3
H132	17.6	17.6	17.6	17.6	19.1	22.0	23.8	24.1	24.7	25.2	27.0	27.2
H133	16.9	16.9	16.9	16.9	18.5	21.4	23.2	23.4	24.1	24.6	26.4	26.6
H134	9.4	9.4	9.4	9.4	13.9	16.7	17.9	18.6	19.3	19.6	22.0	21.9
H135	9.2	9.2	9.2	9.2	13.7	16.4	17.6	18.3	19.0	19.3	21.6	21.6
H136	9.2	9.2	9.2	9.2	13.8	16.5	17.7	18.4	19.1	19.4	21.7	21.6
H137	9.2	9.2	9.2	9.2	13.9	16.6	17.7	18.4	19.1	19.4	21.7	21.6
H138	17.1	17.1	17.1	17.1	18.8	21.7	23.6	23.8	24.3	24.8	26.5	26.7
H139	8.7	8.7	8.7	8.7	15.5	17.4	18.4	18.9	19.5	19.9	21.7	21.5
H140	9.1	9.1	9.1	9.1	14.7	17.1	18.2	18.8	19.5	19.9	22.0	21.9
H141	18.2	18.2	18.2	18.2	19.3	21.4	23.5	23.6	24.3	24.9	27.1	27.3
H142	8.3	8.3	8.3	8.3	15.4	17.2	18.1	18.5	19.2	19.6	21.3	21.1
H143	16.6	16.6	16.6	16.6	18.4	21.2	23.2	23.3	23.9	24.4	26.1	26.2
H144	8.3	8.3	8.3	8.3	15.7	17.5	18.3	18.8	19.4	19.9	21.5	21.2
H145	8.7	8.7	8.7	8.7	16.3	18.1	19.0	19.5	20.2	20.6	22.3	22.0
H146	8.2	8.2	8.2	8.2	15.8	17.5	18.3	18.8	19.5	19.9	21.5	21.2
H147	16.5	16.5	16.5	16.5	18.3	21.1	23.0	23.2	23.7	24.2	25.9	26.0
H148	16.8	16.8	16.8	16.8	18.5	21.3	23.3	23.4	24.0	24.4	26.1	26.3
H149	8.1	8.1	8.1	8.1	14.7	16.6	17.6	18.1	18.8	19.2	20.9	20.7
H150	8.1	8.1	8.1	8.1	16.2	17.8	18.6	19.0	19.7	20.1	21.7	21.3
H151	16.6	16.6	16.6	16.6	18.5	21.2	23.2	23.3	23.8	24.2	26.0	26.1
H152	20.6	20.6	20.6	20.6	21.3	22.9	25.4	25.3	26.0	26.6	29.1	29.2
H153	8.7	8.7	8.7	8.7	16.3	18.1	19.0	19.5	20.2	20.6	22.3	22.0
H154	8.7	8.7	8.7	8.7	16.3	18.0	18.9	19.4	20.1	20.5	22.2	21.9
H155	8.6	8.6	8.6	8.6	18.0	19.4	20.2	20.7	21.3	21.8	23.2	22.8
H156	8.6	8.6	8.6	8.6	18.1	19.5	20.2	20.7	21.3	21.8	23.2	22.8
H157	15.7	15.7	15.7	15.7	18.0	20.6	22.5	22.6	23.2	23.6	25.3	25.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H158	8.7	8.7	8.7	8.7	18.5	19.9	20.6	21.0	21.6	22.1	23.4	22.9
H159	20.4	20.4	20.4	20.4	21.1	22.5	25.0	24.8	25.6	26.2	28.9	28.9
H160	7.9	7.9	7.9	7.9	17.6	18.9	19.6	20.0	20.7	21.1	22.5	22.0
H161	7.9	7.9	7.9	7.9	17.7	19.0	19.7	20.1	20.7	21.2	22.5	22.0
H162	8.2	8.2	8.2	8.2	17.7	19.0	19.7	20.1	20.8	21.2	22.5	22.1
H163	19.6	19.6	19.6	19.6	20.4	21.9	24.3	24.2	24.9	25.6	28.1	28.2
H164	16.9	16.9	16.9	16.9	18.7	21.2	23.3	23.3	23.9	24.3	26.1	26.2
H165	8.2	8.2	8.2	8.2	17.8	19.1	19.8	20.2	20.9	21.4	22.7	22.2
H166	7.9	7.9	7.9	7.9	18.0	19.3	19.9	20.3	21.0	21.5	22.7	22.2
H167	20.2	20.2	20.2	20.2	20.9	22.3	24.8	24.6	25.4	26.0	28.7	28.8
H168	7.7	7.7	7.7	7.7	18.5	19.7	20.3	20.7	21.3	21.8	23.0	22.5
H169	21.9	21.9	21.9	21.9	22.4	23.6	26.2	26.0	26.7	27.4	30.1	30.2
H170	8.0	8.0	8.0	8.0	19.7	20.8	21.3	21.8	22.5	23.0	24.1	23.4
H171	8.0	8.0	8.0	8.0	19.6	20.7	21.3	21.7	22.4	22.9	24.0	23.4
H172	15.5	15.5	15.5	15.5	17.0	18.8	20.9	20.9	21.6	22.2	24.5	24.5
H173	15.5	15.5	15.5	15.5	17.0	18.8	20.9	20.9	21.6	22.2	24.4	24.5
H174	15.3	15.3	15.3	15.3	16.8	18.7	20.8	20.8	21.5	22.0	24.3	24.3
H175	7.9	7.9	7.9	7.9	20.5	21.5	22.1	22.5	23.2	23.7	24.7	24.0
H176	7.9	7.9	7.9	7.9	20.7	21.7	22.2	22.7	23.4	23.9	24.9	24.2
H177	17.4	17.4	17.4	17.4	19.1	21.0	23.3	23.2	23.8	24.3	26.3	26.4
H178	8.0	8.0	8.0	8.0	20.9	21.9	22.4	22.8	23.5	24.0	25.0	24.3
H179	20.1	20.1	20.1	20.1	20.8	21.9	24.5	24.2	25.0	25.7	28.4	28.5
H180	8.3	8.3	8.3	8.3	19.3	20.4	21.2	21.6	22.3	22.8	23.9	23.3
H181	7.5	7.5	7.5	7.5	20.2	21.2	21.7	22.1	22.8	23.3	24.3	23.6
H182	20.0	20.0	20.0	20.0	20.7	21.8	24.4	24.1	24.9	25.6	28.3	28.4
H183	8.3	8.3	8.3	8.3	19.4	20.5	21.2	21.7	22.3	22.8	23.9	23.3
H184	8.3	8.3	8.3	8.3	19.5	20.6	21.3	21.7	22.4	22.9	24.0	23.4
H185	8.5	8.5	8.5	8.5	19.8	20.9	21.6	22.1	22.7	23.2	24.3	23.7
H186	7.5	7.5	7.5	7.5	20.3	21.3	21.8	22.2	22.9	23.4	24.4	23.7
H187	7.5	7.5	7.5	7.5	20.9	21.8	22.3	22.7	23.4	23.9	24.9	24.1
H188	20.8	20.8	20.8	20.8	21.4	22.3	24.9	24.7	25.5	26.2	29.0	29.0
H189	8.2	8.2	8.2	8.2	19.9	20.9	21.6	22.1	22.7	23.3	24.3	23.6
H191	20.5	20.5	20.5	20.5	21.2	22.1	24.7	24.5	25.3	26.0	28.8	28.8
H192	9.1	9.1	9.1	9.1	19.9	21.0	21.7	22.2	22.8	23.4	24.4	23.7
H193	8.1	8.1	8.1	8.1	22.8	23.6	24.1	24.6	25.3	25.8	26.7	25.9
H194	21.3	21.3	21.3	21.3	21.8	22.7	25.4	25.1	25.9	26.6	29.5	29.5
H195	8.1	8.1	8.1	8.1	22.9	23.7	24.3	24.7	25.4	25.9	26.7	25.9
H196	9.0	9.0	9.0	9.0	20.8	21.8	22.5	22.9	23.6	24.1	25.1	24.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H197	21.2	21.2	21.2	21.2	21.7	22.6	25.3	25.0	25.8	26.5	29.4	29.4
H198	15.3	15.3	15.3	15.3	18.7	20.6	22.5	22.6	23.1	23.5	25.1	25.0
H200	8.8	8.8	8.8	8.8	21.3	22.2	22.9	23.4	24.1	24.6	25.5	24.8
H202	16.0	16.0	16.0	16.0	18.6	20.5	22.6	22.6	23.1	23.6	25.3	25.3
H203	18.6	18.6	18.6	18.6	19.6	20.7	23.2	23.0	23.7	24.4	27.0	27.0
H204	15.4	15.4	15.4	15.4	17.0	18.5	20.7	20.6	21.3	21.9	24.2	24.2
H205	18.5	18.5	18.5	18.5	19.6	20.7	23.1	22.9	23.7	24.3	27.0	27.0
H206	7.8	7.8	7.8	7.8	24.2	25.0	25.5	26.0	26.7	27.2	28.0	27.1
H207	7.7	7.7	7.7	7.7	25.1	25.8	26.3	26.8	27.5	28.1	28.8	27.9
H208	8.4	8.4	8.4	8.4	25.7	26.4	27.0	27.5	28.2	28.8	29.5	28.6
H209	13.2	13.2	13.2	13.2	19.9	21.0	22.2	22.5	23.1	23.7	25.0	24.5
H210	8.2	8.2	8.2	8.2	26.4	27.1	27.6	28.2	28.9	29.5	30.2	29.3
H211	8.2	8.2	8.2	8.2	26.5	27.2	27.7	28.2	28.9	29.5	30.2	29.3
H212	8.2	8.2	8.2	8.2	26.5	27.2	27.7	28.2	28.9	29.5	30.2	29.3
H213	17.1	17.1	17.1	17.1	18.5	19.7	22.0	21.8	22.6	23.2	25.7	25.7
H214	15.6	15.6	15.6	15.6	17.7	19.0	21.0	20.9	21.6	22.2	24.5	24.5
H215	7.7	7.7	7.7	7.7	27.2	27.8	28.3	28.9	29.6	30.2	30.8	29.9
H216	13.4	13.4	13.4	13.4	18.2	19.8	21.3	21.4	22.0	22.5	23.9	23.7
H217	8.7	8.7	8.7	8.7	33.0	33.6	34.3	34.9	35.6	36.1	36.8	35.8
H218	16.0	16.0	16.0	16.0	17.7	19.0	21.2	21.1	21.8	22.4	24.8	24.7
H219	8.5	8.5	8.5	8.5	33.1	33.7	34.3	34.9	35.5	36.1	36.8	35.8
H220	8.2	8.2	8.2	8.2	30.1	30.8	31.3	31.9	32.6	33.2	33.8	32.9
H221	15.4	15.4	15.4	15.4	17.2	18.4	20.6	20.4	21.2	21.8	24.2	24.2
H222	15.5	15.5	15.5	15.5	17.4	18.8	20.9	20.8	21.5	22.1	24.4	24.4
H223	8.8	8.8	8.8	8.8	36.5	37.1	37.6	38.3	39.0	39.6	40.2	39.2
H224	8.7	8.7	8.7	8.7	37.6	38.2	38.8	39.4	40.1	40.7	41.3	40.3
H225	13.2	13.2	13.2	13.2	17.5	18.9	20.5	20.6	21.2	21.7	23.4	23.2
H226	9.1	9.1	9.1	9.1	35.2	35.8	36.4	37.0	37.7	38.3	38.9	37.9
H227	14.4	14.4	14.4	14.4	17.0	18.3	20.3	20.2	20.9	21.4	23.6	23.5
H228	12.6	12.6	12.6	12.6	17.7	19.0	20.4	20.5	21.2	21.7	23.2	23.0
H229	8.9	8.9	8.9	8.9	37.2	37.8	38.4	39.0	39.7	40.3	40.9	39.9
H230	8.9	8.9	8.9	8.9	37.5	38.1	38.7	39.3	40.0	40.6	41.2	40.2
H231	9.1	9.1	9.1	9.1	33.6	34.2	34.9	35.4	36.1	36.7	37.4	36.4
H232	14.4	14.4	14.4	14.4	16.6	17.8	19.8	19.7	20.5	21.1	23.3	23.3
H233	14.3	14.3	14.3	14.3	16.5	17.8	19.8	19.7	20.4	21.0	23.3	23.2
H234	14.1	14.1	14.1	14.1	16.4	17.6	19.7	19.6	20.3	20.9	23.1	23.1
H235	11.6	11.6	11.6	11.6	18.2	19.4	20.6	20.8	21.5	22.0	23.3	22.9
H236	12.1	12.1	12.1	12.1	15.0	16.6	18.4	18.5	19.1	19.6	21.6	21.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H237	9.9	9.9	9.9	9.9	26.1	26.8	27.4	27.9	28.6	29.2	29.9	29.0
H238	9.9	9.9	9.9	9.9	26.2	26.9	27.4	28.0	28.7	29.3	30.0	29.1
H239	9.0	9.0	9.0	9.0	30.0	30.7	31.2	31.8	32.5	33.1	33.7	32.8
H240	9.0	9.0	9.0	9.0	29.7	30.4	30.9	31.5	32.2	32.8	33.4	32.5
H241	9.4	9.4	9.4	9.4	22.9	23.6	24.2	24.7	25.4	25.9	26.7	25.9
H242	7.7	7.7	7.7	7.7	33.0	33.6	34.2	34.8	35.5	36.1	36.8	35.8
H243	10.5	10.5	10.5	10.5	20.5	21.4	22.2	22.5	23.2	23.8	24.7	24.1
H244	8.9	8.9	8.9	8.9	25.9	26.6	27.1	27.7	28.3	28.9	29.6	28.7
H245	9.2	9.2	9.2	9.2	24.7	25.5	26.1	26.6	27.2	27.8	28.5	27.6
H246	9.3	9.3	9.3	9.3	24.2	24.9	25.6	26.0	26.7	27.3	28.0	27.1
H247	9.3	9.3	9.3	9.3	23.9	24.6	25.3	25.8	26.4	27.0	27.7	26.9
H248	9.7	9.7	9.7	9.7	21.1	22.0	22.8	23.2	23.9	24.4	25.2	24.5

Derived Acoustic Acceptance Criteria

10.98 The assessment criteria are determined by subtracting the cumulative predicted noise levels (without the proposed development) from the total noise limit to calculate the limit remaining for the proposed development. The results of this calculation for day and night time periods are shown in **Table 10.27** and **Table 10.28**.

10.99 The total noise limit in the cumulative scenario is as previously derived in the context of the proposed development alone with the exception of instances where a higher lower limit is required to accommodate the already existing or consented schemes in the absence of the proposed development. This is the case for the single turbine scheme with planning reference F/2010/0208/F and a lower limit of 45 dB(A) has been adopted at H30 as this property is occupied by a financial beneficiary of the project. It is also the case for the single turbine scheme with planning reference LA02/2017/0715/F and a 39.0 dB(A) daytime lower limit has been adopted at the nearest properties to this project (H223, H224, H226, H229, H230 & H231).

10.100 Where a higher limit is deemed applicable in the cumulative scenario than was derived in the context of the proposed development in isolation the limit remaining for the proposed development is restricted from being greater than the limit that was deemed appropriate for the proposed development in isolation.

Table 10.27 - Limit Remaining for Proposed Development during the Day, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.6	39.6	41.7	43.8	46.1
H2	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.6	39.6	41.7	43.8	46.1
H3	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.6	39.6	41.7	43.8	46.1
H4	37.5	37.5	37.5	37.5	37.5	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H5	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H6	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H7	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H8	37.5	37.5	37.5	37.5	37.5	37.4	37.3	38.2	40.0	42.2	44.3	46.5
H9	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.5
H10	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.5
H11	37.2	37.2	37.2	37.2	37.2	37.0	37.0	37.2	39.2	41.4	43.6	46.0
H12	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.5
H13	37.4	37.4	37.4	37.4	37.3	37.2	37.1	37.4	39.4	41.6	43.7	46.1
H14	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.5
H15	37.3	37.3	37.3	37.3	37.2	37.1	37.0	37.3	39.3	41.5	43.6	46.0
H16	37.3	37.3	37.3	37.3	37.3	37.1	37.1	37.3	39.3	41.5	43.6	46.0
H17	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H18	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H19	37.4	37.4	37.4	37.4	37.4	37.4	37.3	38.2	40.1	42.2	44.3	46.5
H20	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.2	40.1	42.2	44.3	46.5
H21	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H22	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H23	37.4	37.4	37.4	37.4	37.4	37.4	37.3	38.2	40.0	42.2	44.3	46.5
H24	37.3	37.3	37.3	37.3	37.2	37.1	37.0	37.2	39.2	41.5	43.6	46.0
H25	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.5
H26	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.2	40.1	42.2	44.3	46.5
H27	37.4	37.4	37.4	37.4	37.4	37.4	37.3	38.2	40.1	42.2	44.3	46.5
H28	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.2	40.1	42.2	44.3	46.5
H29	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H30	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.8	39.7	37.4	35.0	39.7
H31	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H32	37.4	37.4	37.4	37.4	37.4	37.4	37.3	38.2	40.1	42.2	44.3	46.5
H33	37.4	37.4	37.4	37.4	37.4	37.4	37.3	38.2	40.1	42.2	44.3	46.5
H34	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H35	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H36	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.3	46.6
H37	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H38	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H39	37.4	37.4	37.4	37.4	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H40	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H41	37.3	37.3	37.3	37.3	37.2	37.0	37.0	37.2	39.1	41.4	43.4	45.9
H42	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H43	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H44	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H45	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H46	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.3	46.6
H47	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H48	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H49	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H50	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H51	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H52	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.3	46.6
H53	37.2	37.2	37.2	37.2	37.2	36.9	36.9	37.1	39.0	41.3	43.3	45.8
H54	37.2	37.2	37.2	37.2	37.2	36.9	36.8	37.0	39.0	41.2	43.2	45.8
H55	36.9	36.9	36.9	36.9	36.8	36.6	36.4	36.5	38.7	41.1	43.3	45.9
H56	37.0	37.0	37.0	37.0	36.9	36.7	36.5	36.7	38.9	41.2	43.4	45.9
H57	37.0	37.0	37.0	37.0	37.0	36.8	36.6	36.8	38.9	41.2	43.4	45.9
H58	37.4	37.4	37.4	37.4	37.3	37.3	37.2	38.1	40.0	42.1	44.3	46.5
H59	37.0	37.0	37.0	37.0	37.0	36.5	36.5	36.7	38.5	40.9	42.8	45.6
H61	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.4	46.6
H62	37.1	37.1	37.1	37.1	37.0	36.6	36.6	36.7	38.6	40.9	42.8	45.6
H63	37.0	37.0	37.0	37.0	36.9	36.4	36.4	36.5	38.3	40.7	42.5	45.4
H64	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.4	46.6
H65	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.1	42.3	44.4	46.6
H66	37.2	37.2	37.2	37.2	37.2	37.1	37.0	37.2	39.2	41.5	43.6	46.0
H67	37.1	37.1	37.1	37.1	37.0	36.6	36.6	36.7	38.6	40.9	42.8	45.6
H68	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.1	42.3	44.4	46.6
H69	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H70	36.6	36.6	36.6	36.6	36.6	35.5	35.6	35.6	37.1	39.7	41.2	44.8
H71	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.2	44.3	46.6
H72	36.6	36.6	36.6	36.6	36.5	35.4	35.5	35.4	36.9	39.6	41.0	44.7
H73	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.4	46.6
H74	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.1	42.3	44.4	46.6
H75	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.1	42.3	44.4	46.6
H76	37.5	37.5	37.5	37.5	37.5	37.4	37.4	38.3	40.1	42.3	44.3	46.6
H77	36.3	36.3	36.3	36.3	36.2	34.5	34.8	34.5	35.7	38.6	39.5	44.1
H78	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H79	37.4	37.4	37.4	37.4	37.4	37.3	37.6	39.7	42.3	45.1	45.1	45.1
H80	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H81	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H82	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H83	37.4	37.4	37.4	37.4	37.4	37.3	37.2	37.5	39.4	41.6	43.7	46.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H84	37.1	37.1	37.1	37.1	37.1	36.7	36.7	36.9	38.7	41.0	42.9	45.6
H85	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H86	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H87	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H88	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H89	37.4	37.4	37.4	37.4	37.4	37.3	37.3	37.5	39.5	41.6	43.7	46.1
H90	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H91	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H92	37.4	37.4	37.4	37.4	37.4	37.2	37.2	37.4	39.4	41.6	43.6	46.0
H93	37.4	37.4	37.4	37.4	37.4	37.3	37.2	37.5	39.4	41.6	43.7	46.1
H94	37.4	37.4	37.4	37.4	37.4	37.3	37.3	37.6	39.5	41.7	43.8	46.1
H95	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H96	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H97	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H98	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H99	37.4	37.4	37.4	37.4	37.4	37.3	37.2	37.5	39.4	41.6	43.7	46.1
H100	37.4	37.4	37.4	37.4	37.4	37.3	37.3	37.6	39.5	41.7	43.8	46.1
H101	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H102	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H103	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.3	40.2	42.3	44.4	46.6
H104	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H105	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H106	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H107	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H108	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H109	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H110	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H111	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H112	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H113	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.6	41.7	43.8	46.1
H114	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.6	41.7	43.8	46.1
H115	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.3	40.2	42.3	44.4	46.6
H116	37.4	37.4	37.4	37.4	37.4	37.3	37.3	37.6	39.5	41.7	43.8	46.1
H117	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.6	39.5	41.7	43.8	46.1
H118	37.4	37.4	37.4	37.4	37.4	37.3	37.3	37.6	39.5	41.7	43.8	46.1
H119	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.6	41.7	43.8	46.1
H120	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H121	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.6	41.7	43.8	46.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H122	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H123	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.6	39.6	41.7	43.8	46.2
H124	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.5	40.2	43.1	43.1	43.1
H125	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H126	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.6	39.6	41.7	43.8	46.2
H127	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.6	39.6	41.7	43.8	46.2
H128	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.6	39.6	41.7	43.8	46.1
H129	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H130	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.6	39.6	41.7	43.8	46.2
H131	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H132	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.3	39.1	41.3	43.5	45.5
H133	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.5
H134	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H135	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.4	40.2	42.3	44.4	46.6
H136	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H137	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H138	37.5	37.5	37.5	37.5	37.4	37.4	37.3	37.3	39.1	41.3	43.5	45.5
H139	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H140	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H141	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.1	41.3	43.5	45.5
H142	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H143	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.6
H144	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H145	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H146	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H147	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.6
H148	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.6
H149	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H150	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H151	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.6
H152	37.4	37.4	37.4	37.4	37.4	37.4	37.2	37.2	39.0	41.3	43.4	45.5
H153	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H154	37.5	37.5	37.5	37.5	37.5	37.7	38.4	39.1	40.0	41.0	42.3	43.8
H155	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H156	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H157	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	38.5	41.2	41.2	41.2
H158	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H159	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.5	45.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H160	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	41.0	42.3	43.8
H161	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	41.0	42.3	43.8
H162	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	41.0	42.3	43.8
H163	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.5	45.5
H164	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.6
H165	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	41.0	42.3	43.8
H166	37.5	37.5	37.5	37.5	37.5	37.6	38.3	39.0	39.9	41.0	42.3	43.8
H167	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.5	45.5
H168	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H169	37.4	37.4	37.4	37.4	37.4	37.3	37.2	37.2	39.0	41.2	43.4	45.5
H170	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H171	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H172	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.3	43.5	45.6
H173	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.3	43.5	45.6
H174	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.6	45.6
H175	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H176	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H177	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	39.1	41.3	43.5	45.5
H178	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H179	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.5	45.5
H180	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H181	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H182	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.5	45.5
H183	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H184	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H185	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H186	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H187	37.5	37.5	37.5	37.5	37.4	37.6	38.3	39.0	39.9	40.9	42.2	43.8
H188	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.4	45.5
H189	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H191	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.0	41.3	43.5	45.5
H192	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H193	37.5	37.5	37.5	37.5	37.4	37.3	37.3	37.3	37.9	38.8	39.8	40.9
H194	37.4	37.4	37.4	37.4	37.4	37.4	37.2	37.3	39.0	41.3	43.4	45.5
H195	37.5	37.5	37.5	37.5	37.3	37.3	37.3	37.3	37.9	38.8	39.8	40.9
H196	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	37.9	38.9	39.9	40.9
H197	37.4	37.4	37.4	37.4	37.4	37.4	37.2	37.3	39.0	41.3	43.4	45.5
H198	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	39.1	41.3	43.5	45.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H200	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	37.9	38.8	39.8	40.9
H202	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	39.1	41.3	43.5	45.6
H203	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.3	39.1	41.3	43.5	45.5
H204	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.6	45.6
H205	37.4	37.4	37.4	37.4	37.4	37.4	37.3	37.4	39.1	41.3	43.5	45.5
H206	37.5	37.5	37.5	37.5	37.3	37.3	37.2	37.2	37.8	38.7	39.7	40.8
H207	37.5	37.5	37.5	37.5	37.2	37.2	37.2	37.1	37.7	38.6	39.7	40.8
H208	37.5	37.5	37.5	37.5	37.2	37.1	37.1	37.0	37.6	38.6	39.6	40.7
H209	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H210	37.5	37.5	37.5	37.5	37.2	37.1	37.0	37.0	37.5	38.5	39.5	40.7
H211	37.5	37.5	37.5	37.5	37.1	37.1	37.0	37.0	37.5	38.5	39.5	40.7
H212	37.5	37.5	37.5	37.5	37.1	37.1	37.0	37.0	37.5	38.5	39.5	40.7
H213	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	39.1	41.3	43.5	45.6
H214	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.3	43.5	45.6
H215	37.5	37.5	37.5	37.5	37.1	37.0	36.9	36.9	37.4	38.4	39.4	40.6
H216	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.3	43.6	45.6
H217	37.5	37.5	37.5	37.5	35.6	35.2	34.7	34.1	34.6	35.8	37.2	39.4
H218	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.3	43.5	45.6
H219	37.5	37.5	37.5	37.5	35.5	35.1	34.7	34.1	34.6	35.8	37.2	39.4
H220	37.5	37.5	37.5	37.5	36.6	36.5	36.3	36.1	36.7	37.7	38.8	40.3
H221	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.6	45.6
H222	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.5	45.6
H223	37.5	37.5	37.5	37.5	35.4	34.5	37.5	37.5	38.1	39.0	40.0	41.0
H224	37.5	37.5	37.5	37.5	33.4	31.2	36.4	37.5	38.1	39.0	40.0	41.0
H225	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.6	45.6
H226	37.5	37.5	37.5	37.5	36.6	36.2	37.5	37.5	38.1	39.0	40.0	41.0
H227	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.6	45.6
H228	37.5	37.5	37.5	37.5	37.5	37.4	37.4	37.4	39.1	41.4	43.6	45.6
H229	37.5	37.5	37.5	37.5	34.3	32.8	37.1	37.5	38.1	39.0	40.0	41.0
H230	37.5	37.5	37.5	37.5	33.6	31.7	36.6	37.5	38.1	39.0	40.0	41.0
H231	37.5	37.5	37.5	37.5	37.5	37.2	37.5	37.5	38.1	39.0	40.0	41.0
H232	37.5	37.5	37.5	37.5	37.5	37.5	37.4	37.4	39.1	41.4	43.6	45.6
H233	37.5	37.5	37.5	37.5	37.5	37.5	37.4	37.4	39.1	41.4	43.6	45.6
H234	37.5	37.5	37.5	37.5	37.5	37.5	37.4	37.4	39.1	41.4	43.6	45.6
H235	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H236	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.4	39.2	41.4	43.6	45.6
H237	37.5	37.5	37.5	37.5	37.2	37.1	37.1	37.0	37.6	38.5	39.6	40.7
H238	37.5	37.5	37.5	37.5	37.2	37.1	37.1	37.0	37.6	38.5	39.5	40.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H239	37.5	37.5	37.5	37.5	36.6	36.5	36.3	36.1	36.7	37.7	38.8	40.3
H240	37.5	37.5	37.5	37.5	36.7	36.6	36.4	36.2	36.8	37.8	38.9	40.3
H241	37.5	37.5	37.5	37.5	37.3	37.3	37.3	37.3	37.9	38.8	39.8	40.9
H242	37.5	37.5	37.5	37.5	35.6	35.2	34.7	34.1	34.6	35.8	37.2	39.5
H243	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.4	38.0	38.9	39.9	40.9
H244	37.5	37.5	37.5	37.5	37.2	37.1	37.1	37.0	37.6	38.6	39.6	40.7
H245	37.5	37.5	37.5	37.5	37.3	37.2	37.2	37.1	37.7	38.7	39.7	40.8
H246	37.5	37.5	37.5	37.5	37.3	37.3	37.2	37.2	37.8	38.7	39.7	40.8
H247	37.5	37.5	37.5	37.5	37.3	37.3	37.2	37.2	37.8	38.7	39.7	40.8
H248	37.5	37.5	37.5	37.5	37.4	37.4	37.4	37.3	37.9	38.8	39.9	40.9

Table 10.28 - Limit Remaining for Proposed Development at Night, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	43.1
H2	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	43.1
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	43.1
H4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.8	43.0
H5	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	43.1
H6	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.1
H7	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H8	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	45.2
H9	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H10	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H11	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.7	42.6	42.8
H12	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H13	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.9
H14	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H15	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.7	42.9
H16	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.7	42.9
H17	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H18	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H19	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H20	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H21	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.3
H22	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.3
H23	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H24	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.6	42.8
H25	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H26	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H28	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H29	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H30	43.0	43.0	43.0	43.0	43.0	42.8	42.1	41.2	40.0	37.4	35.0	35.1
H31	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H32	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.0	45.2
H34	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H35	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H36	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H37	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H38	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H39	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H40	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H41	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.7	42.7	42.4	42.6
H42	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H43	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H44	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H45	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H46	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H47	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.2
H48	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H49	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H50	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H51	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.0	45.2
H52	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H53	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.7	42.6	42.2	42.5
H54	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.7	42.6	42.2	42.4
H55	42.8	42.8	42.8	42.8	42.8	42.8	42.7	42.7	42.6	42.5	42.3	42.5
H56	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.7	42.6	42.5	42.4	42.6
H57	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.7	42.6	42.4	42.6
H58	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	45.2
H59	42.9	42.9	42.9	42.9	42.9	42.7	42.7	42.7	42.5	42.3	41.6	41.8
H61	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H62	42.9	42.9	42.9	42.9	42.9	42.8	42.7	42.7	42.5	42.3	41.6	41.9
H63	42.9	42.9	42.9	42.9	42.8	42.7	42.7	42.6	42.4	42.2	41.2	41.5
H64	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H65	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H66	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.6	42.8
H67	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.5	42.3	41.7	41.9
H68	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H69	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H70	42.8	42.8	42.8	42.8	42.8	42.5	42.5	42.4	42.0	41.5	39.3	39.8
H71	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0	45.3
H72	42.8	42.8	42.8	42.8	42.7	42.5	42.5	42.4	41.9	41.4	38.9	39.4
H73	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H74	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H75	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H76	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H77	42.7	42.7	42.7	42.7	42.7	42.3	42.4	42.2	41.6	40.8	36.3	37.1
H78	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H79	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	45.1	45.1	45.1
H80	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H81	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H82	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H83	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.7	42.9
H84	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.7	42.5	42.4	41.7	41.9
H85	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H86	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H87	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
H88	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.1
H89	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.8	43.0
H90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H91	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H92	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.8	42.8	42.7	42.9
H93	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.7	42.9
H94	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.0
H95	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H96	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H97	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H98	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H99	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.8	43.0
H100	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.0
H101	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H102	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H103	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H104	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H105	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.0
H106	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H107	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H108	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H109	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H110	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H111	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H112	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H113	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H114	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H115	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H116	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.0
H117	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.0
H118	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.0
H119	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H120	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H121	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H122	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H123	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	43.1
H124	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9
H125	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H126	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.1
H127	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.1
H128	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	43.1
H129	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H130	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	43.1
H131	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H132	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	44.0
H133	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H134	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H135	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.3
H136	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H137	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H138	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	44.0
H139	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H140	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H141	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	44.0
H142	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H143	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H144	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H145	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H146	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H147	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H148	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H149	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H150	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H151	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H152	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H153	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H154	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H155	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H156	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H157	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9
H158	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H159	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H160	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H161	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H162	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H163	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	44.0
H164	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H165	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H166	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H167	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H168	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4
H169	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.9
H170	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.4
H171	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.4
H172	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H173	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H174	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H175	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.3
H176	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.3
H177	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H178	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.3

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H179	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H180	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0
H181	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.4
H182	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H183	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0
H184	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.0
H185	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9
H186	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	43.4
H187	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.3
H188	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H189	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9
H191	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	44.0
H192	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9
H193	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.9
H194	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.9
H195	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.9
H196	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9
H197	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	43.9
H198	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.0
H200	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9
H202	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.0
H203	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H204	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H205	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	44.0
H206	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9
H207	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.9
H208	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.8	42.8	42.8
H209	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9
H210	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.8
H211	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.8
H212	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.8
H213	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.0
H214	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H215	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.8	42.8	42.8	42.7	42.8
H216	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H217	43.0	43.0	43.0	43.0	42.5	42.5	42.4	42.3	42.1	42.0	41.8	42.1
H218	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.0
H219	43.0	43.0	43.0	43.0	42.5	42.5	42.4	42.3	42.1	42.0	41.8	42.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H220	43.0	43.0	43.0	43.0	42.8	42.7	42.7	42.6	42.6	42.5	42.4	42.6
H221	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H222	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	44.1
H223	43.0	43.0	43.0	43.0	41.9	41.7	41.5	41.2	43.0	43.0	43.0	43.0
H224	43.0	43.0	43.0	43.0	41.5	41.2	40.9	40.5	43.0	43.0	43.0	43.0
H225	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H226	43.0	43.0	43.0	43.0	42.2	42.1	41.9	41.7	43.0	43.0	43.0	43.0
H227	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H228	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H229	43.0	43.0	43.0	43.0	41.7	41.4	41.1	40.8	43.0	43.0	43.0	43.0
H230	43.0	43.0	43.0	43.0	41.6	41.3	41.0	40.6	43.0	43.0	43.0	43.0
H231	43.0	43.0	43.0	43.0	42.5	42.4	42.3	42.2	43.0	43.0	43.0	43.0
H232	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H233	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H234	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H235	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H236	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1
H237	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.8
H238	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.8
H239	43.0	43.0	43.0	43.0	42.8	42.7	42.7	42.7	42.6	42.5	42.5	42.6
H240	43.0	43.0	43.0	43.0	42.8	42.8	42.7	42.7	42.6	42.6	42.5	42.6
H241	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.9
H242	43.0	43.0	43.0	43.0	42.5	42.5	42.4	42.3	42.1	42.0	41.8	42.1
H243	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9
H244	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.8	42.8	42.8	42.8
H245	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.8	42.9
H246	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9
H247	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9
H248	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.9	42.9

Cumulative Acoustic Assessment

10.101 A comparison of the predicted noise levels for the proposed development, as shown in **Table 10.11**, with the noise limits for day and night time periods is shown in **Table 10.29** and **Table 10.30**. A negative margin indicates that the limit is met and a positive margin that the limit is predicted to be exceeded.

10.102 Noise levels at all locations are within the night-time noise limits at all wind speeds considered. The minimum margin during night-time periods is -1.9 dB(A) at H124. The daytime noise limits are predicted to be exceeded by a maximum of 3.5 dB(A) at H124.

It is proposed that a noise management strategy would be implemented to reduce the noise levels during daytime periods so that the noise limit would be met.

10.103 The predicted noise levels and the noise limits for day and night-time periods at H124 are shown in graphical form in **Charts 15-16**.

Table 10.29 - Predictions vs Limit Remaining for Proposed Development during the Day, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	-24.5	-24.5	-24.5	-21.6	-17.4	-13.5	-11.6	-11.7	-13.7	-15.8	-17.9	-20.2
H2	-23.4	-23.4	-23.4	-20.5	-16.3	-12.4	-10.5	-10.6	-12.6	-14.7	-16.8	-19.1
H3	-24.4	-24.4	-24.4	-21.5	-17.3	-13.4	-11.5	-11.6	-13.6	-15.7	-17.8	-20.1
H4	-21.7	-21.7	-21.7	-18.8	-14.6	-10.7	-8.7	-8.9	-10.8	-13.0	-15.1	-17.4
H5	-23.0	-23.0	-23.0	-20.1	-15.8	-12.0	-10.0	-10.2	-12.1	-14.3	-16.4	-18.7
H6	-20.0	-20.0	-20.0	-17.1	-12.8	-9.0	-7.0	-7.2	-9.1	-11.3	-13.4	-15.7
H7	-22.3	-22.3	-22.3	-19.4	-15.3	-11.5	-9.5	-9.6	-11.5	-13.7	-15.8	-18.1
H8	-21.4	-21.4	-21.4	-18.5	-14.3	-10.4	-8.4	-9.2	-11.0	-13.2	-15.3	-17.5
H9	-23.4	-23.4	-23.4	-20.5	-16.3	-12.4	-10.5	-11.3	-13.1	-15.2	-17.3	-19.5
H10	-22.4	-22.4	-22.4	-19.5	-15.3	-11.4	-9.5	-10.3	-12.1	-14.2	-16.3	-18.5
H11	-19.2	-19.2	-19.2	-16.3	-12.1	-8.1	-6.2	-6.3	-8.3	-10.5	-12.7	-15.1
H12	-20.4	-20.4	-20.4	-17.5	-13.3	-9.4	-7.5	-8.3	-10.1	-12.2	-14.3	-16.5
H13	-18.5	-18.5	-18.5	-15.6	-11.3	-7.4	-5.4	-5.6	-7.6	-9.8	-11.9	-14.3
H14	-21.8	-21.8	-21.8	-18.9	-14.7	-10.8	-8.9	-9.7	-11.5	-13.6	-15.7	-17.9
H15	-18.3	-18.3	-18.3	-15.4	-11.1	-7.2	-5.2	-5.4	-7.4	-9.6	-11.7	-14.1
H16	-18.2	-18.2	-18.2	-15.3	-11.1	-7.1	-5.2	-5.3	-7.3	-9.5	-11.6	-14.0
H17	-20.7	-20.7	-20.7	-17.8	-13.6	-9.7	-7.8	-8.6	-10.4	-12.5	-14.6	-16.9
H18	-21.3	-21.3	-21.3	-18.4	-14.2	-10.3	-8.4	-9.2	-11.0	-13.1	-15.2	-17.5
H19	-21.9	-21.9	-21.9	-19.0	-14.8	-11.0	-9.0	-9.8	-11.7	-13.8	-15.9	-18.1
H20	-21.8	-21.8	-21.8	-18.9	-14.7	-10.9	-9.0	-9.7	-11.6	-13.7	-15.8	-18.0
H21	-21.5	-21.5	-21.5	-18.6	-14.4	-10.5	-8.6	-9.4	-11.2	-13.3	-15.4	-17.7
H22	-21.5	-21.5	-21.5	-18.6	-14.4	-10.5	-8.6	-9.4	-11.2	-13.3	-15.4	-17.7
H23	-21.9	-21.9	-21.9	-19.0	-14.8	-11.0	-9.0	-9.8	-11.6	-13.8	-15.9	-18.1
H24	-17.7	-17.7	-17.7	-14.8	-10.5	-6.6	-4.6	-4.7	-6.7	-9.0	-11.1	-13.5
H25	-21.7	-21.7	-21.7	-18.8	-14.6	-10.8	-8.9	-9.7	-11.5	-13.6	-15.7	-17.9
H26	-21.7	-21.7	-21.7	-18.8	-14.6	-10.8	-8.9	-9.6	-11.5	-13.6	-15.7	-17.9
H27	-21.8	-21.8	-21.8	-18.9	-14.7	-10.9	-8.9	-9.7	-11.6	-13.7	-15.8	-18.0
H28	-21.7	-21.7	-21.7	-18.8	-14.6	-10.8	-8.9	-9.6	-11.5	-13.6	-15.7	-17.9
H29	-21.5	-21.5	-21.5	-18.6	-14.4	-10.6	-8.7	-9.5	-11.3	-13.4	-15.5	-17.8
H30	-17.6	-17.6	-17.6	-14.7	-10.5	-6.7	-4.8	-5.0	-6.9	-4.6	-2.2	-6.9
H31	-21.3	-21.3	-21.3	-18.4	-14.2	-10.3	-8.4	-9.2	-11.0	-13.1	-15.2	-17.5
H32	-21.7	-21.7	-21.7	-18.8	-14.7	-10.9	-8.8	-9.6	-11.5	-13.6	-15.7	-17.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H33	-21.7	-21.7	-21.7	-18.8	-14.6	-10.8	-8.8	-9.6	-11.5	-13.6	-15.7	-17.9
H34	-21.5	-21.5	-21.5	-18.6	-14.3	-10.5	-8.6	-9.4	-11.2	-13.3	-15.4	-17.7
H35	-21.4	-21.4	-21.4	-18.5	-14.2	-10.4	-8.5	-9.3	-11.1	-13.2	-15.3	-17.6
H36	-19.7	-19.7	-19.7	-16.8	-12.6	-8.7	-6.8	-7.6	-9.4	-11.6	-13.6	-15.9
H37	-21.2	-21.2	-21.2	-18.3	-14.1	-10.2	-8.3	-9.1	-10.9	-13.0	-15.1	-17.4
H38	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-9.4	-11.2	-13.3	-15.4	-17.7
H39	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-9.4	-11.2	-13.3	-15.4	-17.7
H40	-21.3	-21.3	-21.3	-18.4	-14.1	-10.3	-8.4	-9.2	-11.0	-13.1	-15.2	-17.5
H41	-17.1	-17.1	-17.1	-14.2	-9.9	-5.9	-4.0	-4.1	-6.0	-8.3	-10.3	-12.8
H42	-21.3	-21.3	-21.3	-18.4	-14.1	-10.3	-8.4	-9.2	-11.0	-13.1	-15.2	-17.5
H43	-21.2	-21.2	-21.2	-18.3	-14.0	-10.2	-8.3	-9.1	-10.9	-13.0	-15.1	-17.4
H44	-20.6	-20.6	-20.6	-17.7	-13.5	-9.6	-7.7	-8.5	-10.3	-12.4	-14.5	-16.8
H45	-21.2	-21.2	-21.2	-18.3	-14.0	-10.2	-8.3	-9.1	-10.9	-13.0	-15.1	-17.4
H46	-20.3	-20.3	-20.3	-17.4	-13.2	-9.3	-7.4	-8.2	-10.0	-12.2	-14.2	-16.5
H47	-21.2	-21.2	-21.2	-18.3	-14.0	-10.2	-8.3	-9.1	-10.9	-13.0	-15.1	-17.4
H48	-20.6	-20.6	-20.6	-17.7	-13.5	-9.6	-7.7	-8.5	-10.3	-12.4	-14.5	-16.8
H49	-20.6	-20.6	-20.6	-17.7	-13.4	-9.6	-7.7	-8.5	-10.3	-12.4	-14.5	-16.8
H50	-21.0	-21.0	-21.0	-18.1	-13.9	-10.0	-8.1	-8.9	-10.7	-12.8	-14.9	-17.2
H51	-20.8	-20.8	-20.8	-17.9	-13.6	-9.8	-7.9	-8.7	-10.5	-12.6	-14.7	-17.0
H52	-20.4	-20.4	-20.4	-17.5	-13.3	-9.4	-7.5	-8.3	-10.1	-12.3	-14.3	-16.6
H53	-16.9	-16.9	-16.9	-14.0	-9.8	-5.7	-3.8	-3.9	-5.8	-8.1	-10.1	-12.6
H54	-16.6	-16.6	-16.6	-13.7	-9.5	-5.4	-3.4	-3.5	-5.5	-7.7	-9.7	-12.3
H55	-16.2	-16.2	-16.2	-13.3	-9.0	-5.0	-2.9	-2.9	-5.1	-7.5	-9.7	-12.3
H56	-16.1	-16.1	-16.1	-13.2	-8.9	-4.9	-2.8	-2.9	-5.1	-7.4	-9.6	-12.1
H57	-16.1	-16.1	-16.1	-13.2	-9.0	-5.0	-2.9	-3.0	-5.1	-7.4	-9.6	-12.1
H58	-21.3	-21.3	-21.3	-18.4	-14.1	-10.3	-8.3	-9.1	-11.0	-13.1	-15.3	-17.5
H59	-15.9	-15.9	-15.9	-13.0	-8.8	-4.5	-2.6	-2.7	-4.5	-6.9	-8.8	-11.6
H61	-20.3	-20.3	-20.3	-17.4	-13.2	-9.3	-7.4	-8.2	-10.0	-12.2	-14.3	-16.5
H62	-16.2	-16.2	-16.2	-13.3	-9.0	-4.8	-2.9	-2.9	-4.8	-7.1	-9.0	-11.8
H63	-15.9	-15.9	-15.9	-13.0	-8.7	-4.4	-2.5	-2.5	-4.3	-6.7	-8.5	-11.4
H64	-20.3	-20.3	-20.3	-17.4	-13.2	-9.3	-7.4	-8.2	-10.0	-12.2	-14.3	-16.5
H65	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.1	-7.9	-9.7	-11.9	-14.0	-16.2
H66	-15.4	-15.4	-15.4	-12.5	-8.3	-4.4	-2.4	-2.5	-4.5	-6.8	-8.9	-11.3
H67	-16.3	-16.3	-16.3	-13.4	-9.1	-4.9	-3.0	-3.0	-4.9	-7.2	-9.1	-11.9
H68	-19.8	-19.8	-19.8	-16.9	-12.7	-8.9	-6.9	-7.7	-9.5	-11.7	-13.8	-16.0
H69	-19.8	-19.8	-19.8	-16.9	-12.7	-8.8	-6.9	-7.7	-9.5	-11.6	-13.7	-16.0
H70	-15.3	-15.3	-15.3	-12.4	-8.2	-3.3	-1.5	-1.4	-2.9	-5.5	-7.0	-10.6
H71	-20.2	-20.2	-20.2	-17.3	-13.1	-9.2	-7.3	-8.1	-9.9	-12.0	-14.1	-16.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H72	-15.3	-15.3	-15.3	-12.4	-8.1	-3.2	-1.4	-1.2	-2.7	-5.4	-6.8	-10.5
H73	-19.4	-19.4	-19.4	-16.5	-12.3	-8.4	-6.5	-7.3	-9.1	-11.3	-13.4	-15.6
H74	-19.0	-19.0	-19.0	-16.1	-11.9	-8.1	-6.1	-6.9	-8.7	-10.9	-13.0	-15.2
H75	-18.8	-18.8	-18.8	-15.9	-11.7	-7.9	-5.9	-6.7	-8.5	-10.7	-12.8	-15.0
H76	-15.4	-15.4	-15.4	-12.5	-8.3	-4.4	-2.5	-3.3	-5.1	-7.3	-9.3	-11.6
H77	-15.1	-15.1	-15.1	-12.2	-7.9	-2.4	-0.8	-0.4	-1.6	-4.5	-5.4	-10.0
H78	-18.6	-18.6	-18.6	-15.7	-11.5	-7.7	-5.7	-6.5	-8.4	-10.5	-12.6	-14.8
H79	-12.5	-12.5	-12.5	-9.6	-5.4	-1.5	0.1	-1.9	-4.5	-7.3	-7.3	-7.3
H80	-18.7	-18.7	-18.7	-15.8	-11.6	-7.8	-5.8	-6.6	-8.5	-10.6	-12.7	-14.9
H81	-18.7	-18.7	-18.7	-15.8	-11.6	-7.8	-5.8	-6.6	-8.5	-10.6	-12.7	-14.9
H82	-18.5	-18.5	-18.5	-15.6	-11.4	-7.6	-5.6	-6.4	-8.3	-10.4	-12.5	-14.7
H83	-15.2	-15.2	-15.2	-12.3	-8.1	-4.2	-2.2	-2.4	-4.3	-6.5	-8.6	-11.0
H84	-15.2	-15.2	-15.2	-12.3	-8.1	-3.9	-2.0	-2.1	-3.9	-6.2	-8.1	-10.8
H85	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.1	-7.9	-9.8	-11.9	-14.0	-16.2
H86	-18.5	-18.5	-18.5	-15.6	-11.4	-7.6	-5.7	-6.5	-8.3	-10.4	-12.5	-14.7
H87	-15.3	-15.3	-15.3	-12.4	-8.2	-4.4	-2.4	-3.2	-5.1	-7.2	-9.3	-11.5
H88	-12.4	-12.4	-12.4	-9.5	-5.3	-1.5	0.5	0.3	-1.6	-3.8	-5.9	-8.2
H89	-14.4	-14.4	-14.4	-11.5	-7.3	-3.4	-1.5	-1.6	-3.6	-5.7	-7.8	-10.2
H90	-17.2	-17.2	-17.2	-14.3	-10.1	-6.3	-4.4	-5.2	-7.0	-9.1	-11.2	-13.4
H91	-20.6	-20.6	-20.6	-17.7	-13.5	-9.7	-7.8	-8.6	-10.4	-12.5	-14.6	-16.8
H92	-15.5	-15.5	-15.5	-12.6	-8.4	-4.4	-2.5	-2.6	-4.6	-6.8	-8.8	-11.2
H93	-15.8	-15.8	-15.8	-12.9	-8.7	-4.8	-2.8	-3.0	-4.9	-7.1	-9.2	-11.6
H94	-13.2	-13.2	-13.2	-10.3	-6.1	-2.2	-0.3	-0.5	-2.4	-4.6	-6.7	-9.0
H95	-18.4	-18.4	-18.4	-15.5	-11.3	-7.5	-5.6	-6.4	-8.2	-10.3	-12.4	-14.6
H96	-14.5	-14.5	-14.5	-11.6	-7.4	-3.6	-1.6	-2.4	-4.3	-6.4	-8.5	-10.7
H97	-14.2	-14.2	-14.2	-11.3	-7.1	-3.3	-1.3	-2.1	-4.0	-6.1	-8.2	-10.4
H98	-18.4	-18.4	-18.4	-15.5	-11.3	-7.5	-5.6	-6.4	-8.2	-10.3	-12.4	-14.6
H99	-16.3	-16.3	-16.3	-13.4	-9.2	-5.3	-3.3	-3.5	-5.4	-7.6	-9.7	-12.1
H100	-13.5	-13.5	-13.5	-10.6	-6.4	-2.5	-0.6	-0.8	-2.7	-4.9	-7.0	-9.3
H101	-13.9	-13.9	-13.9	-11.0	-6.8	-3.0	-1.0	-1.8	-3.7	-5.8	-7.9	-10.1
H102	-17.4	-17.4	-17.4	-14.5	-10.3	-6.5	-4.6	-5.4	-7.2	-9.3	-11.4	-13.6
H103	-12.7	-12.7	-12.7	-9.8	-5.6	-1.8	0.2	-0.6	-2.5	-4.6	-6.7	-8.9
H104	-17.3	-17.3	-17.3	-14.4	-10.2	-6.4	-4.5	-5.3	-7.1	-9.2	-11.3	-13.5
H105	-12.8	-12.8	-12.8	-9.9	-5.7	-1.9	0.1	-0.1	-2.0	-4.2	-6.3	-8.6
H106	-12.3	-12.3	-12.3	-9.4	-5.2	-1.4	0.6	0.4	-1.5	-3.7	-5.8	-8.1
H107	-17.4	-17.4	-17.4	-14.5	-10.3	-6.5	-4.6	-5.4	-7.2	-9.3	-11.4	-13.6
H108	-19.5	-19.5	-19.5	-16.6	-12.4	-8.6	-6.7	-7.5	-9.3	-11.4	-13.5	-15.7
H109	-19.6	-19.6	-19.6	-16.7	-12.5	-8.7	-6.8	-7.6	-9.4	-11.5	-13.6	-15.8

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H110	-15.6	-15.6	-15.6	-12.7	-8.5	-4.7	-2.8	-3.6	-5.4	-7.5	-9.6	-11.8
H111	-17.0	-17.0	-17.0	-14.1	-9.9	-6.1	-4.2	-5.0	-6.8	-8.9	-11.0	-13.2
H112	-18.3	-18.3	-18.3	-15.4	-11.2	-7.4	-5.5	-6.3	-8.1	-10.2	-12.3	-14.5
H113	-11.4	-11.4	-11.4	-8.5	-4.2	-0.4	1.6	1.4	-0.6	-2.7	-4.8	-7.1
H114	-11.3	-11.3	-11.3	-8.4	-4.1	-0.3	1.7	1.5	-0.5	-2.6	-4.7	-7.0
H115	-14.5	-14.5	-14.5	-11.6	-7.4	-3.6	-1.7	-2.4	-4.3	-6.4	-8.5	-10.7
H116	-13.1	-13.1	-13.1	-10.2	-6.0	-2.1	-0.2	-0.4	-2.3	-4.5	-6.6	-8.9
H117	-12.8	-12.8	-12.8	-9.9	-5.7	-1.9	0.1	-0.1	-2.0	-4.2	-6.3	-8.6
H118	-13.1	-13.1	-13.1	-10.2	-6.1	-2.2	-0.2	-0.4	-2.3	-4.5	-6.6	-8.9
H119	-10.8	-10.8	-10.8	-7.9	-3.6	0.2	2.2	2.0	0.0	-2.1	-4.2	-6.5
H120	-16.9	-16.9	-16.9	-14.0	-9.8	-6.0	-4.1	-4.9	-6.7	-8.8	-10.9	-13.1
H121	-10.8	-10.8	-10.8	-7.9	-3.6	0.2	2.2	2.0	0.0	-2.1	-4.2	-6.5
H122	-18.3	-18.3	-18.3	-15.4	-11.2	-7.4	-5.5	-6.3	-8.1	-10.2	-12.3	-14.5
H123	-10.8	-10.8	-10.8	-7.9	-3.6	0.2	2.1	2.0	0.0	-2.1	-4.2	-6.6
H124	-9.4	-9.4	-9.4	-6.5	-2.2	1.6	3.5	3.5	0.8	-2.1	-2.1	-2.1
H125	-14.9	-14.9	-14.9	-12.0	-7.8	-4.0	-2.1	-2.9	-4.7	-6.8	-8.9	-11.1
H126	-10.9	-10.9	-10.9	-8.0	-3.7	0.1	2.0	1.9	-0.1	-2.2	-4.3	-6.7
H127	-10.9	-10.9	-10.9	-8.0	-3.7	0.1	2.0	1.9	-0.1	-2.2	-4.3	-6.7
H128	-12.2	-12.2	-12.2	-9.3	-5.0	-1.2	0.8	0.6	-1.4	-3.5	-5.6	-7.9
H129	-17.0	-17.0	-17.0	-14.1	-9.9	-6.1	-4.2	-5.0	-6.8	-8.9	-11.0	-13.2
H130	-10.9	-10.9	-10.9	-8.0	-3.7	0.1	2.0	1.9	-0.1	-2.2	-4.3	-6.7
H131	-16.9	-16.9	-16.9	-14.0	-9.8	-6.0	-4.1	-4.9	-6.7	-8.8	-10.9	-13.1
H132	-13.2	-13.2	-13.2	-10.3	-6.0	-2.2	-0.2	-0.1	-1.9	-4.1	-6.3	-8.3
H133	-10.9	-10.9	-10.9	-8.0	-3.7	0.1	2.0	2.2	0.4	-1.8	-4.0	-6.0
H134	-14.4	-14.4	-14.4	-11.5	-7.3	-3.5	-1.6	-2.4	-4.2	-6.3	-8.4	-10.6
H135	-15.0	-15.0	-15.0	-12.1	-7.9	-4.1	-2.2	-3.0	-4.8	-6.9	-9.0	-11.2
H136	-14.7	-14.7	-14.7	-11.8	-7.6	-4.0	-2.8	-3.4	-4.3	-5.3	-6.6	-8.1
H137	-14.8	-14.8	-14.8	-11.9	-7.7	-4.1	-2.9	-3.5	-4.4	-5.4	-6.7	-8.2
H138	-13.3	-13.3	-13.3	-10.4	-6.1	-2.3	-0.3	-0.2	-2.0	-4.2	-6.4	-8.4
H139	-14.8	-14.8	-14.8	-11.9	-7.7	-4.1	-2.9	-3.5	-4.4	-5.4	-6.7	-8.2
H140	-14.6	-14.6	-14.6	-11.7	-7.5	-3.9	-2.7	-3.3	-4.2	-5.2	-6.5	-8.0
H141	-17.8	-17.8	-17.8	-14.9	-10.7	-6.9	-4.9	-4.8	-6.6	-8.8	-11.0	-13.0
H142	-16.1	-16.1	-16.1	-13.2	-9.0	-5.4	-4.2	-4.8	-5.7	-6.7	-8.0	-9.5
H143	-12.5	-12.5	-12.5	-9.6	-5.3	-1.5	0.4	0.6	-1.2	-3.4	-5.6	-7.7
H144	-15.9	-15.9	-15.9	-13.0	-8.8	-5.2	-4.0	-4.6	-5.5	-6.5	-7.8	-9.3
H145	-14.7	-14.7	-14.7	-11.8	-7.6	-4.0	-2.8	-3.4	-4.3	-5.3	-6.6	-8.1
H146	-15.9	-15.9	-15.9	-13.0	-8.8	-5.2	-4.0	-4.6	-5.5	-6.5	-7.8	-9.3
H147	-12.4	-12.4	-12.4	-9.5	-5.2	-1.4	0.5	0.7	-1.1	-3.3	-5.5	-7.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H148	-13.2	-13.2	-13.2	-10.3	-6.0	-2.2	-0.3	-0.1	-1.9	-4.1	-6.3	-8.4
H149	-15.9	-15.9	-15.9	-13.0	-8.8	-5.2	-4.0	-4.6	-5.5	-6.5	-7.8	-9.3
H150	-16.0	-16.0	-16.0	-13.1	-8.9	-5.3	-4.1	-4.7	-5.6	-6.6	-7.9	-9.4
H151	-13.2	-13.2	-13.2	-10.3	-6.0	-2.2	-0.3	-0.1	-1.9	-4.1	-6.3	-8.4
H152	-18.9	-18.9	-18.9	-16.0	-11.8	-8.0	-5.9	-5.8	-7.6	-9.9	-12.0	-14.1
H153	-13.9	-13.9	-13.9	-11.0	-6.8	-3.2	-2.0	-2.6	-3.5	-4.5	-5.8	-7.3
H154	-14.3	-14.3	-14.3	-11.4	-7.2	-3.6	-2.4	-3.0	-3.9	-4.9	-6.2	-7.7
H155	-14.0	-14.0	-14.0	-11.1	-6.9	-3.2	-2.0	-2.6	-3.5	-4.5	-5.8	-7.4
H156	-14.0	-14.0	-14.0	-11.1	-6.9	-3.2	-2.0	-2.6	-3.5	-4.5	-5.8	-7.4
H157	-11.8	-11.8	-11.8	-8.9	-4.7	-0.8	1.1	1.2	0.1	-2.6	-2.6	-2.6
H158	-12.2	-12.2	-12.2	-9.3	-5.0	-1.4	-0.2	-0.8	-1.7	-2.7	-4.0	-5.6
H159	-19.0	-19.0	-19.0	-16.1	-11.9	-8.1	-6.1	-6.0	-7.7	-10.0	-12.2	-14.2
H160	-15.9	-15.9	-15.9	-13.0	-8.8	-5.1	-3.9	-4.5	-5.4	-6.5	-7.8	-9.3
H161	-15.9	-15.9	-15.9	-13.0	-8.8	-5.1	-3.9	-4.5	-5.4	-6.5	-7.8	-9.3
H162	-16.0	-16.0	-16.0	-13.1	-8.9	-5.2	-4.0	-4.6	-5.5	-6.6	-7.9	-9.4
H163	-19.1	-19.1	-19.1	-16.2	-12.0	-8.2	-6.2	-6.1	-7.8	-10.1	-12.3	-14.3
H164	-15.0	-15.0	-15.0	-12.1	-7.8	-4.0	-2.1	-1.9	-3.7	-5.9	-8.1	-10.2
H165	-16.0	-16.0	-16.0	-13.1	-8.9	-5.2	-4.0	-4.6	-5.5	-6.6	-7.9	-9.4
H166	-15.7	-15.7	-15.7	-12.8	-8.6	-4.9	-3.7	-4.3	-5.2	-6.3	-7.6	-9.1
H167	-19.3	-19.3	-19.3	-16.4	-12.2	-8.4	-6.4	-6.3	-8.0	-10.3	-12.5	-14.5
H168	-16.0	-16.0	-16.0	-13.1	-8.8	-5.2	-4.0	-4.6	-5.5	-6.5	-7.8	-9.4
H169	-19.8	-19.8	-19.8	-16.9	-12.7	-8.8	-6.8	-6.7	-8.5	-10.7	-12.9	-15.0
H170	-15.7	-15.7	-15.7	-12.8	-8.5	-4.9	-3.7	-4.3	-5.2	-6.2	-7.5	-9.1
H171	-15.8	-15.8	-15.8	-12.9	-8.6	-5.0	-3.8	-4.4	-5.3	-6.3	-7.6	-9.2
H172	-21.8	-21.8	-21.8	-18.9	-14.7	-10.8	-8.9	-8.8	-10.5	-12.7	-14.9	-17.0
H173	-21.8	-21.8	-21.8	-18.9	-14.7	-10.8	-8.9	-8.8	-10.5	-12.7	-14.9	-17.0
H174	-21.8	-21.8	-21.8	-18.9	-14.7	-10.8	-8.9	-8.8	-10.5	-12.8	-15.0	-17.0
H175	-14.8	-14.8	-14.8	-11.9	-7.6	-4.0	-2.8	-3.4	-4.3	-5.3	-6.6	-8.2
H176	-14.8	-14.8	-14.8	-11.9	-7.6	-4.0	-2.8	-3.4	-4.3	-5.3	-6.6	-8.2
H177	-18.4	-18.4	-18.4	-15.5	-11.2	-7.4	-5.5	-5.3	-7.1	-9.3	-11.5	-13.5
H178	-14.7	-14.7	-14.7	-11.8	-7.5	-3.9	-2.7	-3.3	-4.2	-5.2	-6.5	-8.1
H179	-19.5	-19.5	-19.5	-16.6	-12.4	-8.6	-6.6	-6.5	-8.2	-10.5	-12.7	-14.7
H180	-14.4	-14.4	-14.4	-11.5	-7.2	-3.4	-1.5	-1.4	-2.0	-2.9	-3.9	-4.9
H181	-15.6	-15.6	-15.6	-12.7	-8.4	-4.8	-3.6	-4.2	-5.1	-6.1	-7.4	-9.0
H182	-19.5	-19.5	-19.5	-16.6	-12.4	-8.6	-6.6	-6.5	-8.2	-10.5	-12.7	-14.7
H183	-14.4	-14.4	-14.4	-11.5	-7.2	-3.4	-1.5	-1.4	-2.0	-2.9	-3.9	-4.9
H184	-14.5	-14.5	-14.5	-11.6	-7.3	-3.5	-1.6	-1.5	-2.1	-3.0	-4.0	-5.0
H185	-13.9	-13.9	-13.9	-11.0	-6.7	-2.9	-1.0	-0.9	-1.5	-2.4	-3.4	-4.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H186	-15.6	-15.6	-15.6	-12.7	-8.4	-4.8	-3.6	-4.2	-5.1	-6.1	-7.4	-9.0
H187	-15.6	-15.6	-15.6	-12.7	-8.4	-4.8	-3.6	-4.2	-5.1	-6.1	-7.4	-9.0
H188	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.1	-7.0	-8.7	-11.0	-13.1	-15.2
H189	-14.1	-14.1	-14.1	-11.2	-6.9	-3.1	-1.2	-1.1	-1.7	-2.6	-3.6	-4.6
H191	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.1	-7.0	-8.7	-11.0	-13.2	-15.2
H192	-13.1	-13.1	-13.1	-10.2	-5.9	-2.1	-0.2	-0.1	-0.7	-1.6	-2.6	-3.6
H193	-15.3	-15.3	-15.3	-12.4	-8.1	-4.2	-2.3	-2.2	-2.8	-3.7	-4.7	-5.8
H194	-20.5	-20.5	-20.5	-17.6	-13.4	-9.6	-7.5	-7.5	-9.2	-11.5	-13.6	-15.7
H195	-15.5	-15.5	-15.5	-12.6	-8.2	-4.4	-2.5	-2.4	-3.0	-3.9	-4.9	-6.0
H196	-14.0	-14.0	-14.0	-11.1	-6.8	-3.0	-1.1	-0.9	-1.5	-2.5	-3.5	-4.5
H197	-20.5	-20.5	-20.5	-17.6	-13.4	-9.6	-7.5	-7.5	-9.2	-11.5	-13.6	-15.7
H198	-18.0	-18.0	-18.0	-15.1	-10.8	-7.0	-5.1	-5.0	-6.7	-8.9	-11.1	-13.2
H200	-14.1	-14.1	-14.1	-11.2	-6.9	-3.1	-1.2	-1.0	-1.6	-2.5	-3.5	-4.6
H202	-21.0	-21.0	-21.0	-18.1	-13.8	-10.0	-8.1	-8.0	-9.7	-11.9	-14.1	-16.2
H203	-20.4	-20.4	-20.4	-17.5	-13.3	-9.5	-7.5	-7.4	-9.2	-11.4	-13.6	-15.6
H204	-23.9	-23.9	-23.9	-21.0	-16.8	-12.9	-11.0	-10.9	-12.6	-14.9	-17.1	-19.1
H205	-20.5	-20.5	-20.5	-17.6	-13.4	-9.6	-7.6	-7.6	-9.3	-11.5	-13.7	-15.7
H206	-16.2	-16.2	-16.2	-13.3	-8.9	-5.1	-3.1	-3.0	-3.6	-4.5	-5.5	-6.6
H207	-16.7	-16.7	-16.7	-13.8	-9.3	-5.5	-3.6	-3.4	-4.0	-4.9	-6.0	-7.1
H208	-16.2	-16.2	-16.2	-13.3	-8.8	-4.9	-3.0	-2.8	-3.4	-4.4	-5.4	-6.5
H209	-17.9	-17.9	-17.9	-15.0	-10.7	-6.9	-5.0	-4.9	-5.5	-6.4	-7.4	-8.4
H210	-17.2	-17.2	-17.2	-14.3	-9.8	-5.9	-3.9	-3.8	-4.3	-5.3	-6.3	-7.5
H211	-17.2	-17.2	-17.2	-14.3	-9.7	-5.9	-3.9	-3.8	-4.3	-5.3	-6.3	-7.5
H212	-17.3	-17.3	-17.3	-14.4	-9.8	-6.0	-4.0	-3.9	-4.4	-5.4	-6.4	-7.6
H213	-21.4	-21.4	-21.4	-18.5	-14.2	-10.4	-8.5	-8.4	-10.1	-12.3	-14.5	-16.6
H214	-23.7	-23.7	-23.7	-20.8	-16.6	-12.7	-10.8	-10.7	-12.4	-14.6	-16.8	-18.9
H215	-17.7	-17.7	-17.7	-14.8	-10.2	-6.3	-4.3	-4.2	-4.7	-5.7	-6.7	-7.9
H216	-22.1	-22.1	-22.1	-19.2	-15.0	-11.1	-9.2	-9.1	-10.8	-13.0	-15.3	-17.3
H217	-17.7	-17.7	-17.7	-14.8	-8.7	-4.5	-2.1	-1.4	-1.9	-3.1	-4.5	-6.7
H218	-21.5	-21.5	-21.5	-18.6	-14.4	-10.5	-8.6	-8.5	-10.2	-12.4	-14.6	-16.7
H219	-17.3	-17.3	-17.3	-14.4	-8.2	-4.0	-1.7	-1.0	-1.5	-2.7	-4.1	-6.3
H220	-18.3	-18.3	-18.3	-15.4	-10.3	-6.4	-4.3	-4.0	-4.6	-5.6	-6.7	-8.2
H221	-24.8	-24.8	-24.8	-21.9	-17.7	-13.8	-11.9	-11.8	-13.5	-15.8	-18.0	-20.0
H222	-21.4	-21.4	-21.4	-18.5	-14.3	-10.4	-8.5	-8.4	-10.1	-12.4	-14.5	-16.6
H223	-18.3	-18.3	-18.3	-15.4	-9.2	-4.5	-5.5	-5.4	-6.0	-6.9	-7.9	-8.9
H224	-18.5	-18.5	-18.5	-15.6	-7.3	-1.3	-4.6	-5.6	-6.2	-7.1	-8.1	-9.1
H225	-22.9	-22.9	-22.9	-20.0	-15.8	-11.9	-10.0	-9.9	-11.6	-13.9	-16.1	-18.1
H226	-18.9	-18.9	-18.9	-16.0	-10.9	-6.7	-6.1	-6.0	-6.6	-7.5	-8.5	-9.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H227	-22.9	-22.9	-22.9	-20.0	-15.8	-11.9	-10.0	-9.9	-11.6	-13.9	-16.1	-18.1
H228	-23.7	-23.7	-23.7	-20.8	-16.6	-12.7	-10.8	-10.7	-12.4	-14.7	-16.9	-18.9
H229	-19.8	-19.8	-19.8	-16.9	-9.5	-4.2	-6.6	-6.9	-7.5	-8.4	-9.4	-10.4
H230	-19.8	-19.8	-19.8	-16.9	-8.8	-3.1	-6.1	-6.9	-7.5	-8.4	-9.4	-10.4
H231	-20.0	-20.0	-20.0	-17.1	-12.9	-8.8	-7.2	-7.1	-7.7	-8.6	-9.6	-10.6
H232	-25.7	-25.7	-25.7	-22.8	-18.6	-14.8	-12.8	-12.7	-14.4	-16.7	-18.9	-20.9
H233	-25.7	-25.7	-25.7	-22.8	-18.6	-14.8	-12.8	-12.7	-14.4	-16.7	-18.9	-20.9
H234	-25.9	-25.9	-25.9	-23.0	-18.8	-15.0	-13.0	-12.9	-14.6	-16.9	-19.1	-21.1
H235	-24.2	-24.2	-24.2	-21.3	-17.0	-13.2	-11.3	-11.2	-11.8	-12.7	-13.7	-14.7
H236	-25.2	-25.2	-25.2	-22.3	-18.1	-14.3	-12.4	-12.2	-14.0	-16.2	-18.4	-20.4
H237	-21.8	-21.8	-21.8	-18.9	-14.4	-10.5	-8.6	-8.4	-9.0	-9.9	-11.0	-12.1
H238	-21.8	-21.8	-21.8	-18.9	-14.4	-10.5	-8.6	-8.4	-9.0	-9.9	-10.9	-12.1
H239	-21.5	-21.5	-21.5	-18.6	-13.5	-9.6	-7.5	-7.2	-7.8	-8.8	-9.9	-11.4
H240	-21.6	-21.6	-21.6	-18.7	-13.7	-9.8	-7.7	-7.4	-8.0	-9.0	-10.1	-11.5
H241	-23.6	-23.6	-23.6	-20.7	-16.3	-12.5	-10.6	-10.5	-11.1	-12.0	-13.0	-14.1
H242	-23.7	-23.7	-23.7	-20.8	-14.7	-10.5	-8.1	-7.4	-7.9	-9.1	-10.5	-12.8
H243	-24.8	-24.8	-24.8	-21.9	-17.6	-13.8	-11.9	-11.8	-12.4	-13.3	-14.3	-15.3
H244	-22.8	-22.8	-22.8	-19.9	-15.4	-11.5	-9.6	-9.4	-10.0	-11.0	-12.0	-13.1
H245	-23.1	-23.1	-23.1	-20.2	-15.8	-11.9	-10.0	-9.8	-10.4	-11.4	-12.4	-13.5
H246	-23.3	-23.3	-23.3	-20.4	-16.0	-12.2	-10.2	-10.1	-10.7	-11.6	-12.6	-13.7
H247	-23.4	-23.4	-23.4	-20.5	-16.1	-12.3	-10.3	-10.2	-10.8	-11.7	-12.7	-13.8
H248	-24.2	-24.2	-24.2	-21.3	-17.0	-13.2	-11.3	-11.1	-11.7	-12.6	-13.7	-14.7

Table 10.30 - Predictions vs Limit Remaining for Proposed Development at Night, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	-30.0	-30.0	-30.0	-27.1	-22.9	-19.1	-17.2	-17.0	-17.0	-17.0	-17.0	-17.2
H2	-28.9	-28.9	-28.9	-26.0	-21.8	-18.0	-16.1	-15.9	-15.9	-15.9	-15.9	-16.1
H3	-29.9	-29.9	-29.9	-27.0	-22.8	-19.0	-17.1	-16.9	-16.9	-16.9	-16.9	-17.1
H4	-27.2	-27.2	-27.2	-24.3	-20.1	-16.3	-14.4	-14.2	-14.2	-14.2	-14.1	-14.3
H5	-28.5	-28.5	-28.5	-25.6	-21.4	-17.6	-15.7	-15.5	-15.5	-15.5	-15.5	-15.7
H6	-25.5	-25.5	-25.5	-22.6	-18.4	-14.6	-12.6	-12.5	-12.5	-12.5	-12.4	-12.7
H7	-27.9	-27.9	-27.9	-25.0	-20.9	-17.1	-15.1	-14.9	-14.9	-14.9	-14.9	-15.1
H8	-26.9	-26.9	-26.9	-24.0	-19.8	-16.0	-14.1	-13.9	-13.9	-13.9	-13.9	-16.2
H9	-28.9	-28.9	-28.9	-26.0	-21.8	-18.0	-16.1	-16.0	-15.9	-15.9	-16.0	-18.2
H10	-27.9	-27.9	-27.9	-25.0	-20.8	-17.0	-15.1	-15.0	-14.9	-14.9	-15.0	-17.2
H11	-24.9	-24.9	-24.9	-22.0	-17.8	-14.0	-12.0	-11.9	-11.9	-11.8	-11.7	-11.9
H12	-25.9	-25.9	-25.9	-23.0	-18.8	-15.0	-13.1	-13.0	-12.9	-12.9	-13.0	-15.2
H13	-24.1	-24.1	-24.1	-21.2	-16.9	-13.1	-11.2	-11.1	-11.0	-11.0	-10.9	-11.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H14	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.4	-14.3	-14.3	-14.4	-16.6
H15	-23.9	-23.9	-23.9	-21.0	-16.8	-13.0	-11.1	-10.9	-10.9	-10.9	-10.8	-11.0
H16	-23.8	-23.8	-23.8	-20.9	-16.7	-12.9	-11.0	-10.8	-10.8	-10.8	-10.7	-10.9
H17	-26.2	-26.2	-26.2	-23.3	-19.1	-15.3	-13.4	-13.3	-13.3	-13.2	-13.3	-15.5
H18	-26.8	-26.8	-26.8	-23.9	-19.7	-15.9	-14.0	-13.9	-13.9	-13.9	-13.9	-16.2
H19	-27.5	-27.5	-27.5	-24.6	-20.4	-16.6	-14.7	-14.5	-14.5	-14.5	-14.6	-16.8
H20	-27.4	-27.4	-27.4	-24.5	-20.3	-16.5	-14.6	-14.4	-14.4	-14.4	-14.5	-16.7
H21	-27.0	-27.0	-27.0	-24.1	-19.9	-16.1	-14.2	-14.1	-14.1	-14.0	-14.1	-16.4
H22	-27.0	-27.0	-27.0	-24.1	-19.9	-16.1	-14.2	-14.1	-14.1	-14.0	-14.1	-16.4
H23	-27.5	-27.5	-27.5	-24.6	-20.4	-16.6	-14.7	-14.5	-14.5	-14.5	-14.6	-16.8
H24	-23.3	-23.3	-23.3	-20.4	-16.2	-12.4	-10.5	-10.3	-10.3	-10.2	-10.1	-10.3
H25	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.3	-14.3	-14.3	-14.4	-16.6
H26	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.3	-14.3	-14.3	-14.4	-16.6
H27	-27.4	-27.4	-27.4	-24.5	-20.3	-16.5	-14.6	-14.4	-14.4	-14.4	-14.5	-16.7
H28	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.3	-14.3	-14.3	-14.4	-16.6
H29	-27.1	-27.1	-27.1	-24.2	-20.0	-16.2	-14.3	-14.2	-14.1	-14.1	-14.2	-16.4
H30	-23.1	-23.1	-23.1	-20.2	-16.0	-12.0	-9.4	-8.4	-7.2	-4.6	-2.2	-2.3
H31	-26.8	-26.8	-26.8	-23.9	-19.7	-15.9	-14.0	-13.9	-13.9	-13.8	-13.9	-16.1
H32	-27.3	-27.3	-27.3	-24.4	-20.3	-16.5	-14.5	-14.3	-14.3	-14.3	-14.4	-16.6
H33	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.3	-14.3	-14.3	-14.4	-16.6
H34	-27.0	-27.0	-27.0	-24.1	-19.9	-16.1	-14.2	-14.1	-14.0	-14.0	-14.1	-16.3
H35	-26.9	-26.9	-26.9	-24.0	-19.8	-16.0	-14.1	-14.0	-14.0	-13.9	-14.0	-16.2
H36	-25.2	-25.2	-25.2	-22.3	-18.1	-14.3	-12.4	-12.3	-12.3	-12.3	-12.3	-14.6
H37	-26.7	-26.7	-26.7	-23.8	-19.6	-15.8	-13.9	-13.8	-13.8	-13.7	-13.8	-16.0
H38	-27.0	-27.0	-27.0	-24.1	-19.9	-16.1	-14.2	-14.1	-14.0	-14.0	-14.1	-16.3
H39	-27.0	-27.0	-27.0	-24.1	-19.9	-16.1	-14.2	-14.1	-14.0	-14.0	-14.1	-16.3
H40	-26.8	-26.8	-26.8	-23.9	-19.7	-15.9	-14.0	-13.9	-13.9	-13.8	-13.9	-16.1
H41	-22.7	-22.7	-22.7	-19.8	-15.6	-11.8	-9.9	-9.7	-9.6	-9.6	-9.3	-9.5
H42	-26.8	-26.8	-26.8	-23.9	-19.7	-15.9	-14.0	-13.9	-13.8	-13.8	-13.9	-16.1
H43	-26.7	-26.7	-26.7	-23.8	-19.6	-15.8	-13.9	-13.8	-13.8	-13.7	-13.8	-16.0
H44	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.3	-13.2	-13.2	-13.2	-13.2	-15.5
H45	-26.7	-26.7	-26.7	-23.8	-19.6	-15.8	-13.9	-13.8	-13.8	-13.7	-13.8	-16.0
H46	-25.8	-25.8	-25.8	-22.9	-18.7	-14.9	-13.0	-12.9	-12.9	-12.9	-12.9	-15.2
H47	-26.7	-26.7	-26.7	-23.8	-19.6	-15.8	-13.9	-13.8	-13.8	-13.7	-13.8	-16.0
H48	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.3	-13.2	-13.2	-13.2	-13.2	-15.5
H49	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.3	-13.2	-13.1	-13.1	-13.2	-15.4
H50	-26.5	-26.5	-26.5	-23.6	-19.4	-15.6	-13.7	-13.6	-13.6	-13.6	-13.6	-15.9
H51	-26.3	-26.3	-26.3	-23.4	-19.2	-15.4	-13.5	-13.4	-13.3	-13.3	-13.4	-15.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H52	-25.9	-25.9	-25.9	-23.0	-18.8	-15.0	-13.1	-13.0	-13.0	-13.0	-13.0	-15.3
H53	-22.6	-22.6	-22.6	-19.7	-15.5	-11.6	-9.7	-9.6	-9.5	-9.4	-9.0	-9.3
H54	-22.3	-22.3	-22.3	-19.4	-15.2	-11.3	-9.4	-9.3	-9.2	-9.1	-8.7	-8.9
H55	-22.1	-22.1	-22.1	-19.2	-15.0	-11.2	-9.2	-9.1	-9.0	-8.9	-8.7	-8.9
H56	-22.0	-22.0	-22.0	-19.1	-14.8	-11.0	-9.0	-8.9	-8.8	-8.7	-8.6	-8.8
H57	-22.0	-22.0	-22.0	-19.1	-14.9	-11.0	-9.1	-8.9	-8.9	-8.8	-8.6	-8.8
H58	-26.9	-26.9	-26.9	-24.0	-19.8	-15.9	-14.0	-13.9	-13.9	-13.9	-13.9	-16.2
H59	-21.8	-21.8	-21.8	-18.9	-14.7	-10.7	-8.8	-8.7	-8.5	-8.3	-7.6	-7.8
H61	-25.8	-25.8	-25.8	-22.9	-18.7	-14.9	-13.0	-12.9	-12.9	-12.9	-12.9	-15.2
H62	-22.0	-22.0	-22.0	-19.1	-14.9	-11.0	-9.0	-8.9	-8.7	-8.5	-7.8	-8.1
H63	-21.8	-21.8	-21.8	-18.9	-14.6	-10.7	-8.8	-8.6	-8.4	-8.2	-7.2	-7.5
H64	-25.8	-25.8	-25.8	-22.9	-18.7	-14.9	-13.0	-12.9	-12.9	-12.9	-12.9	-15.2
H65	-25.5	-25.5	-25.5	-22.6	-18.4	-14.6	-12.7	-12.6	-12.6	-12.6	-12.6	-14.9
H66	-21.1	-21.1	-21.1	-18.2	-14.0	-10.2	-8.3	-8.1	-8.1	-8.0	-7.9	-8.1
H67	-22.1	-22.1	-22.1	-19.2	-15.0	-11.1	-9.2	-9.0	-8.8	-8.6	-8.0	-8.2
H68	-25.3	-25.3	-25.3	-22.4	-18.2	-14.4	-12.5	-12.4	-12.4	-12.4	-12.4	-14.7
H69	-25.3	-25.3	-25.3	-22.4	-18.2	-14.4	-12.5	-12.4	-12.4	-12.4	-12.4	-14.7
H70	-21.5	-21.5	-21.5	-18.6	-14.4	-10.3	-8.4	-8.2	-7.8	-7.3	-5.1	-5.6
H71	-25.7	-25.7	-25.7	-22.8	-18.6	-14.8	-12.9	-12.8	-12.8	-12.7	-12.8	-15.1
H72	-21.5	-21.5	-21.5	-18.6	-14.3	-10.3	-8.4	-8.2	-7.7	-7.2	-4.7	-5.2
H73	-24.9	-24.9	-24.9	-22.0	-17.8	-14.0	-12.1	-12.0	-12.0	-12.0	-12.0	-14.3
H74	-24.5	-24.5	-24.5	-21.6	-17.4	-13.6	-11.7	-11.6	-11.6	-11.6	-11.6	-13.9
H75	-24.3	-24.3	-24.3	-21.4	-17.2	-13.4	-11.5	-11.4	-11.4	-11.4	-11.4	-13.7
H76	-20.9	-20.9	-20.9	-18.0	-13.8	-10.0	-8.1	-8.0	-8.0	-8.0	-8.0	-10.3
H77	-21.5	-21.5	-21.5	-18.6	-14.4	-10.2	-8.4	-8.1	-7.5	-6.7	-2.2	-3.0
H78	-24.1	-24.1	-24.1	-21.2	-17.0	-13.2	-11.3	-11.2	-11.2	-11.2	-11.3	-13.5
H79	-18.1	-18.1	-18.1	-15.2	-11.0	-7.1	-5.2	-5.1	-5.1	-7.3	-7.3	-7.3
H80	-24.2	-24.2	-24.2	-21.3	-17.1	-13.3	-11.4	-11.3	-11.3	-11.3	-11.4	-13.6
H81	-24.2	-24.2	-24.2	-21.3	-17.1	-13.3	-11.4	-11.3	-11.3	-11.3	-11.4	-13.6
H82	-24.0	-24.0	-24.0	-21.1	-16.9	-13.1	-11.2	-11.1	-11.1	-11.1	-11.2	-13.4
H83	-20.8	-20.8	-20.8	-17.9	-13.7	-9.8	-7.9	-7.8	-7.8	-7.7	-7.6	-7.8
H84	-21.0	-21.0	-21.0	-18.1	-13.9	-10.0	-8.1	-7.9	-7.7	-7.6	-6.9	-7.1
H85	-25.5	-25.5	-25.5	-22.6	-18.4	-14.6	-12.7	-12.6	-12.6	-12.6	-12.7	-14.9
H86	-24.0	-24.0	-24.0	-21.1	-16.9	-13.1	-11.2	-11.1	-11.1	-11.1	-11.2	-13.4
H87	-20.8	-20.8	-20.8	-17.9	-13.7	-9.9	-8.0	-7.9	-7.9	-7.9	-7.9	-10.2
H88	-18.0	-18.0	-18.0	-15.1	-10.9	-7.1	-5.1	-5.0	-5.0	-5.0	-4.9	-5.2
H89	-20.0	-20.0	-20.0	-17.1	-12.9	-9.0	-7.1	-7.0	-7.0	-7.0	-6.9	-7.1
H90	-22.7	-22.7	-22.7	-19.8	-15.6	-11.8	-9.9	-9.8	-9.8	-9.8	-9.9	-12.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H91	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.3	-13.2	-13.2	-13.2	-13.3	-15.5
H92	-21.1	-21.1	-21.1	-18.2	-14.0	-10.1	-8.2	-8.1	-8.0	-8.0	-7.9	-8.1
H93	-21.4	-21.4	-21.4	-18.5	-14.3	-10.4	-8.5	-8.4	-8.4	-8.3	-8.2	-8.4
H94	-18.8	-18.8	-18.8	-15.9	-11.7	-7.9	-5.9	-5.8	-5.8	-5.8	-5.7	-5.9
H95	-23.9	-23.9	-23.9	-21.0	-16.8	-13.0	-11.1	-11.0	-11.0	-11.0	-11.1	-13.3
H96	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.2	-7.1	-7.1	-7.1	-7.2	-9.4
H97	-19.7	-19.7	-19.7	-16.8	-12.6	-8.8	-6.9	-6.8	-6.8	-6.8	-6.9	-9.1
H98	-23.9	-23.9	-23.9	-21.0	-16.8	-13.0	-11.1	-11.0	-11.0	-11.0	-11.1	-13.3
H99	-21.9	-21.9	-21.9	-19.0	-14.8	-10.9	-9.0	-8.9	-8.9	-8.9	-8.8	-9.0
H100	-19.1	-19.1	-19.1	-16.2	-12.0	-8.2	-6.2	-6.1	-6.1	-6.1	-6.0	-6.2
H101	-19.4	-19.4	-19.4	-16.5	-12.3	-8.5	-6.6	-6.5	-6.5	-6.5	-6.6	-8.8
H102	-22.9	-22.9	-22.9	-20.0	-15.8	-12.0	-10.1	-10.0	-10.0	-10.0	-10.1	-12.3
H103	-18.2	-18.2	-18.2	-15.3	-11.1	-7.3	-5.4	-5.3	-5.3	-5.3	-5.4	-7.6
H104	-22.8	-22.8	-22.8	-19.9	-15.7	-11.9	-10.0	-9.9	-9.9	-9.9	-10.0	-12.2
H105	-18.4	-18.4	-18.4	-15.5	-11.3	-7.5	-5.5	-5.4	-5.4	-5.4	-5.3	-5.5
H106	-17.9	-17.9	-17.9	-15.0	-10.8	-7.0	-5.0	-4.9	-4.9	-4.9	-4.9	-5.1
H107	-22.9	-22.9	-22.9	-20.0	-15.8	-12.0	-10.1	-10.0	-10.0	-10.0	-10.1	-12.3
H108	-25.0	-25.0	-25.0	-22.1	-17.9	-14.1	-12.2	-12.1	-12.1	-12.1	-12.2	-14.4
H109	-25.1	-25.1	-25.1	-22.2	-18.0	-14.2	-12.3	-12.2	-12.2	-12.2	-12.3	-14.5
H110	-21.1	-21.1	-21.1	-18.2	-14.0	-10.2	-8.3	-8.2	-8.2	-8.2	-8.3	-10.5
H111	-22.5	-22.5	-22.5	-19.6	-15.4	-11.6	-9.7	-9.6	-9.6	-9.6	-9.7	-11.9
H112	-23.8	-23.8	-23.8	-20.9	-16.7	-12.9	-11.0	-10.9	-10.9	-10.9	-11.0	-13.2
H113	-16.9	-16.9	-16.9	-14.0	-9.8	-6.0	-4.0	-3.9	-3.9	-3.9	-3.9	-4.1
H114	-16.8	-16.8	-16.8	-13.9	-9.7	-5.9	-3.9	-3.8	-3.8	-3.8	-3.8	-4.0
H115	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.2	-7.1	-7.1	-7.1	-7.2	-9.4
H116	-18.7	-18.7	-18.7	-15.8	-11.6	-7.8	-5.8	-5.7	-5.7	-5.7	-5.6	-5.8
H117	-18.4	-18.4	-18.4	-15.5	-11.3	-7.5	-5.5	-5.4	-5.4	-5.4	-5.3	-5.5
H118	-18.7	-18.7	-18.7	-15.8	-11.7	-7.9	-5.8	-5.7	-5.7	-5.7	-5.6	-5.8
H119	-16.3	-16.3	-16.3	-13.4	-9.2	-5.4	-3.4	-3.3	-3.3	-3.3	-3.3	-3.5
H120	-22.4	-22.4	-22.4	-19.5	-15.3	-11.5	-9.6	-9.5	-9.5	-9.5	-9.6	-11.8
H121	-16.3	-16.3	-16.3	-13.4	-9.2	-5.4	-3.4	-3.3	-3.3	-3.3	-3.3	-3.5
H122	-23.8	-23.8	-23.8	-20.9	-16.7	-12.9	-11.0	-10.9	-10.9	-10.9	-11.0	-13.2
H123	-16.3	-16.3	-16.3	-13.4	-9.2	-5.4	-3.5	-3.3	-3.3	-3.3	-3.3	-3.5
H124	-14.9	-14.9	-14.9	-12.0	-7.8	-4.0	-2.1	-2.0	-1.9	-1.9	-1.9	-1.9
H125	-20.4	-20.4	-20.4	-17.5	-13.3	-9.5	-7.6	-7.5	-7.5	-7.5	-7.6	-9.8
H126	-16.4	-16.4	-16.4	-13.5	-9.3	-5.5	-3.6	-3.5	-3.4	-3.4	-3.4	-3.6
H127	-16.4	-16.4	-16.4	-13.5	-9.3	-5.5	-3.6	-3.5	-3.4	-3.4	-3.4	-3.6
H128	-17.7	-17.7	-17.7	-14.8	-10.6	-6.8	-4.8	-4.7	-4.7	-4.7	-4.7	-4.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H129	-22.5	-22.5	-22.5	-19.6	-15.4	-11.6	-9.7	-9.6	-9.6	-9.6	-9.7	-11.9
H130	-16.4	-16.4	-16.4	-13.5	-9.3	-5.5	-3.6	-3.5	-3.4	-3.4	-3.4	-3.6
H131	-22.4	-22.4	-22.4	-19.5	-15.3	-11.5	-9.6	-9.5	-9.5	-9.5	-9.6	-11.8
H132	-18.7	-18.7	-18.7	-15.8	-11.6	-7.8	-5.8	-5.7	-5.7	-5.7	-5.7	-6.8
H133	-16.4	-16.4	-16.4	-13.5	-9.3	-5.5	-3.6	-3.5	-3.4	-3.4	-3.4	-4.5
H134	-19.9	-19.9	-19.9	-17.0	-12.8	-9.0	-7.1	-7.0	-7.0	-7.0	-7.1	-9.3
H135	-20.5	-20.5	-20.5	-17.6	-13.4	-9.6	-7.7	-7.6	-7.6	-7.6	-7.7	-9.9
H136	-20.2	-20.2	-20.2	-17.3	-13.1	-9.3	-7.4	-7.3	-7.3	-7.3	-7.3	-7.7
H137	-20.3	-20.3	-20.3	-17.4	-13.2	-9.4	-7.5	-7.4	-7.4	-7.4	-7.4	-7.8
H138	-18.8	-18.8	-18.8	-15.9	-11.7	-7.9	-6.0	-5.8	-5.8	-5.8	-5.8	-6.9
H139	-20.3	-20.3	-20.3	-17.4	-13.2	-9.4	-7.5	-7.4	-7.4	-7.4	-7.4	-7.8
H140	-20.1	-20.1	-20.1	-17.2	-13.0	-9.2	-7.3	-7.2	-7.2	-7.2	-7.2	-7.6
H141	-23.4	-23.4	-23.4	-20.5	-16.3	-12.5	-10.6	-10.4	-10.4	-10.4	-10.4	-11.5
H142	-21.6	-21.6	-21.6	-18.7	-14.5	-10.7	-8.8	-8.7	-8.7	-8.7	-8.7	-9.1
H143	-18.0	-18.0	-18.0	-15.1	-10.9	-7.1	-5.2	-5.1	-5.0	-5.0	-5.0	-6.1
H144	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-8.5	-8.5	-8.5	-8.5	-8.9
H145	-20.2	-20.2	-20.2	-17.3	-13.1	-9.3	-7.4	-7.3	-7.3	-7.3	-7.3	-7.7
H146	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-8.5	-8.5	-8.5	-8.5	-8.9
H147	-17.9	-17.9	-17.9	-15.0	-10.8	-7.0	-5.1	-5.0	-4.9	-4.9	-4.9	-6.0
H148	-18.7	-18.7	-18.7	-15.8	-11.6	-7.8	-5.9	-5.8	-5.7	-5.7	-5.7	-6.8
H149	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-8.5	-8.5	-8.5	-8.5	-8.9
H150	-21.5	-21.5	-21.5	-18.6	-14.4	-10.6	-8.7	-8.6	-8.6	-8.6	-8.6	-9.0
H151	-18.7	-18.7	-18.7	-15.8	-11.6	-7.8	-5.9	-5.8	-5.7	-5.7	-5.7	-6.8
H152	-24.5	-24.5	-24.5	-21.6	-17.4	-13.6	-11.6	-11.5	-11.5	-11.5	-11.4	-12.6
H153	-19.4	-19.4	-19.4	-16.5	-12.3	-8.5	-6.6	-6.5	-6.5	-6.5	-6.5	-6.9
H154	-19.8	-19.8	-19.8	-16.9	-12.7	-8.9	-7.0	-6.9	-6.9	-6.9	-6.9	-7.3
H155	-19.5	-19.5	-19.5	-16.6	-12.4	-8.6	-6.7	-6.6	-6.6	-6.6	-6.6	-7.0
H156	-19.5	-19.5	-19.5	-16.6	-12.4	-8.6	-6.7	-6.6	-6.6	-6.6	-6.6	-7.0
H157	-17.3	-17.3	-17.3	-14.4	-10.2	-6.4	-4.5	-4.4	-4.4	-4.4	-4.3	-4.3
H158	-17.7	-17.7	-17.7	-14.8	-10.6	-6.8	-4.9	-4.8	-4.8	-4.8	-4.8	-5.2
H159	-24.6	-24.6	-24.6	-21.7	-17.5	-13.7	-11.7	-11.6	-11.6	-11.6	-11.5	-12.7
H160	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-8.5	-8.5	-8.5	-8.5	-8.9
H161	-21.4	-21.4	-21.4	-18.5	-14.3	-10.5	-8.6	-8.5	-8.5	-8.5	-8.5	-8.9
H162	-21.5	-21.5	-21.5	-18.6	-14.4	-10.6	-8.7	-8.6	-8.6	-8.6	-8.6	-9.0
H163	-24.7	-24.7	-24.7	-21.8	-17.6	-13.8	-11.8	-11.7	-11.7	-11.7	-11.7	-12.8
H164	-20.5	-20.5	-20.5	-17.6	-13.4	-9.6	-7.7	-7.6	-7.5	-7.5	-7.5	-8.6
H165	-21.5	-21.5	-21.5	-18.6	-14.4	-10.6	-8.7	-8.6	-8.6	-8.6	-8.6	-9.0
H166	-21.2	-21.2	-21.2	-18.3	-14.1	-10.3	-8.4	-8.3	-8.3	-8.3	-8.3	-8.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H167	-24.9	-24.9	-24.9	-22.0	-17.8	-14.0	-12.0	-11.9	-11.9	-11.9	-11.8	-13.0
H168	-21.5	-21.5	-21.5	-18.6	-14.4	-10.6	-8.7	-8.6	-8.6	-8.6	-8.6	-9.0
H169	-25.4	-25.4	-25.4	-22.5	-18.3	-14.5	-12.5	-12.4	-12.4	-12.4	-12.3	-13.4
H170	-21.2	-21.2	-21.2	-18.3	-14.1	-10.3	-8.4	-8.3	-8.3	-8.3	-8.2	-8.7
H171	-21.3	-21.3	-21.3	-18.4	-14.2	-10.4	-8.5	-8.4	-8.4	-8.4	-8.3	-8.8
H172	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.4	-14.4	-14.4	-14.3	-15.5
H173	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.4	-14.4	-14.4	-14.3	-15.5
H174	-27.3	-27.3	-27.3	-24.4	-20.2	-16.4	-14.5	-14.4	-14.4	-14.4	-14.3	-15.5
H175	-20.3	-20.3	-20.3	-17.4	-13.2	-9.4	-7.5	-7.4	-7.4	-7.3	-7.3	-7.7
H176	-20.3	-20.3	-20.3	-17.4	-13.2	-9.4	-7.5	-7.4	-7.4	-7.3	-7.3	-7.7
H177	-23.9	-23.9	-23.9	-21.0	-16.8	-13.0	-11.1	-11.0	-10.9	-10.9	-10.9	-12.0
H178	-20.2	-20.2	-20.2	-17.3	-13.1	-9.3	-7.4	-7.3	-7.3	-7.2	-7.2	-7.6
H179	-25.1	-25.1	-25.1	-22.2	-18.0	-14.2	-12.2	-12.1	-12.1	-12.1	-12.0	-13.2
H180	-19.9	-19.9	-19.9	-17.0	-12.8	-9.0	-7.1	-7.0	-7.0	-7.0	-6.9	-7.0
H181	-21.1	-21.1	-21.1	-18.2	-14.0	-10.2	-8.3	-8.2	-8.2	-8.2	-8.1	-8.6
H182	-25.1	-25.1	-25.1	-22.2	-18.0	-14.2	-12.2	-12.1	-12.1	-12.1	-12.0	-13.2
H183	-19.9	-19.9	-19.9	-17.0	-12.8	-9.0	-7.1	-7.0	-7.0	-7.0	-6.9	-7.0
H184	-20.0	-20.0	-20.0	-17.1	-12.9	-9.1	-7.2	-7.1	-7.1	-7.1	-7.0	-7.1
H185	-19.4	-19.4	-19.4	-16.5	-12.3	-8.5	-6.6	-6.5	-6.5	-6.5	-6.4	-6.4
H186	-21.1	-21.1	-21.1	-18.2	-14.0	-10.2	-8.3	-8.2	-8.2	-8.2	-8.1	-8.6
H187	-21.1	-21.1	-21.1	-18.2	-14.0	-10.2	-8.3	-8.2	-8.2	-8.1	-8.1	-8.5
H188	-25.6	-25.6	-25.6	-22.7	-18.5	-14.7	-12.7	-12.6	-12.6	-12.6	-12.5	-13.7
H189	-19.6	-19.6	-19.6	-16.7	-12.5	-8.7	-6.8	-6.7	-6.7	-6.7	-6.6	-6.6
H191	-25.6	-25.6	-25.6	-22.7	-18.5	-14.7	-12.7	-12.6	-12.6	-12.6	-12.5	-13.7
H192	-18.6	-18.6	-18.6	-15.7	-11.5	-7.7	-5.8	-5.7	-5.7	-5.7	-5.6	-5.6
H193	-20.8	-20.8	-20.8	-17.9	-13.7	-9.8	-7.9	-7.8	-7.8	-7.8	-7.8	-7.8
H194	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.2	-13.1	-13.1	-13.1	-13.0	-14.1
H195	-21.0	-21.0	-21.0	-18.1	-13.9	-10.0	-8.1	-8.0	-8.0	-8.0	-8.0	-8.0
H196	-19.5	-19.5	-19.5	-16.6	-12.4	-8.6	-6.7	-6.6	-6.5	-6.5	-6.5	-6.5
H197	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.2	-13.1	-13.1	-13.1	-13.0	-14.1
H198	-23.5	-23.5	-23.5	-20.6	-16.4	-12.6	-10.7	-10.6	-10.6	-10.6	-10.5	-11.6
H200	-19.6	-19.6	-19.6	-16.7	-12.5	-8.7	-6.8	-6.7	-6.6	-6.6	-6.6	-6.6
H202	-26.5	-26.5	-26.5	-23.6	-19.4	-15.6	-13.7	-13.6	-13.6	-13.6	-13.5	-14.6
H203	-26.0	-26.0	-26.0	-23.1	-18.9	-15.1	-13.2	-13.1	-13.0	-13.0	-13.0	-14.1
H204	-29.4	-29.4	-29.4	-26.5	-22.3	-18.5	-16.6	-16.5	-16.5	-16.5	-16.4	-17.6
H205	-26.1	-26.1	-26.1	-23.2	-19.0	-15.2	-13.3	-13.2	-13.1	-13.1	-13.1	-14.2
H206	-21.7	-21.7	-21.7	-18.8	-14.5	-10.7	-8.8	-8.7	-8.7	-8.7	-8.7	-8.7
H207	-22.2	-22.2	-22.2	-19.3	-15.0	-11.2	-9.3	-9.2	-9.2	-9.2	-9.1	-9.2

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H208	-21.7	-21.7	-21.7	-18.8	-14.5	-10.7	-8.8	-8.7	-8.7	-8.6	-8.6	-8.6
H209	-23.4	-23.4	-23.4	-20.5	-16.3	-12.5	-10.6	-10.5	-10.5	-10.4	-10.4	-10.4
H210	-22.7	-22.7	-22.7	-19.8	-15.5	-11.7	-9.8	-9.7	-9.6	-9.6	-9.6	-9.6
H211	-22.7	-22.7	-22.7	-19.8	-15.5	-11.7	-9.8	-9.7	-9.6	-9.6	-9.6	-9.6
H212	-22.8	-22.8	-22.8	-19.9	-15.6	-11.8	-9.9	-9.8	-9.7	-9.7	-9.7	-9.7
H213	-26.9	-26.9	-26.9	-24.0	-19.8	-16.0	-14.1	-14.0	-14.0	-14.0	-13.9	-15.0
H214	-29.2	-29.2	-29.2	-26.3	-22.1	-18.3	-16.4	-16.3	-16.3	-16.3	-16.2	-17.4
H215	-23.2	-23.2	-23.2	-20.3	-16.0	-12.2	-10.3	-10.1	-10.1	-10.1	-10.0	-10.1
H216	-27.6	-27.6	-27.6	-24.7	-20.5	-16.7	-14.8	-14.7	-14.7	-14.7	-14.6	-15.8
H217	-23.2	-23.2	-23.2	-20.3	-15.6	-11.8	-9.8	-9.6	-9.4	-9.3	-9.1	-9.4
H218	-27.0	-27.0	-27.0	-24.1	-19.9	-16.1	-14.2	-14.1	-14.1	-14.1	-14.0	-15.1
H219	-22.8	-22.8	-22.8	-19.9	-15.2	-11.4	-9.4	-9.2	-9.0	-8.9	-8.7	-9.0
H220	-23.8	-23.8	-23.8	-20.9	-16.5	-12.6	-10.7	-10.5	-10.5	-10.4	-10.3	-10.5
H221	-30.3	-30.3	-30.3	-27.4	-23.2	-19.4	-17.5	-17.4	-17.4	-17.4	-17.3	-18.5
H222	-26.9	-26.9	-26.9	-24.0	-19.8	-16.0	-14.1	-14.0	-14.0	-14.0	-13.9	-15.1
H223	-23.8	-23.8	-23.8	-20.9	-15.7	-11.7	-9.5	-9.1	-10.9	-10.9	-10.9	-10.9
H224	-24.0	-24.0	-24.0	-21.1	-15.4	-11.3	-9.1	-8.6	-11.1	-11.1	-11.1	-11.1
H225	-28.4	-28.4	-28.4	-25.5	-21.3	-17.5	-15.6	-15.5	-15.5	-15.5	-15.5	-16.6
H226	-24.4	-24.4	-24.4	-21.5	-16.5	-12.6	-10.5	-10.2	-11.5	-11.5	-11.5	-11.5
H227	-28.4	-28.4	-28.4	-25.5	-21.3	-17.5	-15.6	-15.5	-15.5	-15.5	-15.5	-16.6
H228	-29.2	-29.2	-29.2	-26.3	-22.1	-18.3	-16.4	-16.3	-16.3	-16.3	-16.3	-17.4
H229	-25.3	-25.3	-25.3	-22.4	-16.9	-12.8	-10.6	-10.2	-12.4	-12.4	-12.4	-12.4
H230	-25.3	-25.3	-25.3	-22.4	-16.8	-12.7	-10.5	-10.0	-12.4	-12.4	-12.4	-12.4
H231	-25.5	-25.5	-25.5	-22.6	-17.9	-14.0	-12.0	-11.8	-12.6	-12.6	-12.6	-12.6
H232	-31.2	-31.2	-31.2	-28.3	-24.1	-20.3	-18.4	-18.3	-18.3	-18.3	-18.3	-19.4
H233	-31.2	-31.2	-31.2	-28.3	-24.1	-20.3	-18.4	-18.3	-18.3	-18.3	-18.3	-19.4
H234	-31.4	-31.4	-31.4	-28.5	-24.3	-20.5	-18.6	-18.5	-18.5	-18.5	-18.5	-19.6
H235	-29.7	-29.7	-29.7	-26.8	-22.6	-18.8	-16.9	-16.8	-16.8	-16.8	-16.8	-16.8
H236	-30.7	-30.7	-30.7	-27.8	-23.6	-19.8	-17.9	-17.8	-17.8	-17.8	-17.8	-18.9
H237	-27.3	-27.3	-27.3	-24.4	-20.1	-16.3	-14.4	-14.3	-14.2	-14.2	-14.2	-14.2
H238	-27.3	-27.3	-27.3	-24.4	-20.1	-16.3	-14.4	-14.3	-14.2	-14.2	-14.2	-14.2
H239	-27.0	-27.0	-27.0	-24.1	-19.7	-15.8	-13.9	-13.8	-13.7	-13.6	-13.6	-13.7
H240	-27.1	-27.1	-27.1	-24.2	-19.8	-16.0	-14.0	-13.9	-13.8	-13.8	-13.7	-13.8
H241	-29.1	-29.1	-29.1	-26.2	-22.0	-18.1	-16.2	-16.1	-16.1	-16.1	-16.1	-16.1
H242	-29.2	-29.2	-29.2	-26.3	-21.6	-17.8	-15.8	-15.6	-15.4	-15.3	-15.1	-15.4
H243	-30.3	-30.3	-30.3	-27.4	-23.2	-19.4	-17.5	-17.4	-17.4	-17.3	-17.3	-17.3
H244	-28.3	-28.3	-28.3	-25.4	-21.1	-17.3	-15.4	-15.3	-15.2	-15.2	-15.2	-15.2
H245	-28.6	-28.6	-28.6	-25.7	-21.4	-17.6	-15.7	-15.6	-15.6	-15.6	-15.5	-15.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H246	-28.8	-28.8	-28.8	-25.9	-21.6	-17.8	-15.9	-15.8	-15.8	-15.8	-15.8	-15.8
H247	-28.9	-28.9	-28.9	-26.0	-21.7	-17.9	-16.0	-15.9	-15.9	-15.9	-15.9	-15.9
H248	-29.7	-29.7	-29.7	-26.8	-22.6	-18.8	-16.9	-16.8	-16.7	-16.7	-16.7	-16.7

10.104 A noise management strategy can be implemented to reduce the predicted noise levels to below the limit remaining for the proposed development. This involves operating certain turbines within the proposed development in reduced noise mode in certain conditions. The Vestas V117 4.2 MW machine has three reduced noise modes whereby the pitch of the turbine blades can be altered, sacrificing power production, to decrease the amount of noise produced. Acoustic emission data for the available noise modes, with the inclusion of a 2 dB(A) allowance for measurement uncertainty, is shown in **Table 10.31**.

Table 10.31 - Reduced Noise Modes for the Vestas V117-4.2MW Wind Turbine

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Mode 1	Mode 2	Mode 3
1	95.1	95.1	95.1
2	95.1	95.1	95.1
3	95.1	95.1	95.1
4	98.0	98.0	98.0
5	102.2	102.1	101.9
6	105.5	104.0	102.9
7	106.9	104.3	103.0
8	107.0	104.5	103.0
9	107.0	104.9	103.0
10	107.0	105.0	103.0
11	107.0	105.0	103.0
12	107.0	105.0	103.0

10.105 An example of a noise management strategy which would allow the daytime noise limit to be met is provided in **Table 10.32**. The strategy is only shown for standardised 10 m wind speeds where the limit is predicted to be exceeded. The turbines would operate in their standard mode of operation ('Mode 0') at all other wind speeds. There are many different combinations of turbines operating in different modes which would result in the limit being met and this is just one example to demonstrate the principle rather than being optimised from an energy capture perspective.

Table 10.32 - Daytime Noise Management Strategy

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	6	7	8	9
T1	Mode 1	Mode 2	Mode 2	Mode 1
T2	Mode 1	Mode 2	Mode 2	Mode 1
T3	Mode 0	Mode 1	Mode 2	Mode 0

T4	Mode 1	Mode 2	Mode 1	Mode 0
T5	Mode 2	Mode 2	Mode 3	Mode 2
T6	Mode 1	Mode 2	Mode 2	Mode 0
T7	Mode 2	Mode 2	Mode 2	Mode 1
T8	Mode 2	Mode 2	Mode 2	Mode 1
T9	Mode 2	Mode 2	Mode 2	Mode 0
T10	Mode 3	Mode 3	Mode 3	Mode 0
T11	Mode 2	Mode 2	Mode 1	Mode 1
T12	Mode 2	Mode 2	Mode 3	Mode 1
T13	Mode 2	Mode 2	Mode 2	Mode 1
T14	Mode 1	Mode 2	Mode 1	Mode 0

10.106 The predicted noise levels with the above noise management strategy in place are provided in **Table 10.33**. The margin between these mitigated predicted noise levels and the limit remaining for the proposed development during daytime periods is shown in **Table 10.34** and there are no longer any exceedances.

Table 10.33 - Predicted Noise Levels for Proposed Development with Daytime Noise Management Strategy in Place, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	13.0	13.0	13.0	15.9	20.1	22.5	22.2	23.0	25.3	25.9	25.9	25.9
H2	14.1	14.1	14.1	17.0	21.2	23.5	23.2	24.1	26.4	27.0	27.0	27.0
H3	13.1	13.1	13.1	16.0	20.2	22.4	22.2	23.0	25.4	26.0	26.0	26.0
H4	15.8	15.8	15.8	18.7	22.9	25.2	24.9	25.8	28.2	28.7	28.7	28.7
H5	14.5	14.5	14.5	17.4	21.6	23.8	23.6	24.4	26.9	27.4	27.4	27.4
H6	17.5	17.5	17.5	20.4	24.6	26.8	26.7	27.3	29.8	30.4	30.4	30.4
H7	15.1	15.1	15.1	18.0	22.1	24.3	24.2	24.8	27.3	28.0	28.0	28.0
H8	16.1	16.1	16.1	19.0	23.2	25.5	25.3	26.3	28.4	29.0	29.0	29.0
H9	14.1	14.1	14.1	17.0	21.2	23.6	23.4	24.2	26.4	27.0	27.0	27.0
H10	15.1	15.1	15.1	18.0	22.2	24.6	24.4	25.4	27.5	28.0	28.0	28.0
H11	18.0	18.0	18.0	20.9	25.1	27.3	27.1	27.8	30.2	30.9	30.9	30.9
H12	17.1	17.1	17.1	20.0	24.2	26.6	26.4	27.5	29.5	30.0	30.0	30.0
H13	18.9	18.9	18.9	21.8	26.0	28.3	28.1	28.8	31.2	31.8	31.8	31.8
H14	15.7	15.7	15.7	18.6	22.8	25.2	25.0	25.8	28.0	28.6	28.6	28.6
H15	19.0	19.0	19.0	21.9	26.1	28.3	28.2	28.6	31.2	31.9	31.9	31.9
H16	19.1	19.1	19.1	22.0	26.2	28.3	28.2	28.6	31.3	32.0	32.0	32.0
H17	16.8	16.8	16.8	19.7	23.9	26.3	26.0	27.0	29.2	29.7	29.7	29.7
H18	16.2	16.2	16.2	19.1	23.3	25.7	25.5	26.3	28.5	29.1	29.1	29.1
H19	15.5	15.5	15.5	18.4	22.6	25.0	24.8	25.5	27.8	28.4	28.4	28.4
H20	15.6	15.6	15.6	18.5	22.7	25.1	25.0	25.6	27.9	28.5	28.5	28.5
H21	16.0	16.0	16.0	18.9	23.1	25.4	25.3	26.0	28.3	28.9	28.9	28.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H22	16.0	16.0	16.0	18.9	23.1	25.5	25.4	26.1	28.4	28.9	28.9	28.9
H23	15.5	15.5	15.5	18.4	22.6	25.0	24.9	25.5	27.8	28.4	28.4	28.4
H24	19.6	19.6	19.6	22.5	26.7	28.9	28.7	29.2	31.8	32.5	32.5	32.5
H25	15.7	15.7	15.7	18.6	22.8	25.2	25.1	25.8	28.0	28.6	28.6	28.6
H26	15.7	15.7	15.7	18.6	22.8	25.2	25.1	25.8	28.0	28.6	28.6	28.6
H27	15.6	15.6	15.6	18.5	22.7	25.1	25.0	25.7	28.0	28.5	28.5	28.5
H28	15.7	15.7	15.7	18.6	22.8	25.2	25.1	25.8	28.1	28.6	28.6	28.6
H29	15.9	15.9	15.9	18.8	23.0	25.4	25.2	25.9	28.2	28.8	28.8	28.8
H30	19.9	19.9	19.9	22.8	27.0	29.3	29.1	30.0	32.2	32.8	32.8	32.8
H31	16.2	16.2	16.2	19.1	23.3	25.7	25.5	26.3	28.5	29.1	29.1	29.1
H32	15.7	15.7	15.7	18.6	22.7	25.1	25.0	25.7	28.0	28.6	28.6	28.6
H33	15.7	15.7	15.7	18.6	22.8	25.2	25.1	25.8	28.1	28.6	28.6	28.6
H34	16.0	16.0	16.0	18.9	23.1	25.5	25.4	26.1	28.3	28.9	28.9	28.9
H35	16.1	16.1	16.1	19.0	23.2	25.6	25.5	26.2	28.5	29.0	29.0	29.0
H36	17.8	17.8	17.8	20.7	24.9	27.3	27.1	28.1	30.2	30.7	30.7	30.7
H37	16.3	16.3	16.3	19.2	23.4	25.8	25.6	26.4	28.6	29.2	29.2	29.2
H38	16.0	16.0	16.0	18.9	23.1	25.5	25.4	26.0	28.3	28.9	28.9	28.9
H39	16.0	16.0	16.0	18.9	23.1	25.5	25.4	26.1	28.4	28.9	28.9	28.9
H40	16.2	16.2	16.2	19.1	23.3	25.7	25.6	26.3	28.6	29.1	29.1	29.1
H41	20.2	20.2	20.2	23.1	27.3	29.6	29.4	30.1	32.5	33.1	33.1	33.1
H42	16.2	16.2	16.2	19.1	23.3	25.7	25.5	26.2	28.5	29.1	29.1	29.1
H43	16.3	16.3	16.3	19.2	23.4	25.8	25.7	26.4	28.7	29.2	29.2	29.2
H44	16.9	16.9	16.9	19.8	24.0	26.4	26.3	27.1	29.3	29.8	29.8	29.8
H45	16.3	16.3	16.3	19.2	23.4	25.8	25.7	26.4	28.7	29.2	29.2	29.2
H46	17.2	17.2	17.2	20.1	24.3	26.7	26.5	27.3	29.5	30.1	30.1	30.1
H47	16.3	16.3	16.3	19.2	23.4	25.8	25.7	26.4	28.6	29.2	29.2	29.2
H48	16.9	16.9	16.9	19.8	24.0	26.4	26.2	27.0	29.2	29.8	29.8	29.8
H49	16.9	16.9	16.9	19.8	24.0	26.4	26.2	27.0	29.2	29.8	29.8	29.8
H50	16.5	16.5	16.5	19.4	23.6	26.0	25.8	26.6	28.8	29.4	29.4	29.4
H51	16.7	16.7	16.7	19.6	23.8	26.2	26.1	26.8	29.1	29.6	29.6	29.6
H52	17.1	17.1	17.1	20.0	24.2	26.6	26.4	27.2	29.4	30.0	30.0	30.0
H53	20.3	20.3	20.3	23.2	27.4	29.7	29.5	30.2	32.6	33.2	33.2	33.2
H54	20.6	20.6	20.6	23.5	27.7	30.0	29.8	30.5	32.9	33.5	33.5	33.5
H55	20.7	20.7	20.7	23.6	27.8	30.1	29.9	30.8	33.0	33.6	33.6	33.6
H56	20.9	20.9	20.9	23.8	28.0	30.3	30.1	30.9	33.2	33.8	33.8	33.8
H57	20.9	20.9	20.9	23.8	28.0	30.3	30.1	31.0	33.2	33.8	33.8	33.8
H58	16.1	16.1	16.1	19.0	23.2	25.6	25.5	26.1	28.4	29.0	29.0	29.0
H59	21.1	21.1	21.1	24.0	28.2	30.4	30.2	30.8	33.3	34.0	34.0	34.0

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H61	17.2	17.2	17.2	20.1	24.3	26.7	26.6	27.3	29.6	30.1	30.1	30.1
H62	20.9	20.9	20.9	23.8	28.0	30.2	30.0	30.5	33.1	33.8	33.8	33.8
H63	21.1	21.1	21.1	24.0	28.2	30.4	30.2	30.8	33.3	34.0	34.0	34.0
H64	17.2	17.2	17.2	20.1	24.3	26.7	26.6	27.3	29.6	30.1	30.1	30.1
H65	17.5	17.5	17.5	20.4	24.6	27.0	26.9	27.6	29.9	30.4	30.4	30.4
H66	21.8	21.8	21.8	24.7	28.9	31.1	30.9	31.8	34.0	34.7	34.7	34.7
H67	20.8	20.8	20.8	23.7	27.9	30.1	29.9	30.5	33.0	33.7	33.7	33.7
H68	17.7	17.7	17.7	20.6	24.8	27.2	27.0	27.8	30.0	30.6	30.6	30.6
H69	17.7	17.7	17.7	20.6	24.8	27.2	27.1	27.8	30.1	30.6	30.6	30.6
H70	21.3	21.3	21.3	24.2	28.4	30.7	30.5	31.0	33.6	34.2	34.2	34.2
H71	17.3	17.3	17.3	20.2	24.4	26.8	26.7	27.4	29.7	30.2	30.2	30.2
H72	21.3	21.3	21.3	24.2	28.4	30.7	30.5	31.0	33.6	34.2	34.2	34.2
H73	18.1	18.1	18.1	21.0	25.2	27.6	27.5	28.2	30.5	31.0	31.0	31.0
H74	18.5	18.5	18.5	21.4	25.6	28.0	27.9	28.7	30.9	31.4	31.4	31.4
H75	18.7	18.7	18.7	21.6	25.8	28.2	28.1	28.8	31.0	31.6	31.6	31.6
H76	22.1	22.1	22.1	25.0	29.2	31.5	31.3	32.4	34.5	35.0	35.0	35.0
H77	21.2	21.2	21.2	24.1	28.3	30.6	30.4	31.0	33.5	34.1	34.1	34.1
H78	18.9	18.9	18.9	21.8	26.0	28.3	28.1	29.1	31.2	31.8	31.8	31.8
H79	24.9	24.9	24.9	27.8	32.0	34.3	34.1	35.0	37.3	37.8	37.8	37.8
H80	18.8	18.8	18.8	21.7	25.9	28.3	28.2	28.9	31.1	31.7	31.7	31.7
H81	18.8	18.8	18.8	21.7	25.9	28.2	28.1	29.0	31.2	31.7	31.7	31.7
H82	19.0	19.0	19.0	21.9	26.1	28.5	28.3	29.2	31.4	31.9	31.9	31.9
H83	22.2	22.2	22.2	25.1	29.3	31.5	31.4	32.0	34.5	35.1	35.1	35.1
H84	21.9	21.9	21.9	24.8	29.0	31.2	31.0	31.4	34.1	34.8	34.8	34.8
H85	17.5	17.5	17.5	20.4	24.6	27.0	26.9	27.5	29.9	30.4	30.4	30.4
H86	19.0	19.0	19.0	21.9	26.1	28.4	28.2	29.1	31.3	31.9	31.9	31.9
H87	22.2	22.2	22.2	25.1	29.3	31.5	31.5	32.4	34.5	35.1	35.1	35.1
H88	25.0	25.0	25.0	27.9	32.1	34.3	34.2	34.8	37.2	37.9	37.9	37.9
H89	23.0	23.0	23.0	25.9	30.1	32.3	32.1	32.8	35.2	35.9	35.9	35.9
H90	20.3	20.3	20.3	23.2	27.4	29.7	29.6	30.5	32.7	33.2	33.2	33.2
H91	16.9	16.9	16.9	19.8	24.0	26.4	26.3	27.0	29.2	29.8	29.8	29.8
H92	21.9	21.9	21.9	24.8	29.0	31.2	31.1	31.5	34.1	34.8	34.8	34.8
H93	21.6	21.6	21.6	24.5	28.7	30.9	30.7	31.3	33.8	34.5	34.5	34.5
H94	24.2	24.2	24.2	27.1	31.3	33.4	33.4	33.8	36.4	37.1	37.1	37.1
H95	19.1	19.1	19.1	22.0	26.2	28.7	28.6	29.2	31.5	32.0	32.0	32.0
H96	23.0	23.0	23.0	25.9	30.1	32.4	32.3	33.3	35.3	35.9	35.9	35.9
H97	23.3	23.3	23.3	26.2	30.4	32.7	32.6	33.7	35.7	36.2	36.2	36.2
H98	19.1	19.1	19.1	22.0	26.2	28.6	28.6	29.1	31.4	32.0	32.0	32.0

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H99	21.1	21.1	21.1	24.0	28.2	30.5	30.3	30.8	33.3	34.0	34.0	34.0
H100	23.9	23.9	23.9	26.8	31.0	33.2	33.1	33.5	36.1	36.8	36.8	36.8
H101	23.6	23.6	23.6	26.5	30.7	33.0	32.9	33.9	36.0	36.5	36.5	36.5
H102	20.1	20.1	20.1	23.0	27.2	29.5	29.4	30.2	32.4	33.0	33.0	33.0
H103	24.8	24.8	24.8	27.7	31.9	34.1	34.0	35.2	37.0	37.7	37.7	37.7
H104	20.2	20.2	20.2	23.1	27.3	29.6	29.6	30.3	32.6	33.1	33.1	33.1
H105	24.6	24.6	24.6	27.5	31.7	33.8	33.7	34.1	36.8	37.5	37.5	37.5
H106	25.1	25.1	25.1	28.0	32.2	34.3	34.2	34.6	37.2	38.0	38.0	38.0
H107	20.1	20.1	20.1	23.0	27.2	29.5	29.4	30.2	32.4	33.0	33.0	33.0
H108	18.0	18.0	18.0	20.9	25.1	27.6	27.6	27.9	30.4	30.9	30.9	30.9
H109	17.9	17.9	17.9	20.8	25.0	27.5	27.5	27.8	30.3	30.8	30.8	30.8
H110	21.9	21.9	21.9	24.8	29.0	31.3	31.2	32.1	34.2	34.8	34.8	34.8
H111	20.5	20.5	20.5	23.4	27.6	29.9	29.9	30.6	32.8	33.4	33.4	33.4
H112	19.2	19.2	19.2	22.1	26.3	28.8	28.8	29.3	31.6	32.1	32.1	32.1
H113	26.1	26.1	26.1	29.0	33.2	35.3	35.2	35.6	38.2	39.0	39.0	39.0
H114	26.2	26.2	26.2	29.1	33.3	35.4	35.4	35.7	38.4	39.1	39.1	39.1
H115	23.0	23.0	23.0	25.9	30.1	32.4	32.3	33.2	35.3	35.9	35.9	35.9
H116	24.3	24.3	24.3	27.2	31.4	33.6	33.5	33.8	36.4	37.2	37.2	37.2
H117	24.6	24.6	24.6	27.5	31.7	33.8	33.7	34.1	36.7	37.5	37.5	37.5
H118	24.3	24.3	24.3	27.2	31.3	33.5	33.4	33.8	36.4	37.2	37.2	37.2
H119	26.7	26.7	26.7	29.6	33.8	36.0	35.9	36.2	38.9	39.6	39.6	39.6
H120	20.6	20.6	20.6	23.5	27.7	30.1	30.0	30.7	32.9	33.5	33.5	33.5
H121	26.7	26.7	26.7	29.6	33.8	36.0	35.9	36.2	38.9	39.6	39.6	39.6
H122	19.2	19.2	19.2	22.1	26.3	28.8	28.7	29.3	31.6	32.1	32.1	32.1
H123	26.7	26.7	26.7	29.6	33.8	36.0	35.9	36.1	38.8	39.6	39.6	39.6
H124	28.1	28.1	28.1	31.0	35.2	37.4	37.3	37.5	40.2	41.0	41.0	41.0
H125	22.6	22.6	22.6	25.5	29.7	32.1	32.1	32.7	35.0	35.5	35.5	35.5
H126	26.6	26.6	26.6	29.5	33.7	35.9	35.8	36.0	38.7	39.5	39.5	39.5
H127	26.6	26.6	26.6	29.5	33.7	35.9	35.8	36.0	38.6	39.5	39.5	39.5
H128	25.3	25.3	25.3	28.2	32.4	34.6	34.5	34.8	37.4	38.2	38.2	38.2
H129	20.5	20.5	20.5	23.4	27.6	30.1	30.0	30.5	32.9	33.4	33.4	33.4
H130	26.6	26.6	26.6	29.5	33.7	35.9	35.8	36.0	38.6	39.5	39.5	39.5
H131	20.6	20.6	20.6	23.5	27.7	30.2	30.1	30.6	33.0	33.5	33.5	33.5
H132	24.3	24.3	24.3	27.2	31.4	33.7	33.5	33.8	36.3	37.2	37.2	37.2
H133	26.6	26.6	26.6	29.5	33.7	35.9	35.8	36.0	38.6	39.5	39.5	39.5
H134	23.1	23.1	23.1	26.0	30.2	32.7	32.6	33.1	35.5	36.0	36.0	36.0
H135	22.5	22.5	22.5	25.4	29.6	32.1	32.0	32.5	34.9	35.4	35.4	35.4
H136	22.8	22.8	22.8	25.7	29.9	32.4	32.3	32.7	35.1	35.7	35.7	35.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H137	22.7	22.7	22.7	25.6	29.8	32.3	32.3	32.7	35.1	35.6	35.6	35.6
H138	24.2	24.2	24.2	27.1	31.3	33.8	33.5	34.0	36.3	37.1	37.1	37.1
H139	22.7	22.7	22.7	25.6	29.8	32.4	32.3	32.6	35.1	35.6	35.6	35.6
H140	22.9	22.9	22.9	25.8	30.0	32.7	32.7	32.7	35.3	35.8	35.8	35.8
H141	19.6	19.6	19.6	22.5	26.7	29.2	28.9	29.2	31.8	32.5	32.5	32.5
H142	21.4	21.4	21.4	24.3	28.5	31.1	31.0	31.3	33.7	34.3	34.3	34.3
H143	25.0	25.0	25.0	27.9	32.1	34.7	34.3	34.8	37.1	37.9	37.9	37.9
H144	21.6	21.6	21.6	24.5	28.7	31.4	31.3	31.6	34.0	34.5	34.5	34.5
H145	22.8	22.8	22.8	25.7	29.9	32.7	32.6	32.7	35.2	35.7	35.7	35.7
H146	21.6	21.6	21.6	24.5	28.7	31.4	31.3	31.5	34.0	34.5	34.5	34.5
H147	25.1	25.1	25.1	28.0	32.2	34.8	34.4	34.9	37.2	38.0	38.0	38.0
H148	24.3	24.3	24.3	27.2	31.4	34.0	33.6	34.1	36.4	37.2	37.2	37.2
H149	21.6	21.6	21.6	24.5	28.7	31.5	31.4	31.5	34.0	34.5	34.5	34.5
H150	21.5	21.5	21.5	24.4	28.6	31.4	31.3	31.5	33.9	34.4	34.4	34.4
H151	24.3	24.3	24.3	27.2	31.4	34.0	33.6	34.1	36.4	37.2	37.2	37.2
H152	18.5	18.5	18.5	21.4	25.6	28.1	27.8	28.1	30.6	31.4	31.4	31.4
H153	23.6	23.6	23.6	26.5	30.7	33.7	33.8	33.4	36.1	36.5	36.5	36.5
H154	23.2	23.2	23.2	26.1	30.3	33.3	33.3	32.9	35.6	36.1	36.1	36.1
H155	23.5	23.5	23.5	26.4	30.6	33.7	33.6	33.4	36.0	36.4	36.4	36.4
H156	23.5	23.5	23.5	26.4	30.6	33.6	33.6	33.4	35.9	36.4	36.4	36.4
H157	25.7	25.7	25.7	28.6	32.8	35.6	35.0	35.6	37.8	38.6	38.6	38.6
H158	25.3	25.3	25.3	28.2	32.4	35.5	35.4	35.2	37.8	38.2	38.2	38.2
H159	18.4	18.4	18.4	21.3	25.5	28.0	27.7	28.0	30.5	31.3	31.3	31.3
H160	21.6	21.6	21.6	24.5	28.7	31.6	31.4	31.5	34.0	34.5	34.5	34.5
H161	21.6	21.6	21.6	24.5	28.7	31.6	31.5	31.5	34.1	34.5	34.5	34.5
H162	21.5	21.5	21.5	24.4	28.6	31.5	31.4	31.4	33.9	34.4	34.4	34.4
H163	18.3	18.3	18.3	21.2	25.4	27.9	27.6	28.0	30.5	31.2	31.2	31.2
H164	22.5	22.5	22.5	25.4	29.6	32.4	31.9	32.4	34.7	35.4	35.4	35.4
H165	21.5	21.5	21.5	24.4	28.6	31.5	31.4	31.4	34.0	34.4	34.4	34.4
H166	21.8	21.8	21.8	24.7	28.9	31.8	31.7	31.7	34.2	34.7	34.7	34.7
H167	18.1	18.1	18.1	21.0	25.2	27.7	27.4	27.8	30.3	31.0	31.0	31.0
H168	21.5	21.5	21.5	24.4	28.6	31.5	31.4	31.4	33.9	34.4	34.4	34.4
H169	17.6	17.6	17.6	20.5	24.7	27.2	26.9	27.2	29.8	30.5	30.5	30.5
H170	21.8	21.8	21.8	24.7	28.9	32.0	31.9	31.7	34.3	34.7	34.7	34.7
H171	21.7	21.7	21.7	24.6	28.8	31.9	31.8	31.6	34.1	34.6	34.6	34.6
H172	15.7	15.7	15.7	18.6	22.8	25.4	25.0	25.3	27.8	28.6	28.6	28.6
H173	15.7	15.7	15.7	18.6	22.8	25.4	25.0	25.3	27.8	28.6	28.6	28.6
H174	15.7	15.7	15.7	18.6	22.8	25.5	25.1	25.4	27.9	28.6	28.6	28.6

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H175	22.7	22.7	22.7	25.6	29.8	33.1	33.2	32.4	35.2	35.6	35.6	35.6
H176	22.7	22.7	22.7	25.6	29.8	33.1	33.2	32.5	35.3	35.6	35.6	35.6
H177	19.1	19.1	19.1	22.0	26.2	28.9	28.4	28.8	31.2	32.0	32.0	32.0
H178	22.8	22.8	22.8	25.7	29.9	33.2	33.3	32.6	35.3	35.7	35.7	35.7
H179	17.9	17.9	17.9	20.8	25.0	27.6	27.2	27.6	30.1	30.8	30.8	30.8
H180	23.1	23.1	23.1	26.0	30.2	33.4	33.3	33.0	35.6	36.0	36.0	36.0
H181	21.9	21.9	21.9	24.8	29.0	32.2	32.1	31.6	34.3	34.8	34.8	34.8
H182	17.9	17.9	17.9	20.8	25.0	27.5	27.2	27.5	30.0	30.8	30.8	30.8
H183	23.1	23.1	23.1	26.0	30.2	33.3	33.2	32.9	35.5	36.0	36.0	36.0
H184	23.0	23.0	23.0	25.9	30.1	33.2	33.1	32.8	35.4	35.9	35.9	35.9
H185	23.6	23.6	23.6	26.5	30.7	33.9	33.7	33.4	36.0	36.5	36.5	36.5
H186	21.9	21.9	21.9	24.8	29.0	32.1	32.1	31.6	34.3	34.8	34.8	34.8
H187	21.9	21.9	21.9	24.8	29.0	32.2	32.1	31.6	34.3	34.8	34.8	34.8
H188	17.4	17.4	17.4	20.3	24.5	27.1	26.7	27.1	29.6	30.3	30.3	30.3
H189	23.4	23.4	23.4	26.3	30.5	33.8	33.9	33.1	35.9	36.3	36.3	36.3
H191	17.4	17.4	17.4	20.3	24.5	27.1	26.8	27.1	29.6	30.3	30.3	30.3
H192	24.4	24.4	24.4	27.3	31.5	34.7	34.5	34.2	36.7	37.3	37.3	37.3
H193	22.2	22.2	22.2	25.1	29.3	32.5	32.6	31.9	34.7	35.1	35.1	35.1
H194	16.9	16.9	16.9	19.8	24.0	26.6	26.3	26.6	29.1	29.8	29.8	29.8
H195	22.0	22.0	22.0	24.9	29.1	32.3	32.4	31.7	34.5	34.9	34.9	34.9
H196	23.5	23.5	23.5	26.4	30.6	33.8	33.5	33.3	35.8	36.4	36.4	36.4
H197	16.9	16.9	16.9	19.8	24.0	26.6	26.2	26.6	29.1	29.8	29.8	29.8
H198	19.5	19.5	19.5	22.4	26.6	29.5	29.0	29.3	31.7	32.4	32.4	32.4
H200	23.4	23.4	23.4	26.3	30.5	33.8	33.8	33.2	35.9	36.3	36.3	36.3
H202	16.5	16.5	16.5	19.4	23.6	26.4	25.9	26.2	28.7	29.4	29.4	29.4
H203	17.0	17.0	17.0	19.9	24.1	26.7	26.2	26.7	29.1	29.9	29.9	29.9
H204	13.6	13.6	13.6	16.5	20.7	23.4	23.0	23.3	25.8	26.5	26.5	26.5
H205	16.9	16.9	16.9	19.8	24.0	26.5	26.1	26.5	29.0	29.8	29.8	29.8
H206	21.3	21.3	21.3	24.2	28.4	31.6	31.5	31.0	33.7	34.2	34.2	34.2
H207	20.8	20.8	20.8	23.7	27.9	31.1	30.9	30.5	33.2	33.7	33.7	33.7
H208	21.3	21.3	21.3	24.2	28.4	31.6	31.6	31.0	33.7	34.2	34.2	34.2
H209	19.6	19.6	19.6	22.5	26.7	29.6	29.1	29.3	31.7	32.5	32.5	32.5
H210	20.3	20.3	20.3	23.2	27.4	30.6	30.5	30.0	32.7	33.2	33.2	33.2
H211	20.3	20.3	20.3	23.2	27.4	30.6	30.5	30.0	32.7	33.2	33.2	33.2
H212	20.2	20.2	20.2	23.1	27.3	30.5	30.5	30.0	32.7	33.1	33.1	33.1
H213	16.1	16.1	16.1	19.0	23.2	25.7	25.3	25.7	28.2	29.0	29.0	29.0
H214	13.8	13.8	13.8	16.7	20.9	23.5	23.1	23.5	26.0	26.7	26.7	26.7
H215	19.8	19.8	19.8	22.7	26.9	30.1	29.9	29.5	32.2	32.7	32.7	32.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H216	15.4	15.4	15.4	18.3	22.5	25.3	24.9	25.1	27.6	28.3	28.3	28.3
H217	19.8	19.8	19.8	22.7	26.9	29.9	29.5	29.6	32.1	32.7	32.7	32.7
H218	16.0	16.0	16.0	18.9	23.1	25.7	25.2	25.6	28.1	28.9	28.9	28.9
H219	20.2	20.2	20.2	23.1	27.3	30.5	30.3	30.0	32.6	33.1	33.1	33.1
H220	19.2	19.2	19.2	22.1	26.3	29.5	29.4	29.0	31.6	32.1	32.1	32.1
H221	12.7	12.7	12.7	15.6	19.8	22.5	22.2	22.4	24.9	25.6	25.6	25.6
H222	16.1	16.1	16.1	19.0	23.2	25.9	25.5	25.7	28.3	29.0	29.0	29.0
H223	19.2	19.2	19.2	22.1	26.2	29.2	28.8	28.9	31.4	32.1	32.1	32.1
H224	19.0	19.0	19.0	21.9	26.1	29.0	28.7	28.7	31.2	31.9	31.9	31.9
H225	14.6	14.6	14.6	17.5	21.7	24.6	24.1	24.4	26.8	27.5	27.5	27.5
H226	18.6	18.6	18.6	21.5	25.7	28.6	28.2	28.3	30.8	31.5	31.5	31.5
H227	14.6	14.6	14.6	17.5	21.7	24.4	23.9	24.4	26.8	27.5	27.5	27.5
H228	13.8	13.8	13.8	16.7	20.9	23.7	23.3	23.5	26.0	26.7	26.7	26.7
H229	17.7	17.7	17.7	20.6	24.8	27.7	27.3	27.5	30.0	30.6	30.6	30.6
H230	17.7	17.7	17.7	20.6	24.8	27.7	27.3	27.5	29.9	30.6	30.6	30.6
H231	17.5	17.5	17.5	20.4	24.6	27.6	27.2	27.2	29.7	30.4	30.4	30.4
H232	11.8	11.8	11.8	14.7	18.9	21.6	21.2	21.5	24.0	24.7	24.7	24.7
H233	11.8	11.8	11.8	14.7	18.9	21.6	21.2	21.5	24.0	24.7	24.7	24.7
H234	11.6	11.6	11.6	14.5	18.7	21.4	21.0	21.3	23.8	24.5	24.5	24.5
H235	13.3	13.3	13.3	16.2	20.4	23.2	22.8	23.0	25.5	26.2	26.2	26.2
H236	12.3	12.3	12.3	15.2	19.4	22.3	21.8	22.1	24.6	25.2	25.2	25.2
H237	15.7	15.7	15.7	18.6	22.8	25.8	25.4	25.5	28.0	28.6	28.6	28.6
H238	15.7	15.7	15.7	18.6	22.8	25.7	25.3	25.4	27.9	28.6	28.6	28.6
H239	16.0	16.0	16.0	18.9	23.1	26.0	25.6	25.7	28.2	28.9	28.9	28.9
H240	15.9	15.9	15.9	18.8	23.0	25.9	25.5	25.6	28.1	28.8	28.8	28.8
H241	13.9	13.9	13.9	16.8	21.0	23.8	23.5	23.5	26.1	26.8	26.8	26.8
H242	13.8	13.8	13.8	16.7	20.9	23.7	23.4	23.5	26.0	26.7	26.7	26.7
H243	12.7	12.7	12.7	15.6	19.8	22.5	22.2	22.4	24.9	25.6	25.6	25.6
H244	14.7	14.7	14.7	17.6	21.8	24.7	24.3	24.4	26.9	27.6	27.6	27.6
H245	14.4	14.4	14.4	17.3	21.5	24.4	24.0	24.1	26.7	27.3	27.3	27.3
H246	14.2	14.2	14.2	17.1	21.3	24.2	23.8	23.9	26.4	27.1	27.1	27.1
H247	14.1	14.1	14.1	17.0	21.2	24.1	23.7	23.9	26.4	27.0	27.0	27.0
H248	13.3	13.3	13.3	16.2	20.4	23.3	22.9	23.0	25.5	26.2	26.2	26.2

Table 10.34 - Predictions with Noise Management vs Limit Remaining for the Proposed Development during the Day, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	-24.5	-24.5	-24.5	-21.6	-17.4	-14.9	-15.2	-14.6	-14.3	-15.8	-17.9	-20.2

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H2	-23.4	-23.4	-23.4	-20.5	-16.3	-13.9	-14.2	-13.5	-13.2	-14.7	-16.8	-19.1
H3	-24.4	-24.4	-24.4	-21.5	-17.3	-15.0	-15.2	-14.6	-14.2	-15.7	-17.8	-20.1
H4	-21.7	-21.7	-21.7	-18.8	-14.6	-12.2	-12.4	-11.8	-11.3	-13.0	-15.1	-17.4
H5	-23.0	-23.0	-23.0	-20.1	-15.8	-13.6	-13.7	-13.2	-12.6	-14.3	-16.4	-18.7
H6	-20.0	-20.0	-20.0	-17.1	-12.8	-10.6	-10.6	-10.3	-9.7	-11.3	-13.4	-15.7
H7	-22.3	-22.3	-22.3	-19.4	-15.3	-13.1	-13.1	-12.8	-12.2	-13.7	-15.8	-18.1
H8	-21.4	-21.4	-21.4	-18.5	-14.3	-11.9	-12.0	-11.9	-11.6	-13.2	-15.3	-17.5
H9	-23.4	-23.4	-23.4	-20.5	-16.3	-13.8	-14.0	-14.1	-13.7	-15.2	-17.3	-19.5
H10	-22.4	-22.4	-22.4	-19.5	-15.3	-12.8	-13.0	-12.9	-12.6	-14.2	-16.3	-18.5
H11	-19.2	-19.2	-19.2	-16.3	-12.1	-9.7	-9.9	-9.4	-9.0	-10.5	-12.7	-15.1
H12	-20.4	-20.4	-20.4	-17.5	-13.3	-10.8	-11.0	-10.8	-10.6	-12.2	-14.3	-16.5
H13	-18.5	-18.5	-18.5	-15.6	-11.3	-8.9	-9.0	-8.6	-8.2	-9.8	-11.9	-14.3
H14	-21.8	-21.8	-21.8	-18.9	-14.7	-12.2	-12.4	-12.5	-12.1	-13.6	-15.7	-17.9
H15	-18.3	-18.3	-18.3	-15.4	-11.1	-8.8	-8.8	-8.7	-8.1	-9.6	-11.7	-14.1
H16	-18.2	-18.2	-18.2	-15.3	-11.1	-8.8	-8.9	-8.7	-8.0	-9.5	-11.6	-14.0
H17	-20.7	-20.7	-20.7	-17.8	-13.6	-11.1	-11.4	-11.3	-10.9	-12.5	-14.6	-16.9
H18	-21.3	-21.3	-21.3	-18.4	-14.2	-11.7	-11.9	-12.0	-11.6	-13.1	-15.2	-17.5
H19	-21.9	-21.9	-21.9	-19.0	-14.8	-12.4	-12.5	-12.7	-12.3	-13.8	-15.9	-18.1
H20	-21.8	-21.8	-21.8	-18.9	-14.7	-12.3	-12.4	-12.6	-12.2	-13.7	-15.8	-18.0
H21	-21.5	-21.5	-21.5	-18.6	-14.4	-12.0	-12.1	-12.3	-11.8	-13.3	-15.4	-17.7
H22	-21.5	-21.5	-21.5	-18.6	-14.4	-11.9	-12.0	-12.2	-11.7	-13.3	-15.4	-17.7
H23	-21.9	-21.9	-21.9	-19.0	-14.8	-12.4	-12.4	-12.7	-12.2	-13.8	-15.9	-18.1
H24	-17.7	-17.7	-17.7	-14.8	-10.5	-8.2	-8.3	-8.0	-7.4	-9.0	-11.1	-13.5
H25	-21.7	-21.7	-21.7	-18.8	-14.6	-12.2	-12.3	-12.5	-12.1	-13.6	-15.7	-17.9
H26	-21.7	-21.7	-21.7	-18.8	-14.6	-12.2	-12.3	-12.4	-12.1	-13.6	-15.7	-17.9
H27	-21.8	-21.8	-21.8	-18.9	-14.7	-12.3	-12.3	-12.5	-12.1	-13.7	-15.8	-18.0
H28	-21.7	-21.7	-21.7	-18.8	-14.6	-12.2	-12.3	-12.4	-12.0	-13.6	-15.7	-17.9
H29	-21.5	-21.5	-21.5	-18.6	-14.4	-12.0	-12.2	-12.4	-11.9	-13.4	-15.5	-17.8
H30	-17.6	-17.6	-17.6	-14.7	-10.5	-8.2	-8.4	-7.8	-7.5	-4.6	-2.2	-6.9
H31	-21.3	-21.3	-21.3	-18.4	-14.2	-11.7	-11.9	-12.0	-11.6	-13.1	-15.2	-17.5
H32	-21.7	-21.7	-21.7	-18.8	-14.7	-12.3	-12.3	-12.5	-12.1	-13.6	-15.7	-17.9
H33	-21.7	-21.7	-21.7	-18.8	-14.6	-12.2	-12.2	-12.4	-12.0	-13.6	-15.7	-17.9
H34	-21.5	-21.5	-21.5	-18.6	-14.3	-11.9	-12.0	-12.2	-11.8	-13.3	-15.4	-17.7
H35	-21.4	-21.4	-21.4	-18.5	-14.2	-11.8	-11.9	-12.1	-11.6	-13.2	-15.3	-17.6
H36	-19.7	-19.7	-19.7	-16.8	-12.6	-10.1	-10.3	-10.2	-9.9	-11.6	-13.6	-15.9
H37	-21.2	-21.2	-21.2	-18.3	-14.1	-11.6	-11.8	-11.9	-11.5	-13.0	-15.1	-17.4
H38	-21.4	-21.4	-21.4	-18.5	-14.3	-11.9	-12.0	-12.3	-11.8	-13.3	-15.4	-17.7
H39	-21.4	-21.4	-21.4	-18.5	-14.3	-11.9	-12.0	-12.2	-11.7	-13.3	-15.4	-17.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H40	-21.3	-21.3	-21.3	-18.4	-14.1	-11.7	-11.8	-12.0	-11.5	-13.1	-15.2	-17.5
H41	-17.1	-17.1	-17.1	-14.2	-9.9	-7.4	-7.6	-7.1	-6.6	-8.3	-10.3	-12.8
H42	-21.3	-21.3	-21.3	-18.4	-14.1	-11.7	-11.9	-12.1	-11.6	-13.1	-15.2	-17.5
H43	-21.2	-21.2	-21.2	-18.3	-14.0	-11.6	-11.7	-11.9	-11.4	-13.0	-15.1	-17.4
H44	-20.6	-20.6	-20.6	-17.7	-13.5	-11.0	-11.1	-11.2	-10.8	-12.4	-14.5	-16.8
H45	-21.2	-21.2	-21.2	-18.3	-14.0	-11.6	-11.7	-11.9	-11.4	-13.0	-15.1	-17.4
H46	-20.3	-20.3	-20.3	-17.4	-13.2	-10.7	-10.9	-11.0	-10.6	-12.2	-14.2	-16.5
H47	-21.2	-21.2	-21.2	-18.3	-14.0	-11.6	-11.7	-11.9	-11.5	-13.0	-15.1	-17.4
H48	-20.6	-20.6	-20.6	-17.7	-13.5	-11.0	-11.2	-11.3	-10.9	-12.4	-14.5	-16.8
H49	-20.6	-20.6	-20.6	-17.7	-13.4	-11.0	-11.2	-11.3	-10.9	-12.4	-14.5	-16.8
H50	-21.0	-21.0	-21.0	-18.1	-13.9	-11.4	-11.6	-11.7	-11.3	-12.8	-14.9	-17.2
H51	-20.8	-20.8	-20.8	-17.9	-13.6	-11.2	-11.3	-11.5	-11.0	-12.6	-14.7	-17.0
H52	-20.4	-20.4	-20.4	-17.5	-13.3	-10.8	-11.0	-11.1	-10.7	-12.3	-14.3	-16.6
H53	-16.9	-16.9	-16.9	-14.0	-9.8	-7.2	-7.4	-6.9	-6.4	-8.1	-10.1	-12.6
H54	-16.6	-16.6	-16.6	-13.7	-9.5	-6.9	-7.0	-6.5	-6.1	-7.7	-9.7	-12.3
H55	-16.2	-16.2	-16.2	-13.3	-9.0	-6.5	-6.5	-5.7	-5.7	-7.5	-9.7	-12.3
H56	-16.1	-16.1	-16.1	-13.2	-8.9	-6.4	-6.4	-5.8	-5.7	-7.4	-9.6	-12.1
H57	-16.1	-16.1	-16.1	-13.2	-9.0	-6.5	-6.5	-5.8	-5.7	-7.4	-9.6	-12.1
H58	-21.3	-21.3	-21.3	-18.4	-14.1	-11.7	-11.7	-12.0	-11.6	-13.1	-15.3	-17.5
H59	-15.9	-15.9	-15.9	-13.0	-8.8	-6.1	-6.3	-5.9	-5.2	-6.9	-8.8	-11.6
H61	-20.3	-20.3	-20.3	-17.4	-13.2	-10.7	-10.8	-11.0	-10.5	-12.2	-14.3	-16.5
H62	-16.2	-16.2	-16.2	-13.3	-9.0	-6.4	-6.6	-6.2	-5.5	-7.1	-9.0	-11.8
H63	-15.9	-15.9	-15.9	-13.0	-8.7	-6.0	-6.2	-5.7	-5.0	-6.7	-8.5	-11.4
H64	-20.3	-20.3	-20.3	-17.4	-13.2	-10.7	-10.8	-11.0	-10.5	-12.2	-14.3	-16.5
H65	-20.0	-20.0	-20.0	-17.1	-12.9	-10.5	-10.5	-10.7	-10.2	-11.9	-14.0	-16.2
H66	-15.4	-15.4	-15.4	-12.5	-8.3	-6.0	-6.1	-5.4	-5.2	-6.8	-8.9	-11.3
H67	-16.3	-16.3	-16.3	-13.4	-9.1	-6.5	-6.7	-6.2	-5.6	-7.2	-9.1	-11.9
H68	-19.8	-19.8	-19.8	-16.9	-12.7	-10.3	-10.4	-10.5	-10.1	-11.7	-13.8	-16.0
H69	-19.8	-19.8	-19.8	-16.9	-12.7	-10.2	-10.3	-10.5	-10.0	-11.6	-13.7	-16.0
H70	-15.3	-15.3	-15.3	-12.4	-8.2	-4.8	-5.1	-4.6	-3.5	-5.5	-7.0	-10.6
H71	-20.2	-20.2	-20.2	-17.3	-13.1	-10.6	-10.7	-10.9	-10.4	-12.0	-14.1	-16.4
H72	-15.3	-15.3	-15.3	-12.4	-8.1	-4.7	-5.0	-4.4	-3.3	-5.4	-6.8	-10.5
H73	-19.4	-19.4	-19.4	-16.5	-12.3	-9.8	-9.9	-10.1	-9.6	-11.3	-13.4	-15.6
H74	-19.0	-19.0	-19.0	-16.1	-11.9	-9.5	-9.5	-9.6	-9.2	-10.9	-13.0	-15.2
H75	-18.8	-18.8	-18.8	-15.9	-11.7	-9.3	-9.3	-9.5	-9.1	-10.7	-12.8	-15.0
H76	-15.4	-15.4	-15.4	-12.5	-8.3	-5.9	-6.1	-5.9	-5.6	-7.3	-9.3	-11.6
H77	-15.1	-15.1	-15.1	-12.2	-7.9	-3.9	-4.4	-3.5	-2.2	-4.5	-5.4	-10.0
H78	-18.6	-18.6	-18.6	-15.7	-11.5	-9.2	-9.3	-9.2	-9.0	-10.5	-12.6	-14.8

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H79	-12.5	-12.5	-12.5	-9.6	-5.4	-3.0	-3.5	-4.7	-5.0	-7.3	-7.3	-7.3
H80	-18.7	-18.7	-18.7	-15.8	-11.6	-9.2	-9.2	-9.4	-9.1	-10.6	-12.7	-14.9
H81	-18.7	-18.7	-18.7	-15.8	-11.6	-9.3	-9.3	-9.3	-9.0	-10.6	-12.7	-14.9
H82	-18.5	-18.5	-18.5	-15.6	-11.4	-9.0	-9.1	-9.1	-8.8	-10.4	-12.5	-14.7
H83	-15.2	-15.2	-15.2	-12.3	-8.1	-5.8	-5.8	-5.5	-4.9	-6.5	-8.6	-11.0
H84	-15.2	-15.2	-15.2	-12.3	-8.1	-5.5	-5.7	-5.5	-4.6	-6.2	-8.1	-10.8
H85	-20.0	-20.0	-20.0	-17.1	-12.9	-10.5	-10.5	-10.8	-10.3	-11.9	-14.0	-16.2
H86	-18.5	-18.5	-18.5	-15.6	-11.4	-9.1	-9.3	-9.3	-8.9	-10.4	-12.5	-14.7
H87	-15.3	-15.3	-15.3	-12.4	-8.2	-6.0	-5.9	-5.9	-5.7	-7.2	-9.3	-11.5
H88	-12.4	-12.4	-12.4	-9.5	-5.3	-3.1	-3.1	-2.8	-2.3	-3.8	-5.9	-8.2
H89	-14.4	-14.4	-14.4	-11.5	-7.3	-5.0	-5.2	-4.7	-4.3	-5.7	-7.8	-10.2
H90	-17.2	-17.2	-17.2	-14.3	-10.1	-7.8	-7.9	-7.9	-7.5	-9.1	-11.2	-13.4
H91	-20.6	-20.6	-20.6	-17.7	-13.5	-11.1	-11.2	-11.4	-11.0	-12.5	-14.6	-16.8
H92	-15.5	-15.5	-15.5	-12.6	-8.4	-6.0	-6.1	-5.9	-5.3	-6.8	-8.8	-11.2
H93	-15.8	-15.8	-15.8	-12.9	-8.7	-6.4	-6.5	-6.2	-5.6	-7.1	-9.2	-11.6
H94	-13.2	-13.2	-13.2	-10.3	-6.1	-3.9	-3.9	-3.8	-3.1	-4.6	-6.7	-9.0
H95	-18.4	-18.4	-18.4	-15.5	-11.3	-8.8	-8.9	-9.2	-8.7	-10.3	-12.4	-14.6
H96	-14.5	-14.5	-14.5	-11.6	-7.4	-5.1	-5.1	-5.0	-4.9	-6.4	-8.5	-10.7
H97	-14.2	-14.2	-14.2	-11.3	-7.1	-4.8	-4.8	-4.6	-4.5	-6.1	-8.2	-10.4
H98	-18.4	-18.4	-18.4	-15.5	-11.3	-8.9	-8.9	-9.3	-8.8	-10.3	-12.4	-14.6
H99	-16.3	-16.3	-16.3	-13.4	-9.2	-6.8	-6.9	-6.7	-6.1	-7.6	-9.7	-12.1
H100	-13.5	-13.5	-13.5	-10.6	-6.4	-4.1	-4.2	-4.1	-3.4	-4.9	-7.0	-9.3
H101	-13.9	-13.9	-13.9	-11.0	-6.8	-4.5	-4.5	-4.4	-4.2	-5.8	-7.9	-10.1
H102	-17.4	-17.4	-17.4	-14.5	-10.3	-8.0	-8.1	-8.2	-7.8	-9.3	-11.4	-13.6
H103	-12.7	-12.7	-12.7	-9.8	-5.6	-3.4	-3.4	-3.1	-3.2	-4.6	-6.7	-8.9
H104	-17.3	-17.3	-17.3	-14.4	-10.2	-7.9	-7.9	-8.1	-7.6	-9.2	-11.3	-13.5
H105	-12.8	-12.8	-12.8	-9.9	-5.7	-3.6	-3.6	-3.5	-2.7	-4.2	-6.3	-8.6
H106	-12.3	-12.3	-12.3	-9.4	-5.2	-3.1	-3.1	-3.0	-2.3	-3.7	-5.8	-8.1
H107	-17.4	-17.4	-17.4	-14.5	-10.3	-8.0	-8.1	-8.2	-7.8	-9.3	-11.4	-13.6
H108	-19.5	-19.5	-19.5	-16.6	-12.4	-9.9	-9.9	-10.5	-9.8	-11.4	-13.5	-15.7
H109	-19.6	-19.6	-19.6	-16.7	-12.5	-10.0	-10.0	-10.6	-9.9	-11.5	-13.6	-15.8
H110	-15.6	-15.6	-15.6	-12.7	-8.5	-6.2	-6.3	-6.3	-6.0	-7.5	-9.6	-11.8
H111	-17.0	-17.0	-17.0	-14.1	-9.9	-7.6	-7.6	-7.8	-7.4	-8.9	-11.0	-13.2
H112	-18.3	-18.3	-18.3	-15.4	-11.2	-8.7	-8.7	-9.1	-8.6	-10.2	-12.3	-14.5
H113	-11.4	-11.4	-11.4	-8.5	-4.2	-2.1	-2.1	-2.0	-1.4	-2.7	-4.8	-7.1
H114	-11.3	-11.3	-11.3	-8.4	-4.1	-2.0	-1.9	-1.9	-1.2	-2.6	-4.7	-7.0
H115	-14.5	-14.5	-14.5	-11.6	-7.4	-5.1	-5.2	-5.1	-4.9	-6.4	-8.5	-10.7
H116	-13.1	-13.1	-13.1	-10.2	-6.0	-3.7	-3.8	-3.8	-3.1	-4.5	-6.6	-8.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H117	-12.8	-12.8	-12.8	-9.9	-5.7	-3.6	-3.6	-3.5	-2.8	-4.2	-6.3	-8.6
H118	-13.1	-13.1	-13.1	-10.2	-6.1	-3.8	-3.9	-3.8	-3.1	-4.5	-6.6	-8.9
H119	-10.8	-10.8	-10.8	-7.9	-3.6	-1.4	-1.4	-1.4	-0.7	-2.1	-4.2	-6.5
H120	-16.9	-16.9	-16.9	-14.0	-9.8	-7.4	-7.5	-7.7	-7.3	-8.8	-10.9	-13.1
H121	-10.8	-10.8	-10.8	-7.9	-3.6	-1.4	-1.4	-1.4	-0.7	-2.1	-4.2	-6.5
H122	-18.3	-18.3	-18.3	-15.4	-11.2	-8.7	-8.8	-9.1	-8.6	-10.2	-12.3	-14.5
H123	-10.8	-10.8	-10.8	-7.9	-3.6	-1.4	-1.5	-1.5	-0.8	-2.1	-4.2	-6.6
H124	-9.4	-9.4	-9.4	-6.5	-2.2	0.0	-0.1	0.0	0.0	-2.1	-2.1	-2.1
H125	-14.9	-14.9	-14.9	-12.0	-7.8	-5.4	-5.4	-5.7	-5.2	-6.8	-8.9	-11.1
H126	-10.9	-10.9	-10.9	-8.0	-3.7	-1.5	-1.6	-1.6	-0.9	-2.2	-4.3	-6.7
H127	-10.9	-10.9	-10.9	-8.0	-3.7	-1.5	-1.6	-1.6	-1.0	-2.2	-4.3	-6.7
H128	-12.2	-12.2	-12.2	-9.3	-5.0	-2.8	-2.8	-2.8	-2.2	-3.5	-5.6	-7.9
H129	-17.0	-17.0	-17.0	-14.1	-9.9	-7.4	-7.5	-7.9	-7.3	-8.9	-11.0	-13.2
H130	-10.9	-10.9	-10.9	-8.0	-3.7	-1.5	-1.6	-1.6	-1.0	-2.2	-4.3	-6.7
H131	-16.9	-16.9	-16.9	-14.0	-9.8	-7.3	-7.4	-7.8	-7.2	-8.8	-10.9	-13.1
H132	-13.2	-13.2	-13.2	-10.3	-6.0	-3.7	-3.8	-3.5	-2.8	-4.1	-6.3	-8.3
H133	-10.9	-10.9	-10.9	-8.0	-3.7	-1.5	-1.6	-1.3	-0.5	-1.8	-4.0	-6.0
H134	-14.4	-14.4	-14.4	-11.5	-7.3	-4.8	-4.9	-5.3	-4.7	-6.3	-8.4	-10.6
H135	-15.0	-15.0	-15.0	-12.1	-7.9	-5.4	-5.5	-5.9	-5.3	-6.9	-9.0	-11.2
H136	-14.7	-14.7	-14.7	-11.8	-7.6	-5.3	-6.1	-6.4	-4.9	-5.3	-6.6	-8.1
H137	-14.8	-14.8	-14.8	-11.9	-7.7	-5.4	-6.1	-6.4	-4.9	-5.4	-6.7	-8.2
H138	-13.3	-13.3	-13.3	-10.4	-6.1	-3.6	-3.8	-3.3	-2.8	-4.2	-6.4	-8.4
H139	-14.8	-14.8	-14.8	-11.9	-7.7	-5.3	-6.1	-6.5	-4.9	-5.4	-6.7	-8.2
H140	-14.6	-14.6	-14.6	-11.7	-7.5	-5.0	-5.7	-6.4	-4.7	-5.2	-6.5	-8.0
H141	-17.8	-17.8	-17.8	-14.9	-10.7	-8.2	-8.4	-8.1	-7.3	-8.8	-11.0	-13.0
H142	-16.1	-16.1	-16.1	-13.2	-9.0	-6.6	-7.4	-7.8	-6.3	-6.7	-8.0	-9.5
H143	-12.5	-12.5	-12.5	-9.6	-5.3	-2.7	-3.1	-2.5	-2.0	-3.4	-5.6	-7.7
H144	-15.9	-15.9	-15.9	-13.0	-8.8	-6.3	-7.1	-7.5	-6.0	-6.5	-7.8	-9.3
H145	-14.7	-14.7	-14.7	-11.8	-7.6	-5.0	-5.8	-6.4	-4.8	-5.3	-6.6	-8.1
H146	-15.9	-15.9	-15.9	-13.0	-8.8	-6.3	-7.1	-7.6	-6.0	-6.5	-7.8	-9.3
H147	-12.4	-12.4	-12.4	-9.5	-5.2	-2.6	-3.0	-2.4	-1.9	-3.3	-5.5	-7.6
H148	-13.2	-13.2	-13.2	-10.3	-6.0	-3.4	-3.8	-3.2	-2.7	-4.1	-6.3	-8.4
H149	-15.9	-15.9	-15.9	-13.0	-8.8	-6.2	-7.0	-7.6	-6.0	-6.5	-7.8	-9.3
H150	-16.0	-16.0	-16.0	-13.1	-8.9	-6.3	-7.1	-7.6	-6.1	-6.6	-7.9	-9.4
H151	-13.2	-13.2	-13.2	-10.3	-6.0	-3.4	-3.8	-3.2	-2.7	-4.1	-6.3	-8.4
H152	-18.9	-18.9	-18.9	-16.0	-11.8	-9.3	-9.4	-9.1	-8.4	-9.9	-12.0	-14.1
H153	-13.9	-13.9	-13.9	-11.0	-6.8	-4.0	-4.6	-5.7	-3.9	-4.5	-5.8	-7.3
H154	-14.3	-14.3	-14.3	-11.4	-7.2	-4.4	-5.1	-6.2	-4.4	-4.9	-6.2	-7.7

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H155	-14.0	-14.0	-14.0	-11.1	-6.9	-3.9	-4.7	-5.6	-3.9	-4.5	-5.8	-7.4
H156	-14.0	-14.0	-14.0	-11.1	-6.9	-4.0	-4.7	-5.6	-4.0	-4.5	-5.8	-7.4
H157	-11.8	-11.8	-11.8	-8.9	-4.7	-1.8	-2.4	-1.8	-0.7	-2.6	-2.6	-2.6
H158	-12.2	-12.2	-12.2	-9.3	-5.0	-2.1	-2.9	-3.8	-2.1	-2.7	-4.0	-5.6
H159	-19.0	-19.0	-19.0	-16.1	-11.9	-9.4	-9.6	-9.3	-8.5	-10.0	-12.2	-14.2
H160	-15.9	-15.9	-15.9	-13.0	-8.8	-6.0	-6.9	-7.5	-5.9	-6.5	-7.8	-9.3
H161	-15.9	-15.9	-15.9	-13.0	-8.8	-6.0	-6.8	-7.5	-5.8	-6.5	-7.8	-9.3
H162	-16.0	-16.0	-16.0	-13.1	-8.9	-6.1	-6.9	-7.6	-6.0	-6.6	-7.9	-9.4
H163	-19.1	-19.1	-19.1	-16.2	-12.0	-9.5	-9.7	-9.3	-8.5	-10.1	-12.3	-14.3
H164	-15.0	-15.0	-15.0	-12.1	-7.8	-5.0	-5.5	-4.9	-4.4	-5.9	-8.1	-10.2
H165	-16.0	-16.0	-16.0	-13.1	-8.9	-6.1	-6.9	-7.6	-5.9	-6.6	-7.9	-9.4
H166	-15.7	-15.7	-15.7	-12.8	-8.6	-5.8	-6.6	-7.3	-5.7	-6.3	-7.6	-9.1
H167	-19.3	-19.3	-19.3	-16.4	-12.2	-9.7	-9.9	-9.5	-8.7	-10.3	-12.5	-14.5
H168	-16.0	-16.0	-16.0	-13.1	-8.8	-6.1	-6.9	-7.6	-6.0	-6.5	-7.8	-9.4
H169	-19.8	-19.8	-19.8	-16.9	-12.7	-10.1	-10.3	-10.0	-9.2	-10.7	-12.9	-15.0
H170	-15.7	-15.7	-15.7	-12.8	-8.5	-5.6	-6.4	-7.3	-5.6	-6.2	-7.5	-9.1
H171	-15.8	-15.8	-15.8	-12.9	-8.6	-5.7	-6.5	-7.4	-5.8	-6.3	-7.6	-9.2
H172	-21.8	-21.8	-21.8	-18.9	-14.7	-12.0	-12.4	-12.1	-11.3	-12.7	-14.9	-17.0
H173	-21.8	-21.8	-21.8	-18.9	-14.7	-12.0	-12.4	-12.1	-11.3	-12.7	-14.9	-17.0
H174	-21.8	-21.8	-21.8	-18.9	-14.7	-11.9	-12.3	-12.0	-11.2	-12.8	-15.0	-17.0
H175	-14.8	-14.8	-14.8	-11.9	-7.6	-4.5	-5.1	-6.6	-4.7	-5.3	-6.6	-8.2
H176	-14.8	-14.8	-14.8	-11.9	-7.6	-4.5	-5.1	-6.5	-4.6	-5.3	-6.6	-8.2
H177	-18.4	-18.4	-18.4	-15.5	-11.2	-8.5	-9.0	-8.5	-7.9	-9.3	-11.5	-13.5
H178	-14.7	-14.7	-14.7	-11.8	-7.5	-4.4	-5.0	-6.4	-4.6	-5.2	-6.5	-8.1
H179	-19.5	-19.5	-19.5	-16.6	-12.4	-9.8	-10.1	-9.7	-8.9	-10.5	-12.7	-14.7
H180	-14.4	-14.4	-14.4	-11.5	-7.2	-4.0	-4.1	-4.4	-2.4	-2.9	-3.9	-4.9
H181	-15.6	-15.6	-15.6	-12.7	-8.4	-5.4	-6.2	-7.4	-5.6	-6.1	-7.4	-9.0
H182	-19.5	-19.5	-19.5	-16.6	-12.4	-9.9	-10.1	-9.8	-9.0	-10.5	-12.7	-14.7
H183	-14.4	-14.4	-14.4	-11.5	-7.2	-4.1	-4.2	-4.5	-2.5	-2.9	-3.9	-4.9
H184	-14.5	-14.5	-14.5	-11.6	-7.3	-4.2	-4.3	-4.6	-2.6	-3.0	-4.0	-5.0
H185	-13.9	-13.9	-13.9	-11.0	-6.7	-3.5	-3.7	-4.0	-2.0	-2.4	-3.4	-4.4
H186	-15.6	-15.6	-15.6	-12.7	-8.4	-5.5	-6.2	-7.4	-5.6	-6.1	-7.4	-9.0
H187	-15.6	-15.6	-15.6	-12.7	-8.4	-5.4	-6.2	-7.4	-5.6	-6.1	-7.4	-9.0
H188	-20.0	-20.0	-20.0	-17.1	-12.9	-10.3	-10.6	-10.2	-9.4	-11.0	-13.1	-15.2
H189	-14.1	-14.1	-14.1	-11.2	-6.9	-3.6	-3.5	-4.3	-2.1	-2.6	-3.6	-4.6
H191	-20.0	-20.0	-20.0	-17.1	-12.9	-10.3	-10.5	-10.2	-9.4	-11.0	-13.2	-15.2
H192	-13.1	-13.1	-13.1	-10.2	-5.9	-2.7	-2.9	-3.2	-1.3	-1.6	-2.6	-3.6
H193	-15.3	-15.3	-15.3	-12.4	-8.1	-4.8	-4.7	-5.4	-3.2	-3.7	-4.7	-5.8

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H194	-20.5	-20.5	-20.5	-17.6	-13.4	-10.8	-10.9	-10.7	-9.9	-11.5	-13.6	-15.7
H195	-15.5	-15.5	-15.5	-12.6	-8.2	-5.0	-4.9	-5.6	-3.4	-3.9	-4.9	-6.0
H196	-14.0	-14.0	-14.0	-11.1	-6.8	-3.6	-3.9	-4.0	-2.1	-2.5	-3.5	-4.5
H197	-20.5	-20.5	-20.5	-17.6	-13.4	-10.8	-11.0	-10.7	-9.9	-11.5	-13.6	-15.7
H198	-18.0	-18.0	-18.0	-15.1	-10.8	-7.9	-8.4	-8.1	-7.4	-8.9	-11.1	-13.2
H200	-14.1	-14.1	-14.1	-11.2	-6.9	-3.6	-3.6	-4.1	-2.0	-2.5	-3.5	-4.6
H202	-21.0	-21.0	-21.0	-18.1	-13.8	-11.0	-11.5	-11.2	-10.4	-11.9	-14.1	-16.2
H203	-20.4	-20.4	-20.4	-17.5	-13.3	-10.7	-11.1	-10.6	-10.0	-11.4	-13.6	-15.6
H204	-23.9	-23.9	-23.9	-21.0	-16.8	-14.0	-14.4	-14.1	-13.3	-14.9	-17.1	-19.1
H205	-20.5	-20.5	-20.5	-17.6	-13.4	-10.9	-11.2	-10.9	-10.1	-11.5	-13.7	-15.7
H206	-16.2	-16.2	-16.2	-13.3	-8.9	-5.7	-5.7	-6.2	-4.1	-4.5	-5.5	-6.6
H207	-16.7	-16.7	-16.7	-13.8	-9.3	-6.1	-6.3	-6.6	-4.5	-4.9	-6.0	-7.1
H208	-16.2	-16.2	-16.2	-13.3	-8.8	-5.5	-5.5	-6.0	-3.9	-4.4	-5.4	-6.5
H209	-17.9	-17.9	-17.9	-15.0	-10.7	-7.8	-8.3	-8.1	-6.3	-6.4	-7.4	-8.4
H210	-17.2	-17.2	-17.2	-14.3	-9.8	-6.5	-6.5	-7.0	-4.8	-5.3	-6.3	-7.5
H211	-17.2	-17.2	-17.2	-14.3	-9.7	-6.5	-6.5	-7.0	-4.8	-5.3	-6.3	-7.5
H212	-17.3	-17.3	-17.3	-14.4	-9.8	-6.6	-6.5	-7.0	-4.8	-5.4	-6.4	-7.6
H213	-21.4	-21.4	-21.4	-18.5	-14.2	-11.7	-12.1	-11.7	-10.9	-12.3	-14.5	-16.6
H214	-23.7	-23.7	-23.7	-20.8	-16.6	-13.9	-14.3	-13.9	-13.1	-14.6	-16.8	-18.9
H215	-17.7	-17.7	-17.7	-14.8	-10.2	-6.9	-7.0	-7.4	-5.2	-5.7	-6.7	-7.9
H216	-22.1	-22.1	-22.1	-19.2	-15.0	-12.1	-12.5	-12.3	-11.5	-13.0	-15.3	-17.3
H217	-17.7	-17.7	-17.7	-14.8	-8.7	-5.3	-5.2	-4.5	-2.5	-3.1	-4.5	-6.7
H218	-21.5	-21.5	-21.5	-18.6	-14.4	-11.7	-12.2	-11.8	-11.0	-12.4	-14.6	-16.7
H219	-17.3	-17.3	-17.3	-14.4	-8.2	-4.6	-4.4	-4.1	-2.0	-2.7	-4.1	-6.3
H220	-18.3	-18.3	-18.3	-15.4	-10.3	-7.0	-6.9	-7.1	-5.1	-5.6	-6.7	-8.2
H221	-24.8	-24.8	-24.8	-21.9	-17.7	-14.9	-15.2	-15.0	-14.2	-15.8	-18.0	-20.0
H222	-21.4	-21.4	-21.4	-18.5	-14.3	-11.5	-11.9	-11.7	-10.8	-12.4	-14.5	-16.6
H223	-18.3	-18.3	-18.3	-15.4	-9.2	-5.3	-8.7	-8.6	-6.7	-6.9	-7.9	-8.9
H224	-18.5	-18.5	-18.5	-15.6	-7.3	-2.2	-7.7	-8.8	-6.9	-7.1	-8.1	-9.1
H225	-22.9	-22.9	-22.9	-20.0	-15.8	-12.8	-13.3	-13.0	-12.3	-13.9	-16.1	-18.1
H226	-18.9	-18.9	-18.9	-16.0	-10.9	-7.6	-9.3	-9.2	-7.3	-7.5	-8.5	-9.5
H227	-22.9	-22.9	-22.9	-20.0	-15.8	-13.0	-13.5	-13.0	-12.3	-13.9	-16.1	-18.1
H228	-23.7	-23.7	-23.7	-20.8	-16.6	-13.7	-14.1	-13.9	-13.1	-14.7	-16.9	-18.9
H229	-19.8	-19.8	-19.8	-16.9	-9.5	-5.1	-9.8	-10.0	-8.1	-8.4	-9.4	-10.4
H230	-19.8	-19.8	-19.8	-16.9	-8.8	-4.0	-9.3	-10.0	-8.2	-8.4	-9.4	-10.4
H231	-20.0	-20.0	-20.0	-17.1	-12.9	-9.6	-10.3	-10.3	-8.4	-8.6	-9.6	-10.6
H232	-25.7	-25.7	-25.7	-22.8	-18.6	-15.9	-16.2	-15.9	-15.1	-16.7	-18.9	-20.9
H233	-25.7	-25.7	-25.7	-22.8	-18.6	-15.9	-16.2	-15.9	-15.1	-16.7	-18.9	-20.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H234	-25.9	-25.9	-25.9	-23.0	-18.8	-16.1	-16.4	-16.1	-15.3	-16.9	-19.1	-21.1
H235	-24.2	-24.2	-24.2	-21.3	-17.0	-14.2	-14.6	-14.4	-12.5	-12.7	-13.7	-14.7
H236	-25.2	-25.2	-25.2	-22.3	-18.1	-15.2	-15.7	-15.3	-14.6	-16.2	-18.4	-20.4
H237	-21.8	-21.8	-21.8	-18.9	-14.4	-11.3	-11.7	-11.5	-9.6	-9.9	-11.0	-12.1
H238	-21.8	-21.8	-21.8	-18.9	-14.4	-11.4	-11.8	-11.6	-9.7	-9.9	-10.9	-12.1
H239	-21.5	-21.5	-21.5	-18.6	-13.5	-10.5	-10.7	-10.4	-8.5	-8.8	-9.9	-11.4
H240	-21.6	-21.6	-21.6	-18.7	-13.7	-10.7	-10.9	-10.6	-8.7	-9.0	-10.1	-11.5
H241	-23.6	-23.6	-23.6	-20.7	-16.3	-13.5	-13.8	-13.8	-11.8	-12.0	-13.0	-14.1
H242	-23.7	-23.7	-23.7	-20.8	-14.7	-11.5	-11.3	-10.6	-8.6	-9.1	-10.5	-12.8
H243	-24.8	-24.8	-24.8	-21.9	-17.6	-14.9	-15.2	-15.0	-13.1	-13.3	-14.3	-15.3
H244	-22.8	-22.8	-22.8	-19.9	-15.4	-12.4	-12.8	-12.6	-10.7	-11.0	-12.0	-13.1
H245	-23.1	-23.1	-23.1	-20.2	-15.8	-12.8	-13.2	-13.0	-11.0	-11.4	-12.4	-13.5
H246	-23.3	-23.3	-23.3	-20.4	-16.0	-13.1	-13.4	-13.3	-11.4	-11.6	-12.6	-13.7
H247	-23.4	-23.4	-23.4	-20.5	-16.1	-13.2	-13.5	-13.3	-11.4	-11.7	-12.7	-13.8
H248	-24.2	-24.2	-24.2	-21.3	-17.0	-14.1	-14.5	-14.3	-12.4	-12.6	-13.7	-14.7

10.107 The predicted noise levels due to the proposed development with the daytime noise management strategy in place are shown in comparison to the noise limit in **Chart 15**.

10.108 The presented noise management strategy is designed such that the limit would be met assuming the properties in question are downwind of the proposed development at all times. The amount of noise management required is likely to reduce for certain wind directions should an assessment considering the attenuation applicable when properties are located crosswind or upwind of the proposed development be undertaken.

10.109 **Figure 10.2** shows a cumulative noise contour plot calculated using the ISO 9613 Part 2 propagation model. The plot is provided to illustrate the cumulative noise 'footprint' and should be considered indicative only. Where properties are located such that they cannot be downwind of all turbines simultaneously, the predictions made using a downwind propagation model such as ISO 9613-2 are conservative given that reductions in noise would be expected when a property is crosswind or upwind of a noise source. The footprint shows the proposed development without noise management and with no scaling applied to the predicted noise levels for the other sites considered.

Potential Construction Impacts

Construction Noise Assessment

10.110 Primary activities creating noise during the construction period are from the construction of the turbine bases; the erection of the turbines; the excavation of trenches for cables; the construction of associated hard standings, access tracks and the construction compound. Noise from vehicles on local roads and access tracks would also arise due to the delivery of turbine components and construction materials, notably aggregates, concrete and steel reinforcement.

10.111 It should be noted that the exact methodology and timing of construction activities cannot be predicted at this time, this assessment is therefore based on assumptions representing a worst-case approach.

Construction Noise Predictions

10.112 The plant assumed for each construction activity is shown in **Table 10.35**. The number of items indicates how many of each plant are required for the specified activity, and the duration of activity is a percentage of a given 12 hour day period needed for that plant to operate. Overall sound power levels are based upon the data in Annex C of BS 5228-1:2009.

Table 10.35 - Construction Phases and Sound Power Levels

Activities	Plant	Sound Power (L_{WA})	No. Items	Activity Duration (%)	Effective Sound Power (L_{WA})
Construct Preliminary Compound	Tracked excavator	113	1	100	116
	Dump truck	113	1	100	
	Tipper lorry	107	2	50	
Construct Main Compound	Tracked excavator	113	2	100	119
	Dump truck	113	2	100	
	Tipper lorry	107	2	50	
	Vibratory roller	102	1	75	
	Lorry	108	1	75	
Construct Site Tracks	Tracked excavator	113	3	100	122
	Dump truck	113	2	75	
	Tipper lorry	107	4	50	
	Dozer	109	1	100	
	Vibratory roller	102	1	75	
	Excavator mounted rock	121	1	50	
Construct Substations	Tracked excavator	113	1	100	115
	Concrete mixer truck	108	2	50	
	Lorry	108	1	50	
	Telescopic Handler	99	1	100	
Construct crane hardstandings	Tracked excavator	113	3	100	120
	Dump truck	113	2	100	
	Tipper lorry	107	4	50	
	Vibratory roller	102	1	50	
Construct Turbine Foundations	Tracked excavator	113	2	75	122
	Dump truck	113	2	75	
	Concrete mixer truck	108	4	50	
	Mobile telescopic crane	110	1	50	
	Concrete pump	106	2	50	

Activities	Plant	Sound Power (L_{WA})	No. Items	Activity Duration (%)	Effective Sound Power (L_{WA})
	Water pump	93	1	100	
	Hand-held pneumatic	111	1	75	
	Compressor	103	3	50	
	Poker vibrator	106	3	50	
	Excavator mounted rock	121	1	50	
Excavate and Lay Site Cables	Tracked excavator	113	2	100	122
	Dump truck	113	2	75	
	Tractor (Towing Equipment)	108	1	75	
	Tractor (Towing Trailer)	107	1	75	
	Vibratory plate	108	1	50	
	Excavator mounted rock	121	1	50	
Erect Turbine	Mobile telescopic crane	110	2	75	119
	Lorry	108	1	75	
	Diesel generator	102	1	100	
	Torque guns	111	4	100	
Reinstate Crane Bases	Tracked excavator	113	1	75	115
	Dump truck	113	1	75	
Lay Cable to Substations	Wheeled loader	108	1	100	117
	Saw	114	1	50	
	Hand-held pneumatic	111	1	50	
	Dump truck	113	1	75	
	Tipper lorry	107	1	50	
	Vibratory plate	108	1	75	
	Tandem roller	102	1	75	
	Tractor (Towing Trailer)	107	1	50	
	Lorry	108	1	75	
Construct New Water Crossing	Tracked Excavator	113	1	100	117
	Dump Truck	113	1	100	
	Tipper lorry	107	2	50	
	Dozer	109	1	75	
	Vibratory Roller	102	1	75	
	Telescopic Handler	99	1	100	

10.113 Predictions of construction noise levels have been carried out using the methods prescribed in Annex F of BS 5228-1:2009[23]. The worst case scenario, where each construction activity takes place at the nearest proposed location to the residential

[23] A 50% mixed ground attenuation has been used throughout to conservatively account for the arable nature of ground conditions in the vicinity of the proposed development

property being assessed, is considered. The locations of the construction activities are taken from the proposed infrastructure layout. The results of these predictions, made at six representative properties, are shown in **Table 10.36**.

10.114 In all cases average noise levels over the construction period would be lower as the worst case is presented for when the activities are closest to the residential property.

Table 10.36 - Predicted Sound Pressure Level due to Construction Noise (dB L_{Aeq})

Activity	H38	H88	H103	H124	H157	H158
Construct Preliminary Compound	34.4	39.9	37.1	34.7	30.7	30.9
Construct Main Compound	36.3	47.3	43.0	41.9	36.5	36.6
Construct Site Tracks	40.6	50.3	48.1	50.2	49.5	50.0
Construct Substations	31.8	42.7	38.2	37.1	31.7	31.8
Construct Crane Hard-standings	37.9	47.5	47.0	48.3	46.9	48.3
Construct Turbine Foundations	39.7	49.3	48.8	50.1	48.7	50.1
Excavate and Lay Site Cables	39.1	49.4	48.2	49.5	48.1	49.5
Erect Turbine	36.2	45.8	45.3	46.6	45.2	46.6
Reinstate Crane Bases	32.2	41.8	41.3	42.6	41.2	42.6
Lay Cable to Substations	34.4	45.3	40.8	39.7	34.3	34.4
Construct New Water Crossing	34.4	43.4	42.2	45.2	41.4	39.1

Construction Traffic

10.115 Due to the delivery of construction material and wind farm components, vehicle movements either into or away from the site shall increase levels of traffic flow on public roads in the area. Traffic regularly accessing the site is shown in **Chapter 11: Access Traffic and Transport** and is assumed to be characterised by the sound power levels of Concrete Mixers. It is estimated that a total of 50 vehicle movements per day would be required during the most intense period of construction activity although this would only be the case for a maximum of 14 days during foundation pouring.

10.116 Construction traffic noise has been quantified using the method described in BS 5228:2009 Part 1. Using the distances from residential properties to the centre of the relevant carriageway where site traffic would be, the noise levels predicted are presented in **Table 10.37**. The maximum sound pressure level due to traffic flows during the most intensive period of activity is predicted to be 59 dB L_{Aeq}. The property where this occurs is adjacent to the proposed delivery route and, as such, corresponds to the worst case.

Table 10.37 - Traffic Noise Predictions by Activity (dB L_{Aeq})

House ID	Concrete Mixer
H38	59.0
H88	36.5
H103	37.5
H124	44.4
H157	32.7
H158	33.5

10.117 The increase in noise level due to the presence of construction traffic on nearby roads has been quantified using the methodology set out in CRTN[24]. The predicted increase in daytime average traffic noise level, during the most intense period of construction, is 7.0 dB(A) on Ballycose Road and 0.6 dB(A) Upper Cairncastle Road. Given that this is temporary and would only occur during the most intense period of construction the impact is not considered significant.

General Construction Noise in Conjunction with Traffic Noise

10.118 Worst case construction noise levels may arise when the following simultaneous activities occur: construction of nearest access tracks; construction of nearest crane hard-standings and construction of nearest turbine foundations. Therefore cumulative predictions of these construction activities and the additional noise contribution from construction traffic have been calculated and are shown in **Table 10.38**.

10.119 It should be noted that the predictions exclude the screening effects of local topography therefore actual levels of noise experienced at nearby residential properties could be lower.

Table 10.38 - Predicted Noise Due to Combined Traffic Noise and Turbine Construction (dB L_{Aeq})

House ID	Construction Plant Noise	Traffic Noise	Combined Noise
H38	44.3	59.0	59.0
H88	54.0	36.5	54.0
H103	52.8	37.5	52.8
H124	54.4	44.4	54.8
H157	53.3	32.7	53.3
H158	54.3	33.5	54.3

Assessment of Construction Noise

10.120 In accordance with the ABC method of Annex E of BS 5228-1:2009, due to the relatively low levels of ambient noise in the vicinity of the proposed development, a Category A assessment is appropriate. This category sets significant effect threshold L_{Aeq} criteria of: 65 dB(A) during weekdays (0700-1900) and Saturdays (0700-1300); 55 dB(A) at evenings and weekends; and 45 dB(A) for night-time (2300-0700) periods.

10.121 **Table 10.38** shows that predicted noise levels from the combined effect of increased traffic flows and activities associated with the peak of construction activities are below the 65 dB(A) daytime threshold specified by BS 5228-1:2009 at all of the assessed residential properties.

10.122 Peak construction noise levels are predicted to exceed the 55 dB(A) threshold for evenings and weekends at one of the assessed properties although, of the times when this criterion applies, construction is only scheduled to take place on Saturdays 1300-1900 with the exception of turbine erection and commissioning or periods of emergency work.

[24] Calculation of Road Traffic Noise (CRTN), HMSO Department of Transport, 1988.

10.123 An assessment against the night-time threshold has not been undertaken as construction work is not scheduled to take place during the night with the exception of turbine erection and commissioning or periods of emergency work. Predicted noise levels of 46.6 dB(A) due to turbine erection imply that this activity should be avoided at night as far as possible.

10.124 The predictions made represent the worst-case combination of most intensive traffic activity with simultaneous construction activity at the nearest possible location to each residential property.

Cumulative Construction Noise

10.125 Any noise due to the construction of the other sites considered in the cumulative operational noise assessment, the majority of which have already been built, is unlikely to be ongoing at the same time as the construction of the proposed development. In the event that this scenario did occur, the activities associated would likely be far enough away so as not to have a cumulative impact.

Mitigation

Operational Noise

10.126 One of the key constraints and considerations in designing the layout of the turbines was the minimisation of potential noise impacts at the nearest residential receptors. As such the turbine layout was designed to ensure that there is an adequate separation distance between any of the proposed turbines and the nearest residential property.

10.127 Due to this consideration of the noise impacts in the design of the wind farm, embedding mitigation measures in the turbine layout, a limited amount of noise management is required to meet noise limits derived in accordance with ETSU-R-97.

10.128 Noise management involves altering the operational mode of the turbines in certain conditions by changing the pitch of the blades, resulting in a trade-off between power production and noise reduction. This provides a potential mechanism for further reducing the level of noise experienced at nearby residential properties although the acoustic assessment demonstrates that this is not required.

10.129 If planning permission is granted for the proposed development, planning conditions can be proposed to provide a degree of protection to nearby residents in the form of limits relating to noise level and tonality.

10.130 **Technical Appendix 10.8** contains a set of conditions that RES considers appropriate.

Construction Noise

10.131 For all activities, measures would be taken to reduce noise levels with due regard to practicality and cost as per the concept of ‘best practicable means’ as defined in Pollution Control and Local Government (NI) Order 1978.

10.132 BS 5228-1:2009 states that the ‘attitude of the contractor’ is important in minimising the likelihood of complaints and therefore consultation with the local authority and Community Liaison Group should occur to inform residents of intended activity. Non-acoustic factors, which influence the overall level of complaints such as mud on roads and dust generation, would also be controlled through construction practices adopted on the site.

10.133 Furthermore, the following noise mitigation options could be implemented where appropriate:

- Consideration would be given to noise emissions when selecting plant and equipment to be used on site;
- All equipment should be maintained in good working order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable;
- Stationary noise sources would be sited as far away as reasonably possible from residential properties; and
- The movement of vehicles to and from the site would be controlled and employees instructed to ensure compliance with the noise control measures adopted.

10.134 Site operations would be limited to 0700-1900 Monday to Saturday except during turbine erection and commissioning or during periods of emergency work. Should it be considered necessary to reduce noise levels from the conservative predicted levels to adhere to the 55 dB(A) target level for Saturdays 1300-1900, the following mitigation measures would be considered:

- Reduce construction traffic as appropriate.

10.135 There are many strategies to reduce construction noise by the limitation of activities that would result in predicted noise levels being lower than the specified target. Any such measures should be considered adequate and the mitigation adopted should not be limited to the measures proposed.

Residual Effects

Operational

10.136 The acoustic assessment demonstrates that predicted noise levels at all residential properties do not exceed the derived noise limits across all wind speeds once a noise management strategy is applied. This should not be interpreted to mean that wind farm operational noise would be inaudible (or masked by background noise) under all conditions, but that the levels of noise are acceptable under ETSU-R-97 and associated guidance.

Construction

10.137 There may be an increase above the 55 dB(A) criteria level for Saturdays 1300-1900 at one property although this can be mitigated by restricting the activities that are allowed to take place as necessary. At all other times predicted noise from worst case combination of increased traffic and site construction noise would not exceed relevant criteria and therefore no significant impacts are expected.

Summary

10.138 The acoustic impact for the operation of the proposed development on nearby residential properties has been assessed in accordance with the guidance on wind farm noise as issued in the DTI publication "The Assessment and Rating of Noise from Wind Farms", otherwise known as ETSU-R-97, and Institute of Acoustics Good Practice Guide (IoA GPG), as recommended for use by relevant planning policy.

10.139 To establish baseline conditions, background noise surveys were carried out at five nearby properties and the measured background noise levels used to determine appropriate noise limits, as specified by ETSU-R-97 and the IoA GPG.

10.140 Operational noise levels were predicted using the recommended noise propagation model. The limit remaining for the proposed development was determined by subtracting the predicted noise levels due to nearby consented and existing sites from the total noise limit. The predicted noise levels for the proposed development are within the derived noise limits at all considered wind speeds with an appropriate noise management strategy in place. The proposed development therefore complies with the relevant guidance on wind farm noise and the impact on the amenity of all nearby residential properties would be regarded as acceptable.

10.141 A construction noise assessment carried out in accordance with BS 5228-1:2009 "Noise control on construction and open sites Part 1 - Noise" found that construction noise levels are predicted to temporarily exceed construction noise criteria at nearby properties although appropriate mitigation measures have been identified.

10.142 The potential impact of the proposed development, along with the mitigation proposed and any residual impact, is summarised in **Table 10.39**.

Table 10.39 - Summary of Potential Impacts, Mitigation and Residual Impacts

Potential Impact	Mitigation Proposed	Means of Implementation	Outcome/ Residual Impact
Operation			
Potential impact on residential amenity due to operational noise	Impact is deemed to be acceptable as wind farm meets noise limits specified by relevant guidance with a noise management strategy in place No additional mitigation measures are required due to absence of identified significant effect	Not applicable	Not significant
Construction			
Potential for noise to be created during general construction activities and by construction traffic	Due regard for 'best practicable means' (defined by Section 72 of the Control of Pollution Act 1974)	Noise mitigation measures would be implemented as part of the Construction and Environmental Management Plan	Not significant

Potential Impact	Mitigation Proposed	Means of Implementation	Outcome/ Residual Impact
	A range of noise mitigation measures are proposed for the construction phase in accordance with measures outlined in BS 5228-1:2009 Site operations to be limited to 0700-1900 Monday to Saturday (except during turbine erection and commissioning/periods of emergency work) Construction traffic to be controlled on Saturdays between 1300-1900, if necessary, to ensure relevant noise criteria are met	which would be required to be agreed as a condition of consent Provision of a Construction Traffic Management Plan to be incorporated into the CEMP and delivered as a condition of consent	

11

Traffic & Transport

11 Traffic & Transport

Introduction

11.1 This assessment considers the potential impacts on traffic and transport associated with the construction, operation and decommissioning phases of the proposed Ballygilbert Wind Farm, hereinafter referred to as 'the Development'.

11.2 The site entrance for the Development is located on Feystown Road, within the townland of Ballygilbert, Co. Antrim c. 2.5km south of Glenarm and c.3.km north west of Cairncastle. The Planning Application Boundary, hereinafter referred to as the 'Site' is shown in **Figure 1.1 Planning Application Boundary.**

11.3 The following have been considered in this chapter:

- Legislation and policy;
- Access routes for abnormal indivisible loads (AIL), normal construction traffic and associated road improvements;
- The type and volume of traffic generated by the Development;
- Identification of sensitive/ critical locations along the delivery route;
- Assessment of construction, operation and decommissioning traffic impacts;
- Outline of suitable mitigation measures and the evaluation of residual impacts; and
- Cumulative impacts of surrounding consented and proposed developments.

11.4 This assessment has been undertaken in-house by Renewable Energy Systems Ltd (RES) with at least one in-house Member of the Institution of Engineers Ireland and the Institution of Civil Engineers involved in its production.

11.5 This assessment is supported by the following Technical Appendices:

- **Technical Appendix 11.1: Delivery Analysis**

Legislation, Policy and Guidance

DOE- Planning Policy Statement 3- Access, Movement and Parking (2005)

11.6 Policy AMP2 of PPS3 issued by the Department of Environment (DOE) in 2005 states that:

- *"planning permission will only be granted for a development proposal involving direct access, of the intensification of the use of an existing access, onto a public road where:*
    - *a) Such access will not prejudice road safety or significantly inconvenience the flow of traffic; and*
    - *b) The proposal does not conflict with Policy AMP3 Access to Protected Routes"*

11.7 Policy AMP3 of PPS3 (Clarification) published by the DOE in October 2006 states that:
"The Department will restrict the number of new access and control the level of use of existing accesses onto Protected routes as follows:

- *Motorways and High Standard Dual Carriageways;*
- *Other Dual Carriageways, Ring Roads, Through- Passes and By-Passes- all Locations;*
- *Other Protected Routes – Outside Settlement Limits; and*
- *Other Protected Routes – Within Settlement Limits"*

Strategic Planning Policy Statement (SPPS)

11.8 The SPPS highlights that transportation issues to be addressed in the LDP should include Protected Routes. Whilst regional policy is to restrict the number of new access and control the level of use of existing accesses onto protected routes, there are exceptions where the principle of development accords with policy elsewhere in the SPPS.

DOE – Planning Policy Statement 18: Renewable Energy (2009)

11.9 Policy RE1 of PPS18 issued by DOE in 2009 requires applications for a wind energy development to demonstrate that no part of a development will have an unacceptable impact on roads, rails or aviation safety:

- *"Where any project is likely to result in unavoidable damage during its installation, operation or decommissioning, the application will need to indicate how this will be minimised and mitigated, including details of any proposed compensatory measures… This matter will need to be agreed before planning permission is granted."*

DOE – Best Practice to Planning Policy Statement 18 'Renewable Energy' (2009)

11.10 Section 1 of the Guidance relates to wind energy and names the "Adequacy of local access road network to facilitate construction of the project and transportation of large machinery and turbine parts to site" as one of the main concerns that needs to be considered by the developer when applying for a wind farm development.

IEMA – Guidelines for the Environmental Assessment of Road Traffic (1993)

11.11 The Institute of Environmental Management and Assessment (IEMA) guidelines (hereinafter referred to as IEMA Guidelines (1993)) are the most widely used guidance document for assessing traffic impacts as part of Environmental Statements and are referred to throughout this Chapter.

11.12 The IEMA Guidelines (1993) suggest two general rules for identifying the extent of the assessment area:

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

11.13 Where the change is less than the above thresholds, the impact shall be considered 'negligible'

Consultation

11.14 Consultation with stakeholders relevant to traffic, roads and infrastructure on and near the delivery routes were undertaken. The feedback from this consultation process helped to clarify the local transport strategy, identify issues of specific local importance and gather basic information on local infrastructure and structures. A summary of the consultation responses and proposed mitigation measures are included in ***Table 11.1***

Table 11.1: Consultation Responses

Consultee	Issue	Solution/ Further Steps
DfI Roads, Northern Division	Advised of proposed AIL delivery route associated with the proposed Development	Mitigation measures required on the public road network should be addressed. A Traffic & Transport Chapter is to be included within the Environmental Statement.

11.15 Please note, further consultation is required post consent with stakeholders relevant to traffic, roads and infrastructure on and near the delivery routes to finalise the preferred HGV access route strategy to the development.

Scope of the Assessment

11.16 The main transport effects will be associated with the movement of commercial Heavy Goods Vehicles (HGVs) and Abnormal Indivisible Loads (AILs) (i.e. turbine component delivery) to and from the site during the construction phase of the Development.

Once operational, it is envisaged that the volume of traffic associated with the Development would be minimal, comprising service and maintenance visits. Occasional visits may also be made to the site for more extensive maintenance/ repairs. The vehicle used for maintenance visits is likely to be a 4x4 vehicle (or similar) but there may be an occasional need for HGV deliveries, road-going cranes or AILs to access the site for heavier maintenance and repairs. However, it is considered that the effects of such operational traffic will be negligible and therefore, detailed consideration of the operational phase of the Development is not included in this assessment.

11.17 For details of the assessment of construction noise associated with deliveries, see **Chapter 10: Noise**.

11.18 The proposed access routes for AILs (turbine delivery) is illustrated in **Figure 11.1 – Turbine Delivery & HGV Route.** It is proposed that HGV deliveries of concrete and stone respectively will also utilise the Feystown Road but could do so from either direction dependant on the source of material and subject to confirmation with DfI Roads.

Abnormal Indivisible Loads (turbine component delivery) and HGV Deliveries

11.19 Specialist vehicles are required to transport components to the site. One vehicle would transport turbine blades, while another type would transport the tower sections. Swept path analyses have been undertaken for blade delivery as this is the more onerous scenario, to determine the works required to allow passage through pinch-points on the route as illustrated in **Appendix 11.1**

11.20 The proposed access route for AILs from Belfast Port has been used previously for the construction of various wind farms that have utilised the A8. From Belfast the route will travel north on the M2, onto the A8 at Sandyknowes Roundabout, continuing for c. 22km. The route exits onto Antiville Road, continuing onto Upper Cairncastle Road, and turning onto Brustin Brae Road. The exit onto Ballycoose Road is taken at Carncastle, becoming Feystown Road, which continues west onto the site entrance.

11.21 The proposed return route for the delivery vehicles is similar to the proposed delivery route noted above. Once the turbine components have been delivered, the vehicles will be shortened so they are no longer than a typical articulated HGV.

11.22 Where required, approval to temporarily remove street furniture (for the minimum period as is reasonably practical), will be obtained from the appropriate bodies prior to deliveries post planning consent.

Widening Works

11.23 Widening works will be required at various locations along the abnormal load delivery route, as illustrated in ***Appendix 11.1.*** Widening locations are:

- Brustin Brae Road
- Ballycoos Road
- Feystown Road

11.24 Widening works will occur in third party land take and accordingly these works are included in the Planning Application Boundary see ES Figure 1.2.

11.25 Widening areas will be reinstated once turbine delivery has been undertaken. If road widenings require the removal of boundary features such as fences, trees or hedgerows, these will be reinstated at suitable locations. Reinstatement will also be applied to any street furniture which may be removed on a temporary basis. In the unlikely event that a replacement blade is required during the operational phase of the wind farm, the widenings will need to be reopened temporarily, after which they will be reinstated.

Normal HGV Delivery

11.26 Normal HGV load delivery routes (including stone and concrete) will utilise the A8, Antiville Road, Upper Cairncastle Road, Brustin Brae Road, Ballycoose Road and Feystown Road, with sources of material to be confirmed prior to construction. No passing bays will be required as the roads are largely two-way with adequate passing provided.

11.27 Where agreed by Dfl Roads, circular HGV haul routes may be implemented for the construction phase of the project.

11.28 Post consent, a detailed review of all bridges/ structures along the preferred route will be undertaken and, if required structural surveys will be carried out. The requirement (if any) of any subsequent improvement will be undertaken following consultation with Dfl Roads and detailed in the Traffic Management Plan (TMP).

Site Entrance

11.29 The site entrance is located on the Feystown Road where an existing farm access is located but would be modified accordingly to accommodate AIL deliveries.

11.30 The proposed site entrance design is shown in ***Figure 1.10*** and has been designed in accordance with the requirements of Development Control Advice Note (DCAN) 15, 2nd Edition.

11.31 As specified in DCAN 15, visibility splays measuring 120m x 4.5m are provided in both directions. Following construction, the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state. Stone pillars and walls removed to allow access will be reinstated as will stock proof fencing. Any trees and hedgerows removed will be replanted.

Ulster Way Walking Route

11.32 The Ulster Way Section: Glenarm to Ballynure incorporating the Antrim Hills Way runs through the Development area north to south.

11.33 Traffic management will be undertaken throughout the works to allow continued walking access, with a defined separation from the onsite works. This will be captured in the Contractor's TMP. The walking route will remain open although diversions along the route will be required during construction, these will be agreed in consultation with the Access Officer for Mid & East Antrim.

Assessment Methodology

11.34 The assessment has been undertaken in accordance with the Institute of Environmental Assessment's 'Guidelines for the Environmental Assessment of Road Traffic' (1993).

11.35 The IEA Guidelines (1993) is the only document available that sets out a methodology for assessing potentially significant environmental impacts where a proposed development is likely to give rise to changes in traffic flows.

11.36 The IEA Guidelines (1993) suggest that, in order to determine the scale and extent of the assessment and the level of impact the development will have on the surrounding network, the following two 'rules' should be followed:

1. Include highways links (public roads) where traffic flows are predicted to increase by 10% or more.
2. Include any other specifically sensitive areas where traffic flows are predicted to increase by 10% or more.

11.37 Where possible, the significance of each impact is considered against the criteria within the IEA Guidelines (1993). However, the IEA Guidelines (1993) State that:
"for many effects there are no simple rules or formulae which defines the thresholds of significance and there is, therefore, a need for interpretation and judgement on the part of the assessor, backed-up by data or quantified information wherever possible. Such judgements will include the assessment of the numbers of people experiencing a change in environmental impact as well as the assessment of the damage to various natural resources."

11.38 In the absence of established significance criteria for traffic and transport impacts, professional judgement has been used to assess whether the impacts on traffic and transport are considered to be significant, using the IEA Guidelines (1993) to identify the scale and extent of the assessment to be undertaken. The significance falls into two categories; 'not significant' and 'significant', the latter corresponding to significant impacts in accordance with IEA Guidelines (1993).

11.39 The IEA Guidelines (1993) state projected changes in traffic of less than 10% creates no discernible environmental impact, given that daily variations in background traffic flow may fluctuate by this amount, and that a 30% change in traffic flow represents a reasonable threshold for including a highway link (public road) within the assessment. The threshold for a detailed assessment therefore has been set at a 30% change in HGV traffic flow.

11.40 The following receptors have been used for this assessment:

- ATC 1, Ballycoose Road
- ACT 2, Upper Cairncastle Road

11.41 The Traffic Count (ATC) surveys were undertaken during a period of seven consecutive days starting on 24th September 2019 as listed in ***Table 11.2.***

Table 11.2 ATC Summaries

Road Reference	24hr Average Daily Flow
ATC 1, Ballycoose Road	166
ACT 2, Upper Cairncastle Road	6096

Potential Significant Effects

11.42 The construction of the Development is anticipated to take approximately 18 months. Construction site working hours will be from 0700 to 1900, Monday to Friday and 0700 to 1300 on Saturdays but deliveries may occur outside these times to minimise disruption to local residents and/ or to comply with Health and Safety, quality or any specific environmental requirements. During both turbine erection and decommissioning periods site workings could be seven days a week.

11.43 The associated traffic flows will vary over that time as different elements of the Development are constructed and will depend on the chosen Contractor's preferred method of working. A Traffic Management Plan (TMP) will be prepared by the Applicant or the chosen Contractor once the construction schedule, plant requirements and the turbine model have been defined, pre-construction. This will ensure impacts to the users of the delivery route are minimised where possible. The TMP will be submitted to DfI Roads for approval prior to the start of construction.

11.44 Estimated traffic generation during the construction stage has been based on the assumption that the following activities will take place:

- Delivery of components for site set-up;
- Delivery of materials for road and hard standings;
- Delivery of materials and components associated with the foundation construction;
- Delivery of components associated with turbines, including meteorological masts;
- Delivery of components and materials associated with cable installation;
- Delivery of substation components and materials;
- Other miscellaneous deliveries/ removal; and
- Construction workers commuting.

11.45 ***Table 11.3*** provides the estimated traffic generation across an assumed 18 month construction period. The assessment has been based on the assumption that all material has to be imported to site, including ready mixed concrete for the turbine foundations and all aggregate for the access tracks and areas of hardstanding, thus providing a worst case assessment.

Table 11.3 Estimated Traffic generation across an assumed 12-month construction period

Phase	Purpose	Delivery Vehicle	Approx. No. of deliveries for project duration	Approx. highest No. of daily deliveries	Approx. period when deliveries occur
Site Set-Up	Portacabin delivery	Low Loader	10	10	1
	Skip delivery	Low Loader	5	5	1
	Generator delivery	Low Loader	2	2	1
	Water and fuel tank delivery	Low Loader	1	1	1
	Excavator delivery	Low Loader	3	2	1-2

Phase	Purpose	Delivery Vehicle	Approx. No. of deliveries for project duration	Approx. highest No. of daily deliveries	Approx. period when deliveries occur
	Tool container delivery	Low Loader	2	2	1-2
	Roller-compactor	Low Loader	3	1	1-2
	Articulated dumper	Tipper Lorry	3	1	1-2
Site tracks & hard standings	Stone for site tracks	Tipper Lorry	2000	50	1-5
	Stone for control building & substation compound	Tipper Lorry	40	10	1-5
	Stone for construction compound	Tipper Lorry	20	20	1-5
	Stone for pathways	Tipper Lorry	30	30	1-5
	Stone for crane hardstandings	Tipper Lorry	1200	50	1-5
Foundation construction	Excavator delivery	Low loader	2	2	2-3
	Misc works	Backhoe loader	2	2	2-3
	Concrete for turbine foundations, piles & transformer plinths	Mixer truck	840	50	2-5
	Steel delivery	Flat bed	28	28	2-5
	Foundation bolts or steel insert delivery	Flat bed	14	14	4-5
	Place foundation bolt cage or steel insert	30t – 50t crane	1	1	4-5
Turbine Erection	Tower section delivery	Clamp lift trailer	56	8	7-8
	Blade delivery	Extendible trailer	42	6	7-8
	Nacelle	Low loader	14	2	7-8
	Hub and rotor	Low loader	14	2	7-8
	Drive train	Low loader	14	3	7-8
	Large crane delivery & removal	1000t – 12000t crane	2	1	7-8
	Crane associated equipment delivery & removal	Low loader	42	10	7-8
	Smaller crane delivery & removal	150t – 200t crane	2	1	7-8
Cable Installation	Cable delivery	Flat bed	14	8	5
	Sand delivery	Tipper lorry	280	20	5
	Excavator delivery	Low loader	2	1	5
	Cable laying	Tele handler	2	1	5
Substation and Control Building	Concrete delivery	Mixer truck	36	36	5
	Brick delivery	Flat bed	3	3	5
	Roofing & Cladding	Flat bed	3	3	6-7
	Switchgear	Flat bed	2	2	6-7
	Misc. electrical equipment	Flat bed	3	3	6-7
Misc.	Waste removal	Skip lorry	90	1	1-10
	Water/ fuel deliveries	Small tanker	90	1	1-10
Site Demobilisation	Portacabin removal	Low loader	6	6	10
	Skip removal	Low loader	5	5	10
	Generator removal	Low loader	2	2	10
	Water & fuel tank removal	Low loader	1	1	10
	Roller-compactor	Low loader	1	1	7-8
	Dumper truck	Low loader	1	1	10
	Excavator removal	Low loader	2	2	5-10
	Misc. works	Low loader	2	2	10
TOTAL Heavy Goods Vehicles			**5888**		
Site Staff & Deliveries	Staff	Cars & minivans	8600	40	1-10
	Miscellaneous	Vans	900	5	1-10

Phase	Purpose	Delivery Vehicle	Approx. No. of deliveries for project duration	Approx. highest No. of daily deliveries	Approx. period when deliveries occur
TOTAL Cars & Light Vehicles			**9500**		
TOTAL VEHICLES			**15388**		

11.46 ***Table 11.3*** has been derived from experience gained from previous wind farm construction phases and assumes approximately 40 stone deliveries per day.

11.47 It is estimated that the greatest concentration of construction traffic occurs on the days when concrete is delivered to the Development for the construction of turbine foundations.

11.48 Technical 'best practice' construction requirements may necessitate that the concrete for an individual turbine base foundation will have to be delivered and poured in one day to prevent 'cold' joints forming in the structure. As a result, there may be a period in which there will be an increased number of delivery vehicles, compared with the rest of the construction period, entering and leaving the Development. The total number of concrete deliveries for each turbine base may be up to 65 journeys per day.

11.49 This equates to approximately one vehicle movement every five minutes over the working day (0700 – 1900). ***Table 11.4*** illustrates the worst case percentage change of traffic flow (ie. Based on the busiest 6 days) along the proposed access route during the turbine base construction stage of the Development.

Table 11.4 Summary of Percentage Increase in Traffic on Local Roads

Road Reference	24hr Average Daily Flow	Average Recorded Daily HGV Flow as a percentage (No. of HGVs)	Percentage increase of HGVs (No. of HGVs)	Is the IEA (1993) threshold of 30% increase in HGV Traffic Flow exceeded?
ATC1, Ballycoose Road	165	13% (21)	738% (155)	Yes
ATC2, Upper Cairncastle Road	6096	6% (358)	43% (155)	Yes

11.50 It is predicted that there will be an increase in vehicle movements of between 43% and 738%. The percentage increase is high given the low volume of traffic which the roads currently accommodate. These roads are two way and therefore will not need to be widened to accommodate vehicles travelling to and from the Development entrance.

11.51 The IEA threshold of 30% us exceeded on both Ballycoose Road and Upper Cairncastle Road and therefore an assessment of potential significant impacts has been provided in ***Table 11.5***.

Table 11.5: IEA Environmental Impact

Predicted Impact	Description	Applicability to Tertiary Road Network
Severance	Severance is a perception that a road is more difficult or possibly less safe to cross. Increased severance can result in the isolation of areas of a settlement or individual properties. However, it is important to note that the impact is largely a function of traffic volumes, rather than one of vehicle composition amongst traffic.	The IEA guidelines suggest changes in traffic flow of 30% are likely to affect severance. There is low existing traffic flow and little pedestrian activity. The TMP will be undertaken with consultation of the utilised quarry and local residents. An agreement will be made to ensure that delivery times do not coincide with 'pick-up' and 'drop-off' times that may affect access to local services. With this measure the temporary impact of severance is considered to be **Not Significant**
Driver Delay	Driver delay is that experienced by non-development related road uses on the surrounding roads and particularly as a consequence of slow moving traffic associated with construction.	The IEA guidelines suggest that delays are only likely to be of significance when the traffic on the surrounding network is at, or close to, full capacity. Given that this is not the case, this is not considered to be an issue. It is acknowledged that there may be localised delays directly attributable to construction traffic due to the large increase in traffic flow on the Ballycoose Road and Upper Cairncastle Roads. This is most likely restricted to junctions, and local road users are familiar with encountering HGVs. The delivery of turbine components will involve large, slow moving vehicles however these will be escorted and timed to cause minimal disruption. The potential impact is considered **Not Significant** given that there is a low volume of vehicles on the tertiary road network and these roads are two way. Deliveries will be timed to minimise disruption, escorted where necessary and information regarding deliveries will be made available via the TMP, prior to construction.
Pedestrian Delay	Pedestrian delay is affected by changes in traffic volume, HGV movements and traffic speed. Pedestrian delay also depends on the existing level of pedestrian activity, visibility and current infrastructure provision. There is no threshold on which pedestrian delay is assessed.	Pedestrian movement on the Upper Cairncastle is minimal. The area therefore has a low sensitivity rating in relation to pedestrian delay and impacts will be **Not significant**

Predicted Impact	Description	Applicability to Tertiary Road Network
Pedestrian Amenity	Pedestrian amenity can be affected by traffic volumes and the distance between pedestrians on the footway and passing traffic. The IEA guidelines suggest that changes to pedestrian amenity may be considered significant where traffic is doubled or halved.	There is minimal volume of pedestrian movement along Upper Cairncastle Road and Ballycoose Road and whilst the volume of HGV sees a significant increase, given the lack of pedestrian movement this does not pose a significant risk. Access to the Ulster Way will be maintained throughout the duration of the works with separation between site activities and pedestrian walkways. The walking route will remain open although diversions along the route will be required during construction, these will be agreed in consultation with the Access Officer for Mid & East Antrim. This mitigation will reduce the impact on pedestrian amenity. It is considered the impact on pedestrian's / cyclist's amenity will be **Not Significant** given that the worst case of vehicle movements will be one per five minutes on the six days associated with the turbine foundations.
Fear & Intimidation: Pedestrians	The IEA guidelines state that the degree of fear and intimidation experienced by pedestrians is affected by the volume of passing traffic, the proportion of HGV traffic and its proximity to pedestrians.	Despite the predicted temporary increase in traffic flows, the minimal volume of pedestrian movement along Ballycoose Road and Upper Cairncastle combined with the largely two-way nature of these roads means this impact will be **Not Significant.**
Accidents & Safety	The IEA guidelines state that road accidents are attributable to a variety of local factors and as such do not provide a threshold to determine significance. Instead the IEA guidelines relies more on the assessor to use their own judgement.	Construction and predicted changes will be temporary and given that consultation will be undertaken with local residents, and traffic generation is low, there is unlikely to be an impact upon road safety and accident levels. Furthermore, all abnormal loads will be escorted, and the movement of these vehicles will be programmed to avoid busy periods thus reducing the potential impacts further. It is considered the overall impact on accidents and safety is **Not Significant** given that the worst case of vehicle movements will be one per five minutes on the six days associated with the turbine foundations.

Cumulative Impacts

11.52 There are two consented and proposed projects within 10km of the Development. These are Ballykeel and Carnalbanagh Wind Farms, located 5.5km south of T14 and 6.7km west of T12 respectively. This could theoretically result in cumulative traffic impacts, however these would likely be limited to the primary road network surrounding the A8. Whilst the developments intend to partially utilise the same turbine delivery route to access the A8, in the unlikely event that the construction periods were to coincide, vehicle movements would not likely exceed the 30% threshold. As part of the TMP, consideration of any cumulative effects arising from the construction of other wind farms will be reviewed in detail and mitigated accordingly.

Table 11.6: Wind Farms in the Vicinity of the Development

Name	Status	Number of Turbines	Distance from Proposed Site Boundary
Ballykeel	Consented	7	5.5km south of T14
Carnalbanagh	Proposed	7	6.7km west of T12

Mitigation

11.53 A Traffic Management Plan (TMP) will be prepared by the Applicant in accordance with the requirements of Department of Infrastructure NI, the local PSNI, and if required, any other relevant stakeholders. Features of the TMP will include:

- Details of the access route, conformation of any points along the access route that require street furniture removal, details of traffic numbers, delivery timings, and signage and escort requirements
- A delivery schedule for normal and abnormal loads to minimise disruption as far as reasonably practicable
- Details of how any movements will comply with legislation regarding the movement of abnormal loads e.g. notice procedures and notice periods
- Details on the use of escorts where required. Where long vehicles and abnormal loads would have to use the wrong side of the carriageway or need to swing into the path of oncoming vehicles a lead warning vehicle would be used. One escort vehicle would drive ahead and pull oncoming traffic into identified passing places. An escort vehicle would travel directly in front of the convoy and pull over any oncoming traffic that comes onto the road after the first escort vehicle has passed. A further convoy escort vehicle would follow the convoy
- Information about marking of vehicles as long/abnormal loads

11.54 Information will be given on how warning signs will be used. These will be used to advise other road users of 'Caution Slow Plant Turning Ahead' and will be placed at intervals from both directions along the main road approaching the site entrance during the construction phase. The TMP will also detail additional measures to ensure impacts from traffic movements are minimised where possible, for example provision of road sweepers and/or wheel wash facilities.

11.55 If required, the wheel wash facilities will include a waterless drive over wheel wash for lorries. This will be provided at the site entrance to prevent mud and dust being brought out from the Site onto the public highway and anything being brought onto Site from public highway. Although experience has shown the majority of mud is shaken off wheels on site before the vehicle reaches the public road, the site entrance and adjacent public highway will also be monitored and cleaned if necessary.

11.56 The TMP will include details about Video Surveying and Road Repairs. A video survey of the pre-construction condition of all public roads will be recorded around the site entrances and access routes (but including the site entrance and access roads), to provide a baseline record of the state of the roads prior to construction work commencing. This will enable any repairs and maintenance work required to the relevant road due to any damage caused by the passing of heavy vehicles associated with the wind farm construction to be identified following the construction phase. The roads will be returned, at minimum, to the baseline condition at the end of the construction phase. Any damage caused by wind farm traffic during the construction period, which would be hazardous to public traffic, will be repaired immediately. These works will be carried out under permits with DfI Roads, as appropriate.

11.57 The TMP will include plans for notifying relevant stakeholders in advance of delivery periods, including the emergency services, DfI Roads, local residents, local business, local services and schools. The local community will be informed prior to the commencement of construction and prior to the commencement of turbine deliveries by letter and through local press. The contact details of the Construction Site Manager will be made available as a contact point for enquiries. Local schools on the delivery routes will be contacted to identify school and nursery drop-off and pick up locations and times. Construction deliveries will be scheduled to avoid these busy periods as far as reasonably possible.

11.58 If cutting or removal of hedges and trees is required, then this should be done outside the bird breeding season (1st March to 31st August). If work is to be done during the breeding season, then there should be a survey to establish whether nesting birds are present.

Summary

11.59 The main traffic impacts are associated with the increase in HGV vehicle movements along the Ballycoose Road and Upper Cairncastle Road during the construction stage of the project. These roads have low levels of existing traffic and a small number of receptors will be affected. At worst, the frequency of vehicle movements is expected to be one vehicle every five minutes during the 6 days when the construction of each wind turbine foundation would occur.

11.60 Consideration has been given to the effect of increased HGV traffic flow on Severance, Driver Delay, Pedestrian Delay, Pedestrian Amenity, Fear and Intimidation, Accidents and Safety and Cumulative Impacts. Furthermore, consideration has been given to the environmental effects of any road improvement/widening works.

11.61 A TMP will be developed and agreed with the relevant stakeholders post consent and pre-construction in order to control and mitigate impacts associated with increased vehicles movements.

11.62 Taking into account the existing vehicle movements on the affected roads, and the proposed type and frequency of vehicle numbers, it is considered that with the appropriate mitigation measures as set out above, there will be no significant impacts.

List of References, Figures and Appendices

References

Department of Environment (2009); Best Practice Guidance to Planning Policy Statement 18 – Renewable Energy, Planning and Environmental Policy Group.

Department of Environment (2005); Access, Movement and Parking Planning Policy Statement 3, PPS 3, The Planning Service.

Department of Environment (2015); Northern Area Plan 2016. Institute of Environmental Assessment (1993);

The Institute of Environmental Assessment's Guidelines for the Environmental Assessment of Road Traffic.

Figures

Appendices

12

Shadow Flicker

12 Shadow Flicker Assessment

12.1 In sunny conditions, any shadow cast by a wind turbine will mirror the movement of the rotor. When the sun is high, any shadows will be confined to the wind farm area but when the sun sinks to a lower azimuth moving shadows can be cast further afield and potentially over adjacent properties. Shadow flicker is generally not a disturbance in the open as light outdoors is reflected from all directions. The possibility of disturbance is greater for occupants of buildings when the moving shadow is cast over an open door or window, since the light source is more directional.

12.2 Whether shadow flicker is a disturbance depends upon the observer's distance from the turbine, the direction of the dwelling and the orientation of its windows and doors from the wind farm, the frequency of the flicker and the duration of the effect, either on any one occasion or averaged over a year.

12.3 In any event and irrespective of distance from the turbines, the flickering frequency will depend upon the rate of rotation and the number of blades. It has been recommended (Clarke, 1991) that the critical frequency should not be above 2.5 Hz, which for a three bladed turbine is equivalent to a rotational speed of 50 rpm. The proposed turbines at Ballygilbert Wind Farm would rotate at a maximum of approximately 17.5 rpm, well below this threshold.

Reflected Light

12.4 A related visual effect to shadow flicker is that of reflected light. Theoretically, should light be reflected off a rotating turbine blade onto an observer then a stroboscopic effect would be experienced. In practice a number of factors limit the severity of the phenomenon and there are no known reports of reflected light being a significant problem at other wind farms.

12.5 Firstly, wind turbines have a semi-matt surface finish which means that they do not reflect light as strongly as materials such as glass or polished vehicle bodies.

12.6 Secondly, due to the convex surfaces found on a turbine, light will generally be reflected in a divergent manner.

12.7 Thirdly, the variability in flow within a wind farm results in slightly differing orientation of rotor directions, therefore it is unlikely that an observer will experience simultaneous reflections from a number of turbines.

12.8 Fourthly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience the phenomenon.

12.9 It is therefore concluded that Ballygilbert Wind Farm will not cause a material reduction to amenity owing to reflected light.

Policy and Guidance

12.10 Whilst there is no specific standard for the assessment of shadow flicker in the UK, planning requirements of shadow flicker are contained within Planning Policy Statement 18 (RE 1) “Renewable Energy” (2009) which states:

“... the development will not cause significant harm to the safety or amenity of any sensitive receptors (including future occupants of committed developments) arising from noise; shadow flicker; ice throw; and reflected light;”

12.11 The Best Practice Guidance to Planning Policy Statement 18 “Renewable Energy” (2009) further describes that,

“...at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low”.

Methodology

12.12 An analysis of shadow flicker throughout the year from Ballygilbert Wind Farm was carried out, taking into account the behaviour of the sun, the local topography and the turbine layout and dimensions. The analysis was performed using a turbine layout consisting of 14 turbines, each with maximum tip heights of 149.9 m and maximum rotor diameter of 117 m.

12.13 In accordance with The Best Practice Guidance to Planning Policy Statement 18 “Renewable Energy” (2009), as described above, analysis would be performed on all occupied houses within 1170 metres of any proposed wind turbine. There are 13 inhabited houses within ten rotor diameters of the proposed turbines.

Results

12.14 With due reference to The Best Practice Guidance to Planning Policy Statement 18 “Renewable Energy” (2009) there are 13 inhabited houses within 10 rotor diameters and, of those, 10 may experience some shadow flicker. The worst case scenario for each house is as shown in the table below.

House ID	Easting	Northing	Address	Hours of Flicker per Year
H79	332071	408420	92 Feystown Road	6.6
H88	331975	408817	86 Feystown Road	0.0
H103	334459	409278	54 Drumnagreagh Road	0.0
H124	331792	410033	72a Feystown Road	29.8
H126	331589	410086	70c Feystown Road	23.1
H127	331584	410115	70b Feystown Road	0.0
H130	331579	410150	70a Feystown Road	23.6
H133	331560	410252	68 Feystown Road	14.8
H153	334470	411327	96a Drumnagreagh Road	1.8
H157	331497	411423	54 Feystown Road	11.6

H158	334345	411444	100 Drumnagreagh Road	15.6
H185	334002	412273	67 Dickeystown Road	11.6
H192	333584	412437	61a Dickeystown Road	24.9

12.15 The number of hours per year for the 10 affected houses is relatively low and it is therefore concluded that Ballygilbert Wind Farm will not cause a significant reduction to residential amenity owing to shadow flicker. Mitigation will be assessed for the affected houses as necessary.

Mitigation

12.16 Mitigation measures can be incorporated into the operation of the wind farm to reduce the instance of shadow flicker. Mitigation measures range from planting tree belts between the affected dwelling and the responsible turbine(s) to curtailing individual turbines during periods when shadow flicker could theoretically occur.

References

[1] The Scottish Office (2002), Planning Advice Note 45

[2] Planning Policy Statement PPS22 (2004)

[3] Clarke A.D (1991), A case of shadow flicker/flashing: assessment and solution, Open University, Milton Keynes

[4] Clarke, A.D (1995), Assessment of Proposed Wind energy Project at Meenacahan, Donegal, Ireland, for Shadow Flicker, Report for B9 Energy Services Ltd

[5] Cloud Cover Statistics from the IPCC Data Distribution Centre: Visualisation Pages (2004), http://www.ipcc-data.org/java/visualisation.html

[6] Planning Policy Statement 18 “Renewable Energy” (including Best Practice Guidance to Planning Policy Statement 18) August 2009

13

Socioeconomics

13. Socioeconomics

Introduction

Background to the Study

13.1 RES commissioned Oxford Economics in the summer of 2019 to undertake a socioeconomic impact report of the proposed Ballygilbert Wind Farm, hereinafter referred to as 'the Development', which is located within the Mid and East Antrim Borough Council area. Oxford Economics subsequently updated the assessment in the summer of 2020.

13.2 The Development will have a total installed capacity of up to 58.8 megawatts (MW), consisting of 14 three-bladed turbines, with a planned operational lifespan of 30 years. It is anticipated that the electricity generated will be exported to the grid.

13.3 This report presents estimates relating to the direct, indirect and induced benefits that could be generated. It also provides a brief discussion on the unquantifiable benefits associated with a development of this type and scale, and the current macroeconomic and socioeconomic environments.

About RES

13.4 RES is one of the world's leading independent renewable energy project developers with operations across Europe, the Americas and Asia-Pacific. At the forefront of renewable energy development for over 30 years, RES has developed and/or built more than 16,000MW of renewable energy capacity worldwide. In the UK alone, RES currently has more than 1,000MW of projects either constructed, under construction or consented. RES is active in a range of renewable energy technologies including both onshore and offshore wind, solar and enabling technologies such as energy storage.

13.5 RES has been building wind farms in Ireland since the early 1990s and from their office in Larne, Co. Antrim, they have a team of over 20 working across a range of disciplines. In Northern Ireland, RES has developed and/or built seventeen wind farms with a total generation capacity of nearly 229MW.

Structure of the Report

13.6 This section of the report is structured as follows:

- Firstly, the estimated quantifiable benefits of the construction and on-going phases of the Development are presented – concentrating on employment, gross value added (GVA)[1] and wages. An assessment of the potential fiscal and environmental benefits is also included;

[1] Gross value added (GVA) measures the value of goods and services produced in an area, industry or sector of an economy and is equal to output minus intermediate consumption.

- Secondly, an overview of the socioeconomic conditions, both at the regional and local level, is provided;
- Finally, we set out our overall conclusions in respect to the Development.

Caveat

13.7 Specific information related to the Development was provided where possible by RES. The estimated benefits are based on a mix of this information, published data and reasonable assumptions.

13.8 The cost of construction could inflate or deflate depending on movements in variables such as exchange rates, demand for wind turbines and metal prices. As such the information is the best current estimate at the time of writing.

13.9 This economic impact study has been developed to form part of the environmental information to be provided to the decision maker. As such, if and when the time comes that the Development is granted full planning permission and has been built, the economic environment may look different. The analysis assumes all facilities contained in the Development are fully developed. We have considered the possibility of displacement during both the construction and operational phases of the development. It is our view that given the current and likely future performance of the local economy, there is little scope for displacement, therefore we have assumed zero levels of displacement in the modelling – see section 13.24-13.27 for further discussion.

13.10 There is no analysis within the report focusing on how the Development would impact income distribution and deprivation levels in the area. This is outside of the scope of this piece of work.

13.11 The quantifiable impacts calculated by Oxford Economics and outlined in this report come from an Economic Impact Model which uses an input-output framework, standard economic underpinnings, published data and few clearly documented reasonable working assumptions. We are aware of other reports such as the Northern Ireland Renewable Industry Group (NIRIG) commissioned study by Redpoint (referred to as "the Redpoint study") titled "The economic effects of increasing wind deployment in Northern Ireland"[2] or from the Irish Wind Energy Association (IWEA) which try to place a figure on the number of direct and indirect jobs per activity from wind farms. We normally use these only as a test of robustness when job estimates are provided by the client. We have also used reports completed by BiGGAR Economics on behalf of RenewableUK and the Department of Energy and Climate Change (DECC)[3] and on behalf of NIRIG, IWEA and RenewableUK[4] for Northern Ireland specifically, to check the number of construction- and professional-related jobs per

[2] http://149.255.57.18/~nirigweb/wp-content/uploads/2017/03/Economic-effects-2012.pdf

[3] Onshore Wind Direct & Wider Economic Impacts, May 2012, BiGGAR Economics. Date accessed: 26th July 2017. Accessed using: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48359/5229-onshore-wind-direct--wider-economic-impacts.pdf

[4] http://149.255.57.18/~nirigweb/wp-content/uploads/2017/03/Onshore-Wind-Economic-Benefits-NI.pdf

megawatt, and have found the figures to be similar in scale to those we have calculated.

13.12 Our modelling does not factor in industry support mechanisms.

Glossary of Definitions

13.13 **Backward linkages**: Backward linkages refer to the channels through which money, materials or information flows between a company and its suppliers, creating a network of economic interdependence. In terms of this study, it refers to the fact that the construction phase of the Development will require the purchase and use of raw materials from sectors like building materials; steel, architectural services etc., which themselves will create supply chain jobs in the economy.

13.14 **Full-time equivalents (FTE)**: All the modelling completed by Oxford Economics and all the impacts associated with this modelling, assumes that employment is expressed in terms of FTE, which is important given the prevalence of part-time working especially in the construction sector. Accordingly, two part-time workers make up one full-time equivalent worker.

13.15 **Gross value added (GVA):** GVA measures the value of goods and services produced in an area, industry or sector of an economy and is equal to output minus intermediate consumption.

13.16 **Direct (impact**): The direct impact is defined as the economic activity and numbers of people employed by the wind farm (both in construction and in on-going roles).

13.17 **Indirect (impact):** The indirect impact is defined as the economic activity and employment supported in the wind farm’s supply chain, as a result of their purchasing of inputs of goods and services from suppliers.

13.18 **Induced (impact):** The induced impact is defined as economic activity and employment supported by those directly or indirectly employed spending their wage income on goods and services in the wider UK economy.

13.19 **Jobs:** Any references to the employment benefits from the on-going phase once the Development becomes operational are expressed in terms of “jobs” per annum. As noted above, these jobs are full-time equivalent in nature.

13.20 **Job years:** Any references to the employment benefits from the construction phase of the Development are expressed in terms of “job years”. This is necessary given that construction phase activity normally spans more than a single year. A job year does not necessarily mean one job. Instead it refers to the amount of activity that is required. So, for example two people could be employed for six months – this would equate to one job year of work. Alternatively, one person could be employed for two years - this would equate to two job years of employment. We do not need to use the term job years when talking about the on-going phase, as these benefits are all expressed in per annum terms as discussed above.

13.21 **Nominal prices:** Nominal prices are those which reflect the current situation and are not adjusted for seasonality or inflation.

13.22 **Real prices (2016 prices):** Real prices refer to values that have been adjusted to remove the effects of inflation and are thus measured in terms of the general price level in some base reference year. They give a more accurate measure. In this case, 2016 is the base year as it is consistent with the base/reference year used within UK ONS National Accounts: the Blue Book 2018.

Quantifiable Benefits

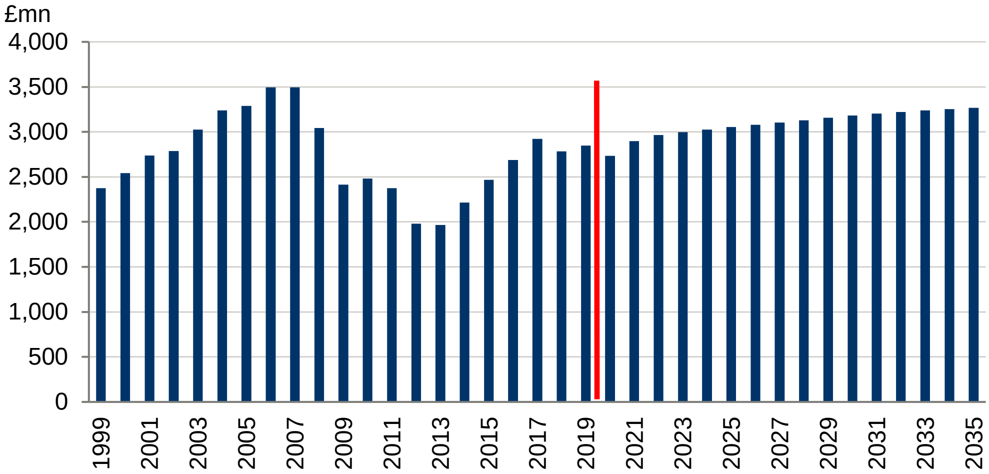
13.23 Recent headwinds facing the UK include the evolving Brexit trade deal and more recently, Covid19. Both elements have impacted current and future growth trajectories at the national level, which ultimately feed down to the regional and local level. This year we expect GDP to fall by 10.9 percent across the UK, followed by a strong bounce-back in 2021. Although we expect growth to return in 2021, it will be early 2022 before activity returns to pre-pandemic levels. However, there is a significant amount of uncertainty surrounding the longer-term impacts of Brexit; as well as the risk of a second wave of coronavirus, triggering another global lockdown. Therefore there are significant downside risks to growth across the UK. Given (as we discuss later), the Mid and East Antrim Borough Council area was already experiencing a challenging economic environment, local private sector investment should be seen in a more positive light. **A further discussion on Brexit and the impact of Covid19 is presented in section 13.72—13.80.**

13.24 This section analyses the estimated quantifiable benefits of the construction and operational phases of the Development - concentrating on employment, GVA and wages, as well as assessing fiscal and further benefits.

13.25 A key assumption behind Oxford Economics' analysis relates to displacement. We have assumed that there will be zero displacement during both the construction and operational phases of the Development. Displacement assumptions are subjective, but we have provided an analysis below to show how we arrived at our modelling assumptions.

13.26 Construction output and employment in Northern Ireland were heavily impacted by the financial recession. Figures 1 and 2 present the scale of decline and shows that recovery in both output and employment terms has been slow. Construction employment levels remain almost 30 percent below those recorded in 2008, while the value of output in the sector is six percent lower.

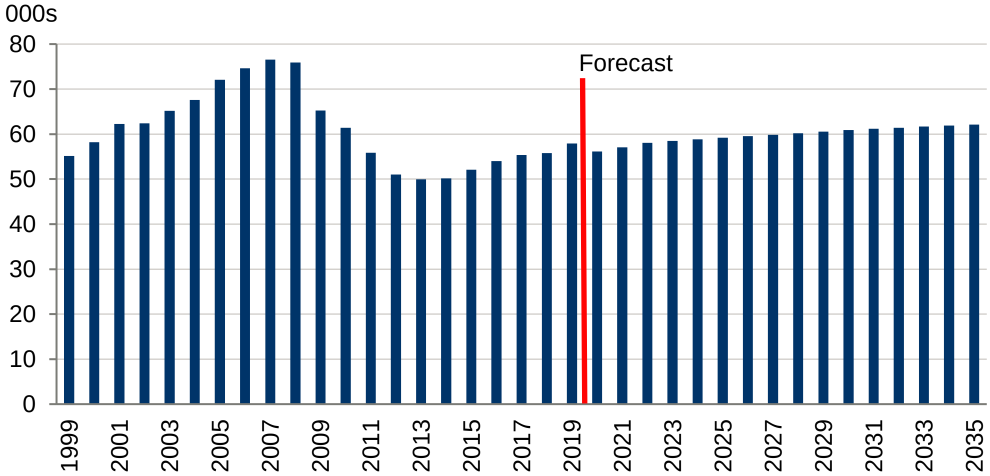
Figure 1: Construction GVA in Northern Ireland (£2016 prices)



Source: Oxford Economics

13.27 Weekly (median) wages in Northern Ireland's construction sector has experienced strong growth in recent years. According to ASHE statistics published by the Northern Ireland Statistics and Research Agency (NISRA), wage growth averaged 4.5 percent a year between 2013 and 2018. This rate of growth is notably higher than the regional as a whole (3.5 percent). Growing demand for labour in this sector, a limited supply of construction related skills or a combination of both can explain the sector's wage inflation. Nonetheless, Figure 2 shows that Northern Ireland's construction employment levels remain notably below pre-recession peaks.

Figure 2: Construction employment in Northern Ireland



Source: Oxford Economics

13.28 Therefore, we can conclude that the construction sector in Northern Ireland is likely to have enough spare capacity to accommodate the Development. As such we have applied a zero rate of displacement of current or future economic activity on the construction phase impacts.

13.29 We understand that the site for the proposed development is currently agricultural land and the Ulster walkway runs through the site. RES however has informed us that farmers will be able to continue to farm their land, as the Development owner will only lease the area/footprint of the land needed. Given the above and that the fact that the number of on-going jobs is limited in volume terms and specialised in nature, our estimates for the benefits arising from the operational phase assumes no displacement of economic or leisure activity.

13.30 We are aware of the argument that increased developments of this nature could displace jobs in fossil fuel activity. We would argue that given its size, the Development would not in isolation displace any actual activity away from the various fossil fuel power stations in Northern Ireland (Kilroot, Coolkeeragh and Ballylumford[5]).

13.31 While it could be acknowledged that cumulatively and in the long-run there may be displacement from the fossil fuel industry because of the on-going drive for increased renewables as a collective, an initiative set by the UK government in the first place in which increased renewable energy is promoted in order to meet the government's target of net zero carbon emissions by 2050..

Economic impact of the Construction Phase

13.32 The benefits associated with the construction phase of the Development (jobs, wages, GVA and fiscal) are presented as a range. This range results from the implementation of two separate methods of estimating direct construction phase impacts. The first approach uses the value of investment expected to be realised in Northern Ireland. By assigning this to sectors of the economy we can estimate GVA levels, jobs and wages (using published and or forecast data).

13.33 The second approach uses full-time job year equivalent figures provided by RES, based on previous projects they have carried out.

13.34 We then use an input-output model to estimate the indirect and induced impacts that are likely to flow from a given level of investment / activity. An input-output table provides information on how sectors purchase from one another. It also shows how households spend their income. We use UK input-output tables and adjust them to account for the local characteristics.

[5] Department for Business, Energy & Industrial Strategy: *Power stations in the United Kingdom*, May 2018. Kilroot, Coolkeeragh and Ballylumford were operational at the end of May 2018.

Method 1: Expenditure approach

13.35 The Development is estimated to result in a capital spend of approximately £39.78 million (in nominal prices). This figure is based on information provided by RES and includes estimated cost of turbines, Balance of Plant, local spend and professional services. Only a fraction of this investment however will be realised in Northern Ireland.

13.36 The total construction phase spend realisable within Northern Ireland is £8.99 million (in nominal prices)[6]. This includes approximately five percent of the estimated £29.78 million turbine cost value, through activities such as the use of local haulage companies and crane companies.

13.37 This regional/total spend split (£10.41 million/£39.78 million) is within ballpark range of that observed in reports carried out by Deloitte and IWEA.[7] The split between construction related spend and professional services related spend in Northern Ireland is assumed to be £8.99 million and £1.42 million respectively. For the purposes of our modelling, we have converted all this expenditure information into 2016 real prices, to keep it consistent with our model inputs and national accounts publications.[8]

13.38 The construction phase of the Development is scheduled to commence in March 2024 and last 18 months, starting operations in September 2025. The analysis therefore assumes a constant spend per quarter, leading to 55.6 percent of total spend being realised in 2024 and the remaining 44.4 percent in 2025. As such we use Oxford Economics baseline forecasts for GVA, productivity and wages to estimate the future impacts.

Method 2: Job posts approach

13.39 RES has provided job figures based on a nine-turbine project (totalling 18MW) with a construction period of 24-months. We have pro-rated the job figures based on 14 turbines of the Development, adjusted for the 18-month construction phase. This figure is shared across the construction and professional sector, based on the split used in Method 1.

13.40 The job figures used for modelling purposes are outlined in Table 13.1.

---

6 For this analysis, the total construction phase spend is defined as the cost for turbines, Balance of Plant (BoP), food, fuel, plant hire, road maintenance and miscellaneous.

7 Jobs and Investment in Irish Wind Energy, Powering Ireland's Economy. Deloitte and IWEA. Accessed on April 1st 2019. Weblink.

8 The construction phase and operational phase benefits within this section are expressed in real/constant prices with a 2016 base year – this is because 2016 is the base year used for all financial variables within Oxford Economics' suite of models – and thus the Economic Impact Model used to calculate this development's impacts. This is not to say 2016 data has been used – we have used the latest available data and the relevant forecast year in every case – 2016 simply refers to the base year for the constant price series. The construction spend figures provided by RES have been adjusted accordingly for consistency. This base year is used as it is consistent with the base/reference year used within UK ONS National Accounts: the Blue Book 2018.

Table 13.1: Job years adjusted for Development

Job years	14 turbine project, 18 month construction phase
Construction	74
Professional	12
Total	**86**

Source: RES.
Note: May not add due to rounding.

Direct construction phase impacts

13.41 The Development's 18-month construction phase is estimated to create or sustain between 79-86 direct job years of employment, 60-74 of which are involved with construction related activities and the remaining 19-12 job years account for professional services related activities (Table 13.2).

13.42 This direct construction phase employment would be likely to create or sustain between £2.02-£2.14 million of additional direct wages in the Northern Ireland economy. Furthermore, the investment is estimated to directly contribute between £3.86-£4.29 million to regional direct GVA.

Table 13.2: Direct benefits from the construction phase

Direct benefits	Job years	Wages (£2016m)	GVA (£2016m)
Construction related	60-74	1.46-1.81	3.1-3.84
Professional services related	19-12	0.55-0.33	0.76-0.46
Total	**79-86**	**2.02-2.14**	**3.86-4.29**

Source: Oxford Economics
Note: May not add due to rounding

Indirect and induced construction phase impacts

13.43 The supply chain (or indirect) impacts arising from the construction related activity have been estimated using the 2014 UK input-output tables (published by ONS) adjusted to take account of the structure and size of the Northern Ireland economy. In doing so we use academic guidelines like those contained in academic papers such as Flegg, A. T. and Tohmo, T. (2013) "Regional input-output tables and the FLQ formula: A case study of Finland" (Regional Studies, 47 (5). pp. 703-721).

13.44 Construction activity typically has strong "backward linkages" with sectors such as building materials, architectural services, legal services and insurance. These linkages tend to result in job creation elsewhere in the local economy. This makes investment in construction particularly effective in fuelling economic growth.

Typically offering high economic multipliers of 2.66 and 1.34 for the UK and Northern Ireland respectively. This means that for every £1 of direct output by the sector, an additional £1.66 and £0.34 is created in the wider UK or Northern Ireland economy, respectively.

13.45 Indirect GVA impacts in Northern Ireland are therefore estimated to be approximately £0.83-£0.97 million, creating or sustaining an estimated 19-22 job years of employment, with associated wages of £0.43-£0.50 million (Table 13.3).

Table 13.3: Total benefits from the construction phase

Total (direct, indirect and induced) benefits	Job years	Wages (£2016m)	GVA (£2016m)
Direct	79-86	2.02-2.14	3.86-4.29
Indirect	19-22	0.43-0.5	0.83-0.97
Induced	22-24	0.41-0.44	0.85-0.93
Total	**120-132**	**2.85-3.09**	**5.53-6.19**

Source: Oxford Economics
Note: May not add due to rounding

13.46 As both direct and indirect wages generated through the construction phase are spent—a further round of benefits will spread through the region. This induced effect will support wider employment of approximately 22-24 job years alongside £0.41-£0.44 million of wages. Through the numerous rounds of supply chain and consumer spending, all sectors in the economy will experience some degree of benefit (Table 13.4).

13.47 It is worth noting that the estimated benefits are at a Northern Ireland level. An exact amount attributable to the Mid and East Antrim Borough Council area is more difficult to identify and outside the scope of this report. Invariably it depends on the location of the companies appointed that enjoy the direct benefits and the location of the suppliers who provide them with the materials. However, speaking qualitatively, RES has informed Oxford Economics that their previous projects have utilised local contractors when possible and it remains their intention to use local suppliers and labour for much of the Balance of Plant (BOP) work. It makes sense, not least in terms of the costs and distance argument, to use local firms (e.g. looking at the cost of transporting aggregates). That is, local firms can prove to be more cost efficient given the closer proximity to required capital, personnel and resources. This means that the vast majority of the direct and indirect benefits are likely to be realised within Northern Ireland, with Mid and East Antrim enjoying some uplift at the local level.

13.48 The benefits quantified above have been tested for robustness against reports compiled by BiGGAR Economics on behalf of RenewableUK and the Department of

Energy and Climate Change (DECC)[9], and on behalf of NIRIG, IWEA and RenewableUK, for Northern Ireland specifically[10]. In most cases, the benefits were of a similar magnitude when looking at jobs per megawatt.

13.49 The aforementioned BiGGAR Economics report backs up the scale of benefits that can be experienced locally, citing the: "…many local economies throughout the UK over the last few years, which have experienced significant direct, supply chain and wider economic benefits from onshore deployment."

Table 13.4: Total sectoral benefits from the construction phase

Total (direct, indirect and induced) benefits	Job years	Wages (£2016m)	GVA (£2016m)
Agriculture, forestry and fishing	1-1	0.01-0.01	0.01-0.01
Mining and quarrying	1-1	0.02-0.02	0.02-0.03
Manufacturing	3-4	0.08-0.1	0.21-0.25
Electricity, gas, steam and air conditioning supply	0-0	0.01-0.01	0.02-0.02
Water supply; sewerage, waste management and remediation activities	0-0	0-0	0.01-0.01
Construction	65-81	1.6-1.98	3.39-4.19
Wholesale and retail trade; repair of motor vehicles and motorcycles	6-6	0.09-0.1	0.24-0.27
Transportation and storage	1-2	0.04-0.04	0.06-0.07
Accommodation and food service activities	4-5	0.05-0.05	0.08-0.09
Information and communication	1-1	0.03-0.03	0.06-0.06
Financial and insurance activities	1-1	0.03-0.03	0.08-0.09
Real estate activities	6-6	0.11-0.12	0.26-0.29
Professional, scientific and technical activities	21-14	0.61-0.4	0.84-0.54
Administrative and support service activities	5-6	0.09-0.11	0.11-0.13
Public administration and defence; compulsory social security	0-0	0.01-0.01	0.02-0.02
Education	1-1	0.02-0.03	0.03-0.03
Human health and social work activities	1-1	0.02-0.02	0.03-0.03
Arts, entertainment and recreation	1-1	0.01-0.01	0.02-0.02
Other service activities	1-1	0.02-0.02	0.03-0.03
Total	**120-132**	**2.85-3.09**	**5.53-6.19**

Source: Oxford Economics
Note: May not add due to rounding

Economic impact of the operational phase

13.50 The starting point for modelling the operational phase of the project uses operations and maintenance direct job post figures again provided by RES, based on their

[9] Onshore Wind Direct & Wider Economic Impacts, May 2012, BiGGAR Economics. Accessed on April 1st 2019. Weblink.

[10] Onshore Wind: Economic benefits in Northern Ireland. NIGIR, IWEA, RenewableUK. Accessed on April 1st 2019. Weblink

extensive experience of operating projects not only in Northern Ireland but across the UK. RES has informed Oxford Economics that the Development will sustain one direct FTE job a year, in the capacity of an asset manager (Table 13.5).[11]

13.51 From there, all indirect and induced estimates are produced using the Economic Impact Model.

Direct operational impacts

13.52 Following the 18-month construction phase, the development is expected to be operational in September 2025. The operational phase impact estimates have therefore been produced using Oxford Economics' 2025 forecasts of both GVA, productivity and wages. Additional earnings/wages have been estimated using Oxford Economics forecasts for average annual earnings per worker from the broad sector 'Electricity, gas and steam' in 2025 (these forecasts are themselves based on published data in the Annual Survey of Hours and Earnings).

13.53 The total direct wage is estimated to be £0.06 million per year. After applying productivity estimates, the on-going direct employment is expected to generate £0.19 million of GVA a year. Given the 30-year lifetime of the development, this equates to 30 direct jobs, £1.70 million of direct wages and £5.71 million of direct GVA over the entirety of the operational phase.

Table 13.5: Direct annual benefits from the operational phase

Direct benefits	Job years	Wages (£2016m)	GVA (£2016m)
Asset manager	1	0.06	0.19

Source: Oxford Economics
Note: May not add due to rounding

Indirect and induced operational impacts

13.54 The electricity industry plays a significant role in enabling other parts of the economy to be more productive. The sector itself is one of the most productive in Northern Ireland, with output per worker significantly above that of the region overall. This reflects both the impact of high levels of investment and improving technology on productivity in the sector.

13.55 Using the adjusted UK input-output tables to identify the supply chain spending, it is estimated that the Development is likely to create or sustain a further indirect job in the Northern Ireland economy each year, with wages of £0.03 million and GVA of £0.06 million per annum respectively (Table 13.6).

[11] Given spare capacity in the economy and the relatively small scale of the development, assumptions include job displacement of zero relating to the operational phase estimates – see 13.24-13.27 for further discussion.

Table 13.6: Total annual benefits from the operational phase

Total (direct, indirect and induced) benefits	Job years	Wages (£2016m)	GVA (£2016m)
Direct	1	0.06	0.19
Indirect	1	0.03	0.06
Induced	1	0.01	0.03
Total	**3**	**0.10**	**0.28**

Source: Oxford Economics
Note: May not add due to rounding

13.56 As both direct and indirect wages generated through the operational phase are spent—a further round of benefits will spread through the region. This induced effect will support another job alongside £0.01 million of wages. Through the numerous rounds of supply chain and consumer spending, all sectors in the economy will experience some degree of benefit (see table below).

Table 13.7: Total annual sectoral benefits from the operational phase

Total (direct, indirect and induced) sectoral benefits	Jobs	Wages (£2016m)	GVA (£2016m)
Agriculture, forestry and fishing	0	0.00	0.00
Mining and quarrying	0	0.01	0.02
Manufacturing	0	0.00	0.01
Electricity, gas, and steam	1	0.06	0.22
Water supply; sewerage and waste	0	0.00	0.00
Construction	0	0.00	0.00
Wholesale and retail	0	0.00	0.01
Transportation and storage	0	0.00	0.00
Accommodation and food	0	0.00	0.00
Information and communication	0	0.00	0.00
Financial and insurance	0	0.00	0.01
Real estate	0	0.00	0.01
Professional, scientific and technical	0	0.00	0.00
Administrative and support	0	0.00	0.00
Public administration and defence	0	0.00	0.00
Education	0	0.00	0.00
Human health and social work	0	0.00	0.00
Arts, entertainment and recreation	0	0.00	0.00
Other services	0	0.00	0.00
Total	**3**	**0.10**	**0.28**

Source: Oxford Economics
Note: May not add due to rounding

Increased tax revenues and benefit savings

13.57 As part of this analysis it is assumed that approximately 34.4 percent of total wages would be paid to the Treasury through the channels of taxation.[12] This considers not only income tax, but value added tax through the purchase of goods and services by those in direct, indirect and induced employment.

13.58 During the construction period of the Development, tax receipts are likely to reach between £0.98-£1.06 million (including direct, indirect and induced wage impacts).

13.59 The operational phase is estimated to generate approximately £0.03 million in additional tax receipts each year of operation (Table 13.8). Over 30 years this would equate to £1.02 million in additional tax revenue.

Table 13.8: Annual tax revenues arising from the proposed Development

Tax revenue (over entire construction phase; per annum of on-going phase)	Wages (£2016m)	Tax revenue (£2016m)
Construction phase	2.85-3.09	0.98-1.06
Operational phase	0.10	0.03
Total	**2.95-3.19**	**1.01-1.09**

Source: Oxford Economics
Note: May not add due to rounding

13.60 In addition to tax receipts, employment creation will provide benefit savings. That is, assuming that each additional job attracts someone from the ranks of the unemployed directly or indirectly through the “job chain” effect, the construction or on-going operation of the site. While the Development may take someone from their current job, they will leave a vacancy and that will have to be filled, and so on and so forth – so eventually, a job will be filled down the line by someone from the ranks of the unemployed, though not necessarily directly. As such, the creation of a new job in the economy will lead to a reduction in the unemployed by a similar amount.

13.61 Currently, unemployment benefit varies between £58.90 and £116.80 per week.[13] Using these lower and upper levels, we estimate between £0.37-£0.80 million of savings will be made during the construction phase of the Development (Table 13.9).

[12] Based on the ONS publication ‘The effects of taxes and benefits on household incomes, 2017/18’. Table 9. Accessed September 24th 2019. Weblink. Direct tax as a share of gross income is 20.7 percent, and indirect taxes as a share of disposable income is 13.7 percent. Combined this information suggests that 34.4 percent of gross income is paid to the Treasury via taxation.

[13] Figures taken from https://www.gov.uk/jobseekers-allowance/overview. Date accessed: 12th September 2019

Table 13.9: Annual benefits saving arising from the construction phase

Construction phase	Unemployment savings (£2016m)	
	Upper	Lower
Direct	0.48-0.52	0.24-0.26
Indirect	0.12-0.13	0.06-0.07
Induced	0.13-0.14	0.07-0.07
Total	**0.73-0.80**	**0.37-0.40**

Source: Oxford Economics
Note: May not add due to rounding

13.62 In addition, the on-going benefits are estimated to provide unemployment savings of between £1.29-£1.55 million over the project's lifetime.

Other quantifiable benefits of the Development

Rates and taxes

13.63 Land & Property Services (LPS) has recently revalued all business properties in Northern Ireland under Reval2020. Following a discussion with the LPS earlier this year, in April 2020, with regards to a suitable rateable value for wind farms in Northern Ireland; Oxford Economics agreed to use RES' assumption of £13,293 per megawatt per annum for this analysis. Given the Development will have a total capacity of 58.8MW, this means a figure of £0.8 million in rateable value is available to the government annually, or approximately £23.45 million over the course of the project.

13.64 It should be noted that there is a difference in the rateable value charged on which the above figures are based, and the business rates revenue collected by the local Councils and the Northern Ireland Assembly – allowing for regional and Borough rate poundages. The most recent figures for Mid and East Antrim Borough Council indicate (total) non-domestic poundage rates of 58.8p for every £1, of which 27.9p is a regional rate paid to the Northern Ireland Assembly, and 30.9p of which is a Borough rate paid to the local Council.[14]

13.65 By applying the Non-Domestic Rate Poundage for Mid and East Antrim Council area, the above rateable values would leave additional business rates revenue of £0.46 million per annum and £13.79 million over the 30-year lifetime of the project. In every case, 52.6 percent of the totals would be attributable to the local Council and the remaining 47.4 percent would be realised by the Northern Ireland Assembly.

13.66 All these additional payments referred to in this paragraph will result in increased income to the recipients, who will spend it in the Northern Ireland economy; over

[14] https://www.finance-ni.gov.uk/articles/poundages-2020-2021. Date accessed: 29th July 2020.

and above those already accounted for in the construction and on-going operations phase results.

13.67 Over the lifetime of the project, rates and taxes will collectively amount to approximately £14.81 million. Due to sensitivity issues this figure excludes land rent contributions.

Energy and Environmental benefits

13.68 According to a report published by Northern Ireland's Department for the Economy, namely 'Energy in Northern Ireland 2020'[15], Northern Ireland had the largest percentage increase in the number of enterprises in the energy sector between 2010 to 2019, compared to other regions in the UK. Over this period, the region recorded an increase of 256 percent compared to 123 percent across the UK as a whole. Furthermore, of the total Low Carbon and Renewable Energy (LCRE) activity in Northern Ireland in 2018, Energy Efficient Products was the group that accounted for the largest proportion of activity—in terms of turnover and employees. This progress complements energy policies both nationally and regionally which highlight the need to move away from finite energy sources toward more renewable energy.

13.69 The Development is a 58.8MW wind farm consisting of 14 x 4.2MW turbines. The amount of electricity that could be produced by the Development is estimated at 236.9gWh per year which is enough electricity to meet the needs of 61,900 homes each year[16], over 5,000 more than the current housing stock (of approximately 56,000[17]) in the local area.

13.70 The Development is also estimated to reduce CO_2 emissions by 109,000 tonnes each year. This equivalent to 68,700 newly registered cars.[18]

13.71 Not only does the generation of electricity through wind present environmental benefits but it also produces benefits for consumers. A recent independent study by Baringa Partners[19] into the benefits of wind energy in Northern Ireland found that renewable electricity produced by wind has benefited consumers. The study estimates that each consumer receives a payback of £4 each year since 2000.

[15] https://www.economy-ni.gov.uk/sites/default/files/publications/economy/Energy-In-Northern-Ireland-2020.pdf

[16] For Ballygilbert, a load fact of 0.46 was provided by RES and applied to Oxford Economics' calculations. This load factor allows us to account for wake and electrical losses using typical wind speeds/directions etc. to give a realistic prediction of electricity output (rather than using a theoretical maximum level whereby it is assumed that wind blows for 24 hours a day 365 days a year on every wind farm site.)

[17] Oxford Economics Internal Model Suite.

[18] https://www.gov.uk/government/publications/new-car-carbon-dioxide-emissions

[19] http://res-group.mediaroom.com/how-wind-pays-back-to-consumers

Socioeconomic Context

Northern Ireland and Mid and East Antrim Borough Council area

13.72 Brexit and Covid19 will impact growth prospects in the UK, its regions and local areas, including Mid and East Antrim Borough Council area. The following section considers the recent and future labour market performances of the region and the local area.

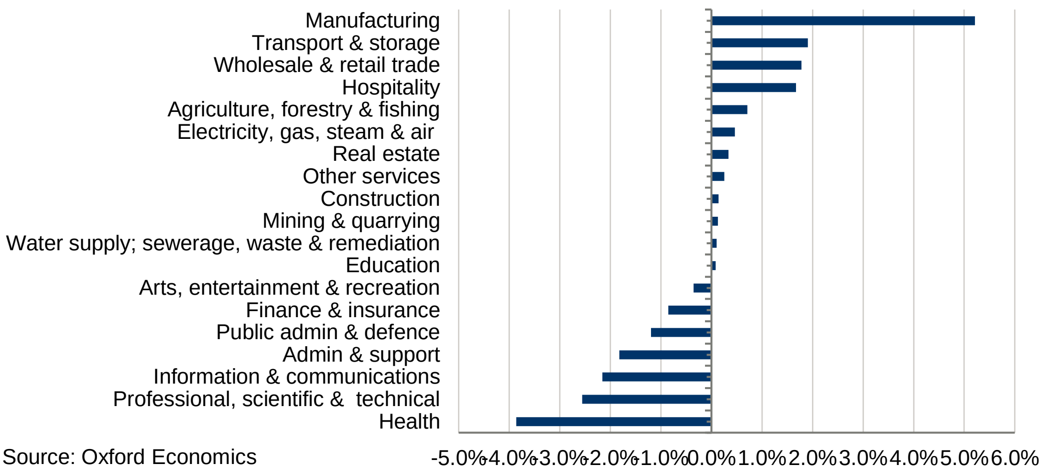
13.73 In employment terms, Northern Ireland was the most heavily impacted region by the financial recession, and recovery has been slow. Between 2008 and 2012, the number of jobs in the region contracted by 6.9 percent – notably more than the UK average (of -0.6 percent) – and it was only recently, in 2016, when levels surpassed pre-recession records. Over the same period, construction employment in Northern Ireland was among the hardest hit sector in the region, accounting for 42 percent of overall job losses. Though the sector has seen some recovery in recent years, employment in this sector remains below levels recorded before the downturn. More specifically, the number of construction jobs in 2019 is estimated to be approximately 25 percent below those recorded in 2007.

13.74 Both Brexit related uncertainty and wider economic headwinds have contributed to relatively weak employment growth within the Council area in recent years. Between 2016 and 2019, job growth in the Council area averaged 0.6 percent per year—1.1 percentage points below the regional average, ranking it the second weakest performer of all Council areas in Northern Ireland. Over this period, job growth was supported by the health and hospitality sector, however, these gains were offset by the contraction in manufacturing.

13.75 Looking ahead, the absence of a free trade agreement with European markets would increase costs (via tariff and non-tariff barriers), thereby adversely impacting competitiveness—adding more pressure to the already declining manufacturing sector; particularly those that are more reliant on exports. That and other Brexit-related uncertainty, coupled with the Covid19 pandemic, will continue to weigh on the national, regional and local economy near-term prospects. By the end of 2020, we expect a contraction of 1,500 jobs within the Council area. Of these losses more than 60 percent are expected within the wholesale & retail trade and hospitality sectors—an impact of the social distancing measures and changes to travel policies following the onset of the pandemic. After which point, job growth across Northern Ireland is expected to be positive, albeit muted, however, the local area is expected to shed jobs. Between 2021 and 2035, the number of jobs in the Council area is expected to decline by 0.3 percent per year, compared to growth of 0.1 percent at the regional level. Thereby highlighting the need for local investment including the construction and operation of the Development.

13.76 Employment growth prospects in the Council area can be, in part, explained by the area's employment structure. The figure below plots the percentage point difference between the share of employment by sector in Mid and East Antrim Borough Council area to the average for Northern Ireland. Sectors with a positive value employ a greater share of employment in the local area than the region as a whole. Conversely, sectors with a negative value employ a smaller share of employment in the local area compared to the regional average.

Figure 3: Sectoral concentration of employment, Council area v Northern Ireland, 2019



Source: Oxford Economics

13.77 Compared to Northern Ireland as a whole, the local area is overrepresented in sectors which have weak employment growth prospects – such as manufacturing. Between 2021 and 2035, the manufacturing sector will continue to shed jobs at a rate of 1.8 percent a year, equivalent to almost 2,000 job losses. Furthermore, the local area is largely underrepresented in sectors likely to drive employment growth at the national level – such as health and admin & support. As such the Council area's low exposure to growth sectors will limit the scope to replace lost manufacturing employment. Over the 2021 to 2035 period, health is expected to be the largest contributor to job growth in the local area, providing only 400 net additional jobs.

13.78 Analysis of other labour market indicators further support the economic need for new employment opportunities. Our data shows that not only is the inactivity rate (the people who are not in employment, unemployed either because they are retired, students and/or long-term sick) for the local area above the regional average, but it also has a higher unemployment rate. According to our latest estimates, the unemployment rate (ILO definition) for the local area stood at 2.7 percent in 2019, in line with Northern Ireland as a whole. By the end of 2020, we expect the rate to more than double in the local area, reaching 5.7 percent. This compares to 4.3 percent across the Northern Ireland as a whole.

13.79 Furthermore, estimates from the Annual Population Survey show that working age economic inactivity rates within the local area is one of the highest in Northern Ireland, with over a quarter of working age residents were economically inactive in

2018. And given we expect employment to fall and unemployment to rise suggests that a larger proportion of residents will find themselves joining the economically inactive population.

13.80 Combined, this evidence base highlights the need for new job prospects in the local economy. Indeed, investment into local climate change assets will help to support the jobs recovery within the Council area, but also more widely via multiplier effects. Investment into such projects will also help to strengthen the UK's overall energy networks, helping to achieve the government's target of net zero emissions by 2050 and reduce the UK's reliance on energy imports.

Local skill levels among the lowest in Northern Ireland

13.81 At both ends of the educational spectrum, the Mid and East Antrim Borough Council area underperforms compared to others in Northern Ireland. According to figures published by NINIS, the proportion of the Council area's working age residents (aged between 16-64) having attained degree level qualification or above stood at 30.1 percent in 2018 – among the lowest of Northern Ireland's Council areas and lagging behind the regional average (34.9 percent). In addition, the local area has one of highest share of working age residents with below NVQ 4 at 52.6 percent in 2018. Once again this is notably below the regional average (50.4 percent).

13.82 Relatively poor skill levels are likely to mean residents invariably do not possess the skills demanded by employers and are therefore more likely be excluded from the labour market. Weak job growth coupled alongside below average skill levels are likely to contribute to economic inactivity and social exclusion within the local community.

13.83 The local economy faces some key socio-economic challenges, which have been further exposed by the last recession. The relatively weak employment outlook is likely to make it more challenging for the local council to address economic need and development. Therefore, investment and development opportunities in the area should be encouraged in order to promote opportunities and boost economic growth prospects.

Conclusions

13.84 The Development will offer a much-needed boost of activity to the local and regional economy. Job creation and economic activity will result throughout its construction, with a strong likelihood of local labour involvement. Both the construction and operational phase will generate increased tax and business rates revenue payable to central, regional and local government.

13.85 Indeed, the Mid and East Antrim economy has faced a challenging backdrop in recent years; and given its exposure to the manufacturing sector, the local area has struggled to create job opportunities over the last decade. Therefore, the labour market conditions have not been ideal in the lead up to the coronavirus outbreak, and its subsequent lockdown. Given the lockdown will have a significant impact on local businesses for at least the short term and put upward pressure on local unemployment, investment of this type and scale can provide positive (direct, indirect and induced) benefits across Northern Ireland; helping to provide and support economywide employment opportunities that would not otherwise have existed. It can also bring about catalytic benefits which can in turn attract further investment into Northern Ireland. For example, the knowledge, expertise and skills accumulated can act as a contributing factor to future investments in the area. Other local areas within Northern Ireland may also benefit as a result, helping to reduce the inequality across the region. Funding for such developments are usually project specific and involve a considerable amount of sunk costs. **Therefore, if the development does not take place the benefits, including the catalytic impact, are unlikely to be realised elsewhere in the Northern Ireland economy.**

13.86 The Development is estimated to involve a capital spend of £39.78 million. Of this total, £10.41 million (nominal prices) will be realised within the Northern Ireland economy. The projected 18-month construction phase is estimated to create or sustain 120-132 total (direct, indirect and induced) job years of employment, £2.85-£3.09 million (2016 prices) of wages and £5.53-£6.19 million (2016 prices) of GVA to the Northern Ireland economy.

13.87 The estimated total (direct, indirect and induced) benefits realised in Northern Ireland by the operational phase of the proposed Development includes wages of £2.95 million (2016 prices) and £8.36 million (2016 prices) in GVA over the 30-year operating period.

13.88 We also expect a fiscal injection from the Development. During the construction, the UK Exchequer is estimated to benefit from increased tax revenue of £0.98-£1.06 million. Over the 30-year operational phase, an estimated £1.02 million revenue will be generated and a further £1.29-£1.56 million in benefit savings.

13.89 Based on rateable values of £13,293 per MW—we calculate that the Development will increase rateable value by £0.8 million each year, or by £23.45 million over the project horizon. From these values business rates are calculated and collected for local Councils and the Northern Ireland Assembly. By applying Mid and East Antrim non-domestic poundage rates, we estimate additional business rates of £0.46 million each year and £13.79 million, or 60.1 percent of the Development’s rateable value, over the 30-year lifetime of the project.

14

Summary of Mitigation

14 Summary of Mitigation

Alongside each mitigation measure identified, the proposed mechanism by which it will be adopted, implemented or enforced has been provided as well as the period by and /or timing which the mitigation measure will be undertaken.

Summary of Mitigation

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
Chapter 4	LVIA	The exterior surfaces of the turbines will be painted in a recessive, non-reflective light grey colour to minimise their visual prominence against the sky in most weather conditions.	By condition.
		Ancillary facilities, such as the control building, substation and energy storage compounds, have been designed in a manner that is sensitive to the immediate landscape character with regards to location, scale, colour, and choice of materials. These facilities have also been sited positioned on lower lying ground in between Scawt Hill and Craigy Hill and would be largely screened from view from the surrounding landscape by the site topography.	Through Construction & Decommissioning Method Statement (CDMS) to be agreed with the Planning Authority prior to construction and implemented during construction.
		The site entrance will utilise and upgrade an existing gateway located to the west of the Development off Feystown Road rather than be newly formed.	By Condition.
Chapter 5 Archaeology and Cultural Heritage	Potential direct effects on currently undiscovered archaeological remains and heritage assets on site	A programme of archaeological works can be implemented ahead of the development to detect and record any remains prior to any impact. This would be agreed with HED:HM.	By Condition. Programme of Works to be agreed with the Planning Authority prior to construction and implemented during construction
		Provision of information boards for the Carin on Scawt Hill and the Standing Stone (SM2) could be produced for these assets, and placed along the Ulster Way in agreement with HED:HM	By Condition
Chapter 6 Ecology	General	Measures required to address ecological concerns described in this ES during the construction phase will be incorporated within a Construction and Decommissioning Method Statement (CDMS), which will be submitted to and agreed with the Planning Authority at the pre-construction stage.	By Condition. CDMS will be agreed with the Planning Authority prior to construction and implemented during construction.

	Designated Watercourses	The contractor will prepare a CDMS prior to construction activities to provide a method statement for working practices that will include measures, among others, to prevent adverse impacts on rivers and other watercourses. Refer to the SUDS design Statement in Appendix 9.1.	By Condition HMP to be agreed with NIEA / the Planning Authority prior to construction and implemented during construction and operation.
	Loss of Wet Heath / degraded Blanket Bog	Heathland restoration and enhancement according to the Outline HMP (Appendix 6.6).	By Condition HMP will be agreed with the Planning Authority prior to construction /NIEA and implemented during construction
	Bats collision risk of bats with turbine blades (under precautionary principle).	The proposed turbine layout was amended to ensure a minimum stand-off distance of 50 m (Natural England TIN051) to all habitat edges (shelterbelts and natural watercourses) which will be maintained through the lifetime of the Development. A Bat Monitoring & Mitigation Plan (BMMP) will be implemented under the Precautionary Principle.	By Condition BMP to be agreed with NIEA / the Planning Authority prior to construction and implemented during construction and operation.

	Impact on Common Lizard	Depending on the commencement of construction on site, the works corridor will be mowed. If possible, this work will be undertaken before the end February (to avoid a conflict with the bird breeding season). If this is not possible, then mowing will take place between August and September, when common lizards are likely to be fully active. Should the latter be required, the corridor will be subjected to an active nest survey by a suitably qualified ornithologist immediately prior to the commencement of mowing operations. Clearance of stones, tree stumps, logs, brash, rocks or piles of similar debris will be undertaken carefully and by hand. Although this is only required in a few areas where the proposed site tracks traverse low stone walls. This work will not take place during the hibernation period for common lizard (i.e. mid-October to mid-March). Clearance of tall vegetation will be undertaken using a strimmer or brush cutter with all cuttings raked and removed the same day. Cutting will only be undertaken in a phased way which will either include: Cutting vegetation to a height of no less than 30mm, clearing no more than one third of the site in anyone day or; Cutting vegetation over three consecutive days to a height of no less than 150mm at the first cut, 75mm at the second cut and 30mm at the third cut; Following removal of tall vegetation using the methods outlined above, the remaining vegetation will be maintained at a height of 30mm through regular mowing or strimming to discourage common lizards from returning. Ground clearance of any remaining low vegetation (if required)	By Condition CDMS and HMP, which will be agreed with NIEA / Planning Authority prior to construction and implemented during construction.

		and any ground works will only be undertaken following the works described above. As an additional precaution the ECoW will be present from the commencement of clearance/construction with a watching brief to ensure that no common lizards remain within the construction corridor and remain in situ until the area is cleared to ensure no species or habitat conflicts emerge affecting damage to the local lizard population. If any common lizards are found during excavation works, all works within the affected area will cease until the ECoW has safely removed them (under licence) from the construction corridor. Should it prove necessary during site supervision (i.e. lizards are observed returning to the construction corridor); a protective lizard barrier fence will be installed along both sides of the construction corridor in order to prevent common lizards from entering the works area.	
Chapter 7 Ornithology	Impacts during bird breeding season	The Ornithology Mitigation Strategy (OMS) would be completed during the construction of the wind farm where this is during the bird breeding season (1st March to 31st August) and would aim to avoid any significant disturbance to the relevant breeding bird species found within the vicinity of the Development.	By Condition CDMS which will be agreed with NIEA / Planning Authority prior to construction and implemented during construction. During Construction

	Breeding Snipe Moorland passerines	The HMP for the wind farm should include measures that would be beneficial for snipe and if at all possible, some of these measures should be within parts of the Development site that are located >400 m from turbines Habitat measures implemented for snipe are likely to have a significant enhancement effect for several moorland passerine species within the survey area	HMP to be agreed with NIEA / the Planning Authority prior to construction and implemented during construction and operation.
Chapter 8 Fisheries	Sediment Run off	During the construction phase it is important that works should be avoided within the area of sensitive watercourses, with the preservation of intact vegetated buffer zones between the development infrastructure and stream channels. To this end, buffer zones of 30m and 70m minimum width for minor and major watercourses, respectively. The larger minimum buffer of 70m will apply to the Clady Burn, which is a key watercourse in its downstream reaches in terms of potential fisheries sensitivity.	CDMS, to be agreed with the Planning Authority prior to construction and implemented during construction.
	Surface Water Management	A surface water management plan will be developed using the principles of Sustainable Drainage, based on the on-site retention of flows and use of buffers, swales, check-dams and other silt removal techniques. Implementation of the management plan will prevent any adverse effects on the ecology of the principal receiving watercourses during the construction phase of the project.	
	Water Quality Monitoring	Implementation of a water quality monitoring programme to examine the effects of the infrastructure construction works on surface water quality.	

	Release of other pollutants	A Pollution Prevention Plan will be included as part of the Construction & Decommissioning Method Statement (CDMS) for the Development, to be agreed with the local planning authority at the pre-construction stage. This will incorporate a contingency plan setting out the procedure to be followed in the event of a significant spillage occurring.	
	Surface Water Run-off (Operational Phase)	As outlined in Chapter 9, site drainage will use the principles of SuDS, with installations to incorporate a "treatment train" of two to three stages of pollutant removal to all surface water runoff during the operational phase, as with the construction and decommissioning phases. Additional measures to prevent the release of suspended solids will include: • Preservation of natural run-off patterns; • Reduction of flow rates from access tracks through use of attenuating check-dams; • Use of shallow ponds to aid settlement; • Linear track drainage swales with regular outflow points throughout the SuDS system to limit the potential for large flows at single outflow points; • Avoidance of peat storage within denoted watercourse buffer zones or in areas of overland water flow.	

Chapter 9: Geology & Water Environment	Site Drainage Management & SuDS Design	The proposed development will adopt a surface water management plan / site drainage design using the principles of Sustainable Drainage, promoting the principles of onsite retention of flows and use of buffers and other silt removal techniques. All drainage related mitigation measures proposed will be encompassed by a robust and proven Sustainable Drainage System (SuDS) design which will be used to control drainage and silt management on the site. Onsite drainage design will minimise modification and disruption of the existing natural hydrology. Drainage design will reduce chemical, silt and other suspended pollutant transport by providing a "treatment train" of two to three stages of pollutant removal to all surface water runoff nominally by: • Ensuring that drainage swales are designed to convey flows at a low velocity by using a wide, flat bottomed drain; • Providing settlement and filtration features in all linear drainage swales (check dams, filtration dams) to reduce flow velocity and encourage settlement; • Encouraging appropriate vegetation growth in the base of all linear drainage to provide additional filtration to flows; • Providing settlement ponds at turbine hard standing areas and other key discharge locations in order to provide treatment to contaminated runoff prior to discharge; • Discharging surface water runoff over undisturbed vegetated ground, hence allowing any remaining silts and other pollutants to drop out of flows before entering the watercourse (having the effect of polishing the runoff); • Preventing the discharge of surface water runoff flows directly to existing watercourses	CDMS and CEMP, which will be agreed with the Planning Authority prior to construction and implemented during construction. Outline SUDS is provided in Technical Appendix 9.1

		or drainage. All discharges shall seek to be via SuDS and buffer zones which will act as a filter strip, allowing deposition of suspended solids and other pollutants; • Providing settlement features in water channels downstream of areas of peat infilling and ditch blocking area proposed as part of habitat management and enhancement planning.	

	Watercourse crossings	Culverts will be designed to accommodate track crossings and minimise length of affected channel in order to comply with Revised PPS15 policy FLD4. Hydraulic design of crossings will be undertaken as per the guidance and requirements provided in CIRIA C689 "Culvert Design and Operation Guide" (or other standard as may be required by DfI Rivers in post-consent consultation), with primary parameters likely to include: • Width of the culvert will be greater than the width of the active drainage channel; • Alignment of the culvert will suit the alignment of the drainage channel, i.e. preserve the existing direction of flow; • The slope of the culvert will not exceed the slope of the bed of the existing drainage channel. • Detailed design of crossings will assume a hydraulic capacity requirement of 1% Annual Equivalent Probability flow as a conservative measure. Detailed hydraulic design of culverts and similar structures post permission is normal and accepted practice for wind farms in Northern Ireland. • Fisheries shall be protected (where applicable) by adopting the guidance stated in Guidelines for Fisheries Protection during Development Works as published by Loughs Agency.	CDMS and CEMP, which will be agreed with the Planning Authority prior to construction and implemented during construction.

		Consultation and approval will be sought from all relevant parties as required by the DAERA Surface Waters Alteration Handbook (November 2017), including and DfI Rivers in particular, at the pre-construction detailed design stage for all works in and affecting watercourses and drains, as per the requirements of Schedule 6 of the Drainage (Northern Ireland) Order 1973 and subsequent amendments. Given that all proposed culverts are of a conventional type and in a number of instances coincide with and replace existing culverts, it is anticipated that Rivers approvals for culvert works can be deferred post-determination of the planning application.	

	Water Quality Monitoring	A water quality monitoring program will be implemented to monitor effects on the surface water quality regime during the infrastructure construction, operational and decommissioning phases of the proposed development, in order to; Demonstrate that the mitigation measures and surface water management is performing as designed; Provide validation that the in-place mitigation measures are not having an adverse effect upon the environment; Indicate the need for additional mitigation measures to prevent, reduce or remove any effects on the water environment, such as additional temporary settlement or filtration structures or short-term flocculant dosing to suit observed site conditions. The monitoring would be informed by existing water quality baseline data and baseline monitoring rounds undertaken prior to the commencement of the construction phase. It is intended that the water monitoring extent, duration and frequency will be agreed with the Department of Infrastructure or the relevant regulating body (nominally NIEA WMU) post consent and will nominally consist of physicochemical and biological monitoring. The extent, duration and frequency of the monitoring will be proportionate to the level of activity during each phase of the proposed development and the associated perceived risks.	Through CDMS, which will be agreed with the Planning Authority prior to construction and implemented during construction. Operational phase. Decommissioning Method Statement

	Pollution Prevention	A detailed Pollution Prevention Plan (PPP) will be implemented and monitored by the site manager as part of a full Construction & Decommissioning Method Statement (CDMS) for the project, to be submitted post-consent following detailed site investigations and agreed with the local planning authority. Although this will be of particular importance during construction, it will apply to potentially polluting activities during all phases of the proposed development. The detailed PPP will be produced following consultation and agreement with NIEA, and all appropriate personnel working on the Site will be trained in its use. As a minimum, the PPP will comply with Guidance for Pollution Prevention (GPP) and Pollution Prevention Guidelines (in particular GPP 21: Pollution Incident Response Planning) and best practice as advocated by CIRIA. The PPP will identify site-specific measures and incorporate a Pollution Incident Plan, which will include emergency contact details, details of spill kits on the Site and instructions on actions in case of spillage / emergency.	Through CDMS, which will be agreed with the Planning Authority prior to construction and implemented during construction.
		All equipment, materials and chemicals on the Site will be stored away from any watercourse (i.e. outwith previously stated buffer zones). Chemical, fuel and oil stores will be sited on impervious bases in accordance with GPP2 and within a secured bund of 110% of the storage capacity, within the temporary storage compound	Through CDMS, which will be agreed with the Planning Authority prior to construction and implemented during construction

		Standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Refuelling of vehicles and machinery will be carried out on an impermeable surface in designated areas, well away from any watercourse or drainage ditches (i.e. outwith previously stated buffer zones) and will adhere to best practice as detailed in PPG 7.	
	Construction in the vicinity of Watercourses	The following procedures apply to the general construction activities either within the watercourses or in defined watercourse buffer zones: • Due consideration will be given to the prevailing ground and weather conditions when programming the execution of the works in order to ensure that in-channel works are undertaken during periods of predicted low flow and low rainfall in order to minimise contact with water. • Ensure that roadside drains do not discharge directly into watercourses, but rather through a riparian buffer area of intact vegetation as denoted on design drawings.	

	Construction of Watercourses	Construction of watercourse crossings will be programmed to coincide with periods of predicted low flow in the affected channel (determined by rainfall and would generally coincide with summer months). Construction will be strictly as per the design for each identified watercourse crossing and will fully implement all SuDS and additional mitigating measures proposed at the detailed design stage. For purposes of outline design, the proposed mitigation will include: • Installation of silt fences parallel to the watercourse channel in the vicinity of the proposed crossing; • Installation of small cut-off drains to prevent natural surface runoff entering area of construction activity; • Installation of filtration or other silt entraining features within the watercourse channel immediately downstream of the works location; • Use of damming and over pumping to allow a dry working environment where deemed appropriate.	

	Temporary SuDs	Temporary drainage and silt management features (SuDS) will be constructed prior to earthworks (including preliminary or enabling works) proceeding to construct any linear works (tracks / hardstanding areas / cable routes), turbine bases, and other infrastructure. Drainage will be provided to temporary works and reinstated to suit the final footprint of the completed development. Temporary drainage measures in particular will be employed in enabling works to facilitate widening of existing tracks. Temporary measures may include: • Temporary silt fences erected in areas where risk of pollution to watercourses has been identified e.g. watercourse crossing locations and areas where tracks or other infrastructure lie within watercourse buffer zones. • Placing temporary filtration silt fences within drainage channels where siltation is observed. • Installing temporary constructed settlement features such as sumps or settlement ponds / lagoons where required. • Upslope cut-off drainage channels approximately parallel to the proposed track alignment installed in advance of any excavated cuttings for the track or turbine hardstanding areas. • Watercourses, drains, natural flow paths and cut-off drain outlet locations should be identified and charted, in order to ensure that piped crossings can be installed in advance of or adjacent to the track construction. • Settlement ponds should be constructed in advance of commencing excavations for foundations and at any other locations identified as	

		required at detailed design stage. • Trackside drainage swales should be installed in parallel with track construction. Note that this may require that drainage swales are reformed on an ongoing basis as temporary track alignments are modified to their eventual finished design level. Suitable prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.	
	Electrical Cable Laying	Due consideration will be given to the prevailing ground conditions and season when programming the execution of cable trench excavations in order to ensure works are undertaken during periods with low rainfall and elevated shallow groundwater levels in order to reduce the likelihood of runoff entering the excavations. Excavation of cable trenches will be carried out over short distances, with frequent backfilling of trenches to minimise opportunity for the ingress of water into open trenches, temporary silt traps will be provided in longer trench runs and on steeper slopes and spoil will be stored in line with a spoil management plan, which will be produced as part of the CDMS at the pre-construction stage.	

	Excavations and Spoil Management	Soil and subsoil excavation and movement will be undertaken in accordance with best practice guidelines such as Good Practice Guide for Handling Soils (MAFF, 2000) in order to minimise potential for silt laden runoff from spoil and excavations. Areas of stockpiled spoil including stored peat: • will not be permitted within previously identified watercourse buffer zones; and • will not be permitted to obstruct the flow of overland surface water with specific drainage to spoil mounds to be provided. Material produced from excavations on the Site will be reused where reasonably practicable in the reinstatement of the site. Excavated materials will be separated into rock material, subsoil, reusable peat and vegetated sod material and will be stored in the designated temporary stockpile zones, under the supervision of a geotechnical expert. These materials will be reused where possible to re-grade slopes, and to re-vegetate and stabilise the sides of access tracks and hard standing areas. Spoil drainage will be designed on a bespoke basis for spoil storage areas to allow controlled dewatering and prevent washout of suspended solids to the receiving water environment. As part of the detailed CDMS a spoil management strategy will be developed by the appointed competent contractor for the development. Outline designs for drainage arrangements for temporary spoil areas are shown on the Drainage Management Drawings within Appendix 9.1: Water Framework Directive Assessment.	

	Dewatering of Excavations	The majority of the turbine base foundations will be on bedrock or other hard strata above bedrock (to be confirmed by detailed site investigation prior to detailed design); therefore, deep excavations within bedrock and the associated bedrock aquifer are not anticipated and dewatering below the bedrock aquifer groundwater table is therefore not anticipated. Shallow groundwater (e.g. in areas of glacial sand and gravel) or rainfall runoff collected in excavations will be discharged via settlement ponds or filter strips prior to entry to the receiving water environment. Any settlement lagoons or filter strips associated with dewatering will be regularly inspected, particularly after periods of heavy rainfall and prior to periods of forecast heavy rainfall. Maintenance (to clear blockages or remove silt) will be carried out in periods of dry weather where practicable.	
	Dust Management	Loose track material generated during the use of access tracks and the construction compound will be prevented from reaching watercourses by maintenance to surface water drainage systems installed at aggregate based hard standing areas. In dry weather dust suppression methods such as by dust suppression bowser will be employed.	
	Radon	Radon protection measures are advised to be implemented for the permanent sub-station and control building or as may be directed by the local Building Control office suitable to the nature of the proposed enclosed space.	

	Operational Phase	Ensure best practice is adhered to on the Site and avoid pollution release to watercourses by incorporating NIEA Pollution Prevention Guidance notes into management policy. In the event that permanent welfare facilities are installed as part of control building / substation facilities, foul effluent will be disposed of through the use of sealed cesspools or chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on the site). Cyclical maintenance of permanent SuDS drainage features installed during the construction phase, including unblocking of drains, maintenance of access road and other hard standing surfaces, and removal of silt build-up from settlement features. An outline maintenance programme is included in Appendix 9.1: Water Framework Directive Assessment.	Operational Development
Chapter 10: Noise	Potential for noise to be created during general construction activities and by construction traffic	Due regard for 'best practicable means' (defined by Section 72 of the Control of Pollution Act 1974) A range of noise mitigation measures are proposed for the construction phase in accordance with measures outlined in BS 5228-1:2009Site operations to be limited to 0700-1900 Monday to Saturday (except during turbine erection and commissioning/periods of emergency work)Construction traffic to be controlled on Saturdays between 1300-1900, if necessary, to ensure relevant noise criteria are met	Noise mitigation measures would be implemented as part of the Construction and Environmental Management Plan which would be required to be agreed as a condition of consent. Provision of a Construction Traffic Management Plan to be incorporated into the CEMP and delivered as a condition of consent

Chapter 11: Traffic & Transport	Impact on other road users	A Traffic Management Plan (TMP) will be prepared by the Applicant in accordance with the requirements of Department of Infrastructure NI, the local PSNI, and if required, any other relevant stakeholders. Features of the TMP will include: • Details of the access route, conformation of any points along the access route that require street furniture removal, details of traffic numbers, delivery timings, and signage and escort requirements • A delivery schedule for normal and abnormal loads to minimise disruption as far as reasonably practicable • Details of how any movements will comply with legislation regarding the movement of abnormal loads e.g. notice procedures and notice periods • Details on the use of escorts where required. Where long vehicles and abnormal loads would have to use the wrong side of the carriageway or need to swing into the path of oncoming vehicles a lead warning vehicle would be used. One escort vehicle would drive ahead and pull oncoming traffic into identified passing places. An escort vehicle would travel directly in front of the convoy and pull over any oncoming traffic that comes onto the road after the first escort vehicle has passed. A further convoy escort vehicle would follow the convoy • Information about marking of vehicles as long/abnormal loads	Through CDMS, which will be agreed with the Planning Authority prior to construction and implemented during construction

		• Information will be given on how warning signs will be used. These will be used to advise other road users of 'Caution Slow Plant Turning Ahead' and will be placed at intervals from both directions along the main road approaching the site entrance during the construction phase. The TMP will also detail additional measures to ensure impacts from traffic movements are minimised where possible, for example provision of road sweepers and/or wheel wash facilities. • If required, the wheel wash facilities will include a waterless drive over wheel wash for lorries. This will be provided at the site entrance to prevent mud and dust being brought out from the Site onto the public highway and anything being brought onto Site from public highway. Although experience has shown the majority of mud is shaken off wheels on site before the vehicle reaches the public road, the site entrance and adjacent public highway will also be monitored and cleaned if necessary. • The TMP will include details about Video Surveying and Road Repairs. A video survey of the pre-construction condition of all public roads will be recorded around the site entrances and access routes (but including the site entrance and access roads), to provide a baseline record of the state of the roads prior to construction work commencing. This will enable any repairs and maintenance work required to the relevant road due to any damage caused by the passing of heavy vehicles associated with the wind farm construction to be identified following the construction phase. The roads will be returned, at minimum, to the baseline condition at the end of the construction phase. Any damage caused by wind farm traffic during the construction period, which would be hazardous to public traffic, will be repaired immediately. These works will be carried out under permits with DfI Roads, as appropriate.	

		• The TMP will include plans for notifying relevant stakeholders in advance of delivery periods, including the emergency services, DfI Roads, local residents, local business, local services and schools. The local community will be informed prior to the commencement of construction and prior to the commencement of turbine deliveries by letter and through local press. The contact details of the Construction Site Manager will be made available as a contact point for enquiries. Local schools on the delivery routes will be contacted to identify school and nursery drop-off and pick up locations and times. Construction deliveries will be scheduled to avoid these busy periods as far as reasonably possible. • If cutting or removal of hedges and trees is required, then this should be done outside the bird breeding season (1st March to 31st August). If work is to be done during the breeding season, then there should be a survey to establish whether nesting birds are present.	
Chapter 12: Shadow Flicker	Material reduction to residential amenity	Mitigation measures can be incorporated into the operation of the wind farm to reduce the instance of shadow flicker. Mitigation measures range from planting tree belts between the affected dwelling and the responsible turbine(s) to curtailing individual turbines during periods when shadow flicker could theoretically occur.	By Condition