Carnbuck Wind Farm

Further Environmental Information

January 2025



power for good

CARNBUCK WIND FARM

Further Environmental Information 2025

Volume 1 - Non-Technical Summary

powering change

Contents

Preface

This Further Environmental Information (FEI) 2025 has been prepared in support of the planning application for the proposed Carnbuck Wind Farm, planning reference SPD/2023/0951/F. The proposed wind farm is located approximately 4.4km north east of Cloughmills and approximately 12 km south west of Cushendall in the townlands of Carnbuck, Magheraboy and Moneyneagh, east of Corkey Village. The planning application was validated in March 2023.

The FEI has been prepared by Renewable Energy Systems Limited (RES) in collaboration with the various specialists outlined below.

FEI Technical Support

Technical Specialism	Organisation
Noise	RES
Vegetation / Peat	Blackstaff Ecology / David Steele
Hydrology	McCloy Consulting
Site Entrance	RES
Telecommunications / Links	Ai Bridges
Landscape and Visual	Shanti McAllister Landscape Planning & Design
Cultural Heritage and Archaeology	Headland Archaeology Shanti McAllister Landscape Planning & Design

An electronic version of the FEI 2025 and other details about the project can be viewed at https://www.carnbuck-windfarm.co.uk/.

Reference copies of the full ES (2022) and FEI (2025) and planning application(s) may be viewed and or purchased during normal opening hours at the following location:

Loughgiel Community Association
Millennium Centre
38 Lough Road
Loughgiel
Ballymena
BT44 9JN
Tel: 028 276 41389

Paper Copies of the NTS are available free of charge. The ES (2022) and FEI (2025) are available free of charge on USB or in paper form at a cost of £50 each from the address above, or by contacting RES. Cheques should be made payable to Renewable Energy Systems Ltd.

Renewable Energy Systems Ltd
Williowbank Business Park
Willowbank Road
Millbrook
Larne
County Antrim
BT40 2SF
028 2844 0580

1. Introduction

Background

1.1 In March 2023, RES submitted an application (reference SPD/2023/0951/F) to the Department for Infrastructure (DFI) Planning Service for permission to construct a wind farm comprising of up to 12 wind turbines located in the townlands of Carnbuck, Magheraboy and Moneyneagh, east of Corkey Village, approximately 4.4km north east of Cloughmills and approximately 12 km south west of Cushendall.

1.2 This followed confirmation by the Strategic Planning Division in February 2022 that the application should be submitted to the Department in accordance with Section 26 of the Planning Act (Northern Ireland) 2011, regarding the Department's jurisdiction in relation to developments of regional significance.

1.3 The application was subject to Environmental Impact Assessment (EIA) prepared by RES Ltd. and was conducted in accordance with the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017. A full project description, including a range of technical and environmental studies were prepared to allow the Planning Service to assess the environmental impacts, and these were reported in the Carnbuck Wind Farm Environmental Statement (ES) which accompanied the planning application. The planning application was validated in March 2023.

1.4 The proposal comprises the construction of up to 12 three-bladed horizontal axis wind turbines; each up to 180m maximum height above ground level; associated external transformers; underground cabling; access tracks; turning heads; crane hardstandings; control building and substation compound, 23 battery energy storage containers; off-site areas of widening to the public road and all ancillary works. The development also comprises upgrades to the existing site entrance and access tracks of Gruig Wind Farm. During construction and commissioning there would be a number of temporary works including a construction compound with car parking; temporary parts of crane hardstandings and welfare facilities.

1.5 DFI Planning requested Further Environmental Information on the 4th of June 2024 following consultation with statutory and non-statutory bodies. This document is a 'non-technical' summary of the Further Environmental Information (2025).

Project Description

1.6 The proposed Carnbuck Wind Farm remains as described in Chapter 1 of the ES (2022). No changes to the project are proposed in this FEI.

Purpose of the FEI

1.7 The purpose of this FEI is to update and complement, where appropriate, the environmental information previously submitted and is to be read in conjunction with the ES (2022) and its associated figures and appendices.

Structure of the FEI

1.8 This FEI has been prepared in accordance with the EIA Regulations and comprises the following volumes:

- **Volume 1** - Non Technical Summary;
- **Volume 2** – Main Text, Figures & Appendices;

1.9 Volume 2 is organised as follows:

- **Section 1 - Introduction**: sets out the purpose of the FEI, highlights what additional information had been provided and provides an overview of supplementary sections.
- **Section 2 - Noise:** provides information to address the queries contained in the consultation responses of Causeway Coast District Council Environment Health and Glens and Mid & East Antrim District Council Environment Health.
- **Section 3 - Vegetation and Peatland:** provides information to address the queries contained in the consultation response of NIEA Natural Environment Division (NED).
- **Section 4 - Hydrology:** provides information to address the queries contained in the consultation response of NI Water (NIW).
- **Section 5 - Site Entrance:** provides information to address issues raised in the consultation response from Department for Infrastructure Roads (DFI Roads) Department.
- **Section 6 - Telecommunication Links:** provides a Telecommunications Impact Assessment focused on the issues raised in the PSNI & JRC consultation responses.
- **Section 7 – Landscape and Visual:** provides information to address issues raised in the consultation response from NIEA Countryside, Coast and Landscape (CC&L) Landscape Team.
- **Section 8 – Built Heritage & Archaeology:** provides an additional, detailed assessment of built heritage focused on the issues raised in the consultation response from the Department for Communities Historic Environment Division.
- **Section 9 – Conclusion**

2. Noise

2.1 Consultation responses were received from Mid & East Antrim District Council Environmental Health Department on the 21st of September 2023 Causeway Coast & Glens District Council Environmental Health Department on the 30th of October 2023.

2.2 The Mid & East Antrim District Council and Causeway Coast & Glens District Council Environmental Health Department requested that the curtailment strategy is reviewed to ensure that there is no cumulative exceedance of ETSU-R-97 limits.

2.3 Within the FEI, RES now presents a revised and amended assessment of the noise levels resulting from Carnbuck Wind Farm to address the queries raised in the consultation responses from Causeway Coast & Glens District Council Environmental Health Department and Mid & East Antrim District Council Environmental Health Department.

2.4 The revised and amended Noise Assessment incorporates minor amendments to the prediction methodology for assessing cumulative impacts; provides further rationale and narrative as to the assessment approach; provides revised criteria for assessing overall cumulative noise levels and proposes revised and simplified noise limits for the Carnbuck scheme operating in isolation.

2.5 The assessment indicates that there is a marginal risk that the cumulative noise levels could be above the overall limiting requirements of ETSU-R-97 at certain residencies surrounding the development and cumulative sites. As a result, planning controls (Appendix B of Revised Assessment) have been proposed such that the introduction of the proposed development would result in noise levels that are considered insignificant in the context of operational noise from other development or that ensures that operational noise from the proposed development would not result in cumulative noise levels that are above the overall limiting requirements of ETSU-R-97 where possible.

3. Vegetation and Peatland

3.1 A DAERA Planning Response Team consultation response dated the 31st of May 2024, NED outlined that further information was required to fully assess the likely impacts on natural heritage interests.

3.2 The Environmental Statement NVC Survey indicates that a number of blanket bog quadrats could be wet heath, and some wet heath quadrats could be blanket bog; NED required clarifications as to whether the habitat present at quadrats Q11, Q12, Q13, Q62, Q34, Q57 and Q60 are wet heath or blanket bog. The FEI has provided clarifications of the habitat present.

3.3 NED requested that active peat maps are produced of the areas around the proposed track east of Turbine 6 and the tracks to the east and west of Turbine 7. In addition, NED requested a map to show the Gruig HMP and Carnbuck HMP areas. Maps are now presented within the FEI to illustrate the location of the active peat areas and the locations of the Gruig HMP and Carnbuck HMP areas, clarification has been provided with regards to the location of active peat.

3.4 The NED states that the oHMP does not provide a breakdown of the hectarage of NIPHs that will be permanently or temporarily impacted by the proposed works, or the hectarage of NIPHs that will be enhanced; this information was provided within Chapter 6 of the ES, the FEI provides further information on this.

3.5 NED have also requested that an assessment is completed evaluate whether the Gruig HMP has achieved its objectives. It is noted that RES do not operate or provide asset management services to this wind farm, and therefore are not able to retrieve the necessary confidential data to assess whether the Gruig HMP has achieved its objectives. The FEI indicates the Planning Conditions relevant to the Gruig Wind Farm which may have resulted in the NIEA receiving reports on the successfulness of the Gruig HMP.

3.6 A number of tracks are marked as ‘floated’ within the ES, NED require clarification regarding the peat depths at the floating track locations. The FEI presents the mean peat depths at proposed floated track locations.

3.7 The NED state that floating tracks across deep peat results in less excavation of peat, however the NED are concerned that there is potential for the permanent floated tracks to gradually subside over time; impacting on hydrology in the peatland habitats. The FEI outlines the current conditions at Carnbuck and also presents mitigation measures to minimise impact to peatland hydrology.

3.8 Finally, the NED requested that measures for Hen Harriers are included within the Habitat Management Plan. The FEI outlines the measures for the Hen Harriers included within the HMP.

4. NI Water

4.1 A consultation response was received from NI Water (NIW) on the 20th of April 2023 in relation to the assessment of the water environment.

4.2 It is noted that the overarching theme of the NIW consultation reply is that the assessment has failed to consider Altnahinch and the source of public water supply; which is not the case.

4.3 In addition, the NIW consultation response also incorrectly confuses statements in submitted assessments in relation to flooding from reservoirs, reading them as meaning that drainage to reservoirs has not been assessed. This is not correct.

4.4 The assessments submitted as part of the Environmental Statement (2022) consider in detail downstream catchments from the whole proposed development; have assigned and assessed sensitivity of those catchments including taking into account the value of the Altnahinch catchment for reasons of its water supply source; and include substantial and robust method statements and drainage plans to manage water quality and pollution prevention. There is no evidence that NIW has reviewed the full submission in reaching its conclusion.

4.5 It is suggested that NIW reviews all of the submission documents / meet with the consultant team if any further clarifications are required. However, it is considered that the clarifications presented in Section 4 and the information supplied within the Environmental Statement (2022) should provide the evidence and mitigation required to queries NIW has raised.

5. Site Entrance

5.1 The Department for Infrastructure Roads (DFI Roads) consultation letter response letter dated the 7th of April 2023 requested further information in relation to the Site Entrance Drg. 34 which should show the following detailed in accordance with DCAN15.

- Indicate access width dimension for existing and proposed.
- Indicate access gradient for existing and proposed with a spot level at edge of carriageway and 10m into the access.
- Indicate radii at access.
- Indicate visibility splays and forward sight distance 2.4m x 90m.
- Indicate drainage provision and outfall location to prevent surface water flowing onto the public road. - This is shown by the two cross channels which will direct surface water flow into the existing drainage swells and into the drainage ditch.

5.2 Section 5 provides an updated figure (Figure 10.1 – Rev3) which takes the DFI Roads requests into consideration. This should therefore supply the Department with sufficient information with regards to the site entrance.

6. Telecommunication Links

6.1 The Department for Infrastructure (DFI) letter dated the 4th of June 2024 requested Further Environmental Information (FEI) in relation to telecommunications, as summarised below:

PSNI has a technical safeguarding objection to this proposal because the assessment indicates that Wind Turbines of the specified details, located on the proposed T6, T8 and T9 coordinates, would be likely to have an impact on the NI Emergency Services Radio Communications and Public Safety Telecommunications Infrastructure. A reduction in the height of the proposed turbine is unlikely to remove this impact.

JRC indicates that part of the proposed development breaches one or more of the radio systems operated by UK and Irish Energy Industry companies in support of their regulatory operational requirements. The affected links are:

460MHz Telemetry and Telecontrol:

JESIXS1 to JESIXO5 J

ESIASS1 to JESIASO1 J

ESIABS1 to JESIABO2

Operated by: Northern Ireland Electricity Networks

The JRC objection may be withdrawn after simple analysis shows no issues; when a satisfactory coordination has been achieved and the zone of protection is implemented; or when an appropriate mitigation agreement is in place.

6.2 RES commissioned Ai Bridges to evaluate the possible impacts that the proposed wind farm at Carnbuck, Co Antrim could have on existing telecommunications operator networks.

6.3 The Ai Bridges compiled a Telecommunications Impact Assessment Report which is presented in Appendix 6.1.

6.4 The following conclusions have been made:

- There are two radio links that pass through the proposed wind farm site: a microwave radio link (operated by the PSNI) and a UHF radio link (operated by SONI).
- From the details provided by the PSNI during consultations, it has been deduced that the radio link they have raised concerns about is a PTP radio link between the telecoms mast-site at Slievanorra and the PSNI Police Station in Ballymena.
- Radio Network analysis indicates that the radio path of the PSNI radio link would be obstructed by Turbine T09. Micro-siting T09 by 50m to the west, would move it away from the PSNI radio link and provide a clearance

distance of over 30m. At this distance, there would be no impact to the PSNI radio link.

- The SONI radio link is a UHF link between Corby Knowe wind farm and Gruig wind farm. Radio Network analysis indicates that this link would not be obstructed by the proposed turbines at Carnbuck. The network analysis also shows that the radio path of the UHF link is already obstructed by terrain. The installation of turbines at Carnbuck would have no additional impacts on the signal degradation of the UHF link that already exists due to terrain blockage.

7. Landscape and Visual

7.1 This section of the FEI report provides a response to the NIEA Countryside, Coast and Landscape (CC&L) Landscape Team's revised consultation response on Carnbuck Wind Farm dated 25th October 2023 (original response dated 11th August 2023).

7.2 The NIEA Countryside, Coast and Landscape (CC&L) Landscape Team's position on Carnbuck Wind Farm is that it would be unacceptable and have an adverse effect on the landscape character, visual amenity and integrity of the Antrim Coast and Glens AONB, due to its scale, the nature of the proposal, its proximity to the AONB and the cumulative effects of other wind farms located in the area.

7.3 The FEI (2025) response indicates that the physical and visual character of the site area surrounding the Proposed Development is already strongly defined by a number of different man-made elements. The same is true of the wider Study Area. There are a number of established clusters of operational wind farms, including Gruig to which the Proposed Development would be integral. There are also large swathes of coniferous forestry, single turbines within a managed pastoral landscape across many lowland parts of the Study Area, a reservoir in close proximity to the site, and a number of busy trunk roads.

7.4 The FEI (2025) response explains that the location of the Proposed Development is in accordance with policy stipulations to recognise and promote the conservation of local identity and distinctive landscape character and it is appropriately located to maintain this character whilst minimising the extent and magnitude of cumulative effects.

7.5 The Proposed Development is not located within part of LCA 118 which could be regarded as having wild character because it is in relatively close proximity to areas of settlement, roads, quarries, forestry, other wind farms and other man-made influences. The Proposed Development conforms to broad guidance in relation to the scale and form of underlying topography, clustering and separation distances between wind farms, avoidance of prominent summits in favour of side slopes and the use of convex landform to reduce visibility. The SPG also repeatedly refers to large scale commercial forestry as being detrimental to landscape character and specifically notes that locations within or close to forestry plantations are the least sensitive parts of the Moyle Moorlands and Forests LCA. The Proposed Development would be located in proximity to a large coniferous plantation at Slieveannorra Forest, a waste water treatment works, and three existing wind farms. It would utilise the site entrance and some of the access tracks that are already in place for Gruig wind farm and is therefore deemed to be accordance with this principle in the SPG.

7.6 The FEI (2025) summarises that whilst the LVIA recognises that the Proposed Development would increase the geographical extent of the existing and consented Gruig cluster of wind farms, it is well located in relation to the underlying topography and takes advantage of the natural screening provided by adjacent upland areas. The layout of the proposed turbines reflects the layouts of some of

the other existing wind farms in this cluster and, in views from the wider landscape it would form a well-integrated element of this cluster. Overall visibility is limited, particularly within the AONB, and in locations beyond 5 km. From viewpoints in the wider area, including those from where the site of the Proposed Development forms the setting for the AONB, it would be a less prominent feature. Man-made influences are an established part of the character of the whole Study Area and also the western-facing edge of the AONB.

8. Cultural Heritage & Archaeology

8.1 The FEI report provides further information on the Built Heritage topic in response to the consultation response from the Historic Environment Division: Historic Monuments team (HED:HM). It covers five topics:

- Proposed mitigation for potential impacts on below ground remains within the footprint of earthing cable trenches, drainage and any other ancillary works;
- Proposed mitigation for potential impacts on the townland boundaries;
- Re-assessment of palaeoenvironmental and prehistoric potential along with proposed mitigation against potential impacts;
- Additional photomontages and further assessment of the potential impact which the proposed development may have on Lissanoure Demesne/ Lissanoure Castle; and,
- Review of heritage assets in relation to proposed access route works.

8.2 The first topic provides information as requested by HED:HM regarding mitigation for potential impacts of any ancillary works such as earthing cable trenches and drainage, to ensure careful management to avoid any impacts to known/ recorded heritage assets. It is now proposed that archaeological monitoring is completed during ground-breaking works associated with installation of cable trenches, drainage, upgrades to PowerNI networks or other ancillary works is carried out during the construction phase. The archaeological monitoring will be carried out by a suitably qualified archaeologist.

8.3 The second topic details the proposed mitigation for potential impacts on the townland boundaries. Gruig and Moneyneagh townland boundaries are now shown on Drawing 8.5 within Built Heritage & Archaeology Section (Section 8). An updated assessment of the importance of these assets and an assessment of potential impacts is now provided within Section 8 of the FEI. It is noted that the proposed development would have a negligible adverse effect on the townland boundaries. Section 8 of the FEI presents further measures to mitigate potential direct impacts upon the townland boundaries, specifically below ground remains.

8.4 A re-assessment of the palaeoenvironmental and prehistoric potential is present in the third topic of Section 8 (Built Heritage & Archaeology) of the FEI. Proposed mitigation measures comprising a programme of peat coring is also proposed to inform the scope of a wider programme of archaeological monitoring of ground breaking works to ensure that the Proposed Development does not have a significant impact to palaeoenvironmental and prehistoric remains.

8.5 The fourth topic address HED:HM concerns with regards to the Lissanoure Demense/ Lissanoure Castle. The FEI presents three photomontages have been produced as follow:

- Viewpoint 1 (Drawing 8.1): 306495, 424220 (shore of Lough Guile, marked by a bench)
- Viewpoint 2 (Drawing 8.2): 306598, 424348 (front of Lissanoure Castle (ANT018:011))
- Viewpoint 3 (Drawing 8.3): 306471, 424592 (from ground looking towards Lissanoure Castle (ANT018:011)) at north-west of pond)

8.6 Further assessment has been completed to assess the potential impact of the Proposed Development on Lissanoure demesne / Lissanoure Castle. It is concluded that the Proposed Development has no effect significance on Lissanoure demesne.

8.7 The fifth and final topic relates to the review of heritage assets in relation to proposed access route works. It was concluded within Section 8 of the FEI that no impacts were predicted and it is considered this assessment remains valid.

9. Conclusion

9.1 The purpose of this FEI is to update and complement, where appropriate, the environmental information previously submitted and has been produced to include a greater level of details to provide clarity for the Strategic Planning Division, based on consultation responses received. FEI was requested on the following topics:

- Noise
- Vegetation and Peatland
- Hydrology
- Site Entrance
- Telecommunication Links
- Landscape & Visual
- Cultural Heritage & Archaeology

9.2 The FEI presents a revised and amended assessment of the noise levels resulting from Carnbuck Wind Farm. In addition, the revised assessment proposes planning controls to ensure that the proposed development would result in noise levels that are considered insignificant in the context of operational noise from other development or that ensures that operational noise from the proposed development would no result in cumulative noise levels are above the overall limiting requirements of ETSU-R-97 where possible.

9.3 The FEI presents clarifications following queries from DAERA: Natural Environment Division with regards to Vegetation and Peatland, Section 3 presents further relevant information.

9.4 The FEI presents clarifications to Northern Ireland Water to highlight the relevant existing information regarding potential effects to the reservoir catchment, including mitigation measures as stated in the previously submitted Technical Appendix 10.1: Surface Water Management Plan (within the ES), which address concerns raised by NIW.

9.5 The FEI presents an updated Site Entrance Drawing – Figure 10.1(Revision 3) which provides information as requested by DFI Roads.

9.6 The FEI presents a Telecommunications Impact Assessment Report which is presented in Appendix 6.1, which responds to queries raised by PSNI & JRC.

9.7 The FEI reiterates in Section 7 that in terms of Landscape & Visual effects it is concluded that the physical and visual character of the site area surrounding the Proposed Development is already strongly defined by a number of different man-made elements. The layout of the proposed turbines reflects the layouts of some of the other existing wind farms in this cluster and, in views from the wider landscape it would form a well-integrated element of this cluster. Overall visibility is limited, particularly within the AONB, and in locations beyond 5 km. From viewpoints in the wider area, including those from where the site of the Proposed Development forms

the setting for the AONB, it would be a less prominent feature. Man-made influences are an established part of the character of the whole Study Area and also the western-facing edge of the AONB.

9.8 With regard to Built Heritage & Archaeology, the FEI presents in Section 8 and with additional Figures 8.1 – 8.5, that the proposed development has no significant effect on Lissanoure Demesne and no impacts are predicted on Cultural heritage or Archaeology as a result of the proposed road widening works. Appropriate mitigation measures have now been proposed for the potential construction phase impacts to townland boundaries, potential below ground archaeological remains which may be truncated by ancillary works, and potential below ground prehistoric and paleoenvironmental remains. Following mitigation, no significant residual construction phase effects are predicted.

9.9 The potential effects of the Proposed Development have been assessed in accordance with regulatory requirements and good practice. The ES & FEI incorporate technical assessments of the Proposed Development based on the requisite legislation and the relevant planning policy framework. The ES & FEI have demonstrated that significant environmental effects associated with the construction, operation and decommissioning of the Proposed Development have been avoided or minimised through the use of the iterative design process and with the application of mitigation measures.

9.10 The amount of electricity that could be produced by the Proposed Development is estimated at 206.4 GWh per year which is equivalent to the electricity needs of 54,800 homes each year.

9.11 The Proposed Development is also estimated to reduce CO_2 emissions by 90,800 tonnes each year when compared against equivalent generation from non-renewable sources. This equivalent to 57,200 newly registered cars.

9.12 The Proposed Development will result in a reduction in greenhouse gas emissions from the electricity generating industry by harnessing wind as an alternative to the burning of fossil fuels, in line with the Climate Change Act (Northern Ireland) legislative target of 80% of total electricity consumption in Northern Ireland to come from renewable sources by 2030.

CARNBUCK WIND FARM

Further Environmental Information 2025

Volume 2 - Main Report, Figures & Appendices

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

res
powering change

Contents

1

Introduction

1. Introduction

Background

1.1 In March 2023, RES submitted an application (reference SPD/2023/0951/F) to the Department for Infrastructure (DFI) Planning Service for permission to construct a wind farm comprising of up to 12 wind turbines located in the townlands of Carnbuck, Magheraboy and Moneyneagh, east of Corkey Village, approximately 4.4km north east of Cloughmills and approximately 12 km south west of Cushendall.

1.2 This followed confirmation by the Strategic Planning Division in February 2022 that the application should be submitted to the Department in accordance with Section 26 of the Planning Act (Northern Ireland) 2011, regarding the Department's jurisdiction in relation to developments of regional significance.

1.3 The application was subject to Environmental Impact Assessment (EIA) prepared by RES Ltd. and was conducted in accordance with the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017. A full project description, including a range of technical and environmental studies were prepared to allow the Planning Service to assess the environmental impacts, and these were reported in the Carnbuck Wind Farm Environmental Statement (ES) which accompanied the planning application. The planning application was validated in March 2023.

1.4 The proposal comprises the construction of up to 12 three-bladed horizontal axis wind turbines; each up to 180m maximum height above ground level; associated external transformers; underground cabling; access tracks; turning heads; crane hardstandings; control building and substation compound, 23 battery energy storage containers; off-site areas of widening to the public road and all ancillary works. The development also comprises upgrades to the existing site entrance and access tracks of Gruig Wind Farm. During construction and commissioning there would be a number of temporary works including a construction compound with car parking; temporary parts of crane hardstandings and welfare facilities.

1.5 DFI Planning requested Further Environmental Information on the 4th of June 2024 following consultation with statutory and non-statutory bodies. This document is a 'non-technical' summary of the Further Environmental Information (2025).

Project Description

1.6 The proposed Carnbuck Wind Farm remains as described in Chapter 1 of the ES (2022). No changes to the project are proposed in this FEI.

Purpose of the FEI

1.7 The purpose of this FEI is to update and complement, where appropriate, the environmental information previously submitted and is to be read in conjunction with the ES (2022) and its associated figures and appendices.

Structure of the FEI

1.8 This FEI has been prepared in accordance with the EIA Regulations and comprises the following volumes:

- **Volume 1** - Non Technical Summary;
- **Volume 2** – Main Text, Figures & Appendices;

1.9 Volume 2 is organised as follows:

- **Section 1 - Introduction**: sets out the purpose of the FEI, highlights what additional information had been provided and provides an overview of supplementary sections.
- **Section 2 - Noise:** provides information to address the queries contained in the consultation responses of Causeway Coast and Glens District Council Environment Health and Mid & East Antrim District Council Environment Health.
- **Section 3 - Vegetation and Peatland:** provides information to address the queries contained in the consultation response of NIEA Natural Environment Division (NED).
- **Section 4 - Hydrology:** provides information to address the queries contained in the consultation response of NI Water (NIW).
- **Section 5 - Site Entrance:** provides information to address issues raised in the consultation response from Department for Infrastructure Roads (DFI Roads) Department.
- **Section 6 - Telecommunication Links:** provides a Telecommunications Impact Assessment focused on the issues raised in the PSNI & JRC consultation responses.
- **Section 7 – Landscape and Visual:** provides information to address issues raised in the consultation response from NIEA Countryside, Coast and Landscape (CC&L) Landscape Team.
- **Section 8 – Built Heritage & Archaeology:** provides an additional, detailed assessment of built heritage focused on the issues raised in the consultation response from the Department for Communities Historic Environment Division.
- **Section 9 – Conclusion**

2

Noise

2. Noise

Introduction

2.1 Following the submission of the Carnbuck Environmental Statement, consultation responses were received from Mid & East Antrim District Council Environmental Health Department on the 5th of April 2023 and Causeway Coast & Glens District Council Environmental Health Department (EHO) on the 20th April 2023.

2.2 A number of queries / clarification requests were raised by Mid & East Antrim District Council EHO and Causeway Coast & Glens District Council EHO.

2.3 A Revised Cumulative Acoustic Assessment for Carnbuck Wind Farm was submitted by RES on the 31st of July 2023 (Report No. 03090-6130963) to respond to the queries raised by Mid & East Antrim District Council EHO and Causeway Coast & Glens District Council EHO.

2.4 Following the submission of the Revised Cumulative Acoustic Assessment for Carnbuck Wind Farm, Mid & East Antrim District Council EHO and Causeway Coast & Glens District Council EHO responded with a further consultation response on the 21st of September 2023 and the 30th of October 2023 respectively and requested a number of clarifications:

- Confirm the selected daytime lower fixed limit for Carnbuck Wind Farm in isolation and justify the selection;
- Review the recommended curtailment strategy to ensure no cumulative exceedance of ETSU-R-97 limits; and,
- Confirm if there is a possibility of Carnbuck Wind Farm operating concurrently with Corkey Wind Farm as currently constructed i.e. prior to repowering.

2.5 It is noted that the clarifications requested above were included within the Department for Infrastructure (DFI) Further Environmental Information request dated the 4th of June 2024.

2.6 In order to provide the necessary information to Mid & East Antrim District Council EHO and Causeway Coast & Glens District Council EHO, RES has prepared a further Revised Cumulative Acoustic Assessment for Carnbuck Wind Farm (Report No. 03090-7004479) – see Appendix 2.1.

2.7 This assessment provides a revised and amended assessment of the noise levels resulting from Carnbuck Wind Farm operating at the same time as various other planned, consented and operational development in the vicinity of the site. The contents are intended to supplement the noise chapter submitted in support of the planning application for the development and supersedes the information provided within the previous report (Report No. 03090-6130963) – see Appendix 2.2.

2.8 The assessment methodology follows applicable guidance on operational noise from wind turbines in the UK i.e. ETSU-R-97 The Assessment and Rating of Noise from Wind Farms and the Institute of Acoustics (IOA) Good Practice Guide to the

Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (GPG) as referred to within relevant planning policy for Northern Ireland (NI).

2.9 The assessment provided incorporates minor amendments to the prediction methodology for assessing cumulative impacts (i.e. with specific regard to the planning consent condition requirements for the neighbouring schemes); provides further rationale and narrative as to the assessment approach; provides revised criteria for assessing overall cumulative noise levels; proposes revised and simplified noise limits for the Carnbuck scheme operating in isolation (based on the predicted noise levels from the scheme and with due regard to the resultant cumulative operational noise levels); and, addresses further commentary from Mid & East Antrim and Causeway Coast & Glens Borough Councils in response to the previous version of the report.

Summary

Mid & East Antrim Borough Council

2.10 The EHO representing Mid & East Antrim Council requested that, whist the adoption of the upper ETSU-R-97 noise limit was fully justified for the purposes of assessing cumulative turbine noise impacts, that the noise limits for the Carnbuck site operating in isolation are also discussed and justified.

2.11 In response, the limits that RES propose to be applied for the site operating in isolation, which are subject to agreement with the relevant representatives of both councils, are shown in Table 27 of the attached revised report. The proposed planning condition limits result in potential levels that are well below the requirements of ETSU-R-97 at the majority of properties neighbouring the site, with a comparatively small number of residences experiencing levels that lie between the lower and upper ETSU-R-97 limits. The Proposed Development has a generating capacity that is substantially higher than many of the other nearby wind farm sites and single turbines considered, which result in similar impacts, and this is considered acceptable in this context.

2.12 The council also requests confirmation as to the likelihood of the existing Corkey Wind Farm, rather than the re-powered Corkey site, being operational at the same time as the Proposed Development.

2.13 The ES supporting the application indicates that construction of the repowered site was intended to have begun in 2023. Whilst this has not occurred as of yet, it is expected that decommissioning of the existing site and construction/commissioning of the repowered development will occur imminently, and it is considered very unlikely that the existing Corkey site would be operating at the same time as the Proposed Development as a result. This is especially true given that the Corkey Re-Powering site is at such a far more advanced stage of development than the Carnbuck proposals.

2.14 Furthermore, Mid & East Antrim Council requests that the proposed mitigation strategy (in the form of specifying relevant noise limits) is reviewed to ensure there

is no cumulative exceedance of the overall cumulative ETSU-R-97 noise limits at H24, H27 & H91.

2.15 As a result of the above, minor revisions have been made to the supplied assessment report (as attached) in order to address this comment as far is considered practicable and proportionate. Despite this, there remains a particularly marginal case at H91 whereby a very small theoretical exceedance could occur. However, this is highly unlikely to occur in practice, the existing two small turbines neighbouring the house and located to the south of the Proposed Development are by far the dominant source of noise at this location and the breach would only theoretically occur during northerly wind speeds, whereas the prevailing wind direction is south-westerly. Furthermore, the proposed planning condition limits for this location have been updated to ensure that the impact from the Proposed Development would be considered negligible for standardised 10 m height wind speeds where the marginal exceedance overall cumulative noise limits is predicted to occur.

Causeway Coast & Glens Borough Council

2.16 The response from representatives of Causeway Coast & Glens Borough Council refers to the assessment locations H1 & H3 as areas of concern in terms of potential cumulative impacts, highlighting that, due to the cumulative predicted exceedances of the overall ETSU-R-97 noise limits and with RES being the latter applicant, responsibility in mitigating overall levels lies with RES.

2.17 In response, the predicted cumulative noise impacts are, in both instances, dominated by the presence of the existing and/or consented turbines in the vicinity of the properties in that they have predicted noise levels that are at least 10 dB greater than the potential impact from the Proposed Development. As such, any potential exceedences (which are not believed to be occurring in practice) are entirely the result of the other existing and consented developments which lie out-with RES control. As a result, it cannot be incumbent on RES to mitigate these theoretical cumulative exceedances. The proposed noise limits for the Carnbuck site have been set to ensure resultant noise levels from the introduction of the site would be negligible as compared with the existing developments (i.e. >10 dB lower than the combined impact of the existing/proposed developments), regardless of any financial involvement of certain dwellings with particular turbine developments.

2.18 Further to the above, the expected noise levels specifically from the Carnbuck development would easily meet the noise limits for an uninvolved property at H3. It is only the single turbine for which H3 is understood to be financially involved which requires this leniency in terms of the overall ETSU-R-97 limits. As such, RES considers that the proposed condition limits restrict noise specifically resulting from the Proposed Development as far as is reasonable and proportionate in this instance.

Updated Revised Noise Assessment (Ref. 03090-7004479) – Appendix 2.1

2.19 An updated revised assessment report has been provided overleaf shows a similar assessment to that previously provided with the following notable updates: additional text regarding the noise limits for the Carnbuck site operating in isolation in the context of ETSU-R-97 requirements; a slight update to the prediction assumptions for the E1 and F1 turbines at the 'controlling properties'; and, an update to the table of proposed condition limits for Carnbuck in order to further minimise/negate the very marginal risk that overall cumulative noise limits would be breached at the locations highlighted by Mid & East Antrim and Causeway Coast & Glens Borough Councils.

APPENDIX 2.1 – REVISED CUMULATIVE ACOUSTIC ASSESSMENT FOR CARNBUCK WIND FARM DATED 27th February 2024 (03090-7004479)

Revised Cumulative Acoustic Assessment for Carnbuck Wind Farm

Author: Mike Craven **Date:** 27th February 2024 **Ref:** 03090-7004479

Revision History

Issue	Date	Author	Nature & Location of Change	Additional Reference(s)
01	7th July 2023	Mike Craven	Initial Version	03090-6009510
02	31st July 2023	Mike Craven	Minor Updates	03090-6009510
03	27th February 2024	Mike Craven	Update Following EHO Comments	03090-7004478

CONTENTS

1. INTRODUCTION

This report provides a revised and amended assessment of the noise levels resulting from Carnbuck Wind Farm operating at the same time as various other planned, consented and operational development in the vicinity of the site. The contents are intended to supplement the noise chapter submitted in support of the planning application for the development and supersedes the further information provided within Report No. 03090-6130963.

The assessment methodology follows applicable guidance on operational noise from wind turbines in the UK i.e. ETSU-R-97 The Assessment and Rating of Noise from Wind Farms and the Institute of Acoustics (IOA) Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (GPG) as referred to within relevant planning policy for Northern Ireland (NI).

The assessment provided herein incorporates minor amendments to the prediction methodology for assessing cumulative impacts (i.e. with specific regard to the planning consent condition requirements for the neighbouring schemes); provides further rationale and narrative as to the assessment approach; provides revised criteria for assessing overall cumulative noise levels; proposes revised and simplified noise limits for the Carnbuck scheme operating in isolation (based on the predicted noise levels from the scheme and with due regard to the resultant cumulative operational noise levels); and, addresses further commentary from Mid & East Antrim and Causeway Coast & Glens Borough Councils in response to the previous version of this report.

2. WIND FARM NOISE GUIDANCE

The Assessment & Rating of Noise from Wind Farms

The operational noise assessment methodology described in ETSU-R-97 The Assessment & Rating of Noise from Wind Farms [1] was developed by a working group comprised of a cross section of interested persons including Environmental Health Officers (EHOs), wind farm operators and independent acoustic experts amongst others.

ETSU-R-97 makes it clear from the outset that any noise restrictions placed on a wind farm must balance the local environmental impact 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.

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'.

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 relevant supplementary guidance. It is the only guidance referenced in Northern Ireland planning policy for rating and assessing operational noise from wind turbines. Based on planning policy and guidance, a wind farm which can operate within noise limits derived according to ETSU-R-97 shall be considered acceptable in respect of operational noise.

A Good Practice Guide to the Assessment & Rating of Noise from Wind Farms

A Good Practice Guide (GPG) to the application of ETSU-R-97 for the assessment and rating of wind turbine noise [2], issued by the IOA 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 in relation to issues not made explicit by, or outside the scope of ETSU-R-97, including propagation modelling and wind shear. The document also includes further information regarding cumulative noise impacts, compliance measurements and other relevant topics.

Supplementary guidance notes were published by the Institute of Acoustics (IOA) in July and September 2014, and these provide further details on specific areas of the IOA GPG. The assessment presented herein adopts the recommendations of the GPG and the Supplementary Guidance Notes (SGN).

3. BASELINE NOISE LEVELS & CORRESPONDING NOISE LIMITS

Chapter 11 of the Carnbuck Wind Farm Environmental Statement (ES) provides full details as to the methodology and results of background noise surveys undertaken at various properties neighbouring the development. This information is also supplemented by background noise data collected as part of other planning applications for wind turbine development in the area.

The background noise surveys were undertaken in accordance with ETSU-R-97 and the GPG discussed earlier. The measurement locations were discussed and agreed with the Environmental Health Officer (EHO) dealing with the development prior to the measurements being undertaken.

Table 1 shows the derived average background noise levels over a range of standardised 10 m height wind speeds and for 'quiet' daytime (18:00 – 23:00 weekdays, 13:00 – 23:00 on Saturdays and 07:00 to 23:00 on Sundays) and night-time (23:00- 07:00) periods respectively. The data sets have been filtered appropriately as per the guidance within ETSU-R-97 and the GPG.

Table 1 – Derived Average Background Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Quiet Daytime										
H1	25.8	29.1	32.4	35.3	38.0	40.5	43.0	45.5	47.9	50.4
H2	26.2	29.0	32.0	34.7	37.3	39.8	42.4	45.0	47.6	50.4
H3	25.6	27.3	28.9	30.5	32.0	34.0	36.2	38.1	39.8	41.4
H27	22.1	23.6	25.1	26.7	28.5	30.5	32.8	35.4	38.4	38.4
H33	24.3	25.4	26.7	28.3	30.2	32.6	35.5	39.2	43.7	43.7
H34	31.3	31.6	31.6	31.7	32.0	33.0	34.7	37.6	41.8	41.8
Night-time										
H1	25.0	26.8	29.8	32.9	35.8	38.7	41.5	44.4	47.3	50.1
H2	24.4	26.8	30.3	33.3	36.2	38.9	41.7	44.4	47.1	49.7
H3	25.4	26.9	28.3	29.6	31.0	32.3	33.8	35.8	37.7	39.5
H27	20.0	21.3	22.8	24.4	26.3	28.3	30.6	33.1	35.8	38.7
H33	21.2	22.1	23.5	25.4	27.8	30.6	33.6	36.9	40.4	43.9
H34	26.4	26.7	27.4	28.5	30.0	31.8	33.9	36.3	39.0	41.9

ETSU-R-97 states that different limits should be applied during daytime and night-time periods. The daytime limits 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 low background noise levels, in which case a fixed limit may be applied. The suggested limits are given at **Table 2**, where L_B is the average background $L_{A90,10min}$ as a function of wind speed. During daytime periods and at low background noise levels, a lower fixed limit of 35-40 dB L_{A90} is applicable. The exact value is dependent upon factors including the number of nearby dwellings, the effect of the noise limits on energy produced and the duration and level of exposure.

Table 2 - Permissible Noise Criteria

Time of Day	Definition
Daytime	35-40 dB(A) for L_B less than 30-35 dB(A) LB + 5 dB, for L_B greater than 30-35 dB(A)
Night-time	43 dB(A) for L_B less than 38 dB(A) LB + 5 dB, for L_B greater than 38 dB(A)

The resultant noise limits, including for the lower and upper bounds of the daytime noise criteria prescribed within ETSU-R-97, are shown at **Table 3**.

Table 3 – Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Lower Daytime										
H1	35.0	35.0	37.4	40.3	43.0	45.5	48.0	50.5	52.9	55.4
H2	35.0	35.0	37.0	39.7	42.3	44.8	47.4	50.0	52.6	55.4
H3	35.0	35.0	35.0	35.5	37.0	39.0	41.2	43.1	44.8	46.4
H27	35.0	35.0	35.0	35.0	35.0	35.5	37.8	40.4	43.4	43.4
H33	35.0	35.0	35.0	35.0	35.2	37.6	40.5	44.2	48.7	48.7
H34	36.3	36.6	36.6	36.7	37.0	38.0	39.7	42.6	46.8	46.8
Upper Daytime										
H1	40.0	40.0	40.0	40.3	43.0	45.5	48.0	50.5	52.9	55.4
H2	40.0	40.0	40.0	40.0	42.3	44.8	47.4	50.0	52.6	55.4
H3	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H27	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H33	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H34	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
Night-time										
H1	43.0	43.0	43.0	43.0	43.0	43.7	46.5	49.4	52.3	55.1
H2	43.0	43.0	43.0	43.0	43.0	43.9	46.7	49.4	52.1	54.7
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H34	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9

The upper daytime noise limit has adopted for the purpose of undertaking the cumulative noise assessment herein. This is on the basis that the combined generating capacity of Carnbuck Wind Farm and the neighbouring schemes is relatively high (especially when considering the relative generating capacity of turbines available at the time that the ETSU-R-97 document was originally released); the majority of assessment locations considered will not be downwind of the site or cumulative developments in the prevailing wind direction; existing planning conditions for neighbouring turbines appear to already allow for operational noise levels that lie between the lower and upper bounds of the ETSU-R-97 daytime limits; that adopting a lower limit would have a substantial effect on the generating capacity of the Carnbuck development; and, due to the 'noise budget' already being occupied by turbines with arguably less planning merit than the larger Carnbuck wind farm in terms of potential generating capacity at some residences.

The intention in the adoption of the upper daytime noise limit is not to allow levels of cumulative turbine noise that are right up to the upper limit in all instances, unless it is absolutely necessary (i.e. in instances where existing turbine noise levels may already be close to or at the overall prescribed cumulative noise limits), but to allow for levels that lie between the lower and upper bounds of the ETSU-R-97 requirements in some circumstances, as already appears to be the case for the existing situation for certain residences.

The Proposed Development itself will have noise levels that are well below the requirements of ETSU-R-97 at the majority of properties neighbouring the site, with a comparatively small number of residences experiencing level that lie between the lower and upper ETSU-R-97 limits (see **Section 5**). As previously discussed, the Proposed Development has a generating capacity that is substantially higher than many of the other nearby wind farm sites considered here, which result in similar impacts, and is considered acceptable in this context.

Further to the above, the proposed Carnbuck wind farm will also have a character of noise that is different to that generated by the smaller planned, consented and operational turbines in the area due the lower rotational speeds and blade passing frequency of larger wind turbines as compared with smaller scale (<500 kW) turbines.

4. PREDICTIONS

The propagation model described within ISO 9613-2 [3] has been used to undertake predictions of the expected noise levels resulting from the operation of the development. The model accounts for geometric spreading, atmospheric absorption, ground and barrier effects. The specific assumptions used and interpretation of the propagation prediction methodology, as detailed in the GPG [2], has been used.

The recommended assumptions include the use of relatively low atmospheric absorption values corresponding to temperature of 10 °C, a relative humidity of 70 % as defined within ISO9613-1 [4], the application of a +3 dB correction should propagation across a valley occur and the limitation of barrier attenuation to -2 dB where there is no direct line-of-sight between a source and receiver due to the intervening topography. The resultant predicted noise levels are considered conservative in nature as an appropriate level of uncertainty has been applied to the candidate turbine source noise levels and the effects of trees and other non-terrain related shielding have not been considered.

A ground absorption coefficient of G=0.5 and a receiver height of 4 m is assumed. Furthermore, the resultant predicted dB L_{Aeq} noise levels have been converted to dB L_{A90} values by subtracting 2 dB to allow for comparison with the limits. All in line with the recommendations of the GPG.

Additionally, rather than making a conservative assumption that properties are always downwind of the wind farm, a more detailed assessment, which incorporates the effects of wind direction has been undertaken. This accounts for the fact that noise levels at a property will be less when the property is crosswind or upwind of a particular development. The directional attenuation factors applied, as shown at **Table 4**, are consistent with the recommendations of the IOA GPG; with reductions in noise of around 2 dB when a receiver is crosswind, and up to 10 dB when a receiver is upwind of a particular turbine. The IOA GPG also states that upwind reductions in noise level will only come into play gradually at distances of between 5 and 10 tip heights. As a result, the attenuation factors applied have been adjusted by the distance between the source and receiver accordingly.

Table 4 - Directional Attenuation

Directional Offset from Directly Downwind, °	0	30	60	90	120	150	180	210	240	270	300	330
Directional Attenuation Factor, dB	0	0	0	-2.0	-6.7	-9.3	-10	-9.3	-6.7	-2.0	0	0

The dwelling locations considered as part of the assessment are listed at **Table 5** below. These represent the most sensitive properties surrounding the site and are considered representative of a much larger selection of dwellings (i.e., if the proposed noise limits can be met at these locations, the limits would also be met at locations nearby or further from the development and cumulative sites).

Table 5 - House Locations

House ID	OSGB Co-ordinates		House ID	OSGB Co-ordinates	
	X / m	Y / m		X / m	Y / m
H1	309979	422676	H34	309622	420847
H2	309761	422704	H39	314273	419792
H3	309656	422220	H45	310324	419519
H4	309384	421839	H49	313292	419204
H5	309407	421621	H52	312066	418151
H6	309586	421332	H91	311806	418089
H10	309697	420992	H94	311025	418993
H11	309512	421032	H158	309337	421817
H12	309551	421004	H162	309385	421272
H13	309596	420995	H164	309513	421335
H14	309508	420901	H165	309536	421306
H16	309474	420886	H168	310037	419469
H22	310478	419181	H173	310346	419531
H24	311566	418066	H209	313135	419377
H27	313138	419356	H222	314326	420005
H33	314432	420189	H224	313231	419053

The Carnbuck Wind Farm and cumulative turbine locations, the corresponding assumed hub-heights and turbine models considered as part of the assessment provided herein are shown at **Table 6.**

Table 6 - Turbine Locations

Turbine ID	OSGB Co-ordinates		Hub-Height, m	Turbine Model
	X / m	Y / m		
Carnbuck				
T1	310866	421041	112	Vestas V136 4.2 MW
T2	310942	420508	112	Vestas V136 4.2 MW
T3	311247	420105	112	Vestas V136 4.2 MW
T4	311927	420074	112	Vestas V136 4.2 MW
T5	311970	419561	112	Vestas V136 4.2 MW
T6	312344	419989	112	Vestas V136 4.2 MW
T7	312305	420580	112	Vestas V136 4.2 MW
T8	312715	420394	112	Vestas V136 4.2 MW
T9	312578	420871	112	Vestas V136 4.2 MW
T10	312971	420639	112	Vestas V136 4.2 MW
T11	312980	421211	112	Vestas V136 4.2 MW
T12	313321	421005	112	Vestas V136 4.2 MW

Turbine ID	OSGB Co-ordinates		Hub-Height, m	Turbine Model
	X / m	Y / m		
Gruig				
A4	311225	420961	60	Nordex N80 2.5 MW
A5	311475	421158	60	Nordex N80 2.5 MW
A8	311465	420672	60	Nordex N80 2.5 MW
A9	311695	420881	60	Nordex N80 2.5 MW
A10	311787	421201	60	Nordex N80 2.5 MW
A11	312008	421415	60	Nordex N80 2.5 MW
A12	312265	421614	60	Nordex N80 2.5 MW
P15	312008	420952	60	Nordex N80 2.5 MW
P16	312245	421168	60	Nordex N80 2.5 MW
P17	312477	421377	60	Nordex N80 2.5 MW
Corkey Re-Powering				
C1	311506	422023	80	Vestas V117 4.2 MW
C2	311146	422326	80	Vestas V117 4.2 MW
C3	310713	422440	80	Vestas V117 4.2 MW
C4	310671	421988	80	Vestas V117 4.2 MW
C5	311046	421744	80	Vestas V117 4.2 MW
Single Turbines				
S1	310606	422923	45	Enercon E44 900 kW
B1	309840	422170	55	Vestas V52 850 kW
D1	310142	419846	40	Vestas V52 850 kW (100dB)
E1	311785	418325	40	EWT DW54 250 kW
F1	311587	418318	40	EWT DW54 250 kW

The predictions assume the installation of Vestas V136 4.2 MW turbines with a hub height of 112 m at the proposed turbine locations for the Carnbuck development, as shown at **Table 6**. The corresponding source noise levels, as obtained from documentation supplied by the turbine manufacturer [6], assuming the use of serrated trailing edge (STE) blade modifications and with a +2 dB allowance for uncertainty included, are shown at **Table 7**. This approach concurs with the approach recommended within the IOA GPG and is considered to provide a reasonably conservative basis of assessment. The source noise information has been supplied with reference to hub-height wind speeds and these have been converted to reference standardised 10 m height wind speeds using the methodology specified within IEC-61400-11 [5]. Furthermore, it is possible to run this model of turbine in a variety of operational modes which may be implemented for numerous parameters not limited to wind speed, direction and time. The source noise levels for a variety of the noise modes which could be implemented at the wind farm, including for the applied uncertainty discussed earlier, are also shown.

The octave band noise levels, as also supplied by the turbine manufacturer [7], corresponding to the maximum noise output of the V136 3.6 MW turbine considered here, operating unrestricted and incorporating the uncertainty described earlier, are shown at Table 8. These octave band noise levels have been adjusted to represent the overall noise levels specified for other/lower wind speeds and for other operational noise modes by subtracting the relative difference between the maximum noise level for unrestricted operation and the level corresponding wind speed/mode of interest from each overall octave band level.

The candidate turbine is assumed not to have any tonal noise output that would attract a penalty at neighbouring residences under the ESTU-R-97 guidance. A warranty or guarantee will be obtained from

the manufacturer which limits the level of tonal noise associated with the operation of the individual turbines (or the site as a whole), should the candidate model of turbine be installed. This will help to ensure tonal noise would not require a penalty under the requirements of ETSU-R-97 and provide recourse with the turbine manufacturer should tonal noise be present.

The Gruig development has 10 Nordex N80 2.5 MW turbines with hub-heights of 60 m. The source noise data for the turbines has been taken from warranted data supplied by the manufacturer [8], which is already considered to incorporate a certain amount of uncertainty, with a further additional 2 dB added to the source noise levels. The corresponding levels in octave bands are taken from further specifications and test reports provided by the turbine manufacturer [9], normalised to the maximum sound power output of the turbine.

The source noise levels for the Vestas V117 4.2 MW turbine, which is expected to be installed at the Corkey Repowering site, are taken from specification documentation [10] supplied by the manufacturer with 2 dB added to account for uncertainty. The data is supplied with reference to hub-height wind speeds and has been corrected to standardised 10 m height wind speeds in accordance with the procedure described in IEC-61400-11. The corresponding octave band levels have been taken from separate documentation provided by the manufacturer [11] for the maximum sound power output of the turbine and with the same uncertainty applied.

The planning consent documentation for the single S1 turbine refers to the source sound power levels stated within the noise assessment submitted in support of the planning application for the turbine [12] and these have been used to undertake the predictions. The levels are supplemented here by additional manufacturers' specification data [13] associated with the installed turbine for wind speeds where source noise levels are not defined at high standardised 10 m height wind speeds. An additional uncertainty of 2 dB has been applied to all levels, as required by the GPG. However, it is expected that specified source values already incorporate a certain amount of uncertainty. The corresponding octave band levels have been taken from a turbine measurement report [14], normalised to the maximum reported sound levels associated with the operation of the turbine.

The source noise levels for the V52 850 kW turbine, corresponding to the turbine referred to as B1, have been taken from specifications provided by the turbine manufacturer [15] with an additional 1 dB of uncertainty applied. In reality, this turbine is likely to be run in a reduced mode of operation or an alternative model is likely to be installed, as explained further at **Section 5**. As a result, and due to the uncertainty in the turbine type that could be installed at this location, the use of this turbine data as part of the assessment provides a particularly conservative basis of assessment. The corresponding octave band data is taken from a measurement report [16] relating to the operation of the turbine, normalised to the maximum sound power output of the model.

The source noise and corresponding octave band level information for the V52 (100 dB) turbine is taken from the noise assessment that supported the planning application for the D1 turbine [17]. Whilst it is considered that the levels used as part of the assessment already account for uncertainty an additional 2 dB has been applied in order to provide a conservative basis of assessment.

The source noise levels and corresponding octave band information for the EWT DW54 250 kW turbines corresponding to E1 & F1 have only been provided for reference and have been taken from the noise assessment that supported both planning applications [18] with 2 dB added to further account for uncertainty over that already included as part of the specified levels. The levels of predicted noise included as part of the assessment provided herein are actually calculated via analysis of the noise levels that are provided as a condition to the planning consent for the turbine in order to maintain consistency with the consent requirements. This aspect is discussed further at **Section 5**.

The overall source noise levels and octave band levels corresponding to the maximum sound output, including for all corrections and the application of the relevant uncertainties, are provided at **Table 7** and **Table 8** respectively.

Table 7 - Sound Power Levels, dB L_{WA}

Turbine	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Vestas V136 3.6 MW - 112 m Hub-Height										
Unrestricted	93.8	97.5	102.5	105.6	105.9	105.9	105.9	105.9	105.9	105.9
SO1	93.8	97.5	102.2	103.8	103.8	104.0	104.0	104.0	104.0	104.0
SO2	93.8	97.5	101.1	101.4	101.5	101.5	101.5	101.5	101.5	101.5
SO11	93.8	96.2	98.0	99.7	100.9	101.2	101.2	101.2	101.2	101.2
SO12	93.8	96.6	99.6	101.5	101.9	101.9	101.9	101.9	101.9	101.9
SO13	93.1	94.2	95.4	97.4	98.6	99.0	99.0	99.0	99.0	99.0
Nordex N80 2.5 MW - 60 m Hub-Height										
N80 2.5 MW	100.0	100.0	102.5	104.5	105.0	105.5	106.0	106.0	106.5	107.0
Vestas V117 4.2 MW - 80 m Hub-Height										
V117 4.2 MW	95.1	97.8	101.8	105.6	107.7	108.0	108.0	108.0	108.0	108.0
Enercon E44 900 kW - 45 m Hub-Height										
E44 900 kW	101.9	101.9	101.9	101.9	101.9	103.5	104.1	104.1	105.0	105.0
Vestas V52 850 kW - 55 m Hub-Height										
V52 850 kW	95.6	95.8	98.6	102.7	105.0	105.5	105.6	104.6	103.8	103.5
Vestas V52 850 kW (100dB) - 40 m Hub-Height										
V52 850 kW (100 dB)	98.0	98.0	98.8	99.6	100.5	101.5	102.1	102.7	103.1	103.6
EWT DW54 250 kW - 40 m Hub-Height										
EWT DW54 250 kW	99.0	99.0	99.0	100.2	100.4	100.6	101.1	102.3	102.8	103.3

Table 8 - Octave Band Sound Power Levels, dB L_{WA}

Turbine	Overall, dB L_{WA}	Centre of Octave Band, Hz							
		63	125	250	500	1k	2k	4k	8k
V136 4.2 MW	105.9	87.0	94.6	99.2	101.0	99.9	95.9	89.0	79.2
N80 2.5 MW	107.0	89.5	97.1	101.9	102.5	98.0	96.5	87.5	76.1
V117 4.2 MW	108.0	88.3	95.5	100.3	102.6	102.4	99.7	94.6	87.0
E44 900 kW	105.0	87.2	92.7	96.2	98.4	100.4	97.7	90.4	84.3
V52 850 kW	105.6	81.9	89.8	95.6	101.2	100.9	97.0	90.6	80.4
V52 (100 dB)	103.6	86.2	92.2	96.7	98.1	97.2	95.3	90.1	81.2
DW54 250 kW	103.3	85.5	91.1	93.1	95.2	97.9	97.1	93.4	89.6

5. ASSESSMENT

The overall noise levels resulting from the combined operation of the Carnbuck proposals with other existing, planned and consented cumulative development in the area is complicated by the various technical basis on which each development has been granted planning consent in terms of their respective planning controls/conditions relating to operational noise; the differences in reference wind speeds for each of the developments and differences in assessment/compliance methodologies, particularly for development that were granted planning consent prior to documents, such as the GPG, being issued and adopted as relevant best practice; and, changes/differences in the preferred approach to consenting requirements, in terms of operational noise, by representatives of the Local Planning

Authority (LPA). As a result, a series of assumptions regarding the operation of each development are made, with due regard to any respective planning consent documentation, to ensure a realistic to conservative basis of cumulative assessment overall and with the aim of providing confidence that that the overall requirements of ETSU-R-97 can be met for the Carnbuck site.

The predicted noise levels for each of the sites considered as part of the assessment are therefore considered on an individual basis in the first instance and a justification for the adoption of the levels for the individual sites as part of the overall cumulative operational noise assessment is provided.

Applied Overall Cumulative Noise Limits

The derived noise limits shown at **Table 3** have been applied to the house locations at **Table 5** based on the proximity of each to a location where background noise survey information is available or where it is expected that the background noise environment would be similar. Where there is ambiguity in this respect the lower of any applicable noise limits have been applied to ensure a conservative basis for assessment. **Table 9** shows the applied upper daytime and night-time noise limits for all the properties to be assessed herein.

Table 9 – Overall Cumulative Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Daytime										
H1	40.0	40.0	40.0	40.3	43.0	45.5	48.0	50.5	52.9	55.4
H2	40.0	40.0	40.0	40.0	42.3	44.8	47.4	50.0	52.6	55.4
H3	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H4	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H5	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H6	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H10	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H11	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H12	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H13	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H14	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H16	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H22	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H24	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H27	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H33	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H34	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H39	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H45	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H49	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H52	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H91	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H94	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H158	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H162	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H164	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H165	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H168	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H173	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H209	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H222	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H224	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
Night-time										
H1	43.0	43.0	43.0	43.0	43.0	43.7	46.5	49.4	52.3	55.1
H2	43.0	43.0	43.0	43.0	43.0	43.9	46.7	49.4	52.1	54.7
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H5	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H6	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H10	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H11	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H12	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H13	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H14	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H16	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H22	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H24	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H34	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H39	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H45	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H49	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H52	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H91	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H94	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H158	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H162	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H164	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H165	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H168	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H173	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H209	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H222	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H224	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7

Carnbuck Predicted Noise Levels & Assessment

Table 10 shows the maximum predicted turbine noise levels associated with the Carnbuck development for any given wind direction (i.e., downwind), incorporating the assumptions and uncertainties detailed at **Section 4**.

Table 10 – Carnbuck Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	16.9	20.6	25.6	28.7	29.0	29.0	29.0	29.0	29.0	29.0
H2	16.4	20.1	25.1	28.2	28.5	28.5	28.5	28.5	28.5	28.5
H3	17.9	21.6	26.6	29.7	30.0	30.0	30.0	30.0	30.0	30.0
H4	18.0	21.7	26.7	29.8	30.1	30.1	30.1	30.1	30.1	30.1
H5	18.8	22.5	27.5	30.6	30.9	30.9	30.9	30.9	30.9	30.9
H6	20.7	24.4	29.4	32.5	32.8	32.8	32.8	32.8	32.8	32.8
H10	22.1	25.8	30.8	33.9	34.2	34.2	34.2	34.2	34.2	34.2
H11	20.9	24.6	29.6	32.7	33.0	33.0	33.0	33.0	33.0	33.0
H12	21.1	24.8	29.8	32.9	33.2	33.2	33.2	33.2	33.2	33.2
H13	21.4	25.1	30.1	33.2	33.5	33.5	33.5	33.5	33.5	33.5
H14	21.0	24.7	29.7	32.8	33.1	33.1	33.1	33.1	33.1	33.1
H16	20.8	24.5	29.5	32.6	32.9	32.9	32.9	32.9	32.9	32.9
H22	23.1	26.8	31.8	34.9	35.2	35.2	35.2	35.2	35.2	35.2
H24	20.4	24.1	29.1	32.2	32.5	32.5	32.5	32.5	32.5	32.5
H27	26.2	29.9	34.9	38.0	38.3	38.3	38.3	38.3	38.3	38.3
H33	20.9	24.6	29.6	32.7	33.0	33.0	33.0	33.0	33.0	33.0
H34	21.8	25.5	30.5	33.6	33.9	33.9	33.9	33.9	33.9	33.9
H39	20.2	23.9	28.9	32.0	32.3	32.3	32.3	32.3	32.3	32.3
H45	24.0	27.7	32.7	35.8	36.1	36.1	36.1	36.1	36.1	36.1
H49	24.4	28.1	33.1	36.2	36.5	36.5	36.5	36.5	36.5	36.5
H52	20.7	24.4	29.4	32.5	32.8	32.8	32.8	32.8	32.8	32.8
H91	21.0	24.7	29.7	32.8	33.1	33.1	33.1	33.1	33.1	33.1
H94	24.5	28.2	33.2	36.3	36.6	36.6	36.6	36.6	36.6	36.6
H158	17.9	21.6	26.6	29.7	30.0	30.0	30.0	30.0	30.0	30.0
H162	19.6	23.3	28.3	31.4	31.7	31.7	31.7	31.7	31.7	31.7
H164	20.3	24.0	29.0	32.1	32.4	32.4	32.4	32.4	32.4	32.4
H165	20.5	24.2	29.2	32.3	32.6	32.6	32.6	32.6	32.6	32.6
H168	21.9	25.6	30.6	33.7	34.0	34.0	34.0	34.0	34.0	34.0
H173	24.1	27.8	32.8	35.9	36.2	36.2	36.2	36.2	36.2	36.2
H209	26.3	30.0	35.0	38.1	38.4	38.4	38.4	38.4	38.4	38.4
H222	20.6	24.3	29.3	32.4	32.7	32.7	32.7	32.7	32.7	32.7
H224	24.1	27.8	32.8	35.9	36.2	36.2	36.2	36.2	36.2	36.2

The maximum predicted turbine noise levels, as predicted at any property, using the assumptions, uncertainties and corrections detailed with GPG, are not more than 38.5 dB L_{A90} which comfortably

comply with the overall noise limits at **Table 9**. These predicted noise levels have therefore been included/incorporated within the overall cumulative assessment.

Gruig Planning Conditions & Predicted Noise Levels

The existing Gruig Wind farm was granted planning consent in 2004 and became operational in 2009 (Planning Reference: D/2004/0790/F) [19]. The consent documentation states, within the 'informatives' to the planning conditions, that 'At the reasonable request of Ballymoney Borough Council, following a complaint to the Council relating to noise emissions from the Wind Turbines, the developer will demonstrate that, at the noise sensitive property in question, the noise levels experienced as a result of the Wind Turbines, excluding the existing background noise levels, do not exceed:

- During Night Hours, the greater of the Night Hours LA90, 10min Background Noise Level plus 5 dB(A) or 43 dB(A) at Wind Speeds not exceeding 12 meters per second;
- The greater of the Quiet Waking Hours LA90, 10 min Background Noise Level plus 5 dB(A) or 37.5 dB(A) at Wind Speeds not exceeding 12 metres per second;

Wind speeds should relate to 10m height on the wind farm site.

Details of the methodology should be extracted from "The Assessment & Rating of Noise from Wind Farms", ETSU (report number ETSU-R-97.)'

The site was granted planning consent at a time where only the ETSU-R-97 guidance was available to inform assessment requirements and the planning conditions. The ETSU-R-97 requires that background and operational noise measurements are related to directly measured 10 m height wind speeds seen at the development rather than standardised 10 m height wind speeds, as required by the supplementary guidance contained within the GPG (i.e. the use of hub-height wind speeds, which most closely correlate to the sound output of turbines, converted to standardised 10 m height wind speeds using the methodology detailed within IEC61400-11 [5]). As a result, the use of the planning conditions limits to inform the predicted operational noise levels associated with the operation of this development, in terms of 'controlling properties' or otherwise, could be considered erroneous or inconsistent in the context of current planning guidance due to this difference in reference wind speeds.

The maximum predicted noise levels associated with operation of the Gruig development, for any given wind direction, and using the assumptions at **Section 4** are shown at **Table 11**. The levels have been generated using the warranted source noise levels for the turbine installed, which is already considered to incorporate a certain margin of uncertainty, with an additional 2 dB of uncertainty applied. All relevant corrections relating to the intervening topography between the site and neighbouring receptors have also been included within the model. This results in predicted noise levels that do not exceed 36 dB L_{A90} at any of the properties neighbouring the site and demonstrates that, regardless of the inconsistences in wind speed reference discussed above, operational noise levels from the site would comfortably meet the planning condition requirements in respect of the lower condition limits applied for daytime and night-time periods respectively.

Table 11 – Gruig Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	24.0	24.0	26.5	28.5	29.0	29.5	30.4	30.4	30.9	31.4
H2	23.9	23.9	26.4	28.4	28.9	29.4	30.3	30.3	30.8	31.3
H3	25.0	25.0	27.5	29.5	30.0	30.5	31.3	31.3	31.8	32.3
H4	24.0	24.0	26.5	28.5	29.0	29.5	30.4	30.4	30.9	31.4
H5	24.9	24.9	27.4	29.4	29.9	30.4	31.3	31.3	31.8	32.3
H6	26.5	26.5	29.0	31.0	31.5	32.0	32.9	32.9	33.4	33.9
H10	27.6	27.6	30.1	32.1	32.6	33.1	33.9	33.9	34.4	34.9

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H11	26.6	26.6	29.1	31.1	31.6	32.1	32.9	32.9	33.4	33.9
H12	26.8	26.8	29.3	31.3	31.8	32.3	33.1	33.1	33.6	34.1
H13	27.0	27.0	29.5	31.5	32.0	32.5	33.3	33.3	33.8	34.3
H14	26.6	26.6	29.1	31.1	31.6	32.1	33.0	33.0	33.5	34.0
H16	26.4	26.4	28.9	30.9	31.4	31.9	32.8	32.8	33.3	33.8
H22	26.0	26.0	28.5	30.5	31.0	31.5	32.4	32.4	32.9	33.4
H24	25.8	25.8	28.3	30.3	30.8	31.3	32.2	32.2	32.7	33.2
H27	27.9	27.9	30.4	32.4	32.9	33.4	34.3	34.3	34.8	35.3
H33	24.9	24.9	27.4	29.4	29.9	30.4	31.3	31.3	31.8	32.3
H34	27.2	27.2	29.7	31.7	32.2	32.7	33.5	33.5	34.0	34.5
H39	24.2	24.2	26.7	28.7	29.2	29.7	30.6	30.6	31.1	31.6
H45	27.6	27.6	30.1	32.1	32.6	33.1	33.9	33.9	34.4	34.9
H49	26.2	26.2	28.7	30.7	31.2	31.7	32.6	32.6	33.1	33.6
H52	24.0	24.0	26.5	28.5	29.0	29.5	30.5	30.5	31.0	31.5
H91	25.6	25.6	28.1	30.1	30.6	31.1	32.0	32.0	32.5	33.0
H94	28.6	28.6	31.1	33.1	33.6	34.1	34.9	34.9	35.4	35.9
H158	24.4	24.4	26.9	28.9	29.4	29.9	30.8	30.8	31.3	31.8
H162	25.7	25.7	28.2	30.2	30.7	31.2	32.1	32.1	32.6	33.1
H164	26.3	26.3	28.8	30.8	31.3	31.8	32.6	32.6	33.1	33.6
H165	26.4	26.4	28.9	30.9	31.4	31.9	32.8	32.8	33.3	33.8
H168	24.3	24.3	26.8	28.8	29.3	29.8	30.7	30.7	31.2	31.7
H173	27.7	27.7	30.2	32.2	32.7	33.2	34.0	34.0	34.5	35.0
H209	28.0	28.0	30.5	32.5	33.0	33.5	34.4	34.4	34.9	35.4
H222	25.0	25.0	27.5	29.5	30.0	30.5	31.4	31.4	31.9	32.4
H224	25.3	25.3	27.8	29.8	30.3	30.8	31.7	31.7	32.2	32.7

Given the additional uncertainty applied to the predicted noise levels, which already represent a conservative basis of assessment, no further corrections have been applied to the predicted noise levels in respect of 'controlling properties' (i.e. properties considered most sensitive to noise associated with a particular development, which would have the effect of controlling noise levels at other dwellings) or otherwise. The application of additional corrections/margins in this respect is considered disproportionate due to the installed turbine having well-defined sound characteristics that are unlikely to exceed those used here. Therefore, the predicted noise levels shown at **Table 11** are used as part of the overall cumulative assessment.

Corkey Re-Powering Planning Conditions & Predicted Noise Levels

The Corkey Re-Powering scheme was granted planning consent in March 2022 (Planning Reference: LA01/2019/0772/F) [20] with conditions relating to operational noise. The noise limits for the repowered site are provided at Condition 16 of the consent documentation which states that 'The level of noise emissions from the combined effects of the permitted wind turbines shall not exceed values set out in Table 1. Noise limits for any dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in Table 1 shall be represented by the physically closest location listed in Table 1 unless otherwise agreed by the Council'.

The specified limits are provided at **Table 12** for reference and includes a reference to the corresponding House ID for each of the assessed properties listed here to enable comparison with the overall assessment provided here on a consistent basis, where this information is available. In instances where the listed House ID is not provided, it is considered that the residential location is not relevant, sensitive or critical to the introduction of the Carnbuck Wind Farm proposals.

Table 12 – Corkey Re-Powering Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Daytime (07:00 to 23:00)										
15 Reservoir Road (H3)	35.0	35.0	35.0	35.5	37.0	39.0	40.7	40.1	39.3	42.7
21 Reservoir Road (H1)	35.0	33.8	33.7	38.4	41.9	44.8	47.6	50.2	52.8	55.3
42 Reservoir Road (H2)	35.0	34.6	33.8	37.8	41.2	44.1	47.0	49.7	52.5	55.3
97 Altnahinch Road	35.0	35.0	35.0	35.4	34.7	37.5	40.2	42.5	44.4	46.1
210 Corkey Road (H10)	35.0	35.0	35.0	34.5	33.9	37.1	40.0	42.3	44.2	46.0
Night-time (23:00 to 07:00)										
15 Reservoir Road (H3)	43.0	42.8	42.5	42.1	41.7	41.3	40.7	40.1	39.3	38.4
21 Reservoir Road (H1)	42.6	42.4	42.2	42.1	41.9	42.5	45.9	49.1	52.1	55.0
42 Reservoir Road (H2)	42.7	42.5	42.4	42.2	42.1	43.1	46.2	49.1	51.9	54.7
97 Altnahinch Road	42.9	42.8	42.7	42.5	42.4	42.3	42.2	42.2	42.2	44.0
210 Corkey Road (H10)	42.9	42.9	42.8	42.7	42.5	42.4	42.4	42.4	42.4	44.1

The predicted noise levels resulting from the Corkey Re-Powering scheme, using the conservative assumptions and uncertainties detailed at **Section 4** are provided at **Table 13**.

Table 13 – Corkey Re-Powering Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	28.0	28.0	28.0	30.7	34.7	38.5	40.6	40.9	40.9	40.9
H2	25.8	25.8	25.8	28.5	32.5	36.3	38.3	38.7	38.7	38.7
H3	24.4	24.4	24.4	27.1	31.1	34.9	36.9	37.3	37.3	37.3
H4	21.9	21.9	21.9	24.6	28.6	32.4	34.5	34.8	34.8	34.8
H5	21.7	21.7	21.7	24.3	28.4	32.1	34.2	34.5	34.6	34.6
H6	22.0	22.0	22.0	24.7	28.7	32.5	34.6	34.9	34.9	34.9
H10	21.3	21.3	21.3	23.9	28.0	31.7	33.8	34.1	34.2	34.2
H11	20.4	20.4	20.4	23.1	27.2	30.9	33.0	33.3	33.3	33.3
H12	20.5	20.5	20.5	23.2	27.2	31.0	33.1	33.4	33.4	33.4
H13	20.7	20.7	20.7	23.4	27.5	31.2	33.3	33.6	33.6	33.6
H14	19.9	19.9	19.9	22.6	26.6	30.4	32.4	32.8	32.8	32.8
H16	20.8	20.8	20.8	23.5	27.6	31.3	33.4	33.7	33.7	33.7
H22	14.3	14.3	14.3	17.0	21.0	24.8	26.8	27.2	27.2	27.2
H24	13.6	13.6	13.6	16.3	20.4	24.1	26.2	26.5	26.5	26.5
H27	14.3	14.3	14.3	17.0	21.0	24.8	26.9	27.2	27.2	27.2
H33	12.2	12.2	12.2	14.9	19.0	22.7	24.8	25.1	25.1	25.1

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H34	20.2	20.2	20.2	22.9	26.9	30.7	32.8	33.1	33.1	33.1
H39	12.0	12.0	12.0	14.7	18.7	22.5	24.5	24.9	24.9	24.9
H45	16.7	16.7	16.7	19.4	23.4	27.2	29.3	29.6	29.6	29.6
H49	13.0	13.0	13.0	15.7	19.7	23.5	25.5	25.9	25.9	25.9
H52	11.6	11.6	11.6	14.3	18.3	22.1	24.2	24.5	24.5	24.5
H91	13.6	13.6	13.6	16.3	20.3	24.1	26.2	26.5	26.5	26.5
H94	14.8	14.8	14.8	17.5	21.6	25.3	27.4	27.7	27.7	27.7
H158	21.5	21.5	21.5	24.2	28.2	32.0	34.1	34.4	34.4	34.4
H162	20.5	20.5	20.5	23.2	27.3	31.0	33.1	33.4	33.4	33.4
H164	21.6	21.6	21.6	24.2	28.3	32.0	34.1	34.4	34.5	34.5
H165	21.6	21.6	21.6	24.3	28.3	32.1	34.2	34.5	34.5	34.5
H168	14.1	14.1	14.1	16.8	20.9	24.6	26.7	27.0	27.0	27.0
H173	16.8	16.8	16.8	19.5	23.5	27.3	29.4	29.7	29.7	29.7
H209	14.4	14.4	14.4	17.1	21.1	24.9	26.9	27.3	27.3	27.3
H222	12.2	12.2	12.2	14.9	19.0	22.7	24.8	25.1	25.1	25.1
H224	12.7	12.7	12.7	15.4	19.4	23.2	25.2	25.6	25.6	25.6

The margin by which the predicted noise levels meet the Corkey Re-Powering noise limits at the locations listed with the planning consent documentation is provided at **Table 14**. A positive number indicates that the predicted noise levels are above the condition limits for the corresponding locations and specific standardised 10 m height wind speeds. This shows that the predicted noise levels from the operation of the Re-Powering scheme are close to or up to 1 dB above the daytime planning condition limits for certain meteorological conditions. As a result, some curtailment/mitigation may be required in order for the site to achieve the planning condition requirements. However, this is a matter for the operator of the site. Furthermore, the source noise levels used to predict the expected operational noise levels are relatively high as compared to levels expected for other turbines of similar size and dimensions which could be installed at the site. If an application to vary the dimensions and potential turbine type at the site is made, this would need to consider the Carnbuck proposals as they currently stand.

Table 14 – Corkey Re-Powering Planning Condition Margins, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
Daytime (07:00 to 23:00)										
15 Reservoir Road (H3)	-10.6	-7.9	-3.9	-0.6	-0.1	-1.7	-3.4	-2.8	-2.0	-5.4
21 Reservoir Road (H1)	-7.0	-3.1	1.0	0.1	-1.3	-3.9	-6.7	-9.3	-11.9	-14.4
42 Reservoir Road (H2)	-9.2	-6.1	-1.3	-1.5	-2.9	-5.4	-8.3	-11.0	-13.8	-16.6
97 Altnahinch Road	-	-	-	-	-	-	-	-	-	-
210 Corkey Road (H10)	-13.7	-11.1	-7.0	-2.8	-0.1	-3.0	-5.8	-8.1	-10.0	-11.8
Night-time (23:00 to 07:00)										
15 Reservoir Road (H3)	-18.6	-15.7	-11.4	-7.2	-4.8	-4.0	-3.4	-2.8	-2.0	-1.1
21 Reservoir Road (H1)	-14.6	-11.7	-7.5	-3.6	-1.3	-1.6	-5.0	-8.2	-11.2	-14.1
42 Reservoir Road (H2)	-16.9	-14.0	-9.9	-5.9	-3.8	-4.4	-7.5	-10.4	-13.2	-16.0
97 Altnahinch Road	-	-	-	-	-	-	-	-	-	-

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
210 Corkey Road (H10)	-21.6	-19.0	-14.8	-11.0	-8.7	-8.3	-8.2	-8.2	-8.2	-9.9

Given the relatively conservative nature of the predicted noise levels (i.e., via the incorporation of appropriate uncertainty in to the propagation model), the well-defined nature of the source sound power levels and the fact that the resultant predictions only just meet or are slightly above the planning condition limits, the predicted noise levels at **Table 13** have been used to inform the overall cumulative assessment discussed herein with no adjustments to account for the planning conditions being made as a conservative basis of assessment.

The existing site has not been included as part of the assessment herein as it is expected to be replaced by the repowered site in due course. The ES supporting the application indicates that construction of the repowered site would begin in 2023. As a result, it is expected that decommissioning of the existing site and construction/commissioning of the repowered development will occur imminently, and it is considered very unlikely that the existing Corkey site would be operating at the same time as the Proposed Development as a result. This is especially true given that the Corkey Re-Powering site is at such a far more advanced stage of development than the Carnbuck proposals.

S1 - D/2013/0081/F Planning Conditions & Predicted Noise Levels

This single turbine, referred to here as S1 (Planning Reference: D/2013/0081/F) [21], has a planning condition which limits the specific source noise level of the installed turbine. Condition 4 of the planning consent documentations states that 'The development hereby approved shall have a sound power level no greater than that specified in the submitted Noise Assessment (Report Number 11514870003.50I/B.0) dated May 2013'. These specified source noise levels, supplemented by manufacturers' specification data associated with the installed turbine for wind speeds where source noise levels are not defined, and with the application of 2 dB of uncertainty as required by the GPG, have been used to calculate the predicted operational noise levels associated with the turbine (see **Section 4**) at the cumulative assessment locations. The resultant predicted noise levels are shown at **Table 15**, are considered to provide a conservative basis of calculation and are used to inform the cumulative assessment herein.

Table 15 – S1 (D/2013/0081/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H1	33.2	33.2	33.2	33.2	33.2	34.8	35.5	35.5	36.4	36.4
H2	30.5	30.5	30.5	30.5	30.5	32.0	32.7	32.8	33.7	33.7
H3	27.1	27.1	27.1	27.1	27.1	28.6	29.4	29.4	30.3	30.3
H4	21.5	21.5	21.5	21.5	21.5	22.9	23.7	23.8	24.7	24.7
H5	20.7	20.7	20.7	20.7	20.7	22.1	22.9	22.9	23.8	23.8
H6	20.0	20.0	20.0	20.0	20.0	21.4	22.2	22.2	23.1	23.1
H10	18.7	18.7	18.7	18.7	18.7	20.0	20.9	20.9	21.8	21.8
H11	20.4	20.4	20.4	20.4	20.4	21.7	22.6	22.6	23.5	23.5
H12	20.4	20.4	20.4	20.4	20.4	21.7	22.6	22.6	23.5	23.5
H13	20.4	20.4	20.4	20.4	20.4	21.8	22.6	22.6	23.5	23.5
H14	19.8	19.8	19.8	19.8	19.8	21.2	22.0	22.0	22.9	22.9
H16	19.6	19.6	19.6	19.6	19.6	21.0	21.9	21.9	22.8	22.8
H22	11.9	11.9	11.9	11.9	11.9	13.2	14.1	14.0	14.9	14.9
H24	11.2	11.2	11.2	11.2	11.2	12.6	13.5	13.4	14.3	14.3
H27	9.9	9.9	9.9	9.9	9.9	11.2	12.1	12.0	12.9	12.9

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H33	11.9	11.9	11.9	11.9	11.9	13.3	14.2	14.1	15.0	15.0
H34	19.8	19.8	19.8	19.8	19.8	21.2	22.0	22.0	22.9	22.9
H39	11.6	11.6	11.6	11.6	11.6	12.9	13.9	13.7	14.6	14.6
H45	13.0	13.0	13.0	13.0	13.0	14.4	15.3	15.2	16.1	16.1
H49	9.2	9.2	9.2	9.2	9.2	10.6	11.5	11.4	12.3	12.3
H52	11.1	11.1	11.1	11.1	11.1	12.5	13.4	13.3	14.2	14.2
H91	11.1	11.1	11.1	11.1	11.1	12.5	13.4	13.3	14.2	14.2
H94	11.2	11.2	11.2	11.2	11.2	12.5	13.4	13.3	14.2	14.2
H158	21.2	21.2	21.2	21.2	21.2	22.6	23.4	23.5	24.4	24.4
H162	19.1	19.1	19.1	19.1	19.1	20.4	21.3	21.3	22.2	22.2
H164	19.8	19.8	19.8	19.8	19.8	21.2	22.0	22.0	22.9	22.9
H165	19.7	19.7	19.7	19.7	19.7	21.1	21.9	21.9	22.8	22.8
H168	12.7	12.7	12.7	12.7	12.7	14.1	15.0	14.9	15.8	15.8
H173	13.1	13.1	13.1	13.1	13.1	14.4	15.3	15.3	16.2	16.2
H209	9.9	9.9	9.9	9.9	9.9	11.3	12.2	12.1	13.0	13.0
H222	11.8	11.8	11.8	11.8	11.8	13.2	14.1	14.0	14.9	14.9
H224	9.0	9.0	9.0	9.0	9.0	10.3	11.3	11.1	12.0	12.0

B1 - LA01/2022/0783/F Planning Conditions & Predicted Noise Levels

The single turbine referred to as B1 (Planning Reference: LA01/2022/0783/F) [22] is proposed to replace an existing turbine at the location (Planning Reference: D/2011/0043/F). An additional consent at the existing turbine location was also approved (Planning Reference: LA01/2020/0078/F). The planning consent documentation for the most recent approval has a condition which limits operational noise associated with the turbine. Condition 7 states that 'The level of noise immissions from the wind turbine (including the application of any tonal penalty when calculated in accordance with the procedures described in Pages 104-109 of ETSU-R-97) shall not exceed the values set out in the attached Table 1 as appropriate. Noise limits for dwellings which lawfully exist of have planning permission for construction at the date of this consent but are not listed in the tables attached shall be those of the physically closest location listed in the tables, unless otherwise agreed by the planning department'.

The noise limits referred to as part the LA01/2022/0783/F condition for are shown at **Table 16** for reference and include a reference to the corresponding House ID for each property listed to enable comparison with the overall assessment provided here on a consistent basis.

Table 16 - B1 (LA01/2022/0783/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
21 Reservoir Road (H1)	-	23.9	28.0	30.5	30.7	31.0	31.0	31.0	31.0	31.0
42 Reservoir Road (H2)	-	23.0	27.1	29.6	29.8	30.1	30.1	30.1	30.1	30.1
15 Reservoir Road (H3)	-	32.8	36.9	39.4	39.6	39.9	39.9	39.9	39.9	39.9
18 Reservoir Road (H4)	-	14.0	18.1	20.6	20.8	21.1	21.1	21.1	21.1	21.1

The planning condition noise limits for the previously approved application LA01/2020/0078/F are provided at **Table 17** for further reference.

Table 17 - B1 (LA01/2020/0078/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
21 Reservoir Road (H1)	-	31.1	32.1	32.7	33.3	34.2	33.9	34.2	32.6	32.6
42 Reservoir Road (H2)	-	30.2	31.2	31.8	32.4	33.3	33.0	33.3	31.7	31.7
15 Reservoir Road (H3)	-	40.1	41.1	41.7	42.3	43.2	42.9	43.2	41.7	41.7
18 Reservoir Road (H4)	-	20.8	21.8	22.4	23.0	23.9	23.7	24.0	22.4	22.4

The two planning condition noise limits appear to be based on the predicted noise levels resulting from the introduction of new potential turbine models and these two consents at the existing turbine location mean there is uncertainty as to what model of turbine may be installed at the site. As a result, noise predictions used for the purposes of this cumulative assessment, as shown at **Table 18**, which assumes the installation of a Vestas V52 turbine operating unrestricted (see **Section 4**), results in noise levels that a much higher than the limiting requirements of the conditions and represents a particularly conservative basis assessment of assessment. In reality, operational noise levels are expected to be over 5 dB lower than shown, depending on what model of turbine eventually replaces the existing turbine at the site and what 'noise mode' the turbine is operated in.

Further to the above, the residence 15 Reservoir Road (H3) has a financial involvement with this scheme.

Table 18 - B1 (LA01/2022/0783/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	27.8	27.9	30.7	34.8	37.1	37.6	37.8	36.7	36.0	35.7
H2	27.5	27.7	30.4	34.5	36.8	37.3	37.5	36.4	35.7	35.4
H3	37.0	37.2	40.0	44.1	46.4	46.9	47.1	46.1	45.3	45.0
H4	26.9	27.0	29.8	33.9	36.2	36.7	36.9	35.8	35.1	34.7
H5	24.7	24.9	27.6	31.7	34.0	34.5	34.7	33.6	32.9	32.5
H6	22.4	22.6	25.3	29.4	31.6	32.1	32.3	31.2	30.5	30.2
H10	19.1	19.3	22.0	26.1	28.3	28.7	28.9	27.9	27.1	26.8
H11	19.1	19.3	22.1	26.2	28.3	28.8	28.9	27.9	27.1	26.8
H12	18.9	19.1	21.9	26.0	28.1	28.6	28.8	27.7	27.0	26.6
H13	19.0	19.1	21.9	26.0	28.2	28.6	28.8	27.7	27.0	26.7
H14	18.0	18.1	20.9	25.0	27.1	27.6	27.8	26.7	25.9	25.6
H16	17.8	17.9	20.7	24.8	26.9	27.4	27.6	26.5	25.7	25.4
H22	6.2	6.4	9.2	13.3	15.2	15.3	15.5	14.4	13.7	13.4
H24	3.3	3.5	6.3	10.4	12.2	12.0	12.2	11.1	10.4	10.0
H27	1.7	1.8	4.6	8.7	10.6	10.4	10.6	9.5	8.8	8.4
H33	2.7	2.9	5.6	9.7	11.5	11.2	11.4	10.4	9.6	9.3
H34	17.7	17.9	20.7	24.8	26.9	27.3	27.5	26.4	25.7	25.4
H39	-0.4	-0.2	2.5	6.6	8.5	8.1	8.3	7.3	6.5	6.2
H45	10.8	10.9	13.7	17.8	19.8	20.0	20.2	19.1	18.4	18.0
H49	1.0	1.2	4.0	8.0	9.9	9.7	9.9	8.8	8.0	7.7
H52	0.9	1.0	3.8	7.9	9.7	9.5	9.7	8.6	7.9	7.6
H91	3.1	3.2	6.0	10.1	11.9	11.7	11.9	10.9	10.1	9.8

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H94	4.9	5.1	7.9	12.0	13.9	13.9	14.1	13.0	12.3	12.0
H158	26.0	26.2	28.9	33.0	35.3	35.8	36.0	34.9	34.2	33.8
H162	20.9	21.0	23.8	27.9	30.1	30.6	30.8	29.7	28.9	28.6
H164	22.1	22.3	25.1	29.2	31.4	31.9	32.0	31.0	30.2	29.9
H165	21.9	22.1	24.9	29.0	31.1	31.6	31.8	30.7	30.0	29.7
H168	10.7	10.9	13.7	17.8	19.7	19.9	20.1	19.0	18.3	18.0
H173	10.8	11.0	13.8	17.9	19.8	20.0	20.2	19.1	18.4	18.1
H209	1.7	1.9	4.7	8.8	10.6	10.5	10.6	9.6	8.8	8.5
H222	2.7	2.9	5.7	9.8	11.6	11.3	11.5	10.4	9.7	9.3
H224	0.8	1.0	3.8	7.9	9.7	9.5	9.7	8.6	7.9	7.5

D1 - LA01/2017/0016/F Planning Conditions & Predicted Noise Levels

This turbine was granted planning consent in December 2016 (Planning Reference: LA01/2017/0016/F) [23] with conditions limiting the operational noise associated with the site attached to the consent. Condition 4 states that 'The level of noise immissions from the wind turbine (including the application of any tonal penalty when calculated in accordance with the procedures described in Parges 104 – 109 of ETSU-R-97) shall not exceed the values set out in Table 1 as appropriate. Noise limits for dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in the table attached shall be those of the physically closest location listed in the table, unless otherwise agreed by the council'.

The noise limits referred to as part the condition are shown at **Table 19** for reference and include a reference to the corresponding House ID for each of the properties listed to enable comparison with the overall assessment provided here.

Table 19 – D1 (LA01/2017/0016/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
18 Gruig Lane (H173)	32.4	33.2	34.1	35.0	35.3	35.8	36.3	36.8	-	-
15a Gruig Lane (H58)	31.0	31.8	32.7	33.6	33.8	34.3	34.9	35.4	-	-
15 Gruig Lane (H59)	30.2	31.0	31.9	32.8	33.0	33.5	34.1	34.6	-	-
12 Gruig Lane (H57)	30.1	30.9	31.8	32.7	32.9	33.4	33.9	34.4	-	-
10 Gruig Lane (H56)	30.3	31.1	32.0	32.9	33.1	33.6	34.1	34.6	-	-
7 Gruig Lane (H20)	28.5	29.3	30.2	31.1	31.3	31.8	32.3	32.8	-	-
8 Gruig Lane (H43)	29.0	29.7	30.6	31.5	31.7	32.2	32.8	33.3	-	-
6 Gruig Lane (H44)	27.3	28.1	29.0	29.9	30.0	30.5	31.1	31.6	-	-

The predicted noise levels, using the assumptions detailed at **Section 4**, result in predicted noise levels that are typically within 1 dB of the condition levels specified as part of the consent documentation for the turbine. As a result, it is considered that the predicted noise levels, as shown at **Table 20**, are appropriate for use within the overall cumulative assessment as they represent very similar levels to those referenced within the planning consent.

Table 20 - D1 (LA01/2017/0016/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	15.2	15.2	16.0	16.8	17.7	18.7	18.4	19.0	19.4	19.9
H2	15.0	15.0	15.8	16.6	17.5	18.5	18.2	18.8	19.2	19.7
H3	17.0	17.0	17.8	18.6	19.5	20.5	20.3	20.9	21.3	21.8
H4	15.4	15.4	16.2	17.0	17.9	18.9	18.7	19.3	19.7	20.2
H5	16.5	16.5	17.3	18.1	19.0	20.0	19.8	20.4	20.8	21.3
H6	18.5	18.5	19.3	20.1	21.0	22.0	21.8	22.4	22.8	23.3
H10	21.1	21.1	21.9	22.7	23.6	24.6	24.5	25.1	25.5	26.0
H11	20.1	20.1	20.9	21.7	22.6	23.6	23.5	24.1	24.5	25.0
H12	20.5	20.5	21.3	22.1	23.0	24.0	23.8	24.4	24.8	25.3
H13	20.7	20.7	21.5	22.3	23.2	24.2	24.1	24.7	25.1	25.6
H14	19.1	19.1	19.9	20.7	21.6	22.6	22.4	23.0	23.4	23.9
H16	19.0	19.0	19.8	20.6	21.5	22.5	22.4	23.0	23.4	23.9
H22	26.4	26.4	27.2	28.0	28.9	29.9	29.9	30.5	30.9	31.4
H24	17.7	17.7	18.5	19.3	20.2	21.2	20.9	21.5	21.9	22.4
H27	14.4	14.4	15.2	16.0	16.9	17.9	17.6	18.2	18.6	19.1
H33	8.0	8.0	8.8	9.6	10.5	11.5	11.4	12.0	12.4	12.9
H34	20.0	20.0	20.8	21.6	22.5	23.5	23.4	24.0	24.4	24.9
H39	8.5	8.5	9.3	10.1	11.0	12.0	11.9	12.5	12.9	13.4
H45	33.3	33.3	34.1	34.9	35.8	36.8	36.9	37.5	37.9	38.4
H49	11.7	11.7	12.5	13.3	14.2	15.2	15.0	15.6	16.0	16.5
H52	16.3	16.3	17.1	17.9	18.8	19.8	19.6	20.2	20.6	21.1
H91	17.0	17.0	17.8	18.6	19.5	20.5	20.3	20.9	21.3	21.8
H94	24.1	24.1	24.9	25.7	26.6	27.6	27.5	28.1	28.5	29.0
H158	15.4	15.4	16.2	17.0	17.9	18.9	18.7	19.3	19.7	20.2
H162	18.3	18.3	19.1	19.9	20.8	21.8	21.6	22.2	22.6	23.1
H164	18.3	18.3	19.1	19.9	20.8	21.8	21.6	22.2	22.6	23.1
H165	18.5	18.5	19.3	20.1	21.0	22.0	21.8	22.4	22.8	23.3
H168	32.8	32.8	33.6	34.4	35.3	36.3	36.4	37.0	37.4	37.9
H173	33.2	33.2	34.0	34.8	35.7	36.7	36.9	37.5	37.9	38.4
H209	14.4	14.4	15.2	16.0	16.9	17.9	17.7	18.3	18.7	19.2
H222	8.4	8.4	9.2	10.0	10.9	11.9	11.7	12.3	12.7	13.2
H224	11.8	11.8	12.6	13.4	14.3	15.3	15.1	15.7	16.1	16.6

E1 - LA02/2021/0788/F Planning Conditions & Predicted Noise Levels

Planning consent for the turbine referred to here as E1 (Planning Reference: LA02/2021/0788/F) [24] was approved in August 2021 subject to conditions relating to operational noise. Condition 2 of the consent documentation states that 'The level of noise emissions from the permitted wind turbine (including the application of any Tonal Penalty when calculated in accordance with the procedures described on pages 104 – 109 of ETSU-R-97 and any Amplitude Modulation penalty when calculated in accordance with the procedures described in condition 5) shall not exceed the values set out in Table 1

below. Noise limits for any dwelling which lawfully exist, or have planning permission for construction, at the date of this consent but are not listed in Table 1 shall be represented by the physically-closest location listed in Table 1, unless otherwise agreed by Mid and East Antrim Borough Council'.

The noise limits referred to as part the condition are shown at **Table 21** for reference and includes the corresponding House ID for each of the properties listed to enable comparison with the overall assessment provided here on a consistent basis.

Table 21 – E1 (LA02/2021/0788/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
24 Omerbane (H24)	-	33.9	33.7	33.7	33.7	33.5	33.5	33.5	33.5	33.5
29 Omerbane (H51)	-	35.9	35.7	35.7	35.7	35.5	35.5	35.5	35.5	35.5
32 Omerbane (H52)	-	34.4	34.2	34.2	34.2	34.0	34.0	34.0	34.0	34.0
20 Omerbane (-)	-	30.1	29.9	29.8	29.8	29.6	29.6	29.6	29.6	29.6
54 Tullykittagh (H77)	-	23.3	23.0	22.8	22.8	22.6	22.6	22.6	22.6	22.6
58 Tullykittagh (H78)	-	24.5	24.2	24.1	24.0	23.8	23.8	23.8	23.8	23.8
62 Tullykittagh (H195)	-	26.2	26.0	25.8	25.8	25.6	25.6	25.6	25.6	25.6
19 Omerbane (-)	-	23.0	22.6	22.4	22.4	22.2	22.2	22.2	22.2	22.2
28 Omerbane (H91)	-	37.3	37.1	37.1	37.1	36.9	36.9	36.9	36.9	36.9
27 Omerbane (-)	-	35.2	35.0	34.9	34.9	34.7	34.7	34.7	34.7	34.7
31 Omerbane (H79)	-	31.5	31.3	31.2	31.2	31.0	31.0	31.0	31.0	31.0
70 Tullykittagh (H202)	-	25.3	25.0	24.9	24.8	24.6	24.6	24.6	24.6	24.6
35 Omerbane (H53)	-	33.3	33.1	33.0	33.0	32.8	32.8	32.8	32.8	32.8
37 Omerbane (H25)	-	28.5	28.3	28.1	28.1	27.9	27.9	27.9	27.9	27.9
39 Omerbane (H205)	-	25.5	25.2	25.1	25.0	24.8	24.8	24.8	24.8	24.8
40 Omerbane (H54)	-	22.6	22.3	22.2	22.2	21.9	21.9	21.9	21.9	21.9
42 Omerbane (H55)	-	17.4	17.1	16.9	16.8	16.6	16.6	16.6	16.6	16.6
43 Omerbane (H80)	-	17.0	16.6	16.4	16.4	16.1	16.1	16.1	16.1	16.1
46 Tullykittagh (H190)	-	20.0	19.6	19.4	19.4	19.2	19.2	19.2	19.2	19.2
48 Tullykittagh (H75)	-	20.2	19.8	19.6	19.6	19.4	19.4	19.4	19.4	19.4
49 Tullykittagh (-)	-	20.7	20.3	20.1	20.1	19.9	19.9	19.9	19.9	19.9
51 Tullykittagh (H193)	-	21.0	20.6	20.4	20.3	20.1	20.1	20.1	20.1	20.1
53 Tullykittagh (H182)	-	19.4	19.0	18.8	18.7	18.5	18.5	18.5	18.5	18.5
63 Tullykittagh (H196)	-	25.8	25.5	25.3	25.3	25.1	25.1	25.1	25.1	25.1
67 Tullykittagh (H197)	-	25.7	25.4	25.2	25.2	25.0	25.0	25.0	25.0	25.0
66 Tullykittagh (H198)	-	26.2	25.9	25.8	25.7	25.5	25.5	25.5	25.5	25.5
80 Tullykittagh (-)	-	19.4	19.0	18.8	18.8	18.6	18.6	18.6	18.6	18.6
82 Tullykittagh (-)	-	12.2	11.8	11.5	11.5	11.3	11.3	11.3	11.3	11.3
84 Tullykittagh (-)	-	12.1	11.7	11.5	11.4	11.2	11.2	11.2	11.2	11.2
85 Tullykittagh (-)	-	17.4	17.0	16.7	16.7	16.5	16.5	16.5	16.5	16.5

The planning condition limits are taken from the noise predictions provided within documentation submitted in support of the planning application for the turbine [18]. As a result, any given property could be considered as 'controlling'. In reality, it is expected that only the dwellings located closest to

the turbine (i.e., H24, H52 & H91) would actually be regarded as 'controlling properties'. Furthermore, many of the dwellings have condition limits that are less than 25 dB L_{A90} which can often be considered insignificant in the context of noise associated with the other turbine development in the area.

To maintain relative consistency with the requirements of the planning conditions, rather than undertake predictions using the assumptions provided at **Section 4**, a logarithmic line of best fit has been plotted through the maximum condition noise levels verses the relative distance of each property from the turbine. Where the conditioned levels are considered to be outliers (i.e., the levels are lower than would be expected, possibly due to the prediction model used to generate the levels incorporating barrier/topographical shielding effects) the corresponding properties have been removed from the analysis. The resultant best-fit trendline has been used to predict/extrapolate the expected noise level at all the dwellings considered as part of the cumulative assessment herein. The resultant predicted noise levels are provided at **Table 22**.

The method results in predicted noise levels that are within 0.2 dB of those specified as part of the operational noise condition at the majority of residences and overestimates the impact at the closest residence (H91) by 0.5 dB, which has been corrected to back to directly reference the planning condition values. These predicted operational noise levels have been used to inform the overall cumulative noise assessment.

Table 22 – E1 (LA02/2021/0788/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	6.8	6.8	6.6	6.6	6.6	6.4	6.4	6.4	6.4	6.4
H2	6.5	6.5	6.3	6.3	6.3	6.1	6.1	6.1	6.1	6.1
H3	7.4	7.4	7.2	7.2	7.2	7.0	7.0	7.0	7.0	7.0
H4	7.8	7.8	7.6	7.6	7.6	7.4	7.4	7.4	7.4	7.4
H5	8.3	8.3	8.1	8.1	8.1	7.9	7.9	7.9	7.9	7.9
H6	9.2	9.2	9.0	9.0	9.0	8.8	8.8	8.8	8.8	8.8
H10	10.2	10.2	10.0	10.0	10.0	9.8	9.8	9.8	9.8	9.8
H11	9.7	9.7	9.5	9.5	9.5	9.3	9.3	9.3	9.3	9.3
H12	9.9	9.9	9.7	9.7	9.7	9.5	9.5	9.5	9.5	9.5
H13	10.0	10.0	9.8	9.8	9.8	9.6	9.6	9.6	9.6	9.6
H14	10.0	10.0	9.8	9.8	9.8	9.6	9.6	9.6	9.6	9.6
H16	10.0	10.0	9.8	9.8	9.8	9.6	9.6	9.6	9.6	9.6
H22	18.2	18.2	18.0	18.0	18.0	17.8	17.8	17.8	17.8	17.8
H24	33.9	33.9	33.7	33.7	33.7	33.5	33.5	33.5	33.5	33.5
H27	17.3	17.3	17.1	17.1	17.1	16.9	16.9	16.9	16.9	16.9
H33	10.7	10.7	10.5	10.5	10.5	10.3	10.3	10.3	10.3	10.3
H34	10.4	10.4	10.2	10.2	10.2	10.0	10.0	10.0	10.0	10.0
H39	11.8	11.8	11.6	11.6	11.6	11.4	11.4	11.4	11.4	11.4
H45	16.3	16.3	16.1	16.1	16.1	15.9	15.9	15.9	15.9	15.9
H49	17.1	17.1	16.9	16.9	16.9	16.7	16.7	16.7	16.7	16.7
H52	34.4	34.4	34.2	34.2	34.2	34.0	34.0	34.0	34.0	34.0
H91	37.3	37.3	37.1	37.1	37.1	36.9	36.9	36.9	36.9	36.9
H94	22.7	22.7	22.5	22.5	22.5	22.3	22.3	22.3	22.3	22.3
H158	7.8	7.8	7.6	7.6	7.6	7.4	7.4	7.4	7.4	7.4
H162	9.0	9.0	8.8	8.8	8.8	8.6	8.6	8.6	8.6	8.6

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H164	9.1	9.1	8.9	8.9	8.9	8.7	8.7	8.7	8.7	8.7
H165	9.2	9.2	9.0	9.0	9.0	8.8	8.8	8.8	8.8	8.8
H168	15.2	15.2	15.0	15.0	15.0	14.8	14.8	14.8	14.8	14.8
H173	16.3	16.3	16.1	16.1	16.1	15.9	15.9	15.9	15.9	15.9
H209	17.3	17.3	17.1	17.1	17.1	16.9	16.9	16.9	16.9	16.9
H222	11.3	11.3	11.1	11.1	11.1	10.9	10.9	10.9	10.9	10.9
H224	17.9	17.9	17.7	17.7	17.7	17.5	17.5	17.5	17.5	17.5

F1 - LA02/2021/0791/F Planning Conditions & Predicted Noise Levels

The turbine referred to here as F1 (Planning Reference: LA02/2021/0791/F) [25] was granted planning consent in August 2021. Condition 2 of the planning consent documentation states, in relation to operational noise, that 'The levels of noise emissions from the permitted wind turbine (including the application of any Tonal Penalty when calculated in accordance with the procedures described on pages 104 – 109 of ETSU-R-97 and any Amplitude Modulation penalty when calculated in accordance with the procedures described in Condition 5), shall not exceed the values set out in Table 1 below. Noise limits for any dwellings which lawfully exist, or have planning permission for construction, at the date of this consent but are not listed in Table 1 shall be represented by the physically-closest location listed in Table 1, unless otherwise agreed by Mid and East Antrim Borough Council'.

The noise limits referred to as part the condition are shown at **Table 23** for reference and includes the corresponding House ID for each of the properties listed to enable comparison with the overall assessment provided here.

Table 23 - F1 (LA02/2021/0791/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
24 Omerbane (H24)	-	36.8	36.7	36.6	36.7	36.5	36.5	36.5	36.5	36.5
29 Omerbane (H51)	-	32.7	32.5	32.4	32.4	32.2	32.2	32.2	32.2	32.2
32 Omerbane (H52)	-	30.2	29.9	29.8	29.8	29.6	29.6	29.6	29.6	29.6
20 Omerbane (-)	-	33.8	33.6	33.5	33.5	33.3	33.3	33.3	33.3	33.3
54 Tullykittagh (H77)	-	25.8	25.5	25.3	25.3	25.1	25.1	25.1	25.1	25.1
58 Tullykittagh (H78)	-	27.2	26.9	26.8	26.7	26.5	26.5	26.5	26.5	26.5
62 Tullykittagh (H195)	-	28.6	28.3	28.2	28.2	27.9	27.9	27.9	27.9	27.9
19 Omerbane (-)	-	25.0	24.6	24.5	24.4	24.2	24.2	24.2	24.2	24.2
28 Omerbane (H91)	-	34.7	34.5	34.4	34.4	34.2	34.2	34.2	34.2	34.2
27 Omerbane (-)	-	32.1	31.9	31.8	31.8	31.6	31.6	31.6	31.6	31.6
31 Omerbane (H79)	-	27.6	27.4	27.3	27.2	27.0	27.0	27.0	27.0	27.0
70 Tullykittagh (H202)	-	25.4	25.1	24.9	24.9	24.7	24.7	24.7	24.7	24.7
35 Omerbane (H53)	-	29.4	29.1	29.0	29.0	28.8	28.8	28.8	28.8	28.8
37 Omerbane (H25)	-	25.7	25.4	25.3	25.2	25.0	25.0	25.0	25.0	25.0
39 Omerbane (H205)	-	20.3	20.0	20.0	19.9	19.6	19.6	19.6	19.6	19.6
40 Omerbane (H54)	-	16.9	16.6	16.4	16.3	16.1	16.1	16.1	16.1	16.1
42 Omerbane (H55)	-	15.4	15.0	14.8	14.8	14.6	14.6	14.6	14.6	14.6

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
43 Omerbane (H80)	-	15.0	14.7	14.4	14.4	14.2	14.2	14.2	14.2	14.2
46 Tullykittagh (H190)	-	21.9	21.5	21.3	21.3	21.1	21.1	21.1	21.1	21.1
48 Tullykittagh (H75)	-	22.1	21.8	21.6	21.5	21.3	21.3	21.3	21.3	21.3
49 Tullykittagh (-)	-	22.7	22.4	22.2	22.1	21.9	21.9	21.9	21.9	21.9
51 Tullykittagh (H193)	-	23.0	22.6	22.5	22.4	22.2	22.2	22.2	22.2	22.2
53 Tullykittagh (H182)	-	21.1	20.7	20.5	20.5	20.3	20.3	20.3	20.3	20.3
63 Tullykittagh (H196)	-	27.7	27.4	27.3	27.3	27.0	27.0	27.0	27.0	27.0
67 Tullykittagh (H197)	-	27.0	26.7	26.6	26.5	26.3	26.3	26.3	26.3	26.3
66 Tullykittagh (H198)	-	27.5	27.2	27.1	27.0	26.8	26.8	26.8	26.8	26.8
80 Tullykittagh (-)	-	18.9	18.5	18.3	18.3	18.1	18.1	18.1	18.1	18.1
82 Tullykittagh (-)	-	11.5	11.1	10.8	10.8	10.6	10.6	10.6	10.6	10.6
84 Tullykittagh (-)	-	11.4	11.0	10.7	10.7	10.5	10.5	10.5	10.5	10.5
85 Tullykittagh (-)	-	15.4	14.9	14.7	14.6	14.4	14.4	14.4	14.4	14.4

Similar to the planning condition for E1, these limits are taken from the noise predictions provided within documentation submitted in support of the planning application for the turbine [18]. As a result, any given property could be considered as 'controlling'. In reality, it is expected that only the dwellings located closest to the turbine (i.e., H24, H52 & H91) would actually be regarded as 'controlling properties'.

To maintain relative consistency with the requirements of the planning conditions, rather than undertake predictions using the assumptions provided at **Section 4**, a logarithmic line of best fit has been plotted through the maximum condition noise levels verses the relative distance of each property from the turbine. Where the conditioned levels are considered to be outliers (i.e., the levels are lower than would be expected, possibly due to the prediction model used to generate the levels incorporating barrier effects) the corresponding properties have been removed from the analysis. The resultant best-fit trendline has been used to predict/extrapolate the expected noise level at all the dwellings considered as part of the cumulative assessment herein. The resultant predicted noise levels are provided at **Table 24**.

The method results in predicted noise levels that are within 0.2 dB of those specified as part of the operational noise condition at the majority of residences and overestimates the impact at the closest residences (H24 & H91) by up to 0.5 dB and has been corrected to back to directly reference the planning condition values. These predicted operational noise levels have been used to inform the overall cumulative noise assessment.

Table 24 - F1 (LA02/2021/0791/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H1	7.0	7.0	6.9	6.8	6.9	6.7	6.7	6.7	6.7	6.7
H2	6.8	6.8	6.7	6.6	6.7	6.5	6.5	6.5	6.5	6.5
H3	7.7	7.7	7.6	7.5	7.6	7.4	7.4	7.4	7.4	7.4
H4	8.2	8.2	8.1	8.0	8.1	7.9	7.9	7.9	7.9	7.9
H5	8.7	8.7	8.6	8.5	8.6	8.4	8.4	8.4	8.4	8.4
H6	9.6	9.6	9.5	9.4	9.5	9.3	9.3	9.3	9.3	9.3
H10	10.6	10.6	10.5	10.4	10.5	10.3	10.3	10.3	10.3	10.3

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H11	10.2	10.2	10.1	10.0	10.1	9.9	9.9	9.9	9.9	9.9
H12	10.3	10.3	10.2	10.1	10.2	10.0	10.0	10.0	10.0	10.0
H13	10.4	10.4	10.3	10.2	10.3	10.1	10.1	10.1	10.1	10.1
H14	10.5	10.5	10.4	10.3	10.4	10.2	10.2	10.2	10.2	10.2
H16	10.5	10.5	10.4	10.3	10.4	10.2	10.2	10.2	10.2	10.2
H22	19.4	19.4	19.3	19.2	19.3	19.1	19.1	19.1	19.1	19.1
H24	36.8	36.8	36.7	36.6	36.7	36.5	36.5	36.5	36.5	36.5
H27	16.5	16.5	16.4	16.3	16.4	16.2	16.2	16.2	16.2	16.2
H33	10.2	10.2	10.1	10.0	10.1	9.9	9.9	9.9	9.9	9.9
H34	10.9	10.9	10.8	10.7	10.8	10.6	10.6	10.6	10.6	10.6
H39	11.3	11.3	11.2	11.1	11.2	11.0	11.0	11.0	11.0	11.0
H45	17.2	17.2	17.1	17.0	17.1	16.9	16.9	16.9	16.9	16.9
H49	16.2	16.2	16.1	16.0	16.1	15.9	15.9	15.9	15.9	15.9
H52	30.0	30.0	29.9	29.8	29.9	29.7	29.7	29.7	29.7	29.7
H91	34.7	34.7	34.6	34.5	34.6	34.4	34.4	34.4	34.4	34.4
H94	24.3	24.3	24.2	24.1	24.2	24.0	24.0	24.0	24.0	24.0
H158	8.2	8.2	8.1	8.0	8.1	7.9	7.9	7.9	7.9	7.9
H162	9.4	9.4	9.3	9.2	9.3	9.1	9.1	9.1	9.1	9.1
H164	9.5	9.5	9.4	9.3	9.4	9.2	9.2	9.2	9.2	9.2
H165	9.6	9.6	9.5	9.4	9.5	9.3	9.3	9.3	9.3	9.3
H168	16.1	16.1	16.0	15.9	16.0	15.8	15.8	15.8	15.8	15.8
H173	17.2	17.2	17.1	17.0	17.1	16.9	16.9	16.9	16.9	16.9
H209	16.4	16.4	16.3	16.2	16.3	16.1	16.1	16.1	16.1	16.1
H222	10.8	10.8	10.7	10.6	10.7	10.5	10.5	10.5	10.5	10.5
H224	16.9	16.9	16.8	16.7	16.8	16.6	16.6	16.6	16.6	16.6

Overall Cumulative Assessment

The overall calculated maximum cumulative noise levels for any given wind direction and incorporating all assumptions and factors detailed above are shown at **Table 25**. The predicted noise levels associated with the Carbuck proposals, the cumulative sites and overall cumulative noise levels, for the assessment locations considered here, are all shown at **Appendix A**.

Table 25 - Overall Cumulative Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H1	35.7	36.3	38.5	41.4	43.1	43.6	43.8	43.5	43.6	43.6
H2	33.8	34.5	36.8	39.8	41.5	42.0	42.2	41.9	41.9	41.8
H3	38.0	38.3	41.1	44.9	47.1	47.6	47.8	46.9	46.3	46.1
H4	30.6	31.4	34.5	37.8	39.5	39.9	40.1	39.7	39.5	39.4
H5	30.0	31.0	34.1	37.3	38.8	39.2	39.4	39.1	39.0	39.0
H6	30.4	31.4	34.7	37.7	39.0	39.3	39.5	39.4	39.4	39.5

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H10	30.6	31.7	35.1	37.9	38.9	39.2	39.4	39.3	39.5	39.6
H11	30.0	31.0	34.2	37.0	38.0	38.4	38.6	38.5	38.7	38.8
H12	30.2	31.2	34.4	37.2	38.2	38.5	38.8	38.7	38.8	39.0
H13	30.4	31.4	34.6	37.4	38.4	38.7	39.0	38.9	39.0	39.2
H14	29.7	30.8	34.0	36.8	37.8	38.1	38.4	38.3	38.4	38.6
H16	29.7	30.8	34.1	36.9	38.0	38.3	38.5	38.5	38.6	38.7
H22	30.7	31.7	34.8	37.2	37.8	38.1	38.3	38.3	38.5	38.8
H24	38.9	39.0	39.4	40.0	40.2	40.2	40.3	40.3	40.4	40.5
H27	30.8	32.5	36.5	39.3	39.7	39.9	40.1	40.1	40.2	40.4
H33	26.9	28.3	32.0	34.7	35.2	35.4	35.7	35.7	35.9	36.1
H34	30.3	31.3	34.6	37.4	38.3	38.6	38.9	38.8	39.0	39.1
H39	26.4	27.7	31.4	34.1	34.6	34.8	35.1	35.1	35.3	35.5
H45	34.9	35.4	37.6	39.6	40.3	40.8	41.0	41.2	41.5	41.8
H49	29.2	30.9	34.8	37.6	38.0	38.1	38.3	38.4	38.5	38.6
H52	36.2	36.4	37.0	38.0	38.2	38.2	38.4	38.4	38.5	38.6
H91	39.5	39.6	39.9	40.5	40.7	40.6	40.8	40.8	40.8	40.9
H94	32.0	33.0	36.1	38.6	39.1	39.3	39.5	39.6	39.8	40.0
H158	30.2	31.1	34.1	37.4	39.0	39.4	39.6	39.2	39.1	39.1
H162	29.4	30.4	33.6	36.6	37.8	38.1	38.3	38.2	38.2	38.4
H164	30.1	31.1	34.4	37.4	38.6	38.9	39.2	39.0	39.0	39.1
H165	30.1	31.2	34.5	37.4	38.7	39.0	39.2	39.1	39.1	39.2
H168	33.9	34.3	36.2	38.0	38.7	39.2	39.4	39.7	40.0	40.3
H173	34.9	35.4	37.6	39.7	40.4	40.8	41.0	41.3	41.5	41.9
H209	30.9	32.6	36.6	39.4	39.8	40.0	40.2	40.2	40.3	40.5
H222	26.9	28.2	31.8	34.5	35.1	35.3	35.6	35.6	35.8	36.0
H224	28.7	30.4	34.3	37.1	37.6	37.7	37.9	37.9	38.0	38.1

The predicted margins between the overall maximum cumulative noise levels shown at **Table 25** and the defined overall cumulative noise limits shown at **Table 9** are provided at **Table 26**. A positive number indicates that predicted noise levels may be above the limits at certain locations, subject to various caveats discussed later.

Table 26 – Margin of Compliance with Cumulative Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
Daytime										
H1	-4.3	-3.7	-1.5	1.1	0.1	-1.9	-4.2	-7.0	-9.3	-11.8
H2	-6.2	-5.5	-3.2	-0.2	-0.8	-2.8	-5.2	-8.1	-10.7	-13.6
H3	-2.0	-1.7	1.1	4.9	7.1	7.6	6.6	3.8	1.5	-0.3
H4	-9.4	-8.6	-5.5	-2.2	-0.5	-0.1	-1.1	-3.4	-5.3	-7.0
H5	-10.0	-9.0	-5.9	-2.7	-1.2	-0.8	-1.8	-4.0	-5.8	-7.4

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H6	-9.6	-8.6	-5.3	-2.3	-1.0	-0.7	-0.5	-3.2	-7.4	-7.3
H10	-9.4	-8.3	-4.9	-2.1	-1.1	-0.8	-0.6	-3.3	-7.3	-7.2
H11	-10.0	-9.0	-5.8	-3.0	-2.0	-1.6	-1.4	-4.1	-8.1	-8.0
H12	-9.8	-8.8	-5.6	-2.8	-1.8	-1.5	-1.2	-3.9	-8.0	-7.8
H13	-9.6	-8.6	-5.4	-2.6	-1.6	-1.3	-1.0	-3.7	-7.8	-7.6
H14	-10.3	-9.2	-6.0	-3.2	-2.2	-1.9	-1.6	-4.3	-8.4	-8.2
H16	-10.3	-9.2	-5.9	-3.1	-2.0	-1.7	-1.5	-4.1	-8.2	-8.1
H22	-9.3	-8.3	-5.2	-2.8	-2.7	-4.3	-6.5	-9.6	-13.1	-12.8
H24	-1.1	-1.0	-0.6	0.0	-0.3	-2.2	-4.5	-7.6	-11.2	-11.1
H27	-9.2	-7.5	-3.5	-0.7	-0.3	-0.1	0.1	-0.3	-3.2	-3.0
H33	-13.1	-11.7	-8.0	-5.3	-4.8	-4.6	-4.8	-8.5	-12.8	-12.6
H34	-9.7	-8.7	-5.4	-2.6	-1.7	-1.4	-1.1	-3.8	-7.8	-7.7
H39	-13.6	-12.3	-8.6	-5.9	-5.4	-5.2	-5.4	-9.1	-13.4	-13.2
H45	-5.1	-4.6	-2.4	-0.4	-0.2	-1.6	-3.8	-6.7	-10.1	-9.8
H49	-10.8	-9.1	-5.2	-2.4	-2.0	-1.9	-1.7	-2.0	-4.9	-4.8
H52	-3.8	-3.6	-3.0	-2.0	-2.3	-4.2	-6.4	-9.5	-13.1	-13.0
H91	-0.5	-0.4	-0.1	0.5	0.2	-1.8	-4.0	-7.1	-10.8	-10.7
H94	-8.0	-7.0	-3.9	-1.4	-1.4	-3.1	-5.3	-8.3	-11.8	-11.6
H158	-9.8	-8.9	-5.9	-2.6	-1.0	-0.6	-1.6	-3.9	-5.7	-7.3
H162	-10.6	-9.6	-6.4	-3.4	-2.2	-1.9	-1.7	-4.4	-8.6	-8.4
H164	-9.9	-8.9	-5.6	-2.6	-1.4	-1.1	-0.8	-3.6	-7.8	-7.7
H165	-9.9	-8.8	-5.5	-2.6	-1.3	-1.0	-0.8	-3.5	-7.7	-7.6
H168	-6.1	-5.7	-3.8	-2.0	-1.8	-3.2	-5.4	-8.2	-11.6	-11.3
H173	-5.1	-4.6	-2.4	-0.3	-0.1	-1.6	-3.8	-6.6	-10.1	-9.7
H209	-9.1	-7.4	-3.4	-0.6	-0.2	0.0	0.2	-0.2	-3.1	-2.9
H222	-13.1	-11.8	-8.2	-5.5	-4.9	-4.7	-4.9	-8.6	-12.9	-12.7
H224	-11.3	-9.6	-5.7	-2.9	-2.4	-2.3	-2.1	-2.5	-5.4	-5.3
Night-time										
H1	-7.3	-6.7	-4.5	-1.6	0.1	-0.1	-2.7	-5.9	-8.7	-11.5
H2	-9.2	-8.5	-6.2	-3.2	-1.5	-1.9	-4.5	-7.5	-10.2	-12.9
H3	-5.0	-4.7	-1.9	1.9	4.1	4.6	4.8	3.9	3.3	1.6
H4	-12.4	-11.6	-8.5	-5.2	-3.5	-3.1	-2.9	-3.3	-3.5	-5.1
H5	-13.0	-12.0	-8.9	-5.7	-4.2	-3.8	-3.6	-3.9	-4.0	-5.5
H6	-12.6	-11.6	-8.3	-5.3	-4.0	-3.7	-3.5	-3.6	-4.6	-7.4
H10	-12.4	-11.3	-7.9	-5.1	-4.1	-3.8	-3.6	-3.7	-4.5	-7.3
H11	-13.0	-12.0	-8.8	-6.0	-5.0	-4.6	-4.4	-4.5	-5.3	-8.1
H12	-12.8	-11.8	-8.6	-5.8	-4.8	-4.5	-4.2	-4.3	-5.2	-7.9
H13	-12.6	-11.6	-8.4	-5.6	-4.6	-4.3	-4.0	-4.1	-5.0	-7.7
H14	-13.3	-12.2	-9.0	-6.2	-5.2	-4.9	-4.6	-4.7	-5.6	-8.3
H16	-13.3	-12.2	-8.9	-6.1	-5.0	-4.7	-4.5	-4.5	-5.4	-8.2

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H22	-12.3	-11.3	-8.2	-5.8	-5.2	-4.9	-4.7	-6.0	-8.6	-11.4
H24	-4.1	-4.0	-3.6	-3.0	-2.8	-2.8	-2.7	-4.0	-6.7	-9.7
H27	-12.2	-10.5	-6.5	-3.7	-3.3	-3.1	-2.9	-2.9	-2.8	-3.3
H33	-16.1	-14.7	-11.0	-8.3	-7.8	-7.6	-7.3	-7.3	-9.5	-12.8
H34	-12.7	-11.7	-8.4	-5.6	-4.7	-4.4	-4.1	-4.2	-5.0	-7.8
H39	-16.6	-15.3	-11.6	-8.9	-8.4	-8.2	-7.9	-7.9	-10.1	-13.4
H45	-8.1	-7.6	-5.4	-3.4	-2.7	-2.2	-2.0	-3.1	-5.6	-8.4
H49	-13.8	-12.1	-8.2	-5.4	-5.0	-4.9	-4.7	-4.6	-4.5	-5.1
H52	-6.8	-6.6	-6.0	-5.0	-4.8	-4.8	-4.6	-5.9	-8.6	-11.6
H91	-3.5	-3.4	-3.1	-2.5	-2.3	-2.4	-2.2	-3.5	-6.3	-9.3
H94	-11.0	-10.0	-6.9	-4.4	-3.9	-3.7	-3.5	-4.7	-7.3	-10.2
H158	-12.8	-11.9	-8.9	-5.6	-4.0	-3.6	-3.4	-3.8	-3.9	-5.4
H162	-13.6	-12.6	-9.4	-6.4	-5.2	-4.9	-4.7	-4.8	-5.8	-8.5
H164	-12.9	-11.9	-8.6	-5.6	-4.4	-4.1	-3.8	-4.0	-5.0	-7.8
H165	-12.9	-11.8	-8.5	-5.6	-4.3	-4.0	-3.8	-3.9	-4.9	-7.7
H168	-9.1	-8.7	-6.8	-5.0	-4.3	-3.8	-3.6	-4.6	-7.1	-9.9
H173	-8.1	-7.6	-5.4	-3.3	-2.6	-2.2	-2.0	-3.0	-5.6	-8.3
H209	-12.1	-10.4	-6.4	-3.6	-3.2	-3.0	-2.8	-2.8	-2.7	-3.2
H222	-16.1	-14.8	-11.2	-8.5	-7.9	-7.7	-7.4	-7.4	-9.6	-12.9
H224	-14.3	-12.6	-8.7	-5.9	-5.4	-5.3	-5.1	-5.1	-5.0	-5.6

The assessment shows that, using the assumptions detailed above, overall cumulative noise levels are predicted to meet the overall requirements of ETSU-R-97 at the majority of assessment locations surrounding the site. Instances where predicted noise levels are shown to be close to or above the overall daytime noise limits are usually a result of the proximity of the relatively small turbines to some of the assessment locations.

The residences H1, H2, H3 & H4 are located relatively close to the turbine referred to as B1, for which particularly conservative assumptions have been incorporated into the assessment. As discussed earlier, the actual noise levels resulting from the operation of the turbine are expected to be more than 5 dB lower than predicted here, as per the requirements of the associated planning consent(s) for the alternative turbine to be installed at the site. H3 is also known to have a financial involvement with the installed turbine and higher planning noise limits for the turbine (i.e., the greater of 45 dB L_{A90} or the background sound level plus 5 dB, as per the requirements of ETSU-R-97) would apply at this location. Additionally, the Carnbuck proposal results in predicted noise levels that would not make an appreciable difference in the overall cumulative noise level from the existing, planned and consented development in the area, which are located closer to these properties and result in much higher noise levels, especially at more critical wind speeds. Alternatively, it could be judged that the predicted operational noise levels associated with the Carnbuck proposals are insignificant in the context of the overall cumulative noise limits applied at these locations (i.e., 10 dB or more lower).

Furthermore, the hub-height wind speed reference for the B1 turbine (55 m) is substantially lower than that for the Carnbuck development (112 m) for which all background sound levels and associated ETSU-R-97 planning limits are referenced. As a result, it would be expected that the hub of this turbine would experience relatively lower wind speeds than that at the hub of the turbines to be introduced as part of the Carnbuck proposals. This would have the effect of 'shifting' or 'skewing' the actual turbine noise levels for the B1 turbine, as shown at the assessment charts within **Appendix A**, to the right and result

in overall cumulative noise levels that are more likely to meet the requirements of ETSU-R-97 where the background sound + 5 dB part of the limits are relevant.

The residences H24 and H91 are located close to the single turbines referred to as E1 & F1. The marginal exceedance of the overall cumulative noise levels at these locations is mainly due to the potential presence of these turbines and the way in which the conditioned noise limits appear to suggest that the operational noise levels would not decrease at lower wind speeds. In practice, it would be expected that the predicted noise levels would be substantially decreased at lower wind speeds (as per normal turbine operation) with overall cumulative noise levels being reduced in these instances as a result. Furthermore, the difference in wind speed reference would also have an effect, as discussed above, and the prediction method for each turbine results in levels that are 0.5 dB above the planning condition limits at the residences or 'controlling properties' closest to each turbine.

The E1 & F1 turbines occupy a large proportion of the 'remaining noise budget' at the residences and leave little 'headroom' for further turbine development. It is considered disproportionate and inappropriate to heavily restrict the operation of the Carnbuck development, which has a much larger electrical generating capacity, to mitigate a very minor/marginal theoretical potential for overall operational noise to be above the overall ETSU-R-97 limits, which would only occur from very specific standardised 10 m height winds speeds and northerly wind directions; would occur relatively rarely as a result and is predicted on a conservative basis which is unlikely to occur in practice. Furthermore, the proposed Carnbuck wind farm will also have a character of noise that is very different to that generated by the smaller planned, consented and operational turbines in the area due the lower rotational speeds and blade passing frequency of the larger wind turbines as compared with these smaller scale sites.

As a result of the above and given that the predicted operational noise levels from the Carnbuck proposals are substantially (> 6 dB) lower than that generated by the other turbines considered as part of the assessment, the very marginal potential for predicted overall cumulative noise levels to be above the overall cumulative noise limits is considered acceptable in this instance. However, further planning controls, in the form of proposed condition limits, have been specified to ensure that the noise levels associated with the Carnbuck site are 10 dB below the combined levels from the E1 & F1 turbines at the nearest controlling properties.

The instances where predicted noise levels are very marginally (< 0.4 dB) above the overall noise limits at H27 & H209 are not expected to occur in practice due to the conservatism incorporated into the predicted model. However, the Carnbuck proposals will be the relatively dominant source at these locations and suitable planning controls have been proposed as a result (see below).

Proposed Planning Condition Limits

The proposed planning condition limits for Carnbuck Wind Farm are provided at **Table 27**. The levels are based on the predicted noise levels for the site, as shown at **Table 10**, but with a nominal and varying uncertainty/margin applied depending on the context of noise expected from other development. In instances where there is headroom for the site to operate without risk of overall cumulative levels being above the ETSU-R-97 limits shown at **Table 9** or the Carnbuck noise levels would remain insignificant in the context of noise from other wind farm development in the area, a margin of up to around 2 dB above the maximum predicted noise levels expected to be generated by the turbines has been applied. This margin is decreased in instances where there is any risk that the introduction of Carnbuck development would result in cumulative operational noise levels that would be above the overall cumulative noise limits. Furthermore, a higher margin over the predicted turbine noise levels has been applied for low wind speeds as the cumulative turbines and/or wind farms will not be operating at their maximum capacity, and therefore noise output, and much more 'headroom' or 'noise budget' is available in these instances. The proposed limits are intended to be applied for both daytime and night-time periods.

The noise limits at H27, H91 & H209 have been set lower than the predicted noise levels from the proposed development at relatively certain standardised 10 m height wind speeds to ensure that the predicted cumulative noise levels are not above the overall cumulative noise limits in any significant sense. This will require slight curtailment of a turbine or turbines to be installed as part of the Carnbuck development, as discussed further at **Section 6**.

This approach is considered to tally with the expectations of the Local Planning Authorities (LPAs) in respect of preferred/favoured approach to consenting in respect of operational noise and allows for some flexibility in the potential turbine model to be installed at the Carnbuck site.

Table 27 – Proposed Carnbuck Planning Condition Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H2	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H3	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H4	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H5	26.0	29.0	32.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
H6	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H10	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H11	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H12	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H13	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H14	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H16	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H22	30.0	33.0	36.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
H24	25.5	28.5	31.5	32.5	32.5	33.0	33.0	33.0	33.0	33.0
H27	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H33	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H34	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H39	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H45	29.5	32.5	35.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
H49	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H52	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H91	30.0	30.0	30.0	30.0	30.5	34.0	34.0	34.0	34.0	34.0
H94	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H158	25.0	28.0	31.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
H162	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H164	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H165	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H168	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H173	29.5	32.5	35.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
H209	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H222	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H224	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0

The maximum predicted cumulative turbine noise levels, assuming that the proposed Carnbuck development is operating at the proposed condition limits are shown at **Table 28**.

Table 28 - Cumulative Noise Levels Incorporating Proposed Planning Condition Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	35.8	36.6	38.8	41.5	43.1	43.6	43.8	43.6	43.6	43.6
H2	34.0	34.9	37.2	40.0	41.6	42.1	42.3	42.0	42.0	41.9
H3	38.1	38.5	41.3	45.0	47.1	47.6	47.8	46.9	46.4	46.1
H4	31.2	32.4	35.2	38.0	39.6	40.0	40.2	39.8	39.6	39.6
H5	31.2	32.7	35.6	37.9	39.2	39.6	39.7	39.4	39.4	39.4
H6	31.7	33.3	36.1	38.2	39.3	39.6	39.8	39.7	39.7	39.8
H10	32.5	34.3	37.1	38.8	39.6	39.8	40.0	39.9	40.1	40.2
H11	31.8	33.5	36.3	38.0	38.8	39.1	39.3	39.2	39.3	39.4
H12	31.9	33.6	36.3	38.1	38.9	39.1	39.3	39.3	39.4	39.5
H13	32.0	33.6	36.4	38.2	39.0	39.2	39.5	39.4	39.5	39.7
H14	31.6	33.3	36.2	37.9	38.5	38.8	39.0	39.0	39.1	39.2
H16	31.6	33.4	36.2	38.0	38.7	39.0	39.2	39.2	39.3	39.4
H22	32.9	34.7	37.4	38.6	38.8	39.1	39.2	39.3	39.5	39.6
H24	39.1	39.2	39.7	40.0	40.2	40.3	40.4	40.4	40.5	40.6
H27	33.1	35.2	38.1	39.3	39.5	39.6	39.9	39.9	40.0	40.2
H33	30.0	32.2	35.0	36.3	36.5	36.7	36.9	36.9	37.1	37.2
H34	31.9	33.5	36.3	38.1	38.8	39.0	39.3	39.2	39.3	39.5
H39	29.8	32.1	34.9	36.2	36.4	36.5	36.7	36.7	36.9	37.0
H45	35.7	36.7	38.7	39.9	40.4	40.9	41.1	41.3	41.6	41.9
H49	32.6	34.9	37.8	38.9	39.1	39.2	39.4	39.4	39.5	39.6
H52	36.6	37.1	37.9	38.5	38.6	38.6	38.7	38.7	38.8	38.9
H91	39.9	39.9	40.0	40.2	40.4	40.8	40.9	40.9	41.0	41.1
H94	34.1	35.9	38.5	39.7	39.9	40.1	40.3	40.3	40.5	40.7
H158	31.2	32.5	35.3	37.9	39.3	39.7	39.9	39.5	39.4	39.4
H162	31.1	32.7	35.6	37.5	38.4	38.7	38.9	38.8	38.8	39.0
H164	31.5	33.1	36.0	38.0	39.1	39.4	39.6	39.4	39.4	39.5
H165	31.5	33.1	36.0	38.0	39.1	39.4	39.6	39.4	39.5	39.6
H168	34.9	35.9	37.9	39.0	39.5	39.9	40.1	40.3	40.6	40.9
H173	35.7	36.7	38.7	39.9	40.5	40.9	41.1	41.4	41.6	41.9
H209	33.1	35.2	38.1	39.3	39.5	39.7	39.9	39.9	40.0	40.2
H222	30.0	32.2	35.0	36.3	36.6	36.7	36.9	36.9	37.1	37.2
H224	32.4	34.8	37.7	38.8	39.0	39.1	39.2	39.2	39.3	39.4

The margins between the overall maximum cumulative noise levels shown at **Table 28** and the defined cumulative noise limits shown at **Table 9** are provided at **Table 29**. A positive number indicates that predicted noise levels may be above the limits at certain locations, subject to the various caveats previously discussed, that equally apply in this instance.

Table 29 – Margin of Compliance with Cumulative Noise Limits (Carnbuck Proposed Limits), dB

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Daytime										
H1	-4.2	-3.4	-1.2	1.2	0.1	-1.9	-4.2	-6.9	-9.3	-11.8
H2	-6.0	-5.1	-2.8	0.0	-0.7	-2.7	-5.1	-8.0	-10.6	-13.5
H3	-1.9	-1.5	1.3	5.0	7.1	7.6	6.6	3.8	1.6	-0.3
H4	-8.8	-7.6	-4.8	-2.0	-0.4	0.0	-1.0	-3.3	-5.2	-6.8
H5	-8.8	-7.3	-4.4	-2.1	-0.8	-0.4	-1.5	-3.7	-5.4	-7.0
H6	-8.3	-6.7	-3.9	-1.8	-0.7	-0.4	-0.2	-2.9	-7.1	-7.0
H10	-7.5	-5.7	-2.9	-1.2	-0.4	-0.2	0.0	-2.7	-6.7	-6.6
H11	-8.2	-6.5	-3.7	-2.0	-1.2	-0.9	-0.7	-3.4	-7.5	-7.4
H12	-8.1	-6.4	-3.7	-1.9	-1.1	-0.9	-0.7	-3.3	-7.4	-7.3
H13	-8.0	-6.4	-3.6	-1.8	-1.0	-0.8	-0.5	-3.2	-7.3	-7.1
H14	-8.4	-6.7	-3.8	-2.1	-1.5	-1.2	-1.0	-3.6	-7.7	-7.6
H16	-8.4	-6.6	-3.8	-2.0	-1.3	-1.0	-0.8	-3.4	-7.5	-7.4
H22	-7.1	-5.3	-2.6	-1.4	-1.7	-3.3	-5.6	-8.6	-12.1	-12.0
H24	-0.9	-0.8	-0.3	0.0	-0.3	-2.1	-4.4	-7.5	-11.1	-11.0
H27	-6.9	-4.8	-1.9	-0.7	-0.5	-0.4	-0.1	-0.5	-3.4	-3.2
H33	-10.0	-7.8	-5.0	-3.7	-3.5	-3.3	-3.6	-7.3	-11.6	-11.5
H34	-8.1	-6.5	-3.7	-1.9	-1.2	-1.0	-0.7	-3.4	-7.5	-7.3
H39	-10.2	-7.9	-5.1	-3.8	-3.6	-3.5	-3.8	-7.5	-11.8	-11.7
H45	-4.3	-3.3	-1.3	-0.1	-0.1	-1.5	-3.7	-6.6	-10.0	-9.7
H49	-7.4	-5.1	-2.2	-1.1	-0.9	-0.8	-0.6	-1.0	-3.9	-3.8
H52	-3.4	-2.9	-2.1	-1.5	-1.9	-3.8	-6.1	-9.2	-12.8	-12.7
H91	-0.1	-0.1	0.0	0.2	-0.1	-1.6	-3.9	-7.0	-10.6	-10.5
H94	-5.9	-4.1	-1.5	-0.3	-0.6	-2.3	-4.5	-7.6	-11.1	-10.9
H158	-8.8	-7.5	-4.7	-2.1	-0.7	-0.3	-1.3	-3.6	-5.4	-7.0
H162	-8.9	-7.3	-4.4	-2.5	-1.6	-1.3	-1.1	-3.8	-8.0	-7.8
H164	-8.5	-6.9	-4.0	-2.0	-0.9	-0.6	-0.4	-3.2	-7.4	-7.3
H165	-8.5	-6.9	-4.0	-2.0	-0.9	-0.6	-0.4	-3.2	-7.3	-7.2
H168	-5.1	-4.1	-2.1	-1.0	-1.0	-2.5	-4.7	-7.6	-11.0	-10.7
H173	-4.3	-3.3	-1.3	-0.1	0.0	-1.5	-3.7	-6.5	-10.0	-9.7
H209	-6.9	-4.8	-1.9	-0.7	-0.5	-0.3	-0.1	-0.5	-3.4	-3.2
H222	-10.0	-7.8	-5.0	-3.7	-3.4	-3.3	-3.6	-7.3	-11.6	-11.5
H224	-7.6	-5.2	-2.3	-1.2	-1.0	-0.9	-0.8	-1.2	-4.1	-4.0
Night-time										
H1	-7.2	-6.4	-4.2	-1.5	0.1	-0.1	-2.7	-5.8	-8.7	-11.5
H2	-9.0	-8.1	-5.8	-3.0	-1.4	-1.8	-4.4	-7.4	-10.1	-12.8
H3	-4.9	-4.5	-1.7	2.0	4.1	4.6	4.8	3.9	3.4	1.6
H4	-11.8	-10.6	-7.8	-5.0	-3.4	-3.0	-2.8	-3.2	-3.4	-4.9
H5	-11.8	-10.3	-7.4	-5.1	-3.8	-3.4	-3.3	-3.6	-3.6	-5.1

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H6	-11.3	-9.7	-6.9	-4.8	-3.7	-3.4	-3.2	-3.3	-4.3	-7.1
H10	-10.5	-8.7	-5.9	-4.2	-3.4	-3.2	-3.0	-3.1	-3.9	-6.7
H11	-11.2	-9.5	-6.7	-5.0	-4.2	-3.9	-3.7	-3.8	-4.7	-7.5
H12	-11.1	-9.4	-6.7	-4.9	-4.1	-3.9	-3.7	-3.7	-4.6	-7.4
H13	-11.0	-9.4	-6.6	-4.8	-4.0	-3.8	-3.5	-3.6	-4.5	-7.2
H14	-11.4	-9.7	-6.8	-5.1	-4.5	-4.2	-4.0	-4.0	-4.9	-7.7
H16	-11.4	-9.6	-6.8	-5.0	-4.3	-4.0	-3.8	-3.8	-4.7	-7.5
H22	-10.1	-8.3	-5.6	-4.4	-4.2	-3.9	-3.8	-5.0	-7.6	-10.6
H24	-3.9	-3.8	-3.3	-3.0	-2.8	-2.7	-2.6	-3.9	-6.6	-9.6
H27	-9.9	-7.8	-4.9	-3.7	-3.5	-3.4	-3.1	-3.1	-3.0	-3.5
H33	-13.0	-10.8	-8.0	-6.7	-6.5	-6.3	-6.1	-6.1	-8.3	-11.7
H34	-11.1	-9.5	-6.7	-4.9	-4.2	-4.0	-3.7	-3.8	-4.7	-7.4
H39	-13.2	-10.9	-8.1	-6.8	-6.6	-6.5	-6.3	-6.3	-8.5	-11.9
H45	-7.3	-6.3	-4.3	-3.1	-2.6	-2.1	-1.9	-3.0	-5.5	-8.3
H49	-10.4	-8.1	-5.2	-4.1	-3.9	-3.8	-3.6	-3.6	-3.5	-4.1
H52	-6.4	-5.9	-5.1	-4.5	-4.4	-4.4	-4.3	-5.6	-8.3	-11.3
H91	-3.1	-3.1	-3.0	-2.8	-2.6	-2.2	-2.1	-3.4	-6.1	-9.1
H94	-8.9	-7.1	-4.5	-3.3	-3.1	-2.9	-2.7	-4.0	-6.6	-9.5
H158	-11.8	-10.5	-7.7	-5.1	-3.7	-3.3	-3.1	-3.5	-3.6	-5.1
H162	-11.9	-10.3	-7.4	-5.5	-4.6	-4.3	-4.1	-4.2	-5.2	-7.9
H164	-11.5	-9.9	-7.0	-5.0	-3.9	-3.6	-3.4	-3.6	-4.6	-7.4
H165	-11.5	-9.9	-7.0	-5.0	-3.9	-3.6	-3.4	-3.6	-4.5	-7.3
H168	-8.1	-7.1	-5.1	-4.0	-3.5	-3.1	-2.9	-4.0	-6.5	-9.3
H173	-7.3	-6.3	-4.3	-3.1	-2.5	-2.1	-1.9	-2.9	-5.5	-8.3
H209	-9.9	-7.8	-4.9	-3.7	-3.5	-3.3	-3.1	-3.1	-3.0	-3.5
H222	-13.0	-10.8	-8.0	-6.7	-6.4	-6.3	-6.1	-6.1	-8.3	-11.7
H224	-10.6	-8.2	-5.3	-4.2	-4.0	-3.9	-3.8	-3.8	-3.7	-4.3

The charts provided at **Appendix A** also show the proposed planning condition limits and the effect of their use adopting them as part of the overall cumulative noise assessment along with all the other relevant predicted noise levels. This shows that the use of these levels as part of the assessment reduces most risk of cumulative noise levels marginally exceeding the overall cumulative ETSU-R-97 limits. However, there remains a particularly marginal case at H91 whereby a very small theoretical exceedance could occur. This is highly unlikely to occur in practice, the existing two small turbines neighbouring the house are by far the dominant source of noise at this location and the breach would only theoretically occur during northerly wind speeds, whereas the prevailing wind direction is south-westerly.

6. PLANNING CONTROLS & CURTAILMENT

A proposed wording for a planning condition that would restrict operational noise associated with the Carnbuck development is provided at Appendix B. This includes the suggested limiting values at **Table 27**.

The predicted turbine noise levels shown at **Table 10** are marginally above the proposed limiting values at certain standardised 10 m height wind speeds at H27, H91 & H209. A mitigation strategy, using the noise modes shown at **Table 7**, can be applied to one or more of the closest turbines to absolutely ensure that operational noise levels are not above the proposed limits for certain standardised 10 m height wind speeds and wind directions to ensure, in the main, that both the proposed noise conditions specifically for Carnbuck and the overall cumulative noise limits can be met, notwithstanding the very marginal daytime cumulative exceedance at H91.

Such a curtailment strategy has not been supplied/detailed here as the required reduction in operational noise levels is considered relatively trivial and the assumed turbine to be installed at the site is only one candidate in a range of potential models. The condition limits will have the desired effect in restricting the levels of operational noise from the development regardless of the specific turbine model that could be installed.

7. CONCLUSIONS

An assessment of the expected noise levels resulting from the Carnbuck wind farm, including the potential for cumulative operational noise effects, has been undertaken. The assessment follows the principles and guidance contained within ETSU-R-97 and the GPG.

The works are intended to supplement and provide revision to the information provided within the noise assessment submitted in support of the planning application for the proposed development.

The assessment indicates that there is a marginal risk the cumulative noise levels could be above the overall limiting requirements of ETSU-R-97 at certain residences surrounding the development and cumulative sites. As a result, planning controls have been proposed such that the introduction of the proposed development would result in noise levels that are considered insignificant in the context of operation noise from other development or that ensures that operational noise from the proposed development would not result in cumulative noise levels that are above the overall limiting requirements of ETSU-R-97 where possible.

The adoption of the proposed noise limits will allow for a range of turbine models to be installed at the site and is considered to fit in with the typical consenting requirements of the local planning authority in terms of operational noise from wind farms.

8. REFERENCES

[1] Department of Trade & Industry (September 1996) ETSU-R-97 The Assessment & Rating of Noise from Wind Farms

[2] Institute of Acoustics (May 2013) A Good Practice Guide to the Assessment & Rating of Noise from Wind Farms

[3] International Organisation for Standardisation (December 1996) ISO 9613-2:1996 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation

[4] International Organisation for Standardisation (June 1993) Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere

[5] International Electrotechnical Commission (2012) IEC 61400-11 Edition 3.0 - Wind turbines – Part 11: Acoustic noise measurement techniques

[6] Vestas (May 2018) Performance Specification V136 – 4.0/4.2 MW 50/60 Hz - Ref: 0067-7065 V06

[7] Vestas (May 2018) V136-4.0/4.2 MW Third octave noise emission – Ref: 0067-4732 V03

[8] Nordex (October 2005) Noise Emission Nordex N80 - Ref: F008_158_EN Revision 2

[9] Nordex (August 2005) Nordex N80 – Noise level - Ref: N80-6-noise-en

[10] Vestas (September 2018) Performance Specification V117-4.0/4.2 MW 50/60 Hz Strong Wind - Ref: 0067-7063 V05

[11] Vestas (March 2018) V150-4.0/4.2 MW Third octave noise emission - Ref: 0067-4767 V05

[12] Golder Associates (May 2013) Single Turbine Planning Application – Noise - Slievenahanaghan Wind Farm – Ref: 11514870O03.501/B.0

[13] Enercon (May 2007) Sound Power Level E-44 – Ref: SA-04-SPL Guarantee E-44-Rev1_2-ger-eng

[14] WIND-consult GmbH (March 2007) Extract of test report 042SE207 regarding noise emission of wind turbine (WT) type ENERCON E-44 – Ref: 042SE207

[15] Vestas (October 2008) General Specification Vestas V52-850 kW 50/60 Hz - Ref: 946506 V10

[16] WINDTEST GmbH (February 2003) Report of Acoustical Emissions of a Wind Turbine Generator System of the Type V52-850 kW 104,2 dB(A) near Sørvad - Ref: 2466/02

[17] KRM (December 2018) Noise Assessment Single Wind Turbine (Replacement Type) – Ref: LA01/2017/0016/F

[18] AONA Environmental (July 2021) Single Wind Turbine Development – Obermane Road – Cloughmills – Proposed change of Wind Turbine model (Previous Planning Ref. G/2012/0460/F) – Noise Impact Assessment Report – Ref: ENV5099

[19] Department of the Environment (October 2004) Gruig Planning Permission - Ref: D/2004/0790/F

[20] Causeway Coast & Glens Borough Council (July 2019) Corkey Wind Farm Approval of Planning Permission – Ref: LA01/2019/0772/F

[21] Department of the Environment (September 2013) Approval of Planning Permission - Ref: D/2013/0081/F

[22] Causeway Coast & Glens Borough Council (July 2022) Approval of Planning Permission – Ref: LA01/2022/0783/F

[23] Causeway Coast & Glens Borough Council (December 2016) Approval of Planning Permission – Ref: LA01/2017/0016/F

[24] Mid & East Antrim Borough Council (August 2021) Approval of Planning Permission – Ref: LA02/2021/0788/F

[25] Mid & East Antrim Borough Council (August 2021) Approval of Planning Permission – Ref: LA02/2021/0791/F

APPENDIX A – ASSESSMENT CHARTS

Chart A.1

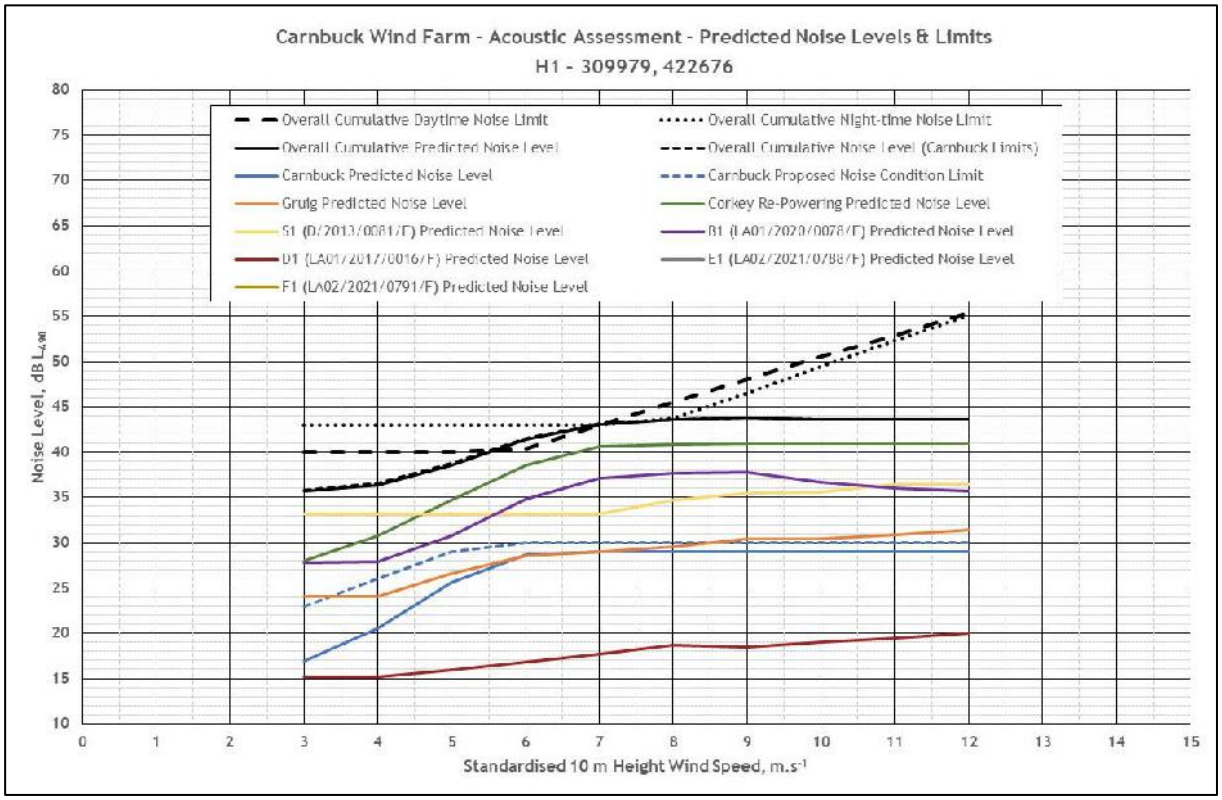


Chart A.2

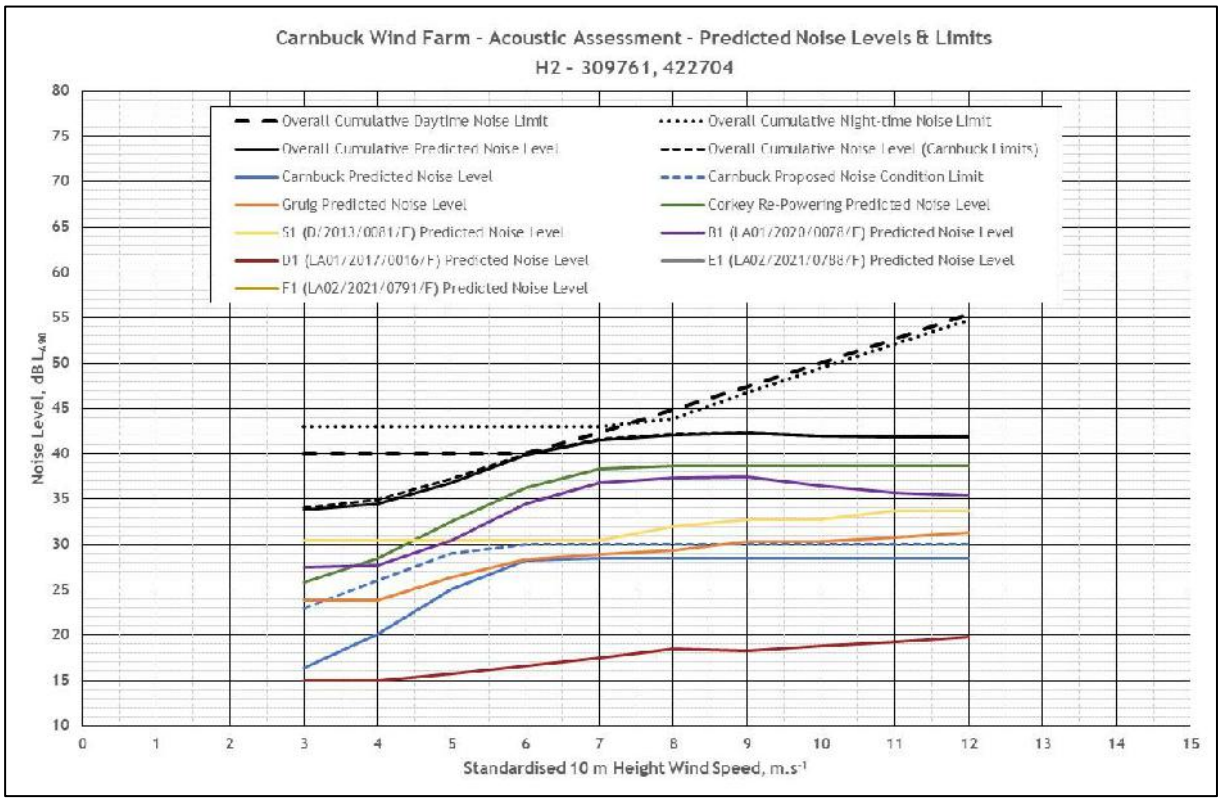


Chart A.3

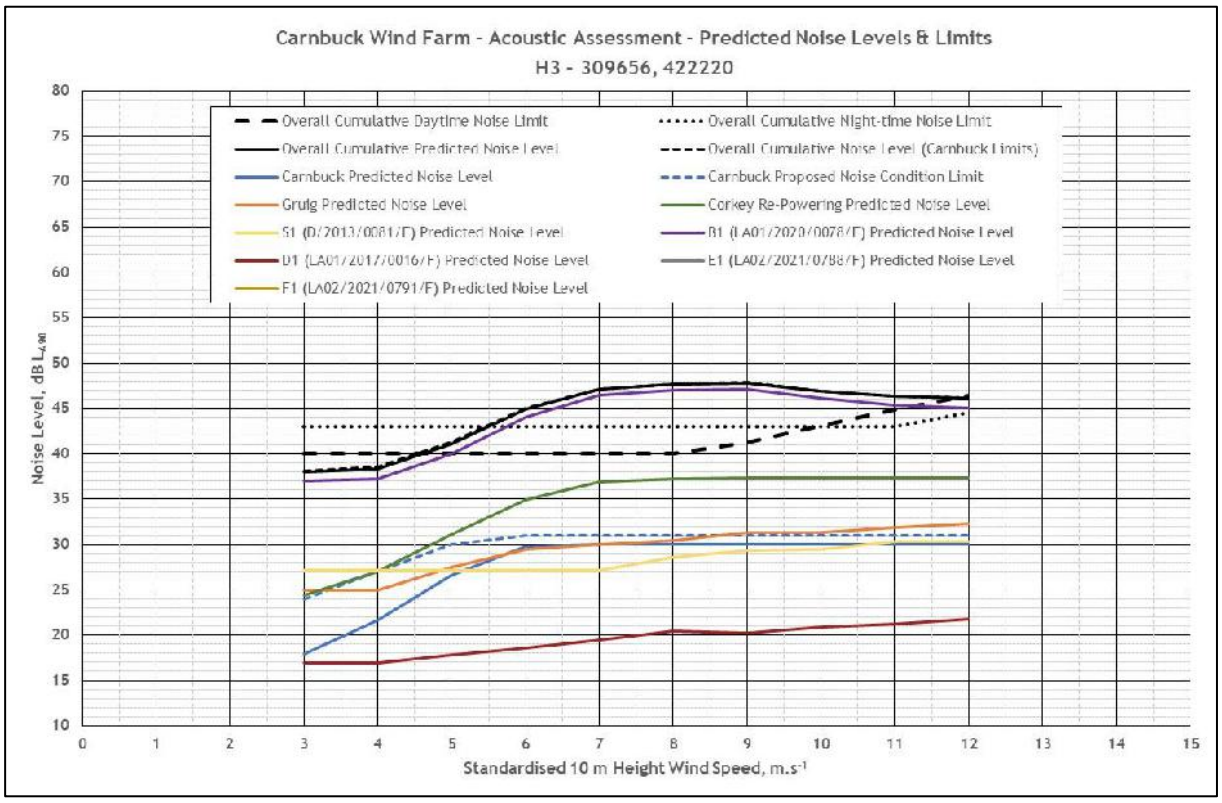


Chart A.4

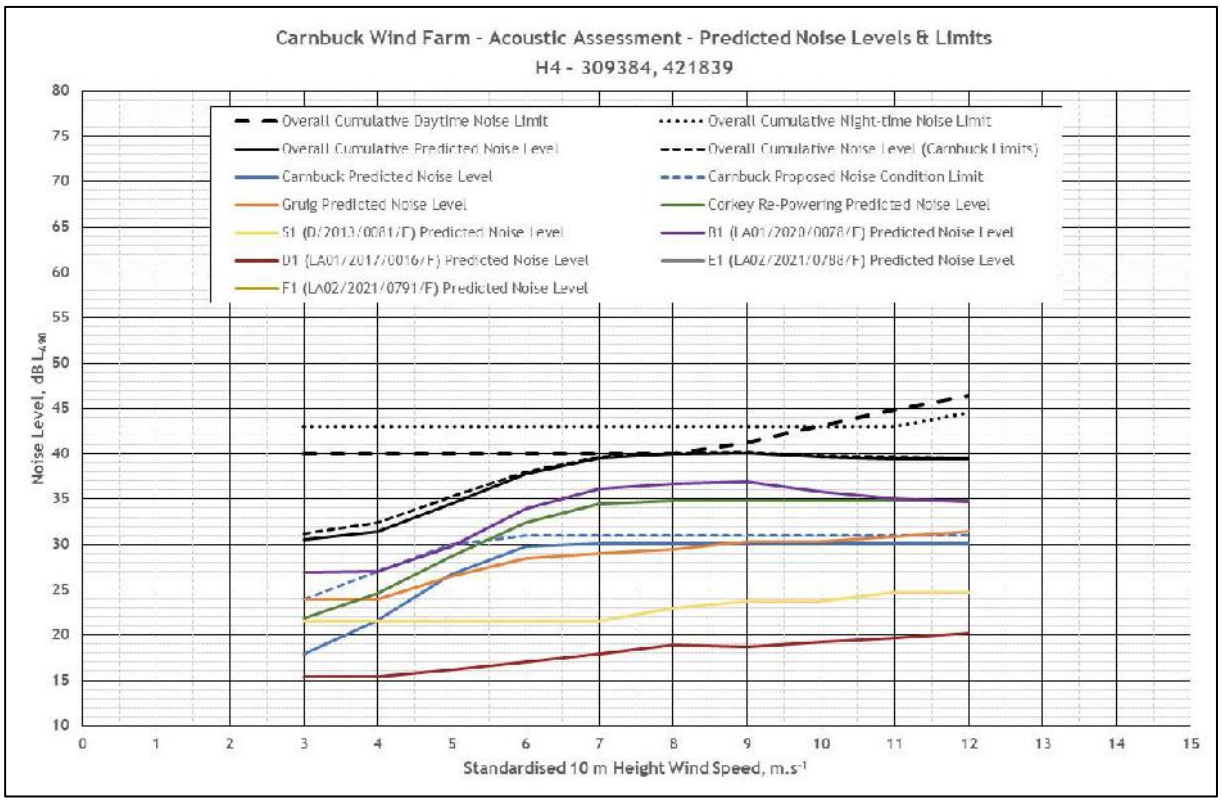


Chart A.5

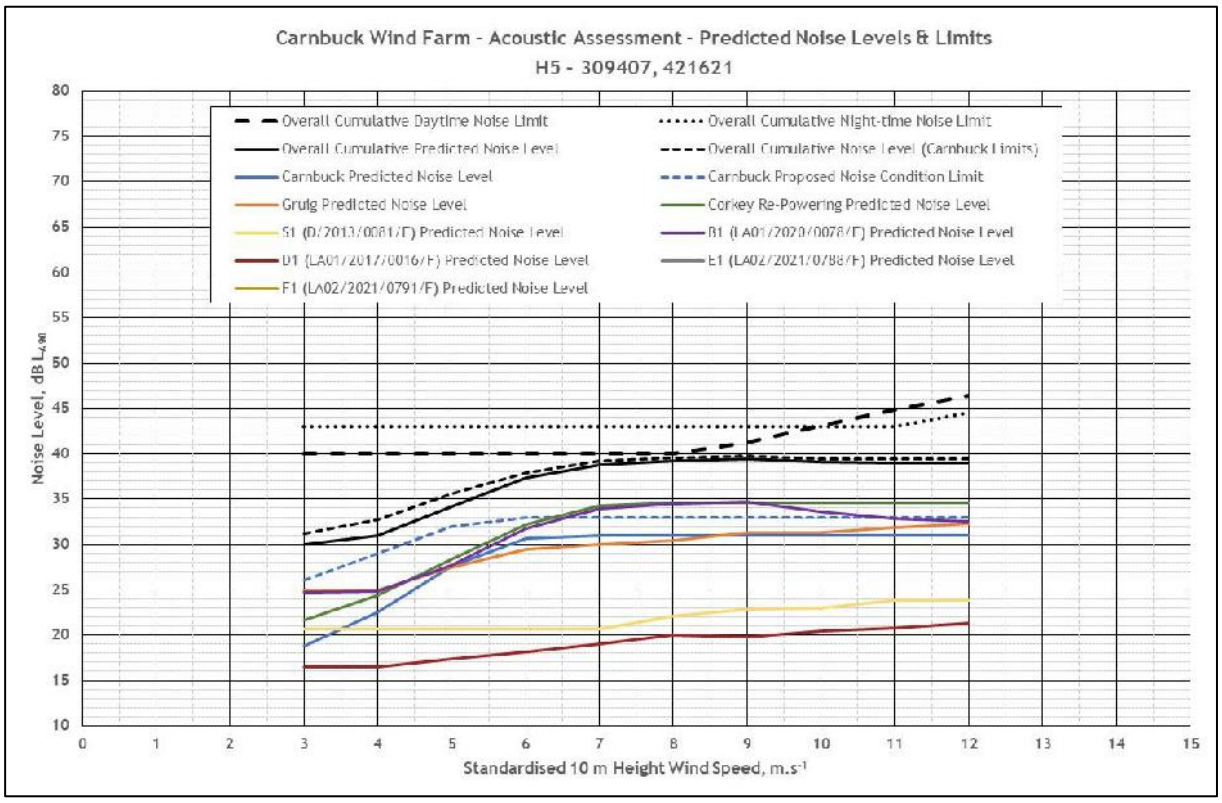


Chart A.6

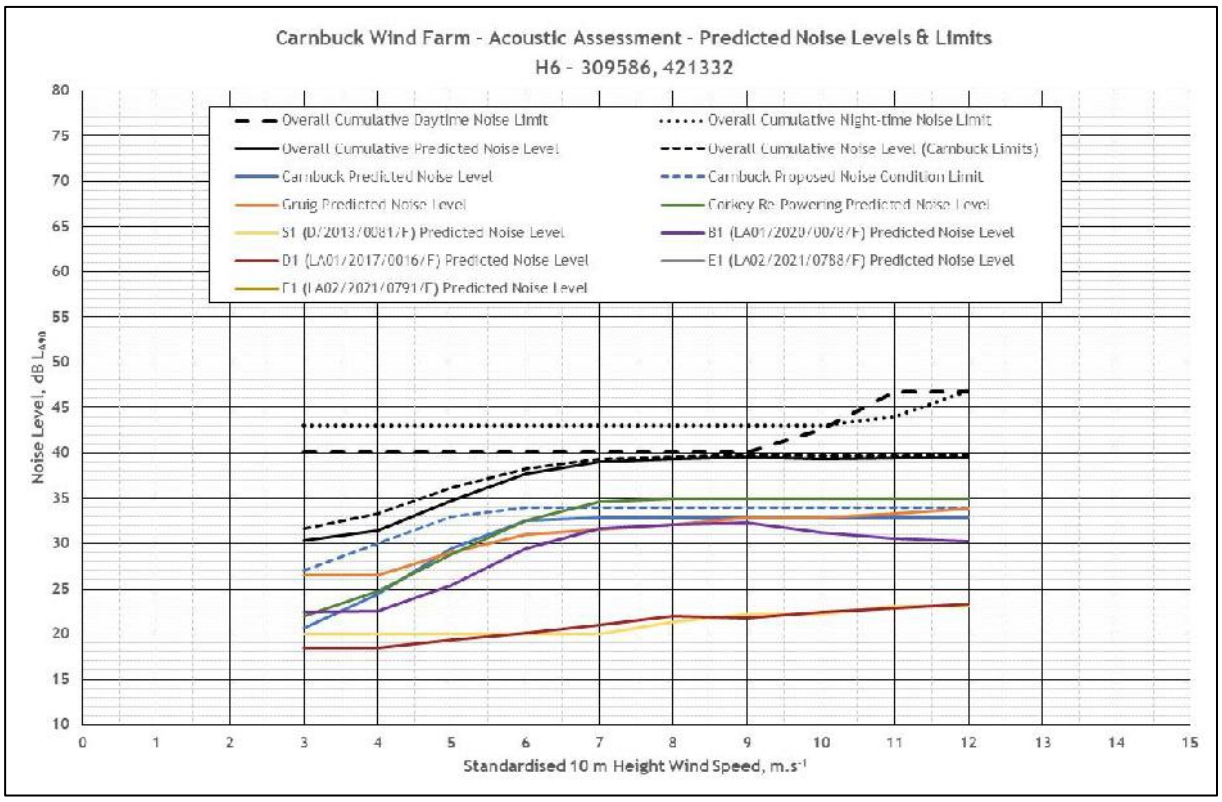


Chart A.7

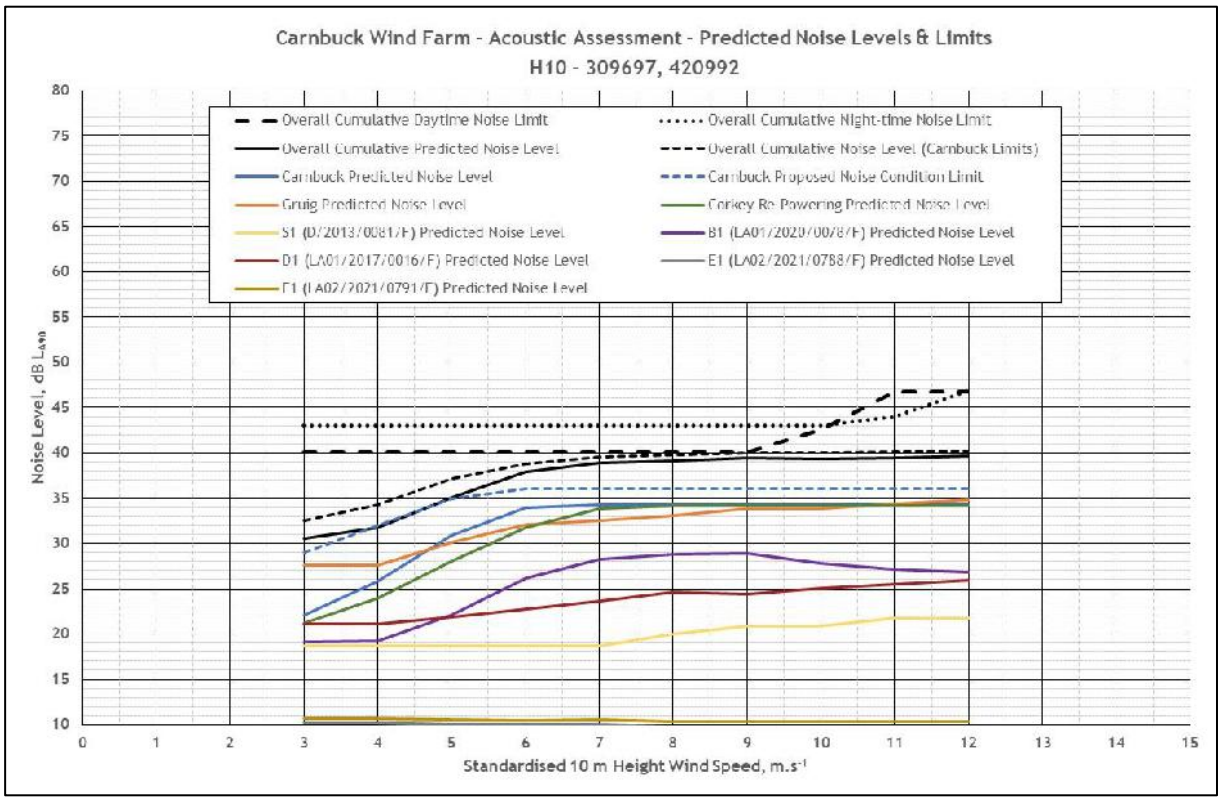


Chart A.8

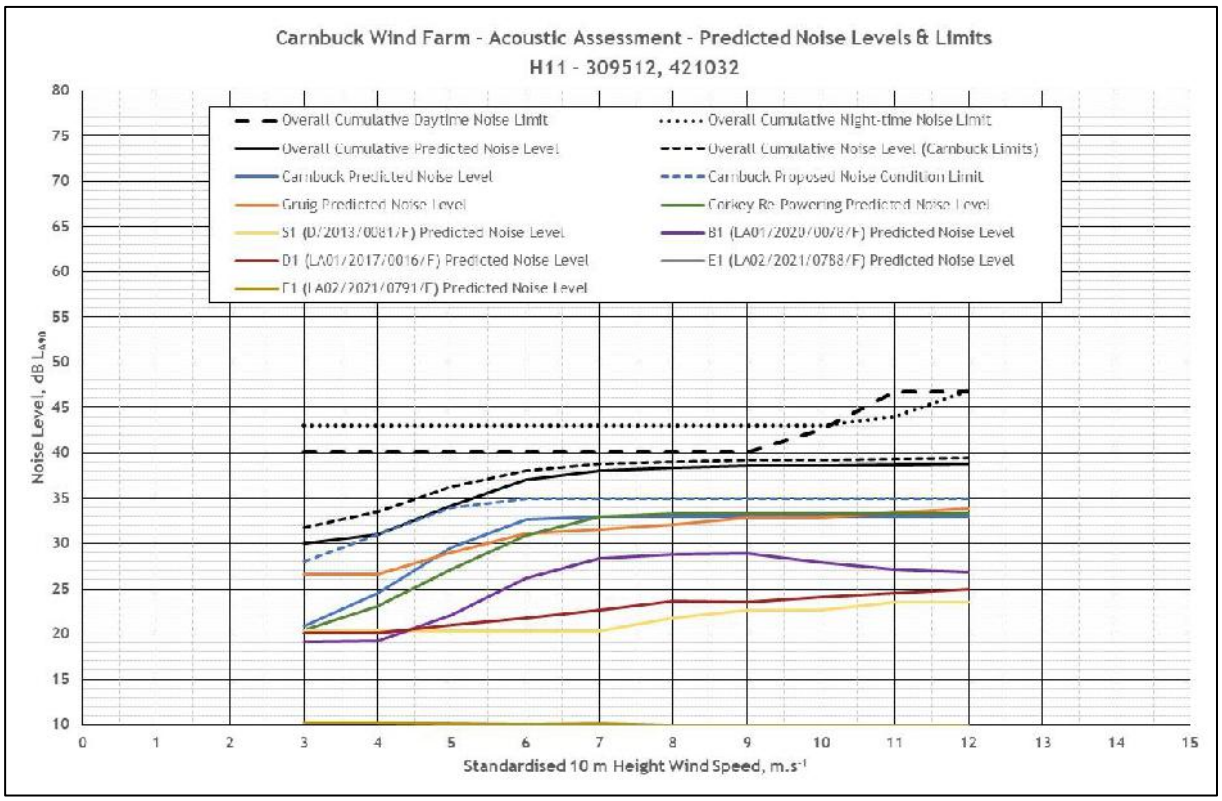


Chart A.9

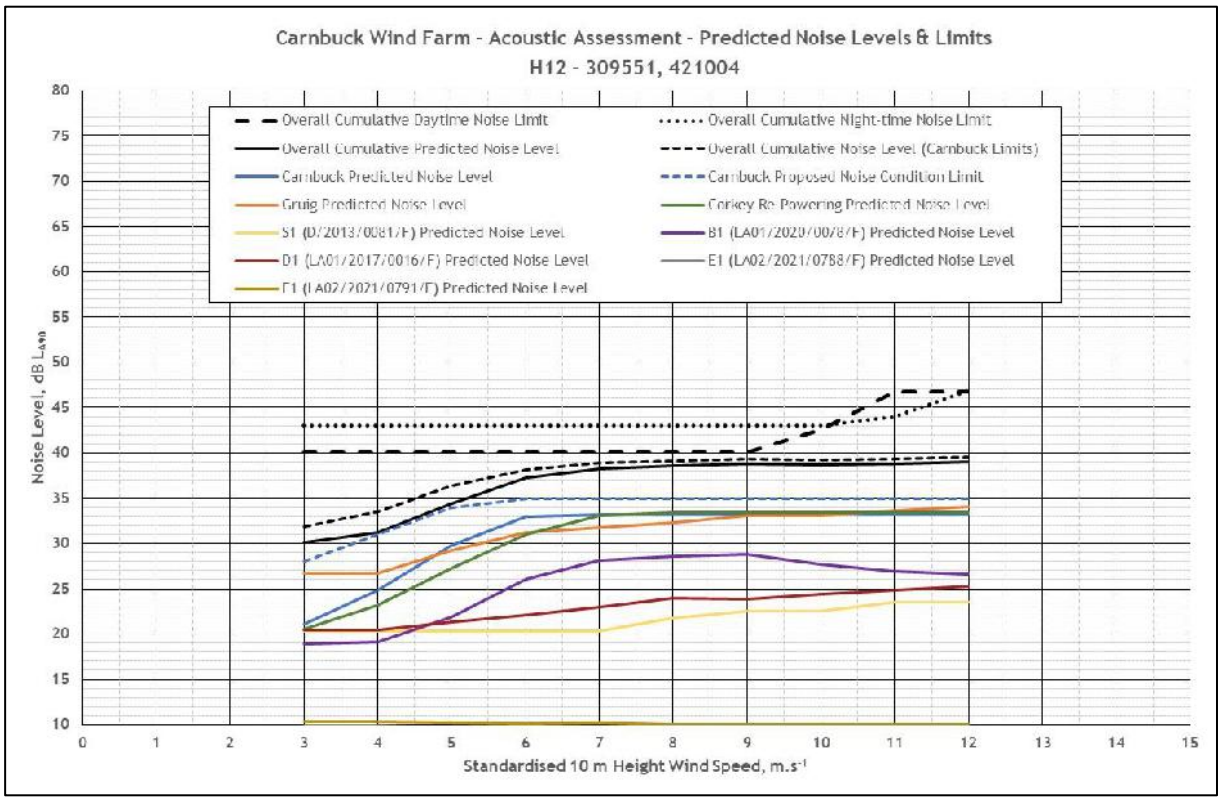


Chart A.10

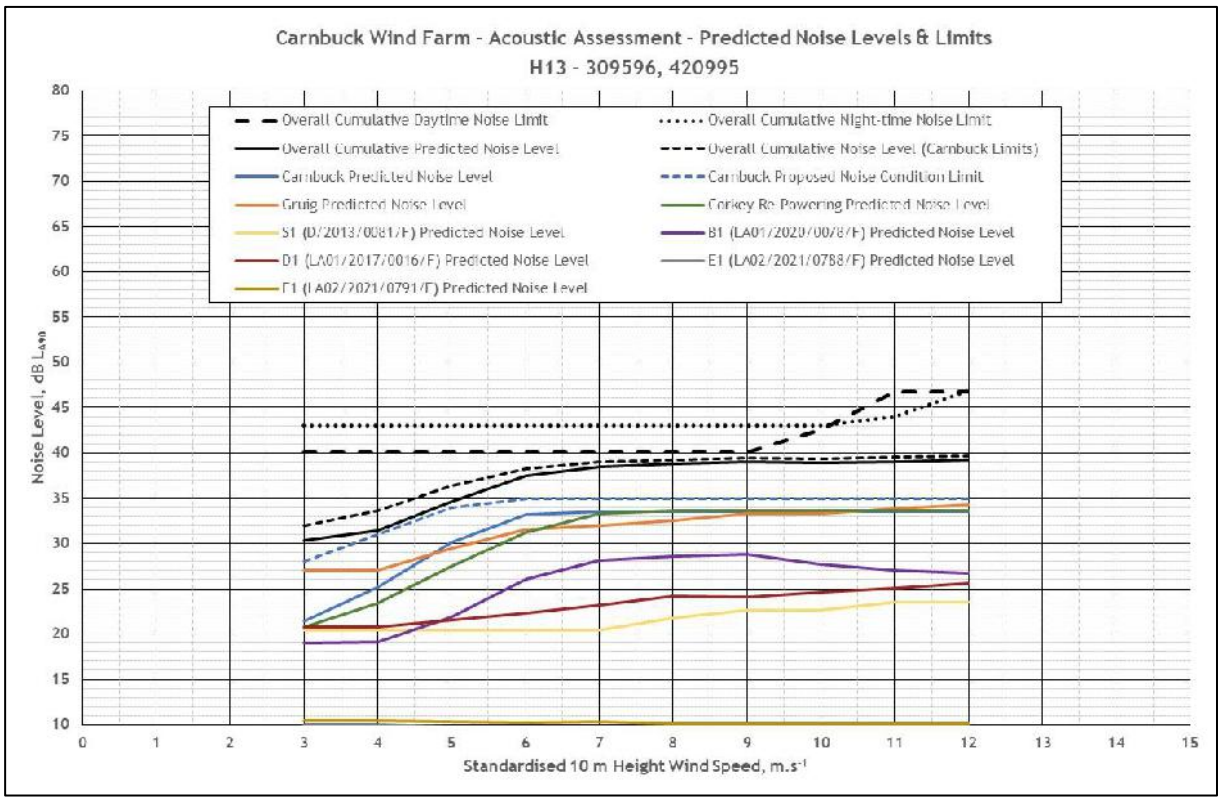


Chart A.11

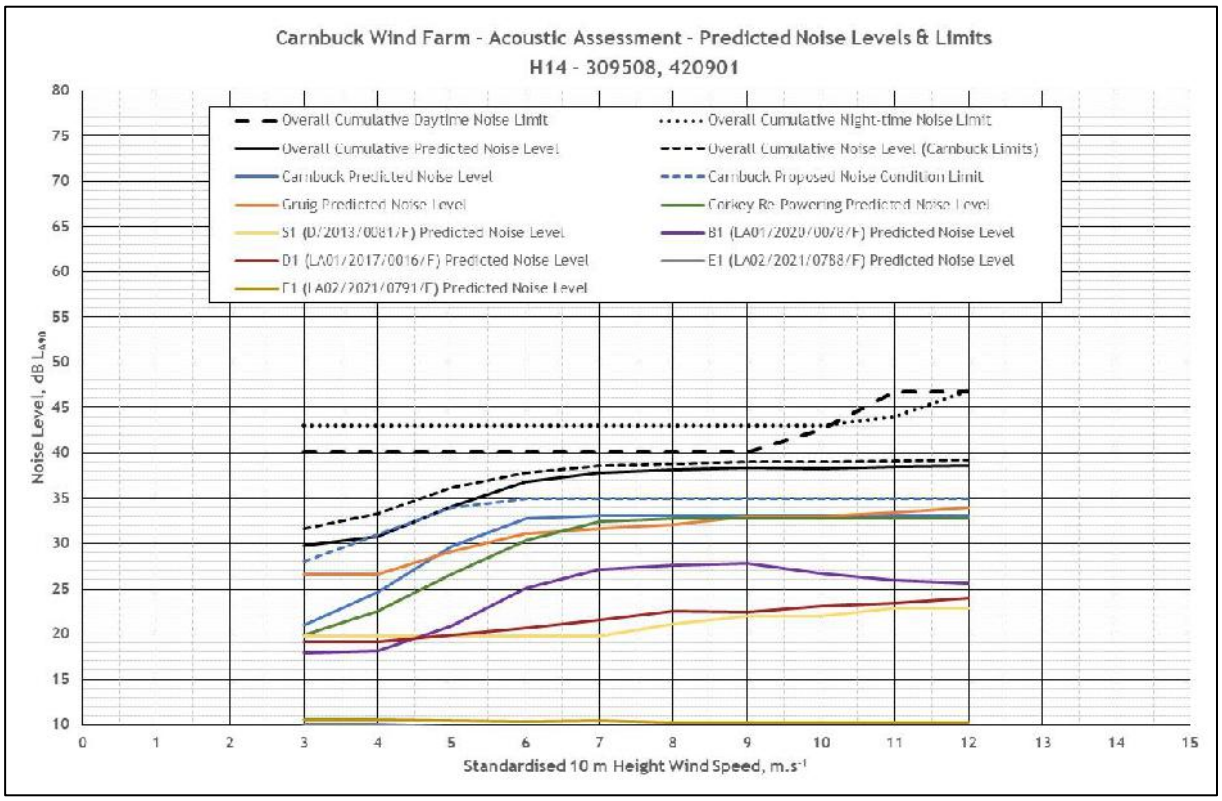


Chart A.12

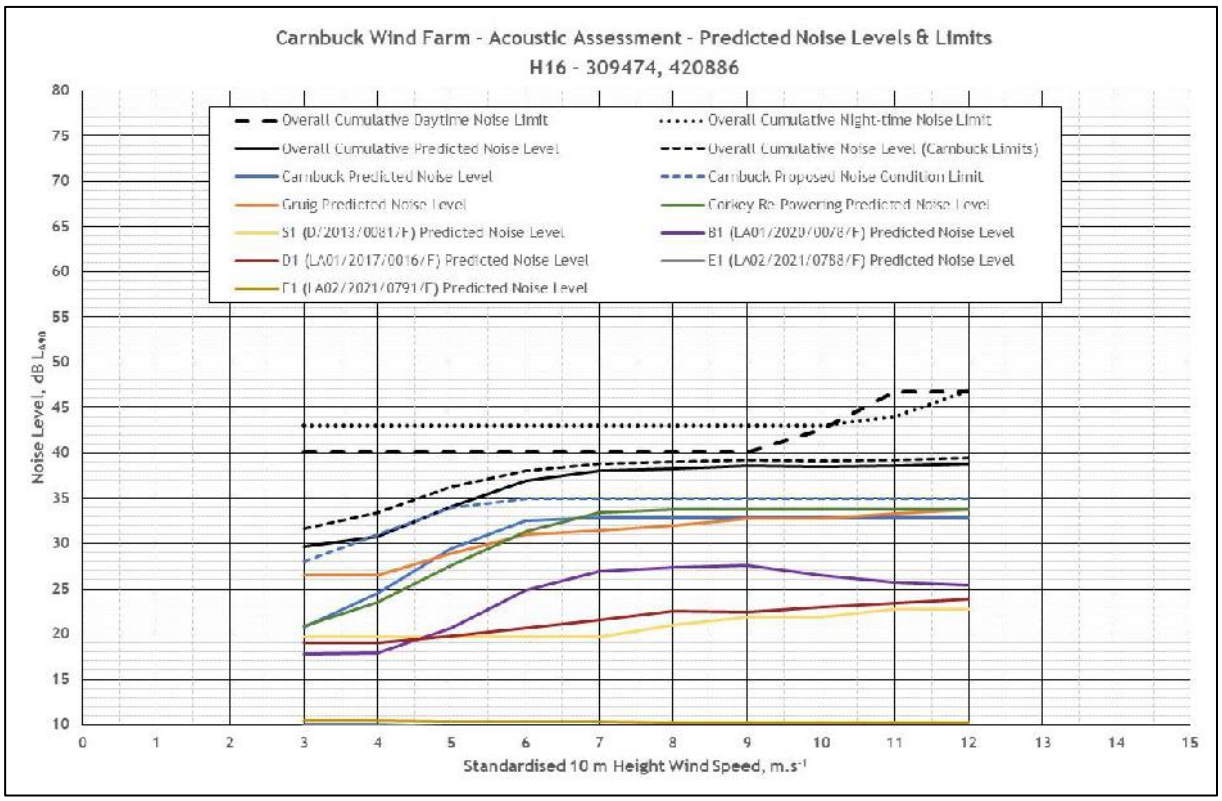


Chart A.13

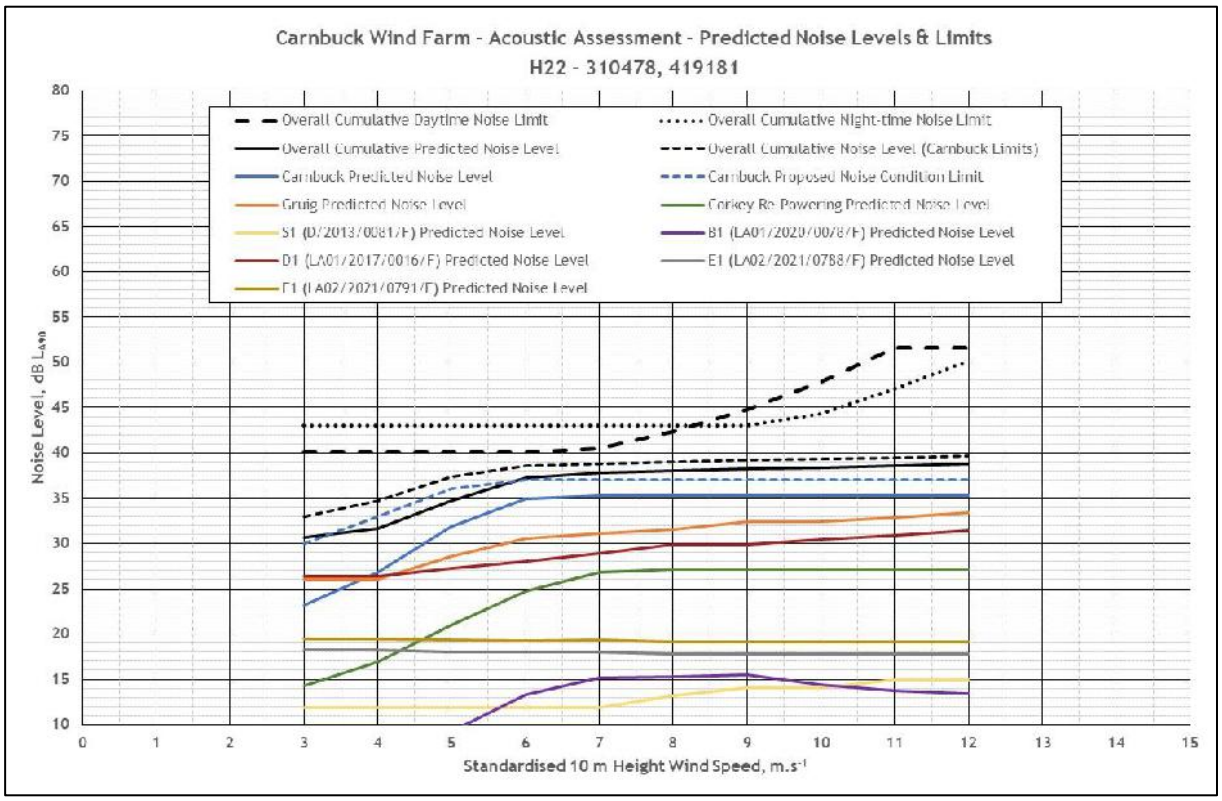


Chart A.14

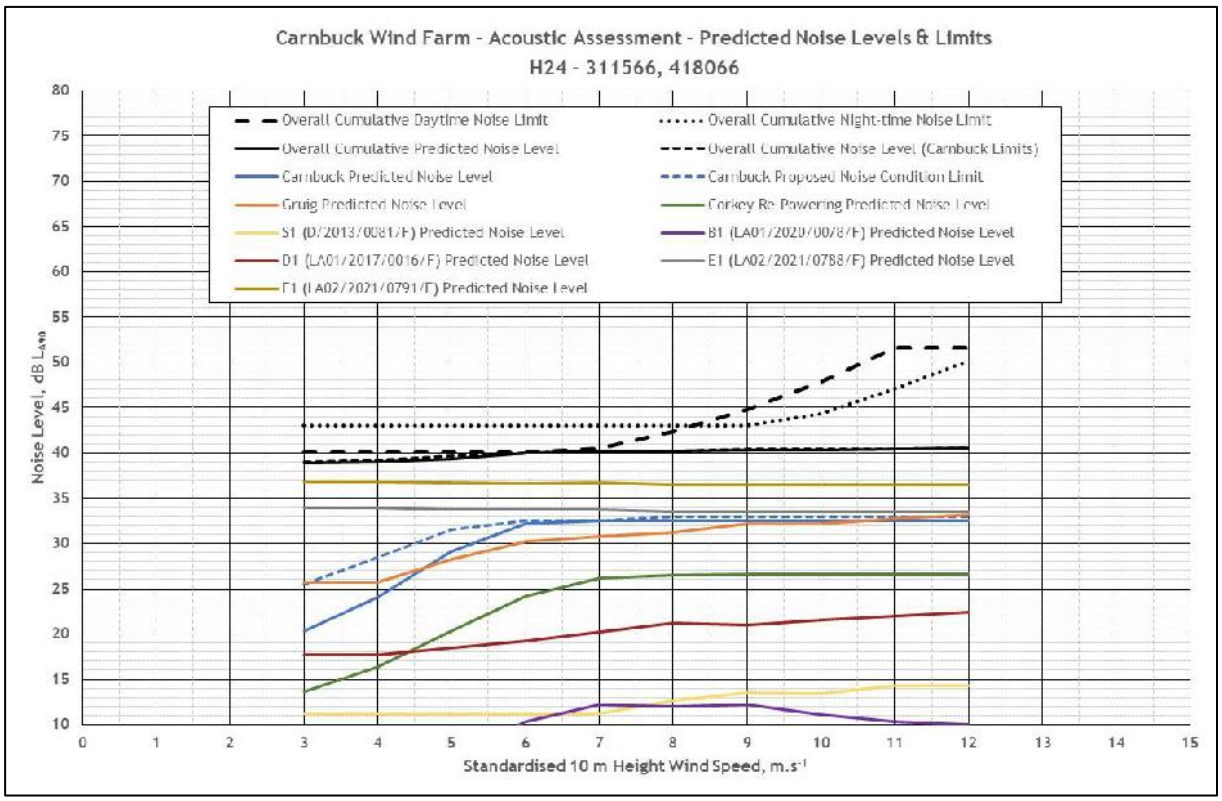


Chart A.15

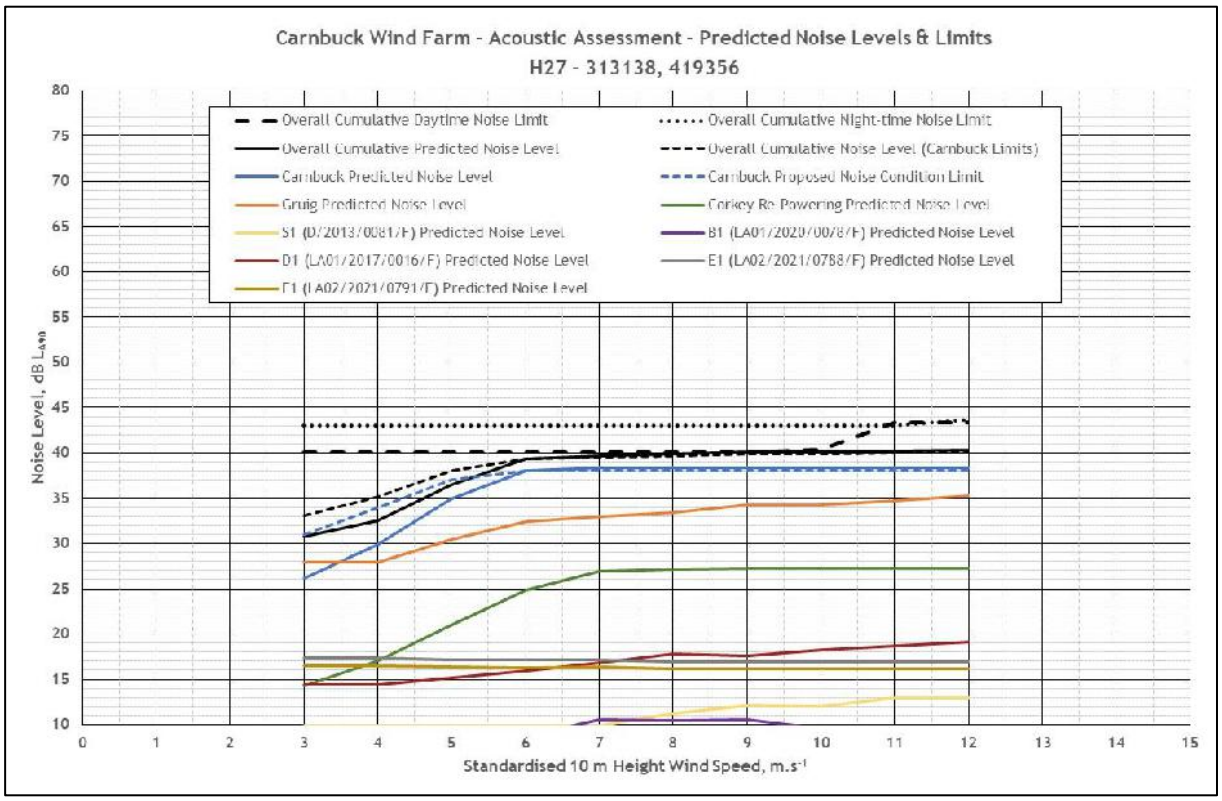


Chart A.16

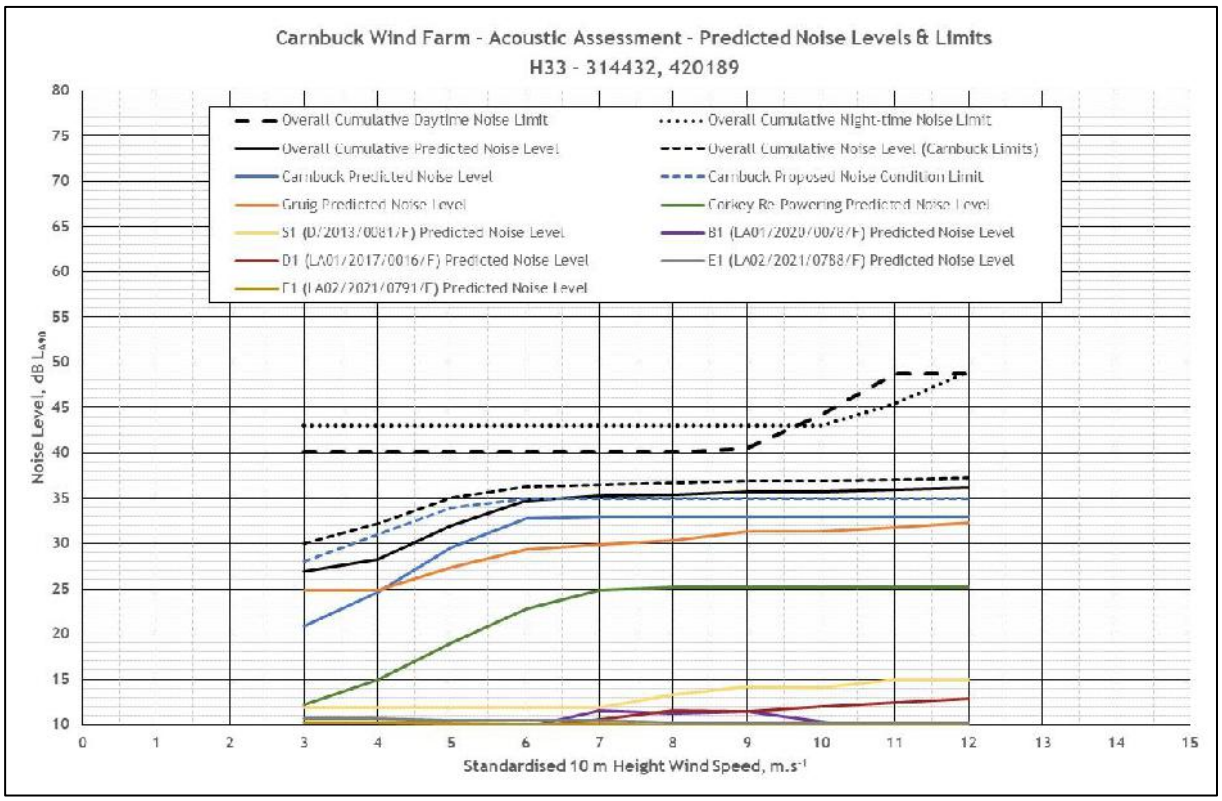


Chart A.17

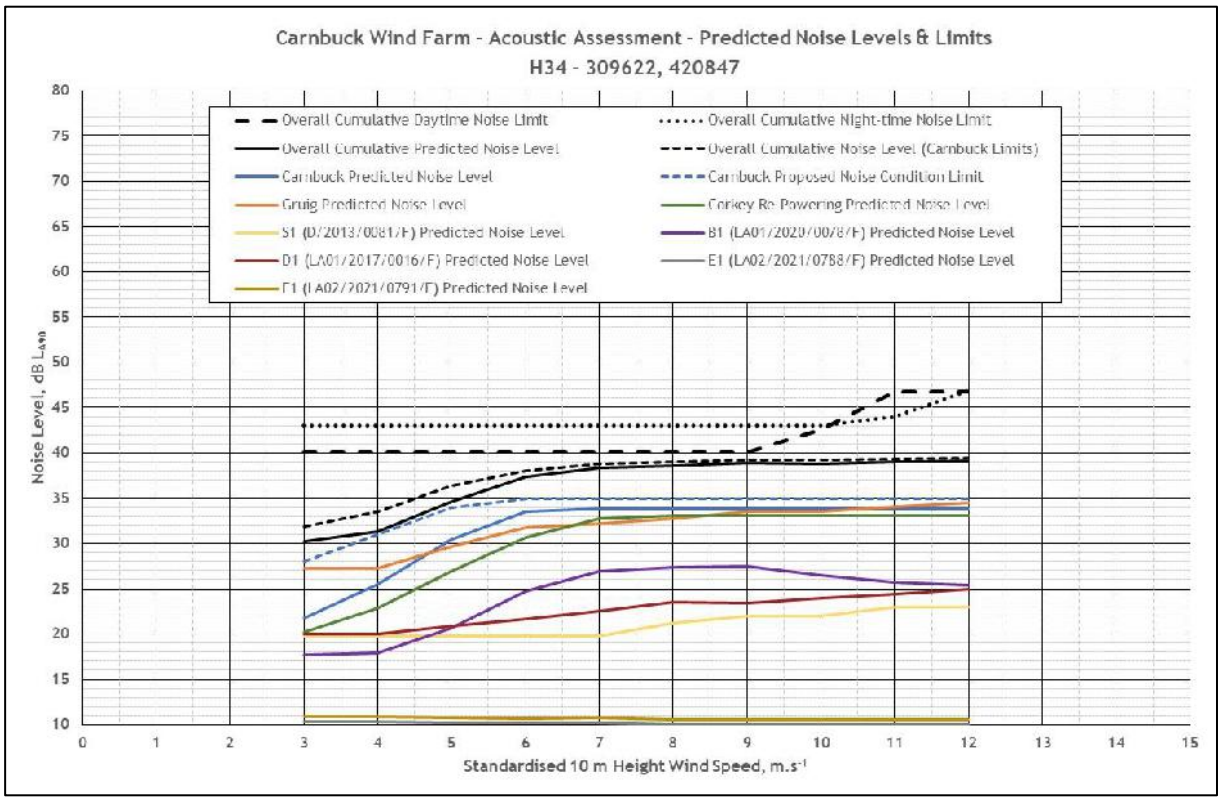


Chart A.18

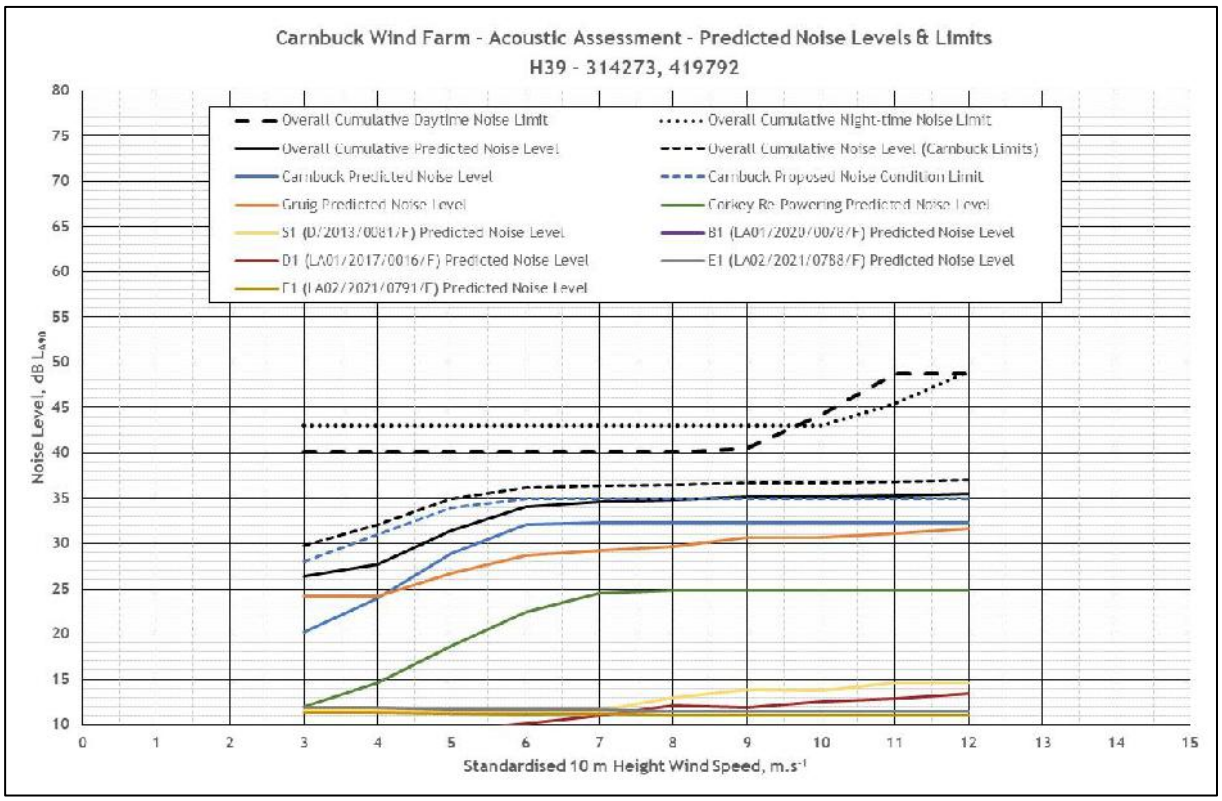


Chart A.19

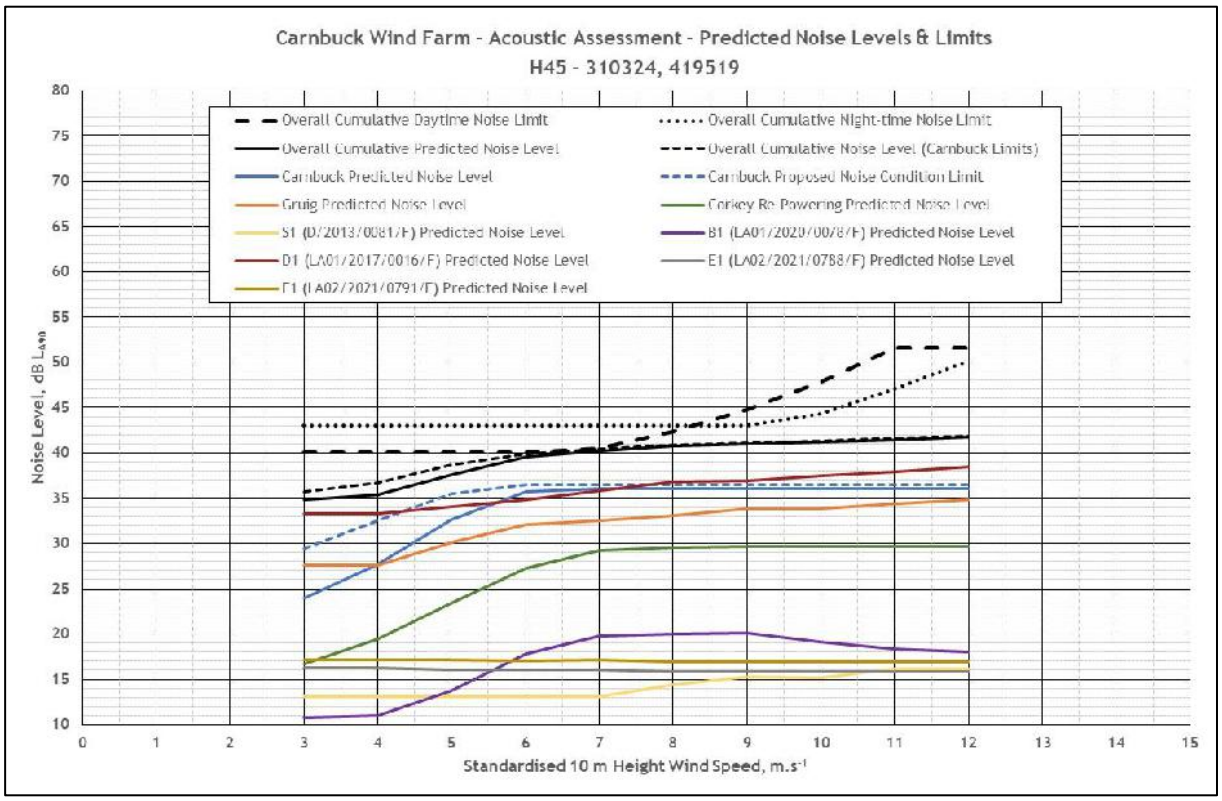


Chart A.20

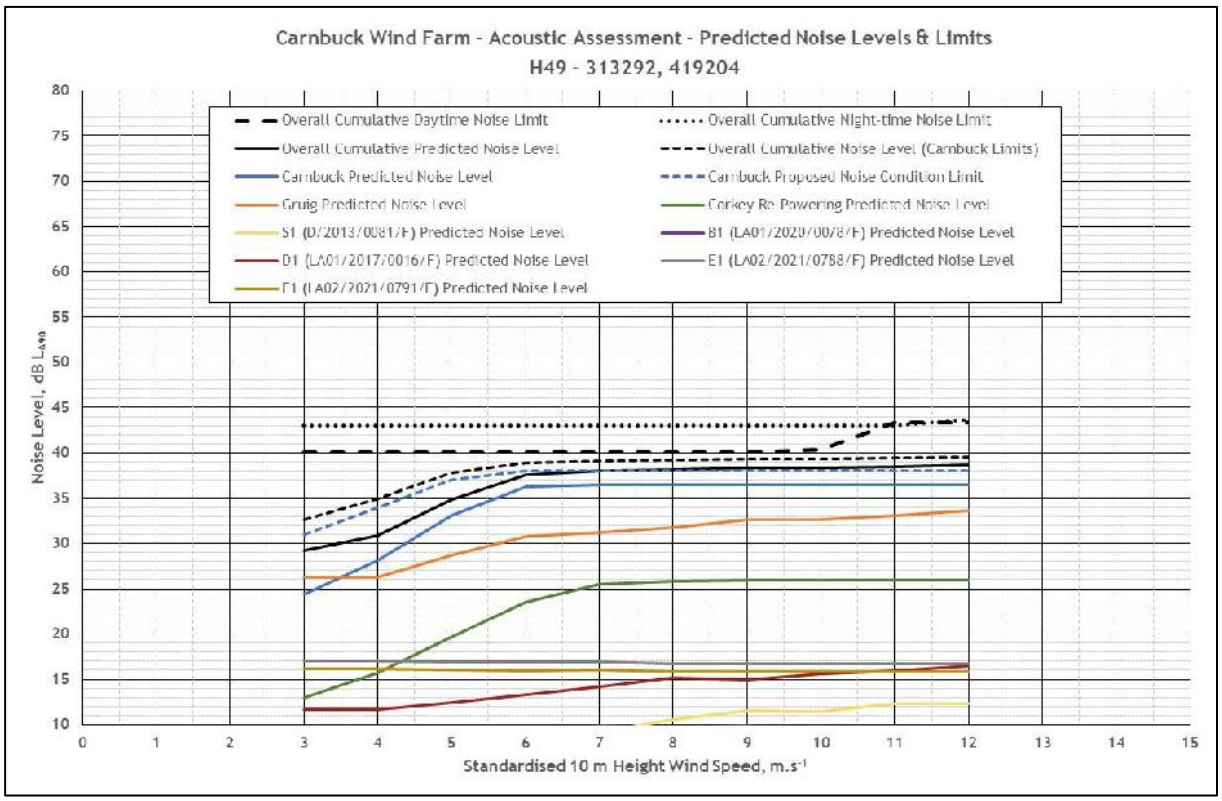


Chart A.21

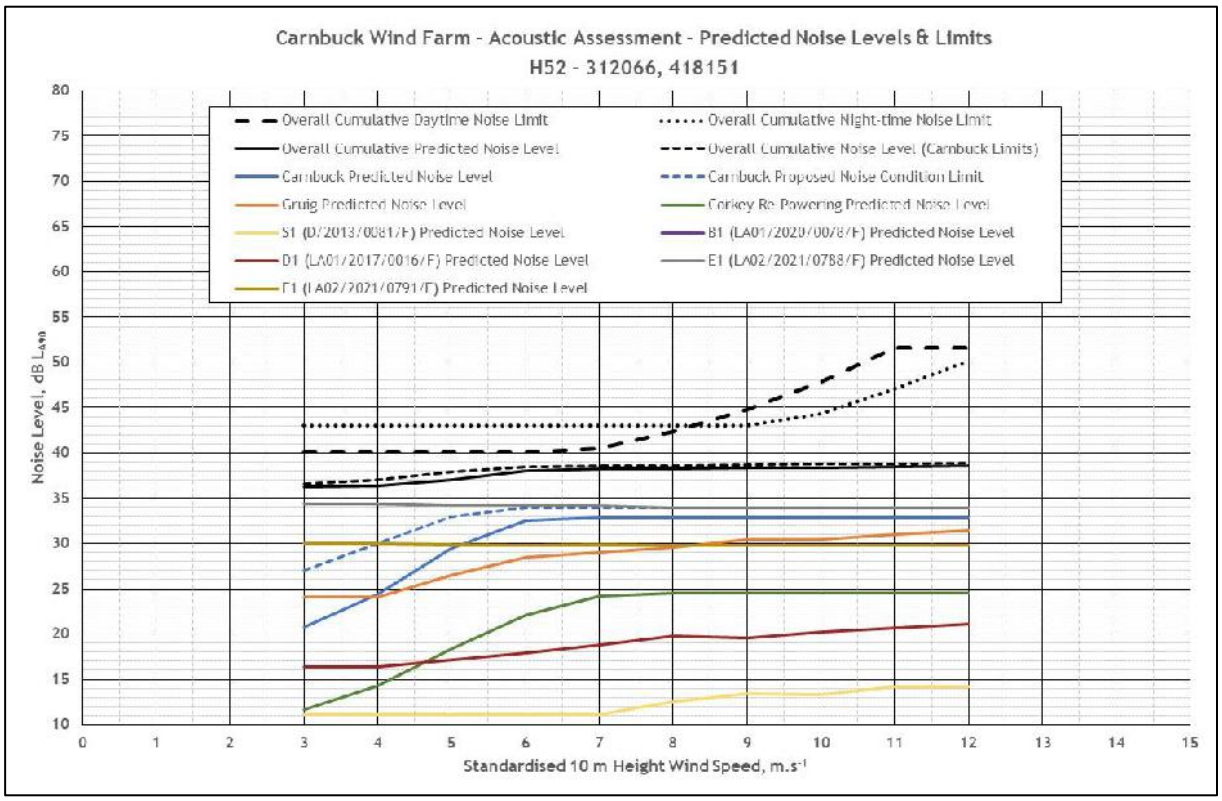


Chart A.22

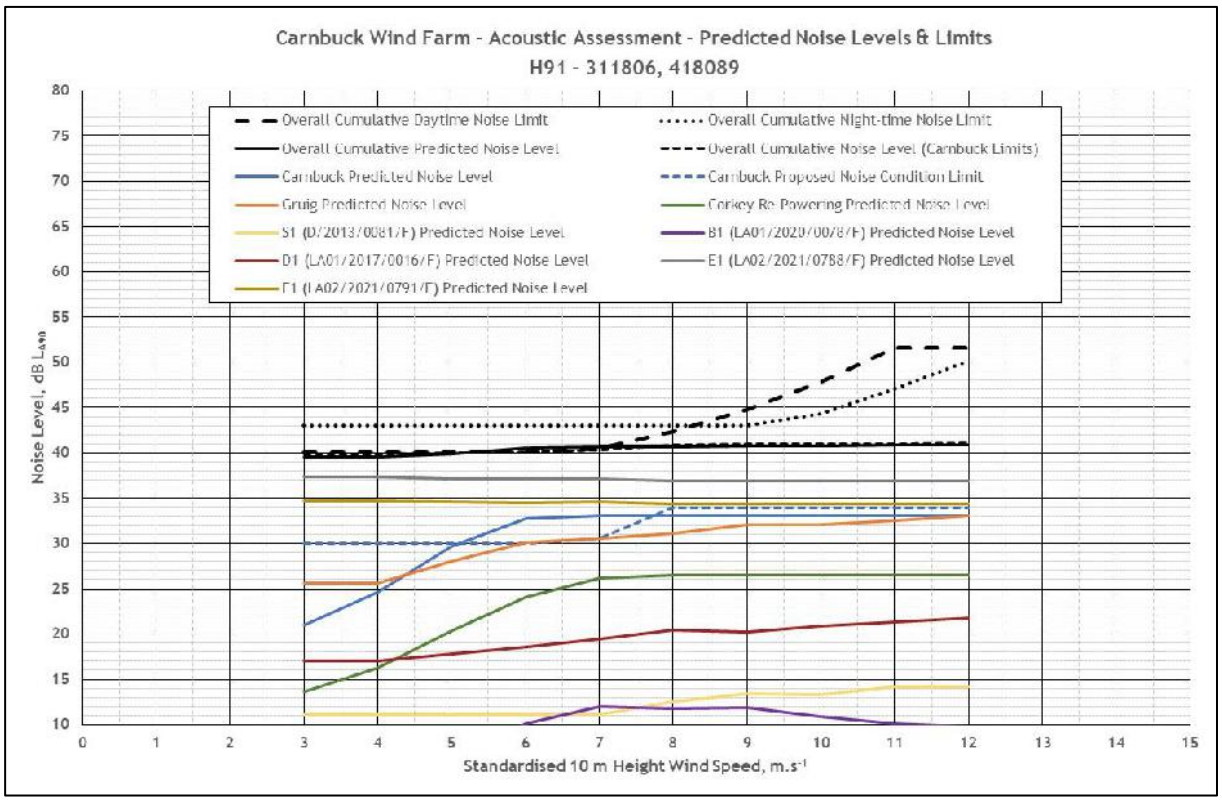


Chart A.23

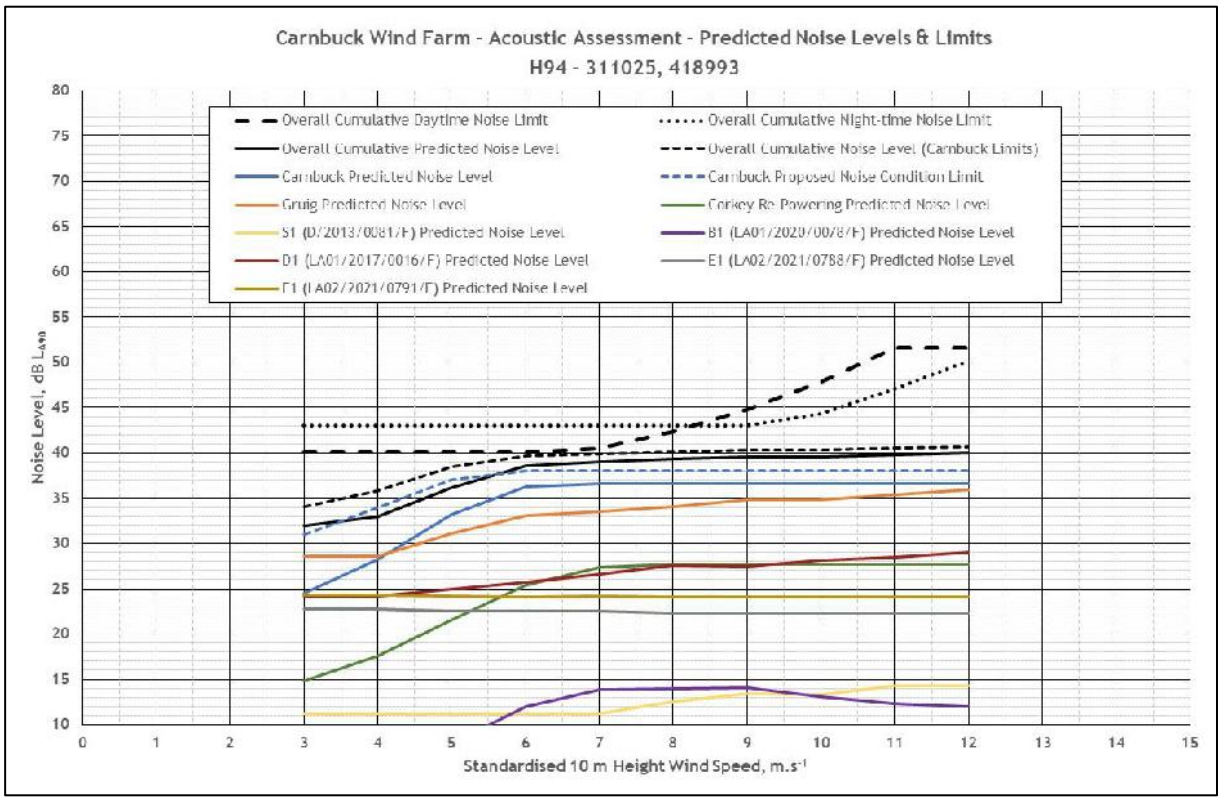


Chart A.24

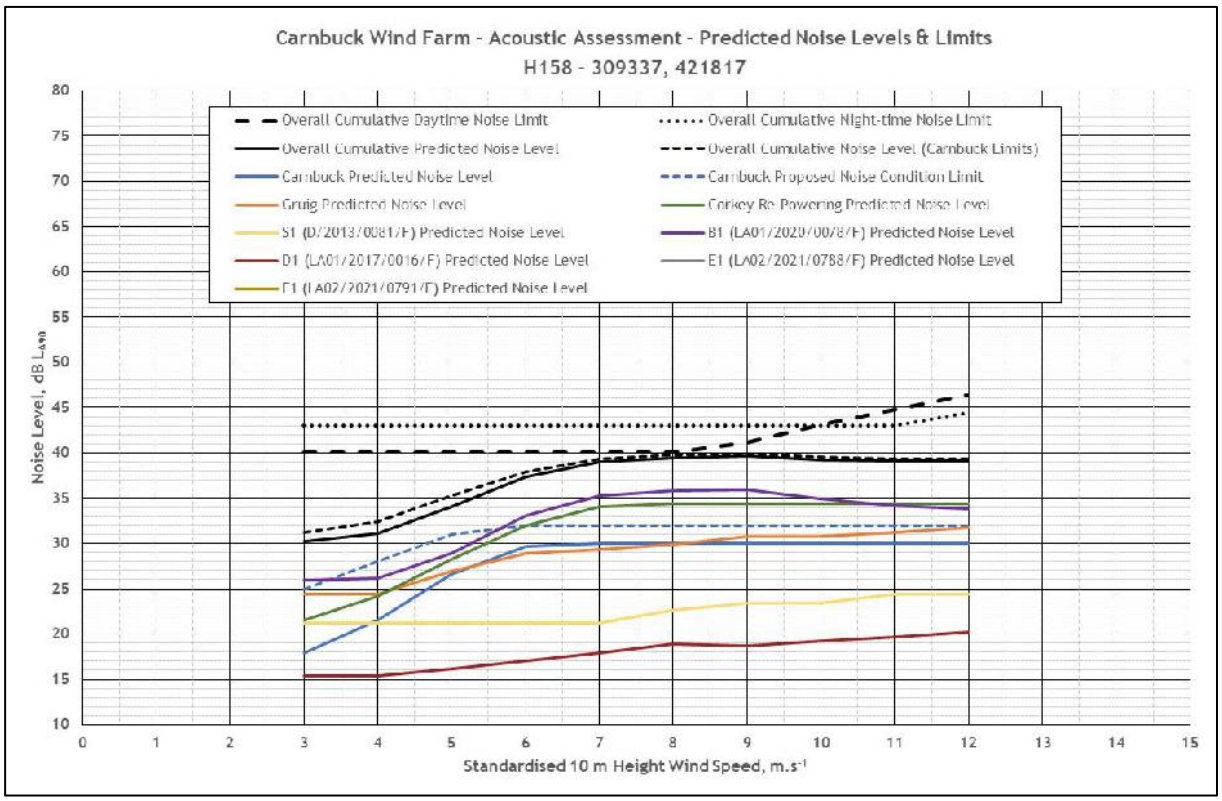


Chart A.25

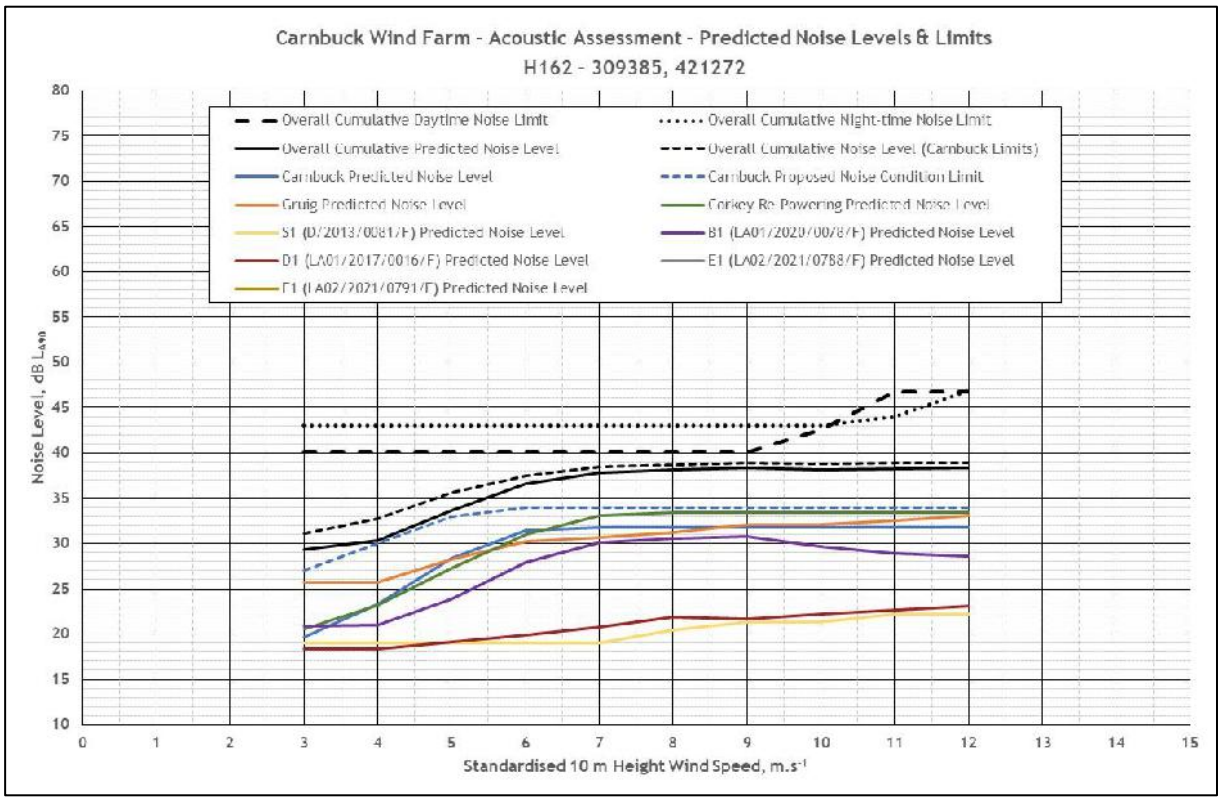


Chart A.26

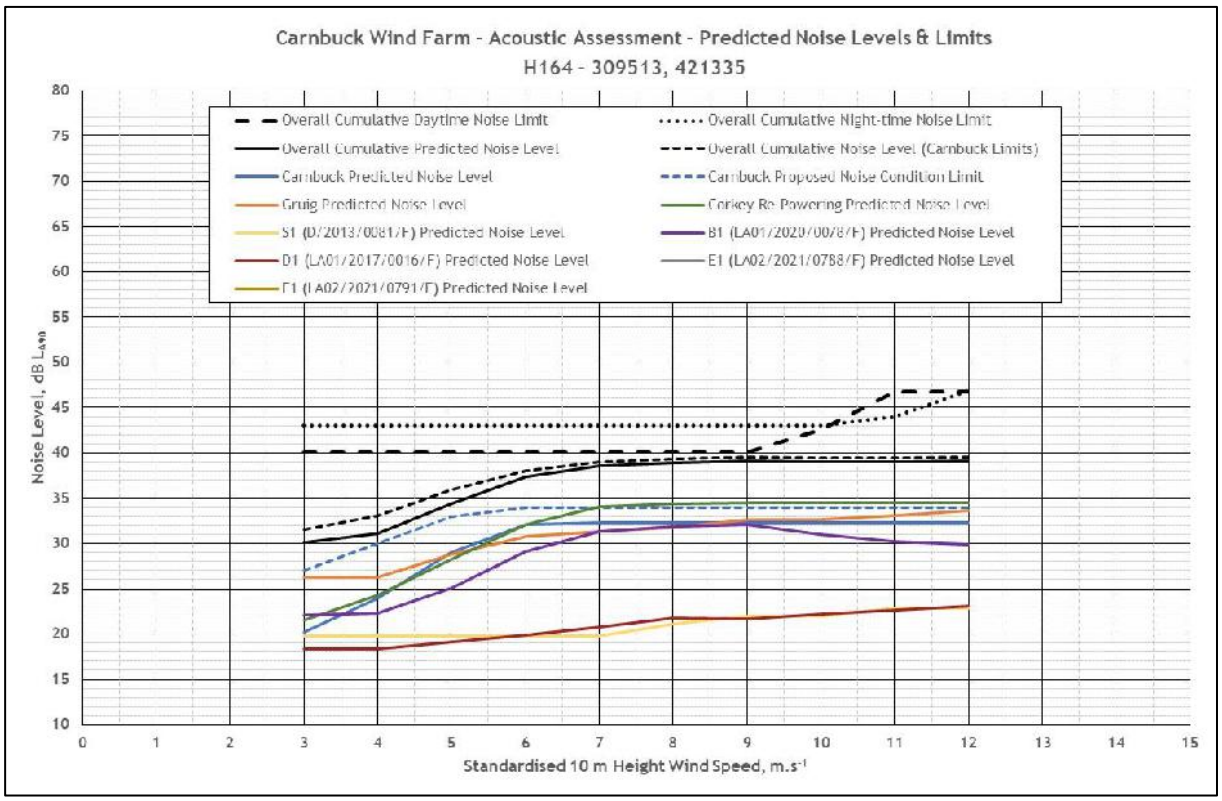


Chart A.27

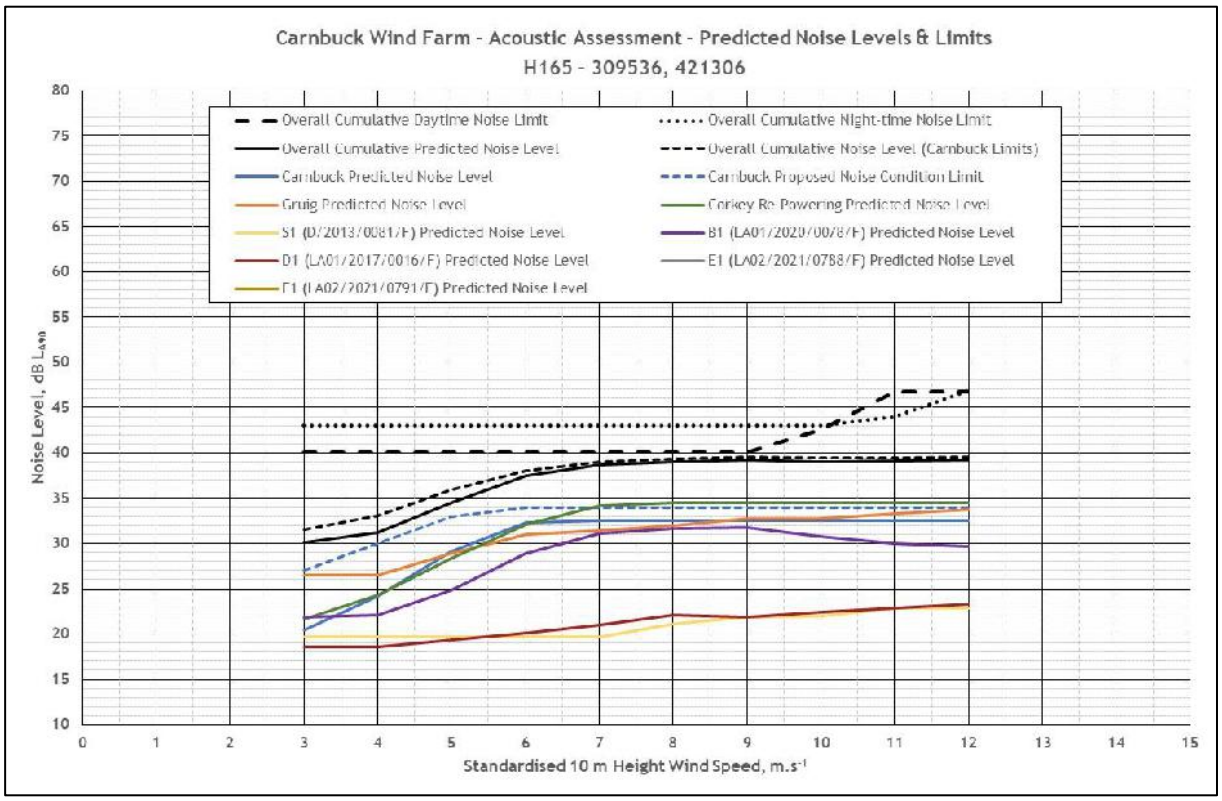


Chart A.28

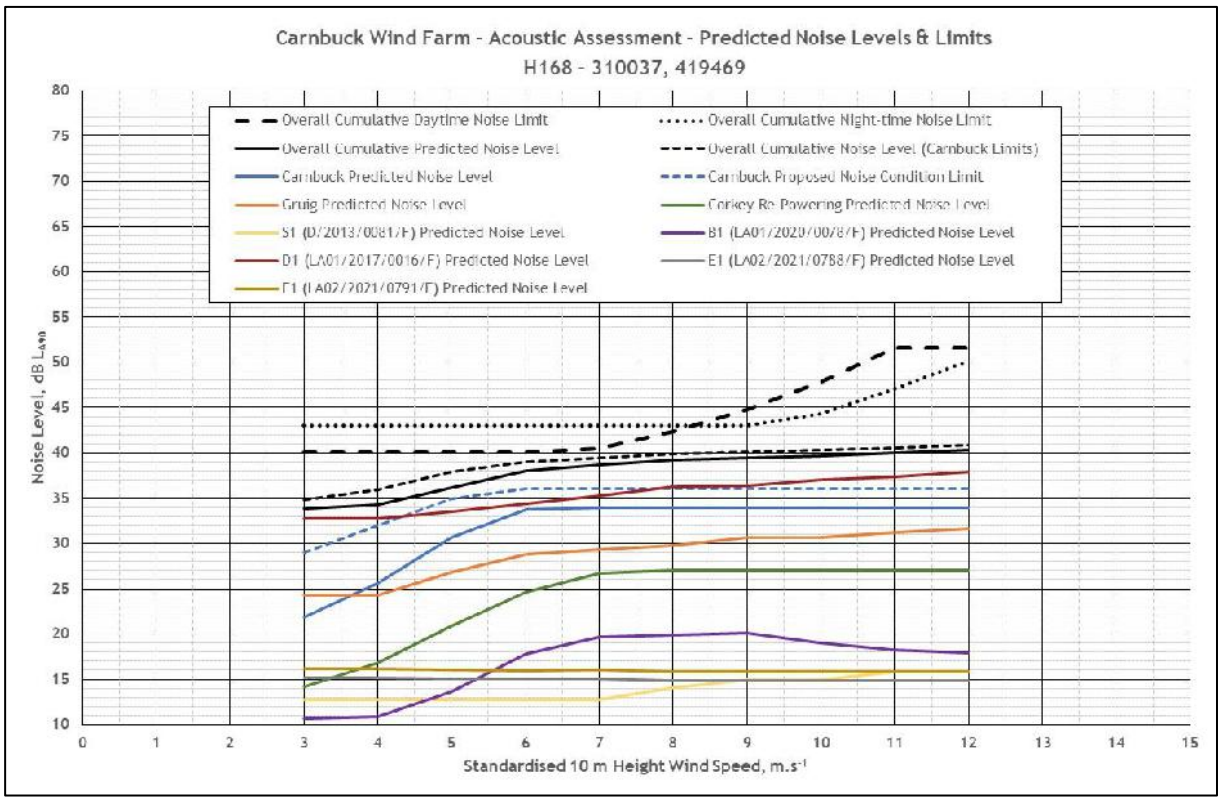


Chart A.29

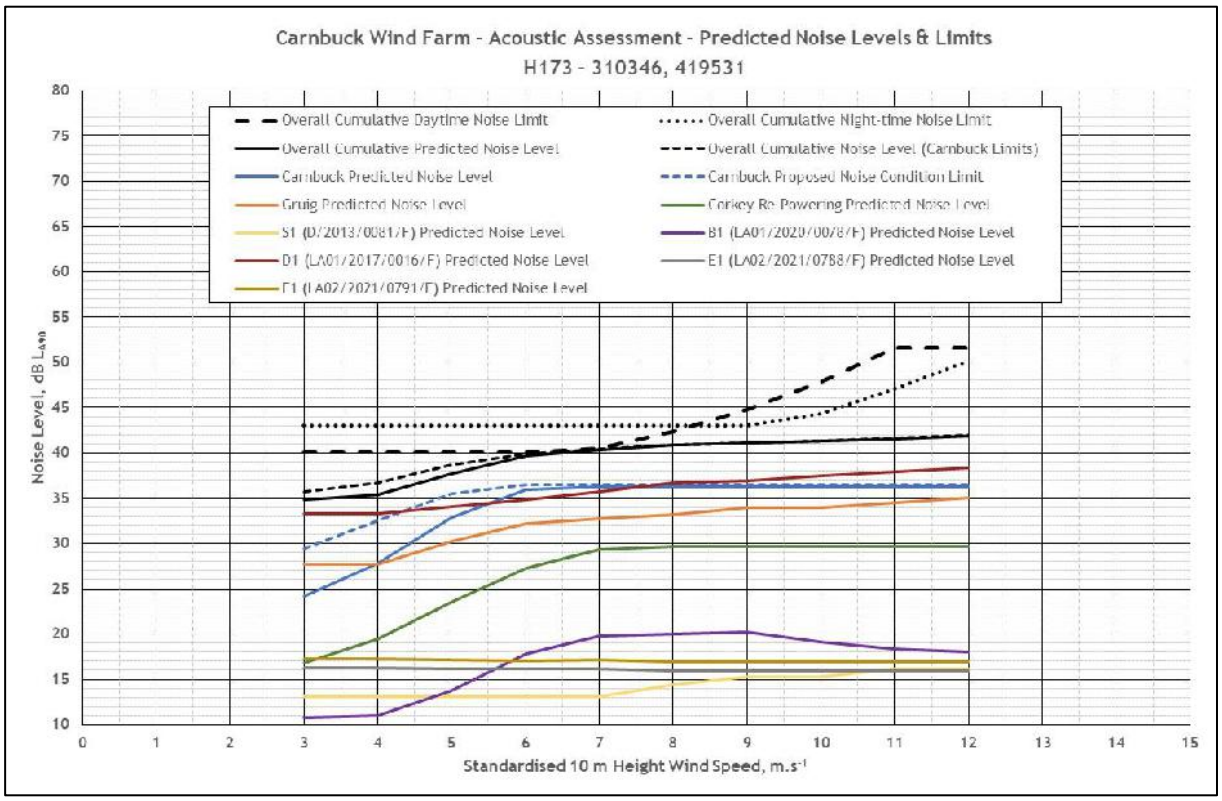


Chart A.30

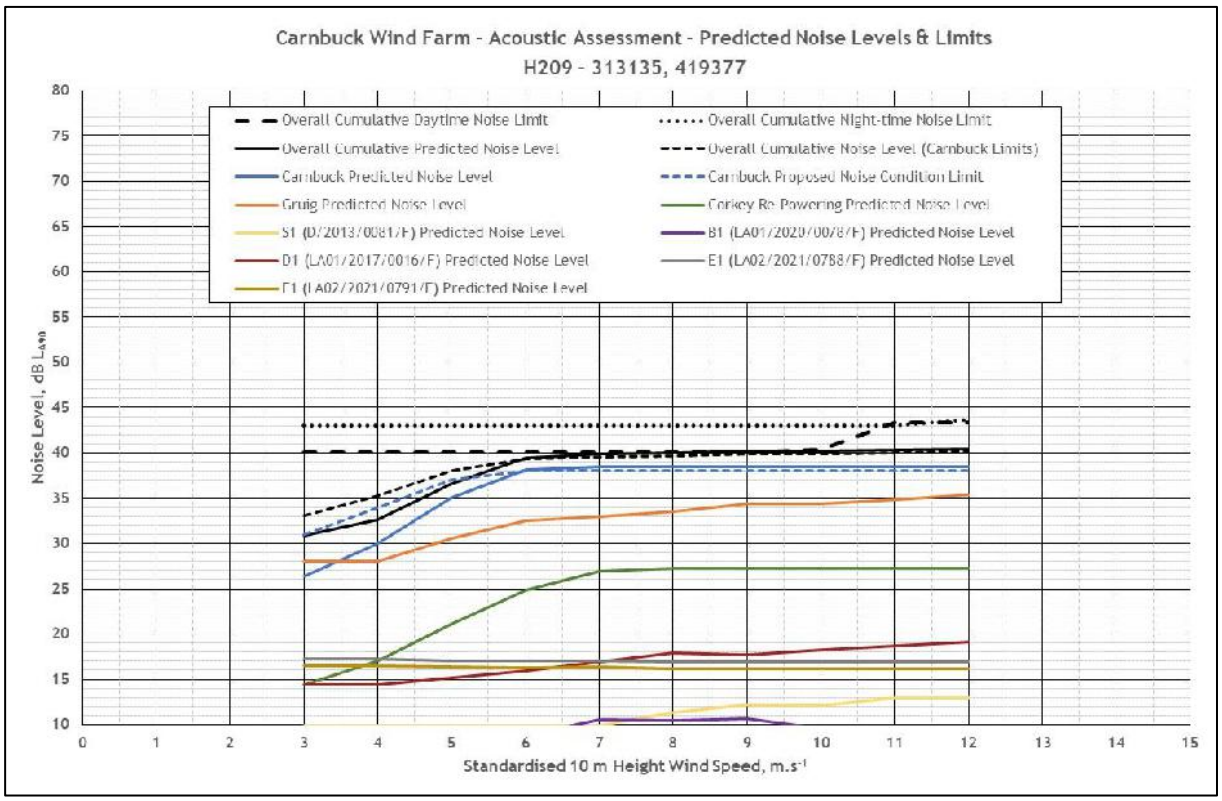


Chart A.31

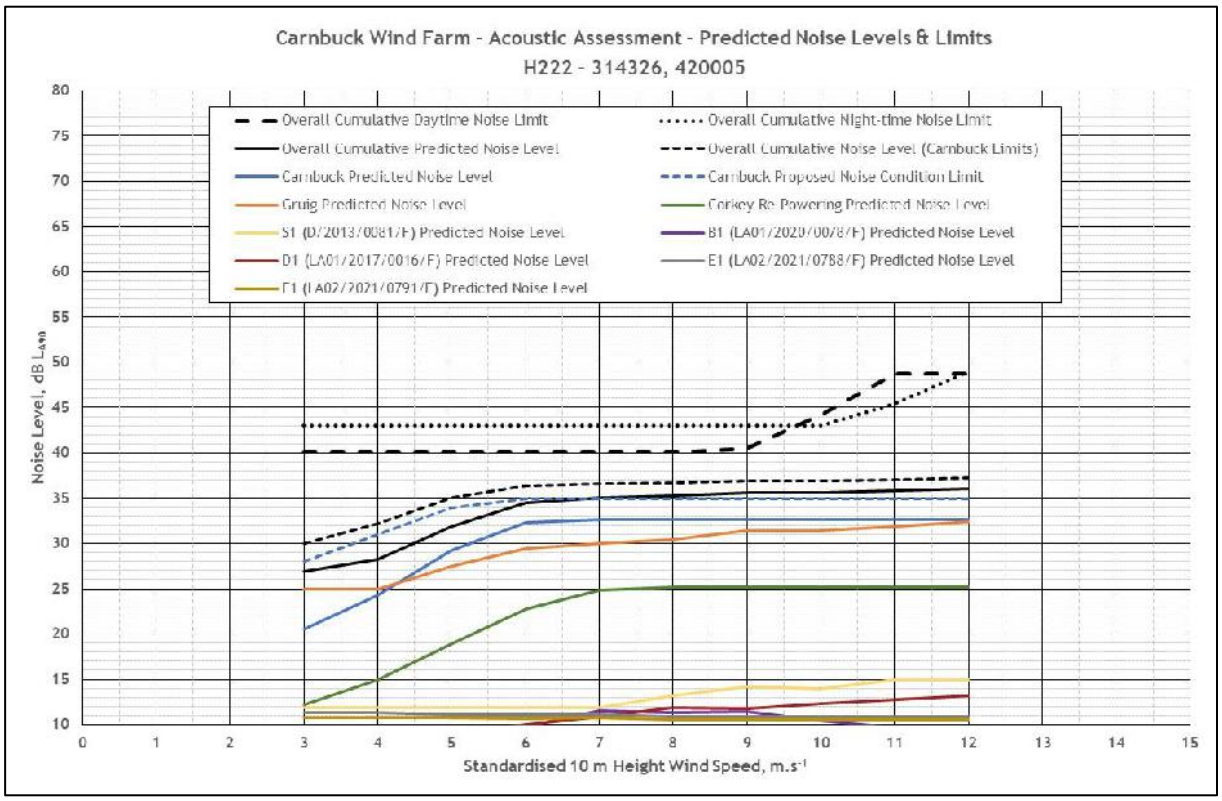
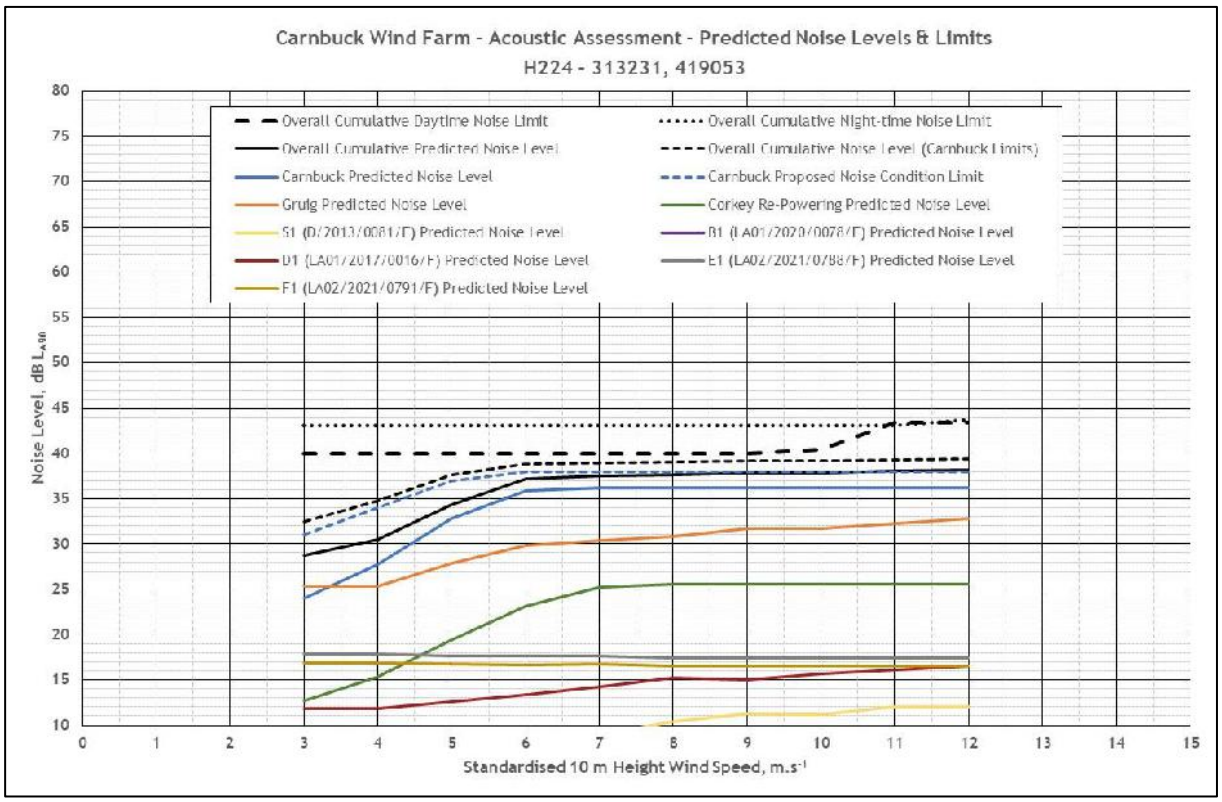


Chart A.32



APPENDIX B – PROPOSED PLANNING CONDITION WORDING

Introduction

In the event that the Proposed Development is successful in gaining planning consent, the decision notice would likely contain appropriately worded noise conditions.

Such conditions will provide a degree of protection to nearby residents should noise from the Proposed Development cause disturbance. To that end, presented below are a set of relevant, precise and enforceable conditions that RES suggest as appropriate. The form of condition wording suggested has been used for many wind farm developments and the final conditions attached to the consent would be according to the discretion of the decision maker.

Draft Planning Condition

The rating level of noise immissions from the combined effects of the wind turbines (including the application of any tonal penalty) when determined in accordance with the attached Guidance Notes (to this condition), shall not exceed the values for the relevant integer wind speed, set out in, or derived from, the Tables attached to this condition at any dwelling which is lawfully existing or has planning permission at the date of this consent and:

a. The Company shall continuously log power production, wind speed and wind direction, all in accordance with Guidance Note 1(d). These data shall be retained for a period of not less than 24 months. The Company shall provide this information in the format set out in Guidance Note 1(e) to the Planning Authority on its request, within 14 days of receipt in writing of such a request.

b. No electricity shall be exported until the Company has submitted to the Local Planning Authority for written approval a list of proposed independent consultants who may undertake compliance measurements in accordance with this condition. Amendments to the list of approved consultants shall be made only with the prior written approval of the Local Planning Authority.

c. Within 21 days from receipt of a written request from the Local Planning Authority following a complaint to it from an occupant of a dwelling alleging noise disturbance at that dwelling, the Company shall, at its expense, employ a consultant approved by the Planning Authority to assess the level of noise immissions from the wind farm at the complainants' dwelling in accordance with the procedures described in the attached Guidance Notes. The written request from the Local Planning Authority shall set out at least the date, time and location that the complaint relates to and any identified atmospheric conditions, including wind direction, and include a statement as to whether, in the opinion of the Local Planning Authority, the noise giving rise to the complaint contains or is likely to contain a tonal component.

d. The assessment of the rating level of noise immissions shall be undertaken in accordance with an assessment protocol that shall, prior to the commencement of any measurements, have been submitted to and approved in writing by the Local Planning Authority. The protocol shall include the proposed measurement location identified in accordance with the Guidance Notes where measurements for compliance checking purposes shall be undertaken and also the range of meteorological and operational conditions (which shall include the range of wind speeds, wind directions, power generation and times of day) to determine the assessment of rating level of noise immissions. The proposed range of conditions shall be those which prevailed during times when the complainant alleges there was disturbance due to noise, having regard to the written request of the Planning Authority under paragraph (c), and such others as the independent consultant considers likely to result in a breach of the noise limits.

e. Where a dwelling to which a complaint is related is not listed in the tables attached to these conditions, the Company shall submit to the Local Planning Authority for written approval proposed noise limits selected from those listed in the tables to be adopted at the complainant's dwelling for compliance checking purposes. The proposed noise limits shall be those limits selected from the Tables specified for a listed location which is the geographically nearest dwelling to the complainant's dwelling, unless otherwise agreed with the Local Planning Authority due to location-specific factors.

f. The Company shall provide to the Local Planning Authority the independent consultant's assessment of the rating level of noise immissions undertaken in accordance with the Guidance Notes within 2 months of the date of the written request of the Local Planning Authority for compliance measurements to be made under paragraph (c), unless the time limit is extended in writing by the Local Planning Authority. Unless otherwise agreed in writing by the Local Planning Authority, the assessment shall be accompanied by all data collected for the purposes of undertaking the compliance measurements, such data to be provided in the format set out in Guidance Note 1(e) of the Guidance Notes with the exception of audio data which shall be supplied in the format in which it is recorded. The instrumentation used to undertake the measurements shall be calibrated in accordance with Guidance Note 1(a) and certificates of calibration shall be submitted to the Local Planning Authority with the independent consultant's assessment of the rating level of noise immissions.

g. Where a further assessment of the rating level of noise immissions from the wind farm is required pursuant to Guidance Note 4(c), the Company shall submit a copy of the further assessment within 21 days of submission of the independent consultant's assessment pursuant to paragraph (d) above unless the time limit has been extended in writing by the Local Planning Authority.

Table 1 Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H2	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H3	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H4	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H5	26.0	29.0	32.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
H6	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H10	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H11	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H12	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H13	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H14	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H16	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H22	30.0	33.0	36.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
H24	25.5	28.5	31.5	32.5	32.5	33.0	33.0	33.0	33.0	33.0
H27	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H33	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H34	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H39	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H45	29.5	32.5	35.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
H49	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H52	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H91	30.0	30.0	30.0	30.0	30.5	34.0	34.0	34.0	34.0	34.0
H94	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H158	25.0	28.0	31.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
H162	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H164	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H165	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H168	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H173	29.5	32.5	35.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
H209	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H222	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H224	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0

Table 2 Co-Ordinate Locations of the Dwellings Listed at Table 1

ID	OSGB Co-Ordinates		ID	OSGB Co-Ordinates		ID	OSGB Co-Ordinates	
	X (m)	Y (m)		X (m)	Y (m)		X (m)	Y (m)
H1	309979	422676	H16	309474	420886	H94	311025	418993
H2	309761	422704	H22	310478	419181	H158	309337	421817
H3	309656	422220	H24	311566	418066	H162	309385	421272
H4	309384	421839	H27	313138	419356	H164	309513	421335
H5	309407	421621	H33	314432	420189	H165	309536	421306
H6	309586	421332	H34	309622	420847	H168	310037	419469
H10	309697	420992	H39	314273	419792	H173	310346	419531
H11	309512	421032	H45	310324	419519	H209	313135	419377
H12	309551	421004	H49	313292	419204	H222	314326	420005
H13	309596	420995	H52	312066	418151	H224	313231	419053
H14	309508	420901	H91	311806	418089			

Note to Table 2: The geographical coordinate references are provided for the purpose of identifying the general location of dwellings to which a given set of noise limits applies.

Reason: To protect the amenity of the area.

Guidance Notes

These notes are to be read with and form part of the noise condition. They further explain the condition and specify the methods to be employed in the assessment of complaints about noise immissions from the wind farm. The rating level at each integer wind speed is the arithmetic sum of the wind farm noise level as determined from the best-fit curve described in Guidance Note 2 of these Guidance Notes and any tonal penalty applied in accordance with Guidance Note 3. Reference to ETSU-R-97 refers to the publication entitled "The Assessment and Rating of Noise from Wind Farms" (1997) published by the Energy Technology Support Unit (ETSU) for the Department of Trade and Industry (DTI).

Guidance Note 1

(a) Values of the $L_{A90,10\text{-minute}}$ noise statistic should be measured at the complainant's property, using a sound level meter of EN 60651/BS EN 60804 Type 1, or BS EN 61672 Class 1 quality (or the equivalent UK adopted standard in force at the time of the measurements) set to measure using the fast time weighted response as specified in BS EN 60651/BS EN 60804 or BS EN 61672-1 (or the equivalent UK adopted standard in force at the time of the measurements). This should be calibrated in accordance with the procedure specified in BS 4142:1997 (or the equivalent UK adopted standard in force at the time of the measurements). Measurements shall be undertaken in such a manner to enable a tonal penalty to be applied in accordance with Guidance Note 3.

(b) The microphone should be mounted at 1.2 – 1.5 metres above ground level, fitted with a two-layer windshield or suitable equivalent approved in writing by the Local Planning Authority, and placed outside the complainant's dwelling. Measurements should be made in "free field" conditions. To achieve this, the microphone should be placed at least 3.5 metres away from the building facade or any reflecting surface except the ground at the approved measurement location. In the event that the consent of the complainant for access to his or her dwelling to undertake compliance measurements is withheld, the wind farm operator shall submit for the written approval of the Planning Authority details of the proposed alternative representative measurement location prior to the commencement of measurements and the measurements shall be undertaken at the approved alternative representative measurement location.

(c) The $L_{A90,10\text{-minute}}$ measurements should be synchronised with measurements of the 10-minute arithmetic mean wind and operational data logged in accordance with Guidance Note 1(d), including the power generation data from the turbine control systems of the wind farm.

(d) To enable compliance with the conditions to be evaluated, the wind farm operator shall continuously log arithmetic mean wind speed in metres per second and wind direction in degrees from north at hub height for each turbine, and at any on site meteorological mast(s), if available, together with the arithmetic mean power generated by each turbine, all in successive 10-minute periods. All 10-minute arithmetic average mean wind speed data measured at hub height shall be 'standardised' to a reference height of 10 metres as described in ETSU-R-97 at page 120 using a reference roughness length of 0.05 metres. It is this standardised 10 metre height wind speed data, as determined from whichever source is agreed in writing with the Local Planning Authority as being most appropriate to the noise compliance measurements being undertaken, which is correlated with the noise measurements determined as valid in accordance with Guidance Note 2, such correlation to be undertaken in the manner described in Guidance Note 2. All 10-minute periods shall commence on the hour and in 10-minute increments thereafter.

(e) Data provided to the Local Planning Authority in accordance with the noise condition shall be provided in comma separated values in electronic format.

(f) A data logging rain gauge shall be installed in the course of the assessment of the levels of noise immissions. The gauge shall record over successive 10-minute periods synchronised with the periods of data recorded in accordance with Note 1(d).

Guidance Note 2

(a) The noise measurements shall be made so as to provide not less than 20 valid data points as defined in Guidance Note 2 (b).

(b) Valid data points are those measured in the conditions specified in the agreed written protocol under paragraph (d) of the noise condition but excluding any periods of rainfall measured in the vicinity of the sound level meter. Rainfall shall be assessed by use of a rain gauge that shall log the occurrence of rainfall in each 10-minute period concurrent with the measurement periods set out in Guidance Note 1.

(c) For those data points considered valid in accordance with Guidance Note 2(b), values of the $L_{A90,10\text{-minute}}$ noise measurements and corresponding values of the 10- minute standardised ten metre height wind speed, as derived from the site measured wind speed source(s) agreed in writing with the Planning Authority in accordance with Guidance Note 1(d), shall be plotted on separate XY charts for each wind direction considered, with noise level on the Y-axis and the standardised mean wind speed on the X-axis. A least-squares, "best fit" curve of an order deemed appropriate by the independent consultant (but which may not be higher than a fourth order) should be fitted to the data points and define the wind farm noise level at each integer speed and direction.

Guidance Note 3

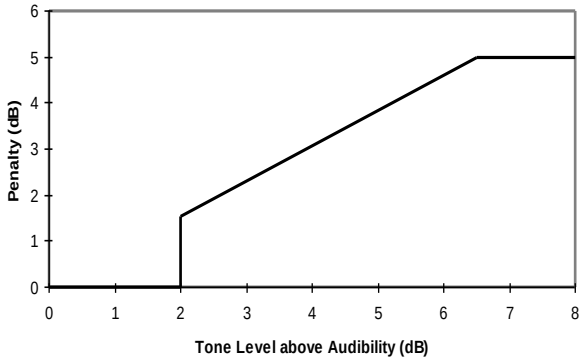
(a) Where, in accordance with the approved assessment protocol under paragraph (d) of the noise condition, noise immissions at the location or locations where compliance measurements are being undertaken contain or are likely to contain a tonal component, a tonal penalty is to be calculated and applied using the following rating procedure.

(b) For each 10-minute interval for which $L_{A90,10\text{-minute}}$ data have been determined as valid in accordance with Guidance Note 2 a tonal assessment shall be performed on noise immissions during 2 minutes of each 10-minute period. The 2-minute periods should be spaced at 10-minute intervals provided that uninterrupted uncorrupted data are available ("the standard procedure"). Where uncorrupted data are not available, the first available uninterrupted clean 2-minute period out of the affected overall 10-minute period shall be selected. Any such deviations from the standard procedure, as described in Section 2.1 on pages 104-109 of ETSU-R-97, shall be reported.

(c) For each of the 2-minute samples the tone level above or below audibility shall be calculated by comparison with the audibility criterion given in Section 2.1 on pages 104-109 of ETSU-R-97.

(d) The average tone level above audibility shall be calculated for each wind speed bin, each bin being 1 metre per second wide and centred on integer wind speeds, for each wind direction. Samples for which the tones were below the audibility criterion or no tone was identified, a value of zero audibility shall be substituted.

(e) The tonal penalty for each wind speed bin is derived from the margin above audibility of the tone according to the figure below.



Guidance Note 4

(a) If a tonal penalty is to be applied in accordance with Guidance Note 3 the rating level of the turbine noise at each wind speed and wind direction is the arithmetic sum of the measured noise level as determined from the best fit curve described in Guidance Note 2 and the penalty for tonal noise as derived in accordance with Guidance Note 3 at each integer wind speed and wind direction within the range specified by the Local Planning Authority in its written protocol under paragraph (d) of the noise condition.

(b) If no tonal penalty is to be applied then the rating level of the turbine noise at each wind speed and wind direction is equal to the measured noise level as determined from the best fit curve described in Guidance Note 2.

(c) In the event that the rating level is above the limit(s) set out in the Tables attached to the noise conditions or the noise limits for a complainants' dwelling approved in accordance with paragraph (e) of the noise condition, the independent consultant shall undertake a further assessment of the rating level to correct for background noise so that the rating level relates to wind turbine noise immission only.

(d) The wind farm operator shall ensure that all necessary wind turbines in the development are turned off for such period as the independent consultant requires to undertake any further noise measurements required under Guidance Note 4(c). If the number of turbines to be turned off are less than the total number of turbines on the site then this shall be agreed in advance with the Planning Authority.

(e) To this end, the steps in Guidance Note 2 shall be repeated with the required number of turbines shutdown in accordance with Guidance Note 4(d) in order to determine the background noise (L3) at each integer wind speed within the range requested by the Planning Authority in its written request under paragraph (c) and the approved protocol under paragraph (d) of the noise condition.

(f) The wind farm noise (L1) at this speed shall then be calculated as follows where L2 is the measured level with turbines running but without the addition of any tonal penalty:

$$L_1 = 10 \log \left[10^{L_2/10} - 10^{L_3/10} \right]$$

(g) The rating level shall be re-calculated by arithmetically adding the tonal penalty (if any is applied in accordance with Note 3) to the derived wind farm noise L1 at that integer wind speed and wind direction.

(h) If the rating level after adjustment for background noise contribution and adjustment for tonal penalty (if required in accordance with Guidance Note 3 above) at any integer wind speed and wind direction lies at or below the values set out in the Tables attached to the conditions or at or below the noise limits approved by the Planning Authority for a complainant's dwelling in accordance with paragraph (e) of the noise condition then no further action is necessary. If the rating level at any integer wind speed and wind direction exceeds the values set out in the Tables attached to the conditions or the noise limits approved by the Local Planning Authority for a complainants' dwelling in accordance with paragraph (e) of the noise condition, then the development fails to comply with the conditions.

APPENDIX 2.2 – SUPERCEDED REVISED CUMULATIVE ACOUSTIC ASSESSMENT FOR CARNBUCK WIND FARM DATED 31st July 2023 (03090-6130963)

Revised Cumulative Acoustic Assessment for Carnbuck Wind Farm

Author: Mike Craven **Date:** 31st July 2023 **Ref:** 03090-6130963

Revision History

Issue	Date	Author	Nature & Location of Change	Additional Reference(s)
01	7th July 2023	Mike Craven	Initial Version	03090-6009510
02	31st July 2023	Mike Craven	Minor Updates	03090-6009510

CONTENTS

1. INTRODUCTION

This report provides a revised and amended assessment of the noise levels resulting from Carnbuck Wind Farm operating at the same time as various other planned, consented and operational development in the vicinity of the site and is intended to supplement the noise chapter submitted in support of the planning application for the development.

The assessment methodology follows applicable guidance on operational noise from wind turbines in the UK i.e. ETSU-R-97 The Assessment and Rating of Noise from Wind Farms and the Institute of Acoustics (IOA) Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (GPG) as referred to within relevant planning policy for Northern Ireland (NI).

The assessment provided herein incorporates minor amendments to the prediction methodology for assessing cumulative impacts (i.e. with specific regard to the planning consent condition requirements for the neighbouring schemes); provides further rationale and narrative as to the assessment approach; provides revised criteria for assessing overall cumulative noise levels and proposes revised and simplified noise limits for the Carnbuck scheme operating in isolation (based on the predicted noise levels from the scheme and with due regard to the resultant cumulative operational noise levels).

2. WIND FARM NOISE GUIDANCE

The Assessment & Rating of Noise from Wind Farms

The operational noise assessment methodology described in ETSU-R-97 The Assessment & Rating of Noise from Wind Farms [1] was developed by a working group comprised of a cross section of interested persons including Environmental Health Officers (EHOs), wind farm operators and independent acoustic experts amongst others.

ETSU-R-97 makes it clear from the outset that any noise restrictions placed on a wind farm must balance the local environmental impact 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.

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'.

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 relevant supplementary guidance. It is the only guidance referenced in Northern Ireland planning policy for rating and assessing operational noise from wind turbines. Based on planning policy and guidance, a wind farm which can operate within noise limits derived according to ETSU-R-97 shall be considered acceptable in respect of operational noise.

A Good Practice Guide to the Assessment & Rating of Noise from Wind Farms

A Good Practice Guide (GPG) to the application of ETSU-R-97 for the assessment and rating of wind turbine noise [2], issued by the IOA 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 in relation to issues not made explicit by, or outside the scope of ETSU-R-97, including propagation modelling and wind shear. The document also includes further information regarding cumulative noise impacts, compliance measurements and other relevant topics.

Supplementary guidance notes were published by the Institute of Acoustics (IOA) in July and September 2014, and these provide further details on specific areas of the IOA GPG. The assessment presented herein adopts the recommendations of the GPG and the Supplementary Guidance Notes (SGN).

2. BASELINE NOISE LEVELS & CORRESPONDING NOISE LIMITS

Chapter 11 of the Carnbuck Wind Farm Environmental Statement (ES) provides full details as to the methodology and results of background noise surveys undertaken at various properties neighbouring the development. This information is also supplemented by background noise data collected as part of other planning applications for wind turbine development in the area.

The background noise surveys were undertaken in accordance with ETSU-R-97 and the GPG discussed earlier. The measurement locations were discussed and agreed with the Environmental Health Officer (EHO) dealing with the development prior to the measurements being undertaken.

Table 1 shows the derived average background noise levels over a range of standardised 10 m height wind speeds and for 'quiet' daytime (18:00 – 23:00 weekdays, 13:00 – 23:00 on Saturdays and 07:00 to 23:00 on Sundays) and night-time (23:00- 07:00) periods respectively. The data sets have been filtered appropriately as per the guidance within ETSU-R-97 and the GPG.

Table 1 – Derived Average Background Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Quiet Daytime										
H1	25.8	29.1	32.4	35.3	38.0	40.5	43.0	45.5	47.9	50.4
H2	26.2	29.0	32.0	34.7	37.3	39.8	42.4	45.0	47.6	50.4
H3	25.6	27.3	28.9	30.5	32.0	34.0	36.2	38.1	39.8	41.4
H27	22.1	23.6	25.1	26.7	28.5	30.5	32.8	35.4	38.4	38.4
H33	24.3	25.4	26.7	28.3	30.2	32.6	35.5	39.2	43.7	43.7
H34	31.3	31.6	31.6	31.7	32.0	33.0	34.7	37.6	41.8	41.8
Night-time										
H1	25.0	26.8	29.8	32.9	35.8	38.7	41.5	44.4	47.3	50.1
H2	24.4	26.8	30.3	33.3	36.2	38.9	41.7	44.4	47.1	49.7
H3	25.4	26.9	28.3	29.6	31.0	32.3	33.8	35.8	37.7	39.5
H27	20.0	21.3	22.8	24.4	26.3	28.3	30.6	33.1	35.8	38.7
H33	21.2	22.1	23.5	25.4	27.8	30.6	33.6	36.9	40.4	43.9
H34	26.4	26.7	27.4	28.5	30.0	31.8	33.9	36.3	39.0	41.9

ETSU-R-97 states that different limits should be applied during daytime and night-time periods. The daytime limits 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 low background noise levels, in which case a fixed limit may be applied. The suggested limits are given at **Table 2**, where L_B is the average background $L_{A90,10min}$ as a function of wind speed. During daytime periods and at low background noise levels, a lower fixed limit of 35-40 dB L_{A90} is applicable. The exact value is dependent upon factors including the number of nearby dwellings, the effect of the noise limits on energy produced and the duration and level of exposure.

Table 2 - Permissible Noise Criteria

Time of Day	Definition
Daytime	35-40 dB(A) for L_B less than 30-35 dB(A) LB + 5 dB, for L_B greater than 30-35 dB(A)
Night-time	43 dB(A) for L_B less than 38 dB(A) LB + 5 dB, for L_B greater than 38 dB(A)

The resultant noise limits, including for the lower and upper bounds of the daytime noise criteria prescribed within ETSU-R-97, are shown at **Table 3**.

Table 3 - Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Lower Daytime										
H1	35.0	35.0	37.4	40.3	43.0	45.5	48.0	50.5	52.9	55.4
H2	35.0	35.0	37.0	39.7	42.3	44.8	47.4	50.0	52.6	55.4
H3	35.0	35.0	35.0	35.5	37.0	39.0	41.2	43.1	44.8	46.4
H27	35.0	35.0	35.0	35.0	35.0	35.5	37.8	40.4	43.4	43.4
H33	35.0	35.0	35.0	35.0	35.2	37.6	40.5	44.2	48.7	48.7
H34	36.3	36.6	36.6	36.7	37.0	38.0	39.7	42.6	46.8	46.8
Upper Daytime										
H1	40.0	40.0	40.0	40.3	43.0	45.5	48.0	50.5	52.9	55.4
H2	40.0	40.0	40.0	40.0	42.3	44.8	47.4	50.0	52.6	55.4
H3	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H27	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H33	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H34	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
Night-time										
H1	43.0	43.0	43.0	43.0	43.0	43.7	46.5	49.4	52.3	55.1
H2	43.0	43.0	43.0	43.0	43.0	43.9	46.7	49.4	52.1	54.7
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H34	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9

The upper daytime noise limit has adopted for the purpose of undertaking the cumulative noise assessment herein. This is on the basis that the combined generating capacity of Carnbuck Wind Farm and the neighbouring schemes is relatively high (especially when considering the relative generating capacity of turbines available at the time that the ETSU-R-97 document was originally released); the majority of assessment locations considered will not be downwind of the site or cumulative developments in the prevailing wind direction; existing planning conditions for neighbouring turbines appear to already allow for operational noise levels that lie between the lower and upper bounds of the ETSU-R-97 daytime limits; that adopting a lower limit would have a substantial effect on the generating capacity of the Carnbuck development; and, due to the 'noise budget' already being occupied by turbines with arguably less planning merit than the larger Carnbuck wind farm in terms of potential generating capacity at some residences.

The intention in the adoption of the upper daytime noise limit is not to allow levels of cumulative turbine noise that are right up to the upper limit in all instances, unless it is absolutely necessary (i.e. in instances where existing turbine noise levels may already be close to or at the overall prescribed cumulative noise limits), but to allow for levels that lie between the lower and upper bounds of the ETSU-R-97 requirements in some circumstances, as already appears to be the case for the existing situation for certain residences.

The proposed Carnbuck wind farm will also have a character of noise that is different to that generated by the smaller planned, consented and operational turbines in the area due the lower rotational speeds and blade passing frequency of larger wind turbines as compared with smaller scale (<500 kW) turbines.

3. PREDICTIONS

The propagation model described within ISO 9613-2 [3] has been used to undertake predictions of the expected noise levels resulting from the operation of the development. The model accounts for geometric spreading, atmospheric absorption, ground and barrier effects. The specific assumptions used and interpretation of the propagation prediction methodology, as detailed in the GPG [2], has been used.

The recommended assumptions include the use of relatively low atmospheric absorption values corresponding to temperature of 10 °C, a relative humidity of 70 % as defined within ISO9613-1 [4], the application of a +3 dB correction should propagation across a valley occur and the limitation of barrier attenuation to -2 dB where there is no direct line-of-sight between a source and receiver due to the intervening topography. The resultant predicted noise levels are considered conservative in nature as an appropriate level of uncertainty has been applied to the candidate turbine source noise levels and the effects of trees and other non-terrain related shielding have not been considered.

A ground absorption coefficient of G=0.5 and a receiver height of 4 m is assumed. Furthermore, the resultant predicted dB L_{Aeq} noise levels have been converted to dB L_{A90} values by subtracting 2 dB to allow for comparison with the limits. All in line with the recommendations of the GPG.

Additionally, rather than making a conservative assumption that properties are always downwind of the wind farm, a more detailed assessment, which incorporates the effects of wind direction has been undertaken. This accounts for the fact that noise levels at a property will be less when the property is crosswind or upwind of a particular development. The directional attenuation factors applied, as shown at **Table 4**, are consistent with the recommendations of the IOA GPG; with reductions in noise of around 2 dB when a receiver is crosswind, and up to 10 dB when a receiver is upwind of a particular turbine. The IOA GPG also states that upwind reductions in noise level will only come into play gradually at distances of between 5 and 10 tip heights. As a result, the attenuation factors applied have been adjusted by the distance between the source and receiver accordingly.

Table 4 - Directional Attenuation

Directional Offset from Directly Downwind, °	0	30	60	90	120	150	180	210	240	270	300	330
Directional Attenuation Factor, dB	0	0	0	-2.0	-6.7	-9.3	-10	-9.3	-6.7	-2.0	0	0

The dwelling locations considered as part of the assessment are listed at **Table 5** below. These represent the most sensitive properties surrounding the site and are considered representative of a much larger selection of dwellings (i.e., if the proposed noise limits can be met at these locations, the limits would also be met at locations nearby or further from the development and cumulative sites).

Table 5 - House Locations

House ID	OSGB Co-ordinates		House ID	OSGB Co-ordinates	
	X / m	Y / m		X / m	Y / m
H1	309979	422676	H34	309622	420847
H2	309761	422704	H39	314273	419792
H3	309656	422220	H45	310324	419519
H4	309384	421839	H49	313292	419204

House ID	OSGB Co-ordinates		House ID	OSGB Co-ordinates	
	X / m	Y / m		X / m	Y / m
H5	309407	421621	H52	312066	418151
H6	309586	421332	H91	311806	418089
H10	309697	420992	H94	311025	418993
H11	309512	421032	H158	309337	421817
H12	309551	421004	H162	309385	421272
H13	309596	420995	H164	309513	421335
H14	309508	420901	H165	309536	421306
H16	309474	420886	H168	310037	419469
H22	310478	419181	H173	310346	419531
H24	311566	418066	H209	313135	419377
H27	313138	419356	H222	314326	420005
H33	314432	420189	H224	313231	419053

The Carnbuck Wind Farm and cumulative turbine locations, the corresponding assumed hub-heights and turbine models considered as part of the assessment provided herein are shown at **Table 6.**

Table 6 - Turbine Locations

Turbine ID	OSGB Co-ordinates		Hub-Height, m	Turbine Model
	X / m	Y / m		
Carnbuck				
T1	310866	421041	112	Vestas V136 4.2 MW
T2	310942	420508	112	Vestas V136 4.2 MW
T3	311247	420105	112	Vestas V136 4.2 MW
T4	311927	420074	112	Vestas V136 4.2 MW
T5	311970	419561	112	Vestas V136 4.2 MW
T6	312344	419989	112	Vestas V136 4.2 MW
T7	312305	420580	112	Vestas V136 4.2 MW
T8	312715	420394	112	Vestas V136 4.2 MW
T9	312578	420871	112	Vestas V136 4.2 MW
T10	312971	420639	112	Vestas V136 4.2 MW
T11	312980	421211	112	Vestas V136 4.2 MW
T12	313321	421005	112	Vestas V136 4.2 MW
Gruig				
A4	311225	420961	60	Nordex N80 2.5 MW
A5	311475	421158	60	Nordex N80 2.5 MW
A8	311465	420672	60	Nordex N80 2.5 MW
A9	311695	420881	60	Nordex N80 2.5 MW
A10	311787	421201	60	Nordex N80 2.5 MW
A11	312008	421415	60	Nordex N80 2.5 MW
A12	312265	421614	60	Nordex N80 2.5 MW
P15	312008	420952	60	Nordex N80 2.5 MW

Turbine ID	OSGB Co-ordinates		Hub-Height, m	Turbine Model
	X / m	Y / m		
P16	312245	421168	60	Nordex N80 2.5 MW
P17	312477	421377	60	Nordex N80 2.5 MW
Corkey Re-Powering				
C1	311506	422023	80	Vestas V117 4.2 MW
C2	311146	422326	80	Vestas V117 4.2 MW
C3	310713	422440	80	Vestas V117 4.2 MW
C4	310671	421988	80	Vestas V117 4.2 MW
C5	311046	421744	80	Vestas V117 4.2 MW
Single Turbines				
S1	310606	422923	45	Enercon E44 900 kW
B1	309840	422170	55	Vestas V52 850 kW
D1	310142	419846	40	Vestas V52 850 kW (100dB)
E1	311785	418325	40	EWT DW54 250 kW
F1	311587	418318	40	EWT DW54 250 kW

The predictions assume the installation of Vestas V136 4.2 MW turbines with a hub height of 112 m at the proposed turbine locations for the Carnbuck development, as shown at **Table 6**. The corresponding source noise levels, as obtained from documentation supplied by the turbine manufacturer [6], assuming the use of serrated trailing edge (STE) blade modifications and with a +2 dB allowance for uncertainty included, are shown at **Table 7**. This approach concurs with the approach recommended within the IOA GPG and is considered to provide a reasonably conservative basis of assessment. The source noise information has been supplied with reference to hub-height wind speeds and these have been converted to reference standardised 10 m height wind speeds using the methodology specified within IEC-61400-11 [5]. Furthermore, it is possible to run this model of turbine in a variety of operational modes which may be implemented for numerous parameters not limited to wind speed, direction and time. The source noise levels for a variety of the noise modes which could be implemented at the wind farm, including for the applied uncertainty discussed earlier, are also shown.

The octave band noise levels, as also supplied by the turbine manufacturer [7], corresponding to the maximum noise output of the V136 3.6 MW turbine considered here, operating unrestricted and incorporating the uncertainty described earlier, are shown at Table 8. These octave band noise levels have been adjusted to represent the overall noise levels specified for other/lower wind speeds and for other operational noise modes by subtracting the relative difference between the maximum noise level for unrestricted operation and the level corresponding wind speed/mode of interest from each overall octave band level.

The candidate turbine is assumed not to have any tonal noise output that would attract a penalty at neighbouring residences under the ESTU-R-97 guidance. A warranty or guarantee will be obtained from the manufacturer which limits the level of tonal noise associated with the operation of the individual turbines (or the site as a whole), should the candidate model of turbine be installed. This will help to ensure tonal noise would not require a penalty under the requirements of ETSU-R-97 and provide recourse with the turbine manufacturer should tonal noise be present.

The Gruig development has 10 Nordex N80 2.5 MW turbines with hub-heights of 60 m. The source noise data for the turbines has been taken from warranted data supplied by the manufacturer [8], which is already considered to incorporate a certain amount of uncertainty, with a further additional 2 dB added to the source noise levels. The corresponding levels in octave bands are taken from further specifications and test reports provided by the turbine manufacturer [9], normalised to the maximum sound power output of the turbine.

The source noise levels for the Vestas V117 4.2 MW turbine, which is expected to be installed at the Corkey Repowering site, are taken from specification documentation [10] supplied by the manufacturer with 2 dB added to account for uncertainty. The data is supplied with reference to hub-height wind speeds and has been corrected to standardised 10 m height wind speeds in accordance with the procedure described in IEC-61400-11. The corresponding octave band levels have been taken from separate documentation provided by the manufacturer [11] for the maximum sound power output of the turbine and with the same uncertainty applied.

The planning consent documentation for the single S1 turbine refers to the source sound power levels stated within the noise assessment submitted in support of the planning application for the turbine [12] and these have been used to undertake the predictions. The levels are supplemented here by additional manufacturers' specification data [13] associated with the installed turbine for wind speeds where source noise levels are not defined at high standardised 10 m height wind speeds. An additional uncertainty of 2 dB has been applied to all levels, as required by the GPG. However, it is expected that specified source values already incorporate a certain amount of uncertainty. The corresponding octave band levels have been taken from a turbine measurement report [14], normalised to the maximum reported sound levels associated with the operation of the turbine.

The source noise levels for the V52 850 kW turbine, corresponding to the turbine referred to as B1, have been taken from specifications provided by the turbine manufacturer [15] with an additional 1 dB of uncertainty applied. In reality, this turbine is likely to be run in a reduced mode of operation or an alternative model is likely to be installed, as explained further at **Section 4**. As a result, and due to the uncertainty in the turbine type that could be installed at this location, the use of this turbine data as part of the assessment provides a particularly conservative basis of assessment. The corresponding octave band data is taken from a measurement report [16] relating to the operation of the turbine, normalised to the maximum sound power output of the model.

The source noise and corresponding octave band level information for the V52 (100 dB) turbine is taken from the noise assessment that supported the planning application for the D1 turbine [17]. Whilst it is considered that the levels used as part of the assessment already account for uncertainty an additional 2 dB has been applied in order to provide a conservative basis of assessment.

The source noise levels and corresponding octave band information for the EWT DW54 250 kW turbines corresponding to E1 & F1 have only been provided for reference and have been taken from the noise assessment that supported both planning applications [18] with 2 dB added to further account for uncertainty over that already included as part of the specified levels. The levels of predicted noise included as part of the assessment provided herein are actually calculated via analysis of the noise levels that are provided as a condition to the planning consent for the turbine in order to maintain consistency with the consent requirements. This aspect is discussed further at **Section 4**.

The overall source noise levels and corresponding octave band levels, including for all corrections and the application of the relevant uncertainties, are provided at **Table 7** and **Table 8** respectively.

Table 7 – Sound Power Levels, dB L_{WA}

Turbine	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Vestas V136 3.6 MW – 112 m Hub-Height										
Unrestricted	93.8	97.5	102.5	105.6	105.9	105.9	105.9	105.9	105.9	105.9
SO1	93.8	97.5	102.2	103.8	103.8	104.0	104.0	104.0	104.0	104.0
SO2	93.8	97.5	101.1	101.4	101.5	101.5	101.5	101.5	101.5	101.5
SO11	93.8	96.2	98.0	99.7	100.9	101.2	101.2	101.2	101.2	101.2
SO12	93.8	96.6	99.6	101.5	101.9	101.9	101.9	101.9	101.9	101.9
SO13	93.1	94.2	95.4	97.4	98.6	99.0	99.0	99.0	99.0	99.0
Nordex N80 2.5 MW – 60 m Hub-Height										

Turbine	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
N80 2.5 MW	100.0	100.0	102.5	104.5	105.0	105.5	106.0	106.0	106.5	107.0
Vestas V117 4.2 MW - 80 m Hub-Height										
V117 4.2 MW	95.1	97.8	101.8	105.6	107.7	108.0	108.0	108.0	108.0	108.0
Enercon E44 900 kW - 45 m Hub-Height										
E44 900 kW	101.9	101.9	101.9	101.9	101.9	103.5	104.1	104.1	105.0	105.0
Vestas V52 850 kW - 55 m Hub-Height										
V52 850 kW	95.6	95.8	98.6	102.7	105.0	105.5	105.6	104.6	103.8	103.5
Vestas V52 850 kW (100dB) - 40 m Hub-Height										
V52 850 kW (100 dB)	98.0	98.0	98.8	99.6	100.5	101.5	102.1	102.7	103.1	103.6
EWT DW54 250 kW - 40 m Hub-Height										
EWT DW54 250 kW	99.0	99.0	99.0	100.2	100.4	100.6	101.1	102.3	102.8	103.3

Table 8 - Octave Band Sound Power Levels, dB L_{WA}

Turbine	Overall, dB L_{WA}	Centre of Octave Band, Hz							
		63	125	250	500	1k	2k	4k	8k
V136 4.2 MW	105.9	87.0	94.6	99.2	101.0	99.9	95.9	89.0	79.2
N80 2.5 MW	107.0	89.5	97.1	101.9	102.5	98.0	96.5	87.5	76.1
V117 4.2 MW	108.0	88.3	95.5	100.3	102.6	102.4	99.7	94.6	87.0
E44 900 kW	105.0	87.2	92.7	96.2	98.4	100.4	97.7	90.4	84.3
V52 850 kW	105.6	81.9	89.8	95.6	101.2	100.9	97.0	90.6	80.4
V52 (100 dB)	103.6	86.2	92.2	96.7	98.1	97.2	95.3	90.1	81.2
DW54 250 kW	103.3	85.5	91.1	93.1	95.2	97.9	97.1	93.4	89.6

4. ASSESSMENT

The overall noise levels resulting from the combined operation of the Carnbuck proposals with other existing, planned and consented cumulative development in the area is complicated by the various technical basis on which each development has been granted planning consent in terms of their respective planning controls/conditions relating to operational noise; the differences in reference wind speeds for each of the developments and differences in assessment/compliance methodologies, particularly for development that were granted planning consent prior to documents, such as the GPG, being issued and adopted as relevant best practice; and, changes/differences in the preferred approach to consenting requirements, in terms of operational noise, by representatives of the Local Planning Authority (LPA). As a result, a series of assumptions regarding the operation of each development are made, with due regard to any respective planning consent documentation, to ensure a realistic to conservative basis of cumulative assessment overall and with the aim of providing confidence that that the overall requirements of ETSU-R-97 can be met for the Carnbuck site.

The predicted noise levels for each of the sites considered as part of the assessment are therefore considered on an individual basis in the first instance and a justification for the adoption of the levels for the individual sites as part of the overall cumulative operational noise assessment is provided.

Applied Overall Cumulative Noise Limits

The derived noise limits shown at **Table 3** have been applied to the house locations at **Table 5** based on the proximity of each to a location where background noise survey information is available or where it

is expected that the background noise environment would be similar. Where there is ambiguity in this respect the lower of any applicable noise limits have been applied to ensure a conservative basis for assessment. **Table 9** shows the applied upper daytime and night-time noise limits for all the properties to be assessed herein.

Table 9 - Overall Cumulative Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Daytime										
H1	40.0	40.0	40.0	40.3	43.0	45.5	48.0	50.5	52.9	55.4
H2	40.0	40.0	40.0	40.0	42.3	44.8	47.4	50.0	52.6	55.4
H3	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H4	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H5	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H6	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H10	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H11	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H12	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H13	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H14	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H16	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H22	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H24	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H27	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H33	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H34	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H39	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H45	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H49	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H52	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H91	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H94	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H158	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.1	44.8	46.4
H162	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H164	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H165	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.6	46.8	46.8
H168	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H173	40.0	40.0	40.0	40.0	40.5	42.4	44.8	47.9	51.6	51.6
H209	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
H222	40.0	40.0	40.0	40.0	40.0	40.0	40.5	44.2	48.7	48.7
H224	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	43.4	43.4
Night-time										
H1	43.0	43.0	43.0	43.0	43.0	43.7	46.5	49.4	52.3	55.1

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H2	43.0	43.0	43.0	43.0	43.0	43.9	46.7	49.4	52.1	54.7
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H5	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H6	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H10	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H11	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H12	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H13	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H14	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H16	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H22	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H24	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H34	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H39	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H45	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H49	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H52	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H91	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H94	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H158	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.5
H162	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H164	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H165	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.0	46.9
H168	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H173	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	47.1	50.2
H209	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7
H222	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.4	48.9
H224	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.7

Carnbuck Predicted Noise Levels & Assessment

Table 10 shows the maximum predicted turbine noise levels associated with the Carnbuck development for any given wind direction (i.e., downwind), incorporating the assumptions and uncertainties detailed at **Section 3**.

Table 10 - Carnbuck Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	16.9	20.6	25.6	28.7	29.0	29.0	29.0	29.0	29.0	29.0

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H2	16.4	20.1	25.1	28.2	28.5	28.5	28.5	28.5	28.5	28.5
H3	17.9	21.6	26.6	29.7	30.0	30.0	30.0	30.0	30.0	30.0
H4	18.0	21.7	26.7	29.8	30.1	30.1	30.1	30.1	30.1	30.1
H5	18.8	22.5	27.5	30.6	30.9	30.9	30.9	30.9	30.9	30.9
H6	20.7	24.4	29.4	32.5	32.8	32.8	32.8	32.8	32.8	32.8
H10	22.1	25.8	30.8	33.9	34.2	34.2	34.2	34.2	34.2	34.2
H11	20.9	24.6	29.6	32.7	33.0	33.0	33.0	33.0	33.0	33.0
H12	21.1	24.8	29.8	32.9	33.2	33.2	33.2	33.2	33.2	33.2
H13	21.4	25.1	30.1	33.2	33.5	33.5	33.5	33.5	33.5	33.5
H14	21.0	24.7	29.7	32.8	33.1	33.1	33.1	33.1	33.1	33.1
H16	20.8	24.5	29.5	32.6	32.9	32.9	32.9	32.9	32.9	32.9
H22	23.1	26.8	31.8	34.9	35.2	35.2	35.2	35.2	35.2	35.2
H24	20.4	24.1	29.1	32.2	32.5	32.5	32.5	32.5	32.5	32.5
H27	26.2	29.9	34.9	38.0	38.3	38.3	38.3	38.3	38.3	38.3
H33	20.9	24.6	29.6	32.7	33.0	33.0	33.0	33.0	33.0	33.0
H34	21.8	25.5	30.5	33.6	33.9	33.9	33.9	33.9	33.9	33.9
H39	20.2	23.9	28.9	32.0	32.3	32.3	32.3	32.3	32.3	32.3
H45	24.0	27.7	32.7	35.8	36.1	36.1	36.1	36.1	36.1	36.1
H49	24.4	28.1	33.1	36.2	36.5	36.5	36.5	36.5	36.5	36.5
H52	20.7	24.4	29.4	32.5	32.8	32.8	32.8	32.8	32.8	32.8
H91	21.0	24.7	29.7	32.8	33.1	33.1	33.1	33.1	33.1	33.1
H94	24.5	28.2	33.2	36.3	36.6	36.6	36.6	36.6	36.6	36.6
H158	17.9	21.6	26.6	29.7	30.0	30.0	30.0	30.0	30.0	30.0
H162	19.6	23.3	28.3	31.4	31.7	31.7	31.7	31.7	31.7	31.7
H164	20.3	24.0	29.0	32.1	32.4	32.4	32.4	32.4	32.4	32.4
H165	20.5	24.2	29.2	32.3	32.6	32.6	32.6	32.6	32.6	32.6
H168	21.9	25.6	30.6	33.7	34.0	34.0	34.0	34.0	34.0	34.0
H173	24.1	27.8	32.8	35.9	36.2	36.2	36.2	36.2	36.2	36.2
H209	26.3	30.0	35.0	38.1	38.4	38.4	38.4	38.4	38.4	38.4
H222	20.6	24.3	29.3	32.4	32.7	32.7	32.7	32.7	32.7	32.7
H224	24.1	27.8	32.8	35.9	36.2	36.2	36.2	36.2	36.2	36.2

The maximum predicted turbine noise levels, as predicted at any property, using the assumptions, uncertainties and corrections detailed with GPG, are not more than 38.5 dB L_{A90} which comfortably comply with the overall noise limits at **Table 9**. These predicted noise levels have therefore been included/incorporated within the overall cumulative assessment.

Gruig Planning Conditions & Predicted Noise Levels

The existing Gruig Wind farm was granted planning consent in 2004 and became operational in 2009 (Planning Reference: D/2004/0790/F) [19]. The consent documentation states, within the 'informatives' to the planning conditions, that 'At the reasonable request of Ballymoney Borough Council, following a complaint to the Council relating to noise emissions from the Wind Turbines, the developer will

demonstrate that, at the noise sensitive property in question, the noise levels experienced as a result of the Wind Turbines, excluding the existing background noise levels, do not exceed:

- During Night Hours, the greater of the Night Hours LA90, 10min Background Noise Level plus 5 dB(A) or 43 dB(A) at Wind Speeds not exceeding 12 meters per second;
- The greater of the Quiet Waking Hours LA90, 10 min Background Noise Level plus 5 dB(A) or 37.5 dB(A) at Wind Speeds not exceeding 12 metres per second;

Wind speeds should relate to 10m height on the wind farm site.

Details of the methodology should be extracted from "The Assessment & Rating of Noise from Wind Farms", ETSU (report number ETSU-R-97.)'

The site was granted planning consent at a time where only the ETSU-R-97 guidance was available to inform assessment requirements and the planning conditions. The ETSU-R-97 requires that background and operational noise measurements are related to directly measured 10 m height wind speeds seen at the development rather than standardised 10 m height wind speeds, as required by the supplementary guidance contained within the GPG (i.e. the use of hub-height wind speeds, which most closely correlate to the sound output of turbines, converted to standardised 10 m height wind speeds using the methodology detailed within IEC61400-11 [5]). As a result, the use of the planning conditions limits to inform the predicted operational noise levels associated with the operation of this development, in terms of 'controlling properties' or otherwise, could be considered erroneous or inconsistent in the context of current planning guidance due to this difference in reference wind speeds.

The maximum predicted noise levels associated with operation of the Gruig development, for any given wind direction, and using the assumptions at **Section 3** are shown at **Table 11**. The levels have been generated using the warranted source noise levels for the turbine installed, which is already considered to incorporate a certain margin of uncertainty, with an additional 2 dB of uncertainty applied. All relevant corrections relating to the intervening topography between the site and neighbouring receptors have also been included within the model. This results in predicted noise levels that do not exceed 36 dB L_{A90} at any of the properties neighbouring the site and demonstrates that, regardless of the inconsistences in wind speed reference discussed above, operational noise levels from the site would comfortably meet the planning condition requirements in respect of the lower condition limits applied for daytime and night-time periods respectively.

Table 11 - Gruig Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	24.0	24.0	26.5	28.5	29.0	29.5	30.4	30.4	30.9	31.4
H2	23.9	23.9	26.4	28.4	28.9	29.4	30.3	30.3	30.8	31.3
H3	25.0	25.0	27.5	29.5	30.0	30.5	31.3	31.3	31.8	32.3
H4	24.0	24.0	26.5	28.5	29.0	29.5	30.4	30.4	30.9	31.4
H5	24.9	24.9	27.4	29.4	29.9	30.4	31.3	31.3	31.8	32.3
H6	26.5	26.5	29.0	31.0	31.5	32.0	32.9	32.9	33.4	33.9
H10	27.6	27.6	30.1	32.1	32.6	33.1	33.9	33.9	34.4	34.9
H11	26.6	26.6	29.1	31.1	31.6	32.1	32.9	32.9	33.4	33.9
H12	26.8	26.8	29.3	31.3	31.8	32.3	33.1	33.1	33.6	34.1
H13	27.0	27.0	29.5	31.5	32.0	32.5	33.3	33.3	33.8	34.3
H14	26.6	26.6	29.1	31.1	31.6	32.1	33.0	33.0	33.5	34.0
H16	26.4	26.4	28.9	30.9	31.4	31.9	32.8	32.8	33.3	33.8
H22	26.0	26.0	28.5	30.5	31.0	31.5	32.4	32.4	32.9	33.4

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H24	25.8	25.8	28.3	30.3	30.8	31.3	32.2	32.2	32.7	33.2
H27	27.9	27.9	30.4	32.4	32.9	33.4	34.3	34.3	34.8	35.3
H33	24.9	24.9	27.4	29.4	29.9	30.4	31.3	31.3	31.8	32.3
H34	27.2	27.2	29.7	31.7	32.2	32.7	33.5	33.5	34.0	34.5
H39	24.2	24.2	26.7	28.7	29.2	29.7	30.6	30.6	31.1	31.6
H45	27.6	27.6	30.1	32.1	32.6	33.1	33.9	33.9	34.4	34.9
H49	26.2	26.2	28.7	30.7	31.2	31.7	32.6	32.6	33.1	33.6
H52	24.0	24.0	26.5	28.5	29.0	29.5	30.5	30.5	31.0	31.5
H91	25.6	25.6	28.1	30.1	30.6	31.1	32.0	32.0	32.5	33.0
H94	28.6	28.6	31.1	33.1	33.6	34.1	34.9	34.9	35.4	35.9
H158	24.4	24.4	26.9	28.9	29.4	29.9	30.8	30.8	31.3	31.8
H162	25.7	25.7	28.2	30.2	30.7	31.2	32.1	32.1	32.6	33.1
H164	26.3	26.3	28.8	30.8	31.3	31.8	32.6	32.6	33.1	33.6
H165	26.4	26.4	28.9	30.9	31.4	31.9	32.8	32.8	33.3	33.8
H168	24.3	24.3	26.8	28.8	29.3	29.8	30.7	30.7	31.2	31.7
H173	27.7	27.7	30.2	32.2	32.7	33.2	34.0	34.0	34.5	35.0
H209	28.0	28.0	30.5	32.5	33.0	33.5	34.4	34.4	34.9	35.4
H222	25.0	25.0	27.5	29.5	30.0	30.5	31.4	31.4	31.9	32.4
H224	25.3	25.3	27.8	29.8	30.3	30.8	31.7	31.7	32.2	32.7

Given the additional uncertainty applied to the predicted noise levels, which already represent a conservative basis of assessment, no further corrections have been applied to the predicted noise levels in respect of 'controlling properties' (i.e. properties considered most sensitive to noise associated with a particular development, which would have the effect of controlling noise levels at other dwellings) or otherwise. The application of additional corrections/margins in this respect is considered disproportionate due to the installed turbine having well-defined sound characteristics that are unlikely to exceed those used here. Therefore, the predicted noise levels shown at **Table 11** are used as part of the overall cumulative assessment.

Corkey Re-Powering Planning Conditions & Predicted Noise Levels

The Corkey Re-Powering scheme was granted planning consent in March 2022 (Planning Reference: LA01/2019/0772/F) [20] with conditions relating to operational noise. The noise limits for the repowered site are provided at Condition 16 of the consent documentation which states that 'The level of noise emissions from the combined effects of the permitted wind turbines shall not exceed values set out in Table 1. Noise limits for any dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in Table 1 shall be represented by the physically closest location listed in Table 1 unless otherwise agreed by the Council'.

The specified limits are provided at **Table 12** for reference and includes a reference to the corresponding House ID for each of the assessed properties listed here to enable comparison with the overall assessment provided here on a consistent basis, where this information is available. In instances where the listed House ID is not provided, it is considered that the residential location is not relevant, sensitive or critical to the introduction of the Carnbuck Wind Farm proposals.

Table 12 – Corkey Re-Powering Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Daytime (07:00 to 23:00)										
15 Reservoir Road (H3)	35.0	35.0	35.0	35.5	37.0	39.0	40.7	40.1	39.3	42.7
21 Reservoir Road (H1)	35.0	33.8	33.7	38.4	41.9	44.8	47.6	50.2	52.8	55.3
42 Reservoir Road (H2)	35.0	34.6	33.8	37.8	41.2	44.1	47.0	49.7	52.5	55.3
97 Altnahinch Road	35.0	35.0	35.0	35.4	34.7	37.5	40.2	42.5	44.4	46.1
210 Corkey Road (H10)	35.0	35.0	35.0	34.5	33.9	37.1	40.0	42.3	44.2	46.0
Night-time (23:00 to 07:00)										
15 Reservoir Road (H3)	43.0	42.8	42.5	42.1	41.7	41.3	40.7	40.1	39.3	38.4
21 Reservoir Road (H1)	42.6	42.4	42.2	42.1	41.9	42.5	45.9	49.1	52.1	55.0
42 Reservoir Road (H2)	42.7	42.5	42.4	42.2	42.1	43.1	46.2	49.1	51.9	54.7
97 Altnahinch Road	42.9	42.8	42.7	42.5	42.4	42.3	42.2	42.2	42.2	44.0
210 Corkey Road (H10)	42.9	42.9	42.8	42.7	42.5	42.4	42.4	42.4	42.4	44.1

The predicted noise levels resulting from the Corkey Re-Powering scheme, using the conservative assumptions and uncertainties detailed at **Section 3** are provided at **Table 13**.

Table 13 – Corkey Re-Powering Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	28.0	28.0	28.0	30.7	34.7	38.5	40.6	40.9	40.9	40.9
H2	25.8	25.8	25.8	28.5	32.5	36.3	38.3	38.7	38.7	38.7
H3	24.4	24.4	24.4	27.1	31.1	34.9	36.9	37.3	37.3	37.3
H4	21.9	21.9	21.9	24.6	28.6	32.4	34.5	34.8	34.8	34.8
H5	21.7	21.7	21.7	24.3	28.4	32.1	34.2	34.5	34.6	34.6
H6	22.0	22.0	22.0	24.7	28.7	32.5	34.6	34.9	34.9	34.9
H10	21.3	21.3	21.3	23.9	28.0	31.7	33.8	34.1	34.2	34.2
H11	20.4	20.4	20.4	23.1	27.2	30.9	33.0	33.3	33.3	33.3
H12	20.5	20.5	20.5	23.2	27.2	31.0	33.1	33.4	33.4	33.4
H13	20.7	20.7	20.7	23.4	27.5	31.2	33.3	33.6	33.6	33.6
H14	19.9	19.9	19.9	22.6	26.6	30.4	32.4	32.8	32.8	32.8
H16	20.8	20.8	20.8	23.5	27.6	31.3	33.4	33.7	33.7	33.7
H22	14.3	14.3	14.3	17.0	21.0	24.8	26.8	27.2	27.2	27.2
H24	13.6	13.6	13.6	16.3	20.4	24.1	26.2	26.5	26.5	26.5
H27	14.3	14.3	14.3	17.0	21.0	24.8	26.9	27.2	27.2	27.2
H33	12.2	12.2	12.2	14.9	19.0	22.7	24.8	25.1	25.1	25.1
H34	20.2	20.2	20.2	22.9	26.9	30.7	32.8	33.1	33.1	33.1
H39	12.0	12.0	12.0	14.7	18.7	22.5	24.5	24.9	24.9	24.9
H45	16.7	16.7	16.7	19.4	23.4	27.2	29.3	29.6	29.6	29.6
H49	13.0	13.0	13.0	15.7	19.7	23.5	25.5	25.9	25.9	25.9
H52	11.6	11.6	11.6	14.3	18.3	22.1	24.2	24.5	24.5	24.5

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H91	13.6	13.6	13.6	16.3	20.3	24.1	26.2	26.5	26.5	26.5
H94	14.8	14.8	14.8	17.5	21.6	25.3	27.4	27.7	27.7	27.7
H158	21.5	21.5	21.5	24.2	28.2	32.0	34.1	34.4	34.4	34.4
H162	20.5	20.5	20.5	23.2	27.3	31.0	33.1	33.4	33.4	33.4
H164	21.6	21.6	21.6	24.2	28.3	32.0	34.1	34.4	34.5	34.5
H165	21.6	21.6	21.6	24.3	28.3	32.1	34.2	34.5	34.5	34.5
H168	14.1	14.1	14.1	16.8	20.9	24.6	26.7	27.0	27.0	27.0
H173	16.8	16.8	16.8	19.5	23.5	27.3	29.4	29.7	29.7	29.7
H209	14.4	14.4	14.4	17.1	21.1	24.9	26.9	27.3	27.3	27.3
H222	12.2	12.2	12.2	14.9	19.0	22.7	24.8	25.1	25.1	25.1
H224	12.7	12.7	12.7	15.4	19.4	23.2	25.2	25.6	25.6	25.6

The margin by which the predicted noise levels meet the Corkey Re-Powering noise limits at the locations listed with the planning consent documentation is provided at **Table 14**. A positive number indicates that the predicted noise levels are above the condition limits for the corresponding locations and specific standardised 10 m height wind speeds. This shows that the predicted noise levels from the operation of the Re-Powering scheme are close to or up to 1 dB above the daytime planning condition limits for certain meteorological conditions. As a result, some curtailment/mitigation may be required in order for the site to achieve the planning condition requirements. However, this is a matter for the operator of the site. Furthermore, the source noise levels used to predict the expected operational noise levels are relatively high as compared to levels expected for other turbines of similar size and dimensions which could be installed at the site. If an application to vary the dimensions and potential turbine type at the site is made, this would need to consider the Carnbuck proposals as they currently stand.

Table 14 – Corkey Re-Powering Planning Condition Margins, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
Daytime (07:00 to 23:00)										
15 Reservoir Road (H3)	-10.6	-7.9	-3.9	-0.6	-0.1	-1.7	-3.4	-2.8	-2.0	-5.4
21 Reservoir Road (H1)	-7.0	-3.1	1.0	0.1	-1.3	-3.9	-6.7	-9.3	-11.9	-14.4
42 Reservoir Road (H2)	-9.2	-6.1	-1.3	-1.5	-2.9	-5.4	-8.3	-11.0	-13.8	-16.6
97 Altnahinch Road	-	-	-	-	-	-	-	-	-	-
210 Corkey Road (H10)	-13.7	-11.1	-7.0	-2.8	-0.1	-3.0	-5.8	-8.1	-10.0	-11.8
Night-time (23:00 to 07:00)										
15 Reservoir Road (H3)	-18.6	-15.7	-11.4	-7.2	-4.8	-4.0	-3.4	-2.8	-2.0	-1.1
21 Reservoir Road (H1)	-14.6	-11.7	-7.5	-3.6	-1.3	-1.6	-5.0	-8.2	-11.2	-14.1
42 Reservoir Road (H2)	-16.9	-14.0	-9.9	-5.9	-3.8	-4.4	-7.5	-10.4	-13.2	-16.0
97 Altnahinch Road	-	-	-	-	-	-	-	-	-	-
210 Corkey Road (H10)	-21.6	-19.0	-14.8	-11.0	-8.7	-8.3	-8.2	-8.2	-8.2	-9.9

Given the relatively conservative nature of the predicted noise levels (i.e., via the incorporation of appropriate uncertainty in to the propagation model), the well-defined nature of the source sound power levels and the fact that the resultant predictions only just meet or are slightly above the planning condition limits, the predicted noise levels at **Table 13** have been used to inform the overall cumulative

assessment discussed herein with no adjustments to account for the planning conditions being made as a conservative basis of assessment.

The existing site has not been included as part of the assessment herein as it is expected to be replaced by the repowered site in due course.

S1 - D/2013/0081/F Planning Conditions & Predicted Noise Levels

This single turbine, referred to here as S1 (Planning Reference: D/2013/0081/F) [21], has a planning condition which limits the specific source noise level of the installed turbine. Condition 4 of the planning consent documentations states that 'The development hereby approved shall have a sound power level no greater than that specified in the submitted Noise Assessment (Report Number 11514870003.50I/B.0) dated May 2013'. These specified source noise levels, supplemented by manufacturers' specification data associated with the installed turbine for wind speeds where source noise levels are not defined, and with the application of 2 dB of uncertainty as required by the GPG, have been used to calculate the predicted operational noise levels associated with the turbine (see **Section 3**) at the cumulative assessment locations. The resultant predicted noise levels are shown at **Table 15**, are considered to provide a conservative basis of calculation and are used to inform the cumulative assessment herein.

Table 15 - S1 (D/2013/0081/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	33.2	33.2	33.2	33.2	33.2	34.8	35.5	35.5	36.4	36.4
H2	30.5	30.5	30.5	30.5	30.5	32.0	32.7	32.8	33.7	33.7
H3	27.1	27.1	27.1	27.1	27.1	28.6	29.4	29.4	30.3	30.3
H4	21.5	21.5	21.5	21.5	21.5	22.9	23.7	23.8	24.7	24.7
H5	20.7	20.7	20.7	20.7	20.7	22.1	22.9	22.9	23.8	23.8
H6	20.0	20.0	20.0	20.0	20.0	21.4	22.2	22.2	23.1	23.1
H10	18.7	18.7	18.7	18.7	18.7	20.0	20.9	20.9	21.8	21.8
H11	20.4	20.4	20.4	20.4	20.4	21.7	22.6	22.6	23.5	23.5
H12	20.4	20.4	20.4	20.4	20.4	21.7	22.6	22.6	23.5	23.5
H13	20.4	20.4	20.4	20.4	20.4	21.8	22.6	22.6	23.5	23.5
H14	19.8	19.8	19.8	19.8	19.8	21.2	22.0	22.0	22.9	22.9
H16	19.6	19.6	19.6	19.6	19.6	21.0	21.9	21.9	22.8	22.8
H22	11.9	11.9	11.9	11.9	11.9	13.2	14.1	14.0	14.9	14.9
H24	11.2	11.2	11.2	11.2	11.2	12.6	13.5	13.4	14.3	14.3
H27	9.9	9.9	9.9	9.9	9.9	11.2	12.1	12.0	12.9	12.9
H33	11.9	11.9	11.9	11.9	11.9	13.3	14.2	14.1	15.0	15.0
H34	19.8	19.8	19.8	19.8	19.8	21.2	22.0	22.0	22.9	22.9
H39	11.6	11.6	11.6	11.6	11.6	12.9	13.9	13.7	14.6	14.6
H45	13.0	13.0	13.0	13.0	13.0	14.4	15.3	15.2	16.1	16.1
H49	9.2	9.2	9.2	9.2	9.2	10.6	11.5	11.4	12.3	12.3
H52	11.1	11.1	11.1	11.1	11.1	12.5	13.4	13.3	14.2	14.2
H91	11.1	11.1	11.1	11.1	11.1	12.5	13.4	13.3	14.2	14.2
H94	11.2	11.2	11.2	11.2	11.2	12.5	13.4	13.3	14.2	14.2
H158	21.2	21.2	21.2	21.2	21.2	22.6	23.4	23.5	24.4	24.4
H162	19.1	19.1	19.1	19.1	19.1	20.4	21.3	21.3	22.2	22.2

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H164	19.8	19.8	19.8	19.8	19.8	21.2	22.0	22.0	22.9	22.9
H165	19.7	19.7	19.7	19.7	19.7	21.1	21.9	21.9	22.8	22.8
H168	12.7	12.7	12.7	12.7	12.7	14.1	15.0	14.9	15.8	15.8
H173	13.1	13.1	13.1	13.1	13.1	14.4	15.3	15.3	16.2	16.2
H209	9.9	9.9	9.9	9.9	9.9	11.3	12.2	12.1	13.0	13.0
H222	11.8	11.8	11.8	11.8	11.8	13.2	14.1	14.0	14.9	14.9
H224	9.0	9.0	9.0	9.0	9.0	10.3	11.3	11.1	12.0	12.0

B1 - LA01/2022/0783/F Planning Conditions & Predicted Noise Levels

The single turbine referred to as B1 (Planning Reference: LA01/2022/0783/F) [22] is proposed to replace an existing turbine at the location (Planning Reference: D/2011/0043/F). An additional consent at the existing turbine location was also approved (Planning Reference: LA01/2020/0078/F). The planning consent documentation for the most recent approval has a condition which limits operational noise associated with the turbine. Condition 7 states that 'The level of noise immissions from the wind turbine (including the application of any tonal penalty when calculated in accordance with the procedures described in Pages 104-109 of ETSU-R-97) shall not exceed the values set out in the attached Table 1 as appropriate. Noise limits for dwellings which lawfully exist of have planning permission for construction at the date of this consent but are not listed in the tables attached shall be those of the physically closest location listed in the tables, unless otherwise agreed by the planning department'.

The noise limits referred to as part the LA01/2022/0783/F condition for are shown at **Table 16** for reference and include a reference to the corresponding House ID for each property listed to enable comparison with the overall assessment provided here on a consistent basis.

Table 16 - B1 (LA01/2022/0783/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
21 Reservoir Road (H1)	-	23.9	28.0	30.5	30.7	31.0	31.0	31.0	31.0	31.0
42 Reservoir Road (H2)	-	23.0	27.1	29.6	29.8	30.1	30.1	30.1	30.1	30.1
15 Reservoir Road (H3)	-	32.8	36.9	39.4	39.6	39.9	39.9	39.9	39.9	39.9
18 Reservoir Road (H4)	-	14.0	18.1	20.6	20.8	21.1	21.1	21.1	21.1	21.1

The planning condition noise limits for the previously approved application LA01/2020/0078/F are provided at **Table 17** for further reference.

Table 17 - B1 (LA01/2020/0078/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
21 Reservoir Road (H1)	-	31.1	32.1	32.7	33.3	34.2	33.9	34.2	32.6	32.6
42 Reservoir Road (H2)	-	30.2	31.2	31.8	32.4	33.3	33.0	33.3	31.7	31.7
15 Reservoir Road (H3)	-	40.1	41.1	41.7	42.3	43.2	42.9	43.2	41.7	41.7
18 Reservoir Road (H4)	-	20.8	21.8	22.4	23.0	23.9	23.7	24.0	22.4	22.4

The two planning condition noise limits appear to be based on the predicted noise levels resulting from the introduction of new potential turbine models and these two consents at the existing turbine location mean there is uncertainty as to what model of turbine may be installed at the site. As a result, noise

predictions used for the purposes of this cumulative assessment, as shown at **Table 18**, which assumes the installation of a Vestas V52 turbine operating unrestricted (see **Section 3**), results in noise levels that a much higher than the limiting requirements of the conditions and represents a particularly conservative basis assessment of assessment. In reality, operational noise levels are expected to be over 5 dB lower than shown, depending on what model of turbine eventually replaces the existing turbine at the site and what 'noise mode' the turbine is operated in.

Further to the above, the residence 15 Reservoir Road (H3) has a financial involvement with this scheme.

Table 18 - B1 (LA01/2022/0783/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	27.8	27.9	30.7	34.8	37.1	37.6	37.8	36.7	36.0	35.7
H2	27.5	27.7	30.4	34.5	36.8	37.3	37.5	36.4	35.7	35.4
H3	37.0	37.2	40.0	44.1	46.4	46.9	47.1	46.1	45.3	45.0
H4	26.9	27.0	29.8	33.9	36.2	36.7	36.9	35.8	35.1	34.7
H5	24.7	24.9	27.6	31.7	34.0	34.5	34.7	33.6	32.9	32.5
H6	22.4	22.6	25.3	29.4	31.6	32.1	32.3	31.2	30.5	30.2
H10	19.1	19.3	22.0	26.1	28.3	28.7	28.9	27.9	27.1	26.8
H11	19.1	19.3	22.1	26.2	28.3	28.8	28.9	27.9	27.1	26.8
H12	18.9	19.1	21.9	26.0	28.1	28.6	28.8	27.7	27.0	26.6
H13	19.0	19.1	21.9	26.0	28.2	28.6	28.8	27.7	27.0	26.7
H14	18.0	18.1	20.9	25.0	27.1	27.6	27.8	26.7	25.9	25.6
H16	17.8	17.9	20.7	24.8	26.9	27.4	27.6	26.5	25.7	25.4
H22	6.2	6.4	9.2	13.3	15.2	15.3	15.5	14.4	13.7	13.4
H24	3.3	3.5	6.3	10.4	12.2	12.0	12.2	11.1	10.4	10.0
H27	1.7	1.8	4.6	8.7	10.6	10.4	10.6	9.5	8.8	8.4
H33	2.7	2.9	5.6	9.7	11.5	11.2	11.4	10.4	9.6	9.3
H34	17.7	17.9	20.7	24.8	26.9	27.3	27.5	26.4	25.7	25.4
H39	-0.4	-0.2	2.5	6.6	8.5	8.1	8.3	7.3	6.5	6.2
H45	10.8	10.9	13.7	17.8	19.8	20.0	20.2	19.1	18.4	18.0
H49	1.0	1.2	4.0	8.0	9.9	9.7	9.9	8.8	8.0	7.7
H52	0.9	1.0	3.8	7.9	9.7	9.5	9.7	8.6	7.9	7.6
H91	3.1	3.2	6.0	10.1	11.9	11.7	11.9	10.9	10.1	9.8
H94	4.9	5.1	7.9	12.0	13.9	13.9	14.1	13.0	12.3	12.0
H158	26.0	26.2	28.9	33.0	35.3	35.8	36.0	34.9	34.2	33.8
H162	20.9	21.0	23.8	27.9	30.1	30.6	30.8	29.7	28.9	28.6
H164	22.1	22.3	25.1	29.2	31.4	31.9	32.0	31.0	30.2	29.9
H165	21.9	22.1	24.9	29.0	31.1	31.6	31.8	30.7	30.0	29.7
H168	10.7	10.9	13.7	17.8	19.7	19.9	20.1	19.0	18.3	18.0
H173	10.8	11.0	13.8	17.9	19.8	20.0	20.2	19.1	18.4	18.1
H209	1.7	1.9	4.7	8.8	10.6	10.5	10.6	9.6	8.8	8.5
H222	2.7	2.9	5.7	9.8	11.6	11.3	11.5	10.4	9.7	9.3
H224	0.8	1.0	3.8	7.9	9.7	9.5	9.7	8.6	7.9	7.5

D1 - LA01/2017/0016/F Planning Conditions & Predicted Noise Levels

This turbine was granted planning consent in December 2016 (Planning Reference: LA01/2017/0016/F) [23] with conditions limiting the operational noise associated with the site attached to the consent. Condition 4 states that 'The level of noise immissions from the wind turbine (including the application of any tonal penalty when calculated in accordance with the procedures described in Parges 104 – 109 of ETSU-R-97) shall not exceed the values set out in Table 1 as appropriate. Noise limits for dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in the table attached shall be those of the physically closest location listed in the table, unless otherwise agreed by the council'.

The noise limits referred to as part the condition are shown at **Table 19** for reference and include a reference to the corresponding House ID for each of the properties listed to enable comparison with the overall assessment provided here.

Table 19 - D1 (LA01/2017/0016/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
18 Gruig Lane (H173)	32.4	33.2	34.1	35.0	35.3	35.8	36.3	36.8	-	-
15a Gruig Lane (H58)	31.0	31.8	32.7	33.6	33.8	34.3	34.9	35.4	-	-
15 Gruig Lane (H59)	30.2	31.0	31.9	32.8	33.0	33.5	34.1	34.6	-	-
12 Gruig Lane (H57)	30.1	30.9	31.8	32.7	32.9	33.4	33.9	34.4	-	-
10 Gruig Lane (H56)	30.3	31.1	32.0	32.9	33.1	33.6	34.1	34.6	-	-
7 Gruig Lane (H20)	28.5	29.3	30.2	31.1	31.3	31.8	32.3	32.8	-	-
8 Gruig Lane (H43)	29.0	29.7	30.6	31.5	31.7	32.2	32.8	33.3	-	-
6 Gruig Lane (H44)	27.3	28.1	29.0	29.9	30.0	30.5	31.1	31.6	-	-

The predicted noise levels, using the assumptions detailed at **Section 3**, result in predicted noise levels that are typically within 1 dB of the condition levels specified as part of the consent documentation for the turbine. As a result, it is considered that the predicted noise levels, as shown at **Table 20**, are appropriate for use within the overall cumulative assessment as they represent very similar levels to those referenced within the planning consent.

Table 20 - D1 (LA01/2017/0016/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	15.2	15.2	16.0	16.8	17.7	18.7	18.4	19.0	19.4	19.9
H2	15.0	15.0	15.8	16.6	17.5	18.5	18.2	18.8	19.2	19.7
H3	17.0	17.0	17.8	18.6	19.5	20.5	20.3	20.9	21.3	21.8
H4	15.4	15.4	16.2	17.0	17.9	18.9	18.7	19.3	19.7	20.2
H5	16.5	16.5	17.3	18.1	19.0	20.0	19.8	20.4	20.8	21.3
H6	18.5	18.5	19.3	20.1	21.0	22.0	21.8	22.4	22.8	23.3
H10	21.1	21.1	21.9	22.7	23.6	24.6	24.5	25.1	25.5	26.0
H11	20.1	20.1	20.9	21.7	22.6	23.6	23.5	24.1	24.5	25.0
H12	20.5	20.5	21.3	22.1	23.0	24.0	23.8	24.4	24.8	25.3
H13	20.7	20.7	21.5	22.3	23.2	24.2	24.1	24.7	25.1	25.6
H14	19.1	19.1	19.9	20.7	21.6	22.6	22.4	23.0	23.4	23.9
H16	19.0	19.0	19.8	20.6	21.5	22.5	22.4	23.0	23.4	23.9

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H22	26.4	26.4	27.2	28.0	28.9	29.9	29.9	30.5	30.9	31.4
H24	17.7	17.7	18.5	19.3	20.2	21.2	20.9	21.5	21.9	22.4
H27	14.4	14.4	15.2	16.0	16.9	17.9	17.6	18.2	18.6	19.1
H33	8.0	8.0	8.8	9.6	10.5	11.5	11.4	12.0	12.4	12.9
H34	20.0	20.0	20.8	21.6	22.5	23.5	23.4	24.0	24.4	24.9
H39	8.5	8.5	9.3	10.1	11.0	12.0	11.9	12.5	12.9	13.4
H45	33.3	33.3	34.1	34.9	35.8	36.8	36.9	37.5	37.9	38.4
H49	11.7	11.7	12.5	13.3	14.2	15.2	15.0	15.6	16.0	16.5
H52	16.3	16.3	17.1	17.9	18.8	19.8	19.6	20.2	20.6	21.1
H91	17.0	17.0	17.8	18.6	19.5	20.5	20.3	20.9	21.3	21.8
H94	24.1	24.1	24.9	25.7	26.6	27.6	27.5	28.1	28.5	29.0
H158	15.4	15.4	16.2	17.0	17.9	18.9	18.7	19.3	19.7	20.2
H162	18.3	18.3	19.1	19.9	20.8	21.8	21.6	22.2	22.6	23.1
H164	18.3	18.3	19.1	19.9	20.8	21.8	21.6	22.2	22.6	23.1
H165	18.5	18.5	19.3	20.1	21.0	22.0	21.8	22.4	22.8	23.3
H168	32.8	32.8	33.6	34.4	35.3	36.3	36.4	37.0	37.4	37.9
H173	33.2	33.2	34.0	34.8	35.7	36.7	36.9	37.5	37.9	38.4
H209	14.4	14.4	15.2	16.0	16.9	17.9	17.7	18.3	18.7	19.2
H222	8.4	8.4	9.2	10.0	10.9	11.9	11.7	12.3	12.7	13.2
H224	11.8	11.8	12.6	13.4	14.3	15.3	15.1	15.7	16.1	16.6

E1 - LA02/2021/0788/F Planning Conditions & Predicted Noise Levels

Planning consent for the turbine referred to here as E1 (Planning Reference: LA02/2021/0788/F) [24] was approved in August 2021 subject to conditions relating to operational noise. Condition 2 of the consent documentation states that 'The level of noise emissions from the permitted wind turbine (including the application of any Tonal Penalty when calculated in accordance with the procedures described on pages 104 – 109 of ETSU-R-97 and any Amplitude Modulation penalty when calculated in accordance with the procedures described in condition 5) shall not exceed the values set out in Table 1 below. Noise limits for any dwelling which lawfully exist, or have planning permission for construction, at the date of this consent but are not listed in Table 1 shall be represented by the physically-closest location listed in Table 1, unless otherwise agreed by Mid and East Antrim Borough Council'.

The noise limits referred to as part the condition are shown at **Table 21** for reference and includes the corresponding House ID for each of the properties listed to enable comparison with the overall assessment provided here on a consistent basis.

Table 21 - E1 (LA02/2021/0788/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
24 Omerbane (H24)	-	33.9	33.7	33.7	33.7	33.5	33.5	33.5	33.5	33.5
29 Omerbane (H51)	-	35.9	35.7	35.7	35.7	35.5	35.5	35.5	35.5	35.5
32 Omerbane (H52)	-	34.4	34.2	34.2	34.2	34.0	34.0	34.0	34.0	34.0
20 Omerbane (-)	-	30.1	29.9	29.8	29.8	29.6	29.6	29.6	29.6	29.6

Property / House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
54 Tullykittagh (H77)	-	23.3	23.0	22.8	22.8	22.6	22.6	22.6	22.6	22.6
58 Tullykittagh (H78)	-	24.5	24.2	24.1	24.0	23.8	23.8	23.8	23.8	23.8
62 Tullykittagh (H195)	-	26.2	26.0	25.8	25.8	25.6	25.6	25.6	25.6	25.6
19 Omerbane (-)	-	23.0	22.6	22.4	22.4	22.2	22.2	22.2	22.2	22.2
28 Omerbane (H91)	-	37.3	37.1	37.1	37.1	36.9	36.9	36.9	36.9	36.9
27 Omerbane (-)	-	35.2	35.0	34.9	34.9	34.7	34.7	34.7	34.7	34.7
31 Omerbane (H79)	-	31.5	31.3	31.2	31.2	31.0	31.0	31.0	31.0	31.0
70 Tullykittagh (H202)	-	25.3	25.0	24.9	24.8	24.6	24.6	24.6	24.6	24.6
35 Omerbane (H53)	-	33.3	33.1	33.0	33.0	32.8	32.8	32.8	32.8	32.8
37 Omerbane (H25)	-	28.5	28.3	28.1	28.1	27.9	27.9	27.9	27.9	27.9
39 Omerbane (H205)	-	25.5	25.2	25.1	25.0	24.8	24.8	24.8	24.8	24.8
40 Omerbane (H54)	-	22.6	22.3	22.2	22.2	21.9	21.9	21.9	21.9	21.9
42 Omerbane (H55)	-	17.4	17.1	16.9	16.8	16.6	16.6	16.6	16.6	16.6
43 Omerbane (H80)	-	17.0	16.6	16.4	16.4	16.1	16.1	16.1	16.1	16.1
46 Tullykittagh (H190)	-	20.0	19.6	19.4	19.4	19.2	19.2	19.2	19.2	19.2
48 Tullykittagh (H75)	-	20.2	19.8	19.6	19.6	19.4	19.4	19.4	19.4	19.4
49 Tullykittagh (-)	-	20.7	20.3	20.1	20.1	19.9	19.9	19.9	19.9	19.9
51 Tullykittagh (H193)	-	21.0	20.6	20.4	20.3	20.1	20.1	20.1	20.1	20.1
53 Tullykittagh (H182)	-	19.4	19.0	18.8	18.7	18.5	18.5	18.5	18.5	18.5
63 Tullykittagh (H196)	-	25.8	25.5	25.3	25.3	25.1	25.1	25.1	25.1	25.1
67 Tullykittagh (H197)	-	25.7	25.4	25.2	25.2	25.0	25.0	25.0	25.0	25.0
66 Tullykittagh (H198)	-	26.2	25.9	25.8	25.7	25.5	25.5	25.5	25.5	25.5
80 Tullykittagh (-)	-	19.4	19.0	18.8	18.8	18.6	18.6	18.6	18.6	18.6
82 Tullykittagh (-)	-	12.2	11.8	11.5	11.5	11.3	11.3	11.3	11.3	11.3
84 Tullykittagh (-)	-	12.1	11.7	11.5	11.4	11.2	11.2	11.2	11.2	11.2
85 Tullykittagh (-)	-	17.4	17.0	16.7	16.7	16.5	16.5	16.5	16.5	16.5

The planning condition limits are taken from the noise predictions provided within documentation submitted in support of the planning application for the turbine [18]. As a result, any given property could be considered as 'controlling'. In reality, it is expected that only the dwellings located closest to the turbine (i.e., H24, H52 & H91) would actually be regarded as 'controlling properties'. Furthermore, many of the dwellings have condition limits that are less than 25 dB L_{A90} which can often be considered insignificant in the context of noise associated with the other turbine development in the area.

To maintain relative consistency with the requirements of the planning conditions, rather than undertake predictions using the assumptions provided at **Section 3**, a logarithmic line of best fit has been plotted through the maximum condition noise levels verses the relative distance of each property from the turbine. Where the conditioned levels are considered to be outliers (i.e., the levels are lower than would be expected, possibly due to the prediction model used to generate the levels incorporating barrier/topographical shielding effects) the corresponding properties have been removed from the analysis. The resultant best-fit trendline has been used to predict/extrapolate the expected noise level at all the dwellings considered as part of the cumulative assessment herein. The resultant predicted noise levels are provided at **Table 22**.

The method results in predicted noise levels that are within 0.2 dB of those specified as part of the operational noise condition at the majority of residences and overestimates the impact at the closest

residence (H91) by 0.5 dB. These predicted operational noise levels have been used to inform the overall cumulative noise assessment.

Table 22 – E1 (LA02/2021/0788/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	6.8	6.8	6.6	6.6	6.6	6.4	6.4	6.4	6.4	6.4
H2	6.5	6.5	6.3	6.3	6.3	6.1	6.1	6.1	6.1	6.1
H3	7.4	7.4	7.2	7.2	7.2	7.0	7.0	7.0	7.0	7.0
H4	7.8	7.8	7.6	7.6	7.6	7.4	7.4	7.4	7.4	7.4
H5	8.3	8.3	8.1	8.1	8.1	7.9	7.9	7.9	7.9	7.9
H6	9.2	9.2	9.0	9.0	9.0	8.8	8.8	8.8	8.8	8.8
H10	10.2	10.2	10.0	10.0	10.0	9.8	9.8	9.8	9.8	9.8
H11	9.7	9.7	9.5	9.5	9.5	9.3	9.3	9.3	9.3	9.3
H12	9.9	9.9	9.7	9.7	9.7	9.5	9.5	9.5	9.5	9.5
H13	10.0	10.0	9.8	9.8	9.8	9.6	9.6	9.6	9.6	9.6
H14	10.0	10.0	9.8	9.8	9.8	9.6	9.6	9.6	9.6	9.6
H16	10.0	10.0	9.8	9.8	9.8	9.6	9.6	9.6	9.6	9.6
H22	18.2	18.2	18.0	18.0	18.0	17.8	17.8	17.8	17.8	17.8
H24	34.1	34.1	33.9	33.9	33.9	33.7	33.7	33.7	33.7	33.7
H27	17.3	17.3	17.1	17.1	17.1	16.9	16.9	16.9	16.9	16.9
H33	10.7	10.7	10.5	10.5	10.5	10.3	10.3	10.3	10.3	10.3
H34	10.4	10.4	10.2	10.2	10.2	10.0	10.0	10.0	10.0	10.0
H39	11.8	11.8	11.6	11.6	11.6	11.4	11.4	11.4	11.4	11.4
H45	16.3	16.3	16.1	16.1	16.1	15.9	15.9	15.9	15.9	15.9
H49	17.1	17.1	16.9	16.9	16.9	16.7	16.7	16.7	16.7	16.7
H52	34.4	34.4	34.2	34.2	34.2	34.0	34.0	34.0	34.0	34.0
H91	37.8	37.8	37.6	37.6	37.6	37.4	37.4	37.4	37.4	37.4
H94	22.7	22.7	22.5	22.5	22.5	22.3	22.3	22.3	22.3	22.3
H158	7.8	7.8	7.6	7.6	7.6	7.4	7.4	7.4	7.4	7.4
H162	9.0	9.0	8.8	8.8	8.8	8.6	8.6	8.6	8.6	8.6
H164	9.1	9.1	8.9	8.9	8.9	8.7	8.7	8.7	8.7	8.7
H165	9.2	9.2	9.0	9.0	9.0	8.8	8.8	8.8	8.8	8.8
H168	15.2	15.2	15.0	15.0	15.0	14.8	14.8	14.8	14.8	14.8
H173	16.3	16.3	16.1	16.1	16.1	15.9	15.9	15.9	15.9	15.9
H209	17.3	17.3	17.1	17.1	17.1	16.9	16.9	16.9	16.9	16.9
H222	11.3	11.3	11.1	11.1	11.1	10.9	10.9	10.9	10.9	10.9
H224	17.9	17.9	17.7	17.7	17.7	17.5	17.5	17.5	17.5	17.5

F1 - LA02/2021/0791/F Planning Conditions & Predicted Noise Levels

The turbine referred to here as F1 (Planning Reference: LA02/2021/0791/F) [25] was granted planning consent in August 2021. Condition 2 of the planning consent documentation states, in relation to operational noise, that 'The levels of noise emissions from the permitted wind turbine (including the

application of any Tonal Penalty when calculated in accordance with the procedures described on pages 104 – 109 of ETSU-R-97 and any Amplitude Modulation penalty when calculated in accordance with the procedures described in Condition 5), shall not exceed the values set out in Table 1 below. Noise limits for any dwellings which lawfully exist, or have planning permission for construction, at the date of this consent but are not listed in Table 1 shall be represented by the physically-closest location listed in Table 1, unless otherwise agreed by Mid and East Antrim Borough Council'.

The noise limits referred to as part the condition are shown at **Table 23** for reference and includes the corresponding House ID for each of the properties listed to enable comparison with the overall assessment provided here.

Table 23 – F1 (LA02/2021/0791/F) Condition Noise Limits, dB L_{A90}

Property / House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
24 Omerbane (H24)	-	36.8	36.7	36.6	36.7	36.5	36.5	36.5	36.5	36.5
29 Omerbane (H51)	-	32.7	32.5	32.4	32.4	32.2	32.2	32.2	32.2	32.2
32 Omerbane (H52)	-	30.2	29.9	29.8	29.8	29.6	29.6	29.6	29.6	29.6
20 Omerbane (-)	-	33.8	33.6	33.5	33.5	33.3	33.3	33.3	33.3	33.3
54 Tullykittagh (H77)	-	25.8	25.5	25.3	25.3	25.1	25.1	25.1	25.1	25.1
58 Tullykittagh (H78)	-	27.2	26.9	26.8	26.7	26.5	26.5	26.5	26.5	26.5
62 Tullykittagh (H195)	-	28.6	28.3	28.2	28.2	27.9	27.9	27.9	27.9	27.9
19 Omerbane (-)	-	25.0	24.6	24.5	24.4	24.2	24.2	24.2	24.2	24.2
28 Omerbane (H91)	-	34.7	34.5	34.4	34.4	34.2	34.2	34.2	34.2	34.2
27 Omerbane (-)	-	32.1	31.9	31.8	31.8	31.6	31.6	31.6	31.6	31.6
31 Omerbane (H79)	-	27.6	27.4	27.3	27.2	27.0	27.0	27.0	27.0	27.0
70 Tullykittagh (H202)	-	25.4	25.1	24.9	24.9	24.7	24.7	24.7	24.7	24.7
35 Omerbane (H53)	-	29.4	29.1	29.0	29.0	28.8	28.8	28.8	28.8	28.8
37 Omerbane (H25)	-	25.7	25.4	25.3	25.2	25.0	25.0	25.0	25.0	25.0
39 Omerbane (H205)	-	20.3	20.0	20.0	19.9	19.6	19.6	19.6	19.6	19.6
40 Omerbane (H54)	-	16.9	16.6	16.4	16.3	16.1	16.1	16.1	16.1	16.1
42 Omerbane (H55)	-	15.4	15.0	14.8	14.8	14.6	14.6	14.6	14.6	14.6
43 Omerbane (H80)	-	15.0	14.7	14.4	14.4	14.2	14.2	14.2	14.2	14.2
46 Tullykittagh (H190)	-	21.9	21.5	21.3	21.3	21.1	21.1	21.1	21.1	21.1
48 Tullykittagh (H75)	-	22.1	21.8	21.6	21.5	21.3	21.3	21.3	21.3	21.3
49 Tullykittagh (-)	-	22.7	22.4	22.2	22.1	21.9	21.9	21.9	21.9	21.9
51 Tullykittagh (H193)	-	23.0	22.6	22.5	22.4	22.2	22.2	22.2	22.2	22.2
53 Tullykittagh (H182)	-	21.1	20.7	20.5	20.5	20.3	20.3	20.3	20.3	20.3
63 Tullykittagh (H196)	-	27.7	27.4	27.3	27.3	27.0	27.0	27.0	27.0	27.0
67 Tullykittagh (H197)	-	27.0	26.7	26.6	26.5	26.3	26.3	26.3	26.3	26.3
66 Tullykittagh (H198)	-	27.5	27.2	27.1	27.0	26.8	26.8	26.8	26.8	26.8
80 Tullykittagh (-)	-	18.9	18.5	18.3	18.3	18.1	18.1	18.1	18.1	18.1
82 Tullykittagh (-)	-	11.5	11.1	10.8	10.8	10.6	10.6	10.6	10.6	10.6
84 Tullykittagh (-)	-	11.4	11.0	10.7	10.7	10.5	10.5	10.5	10.5	10.5
85 Tullykittagh (-)	-	15.4	14.9	14.7	14.6	14.4	14.4	14.4	14.4	14.4

Similar to the planning condition for E1, these limits are taken from the noise predictions provided within documentation submitted in support of the planning application for the turbine [18]. As a result, any given property could be considered as 'controlling'. In reality, it is expected that only the dwellings located closest to the turbine (i.e., H24, H52 & H91) would actually be regarded as 'controlling properties'.

To maintain relative consistency with the requirements of the planning conditions, rather than undertake predictions using the assumptions provided at **Section 3**, a logarithmic line of best fit has been plotted through the maximum condition noise levels verses the relative distance of each property from the turbine. Where the conditioned levels are considered to be outliers (i.e., the levels are lower than would be expected, possibly due to the prediction model used to generate the levels incorporating barrier effects) the corresponding properties have been removed from the analysis. The resultant best-fit trendline has been used to predict/extrapolate the expected noise level at all the dwellings considered as part of the cumulative assessment herein. The resultant predicted noise levels are provided at **Table 24**.

The method results in predicted noise levels that are within 0.2 dB of those specified as part of the operational noise condition at the majority of residences and overestimates the impact at the closest residences (H24 & H91) by up to 0.5 dB. These predicted operational noise levels have been used to inform the overall cumulative noise assessment.

Table 24 - F1 (LA02/2021/0791/F) Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	7.0	7.0	6.9	6.8	6.9	6.7	6.7	6.7	6.7	6.7
H2	6.8	6.8	6.7	6.6	6.7	6.5	6.5	6.5	6.5	6.5
H3	7.7	7.7	7.6	7.5	7.6	7.4	7.4	7.4	7.4	7.4
H4	8.2	8.2	8.1	8.0	8.1	7.9	7.9	7.9	7.9	7.9
H5	8.7	8.7	8.6	8.5	8.6	8.4	8.4	8.4	8.4	8.4
H6	9.6	9.6	9.5	9.4	9.5	9.3	9.3	9.3	9.3	9.3
H10	10.6	10.6	10.5	10.4	10.5	10.3	10.3	10.3	10.3	10.3
H11	10.2	10.2	10.1	10.0	10.1	9.9	9.9	9.9	9.9	9.9
H12	10.3	10.3	10.2	10.1	10.2	10.0	10.0	10.0	10.0	10.0
H13	10.4	10.4	10.3	10.2	10.3	10.1	10.1	10.1	10.1	10.1
H14	10.5	10.5	10.4	10.3	10.4	10.2	10.2	10.2	10.2	10.2
H16	10.5	10.5	10.4	10.3	10.4	10.2	10.2	10.2	10.2	10.2
H22	19.4	19.4	19.3	19.2	19.3	19.1	19.1	19.1	19.1	19.1
H24	37.3	37.3	37.2	37.1	37.2	37.0	37.0	37.0	37.0	37.0
H27	16.5	16.5	16.4	16.3	16.4	16.2	16.2	16.2	16.2	16.2
H33	10.2	10.2	10.1	10.0	10.1	9.9	9.9	9.9	9.9	9.9
H34	10.9	10.9	10.8	10.7	10.8	10.6	10.6	10.6	10.6	10.6
H39	11.3	11.3	11.2	11.1	11.2	11.0	11.0	11.0	11.0	11.0
H45	17.2	17.2	17.1	17.0	17.1	16.9	16.9	16.9	16.9	16.9
H49	16.2	16.2	16.1	16.0	16.1	15.9	15.9	15.9	15.9	15.9
H52	30.0	30.0	29.9	29.8	29.9	29.7	29.7	29.7	29.7	29.7
H91	34.9	34.9	34.8	34.7	34.8	34.6	34.6	34.6	34.6	34.6
H94	24.3	24.3	24.2	24.1	24.2	24.0	24.0	24.0	24.0	24.0
H158	8.2	8.2	8.1	8.0	8.1	7.9	7.9	7.9	7.9	7.9

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H162	9.4	9.4	9.3	9.2	9.3	9.1	9.1	9.1	9.1	9.1
H164	9.5	9.5	9.4	9.3	9.4	9.2	9.2	9.2	9.2	9.2
H165	9.6	9.6	9.5	9.4	9.5	9.3	9.3	9.3	9.3	9.3
H168	16.1	16.1	16.0	15.9	16.0	15.8	15.8	15.8	15.8	15.8
H173	17.2	17.2	17.1	17.0	17.1	16.9	16.9	16.9	16.9	16.9
H209	16.4	16.4	16.3	16.2	16.3	16.1	16.1	16.1	16.1	16.1
H222	10.8	10.8	10.7	10.6	10.7	10.5	10.5	10.5	10.5	10.5
H224	16.9	16.9	16.8	16.7	16.8	16.6	16.6	16.6	16.6	16.6

Overall Cumulative Assessment

The overall calculated maximum cumulative noise levels for any given wind direction and incorporating all assumptions and factors detailed above are shown at **Table 25**. The predicted noise levels associated with the Carbuck proposals, the cumulative sites and overall cumulative noise levels, for the assessment locations considered here, are all shown at **Appendix A**.

Table 25 - Overall Cumulative Predicted Noise Levels, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	35.7	36.3	38.5	41.4	43.1	43.6	43.8	43.5	43.6	43.6
H2	33.8	34.5	36.8	39.8	41.5	42.0	42.2	41.9	41.9	41.8
H3	38.0	38.3	41.1	44.9	47.1	47.6	47.8	46.9	46.3	46.1
H4	30.6	31.4	34.5	37.8	39.5	39.9	40.1	39.7	39.5	39.4
H5	30.0	31.0	34.1	37.3	38.8	39.2	39.4	39.1	39.0	39.0
H6	30.4	31.4	34.7	37.7	39.0	39.3	39.5	39.4	39.4	39.5
H10	30.6	31.7	35.1	37.9	38.9	39.2	39.4	39.3	39.5	39.6
H11	30.0	31.0	34.2	37.0	38.0	38.4	38.6	38.5	38.7	38.8
H12	30.2	31.2	34.4	37.2	38.2	38.5	38.8	38.7	38.8	39.0
H13	30.4	31.4	34.6	37.4	38.4	38.7	39.0	38.9	39.0	39.2
H14	29.7	30.8	34.0	36.8	37.8	38.1	38.4	38.3	38.4	38.6
H16	29.7	30.8	34.1	36.9	38.0	38.3	38.5	38.5	38.6	38.7
H22	30.7	31.7	34.8	37.2	37.8	38.1	38.3	38.3	38.5	38.8
H24	39.3	39.4	39.7	40.3	40.5	40.4	40.6	40.6	40.6	40.7
H27	30.8	32.5	36.5	39.3	39.7	39.9	40.1	40.1	40.2	40.4
H33	26.9	28.3	32.0	34.7	35.2	35.4	35.7	35.7	35.9	36.1
H34	30.3	31.3	34.6	37.4	38.3	38.6	38.9	38.8	39.0	39.1
H39	26.4	27.7	31.4	34.1	34.6	34.8	35.1	35.1	35.3	35.5
H45	34.9	35.4	37.6	39.6	40.3	40.8	41.0	41.2	41.5	41.8
H49	29.2	30.9	34.8	37.6	38.0	38.1	38.3	38.4	38.5	38.6
H52	36.2	36.4	37.0	38.0	38.2	38.2	38.4	38.4	38.5	38.6
H91	39.9	40.0	40.3	40.8	41.0	40.9	41.0	41.0	41.1	41.2
H94	32.0	33.0	36.1	38.6	39.1	39.3	39.5	39.6	39.8	40.0

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H158	30.2	31.1	34.1	37.4	39.0	39.4	39.6	39.2	39.1	39.1
H162	29.4	30.4	33.6	36.6	37.8	38.1	38.3	38.2	38.2	38.4
H164	30.1	31.1	34.4	37.4	38.6	38.9	39.2	39.0	39.0	39.1
H165	30.1	31.2	34.5	37.4	38.7	39.0	39.2	39.1	39.1	39.2
H168	33.9	34.3	36.2	38.0	38.7	39.2	39.4	39.7	40.0	40.3
H173	34.9	35.4	37.6	39.7	40.4	40.8	41.0	41.3	41.5	41.9
H209	30.9	32.6	36.6	39.4	39.8	40.0	40.2	40.2	40.3	40.5
H222	26.9	28.2	31.8	34.5	35.1	35.3	35.6	35.6	35.8	36.0
H224	28.7	30.4	34.3	37.1	37.6	37.7	37.9	37.9	38.0	38.1

The predicted margins between the overall maximum cumulative noise levels shown at **Table 25** and the defined overall cumulative noise limits shown at **Table 9** are provided at **Table 26**. A positive number indicates that predicted noise levels may be above the limits at certain locations, subject to various caveats discussed later.

Table 26 - Margin of Compliance with Cumulative Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
Daytime										
H1	-4.3	-3.7	-1.5	1.1	0.1	-1.9	-4.2	-7.0	-9.3	-11.8
H2	-6.2	-5.5	-3.2	-0.2	-0.8	-2.8	-5.2	-8.1	-10.7	-13.6
H3	-2.0	-1.7	1.1	4.9	7.1	7.6	6.6	3.8	1.5	-0.3
H4	-9.4	-8.6	-5.5	-2.2	-0.5	-0.1	-1.1	-3.4	-5.3	-7.0
H5	-10.0	-9.0	-5.9	-2.7	-1.2	-0.8	-1.8	-4.0	-5.8	-7.4
H6	-9.6	-8.6	-5.3	-2.3	-1.0	-0.7	-0.5	-3.2	-7.4	-7.3
H10	-9.4	-8.3	-4.9	-2.1	-1.1	-0.8	-0.6	-3.3	-7.3	-7.2
H11	-10.0	-9.0	-5.8	-3.0	-2.0	-1.6	-1.4	-4.1	-8.1	-8.0
H12	-9.8	-8.8	-5.6	-2.8	-1.8	-1.5	-1.2	-3.9	-8.0	-7.8
H13	-9.6	-8.6	-5.4	-2.6	-1.6	-1.3	-1.0	-3.7	-7.8	-7.6
H14	-10.3	-9.2	-6.0	-3.2	-2.2	-1.9	-1.6	-4.3	-8.4	-8.2
H16	-10.3	-9.2	-5.9	-3.1	-2.0	-1.7	-1.5	-4.1	-8.2	-8.1
H22	-9.3	-8.3	-5.2	-2.8	-2.7	-4.3	-6.5	-9.6	-13.1	-12.8
H24	-0.7	-0.6	-0.3	0.3	0.0	-2.0	-4.2	-7.3	-11.0	-10.9
H27	-9.2	-7.5	-3.5	-0.7	-0.3	-0.1	0.1	-0.3	-3.2	-3.0
H33	-13.1	-11.7	-8.0	-5.3	-4.8	-4.6	-4.8	-8.5	-12.8	-12.6
H34	-9.7	-8.7	-5.4	-2.6	-1.7	-1.4	-1.1	-3.8	-7.8	-7.7
H39	-13.6	-12.3	-8.6	-5.9	-5.4	-5.2	-5.4	-9.1	-13.4	-13.2
H45	-5.1	-4.6	-2.4	-0.4	-0.2	-1.6	-3.8	-6.7	-10.1	-9.8
H49	-10.8	-9.1	-5.2	-2.4	-2.0	-1.9	-1.7	-2.0	-4.9	-4.8
H52	-3.8	-3.6	-3.0	-2.0	-2.3	-4.2	-6.4	-9.5	-13.1	-13.0
H91	-0.1	0.0	0.3	0.8	0.5	-1.5	-3.8	-6.9	-10.5	-10.4

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H94	-8.0	-7.0	-3.9	-1.4	-1.4	-3.1	-5.3	-8.3	-11.8	-11.6
H158	-9.8	-8.9	-5.9	-2.6	-1.0	-0.6	-1.6	-3.9	-5.7	-7.3
H162	-10.6	-9.6	-6.4	-3.4	-2.2	-1.9	-1.7	-4.4	-8.6	-8.4
H164	-9.9	-8.9	-5.6	-2.6	-1.4	-1.1	-0.8	-3.6	-7.8	-7.7
H165	-9.9	-8.8	-5.5	-2.6	-1.3	-1.0	-0.8	-3.5	-7.7	-7.6
H168	-6.1	-5.7	-3.8	-2.0	-1.8	-3.2	-5.4	-8.2	-11.6	-11.3
H173	-5.1	-4.6	-2.4	-0.3	-0.1	-1.6	-3.8	-6.6	-10.1	-9.7
H209	-9.1	-7.4	-3.4	-0.6	-0.2	0.0	0.2	-0.2	-3.1	-2.9
H222	-13.1	-11.8	-8.2	-5.5	-4.9	-4.7	-4.9	-8.6	-12.9	-12.7
H224	-11.3	-9.6	-5.7	-2.9	-2.4	-2.3	-2.1	-2.5	-5.4	-5.3
Night-time										
H1	-7.3	-6.7	-4.5	-1.6	0.1	-0.1	-2.7	-5.9	-8.7	-11.5
H2	-9.2	-8.5	-6.2	-3.2	-1.5	-1.9	-4.5	-7.5	-10.2	-12.9
H3	-5.0	-4.7	-1.9	1.9	4.1	4.6	4.8	3.9	3.3	1.6
H4	-12.4	-11.6	-8.5	-5.2	-3.5	-3.1	-2.9	-3.3	-3.5	-5.1
H5	-13.0	-12.0	-8.9	-5.7	-4.2	-3.8	-3.6	-3.9	-4.0	-5.5
H6	-12.6	-11.6	-8.3	-5.3	-4.0	-3.7	-3.5	-3.6	-4.6	-7.4
H10	-12.4	-11.3	-7.9	-5.1	-4.1	-3.8	-3.6	-3.7	-4.5	-7.3
H11	-13.0	-12.0	-8.8	-6.0	-5.0	-4.6	-4.4	-4.5	-5.3	-8.1
H12	-12.8	-11.8	-8.6	-5.8	-4.8	-4.5	-4.2	-4.3	-5.2	-7.9
H13	-12.6	-11.6	-8.4	-5.6	-4.6	-4.3	-4.0	-4.1	-5.0	-7.7
H14	-13.3	-12.2	-9.0	-6.2	-5.2	-4.9	-4.6	-4.7	-5.6	-8.3
H16	-13.3	-12.2	-8.9	-6.1	-5.0	-4.7	-4.5	-4.5	-5.4	-8.2
H22	-12.3	-11.3	-8.2	-5.8	-5.2	-4.9	-4.7	-6.0	-8.6	-11.4
H24	-3.7	-3.6	-3.3	-2.7	-2.5	-2.6	-2.4	-3.7	-6.5	-9.5
H27	-12.2	-10.5	-6.5	-3.7	-3.3	-3.1	-2.9	-2.9	-2.8	-3.3
H33	-16.1	-14.7	-11.0	-8.3	-7.8	-7.6	-7.3	-7.3	-9.5	-12.8
H34	-12.7	-11.7	-8.4	-5.6	-4.7	-4.4	-4.1	-4.2	-5.0	-7.8
H39	-16.6	-15.3	-11.6	-8.9	-8.4	-8.2	-7.9	-7.9	-10.1	-13.4
H45	-8.1	-7.6	-5.4	-3.4	-2.7	-2.2	-2.0	-3.1	-5.6	-8.4
H49	-13.8	-12.1	-8.2	-5.4	-5.0	-4.9	-4.7	-4.6	-4.5	-5.1
H52	-6.8	-6.6	-6.0	-5.0	-4.8	-4.8	-4.6	-5.9	-8.6	-11.6
H91	-3.1	-3.0	-2.7	-2.2	-2.0	-2.1	-2.0	-3.3	-6.0	-9.0
H94	-11.0	-10.0	-6.9	-4.4	-3.9	-3.7	-3.5	-4.7	-7.3	-10.2
H158	-12.8	-11.9	-8.9	-5.6	-4.0	-3.6	-3.4	-3.8	-3.9	-5.4
H162	-13.6	-12.6	-9.4	-6.4	-5.2	-4.9	-4.7	-4.8	-5.8	-8.5
H164	-12.9	-11.9	-8.6	-5.6	-4.4	-4.1	-3.8	-4.0	-5.0	-7.8
H165	-12.9	-11.8	-8.5	-5.6	-4.3	-4.0	-3.8	-3.9	-4.9	-7.7
H168	-9.1	-8.7	-6.8	-5.0	-4.3	-3.8	-3.6	-4.6	-7.1	-9.9
H173	-8.1	-7.6	-5.4	-3.3	-2.6	-2.2	-2.0	-3.0	-5.6	-8.3

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H209	-12.1	-10.4	-6.4	-3.6	-3.2	-3.0	-2.8	-2.8	-2.7	-3.2
H222	-16.1	-14.8	-11.2	-8.5	-7.9	-7.7	-7.4	-7.4	-9.6	-12.9
H224	-14.3	-12.6	-8.7	-5.9	-5.4	-5.3	-5.1	-5.1	-5.0	-5.6

The assessment shows that, using the assumptions detailed above, overall cumulative noise levels are predicted to meet the overall requirements of ETSU-R-97 at the majority of assessment locations surrounding the site. Instances where predicted noise levels are shown to be close to or above the overall daytime noise limits are usually a result of the proximity of the relatively small turbines to some of the assessment locations.

The residences H1, H2, H3 & H4 are located relatively close to the turbine referred to as B1, for which particularly conservative assumptions have been incorporated into the assessment. As discussed earlier, the actual noise levels resulting from the operation of the turbine are expected to be more than 5 dB lower than predicted here, as per the requirements of the associated planning consent(s) for the alternative turbine to be installed at the site. H3 is also known to have a financial involvement with the installed turbine and higher planning noise limits for the turbine (i.e., the greater of 45 dB L_{A90} or the background sound level plus 5 dB, as per the requirements of ETSU-R-97) would apply at this location. Additionally, the Carnbuck proposal results in predicted noise levels that would not make an appreciable difference in the overall cumulative noise level from the existing, planned and consented development in the area, which are located closer to these properties and result in much higher noise levels, especially at more critical wind speeds. Alternatively, it could be judged that the predicted operational noise levels associated with the Carnbuck proposals are relatively insignificant in the context of the overall cumulative noise limits applied at these locations (i.e., nearly 10 dB or more lower).

Furthermore, the hub-height wind speed reference for the B1 turbine (55 m) is substantially lower than that for the Carnbuck development (112 m) for which all background sound levels and associated ETSU-R-97 planning limits are referenced. As a result, it would be expected that the hub of this turbine would experience relatively lower wind speeds than that at the hub of the turbines to be introduced as part of the Carnbuck proposals. This would have the effect of 'shifting' or 'skewing' the actual turbine noise levels for the B1 turbine, as shown at the assessment charts within **Appendix A**, to the right and result in overall cumulative noise levels that are more likely to meet the requirements of ETSU-R-97 where the background sound + 5 dB part of the limits are relevant.

The residences H24 and H91 are located close to the single turbines referred to as E1 & F1. The marginal exceedance of the overall cumulative noise levels at these locations is mainly due to the potential presence of these turbines and the way in which the conditioned noise limits appear to suggest that the operational noise levels would not decrease at lower wind speeds. In practice, it would be expected that the predicted noise levels would be substantially decreased at lower wind speeds (as per normal turbine operation) with overall cumulative noise levels being reduced in these instances as a result. Furthermore, the difference in wind speed reference would also have an effect, as discussed above, and the prediction method for each turbine results in levels that are 0.5 dB above the planning condition limits at the residences or 'controlling properties' closest to each turbine.

The E1 & F1 turbines occupy a large proportion of the 'remaining noise budget' at the residences and leave little 'headroom' for further turbine development. It is considered disproportionate and inappropriate to heavily restrict the operation of the Carnbuck development, which has a much larger electrical generating capacity, to mitigate a very minor/marginal theoretical potential for overall operational noise to be above the overall ETSU-R-97 limits, which would only occur from very specific standardised 10 m height winds speeds and northerly wind directions; would occur relatively rarely as a result and is predicted on a conservative basis which is unlikely to occur in practice. Furthermore, the proposed Carnbuck wind farm will also have a character of noise that is very different to that generated by the smaller planned, consented and operational turbines in the area due the lower rotational speeds and blade passing frequency of the larger wind turbines as compared with these smaller scale sites.

As a result of the above and given that the predicted operational noise levels from the Carnbuck proposals are substantially (> 6 dB) lower than that generated by the other turbines considered as part of the assessment, the very marginal potential for predicted overall cumulative noise levels to be above the overall cumulative noise limits is considered acceptable in this instance.

The instances where predicted noise levels are very marginally (< 0.4 dB) above the overall noise limits at H27 & H209 are not expected to occur in practice due to the conservatism incorporated into the predicted model. However, the Carnbuck proposals will be the relatively dominant source at these locations and suitable planning controls have been proposed as a result (see below).

Proposed Planning Condition Limits

The proposed planning condition limits for Carnbuck Wind Farm are provided at **Table 27**. The levels are based on the predicted noise levels for the site, as shown at **Table 10**, but with a nominal and varying uncertainty/margin applied depending on the context of noise expected from other development. In instances where there is headroom for the site to operate without risk of overall cumulative levels being above the ETSU-R-97 limits shown at **Table 9** or the Carnbuck noise levels would remain insignificant in the context of noise from other wind farm development in the area, a margin of up to around 2 dB above the maximum predicted noise levels expected to be generated by the turbines has been applied. This margin is decreased in instances where there is any risk that the introduction of Carnbuck development would result in cumulative operational noise levels that would be above the overall cumulative noise limits. Furthermore, a higher margin over the predicted turbine noise levels has been applied for low wind speeds as the cumulative turbines and/or wind farms will not be operating at their maximum capacity, and therefore noise output, and much more 'headroom' or 'noise budget' is available in these instances. The proposed limits are intended to be applied for both daytime and night-time periods.

The noise limits at H27 & H209 have been set slightly lower than the predicted noise levels from the proposed development at relatively high standardised 10 m height wind speeds to ensure that the predicted cumulative noise levels are not above the overall cumulative noise limits. This will require slight curtailment of a turbine or turbines to be installed as part of the Carnbuck development which is discussed further at **Section 5**.

This approach is considered to tally with the expectations of the Local Planning Authority (LPA) in respect of preferred/favoured approach to consenting in respect of operational noise and allows for flexibility in the potential turbine to be installed at the Carnbuck site.

Table 27 - Proposed Carnbuck Planning Condition Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H2	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H3	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H4	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H5	26.0	29.0	32.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
H6	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H10	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H11	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H12	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H13	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H14	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H16	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H22	30.0	33.0	36.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
H24	26.0	29.0	32.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
H27	31.5	34.5	37.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
H33	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H34	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H39	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H45	30.0	33.0	36.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
H49	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H52	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H91	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H94	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H158	25.0	28.0	31.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
H162	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H164	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H165	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H168	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H173	29.5	32.5	35.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
H209	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H222	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H224	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0

The maximum predicted cumulative turbine noise levels, assuming that the proposed Carnbuck development is operating at the proposed condition limits are shown at **Table 28**.

Table 28 - Cumulative Noise Levels Incorporating Proposed Planning Condition Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, m.s^{-1}									
	3	4	5	6	7	8	9	10	11	12
H1	35.8	36.6	38.8	41.5	43.1	43.6	43.8	43.6	43.6	43.6
H2	34.0	34.9	37.2	40.0	41.6	42.1	42.3	42.0	42.0	41.9
H3	38.1	38.5	41.3	45.0	47.1	47.6	47.8	46.9	46.4	46.1
H4	31.2	32.4	35.2	38.0	39.6	40.0	40.2	39.8	39.6	39.6
H5	31.2	32.7	35.6	37.9	39.2	39.6	39.7	39.4	39.4	39.4
H6	31.7	33.3	36.1	38.2	39.3	39.6	39.8	39.7	39.7	39.8
H10	32.5	34.3	37.1	38.8	39.6	39.8	40.0	39.9	40.1	40.2
H11	31.8	33.5	36.3	38.0	38.8	39.1	39.3	39.2	39.3	39.4
H12	31.9	33.6	36.3	38.1	38.9	39.1	39.3	39.3	39.4	39.5
H13	32.0	33.6	36.4	38.2	39.0	39.2	39.5	39.4	39.5	39.7
H14	31.6	33.3	36.2	37.9	38.5	38.8	39.0	39.0	39.1	39.2
H16	31.6	33.4	36.2	38.0	38.7	39.0	39.2	39.2	39.3	39.4
H22	32.9	34.7	37.4	38.6	38.8	39.1	39.2	39.3	39.5	39.6
H24	39.4	39.6	40.1	40.4	40.6	40.5	40.6	40.7	40.7	40.8

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H27	33.4	35.6	38.4	39.7	39.9	40.0	40.2	40.2	40.3	40.5
H33	30.0	32.2	35.0	36.3	36.5	36.7	36.9	36.9	37.1	37.2
H34	31.9	33.5	36.3	38.1	38.8	39.0	39.3	39.2	39.3	39.5
H39	29.8	32.1	34.9	36.2	36.4	36.5	36.7	36.7	36.9	37.0
H45	35.8	36.9	38.9	40.1	40.6	41.1	41.3	41.5	41.8	42.1
H49	32.6	34.9	37.8	38.9	39.1	39.2	39.4	39.4	39.5	39.6
H52	36.6	37.1	37.9	38.5	38.6	38.6	38.7	38.7	38.8	38.9
H91	40.1	40.3	40.7	41.0	41.1	41.1	41.2	41.2	41.3	41.3
H94	34.1	35.9	38.5	39.7	39.9	40.1	40.3	40.3	40.5	40.7
H158	31.2	32.5	35.3	37.9	39.3	39.7	39.9	39.5	39.4	39.4
H162	31.1	32.7	35.6	37.5	38.4	38.7	38.9	38.8	38.8	39.0
H164	31.5	33.1	36.0	38.0	39.1	39.4	39.6	39.4	39.4	39.5
H165	31.5	33.1	36.0	38.0	39.1	39.4	39.6	39.4	39.5	39.6
H168	34.9	35.9	37.9	39.0	39.5	39.9	40.1	40.3	40.6	40.9
H173	35.7	36.7	38.7	39.9	40.5	40.9	41.1	41.4	41.6	41.9
H209	33.1	35.2	38.1	39.3	39.5	39.7	39.9	39.9	40.0	40.2
H222	30.0	32.2	35.0	36.3	36.6	36.7	36.9	36.9	37.1	37.2
H224	32.4	34.8	37.7	38.8	39.0	39.1	39.2	39.2	39.3	39.4

The margins between the overall maximum cumulative noise levels shown at **Table 28** and the defined cumulative noise limits shown at **Table 9** are provided at **Table 29**. A positive number indicates that predicted noise levels may be above the limits at certain locations, subject to the various caveats previously discussed, that equally apply in this instance.

Table 29 – Margin of Compliance with Cumulative Noise Limits (Carnbuck Proposed Limits), dB

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
Daytime										
H1	-4.2	-3.4	-1.2	1.2	0.1	-1.9	-4.2	-6.9	-9.3	-11.8
H2	-6.0	-5.1	-2.8	0.0	-0.7	-2.7	-5.1	-8.0	-10.6	-13.5
H3	-1.9	-1.5	1.3	5.0	7.1	7.6	6.6	3.8	1.6	-0.3
H4	-8.8	-7.6	-4.8	-2.0	-0.4	0.0	-1.0	-3.3	-5.2	-6.8
H5	-8.8	-7.3	-4.4	-2.1	-0.8	-0.4	-1.5	-3.7	-5.4	-7.0
H6	-8.3	-6.7	-3.9	-1.8	-0.7	-0.4	-0.2	-2.9	-7.1	-7.0
H10	-7.5	-5.7	-2.9	-1.2	-0.4	-0.2	0.0	-2.7	-6.7	-6.6
H11	-8.2	-6.5	-3.7	-2.0	-1.2	-0.9	-0.7	-3.4	-7.5	-7.4
H12	-8.1	-6.4	-3.7	-1.9	-1.1	-0.9	-0.7	-3.3	-7.4	-7.3
H13	-8.0	-6.4	-3.6	-1.8	-1.0	-0.8	-0.5	-3.2	-7.3	-7.1
H14	-8.4	-6.7	-3.8	-2.1	-1.5	-1.2	-1.0	-3.6	-7.7	-7.6
H16	-8.4	-6.6	-3.8	-2.0	-1.3	-1.0	-0.8	-3.4	-7.5	-7.4
H22	-7.1	-5.3	-2.6	-1.4	-1.7	-3.3	-5.6	-8.6	-12.1	-12.0

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H24	-0.6	-0.4	0.1	0.4	0.1	-1.9	-4.2	-7.2	-10.9	-10.8
H27	-6.6	-4.4	-1.6	-0.3	-0.1	0.0	0.2	-0.2	-3.1	-2.9
H33	-10.0	-7.8	-5.0	-3.7	-3.5	-3.3	-3.6	-7.3	-11.6	-11.5
H34	-8.1	-6.5	-3.7	-1.9	-1.2	-1.0	-0.7	-3.4	-7.5	-7.3
H39	-10.2	-7.9	-5.1	-3.8	-3.6	-3.5	-3.8	-7.5	-11.8	-11.7
H45	-4.2	-3.1	-1.1	0.1	0.1	-1.3	-3.5	-6.4	-9.8	-9.5
H49	-7.4	-5.1	-2.2	-1.1	-0.9	-0.8	-0.6	-1.0	-3.9	-3.8
H52	-3.4	-2.9	-2.1	-1.5	-1.9	-3.8	-6.1	-9.2	-12.8	-12.7
H91	0.1	0.3	0.7	1.0	0.6	-1.3	-3.6	-6.7	-10.3	-10.3
H94	-5.9	-4.1	-1.5	-0.3	-0.6	-2.3	-4.5	-7.6	-11.1	-10.9
H158	-8.8	-7.5	-4.7	-2.1	-0.7	-0.3	-1.3	-3.6	-5.4	-7.0
H162	-8.9	-7.3	-4.4	-2.5	-1.6	-1.3	-1.1	-3.8	-8.0	-7.8
H164	-8.5	-6.9	-4.0	-2.0	-0.9	-0.6	-0.4	-3.2	-7.4	-7.3
H165	-8.5	-6.9	-4.0	-2.0	-0.9	-0.6	-0.4	-3.2	-7.3	-7.2
H168	-5.1	-4.1	-2.1	-1.0	-1.0	-2.5	-4.7	-7.6	-11.0	-10.7
H173	-4.3	-3.3	-1.3	-0.1	0.0	-1.5	-3.7	-6.5	-10.0	-9.7
H209	-6.9	-4.8	-1.9	-0.7	-0.5	-0.3	-0.1	-0.5	-3.4	-3.2
H222	-10.0	-7.8	-5.0	-3.7	-3.4	-3.3	-3.6	-7.3	-11.6	-11.5
H224	-7.6	-5.2	-2.3	-1.2	-1.0	-0.9	-0.8	-1.2	-4.1	-4.0
Night-time										
H1	-7.2	-6.4	-4.2	-1.5	0.1	-0.1	-2.7	-5.8	-8.7	-11.5
H2	-9.0	-8.1	-5.8	-3.0	-1.4	-1.8	-4.4	-7.4	-10.1	-12.8
H3	-4.9	-4.5	-1.7	2.0	4.1	4.6	4.8	3.9	3.4	1.6
H4	-11.8	-10.6	-7.8	-5.0	-3.4	-3.0	-2.8	-3.2	-3.4	-4.9
H5	-11.8	-10.3	-7.4	-5.1	-3.8	-3.4	-3.3	-3.6	-3.6	-5.1
H6	-11.3	-9.7	-6.9	-4.8	-3.7	-3.4	-3.2	-3.3	-4.3	-7.1
H10	-10.5	-8.7	-5.9	-4.2	-3.4	-3.2	-3.0	-3.1	-3.9	-6.7
H11	-11.2	-9.5	-6.7	-5.0	-4.2	-3.9	-3.7	-3.8	-4.7	-7.5
H12	-11.1	-9.4	-6.7	-4.9	-4.1	-3.9	-3.7	-3.7	-4.6	-7.4
H13	-11.0	-9.4	-6.6	-4.8	-4.0	-3.8	-3.5	-3.6	-4.5	-7.2
H14	-11.4	-9.7	-6.8	-5.1	-4.5	-4.2	-4.0	-4.0	-4.9	-7.7
H16	-11.4	-9.6	-6.8	-5.0	-4.3	-4.0	-3.8	-3.8	-4.7	-7.5
H22	-10.1	-8.3	-5.6	-4.4	-4.2	-3.9	-3.8	-5.0	-7.6	-10.6
H24	-3.6	-3.4	-2.9	-2.6	-2.4	-2.5	-2.4	-3.6	-6.4	-9.4
H27	-9.6	-7.4	-4.6	-3.3	-3.1	-3.0	-2.8	-2.8	-2.7	-3.2
H33	-13.0	-10.8	-8.0	-6.7	-6.5	-6.3	-6.1	-6.1	-8.3	-11.7
H34	-11.1	-9.5	-6.7	-4.9	-4.2	-4.0	-3.7	-3.8	-4.7	-7.4
H39	-13.2	-10.9	-8.1	-6.8	-6.6	-6.5	-6.3	-6.3	-8.5	-11.9
H45	-7.2	-6.1	-4.1	-2.9	-2.4	-1.9	-1.7	-2.8	-5.3	-8.1
H49	-10.4	-8.1	-5.2	-4.1	-3.9	-3.8	-3.6	-3.6	-3.5	-4.1

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H52	-6.4	-5.9	-5.1	-4.5	-4.4	-4.4	-4.3	-5.6	-8.3	-11.3
H91	-2.9	-2.7	-2.3	-2.0	-1.9	-1.9	-1.8	-3.1	-5.8	-8.9
H94	-8.9	-7.1	-4.5	-3.3	-3.1	-2.9	-2.7	-4.0	-6.6	-9.5
H158	-11.8	-10.5	-7.7	-5.1	-3.7	-3.3	-3.1	-3.5	-3.6	-5.1
H162	-11.9	-10.3	-7.4	-5.5	-4.6	-4.3	-4.1	-4.2	-5.2	-7.9
H164	-11.5	-9.9	-7.0	-5.0	-3.9	-3.6	-3.4	-3.6	-4.6	-7.4
H165	-11.5	-9.9	-7.0	-5.0	-3.9	-3.6	-3.4	-3.6	-4.5	-7.3
H168	-8.1	-7.1	-5.1	-4.0	-3.5	-3.1	-2.9	-4.0	-6.5	-9.3
H173	-7.3	-6.3	-4.3	-3.1	-2.5	-2.1	-1.9	-2.9	-5.5	-8.3
H209	-9.9	-7.8	-4.9	-3.7	-3.5	-3.3	-3.1	-3.1	-3.0	-3.5
H222	-13.0	-10.8	-8.0	-6.7	-6.4	-6.3	-6.1	-6.1	-8.3	-11.7
H224	-10.6	-8.2	-5.3	-4.2	-4.0	-3.9	-3.8	-3.8	-3.7	-4.3

The charts provided at **Appendix A** also show the proposed planning condition limits and the effect of their use adopting them as part of the overall cumulative noise assessment along with all the other relevant predicted noise levels. This shows that the use of these levels as part of the assessment makes no substantive difference to the overall conclusions and narrative provided as part of the cumulative noise assessment provided under the sub-heading above.

5. PLANNING CONTROLS & CURTAILMENT

A proposed wording for a planning condition that would restrict operational noise associated with the Carnbuck development is provided at Appendix B. This includes the suggested limiting values at **Table 27**.

The predicted turbine noise levels shown at **Table 10** are marginally above the proposed limiting values at high wind speeds by 0.4 dB at the residence H209. Whilst this is not expected to occur in practice due to the inherent conservatism in the prediction model, a mitigation strategy, using the noise modes shown at **Table 7**, can be applied to one or more of the closest turbines to absolutely ensure that operational noise levels are not above the proposed limits for certain standardised 10 m height wind speeds and wind directions.

Such a curtailment strategy has not been supplied/detailed here as the required reduction in operational noise levels is considered relatively trivial and the assumed turbine to be installed at the site is only one candidate in a range of potential models. The condition limits will have the desired effect in restricting the levels of operational noise from the development regardless of the specific turbine model that could be installed.

6. CONCLUSIONS

An assessment of the expected noise levels resulting from the Carnbuck wind farm, including the potential for cumulative operational noise effects, has been undertaken. The assessment follows the principles and guidance contained within ETSU-R-97 and the GPG.

The works are intended to supplement and provide revision to the information provided within the noise assessment submitted in support of the planning application for the proposed development.

The assessment indicates that there is a marginal risk the cumulative noise levels could be above the overall limiting requirements of ETSU-R-97 at certain residences surrounding the development and cumulative sites. As a result, planning controls have been proposed such that the introduction of the proposed development would result in noise levels that are considered insignificant in the context of operation noise from other development or that ensures that operational noise from the proposed

development would not result in cumulative noise levels that are above the overall limiting requirements of ETSU-R-97 where possible.

The adoption of the proposed noise limits will allow for a range of turbine models to be installed at the site and is considered to fit in with the typical consenting requirements of the local planning authority in terms of operational noise from wind farms.

7. REFERENCES

[1] Department of Trade & Industry (September 1996) ETSU-R-97 The Assessment & Rating of Noise from Wind Farms

[2] Institute of Acoustics (May 2013) A Good Practice Guide to the Assessment & Rating of Noise from Wind Farms

[3] International Organisation for Standardisation (December 1996) ISO 9613-2:1996 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation

[4] International Organisation for Standardisation (June 1993) Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere

[5] International Electrotechnical Commission (2012) IEC 61400-11 Edition 3.0 - Wind turbines – Part 11: Acoustic noise measurement techniques

[6] Vestas (May 2018) Performance Specification V136 – 4.0/4.2 MW 50/60 Hz - Ref: 0067-7065 V06

[7] Vestas (May 2018) V136-4.0/4.2 MW Third octave noise emission – Ref: 0067-4732 V03

[8] Nordex (October 2005) Noise Emission Nordex N80 - Ref: F008_158_EN Revision 2

[9] Nordex (August 2005) Nordex N80 – Noise level - Ref: N80-6-noise-en

[10] Vestas (September 2018) Performance Specification V117-4.0/4.2 MW 50/60 Hz Strong Wind - Ref: 0067-7063 V05

[11] Vestas (March 2018) V150-4.0/4.2 MW Third octave noise emission - Ref: 0067-4767 V05

[12] Golder Associates (May 2013) Single Turbine Planning Application – Noise - Slievenahanaghan Wind Farm – Ref: 11514870O03.501/B.0

[13] Enercon (May 2007) Sound Power Level E-44 – Ref: SA-04-SPL Guarantee E-44-Rev1_2-ger-eng

[14] WIND-consult GmbH (March 2007) Extract of test report 042SE207 regarding noise emission of wind turbine (WT) type ENERCON E-44 – Ref: 042SE207

[15] Vestas (October 2008) General Specification Vestas V52-850 kW 50/60 Hz - Ref: 946506 V10

[16] WINDTEST GmbH (February 2003) Report of Acoustical Emissions of a Wind Turbine Generator System of the Type V52-850 kW 104,2 dB(A) near Sørvad - Ref: 2466/02

[17] KRM (December 2018) Noise Assessment Single Wind Turbine (Replacement Type) – Ref: LA01/2017/0016/F

[18] AONA Environmental (July 2021) Single Wind Turbine Development – Obermane Road – Cloughmills – Proposed change of Wind Turbine model (Previous Planning Ref. G/2012/0460/F) – Noise Impact Assessment Report – Ref: ENV5099

[19] Department of the Environment (October 2004) Gruig Planning Permission - Ref: D/2004/0790/F

[20] Causeway Coast & Glens Borough Council (July 2019) Corkey Wind Farm Approval of Planning Permission – Ref: LA01/2019/0772/F

[21] Department of the Environment (September 2013) Approval of Planning Permission - Ref: D/2013/0081/F

[22] Causeway Coast & Glens Borough Council (July 2022) Approval of Planning Permission – Ref: LA01/2022/0783/F

[23] Causeway Coast & Glens Borough Council (December 2016) Approval of Planning Permission – Ref: LA01/2017/0016/F

[24] Mid & East Antrim Borough Council (August 2021) Approval of Planning Permission – Ref: LA02/2021/0788/F

[25] Mid & East Antrim Borough Council (August 2021) Approval of Planning Permission – Ref: LA02/2021/0791/F

APPENDIX A – ASSESSMENT CHARTS

Chart A.1

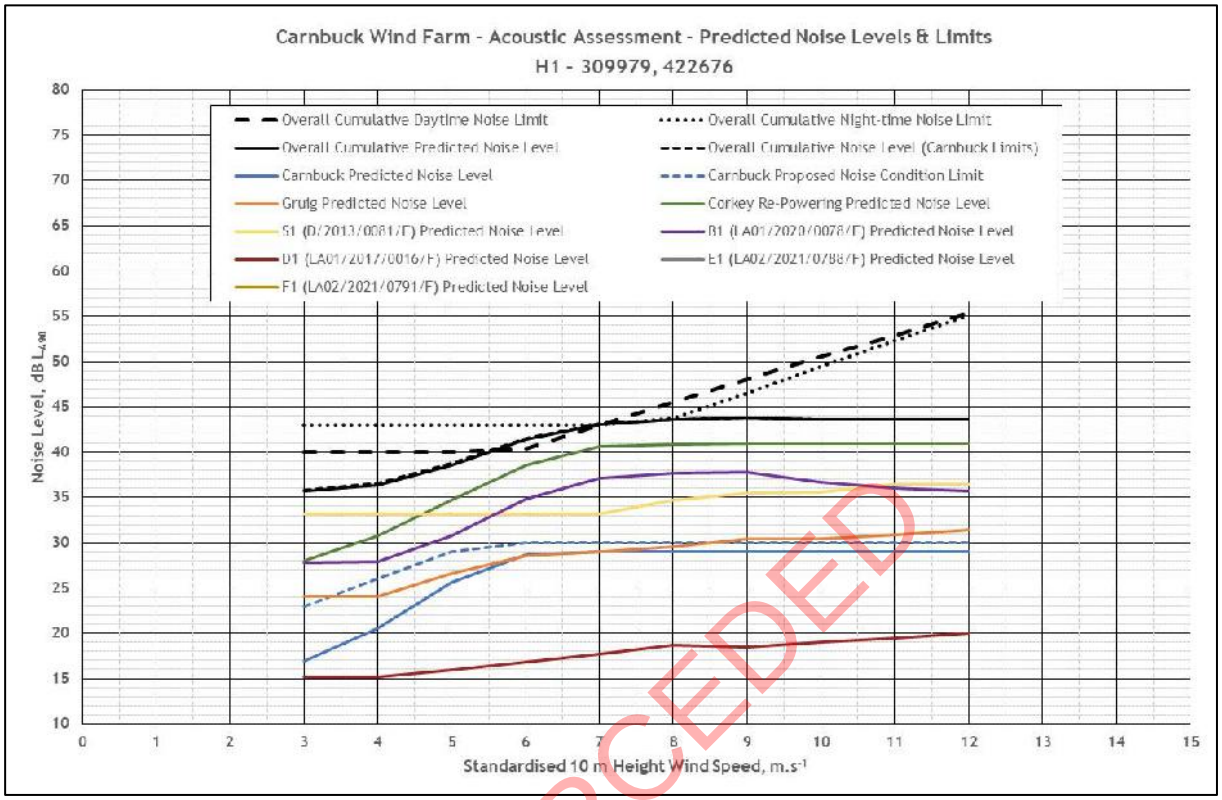


Chart A.2

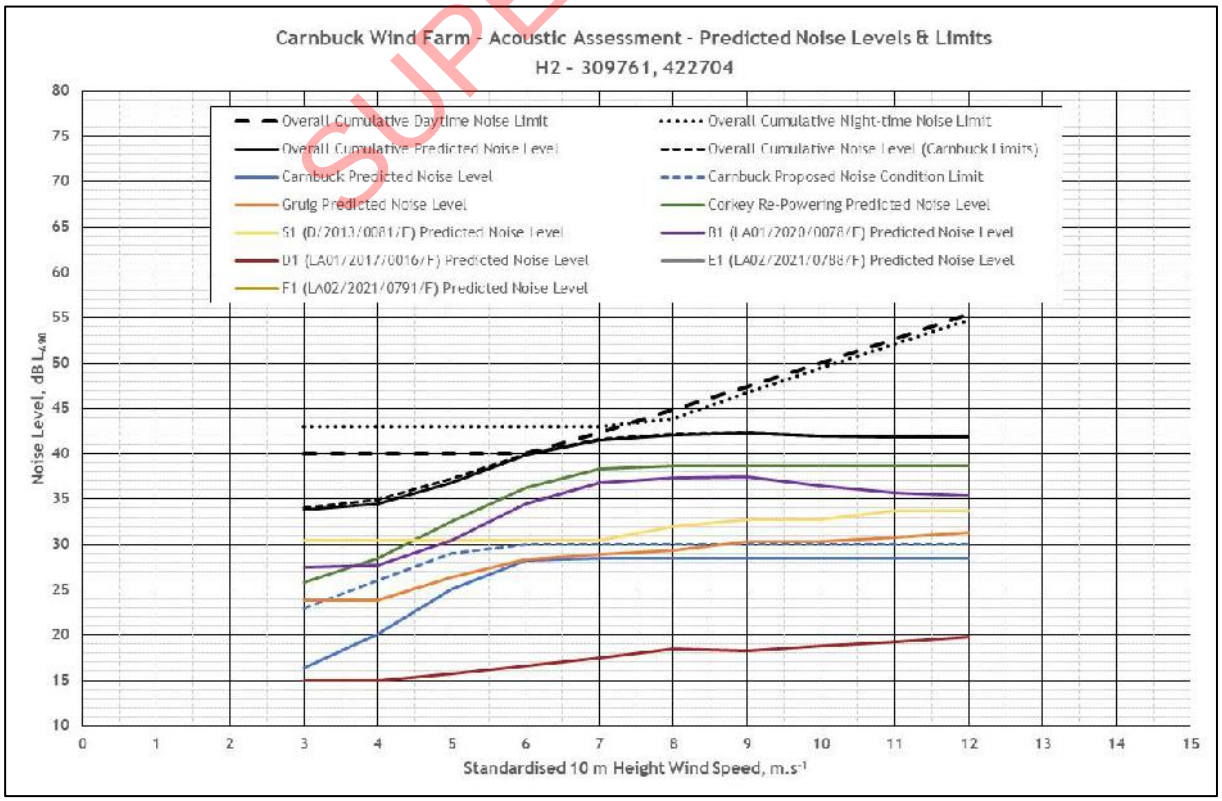


Chart A.3

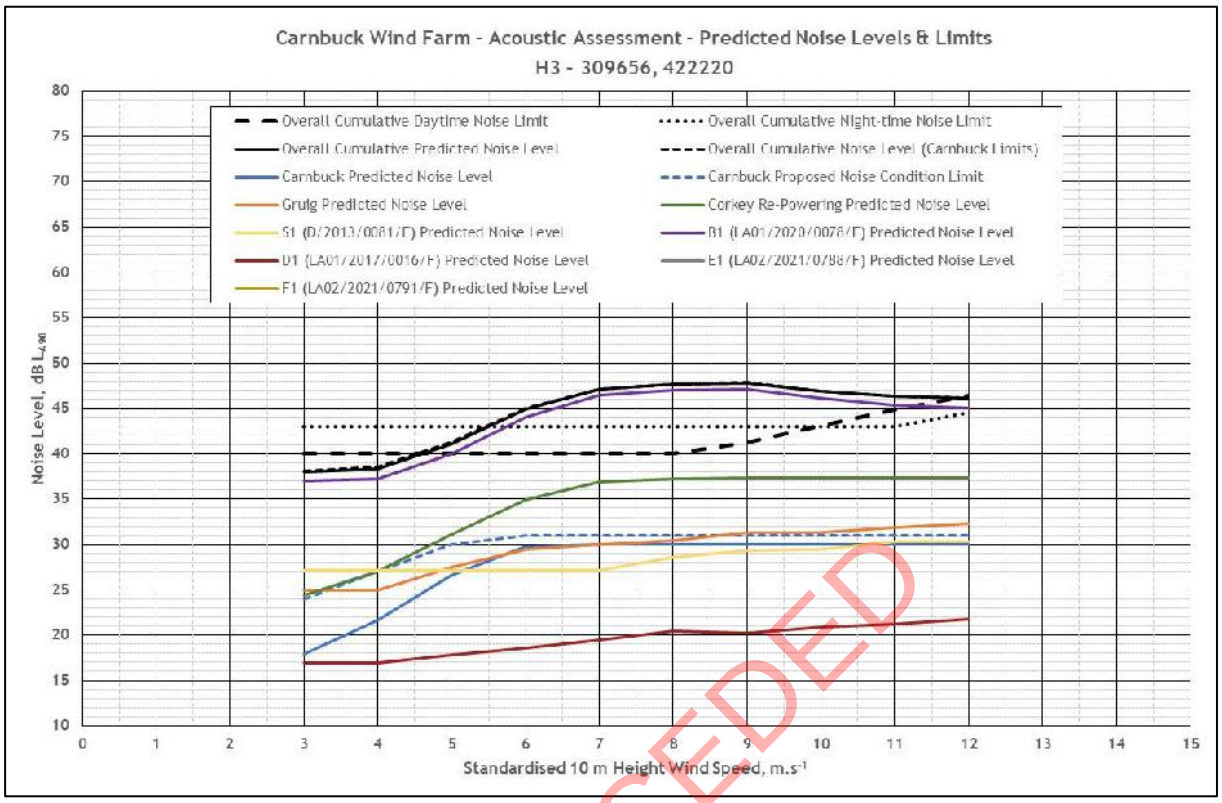


Chart A.4

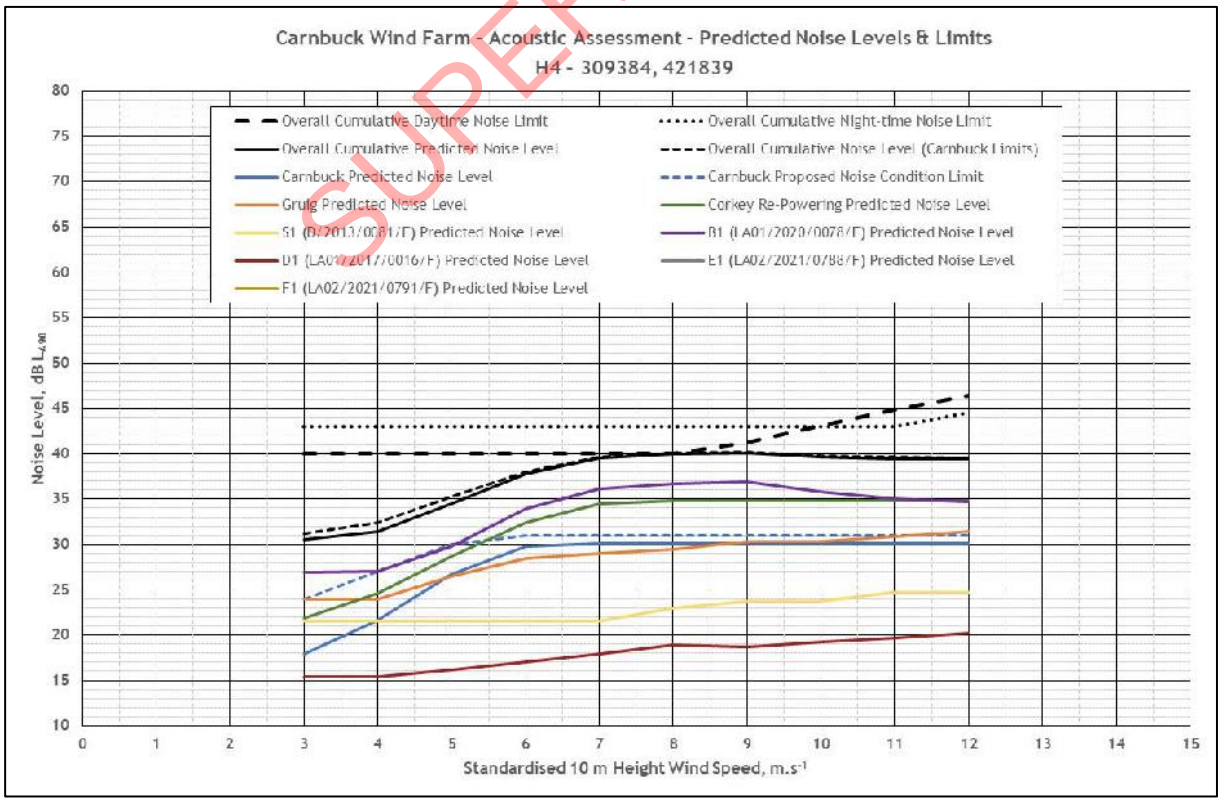


Chart A.5

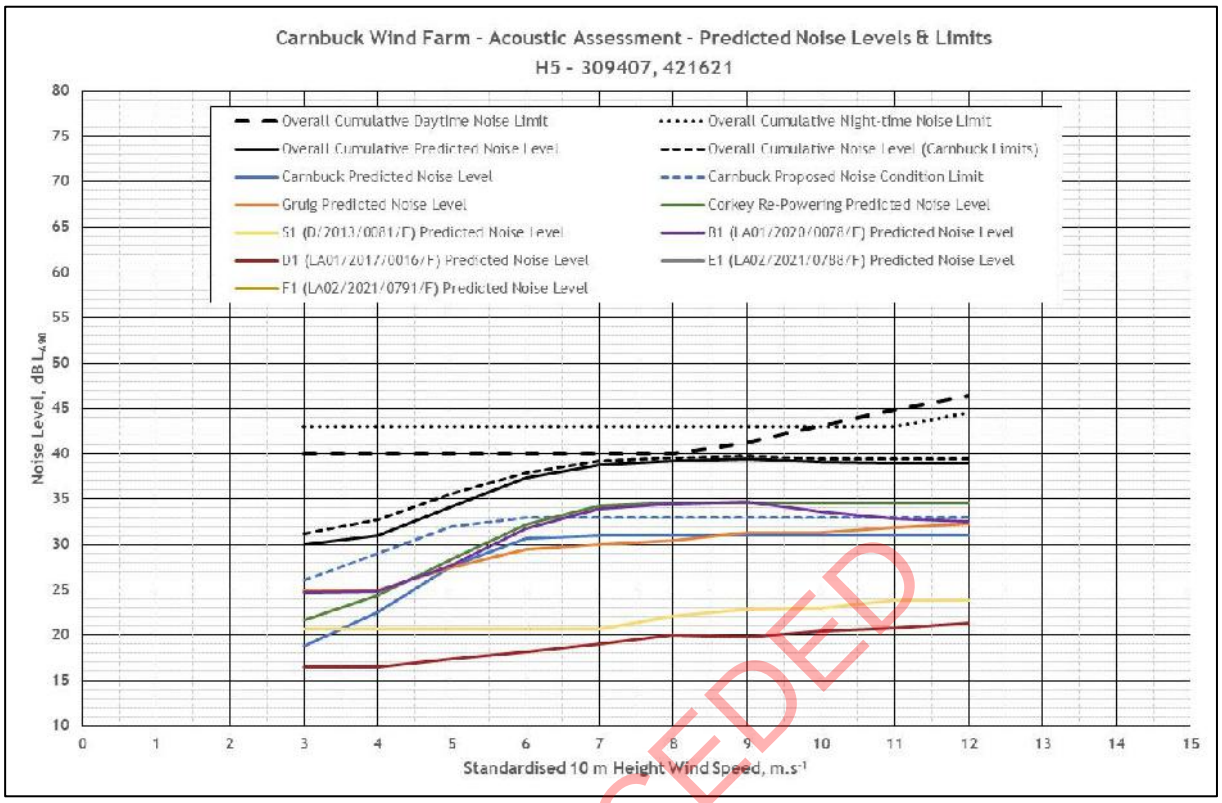


Chart A.6

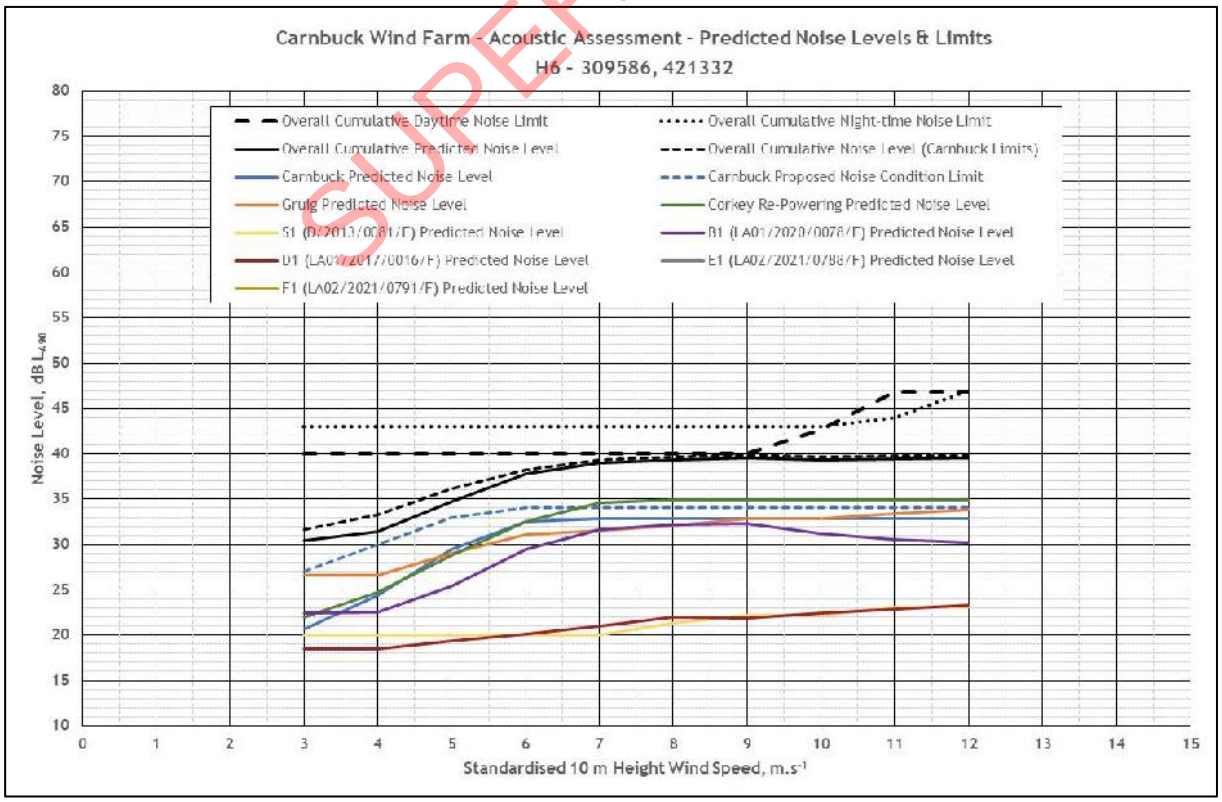


Chart A.7

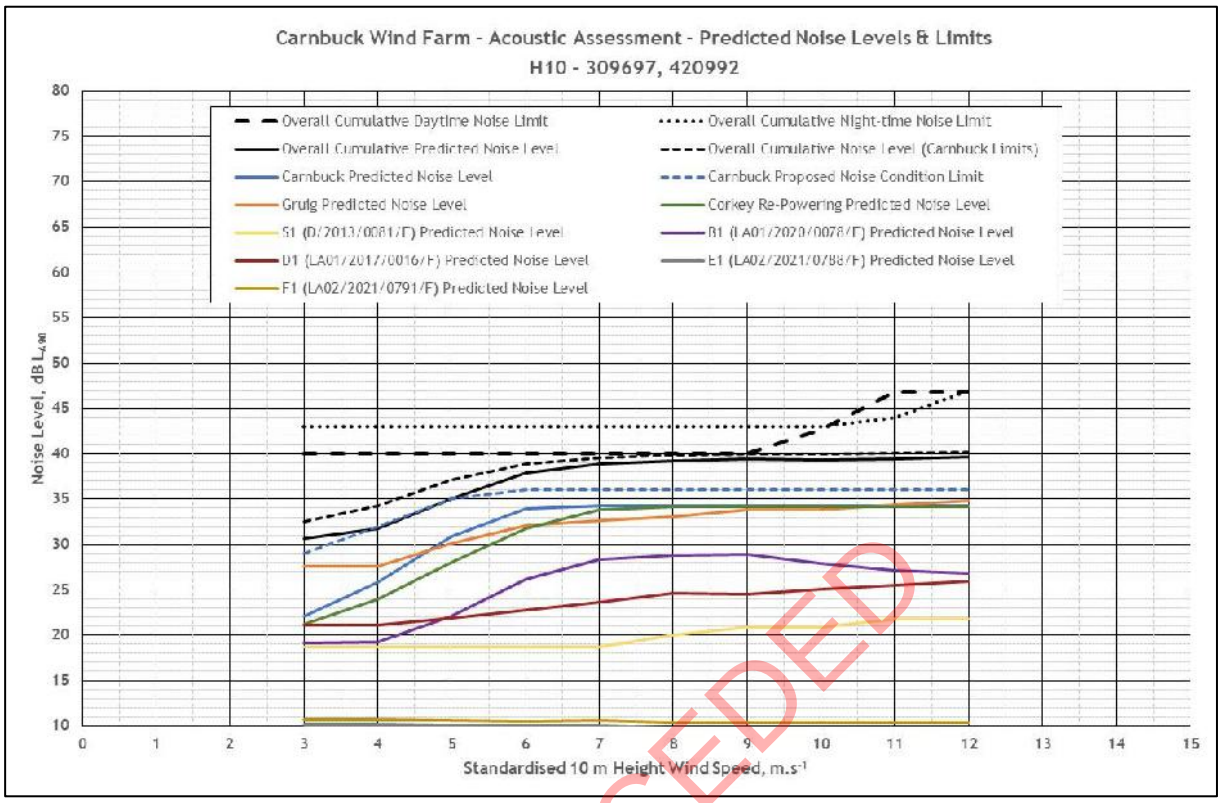


Chart A.8

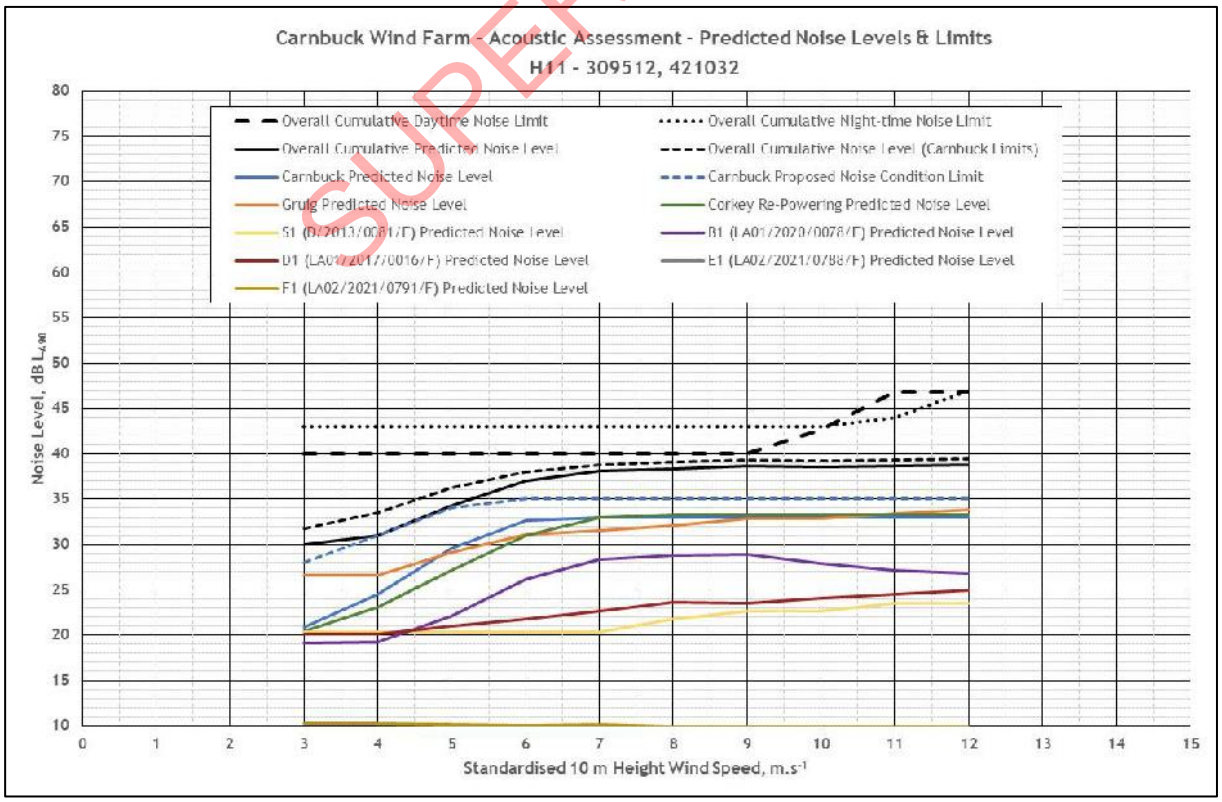


Chart A.9

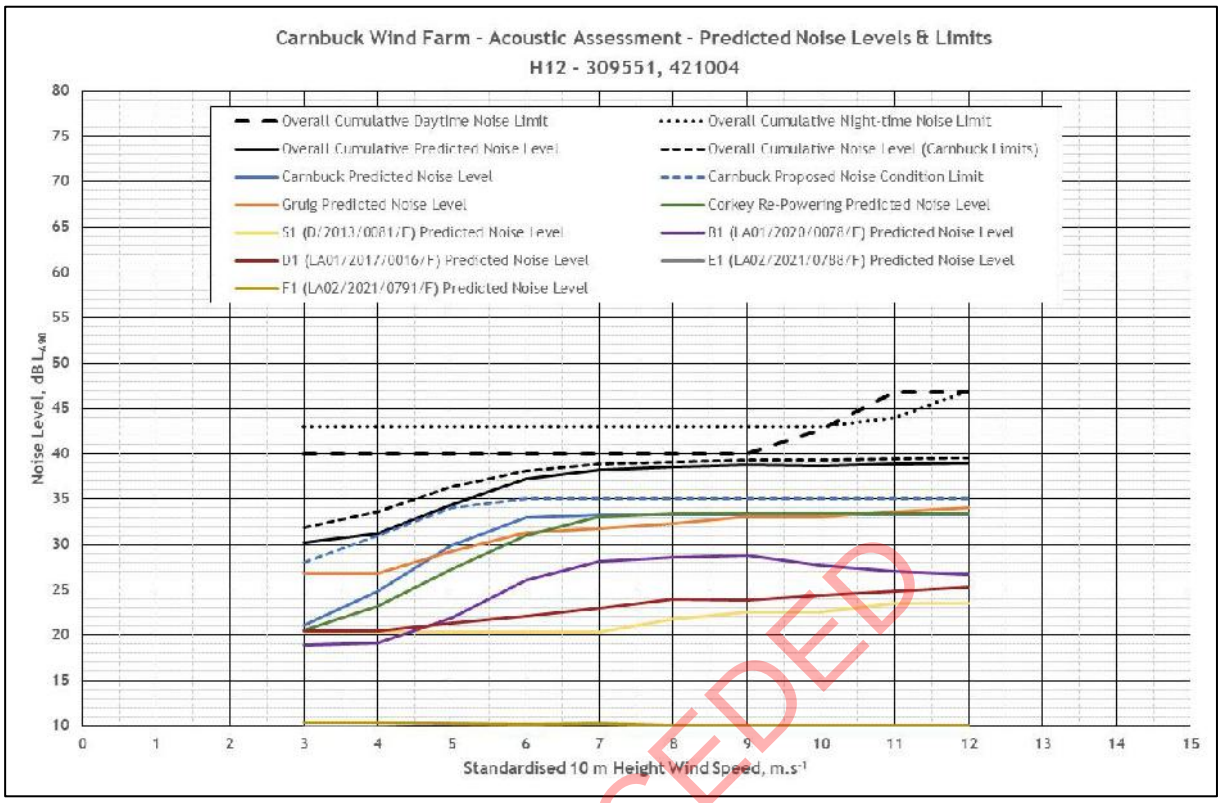


Chart A.10

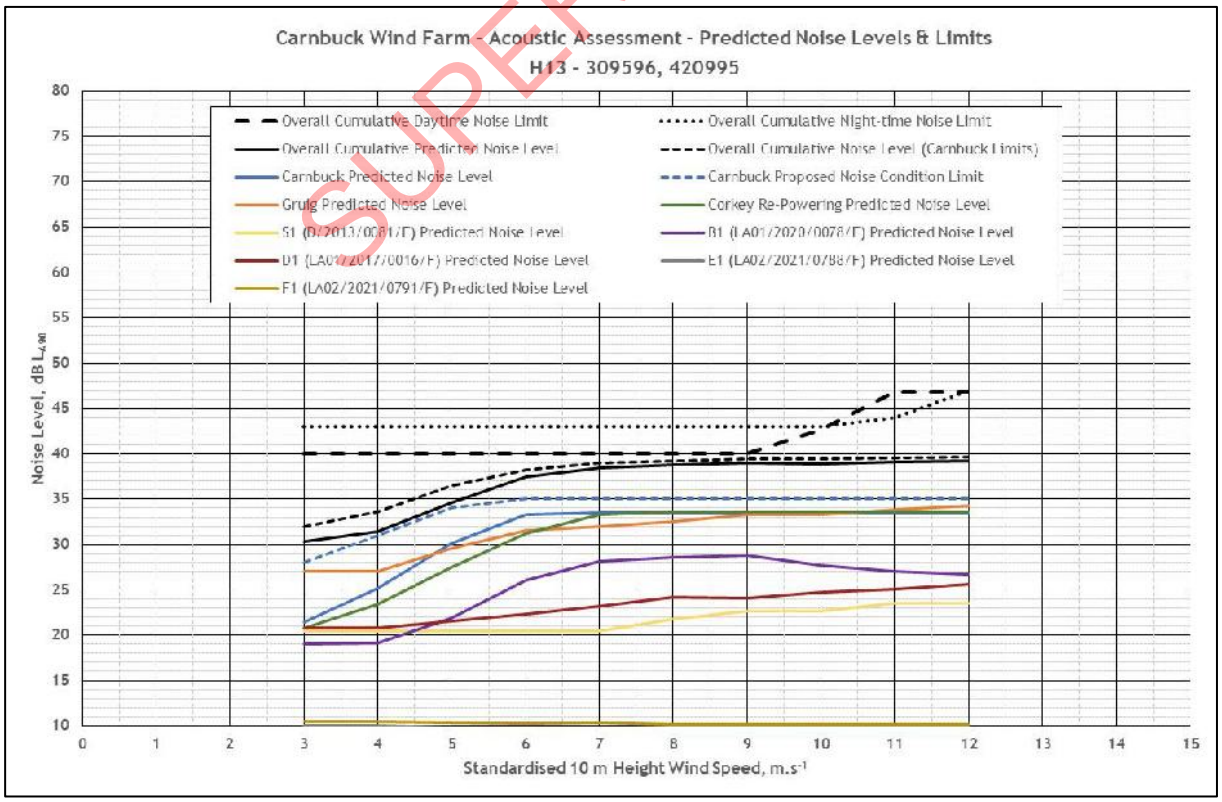


Chart A.11

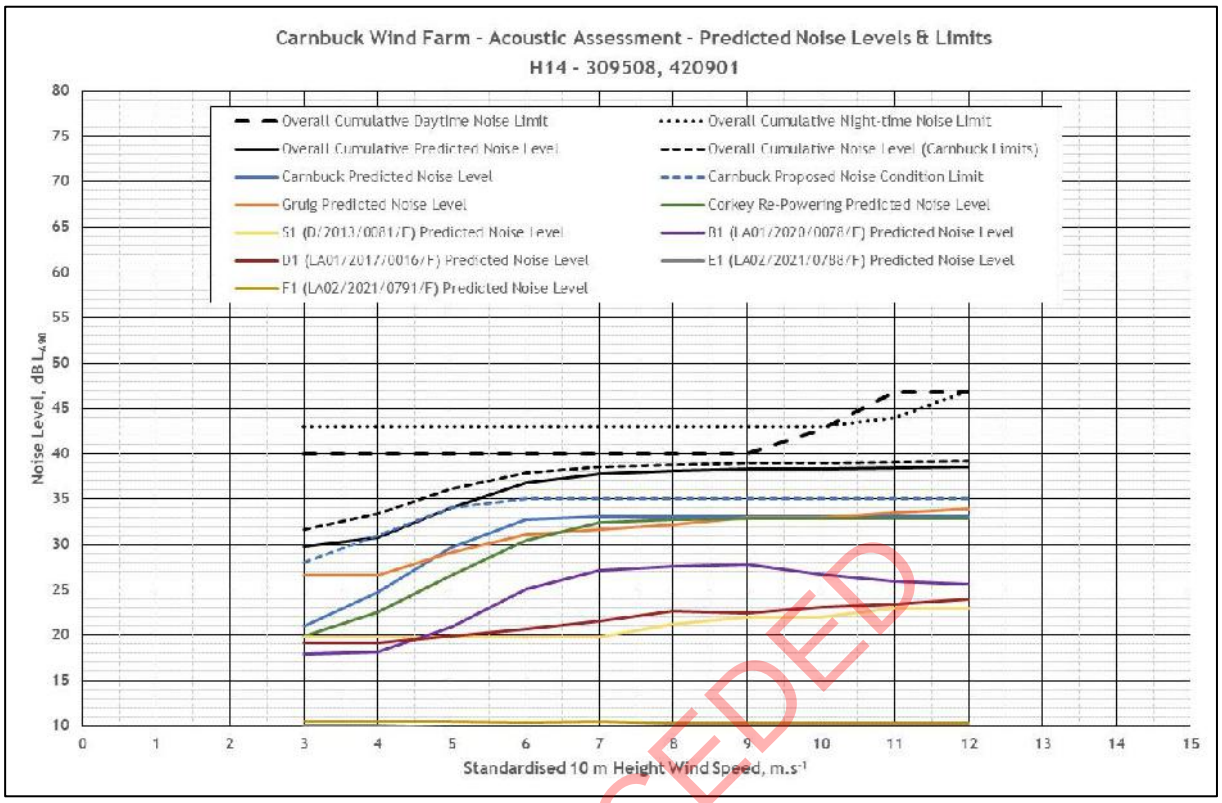


Chart A.12

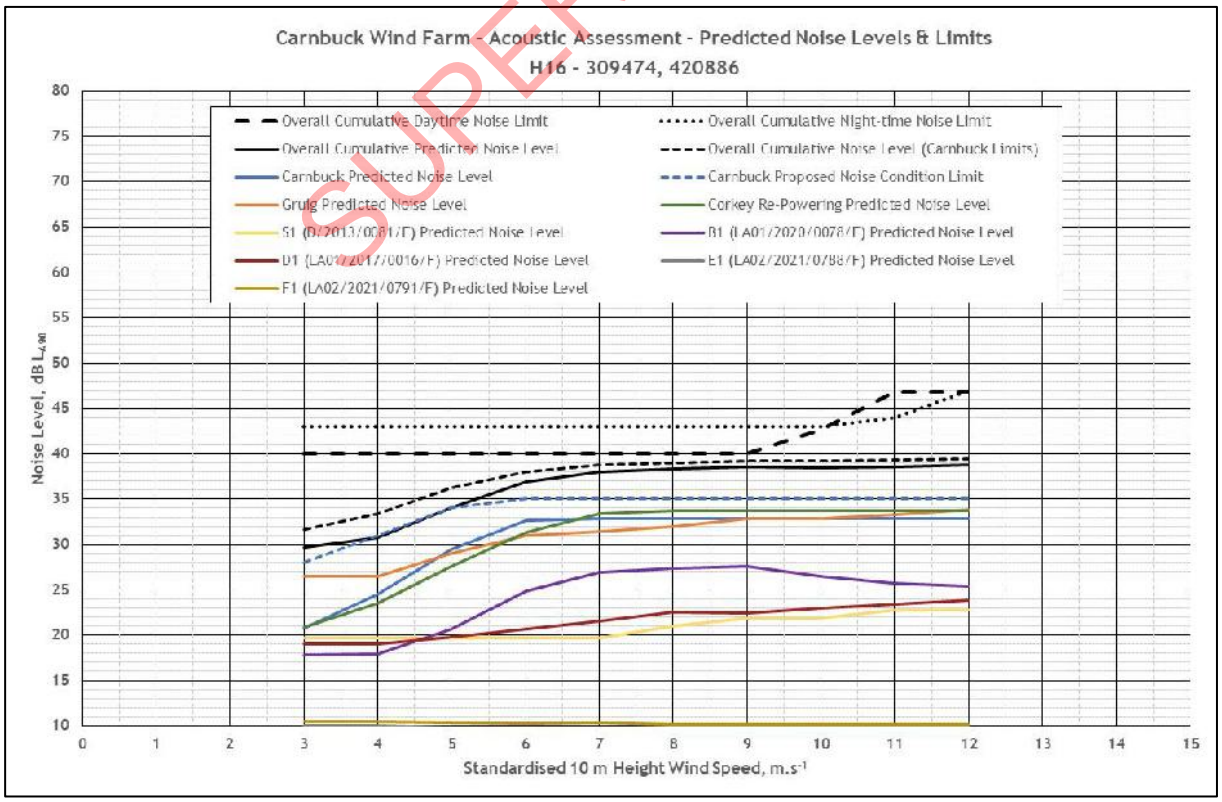


Chart A.13

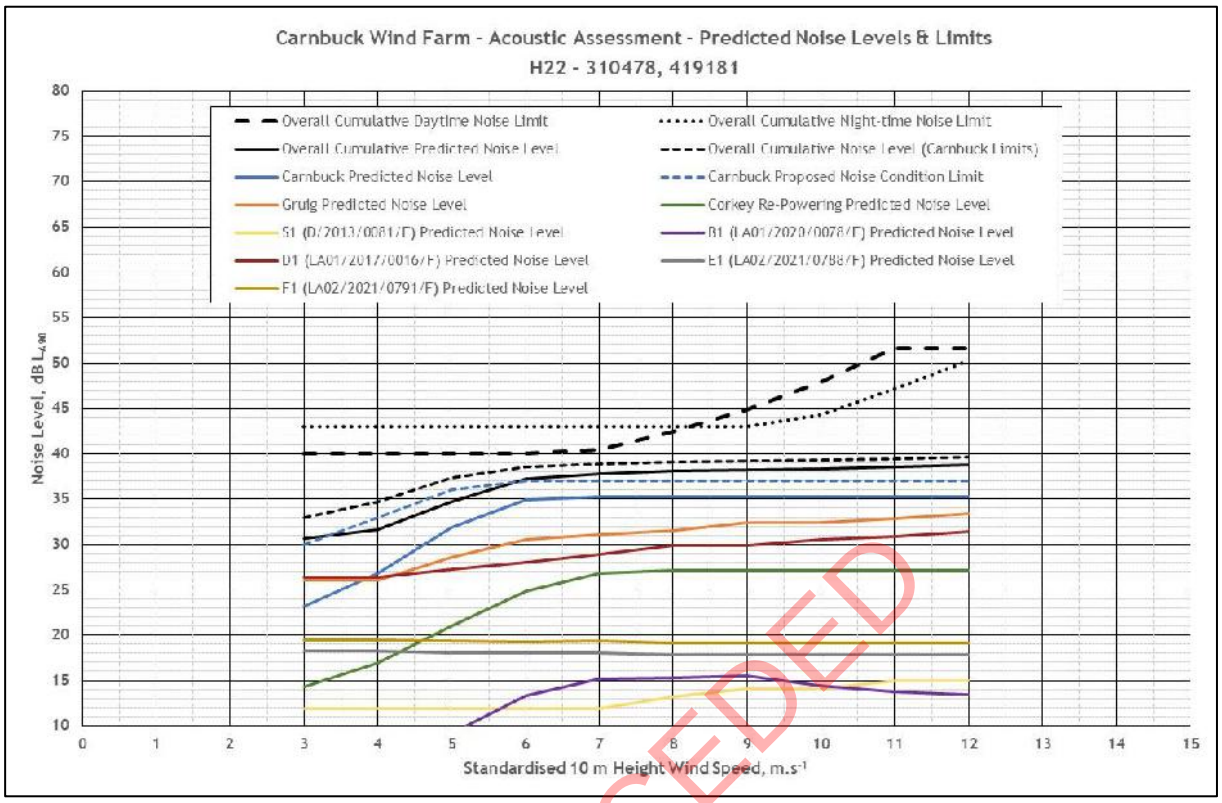


Chart A.14

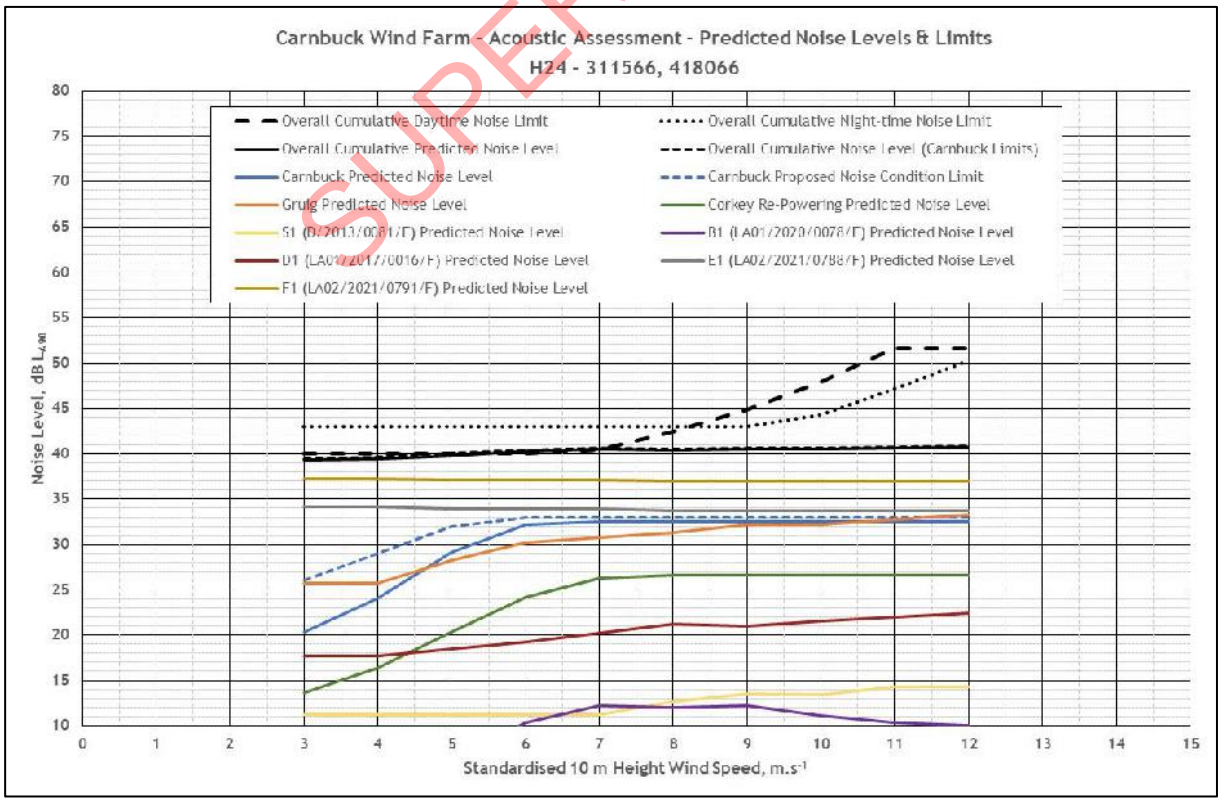


Chart A.15

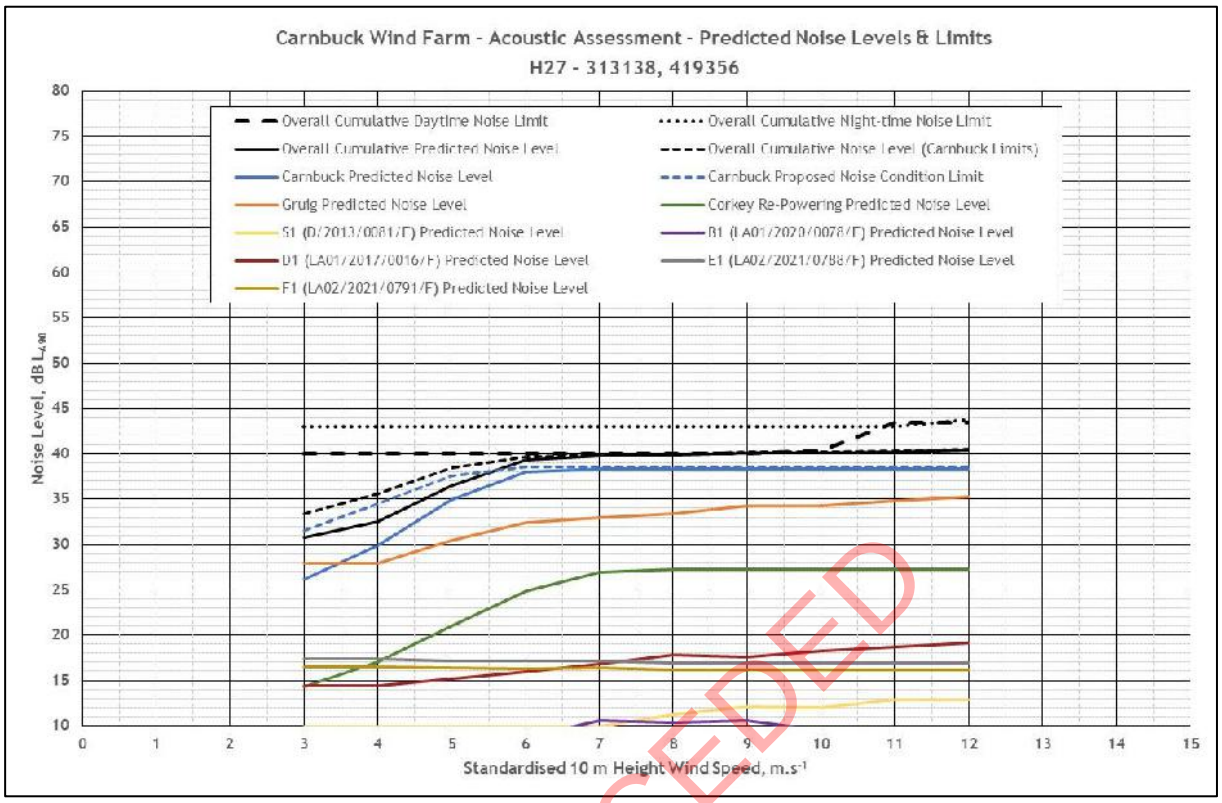


Chart A.16

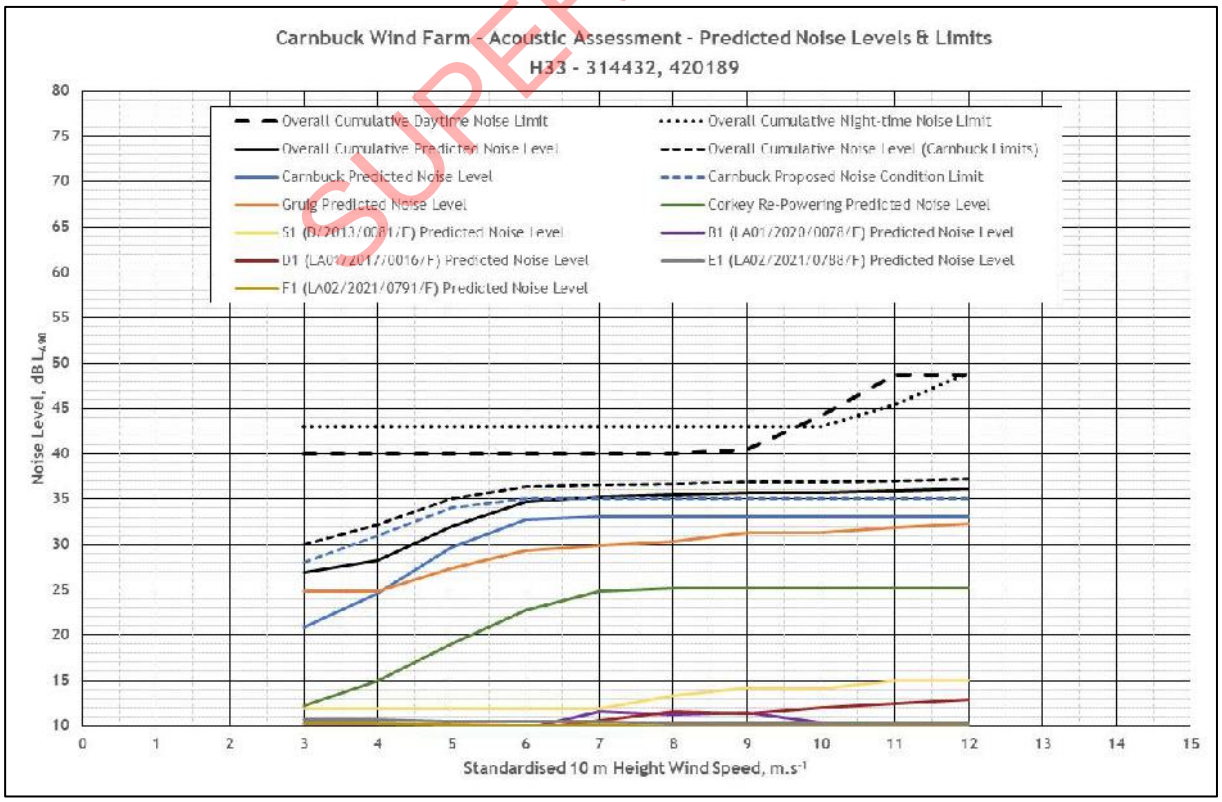


Chart A.17

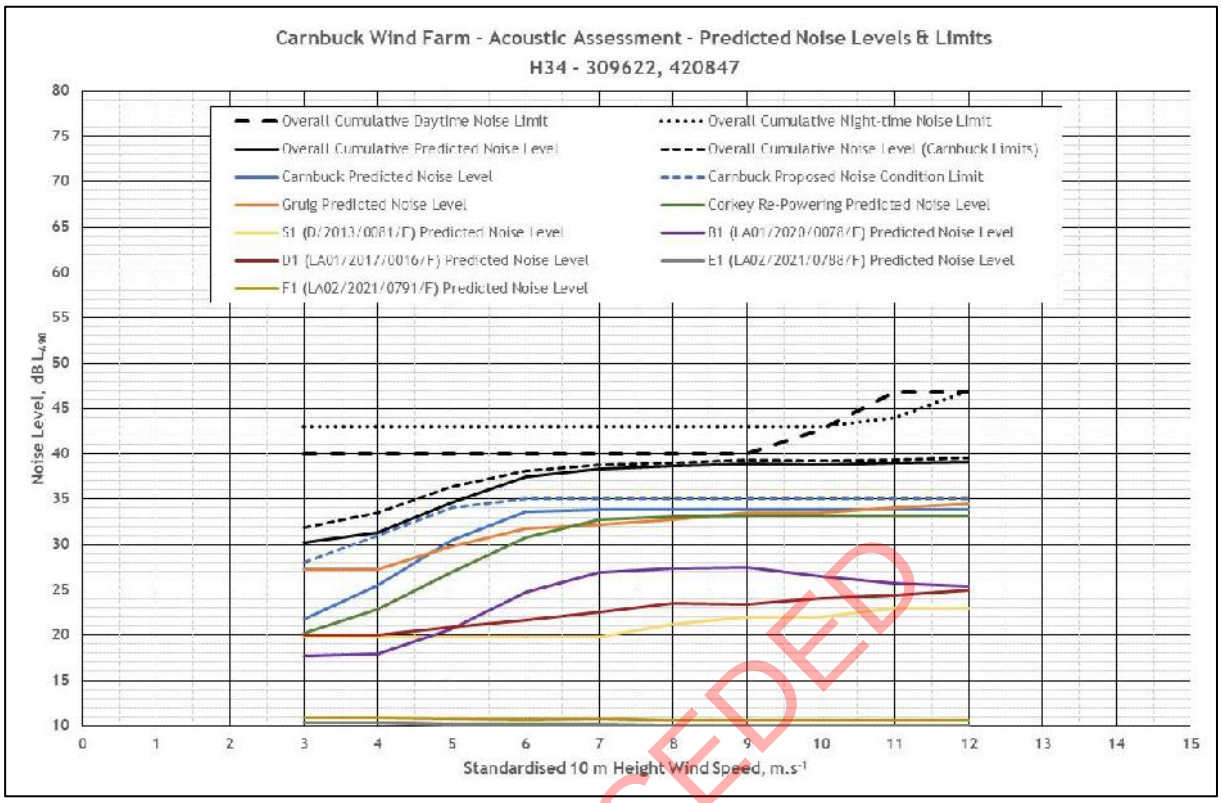


Chart A.18

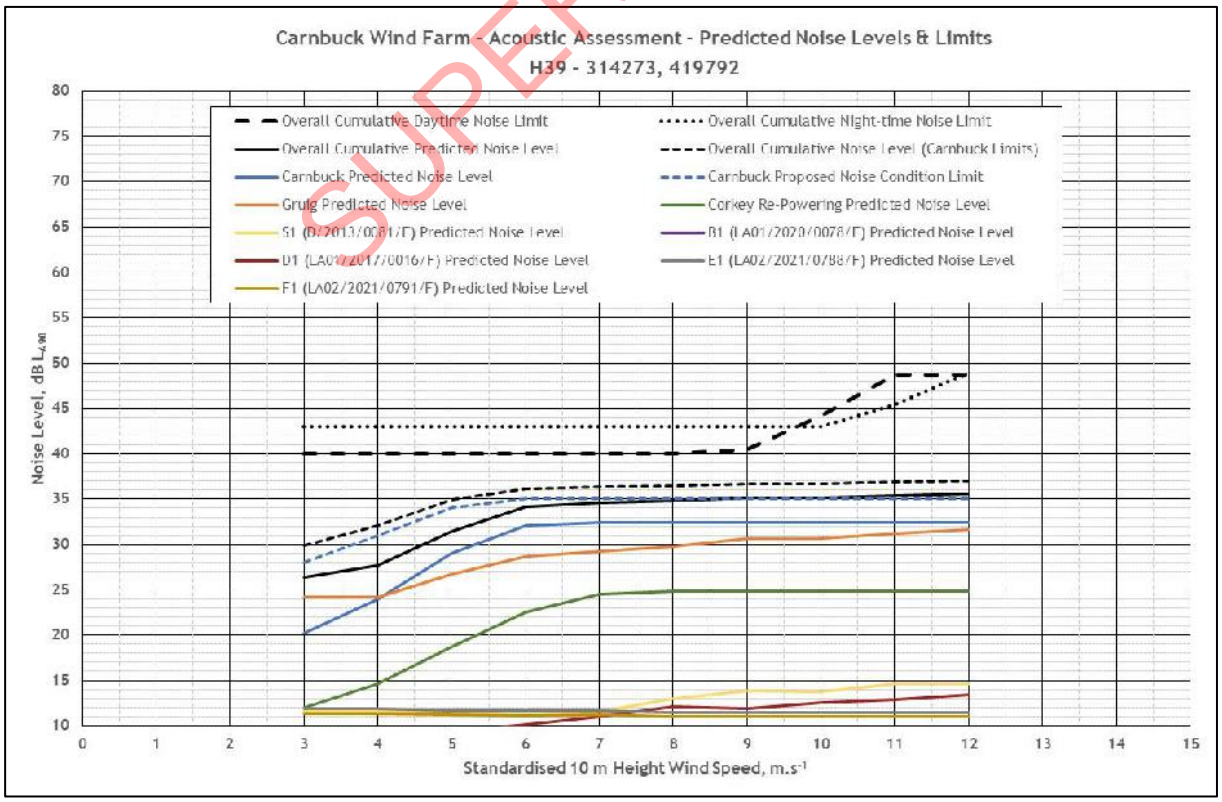


Chart A.19

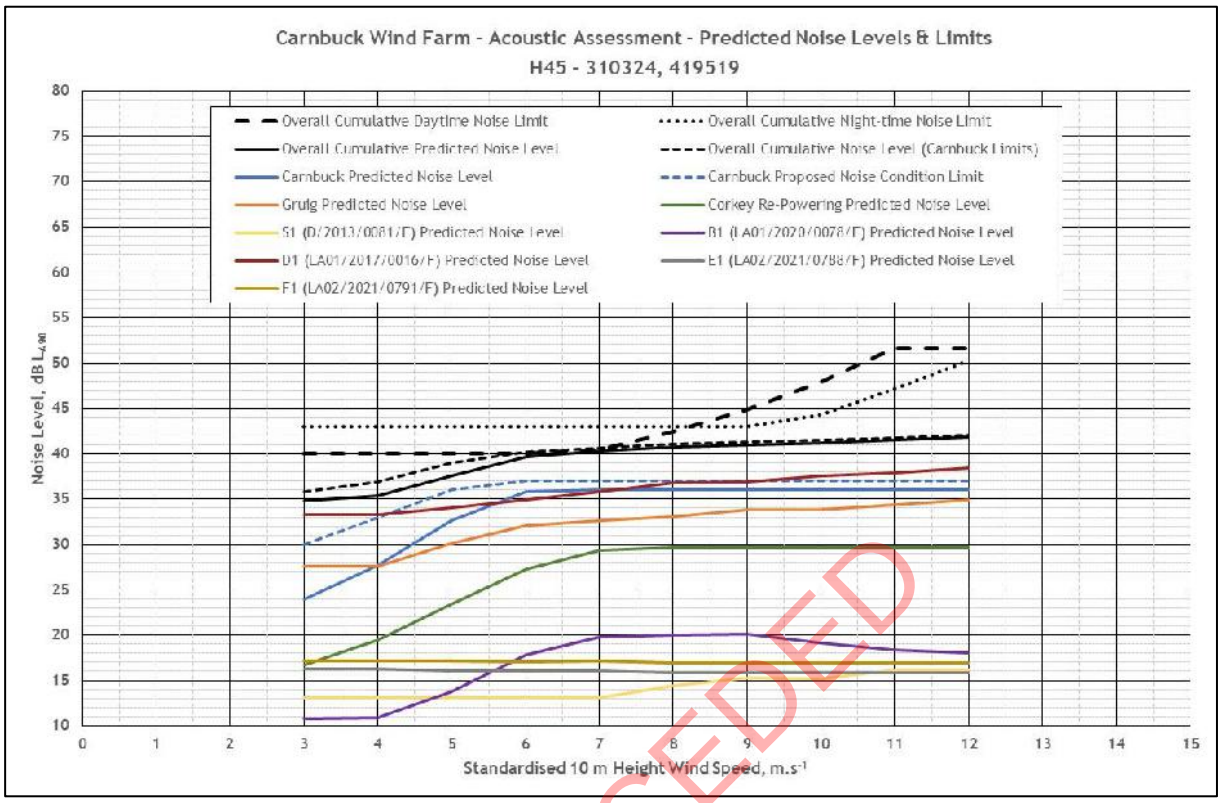


Chart A.20

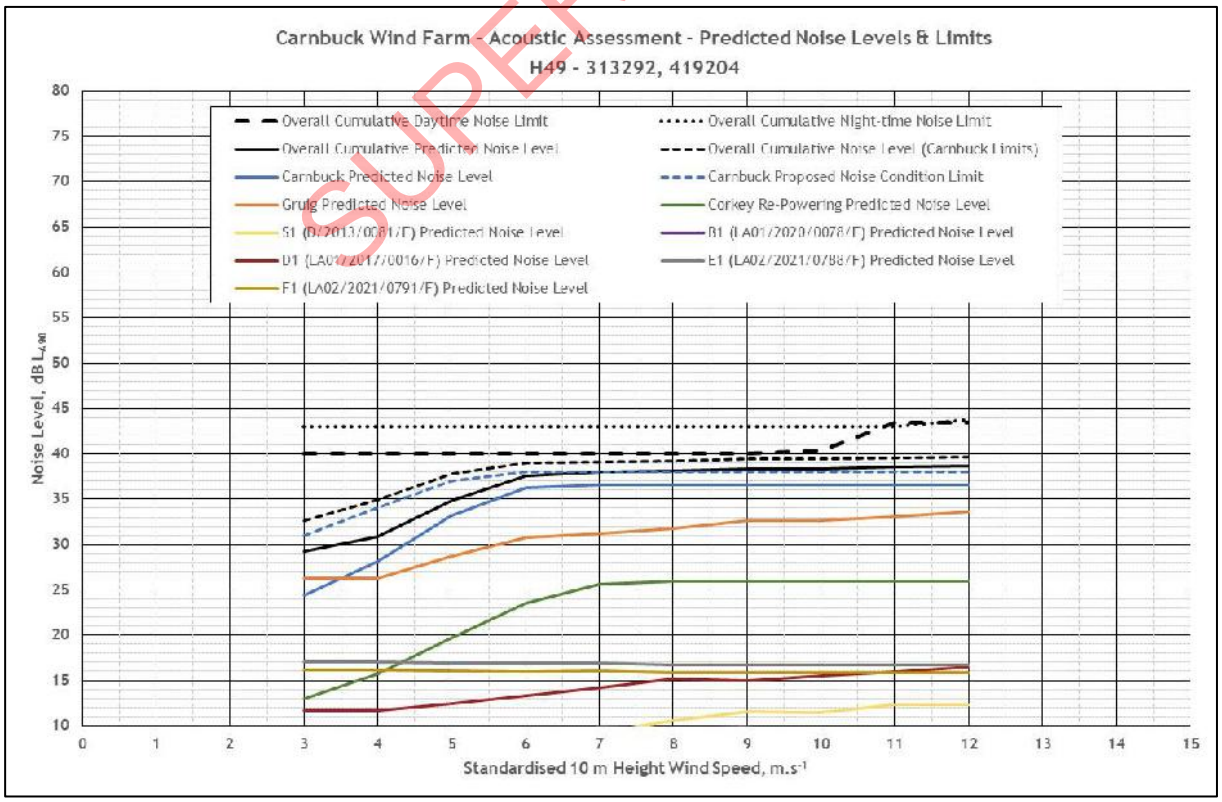


Chart A.21

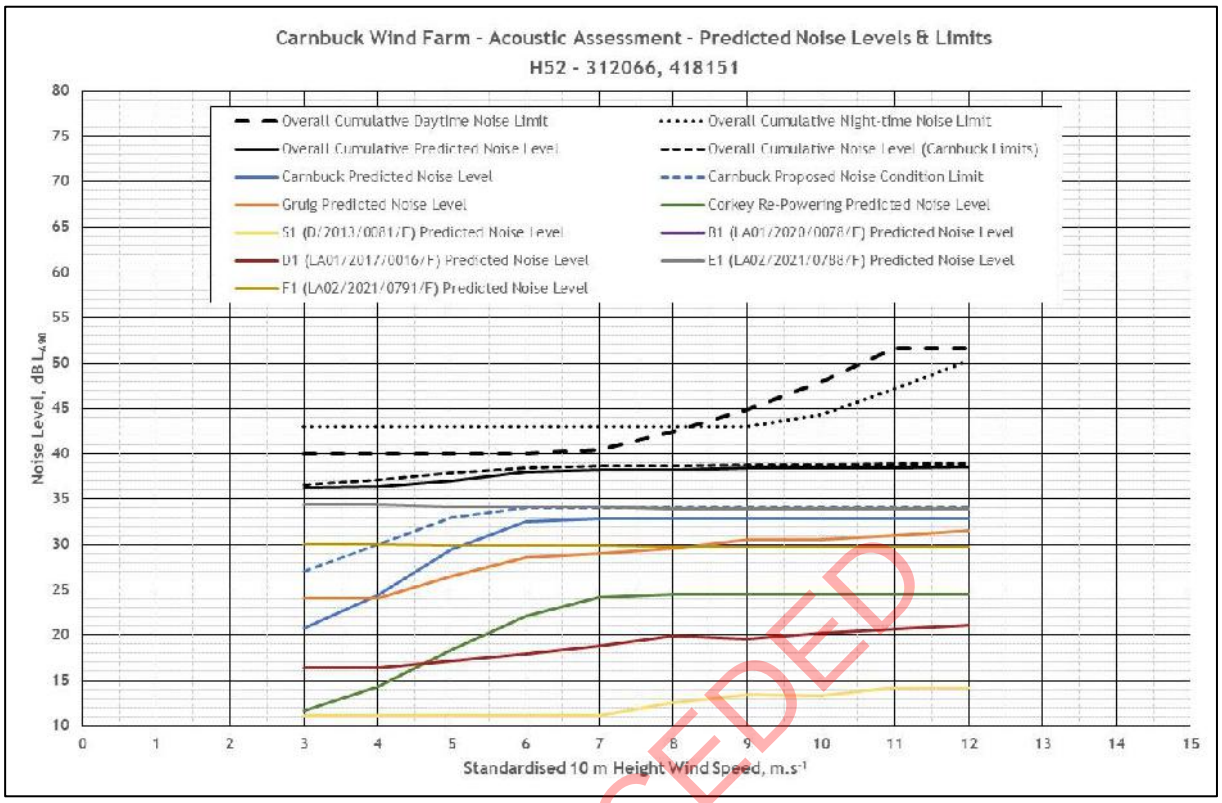


Chart A.22

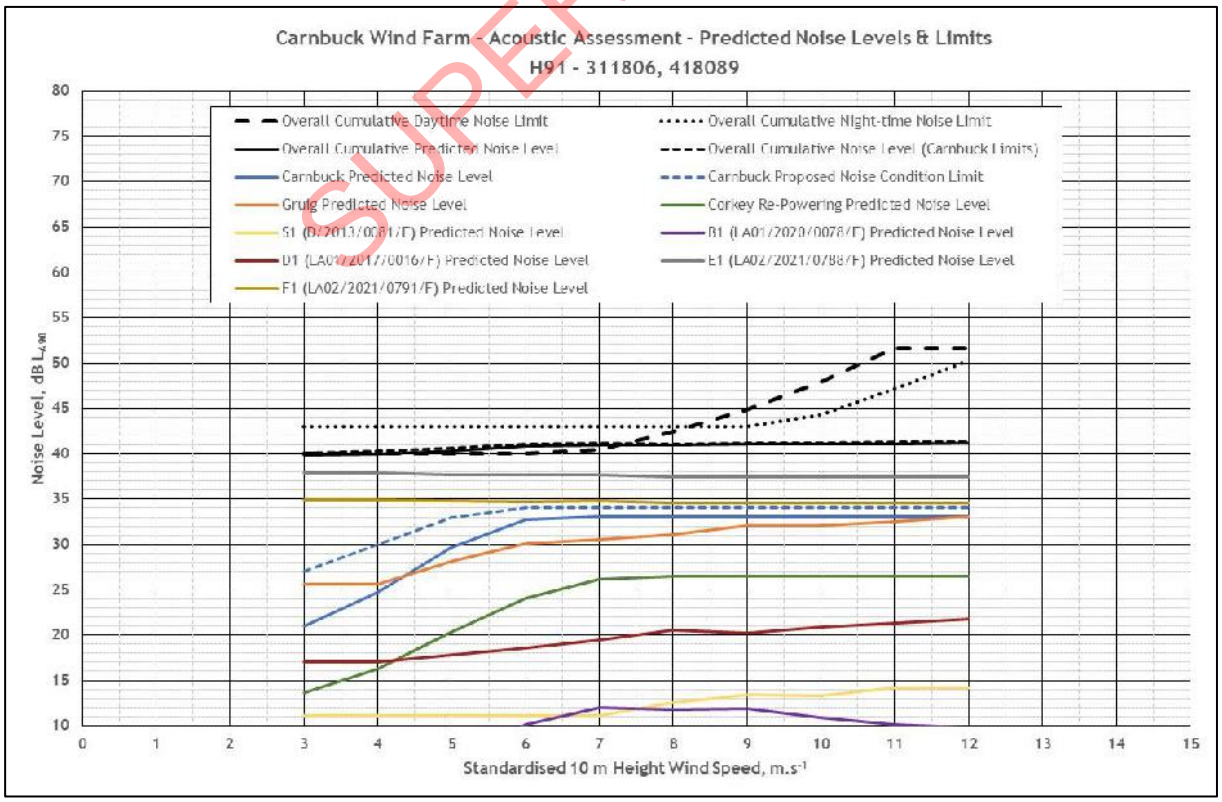


Chart A.23

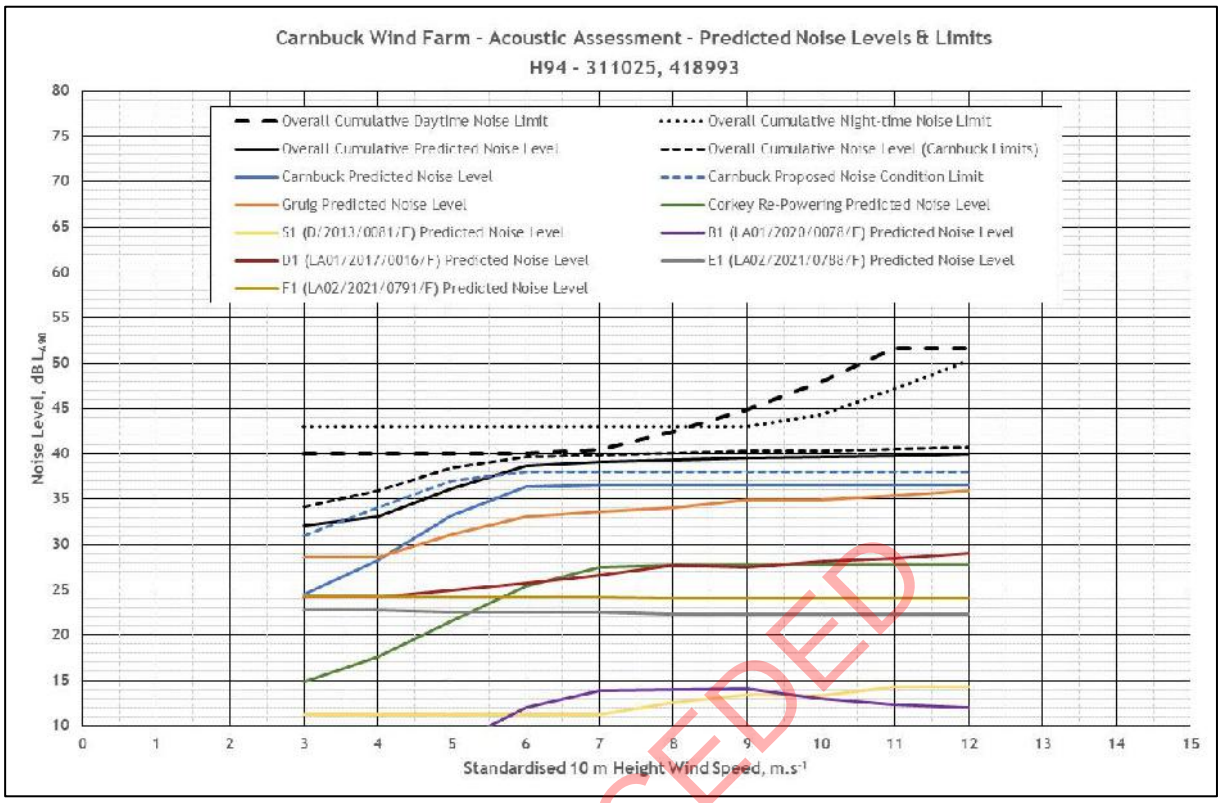


Chart A.24

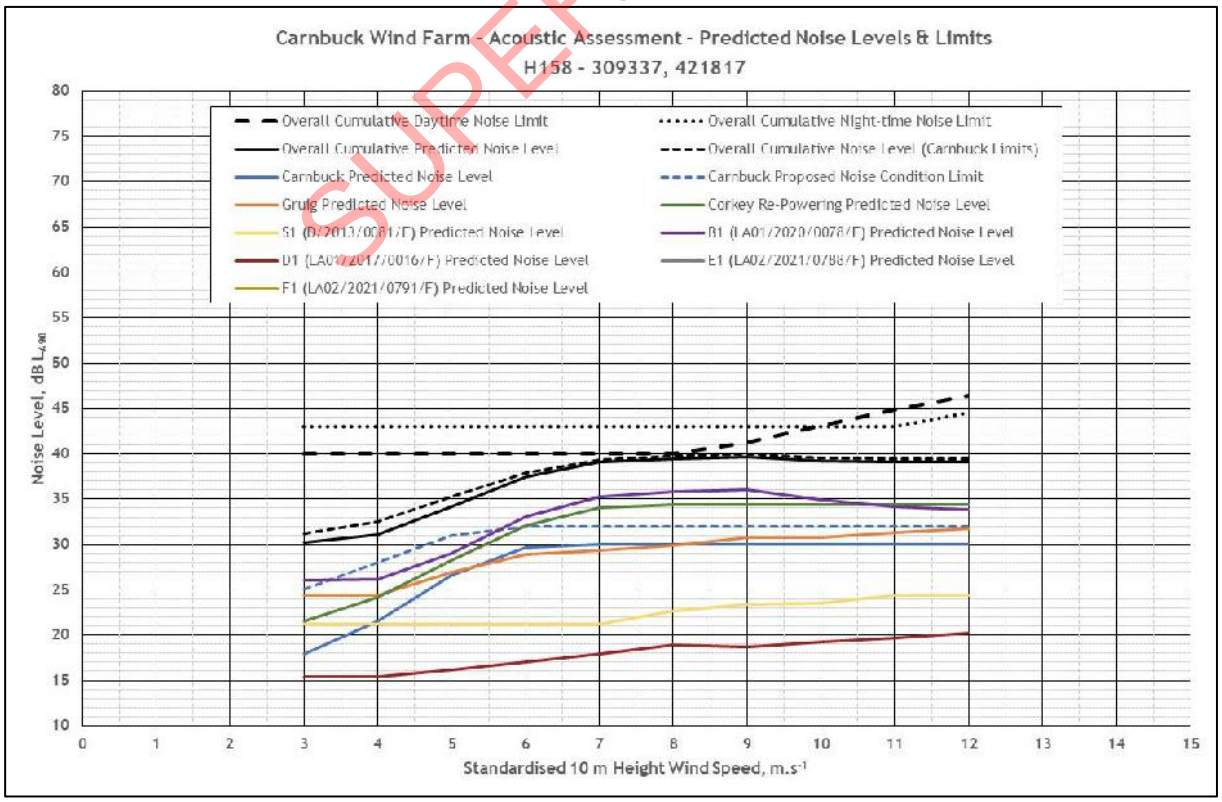


Chart A.25

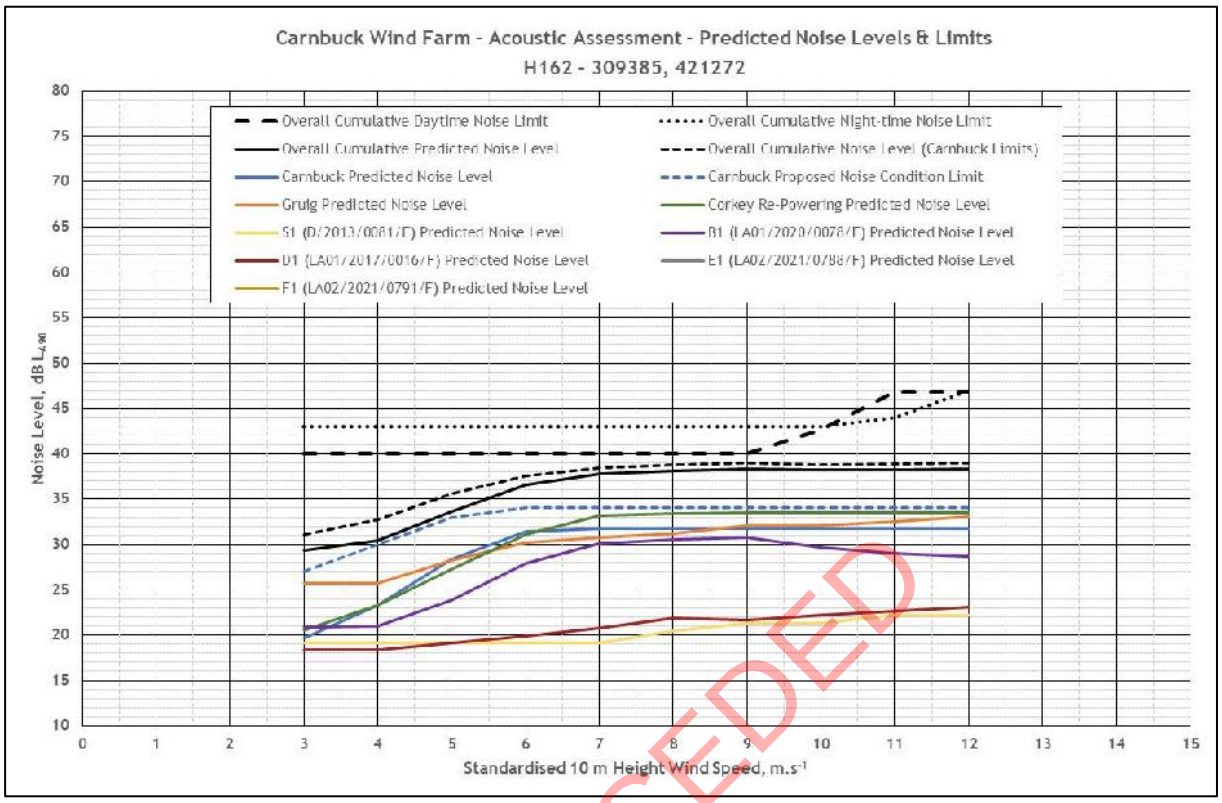


Chart A.26

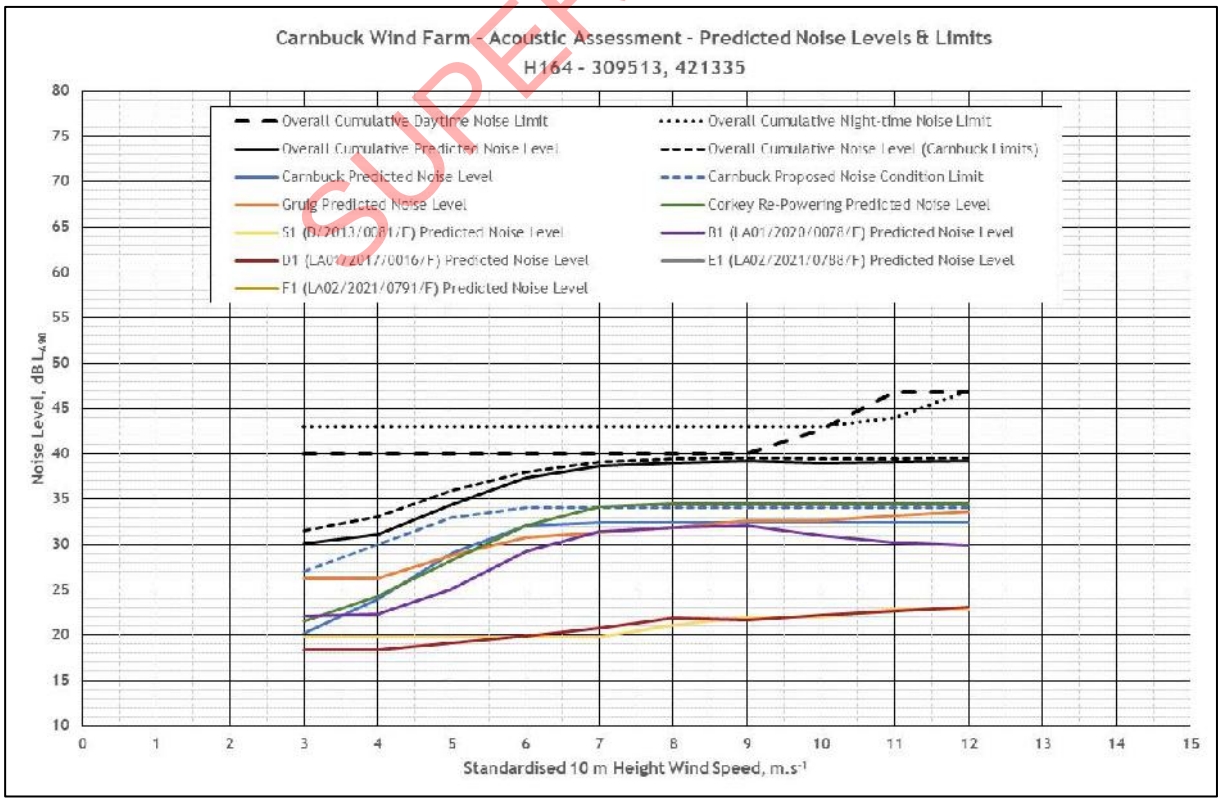


Chart A.27

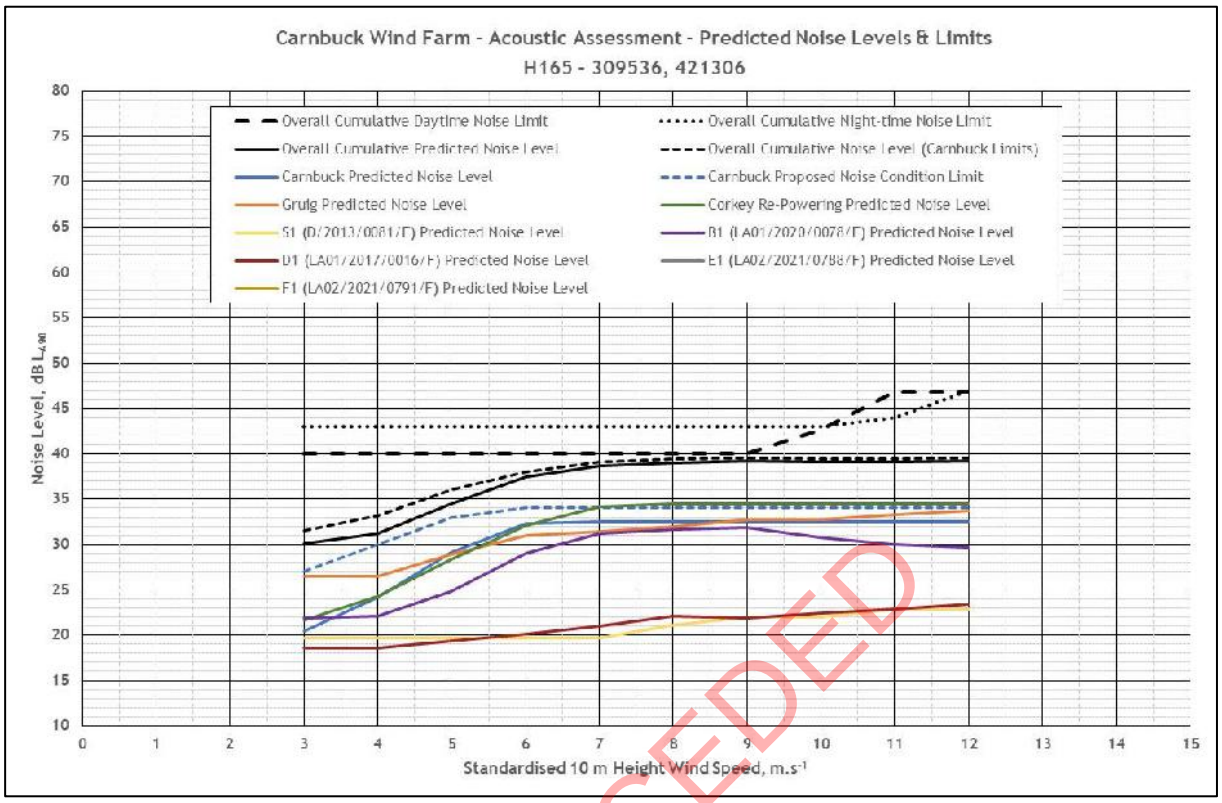


Chart A.28

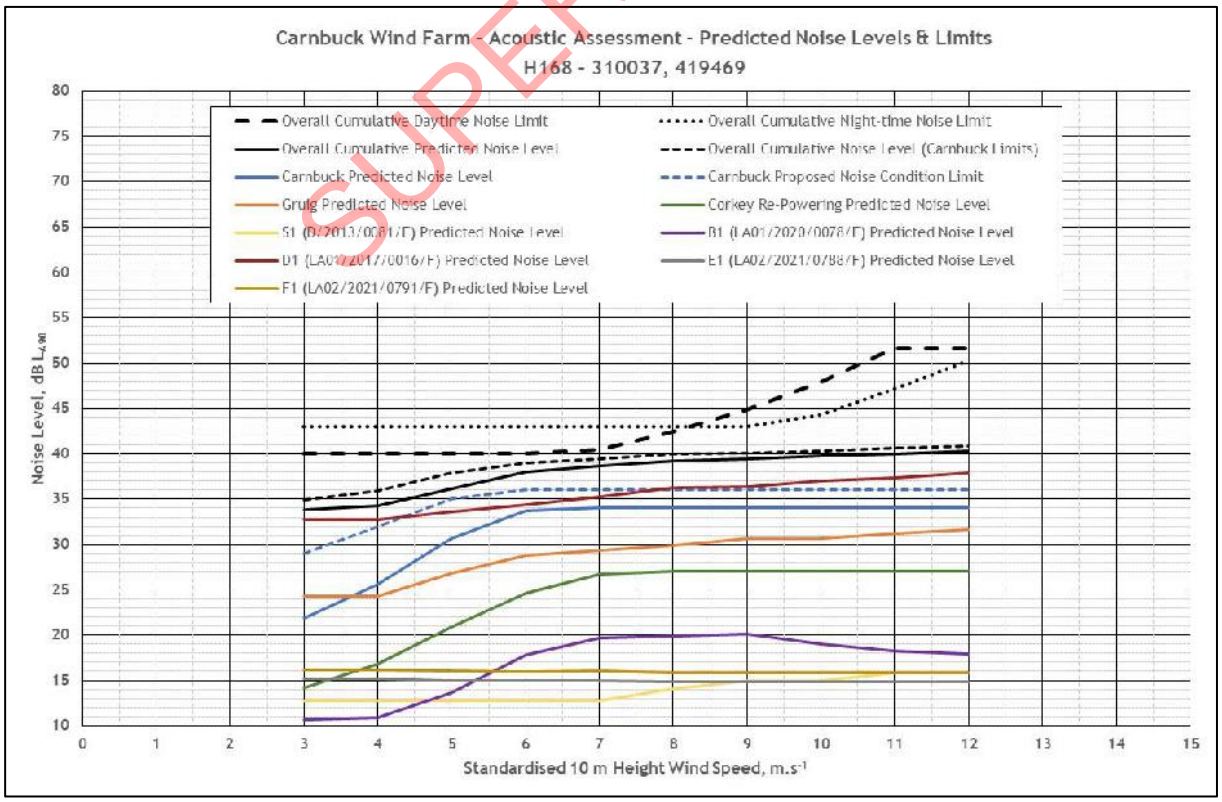


Chart A.29

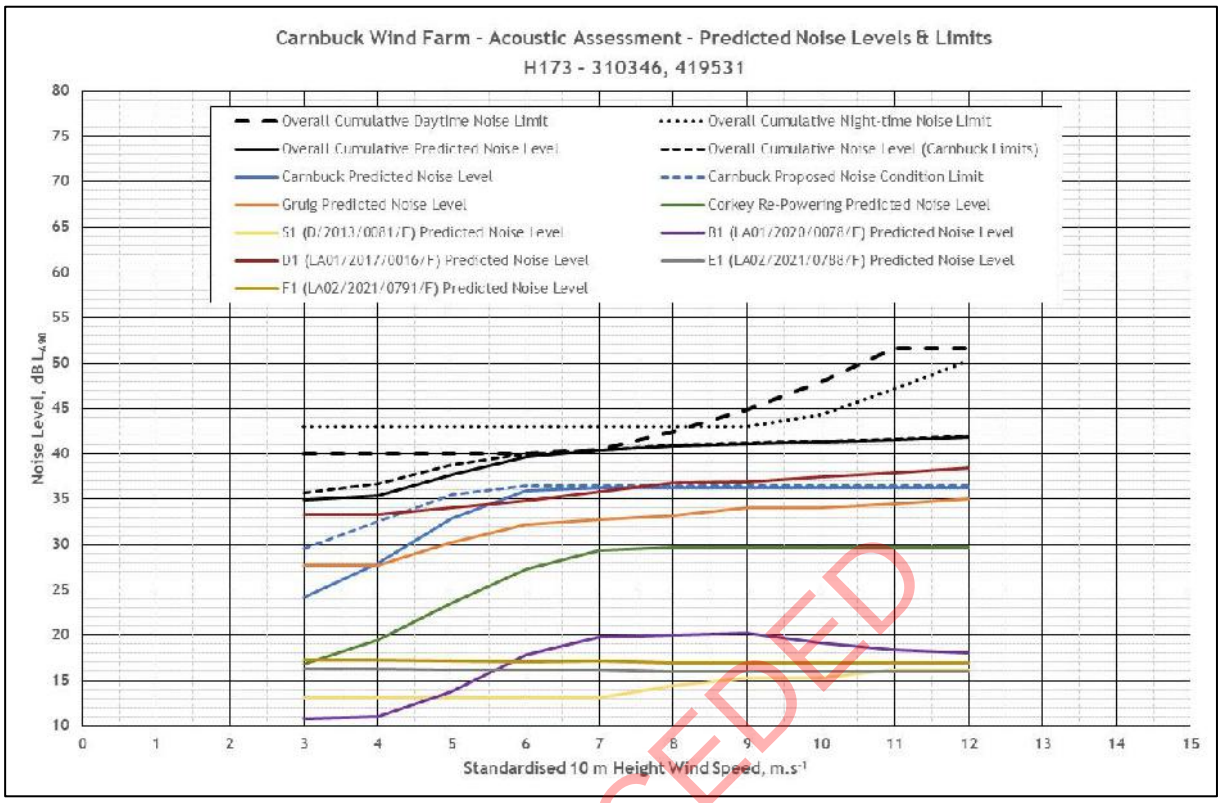


Chart A.30

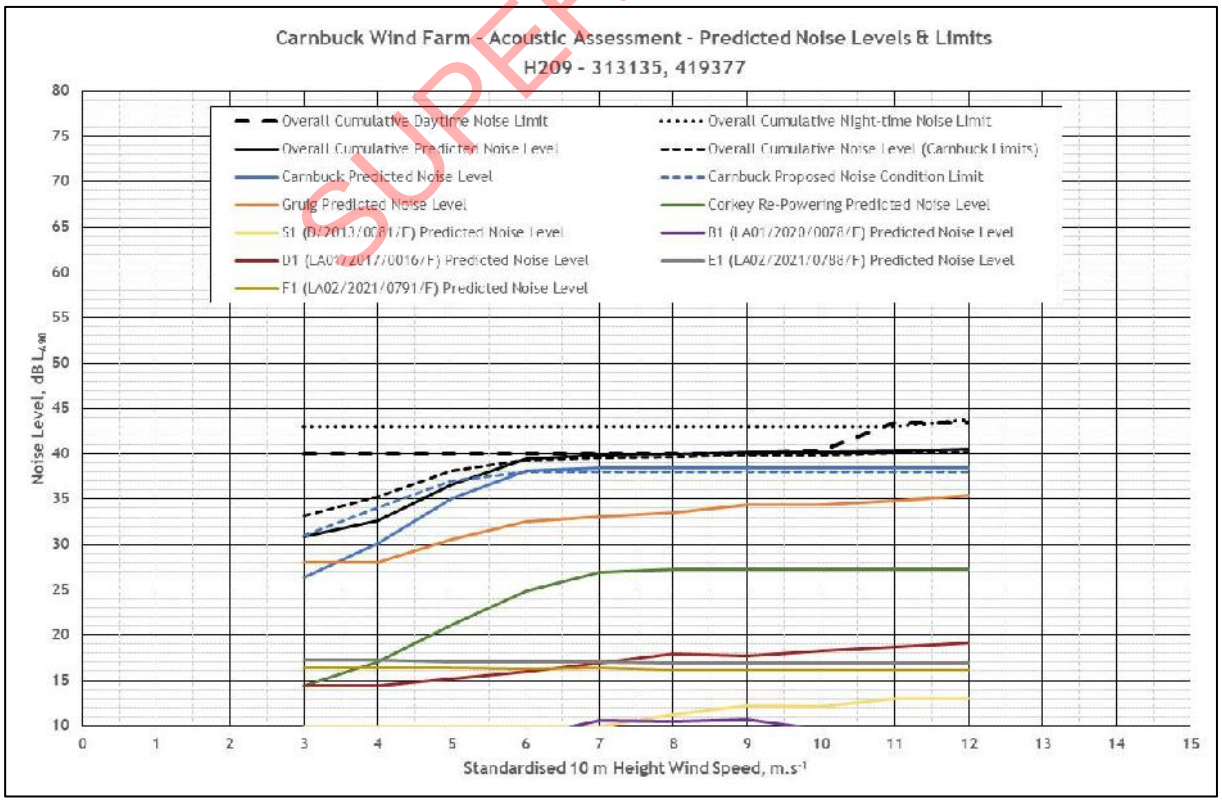


Chart A.31

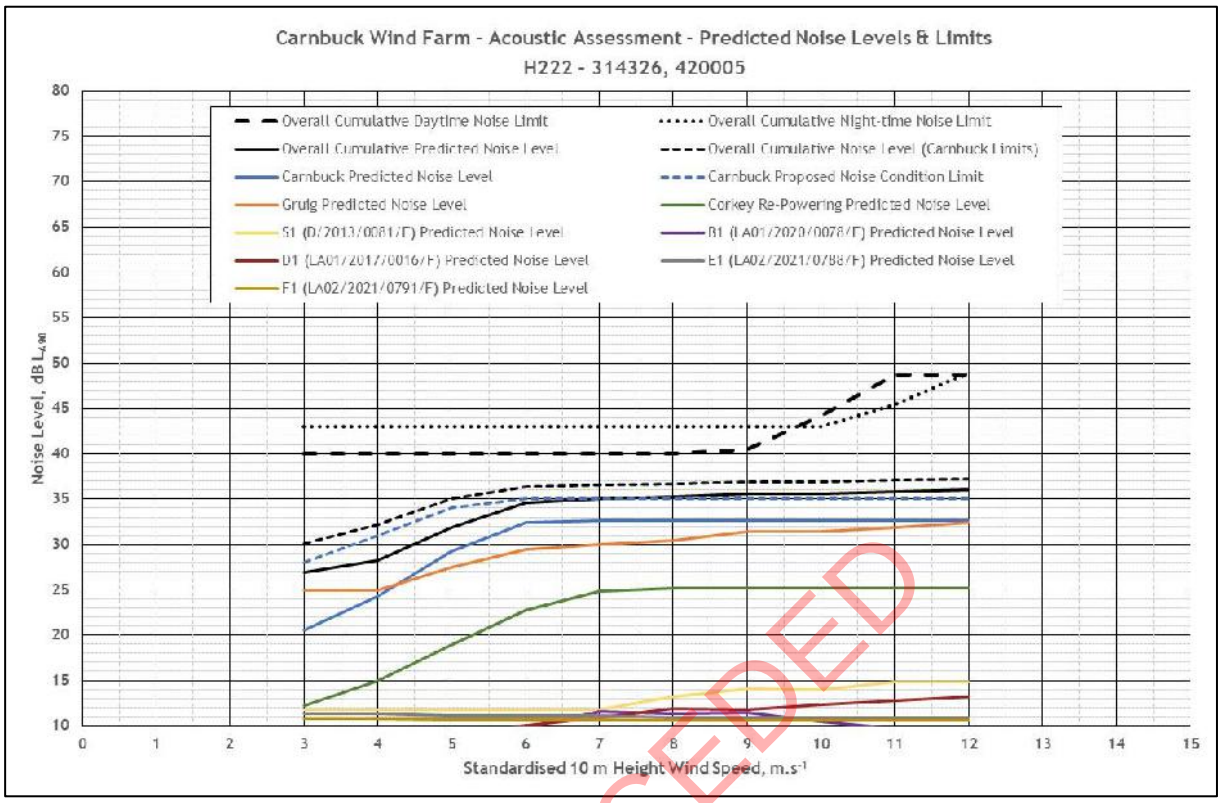
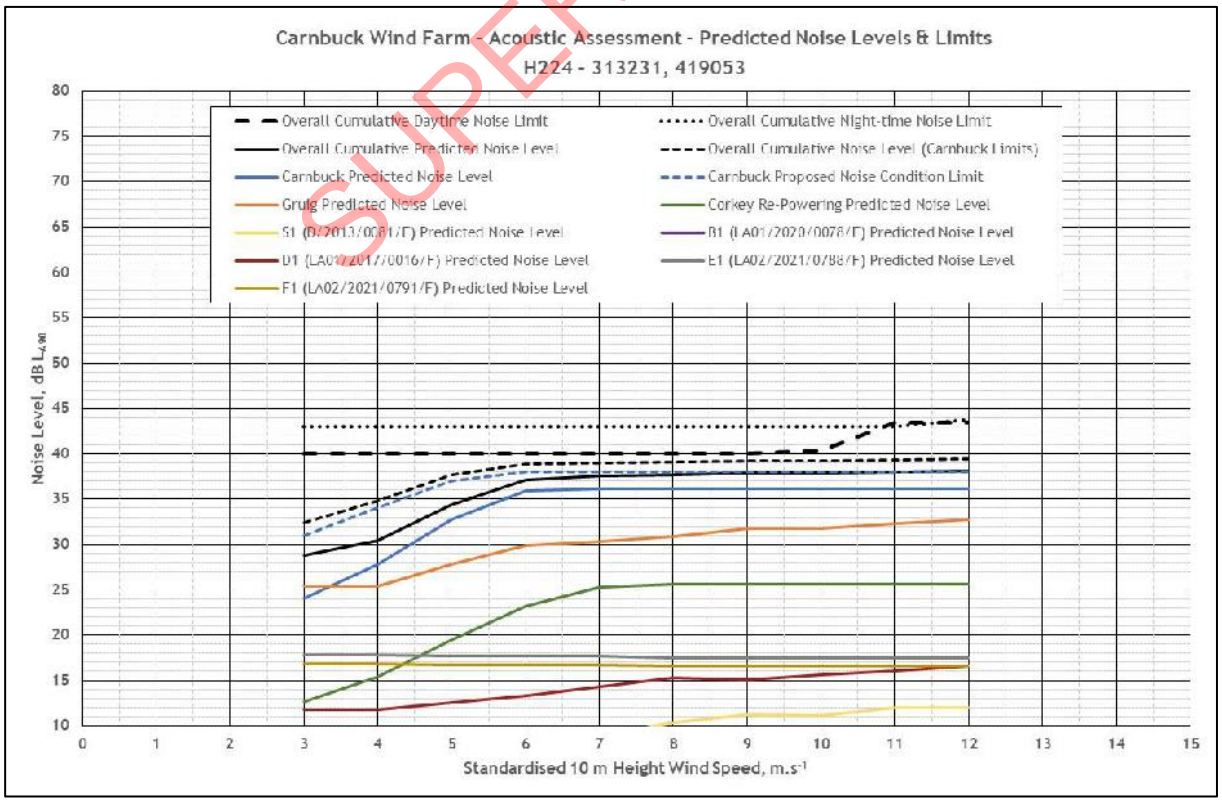


Chart A.32



APPENDIX B – PROPOSED PLANNING CONDITION WORDING

Introduction

In the event that the Proposed Development is successful in gaining planning consent, the decision notice would likely contain appropriately worded noise conditions.

Such conditions will provide a degree of protection to nearby residents should noise from the Proposed Development cause disturbance. To that end, presented below are a set of relevant, precise and enforceable conditions that RES suggest as appropriate. The form of condition wording suggested has been used for many wind farm developments and the final conditions attached to the consent would be according to the discretion of the decision maker.

Draft Planning Condition

The rating level of noise immissions from the combined effects of the wind turbines (including the application of any tonal penalty) when determined in accordance with the attached Guidance Notes (to this condition), shall not exceed the values for the relevant integer wind speed, set out in, or derived from, the Tables attached to this condition at any dwelling which is lawfully existing or has planning permission at the date of this consent and:

a. The Company shall continuously log power production, wind speed and wind direction, all in accordance with Guidance Note 1(d). These data shall be retained for a period of not less than 24 months. The Company shall provide this information in the format set out in Guidance Note 1(e) to the Planning Authority on its request, within 14 days of receipt in writing of such a request.

b. No electricity shall be exported until the Company has submitted to the Local Planning Authority for written approval a list of proposed independent consultants who may undertake compliance measurements in accordance with this condition. Amendments to the list of approved consultants shall be made only with the prior written approval of the Local Planning Authority.

c. Within 21 days from receipt of a written request from the Local Planning Authority following a complaint to it from an occupant of a dwelling alleging noise disturbance at that dwelling, the Company shall, at its expense, employ a consultant approved by the Planning Authority to assess the level of noise immissions from the wind farm at the complainants' dwelling in accordance with the procedures described in the attached Guidance Notes. The written request from the Local Planning Authority shall set out at least the date, time and location that the complaint relates to and any identified atmospheric conditions, including wind direction, and include a statement as to whether, in the opinion of the Local Planning Authority, the noise giving rise to the complaint contains or is likely to contain a tonal component.

d. The assessment of the rating level of noise immissions shall be undertaken in accordance with an assessment protocol that shall, prior to the commencement of any measurements, have been submitted to and approved in writing by the Local Planning Authority. The protocol shall include the proposed measurement location identified in accordance with the Guidance Notes where measurements for compliance checking purposes shall be undertaken and also the range of meteorological and operational conditions (which shall include the range of wind speeds, wind directions, power generation and times of day) to determine the assessment of rating level of noise immissions. The proposed range of conditions shall be those which prevailed during times when the complainant alleges there was disturbance due to noise, having regard to the written request of the Planning Authority under paragraph (c), and such others as the independent consultant considers likely to result in a breach of the noise limits.

e. Where a dwelling to which a complaint is related is not listed in the tables attached to these conditions, the Company shall submit to the Local Planning Authority for written approval proposed noise limits selected from those listed in the tables to be adopted at the complainant's dwelling for compliance checking purposes. The proposed noise limits shall be those limits selected from the Tables specified for a listed location which is the geographically nearest dwelling to the complainant's dwelling, unless otherwise agreed with the Local Planning Authority due to location-specific factors.

f. The Company shall provide to the Local Planning Authority the independent consultant's assessment of the rating level of noise immissions undertaken in accordance with the Guidance Notes within 2 months of the date of the written request of the Local Planning Authority for compliance measurements to be made under paragraph (c), unless the time limit is extended in writing by the Local Planning Authority. Unless otherwise agreed in writing by the Local Planning Authority, the assessment shall be accompanied by all data collected for the purposes of undertaking the compliance measurements, such data to be provided in the format set out in Guidance Note 1(e) of the Guidance Notes with the exception of audio data which shall be supplied in the format in which it is recorded. The instrumentation used to undertake the measurements shall be calibrated in accordance with Guidance Note 1(a) and certificates of calibration shall be submitted to the Local Planning Authority with the independent consultant's assessment of the rating level of noise immissions.

g. Where a further assessment of the rating level of noise immissions from the wind farm is required pursuant to Guidance Note 4(c), the Company shall submit a copy of the further assessment within 21 days of submission of the independent consultant's assessment pursuant to paragraph (d) above unless the time limit has been extended in writing by the Local Planning Authority.

Table 1 Noise Limits, dB L_{A90}

House ID	Standardised 10 m Height Wind Speed, $m.s^{-1}$									
	3	4	5	6	7	8	9	10	11	12
H1	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H2	23.0	26.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
H3	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H4	24.0	27.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
H5	26.0	29.0	32.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
H6	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H10	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H11	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H12	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H13	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H14	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H16	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H22	30.0	33.0	36.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
H24	26.0	29.0	32.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
H27	31.5	34.5	37.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
H33	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H34	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H39	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H45	30.0	33.0	36.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
H49	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H52	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H91	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H94	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H158	25.0	28.0	31.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
H162	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H164	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H165	27.0	30.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
H168	29.0	32.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
H173	29.5	32.5	35.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
H209	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
H222	28.0	31.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
H224	31.0	34.0	37.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0

Table 2 Co-Ordinate Locations of the Dwellings Listed at Table 1

ID	OSGB Co-Ordinates		ID	OSGB Co-Ordinates		ID	OSGB Co-Ordinates	
	X (m)	Y (m)		X (m)	Y (m)		X (m)	Y (m)
H1	309979	422676	H16	309474	420886	H94	311025	418993
H2	309761	422704	H22	310478	419181	H158	309337	421817
H3	309656	422220	H24	311566	418066	H162	309385	421272
H4	309384	421839	H27	313138	419356	H164	309513	421335
H5	309407	421621	H33	314432	420189	H165	309536	421306
H6	309586	421332	H34	309622	420847	H168	310037	419469
H10	309697	420992	H39	314273	419792	H173	310346	419531
H11	309512	421032	H45	310324	419519	H209	313135	419377
H12	309551	421004	H49	313292	419204	H222	314326	420005
H13	309596	420995	H52	312066	418151	H224	313231	419053
H14	309508	420901	H91	311806	418089			

Note to Table 2: The geographical coordinate references are provided for the purpose of identifying the general location of dwellings to which a given set of noise limits applies.

Reason: To protect the amenity of the area.

Guidance Notes

These notes are to be read with and form part of the noise condition. They further explain the condition and specify the methods to be employed in the assessment of complaints about noise immissions from the wind farm. The rating level at each integer wind speed is the arithmetic sum of the wind farm noise level as determined from the best-fit curve described in Guidance Note 2 of these Guidance Notes and any tonal penalty applied in accordance with Guidance Note 3. Reference to ETSU-R-97 refers to the publication entitled "The Assessment and Rating of Noise from Wind Farms" (1997) published by the Energy Technology Support Unit (ETSU) for the Department of Trade and Industry (DTI).

Guidance Note 1

(a) Values of the $L_{A90,10\text{-minute}}$ noise statistic should be measured at the complainant's property, using a sound level meter of EN 60651/BS EN 60804 Type 1, or BS EN 61672 Class 1 quality (or the equivalent UK adopted standard in force at the time of the measurements) set to measure using the fast time weighted response as specified in BS EN 60651/BS EN 60804 or BS EN 61672-1 (or the equivalent UK adopted standard in force at the time of the measurements). This should be calibrated in accordance with the procedure specified in BS 4142:1997 (or the equivalent UK adopted standard in force at the time of the measurements). Measurements shall be undertaken in such a manner to enable a tonal penalty to be applied in accordance with Guidance Note 3.

(b) The microphone should be mounted at 1.2 – 1.5 metres above ground level, fitted with a two-layer windshield or suitable equivalent approved in writing by the Local Planning Authority, and placed outside the complainant's dwelling. Measurements should be made in "free field" conditions. To achieve this, the microphone should be placed at least 3.5 metres away from the building facade or any reflecting surface except the ground at the approved measurement location. In the event that the consent of the complainant for access to his or her dwelling to undertake compliance measurements is withheld, the wind farm operator shall submit for the written approval of the Planning Authority details of the proposed alternative representative measurement location prior to the commencement of measurements and the measurements shall be undertaken at the approved alternative representative measurement location.

(c) The $L_{A90,10\text{-minute}}$ measurements should be synchronised with measurements of the 10-minute arithmetic mean wind and operational data logged in accordance with Guidance Note 1(d), including the power generation data from the turbine control systems of the wind farm.

(d) To enable compliance with the conditions to be evaluated, the wind farm operator shall continuously log arithmetic mean wind speed in metres per second and wind direction in degrees from north at hub height for each turbine, and at any on site meteorological mast(s), if available, together with the arithmetic mean power generated by each turbine, all in successive 10-minute periods. All 10-minute arithmetic average mean wind speed data measured at hub height shall be 'standardised' to a reference height of 10 metres as described in ETSU-R-97 at page 120 using a reference roughness length of 0.05 metres. It is this standardised 10 metre height wind speed data, as determined from whichever source is agreed in writing with the Local Planning Authority as being most appropriate to the noise compliance measurements being undertaken, which is correlated with the noise measurements determined as valid in accordance with Guidance Note 2, such correlation to be undertaken in the manner described in Guidance Note 2. All 10-minute periods shall commence on the hour and in 10-minute increments thereafter.

(e) Data provided to the Local Planning Authority in accordance with the noise condition shall be provided in comma separated values in electronic format.

(f) A data logging rain gauge shall be installed in the course of the assessment of the levels of noise immissions. The gauge shall record over successive 10-minute periods synchronised with the periods of data recorded in accordance with Note 1(d).

Guidance Note 2

(a) The noise measurements shall be made so as to provide not less than 20 valid data points as defined in Guidance Note 2 (b).

(b) Valid data points are those measured in the conditions specified in the agreed written protocol under paragraph (d) of the noise condition but excluding any periods of rainfall measured in the vicinity of the sound level meter. Rainfall shall be assessed by use of a rain gauge that shall log the occurrence of rainfall in each 10-minute period concurrent with the measurement periods set out in Guidance Note 1.

(c) For those data points considered valid in accordance with Guidance Note 2(b), values of the $L_{A90,10\text{-minute}}$ noise measurements and corresponding values of the 10- minute standardised ten metre height wind speed, as derived from the site measured wind speed source(s) agreed in writing with the Planning Authority in accordance with Guidance Note 1(d), shall be plotted on separate XY charts for each wind direction considered, with noise level on the Y-axis and the standardised mean wind speed on the X-axis. A least-squares, "best fit" curve of an order deemed appropriate by the independent consultant (but which may not be higher than a fourth order) should be fitted to the data points and define the wind farm noise level at each integer speed and direction.

Guidance Note 3

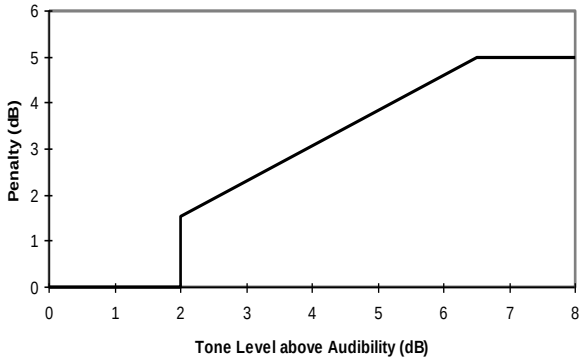
(a) Where, in accordance with the approved assessment protocol under paragraph (d) of the noise condition, noise immissions at the location or locations where compliance measurements are being undertaken contain or are likely to contain a tonal component, a tonal penalty is to be calculated and applied using the following rating procedure.

(b) For each 10-minute interval for which $L_{A90,10\text{-minute}}$ data have been determined as valid in accordance with Guidance Note 2 a tonal assessment shall be performed on noise immissions during 2 minutes of each 10-minute period. The 2-minute periods should be spaced at 10-minute intervals provided that uninterrupted uncorrupted data are available ("the standard procedure"). Where uncorrupted data are not available, the first available uninterrupted clean 2-minute period out of the affected overall 10-minute period shall be selected. Any such deviations from the standard procedure, as described in Section 2.1 on pages 104-109 of ETSU-R-97, shall be reported.

(c) For each of the 2-minute samples the tone level above or below audibility shall be calculated by comparison with the audibility criterion given in Section 2.1 on pages 104-109 of ETSU-R-97.

(d) The average tone level above audibility shall be calculated for each wind speed bin, each bin being 1 metre per second wide and centred on integer wind speeds, for each wind direction. Samples for which the tones were below the audibility criterion or no tone was identified, a value of zero audibility shall be substituted.

(e) The tonal penalty for each wind speed bin is derived from the margin above audibility of the tone according to the figure below.



Guidance Note 4

(a) If a tonal penalty is to be applied in accordance with Guidance Note 3 the rating level of the turbine noise at each wind speed and wind direction is the arithmetic sum of the measured noise level as determined from the best fit curve described in Guidance Note 2 and the penalty for tonal noise as derived in accordance with Guidance Note 3 at each integer wind speed and wind direction within the range specified by the Local Planning Authority in its written protocol under paragraph (d) of the noise condition.

(b) If no tonal penalty is to be applied then the rating level of the turbine noise at each wind speed and wind direction is equal to the measured noise level as determined from the best fit curve described in Guidance Note 2.

(c) In the event that the rating level is above the limit(s) set out in the Tables attached to the noise conditions or the noise limits for a complainants' dwelling approved in accordance with paragraph (e) of the noise condition, the independent consultant shall undertake a further assessment of the rating level to correct for background noise so that the rating level relates to wind turbine noise immission only.

(d) The wind farm operator shall ensure that all necessary wind turbines in the development are turned off for such period as the independent consultant requires to undertake any further noise measurements required under Guidance Note 4(c). If the number of turbines to be turned off are less than the total number of turbines on the site then this shall be agreed in advance with the Planning Authority.

(e) To this end, the steps in Guidance Note 2 shall be repeated with the required number of turbines shutdown in accordance with Guidance Note 4(d) in order to determine the background noise (L3) at each integer wind speed within the range requested by the Planning Authority in its written request under paragraph (c) and the approved protocol under paragraph (d) of the noise condition.

(f) The wind farm noise (L1) at this speed shall then be calculated as follows where L2 is the measured level with turbines running but without the addition of any tonal penalty:

$$L_1 = 10 \log \left[10^{L_2/10} - 10^{L_3/10} \right]$$

(g) The rating level shall be re-calculated by arithmetically adding the tonal penalty (if any is applied in accordance with Note 3) to the derived wind farm noise L1 at that integer wind speed and wind direction.

(h) If the rating level after adjustment for background noise contribution and adjustment for tonal penalty (if required in accordance with Guidance Note 3 above) at any integer wind speed and wind direction lies at or below the values set out in the Tables attached to the conditions or at or below the noise limits approved by the Planning Authority for a complainant's dwelling in accordance with paragraph (e) of the noise condition then no further action is necessary. If the rating level at any integer wind speed and wind direction exceeds the values set out in the Tables attached to the conditions or the noise limits approved by the Local Planning Authority for a complainants' dwelling in accordance with paragraph (e) of the noise condition, then the development fails to comply with the conditions.

3

Vegetation & Peatland

3. Vegetation and Peatland

3.1 A DAERA Planning Response Team consultation response dated the 31st of May 2024, NED outlined that further information was required to fully assess the likely impacts on natural heritage interests. Further information was requested on a number of topics as indicate below:

- Clarification as to whether the habitat present at quadrats Q11, Q12, Q13, Q62, Q34, Q57 and Q60 are wet heath or blanket bog.
- Active peat maps of the areas around the proposed track east of Turbine 6 and the tracks to the east and west of Turbine 7.
- A Phase 1 map of the whole proposed oHMP area.
- A breakdown of the hectarage of NIPHs that will be permanently or temporarily impacted by the proposed works.
- A map showing the Gruig HMP and Carnbuck oHMP areas.
- An assessment as to whether the Gruig HMP delivered all management measures, including the drain blocking, and achieved its objectives.
- Clarification regarding the peat depths for the floating track locations.
- An assessment of impacts to peatland unit hydrology resulting from floating road subsidence.
- Measures for Hen Harrier included in the Habitat Management Plan.

3.2 This Section of the Further Environmental Information addresses each of these requests for further information. Information was provided by Blackstaff Ecology (Ecology Consultancy), David Steele (Ornithology), Natural Power (Peatland Consultants).

Clarification whether the habitat present at quadrats are wet heath or blanket bog

3.3 The Q11-Q12: This is an area of intensively cutover bog, resulting in shallow residual peat depths. The recolonising vegetation is most likely to represent a recolonisation of the original bog flora. As regards the shallow peat depth, this area cannot be regarded as having a mature peat profile and the supported vegetation is not a result of the evolution of heath vegetation but rather the re-establishment of the former blanket bog flora on residual peat.

3.4 Q34: This quadrat identifies wet heath on peat with a depth of 50cm. This conforms to the generally accepted definition of heath flora on peat that is at the depth limit of the defined habitat. The vegetation community at this location is rather indeterminate in terms of NVC classification, with a moderately high cover of both bog and pleurocarpous mosses, and with a relatively low *Calluna* cover. The quadrat is on the edge of a mapped flush and likely represents a localised

transition between mapped marshy grassland and flush habitats that is not of sufficient scale or significance to be considered in detail.

3.5 Q57: This quadrat refers to modified bog that has some characteristics of wet heath. It is recorded as bog M15c/M19 in the quadrat table. It is more logically identified simply as M19 blanket mire, and is mapped as modified bog in the Phase 1 habitat map.

3.6 Q60: This quadrat is identified as bog due to its depth (90cm) but has been mislabelled as M15 wet heath. It has been correctly mapped as modified bog in the Phase 1 habitat map.

3.7 Q62: This quadrat has been identified as heat, due to the peat depth of 45cm, but has been correctly labelled as M19a blanket mire. The quadrat records recolonising bog vegetation (see note for Q11-Q12 above) and is correctly mapped as modified bog in the Phase 1 habitat map.

3.8 It is noted in the DAERA Natural Environmental Division Response (31.05.24) that:

> *"NED considers that Hare's-tail Cottongrass Eriophorum vaginatum can also be considered to be a peat-forming species. The ES states that the M23b rush pasture and M20a mire habitats present at Q28 on the route of the proposed track east of Turbine 6 are not considered to be peat-forming. However, the data for Q28 shows that, while Sphagnum cover is low and not peat-forming (15% S.fallax and 3% S. palustre), E. vaginatum cover is 85% and peat depth is 65cm, so the peat at Q28 on the route of the proposed track east of T6 is potentially active."*

3.9 The definition of active peat adopted by NIEA requires that E. vaginatum/ angustifolium is present in significant quantities with some Sphagnum and that active peat should be present over a significant area. While Q28 supports a high cover of E. vaginatum, the low cover of Sphagnum is of species that are generally regarded as non-peat forming. The abundance of E. vaginatum may reflect its location on the edge of a mapped flushed area. Further, it is not considered that the area with high E. vaginatum cover is significant in terms of area – the closest quadrats to Q28 are Q34 (38m to the west) and Q35 (56m to the east), which support 5% and 8% cover respectively.

NED require active peat maps of the areas around the proposed track east of Turbine 6 and the tracks to the east and west of Turbine 7

3.10 The DAERA Natural Environmental Division Response (31.05.24) states that:

> *"Target Note 119 is located north of and within the development boundary around the access track to the east of Turbine 7. It was recorded as potentially active peat on wet modified bog with abundant Sphagnum throughout. Q43 on the track west of Turbine 7 has a peat depth of 65cm, and an E. vaginatum cover of 70%. This quadrat could potentially support active peat. Quadrats Q39 and Q41 along the proposed track to the east of Turbine 7 both had a peat depth of over 1m. Q39 was recorded as M20a blanket mire, but had a significant E. vaginatum cover of 70%. Q41 was recorded as M19 blanket mire and had an E. vaginatum cover of 65%. These quadrats could potentially support active peat."*

3.11 Q39 and Q41 are within the area mapped as supporting active peat. Quadrat Q43 has many of the same species, however, interrogation of the aerial photography clearly shows a transition in vegetation type/colour (with significant drainage (as the land gradually falls away towards the river)). The transition from active peat to wet modified bog is often gradual, and along a gradient; therefore, Q43 is likely on a transitional area. Target Note 119 is closer to an area of wet modified bog located directly to the north of the TN in question. The area of potentially active peat is presented in Figure 3.3.

Breakdown of hectarage of NIPHs that will be permanently of temporarily impacted by the proposed works

3.12 The habitat loss calculations (including NIPHs) presented in Chapter 6, Table 6.8 were calculated using a continuous 1.5m buffer around all construction structures and an 8m wide track (5m for running surface, including shoulders, and 1.5m either side for drainage. Therefore, the temporary impacts arising from construction were simply included with the overall habitat loss calculations (on a precautionary basis) and therefore, the impact was assessed on a combined basis. While Floating track was calculated, using actual width of 4.5m.

Map showing the Gruig HMP and Carnbuck OHMP Areas

3.13 A map of the whole proposed Carnbuck oHMP area and the Gruig HMP area is presented in Figure 3.1.

A Phase 1 Map of the Whole Proposed OHMP Areas

3.14 A Phase 1 map of the whole proposed oHMP area is presented in Figure 3.2, along with appended target notes.

Assessment as to whether Gruig HMP Delivered all management measures, including the drain blocking and achieving its objectives

3.15 NED have also requested that an assessment is completed evaluate whether the Gruig HMP has achieved its objectives. It is noted that RES do not operate or provide asset management services to this wind farm, and therefore are not able to retrieve the necessary confidential data to assess whether the Gruig HMP has achieved its objectives. We understand that under the planning permission (D/2004/0790/F) for Gruig Wind Farm that condition 8 relates to Hen Harrier monitoring and condition 9 relates to the submission of a habitat management plan. These conditions have been implemented to monitor and ensure the habitat management programme is delivering benefits to Hen Harriers in terms of potential breeding sites, foraging habitat and winter roosting. We believe that this information with regards to the monitoring of the HMP would have been submitted to the NIEA. The relevant conditions are outlined below:

Condition 8

Ornithology monitoring shall be carried out in years 1 (year of construction), 2,3,5 and 10 and 20 in respect of Hen Harrier. The survey methodology shall be agreed in writing with the Department prior to the commencement of any preparation or construction activity. A written report shall be submitted to the Department at the end of each survey period and should include details of ecological monitoring and habitat management/ enhancement.

Condition 9

A habitat management plan shall be submitted to and agreed in writing with the Department prior the commencement of construction. The plan shall include heather management details, appropriate grazing, fencing and onsite management proposals. This agreed plan shall be actively implemented throughout the lifetime of the wind farm operations.

Clarification regarding the peat depths for floating track locations

3.16 It is noted that the northern portion of the track relates to existing infrastructure currently in position for the Gruig Wind Farm, and therefore the proposal would plan on using the existing tracks located within this area; hence not marked as floating track.

3.17 **Table 3.1 below indicates mean peat depths at floated road locations:**

Track Locations	Mean Peat Depths
Entrance to T12	1.50m
T12 to T10	1.20m
T10 to T8	0.70m
T8 to T6	1.50m
T9 Spur	1.80m
T11 Spur	2.0m

3.18 Floating construction of tracks is proposed where peat depths are consistently deeper than 0.5m and where slop geometry is acceptable, which is the case for all those tracks highlighted by the NIEA and presented in Table 3.1 above.

3.19 The feasibility of the floated track 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.

Assessment on impacts to peatland unit hydrology resulting from floating road subsidence

3.20 A Geotechnical Advice Note completed by Natural Power is presented in Appendix 3.1. The advice note is aimed at providing additional commentary on the potential impact on peatland hydrology from the use of floating tracks, focusing on investigation, assessment, and discussion of suitable design approaches for floating track at the Development.

3.21 Due to highly variable and non-linear geotechnical behaviour of peat soils, site-specific ground investigation would be undertaken to ensure these effects can be understood as closely as possible for the site-specific conditions.

3.22 It is concluded within the Natural Power Geotechnical Advice Note that floating construction is likely to have a lower impact on the peatland hydrology compared to a traditional cut and fill track. Natural Power concludes that with the application of a detailed survey, investigation and design elements, the implementation of floating access track at Carnbuck Wind Farm will minimise impact to peatland hydrology.

3.23 It is noted that floated track was used in sections across the Gruig Wind Farm located adjacent to the proposed Carnbuck Wind Farm site; no issues of settlement and therefore impacts on peatland hydrology were noted.

3.24 Further information is presented in Appendix 3.1.

Measures for Hen Harrier in the Habitat Management Plan

3.25 Finally, the NED requested that measures for Hen Harriers are included within the Habitat Management Plan. The FEI outlines the measures for the Hen Harriers included within the HMP:

Overview

- For hen harriers the objective of the habitat management will be to improve foraging opportunities for this species within the Habitat Management Area (80.25 ha).
- This would be achieved principally by way of a grazing regime designed to improve and maintain the quality and structure of the vegetation.
- A mosaic of taller tussocks (e.g. of soft rush or heather) and more open areas is likely to increase densities of prey species and also create the type of vegetation cover favoured by foraging harriers.
- The harrier measures are proposed without prejudice to the wider objectives of the HMP however habitat measures that are beneficial for breeding waders, wet heath, blanket bog rush pasture and semi-improved grassland are also likely to be beneficial for foraging harriers.

Habitat Objectives

- Numerous habitat edges created by a mosaic of taller and shorter vegetation.
- Taller tussocks (>30 cm) of soft rush, heather or similar species covering typically 60 – 70 % of the area.
- Shorter sward covering typically 30 – 40 % of the area.
- Damp or wet areas within the habitat are to be maintained.

Specific Dates and Measures

- 15th March – 14th July: this is the main breeding season for the hen harrier's principal prey species (small moorland birds) and no management activities except grazing should be carried out during this period; grazing should continue however stocking density should be low (no more than 0.75 LU per hectare is recommended during this period).
- 15th July – 14th March: other management activities that might be required (e.g. rush cutting, scrub control and management of drainage features) can be carried out during this period however if late breeding snipe are present

the dates are 15th August – 14th March; grazing density is not specified during this period however it is important that overgrazing is not allowed to occur.

- The specific measures are to be implemented within all of the Habitat Management Area.

APPENDIX 3.1 – FLOATING ROADS & IMPACT ON PEAT HYDROLOGY

Natural Power (Geotechnical Advice Note)			
To	RES: Garth McGimpsey	Date	16/01/2025 11:00:00
From	Gavin Germaine	Ref.	1370656

Carnbuck Wind Farm

Floating roads & impact on peatland hydrology

Introduction

A planning application has been submitted for the proposed Carnbuck Wind Farm development, Co Antrim. The renewable energy scheme if consented shall comprise:

- Up to x12 wind turbine generators with supporting access and electrical infrastructure.

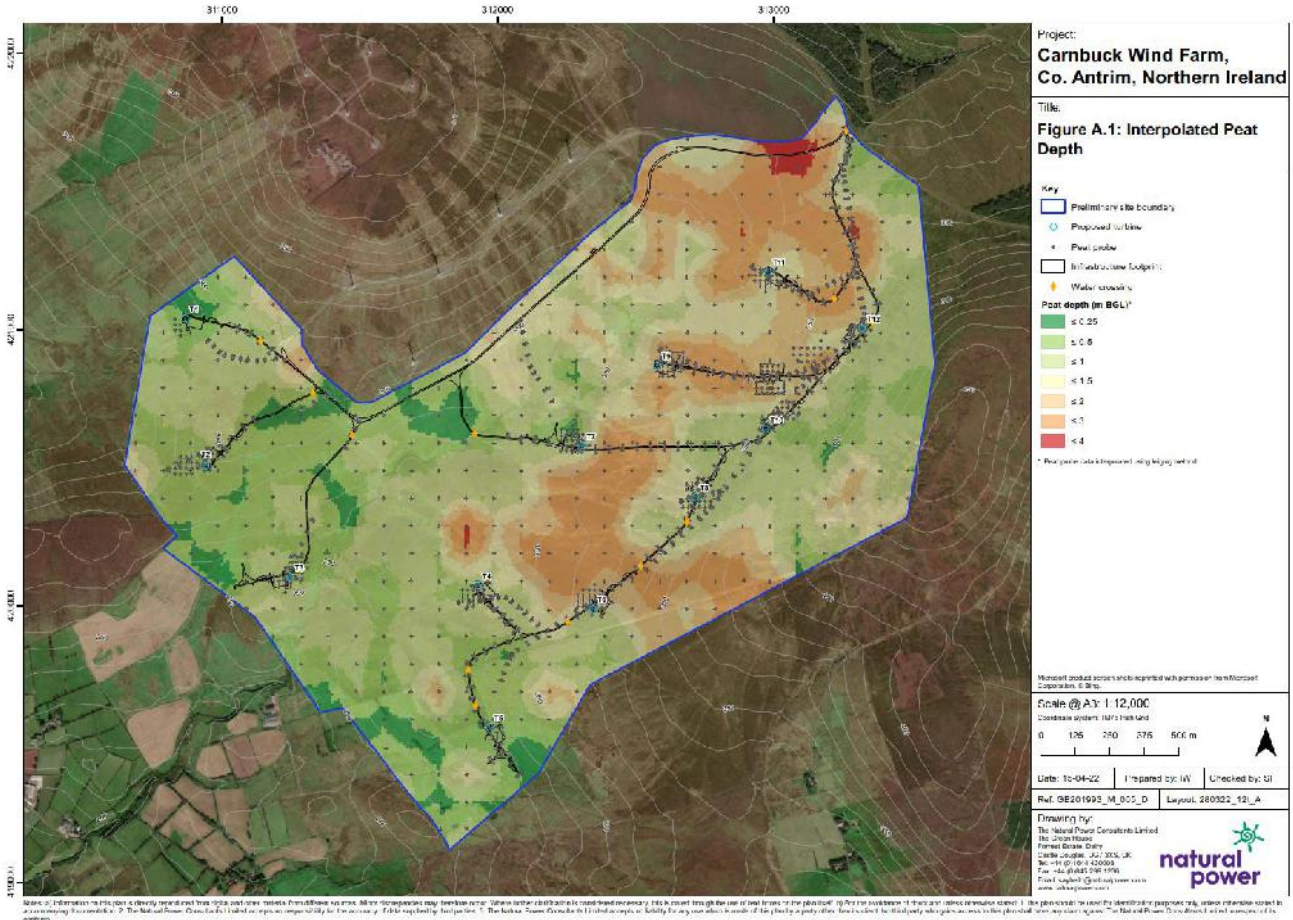
The proposed development interacts with non-contiguous areas of peatland. These organic accumulations form shallow layers across the higher elevations of the development. Deeper pockets of peat have formed across lower topographic zones. A detailed presentation of the peat coverage is provided at Figure A.1.

The proposed turbine foundation and main infrastructure locations have been optimised to avoid the deepest areas of peat. However, the access track network will be required to cross deep peat in the following areas:

- Track section T6-T8
- Track section to T9
- Track section T7-T10
- Track section entrance to T11

Outlined in the Peat Slide Risk Assessment Report (Ref: 1218617) and Peat Management Plan (Ref: 1277447) are recommendations for the consideration of floating track construction to cross areas of deep peat.

Figure 1 Peat Depth Map Information



Floating track construction is proposed as part of the Development to meet two key objectives:

- Floating track construction, which leaves the deposits insitu is aimed at lowering the risk of peat instability (e.g., peat slide or other mass movement). The floating track is considered by the peat slide risk assessment to have overall a reduced impact to the internal groundwater flow within the peat mass and therefore is reducing the risk of peat slide.

- The use of floating track and other low volume construction techniques is aimed at avoiding the mass excavation of peat material. Thus, reducing significant impact on the peatland through removal and interruption of the groundwater system and the vital carbon sink.

The developer has received a request for further environmental information. Where the Northern Ireland Environment Agency (NIEA) have stated:

'While NED notes that floating tracks across deep peat results in less excavated peat than cut tracks, there is a potential for permanent floated tracks to gradually subside over time. This could impact hydrology in the peatland habitats. NED therefore require an assessment of impact to peatland unit hydrology resulting from floating road subsidence".

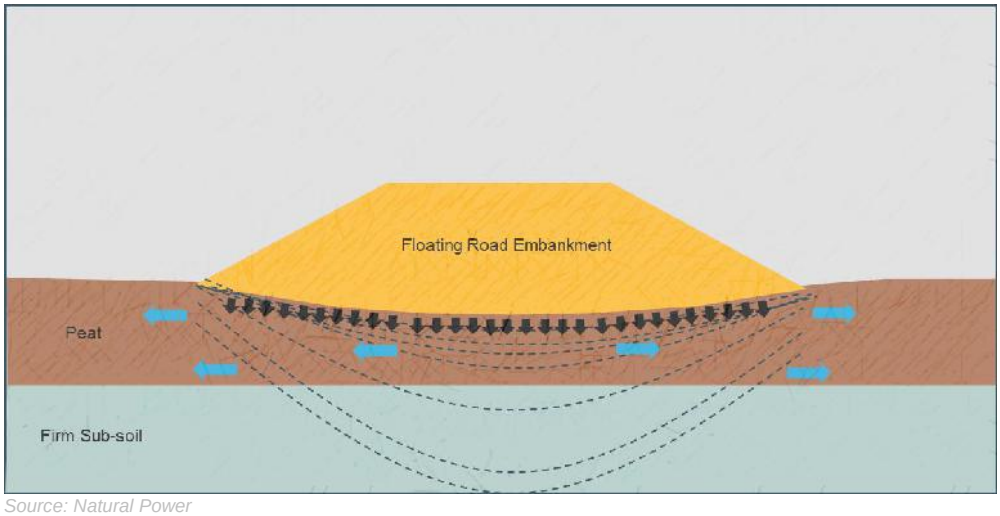
This geotechnical advice note is aimed at providing additional commentary on the potential impact on peatland hydrology from the use of floating tracks. Focus is on investigation, assessment, and discussion of suitable design approaches for floating track at the Development.

Floating Road Concept

Floating construction imparts a surface load and hence bearing pressure onto the insitu peat mass. Overtime the peat soil mass will undergo a process of consolidation settlement. This is driven by a complex process and interplay over two main stages. The expulsion of soil porewater from the peat mass under load as well as stresses being transferred onto the soil matrix leading to further deformation and compression. Permeability of the consolidated peat soil can reduce and therefore affect the ability of the peat soil to act as an infiltration medium for surface water and this may also affect groundwater flow within the peat. Figure 2 provides a schematic view of the process.

The rate and magnitude at which these processes operate is nonlinear and controlled by a wide range of factors. Understanding the detailed makeup of the peat, underlying sub-soils, surface loading and frequency will all affect the consolidation process. The existing drainage condition and the introduction of additional drainage may also impact the rate and magnitude of settlement.

Figure 2: Cross section schematic of floating embankment over peat



Source: Natural Power

Background Information

In the UK floating infrastructure across peatland has been adopted in the construction of major infrastructure (railways and roads) since the early 19th Century.[1] More recently and following the development of advanced geosynthetic materials (geo-grid and geo-textiles); floating construction has been used across wind farm and infrastructure routinely over the last decade[2]. Key drivers being the more efficient construction technique with a perceived lower environmental impact.

Informing the geotechnical peat studies including the peat slide risk assessment and peat management plan at Carnbuck Wind Farm are a variety of national guidance and publications. These provide a range of information, strategies and case studies for environmentally sensitive construction over peatland. Key documents relevant to the development are cited below and based on UK experience:

- **Floating Roads on Peat**, A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with reference to Wind Farm Developments in Scotland, Prepared by Forestry Civil Engineering Scottish Natural Heritage August 2010.[3]
- **Constructed tracks in the Scottish Uplands**, NatureScot (SNH) 2nd Edition Updated 2015.[4]
- **Forestry Commission Operations Note 25,** Forest roads and tracks, 2011.[5]
- **The impacts of tracks on the integrity and hydrological function of blanket peat,** Natural England (NEER002)[6]
- **Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Development,** Prepared for Energy Consents Unit Scottish Government, Second Edition, April 2017.[7]
- **Guidelines for the Risk Management of Peat Slips on the Construction of Low Volume/Low-Cost Roads over Peat**, MacCulloch, F. (2006).[8]
- **Good practice during wind farm construction,** NatureScot, July 2024.[9]

Best Practice Construction

The design and construction of floating road at Carnbuck Wind Farm shall follow relevant the national guidance as highlighted above. Detailed geotechnical design will also be undertaken, including where additional systems such as geosynthetic materials, reinforced and lightweight fills are used. Ultimately the track design and final make-up will form part of the wider civil infrastructure design. This is carried out during the pre-construction phase and following the main phase of detailed ground investigation.

As well as the environmental considerations the design shall be capable of supporting the wind turbine delivery components including HGV and abnormal indivisible loads (AILs) which need to traverse the access track network. Wind turbine supplier design specifications should therefore also be incorporated into the final track design for bearing capacity and geometry.

[1] IUCN UK Committee Peatland Programme Briefing Note No. 12
[2] https://www.tensar.co.uk/resources/guides/floating-roads-on-peat-guidance.
[3] https://www.roadex.org/wp-content/uploads/2014/01/FCE-SNH-Floating-Roads-on-Peat-report.pdf
[4] https://www.nature.scot/doc/archive/constructed-tracks-scottish-uplands
[5] https://www.gov.uk/government/publications/roads-and-tracks-operations-note-25
[6] GRACE, M., DYKES, A. P., THORP, S. P. R. & CROWLE, A.J.W. 2013. Natural England review of upland evidence - The impacts of tracks on the integrity and hydrological function of blanket peat. Natural England Evidence Review, Number 002.
[7] https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2017/04/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/documents/00517176-pdf/00517176-pdf/govscot%3Adocument/00517176.pdf
[8] https://www.roadex.org/wp-content/uploads/2014/01/Guidelines-for-the-Risk-Management-of-Peat-Slips.pdf
[9] https://www.nature.scot/doc/good-practice-during-wind-farm-construction

To minimise the impact on the underlying peat soils and surrounding hydrology, the following control measures would be integral to the final design:

- The selection and appointment of an approved and experienced contractor with a proven track record of construction of peat floating roads and safe operation in peatland environments.
- Use of specialist low ground pressure construction plant for the construction phase. To ensure build-out of the floating track imparts the lowest possible ground pressure. This shall help minimise consolidation settlement and risk of peat failure. This should be coupled where appropriate with the use of long reach excavation plant. This can be a suitable strategy to reduce tracking of heavy plant and excessive loading of deep peat areas during construction.
- Prevent the disturbance and rupture of peat surface by avoiding the use of large diameter, sharp rock clasts during initial fill placement. Maintaining the integrity and strength of the fibrous vegetated surface of the peat.
- A slow, measured pace of construction of floating roads on peat to ensure primary consolidation and dissipation of excess groundwater pressure can occur within the peat soil. This will reduce potential for shear failure and control the overall rate of settlement.
- The use of approved geotextile and geo-grid reinforced fill to protect the peat surface and reduce bearing pressure from the floating road on the peatland. This can reduce rate and overall magnitude of consolidation settlement over the lifetime of the project.
- Consideration for the use of engineered lightweight fill (Lightweight Aggregate - LWA) within the floating track construction. LWA fills have a lower bulk density and can offer reduced settlement and increased stability. They are free draining and chemically inert. Suitable products would be subject to design assessment and require importation from a specialist supplier.
- Monitoring of settlement of the floating road and shallow groundwater levels at regular intervals along the floating track sections. To be undertaken during the construction phase with post construction monitoring depending on outcome.
- Implement drainage and drainage relieve measures where increased groundwater pressures / levels are recorded on either side of the access track. To ensure groundwater flows are preserved.
- Avoidance of floating track construction across sloping ground or complex terrain typically more than >5% grade.
- Implement HGV traffic restrictions. With prohibition and restriction of vehicle loading in line with the geotechnical design. Control on the frequency and timing of the floating track used for HGVs to reduce effects of cyclical loading which may increase subsidence of the road and underlying peat.
- Regular visual inspection during construction phase to detect any significant deformation or signs of failure in the floating road construction or underlying peatland.

Drainage

The aim for the floating track design will be to ensure that the naturally established hydrology at the site is maintained. The targeted drainage strategy will incorporate:

- Use of sustainable drainage systems to ensure environmentally compliant discharge which mimics natural drainage patterns specific to the site.
- Avoiding the use of interceptor drainage systems where the floating track crosses flat ground.

- On gently sloping ground provide interceptor drainage uphill of the floating road system and use culverts to transmit surface water run-off through the road construction to the downslope peatland.

- Culverts designed tied into the floating road construction to ensure performance is maintained even with moderate settlement. Geo-grid wrap is used to keep drainage system integral to the road embankment.

- The frequency of installed cross drains shall be sufficient to ensure the natural supply in surface run-off can be maintained on the downslope side of the track construction.

- The use of flat ditches where interceptors are used to minimise any effect on the local hydrology. Shallow outfalls shall similarly be used to ensure a diffuse outflow pattern onto the peatland to mimic natural conditions.

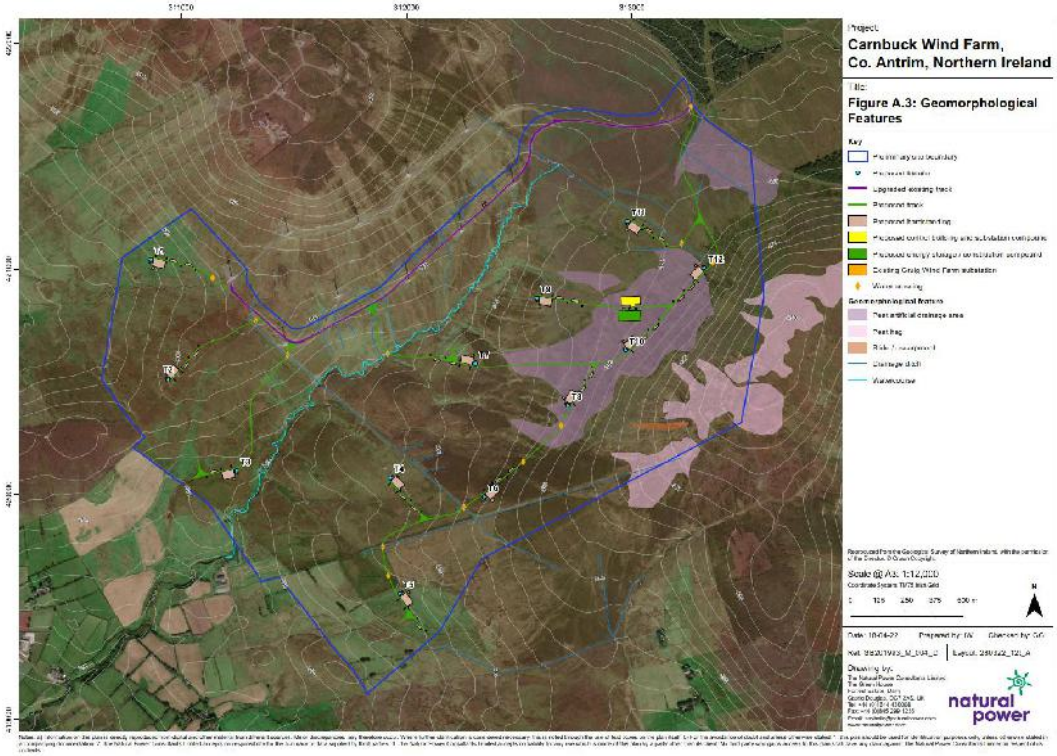
- Identification of springs and flushes and the strategic use of drainage blankets to successfully intercept and transmit flow through the floating road construction.

- Low impact cable installation would be prioritised for floating roads. This shall minimise any effects on the groundwater system.

The proposed floating track sections cross flat to gently sloping terrain. Based on the previous studies at the site; the low-lying areas of peat have been subject to historical land drainage practices. Thes have been undertaken to modify the peatland for activities such as animal grazing, peat cutting or preparation for forestry planting. Figure A.3 identifies these areas based on the previous studies.

It is therefore important to highlight that the current hydrological condition is that of a modified peatland. The groundwater level is artificially lowered by the cutting of regular ditches. This historical intervention in the peatland may therefore have already subjected the peat mass to a degree of consolidation settlement through the expulsion of pore waters which can lead to settlement of the drained peat layer under its self-weight.

Figure A.3 – Geomorphological Features



The application of drainage measures shall be carefully considered by the infrastructure design for Carnbuck Wind Farm. Increasing drainage capacity of the peatland beneath the floating construction can have the effect of increasing rates and magnitude of consolidation settlement. This can force a negative feedback loop. Increased drainage leads to increased compression and reduced permeability through the peat mass. This situation shall be avoided.

The drainage design shall be based on a detailed pre-construction topographical and hydrological feature survey coupled with monitoring of the construction. Any adverse changes in settlement and groundwater levels can then be tackled with additional relief drainage if required.

Gathering further information

As part of the pre-construction phase of works a detailed ground investigation would be undertaken to provide additional geotechnical and hydrological design parameters for the peatland floating track infrastructure. Along the track sections intended for floating type construction it shall be important to establish the following:

- Peat depth and undrained shear strength measured vertically through the peat mass at regular intervals.

- Peat soil sampling (undisturbed coring / block samples), to characterise the following under laboratory conditions:
    - Fibre content,
    - Moisture content,
    - Compressibility,
    - Shear strength (cohesion and friction angle)
    - Plasticity index,
    - permeability.

- Peat soil sampling (coring) with detailed logging to define the layer structure.

- Baseline groundwater level including where possible tracking seasonal variation. Groundwater monitoring well installations shall measure a response zone through the full depth of the peat. Installations shall be implemented up and down stream of the proposed floating track corridor.

- Detailed topographical survey mapping drainage features, patterns and constraints which shall need to be included in the track design.

Ground investigation of the peatland would be integrated into a wider multi-phase ground investigation which would be undertaken for the full range of proposed wind farm infrastructure locations. Ground investigation would be undertaken in accordance with National/Eurocode guidance[10].

The detailed ground investigation information would be used to refine the design of the floating track and provide critical feedback to define:

- Confirmation of areas suitable for floating track design based on geotechnical design performance;
- Track-makup thickness;
- Required engineered fill properties and earthworks specification;
- Geogrid reinforcement spacing and overlap;
- Drainage system sizing and intervals.

[10] BS 5930:2015+A1:2020 Code of practice for ground investigations

Conclusion:

The proposed Carnbuck Wind Farm shall consider the use of floating track construction to reduce impact on peatland and peatland hydrology. Outline assessment for the potential for consolidation settlement to affect peatland hydrology has been discussed.

From review of the existing literature and based on significant experience; it can be postulated that floating construction is likely to have a lower impact on the peatland hydrology compared to a traditional cut and fill track.

The floating tack construction provides opportunities for preserving the hydrological equilibrium and ensuring where changes in groundwater flow occur this can be anticipated and relieved if necessary. The development will ensure that detailed design for floating access track will incorporate a detailed geotechnical and hydrological assessment of conditions. This information will be used to ensure that the access track make-up and drainage systems are such that they meet best practice and preserve the peatland condition as far as is practicable.

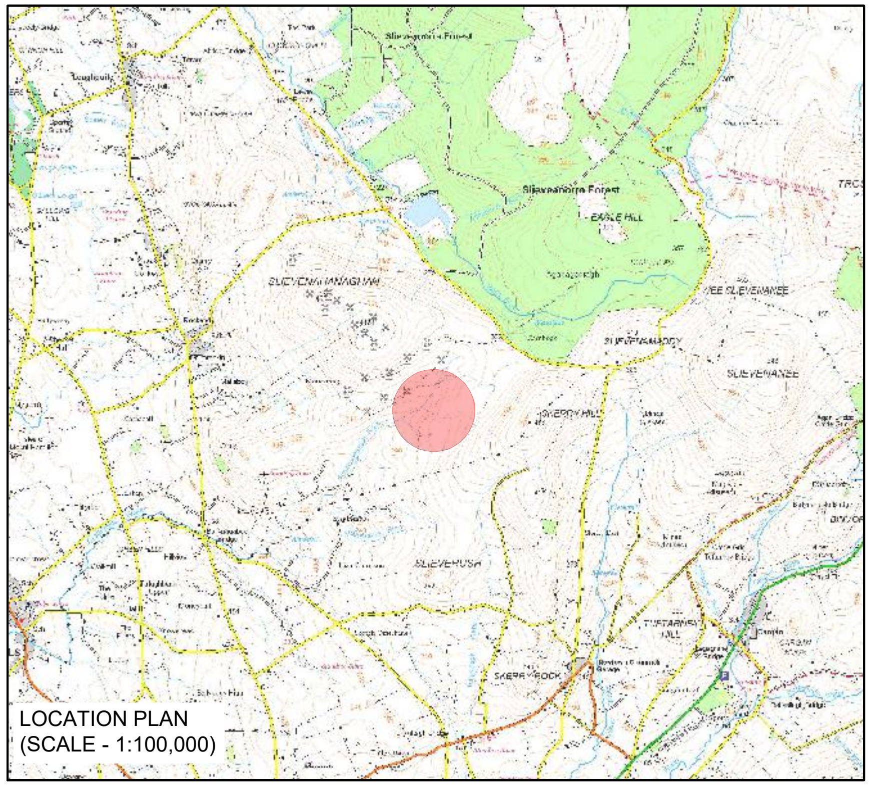
Floating track construction is not zero impact and construction over peatland will generally lead to settlement, compression of the peat soils and expulsion of soil pore waters over time. Due to the highly variable and non-linear geotechnical behaviour of peat soils the site-specific ground investigation would be undertaken to ensure these effects can be understood as closely as possible for the site-specific conditions.

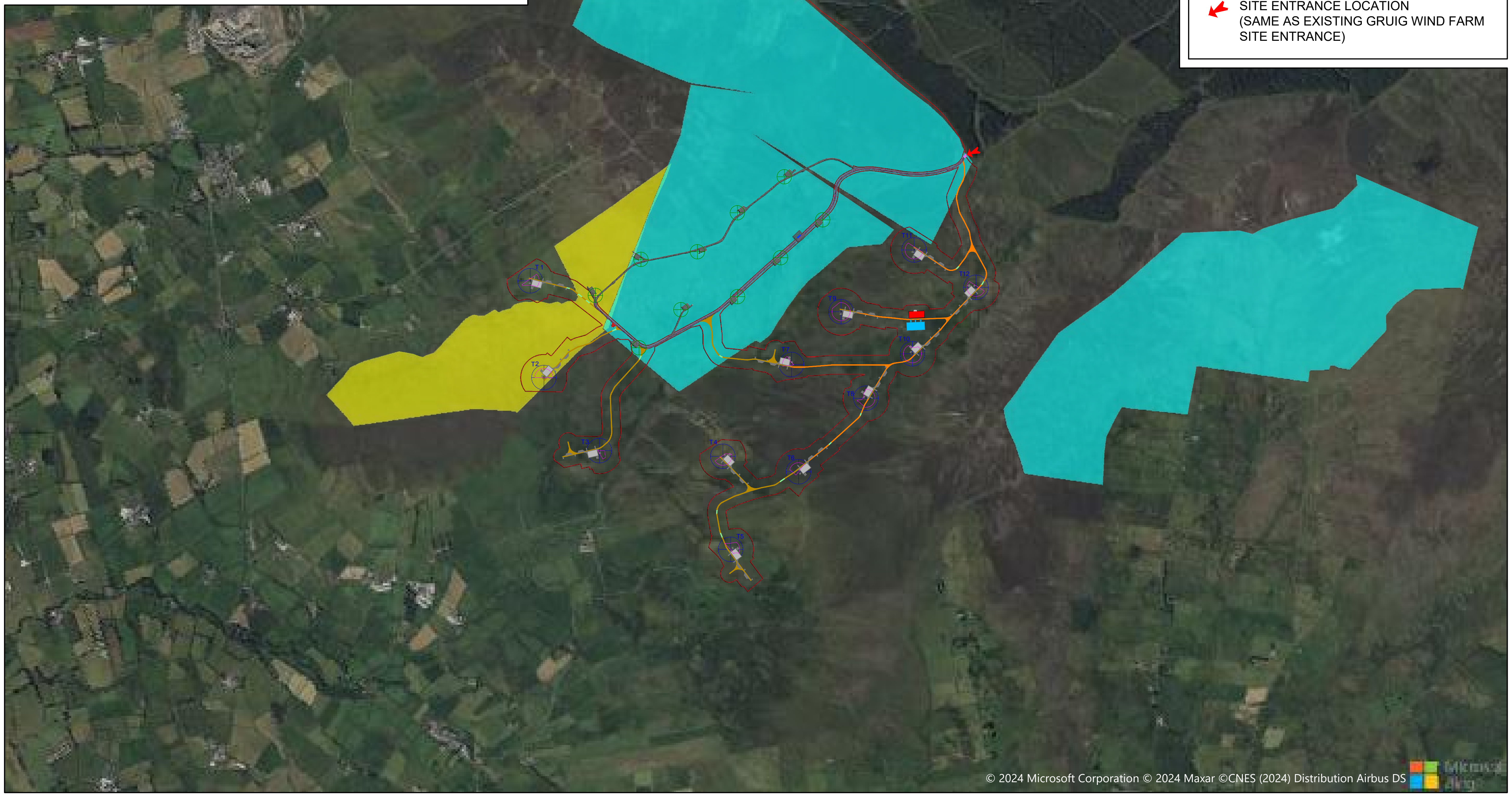
It is the view of Natural Power that with the application of the detailed survey, investigation and design elements the implementation of floating access track at Carnbuck Wind Farm will minimise impact to peatland hydrology.

End

Gavin Germaine, CGEOL
Principal Geotechnical Engineer

FIGURES 3.1 – 3.3





KEY - INFRASTRUCTURE LAYOUT

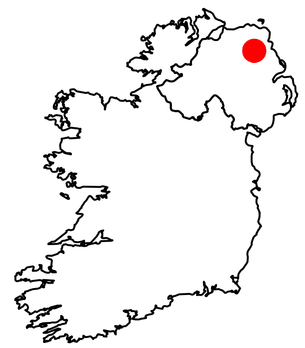
- PLANNING APPLICATION BOUNDARY
- WIND TURBINE LOCATION
- TURBINE MICROSITING
- NEW SITE TRACKS
- INDICATIVE FLOATED TRACKS
- EXISTING GRUIG WIND FARM SITE TRACKS - TO BE UPGRADED
- WATERCOURSE CROSSING
- CRANE HARDSTANDING AREA
  - PERMANENT
  - TEMPORARY
- TEMPORARY CONSTRUCTION COMPOUND AND BATTERY STORAGE
- CONTROL BUILDING & SUBSTATION COMPOUND WITH PERMANENT HARDSTANDING AREA
- SITE ENTRANCE LOCATION (SAME AS EXISTING GRUIG WIND FARM SITE ENTRANCE)

HABITAT MANAGEMENT KEY:

- GRUIG HABITAT MANAGEMENT AREA
- CARNBUCK HABITAT MANAGEMENT AREA

GRUIG WIND FARM - EXISTING SITE INFRASTRUCTURE

- TURBINE LAYOUT
- SITE TRACKS & HARDSTANDING
- EXISTING SITE TRACKS - TO BE UPGRADED
- EXISTING MAST
- EXISTING SUBSTATION



SITE LOCATION - NOT TO SCALE

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
0	CM				First Issue

PURPOSE: OTHER	PROJECTION: OSNI
SCALE: 1:25,000 @A3	DATUM: N/A
LAYOUT DRAWING: N/A	T-LAYOUT NO: N/A

PROJECT TITLE
CARNBUCK WIND FARM

DRAWING TITLE
HABITAT MANAGEMENT
GRUIG & CARNBUCK

RES DRAWING NUMBER	REV
FIGURE 3.1	0

BEAUFORT COURT,
EGG FARM LANE,
KINGS LANGLEY,
HERTS WD4 8LR. UK
TEL +44 (0) 1923 299200
WWW.RES-GROUP.COM

Figure 3.2 Target Notes (to be read in conjunction with Figure 3.2 – JNCC Phase 1 Habitat Survey Updated overleaf)

Overview

The greater part of the surveyed area supports *E. vaginatum*-dominated mire, with frequent grass-dominated areas. Mosses are dominated by *R. squarrosus* and *Sphagnum* species are generally absent. The upslope and eastern margins of the site are generally dominated by *J. effusus* marshy grassland, but open grassy areas are again frequent. The lower slopes have been considerably modified and *L. perenne*-dominated species-poor grassland extends upslope from the boundary track; acid grassland with much *N. stricta* is present in places along its margins. A low-relief ridge along the eastern margin of the site has been re-seeded with *L. perenne*, as has a field at the extreme western end of the site, although the latter also supports much *J. effusus*. A minor drain or stream flows near the northern margin of the site.

TN no	Location	Description	Photo no
TN1	D 09870 20556	Flowing drain/minor stream over muddy substrate. Banks stock-eroded in places, with short, grazed grasses (*Lolium perenne, Cynosurus cristatus*) and patchy *Juncus effusus*.	1
TN2	D 09874 20549	Semi-improved grassland along farm track and extending unevenly into lower slopes. Dominated by *L. perenne*, with much *C. cristatus,* occasional *Agrostis capillaris, Holcus lanatus*. Herbs scarce – occasional *Montia fontana, Ranunculus repens*. Likely that a more diverse forb flora will be evident earlier in the year. Mosses dominated by locally frequent *Rhytidiadelphus squarrosus*. Occasional stands and small patches of *J. effusus*. Boulder-strewn in places.	2
TN3	D 10060 20657	Minor stream flowing over pebble gravel and bedrock bed.	
TN4	D 10034 20649	Species-poor semi improved grassland grades into acid grassland with much *Nardus stricta, C. cristatus,* occasional *Molinia caerulea,* sparse *Juncus acutiflorus*. Mosses generally dominated by *R. squarrosus*, but occasional *Hylocomium splendens, Philonitis fontana* and isolated, sparsely distributed small mounds of *Sphagnum capillifolium*. Locally flushed and here with occasional *Carex binervis, Cirsium palustre*.	3
TN5	D 10191 20680	Uniform *L. perenne* grassland on well-marked ridge.	4
TN6	D 10284 20608	Marshy grassland largely dominated by *J. effusus*, but with much (locally dominant) *J. acutiflorus*. Interspersed with	5

		small patches of *Eriophorum vaginatum* or *N. stricta*-dominated grassland. *Sphagnum* scarce and generally absent throughout.	
TN7	D 10226 20500	Marshy grassland grades into *E. vaginatum*-dominated modified bog, with patchy *J. effusus,* particularly along drain courses. Open areas with much *R. squarrosus* and grasses – *M. caerulea, A. capillaris, N. stricta*. *Sphagnum* rare.	6
TN8	D 10389 20314	Mosaic of acid grassland and patches where *E. vaginatum* is frequent to abundant, with patches of re-seeded *L. perenne* and patchy *J. effusus*.	7
TN9	D 10233 20326	Grassland mosaic grades into extensive area of *E. vaginatum*-dominated blanket bog, with frequent grassy patches and abundant mosses dominated by *R. squarrosus*. *Sphagnum* generally absent.	8
TN10	D 09936 20275	Flushed acid marshy grassland with much *S. cuspidatum* in and around open water.	9
TN11	D 09662 20526	Species-poor semi improved grassland field dominated by *L. perenne* and with frequent patchy *J. effusus*.	
TN12	D 09776 20531	Small conifer shelter belt within semi-improved grassland field.	

Photograph 1: Minor drain/stream at foot of slope

Photograph 2: Semi-improved grassland near foot of slope.

Photograph 3: Acid grassland with much *Nardus*.

Photograph 4: Re-seeded *Lolium* grassland on ridge.

Photograph 5: Marshy grassland/acid grassland mosaic.

Photograph 6: Marshy grassland grading into *E. vaginatum*-dominated mire.

Photograph 7: Acid grassland/reseeded *Lolium* grassland mosaic.

Photograph 8: Marshy grassland grading into *E. vaginatum*-dominated mire.

Photograph 9: Extensive flush with much *Sphagnum cuspidatum*.

N

KEY

- 2016/2018 PRELIMINARY SITE AREA
- LAND UNDER APPLICANT CONTROL
- TARGET NOTE LOCATION
- HABITAT MANAGEMENT AREA
- WIND TURBINE LOCATION
- WIND TURBINE MICROSITING
- WATERCOURSE CROSSING
- INDICATIVE NEW FLOATED TRACK
- UPGRADED SITE TRACK
- NEW SITE TRACKS
- TEMPORARY HARDSTANDING AREA
- PERMANENT HARDSTANDING AREA
- EXISTING SUBSTATION
- TEMPORARY CONSTRUCTION COMPOUND & BATTERY STORAGE
- CONTROL BUILDING & SUBSTATION COMPOUND WITH PERMANENT HARDSTANDING AREA
- EXISTING METEOROLOGICAL MAST
- MODIFIED BOG
- NON-ACTIVE PEAT
- POTENTIALLY ACTIVE PEAT
- FLUSH
- BLANKET BOG
- DRY HEATH
- WET HEATH
- MARSHY GRASSLAND
- ACID GRASSLAND
- SPECIES RICH GRASSLAND
- SEMI-IMPROVED GRASSLAND
- ARABLE GRASSLAND
- CONIFER PLANTATION

SURVEYORS

Blackstaff Ecology

DRAWING NUMBER

COORDS: TM65 IRISH GRID

PURPOSE: ENVIRONMENTAL STATEMENT

SCALE: 1:6,500

ORIGINAL PLOT SIZE: A3

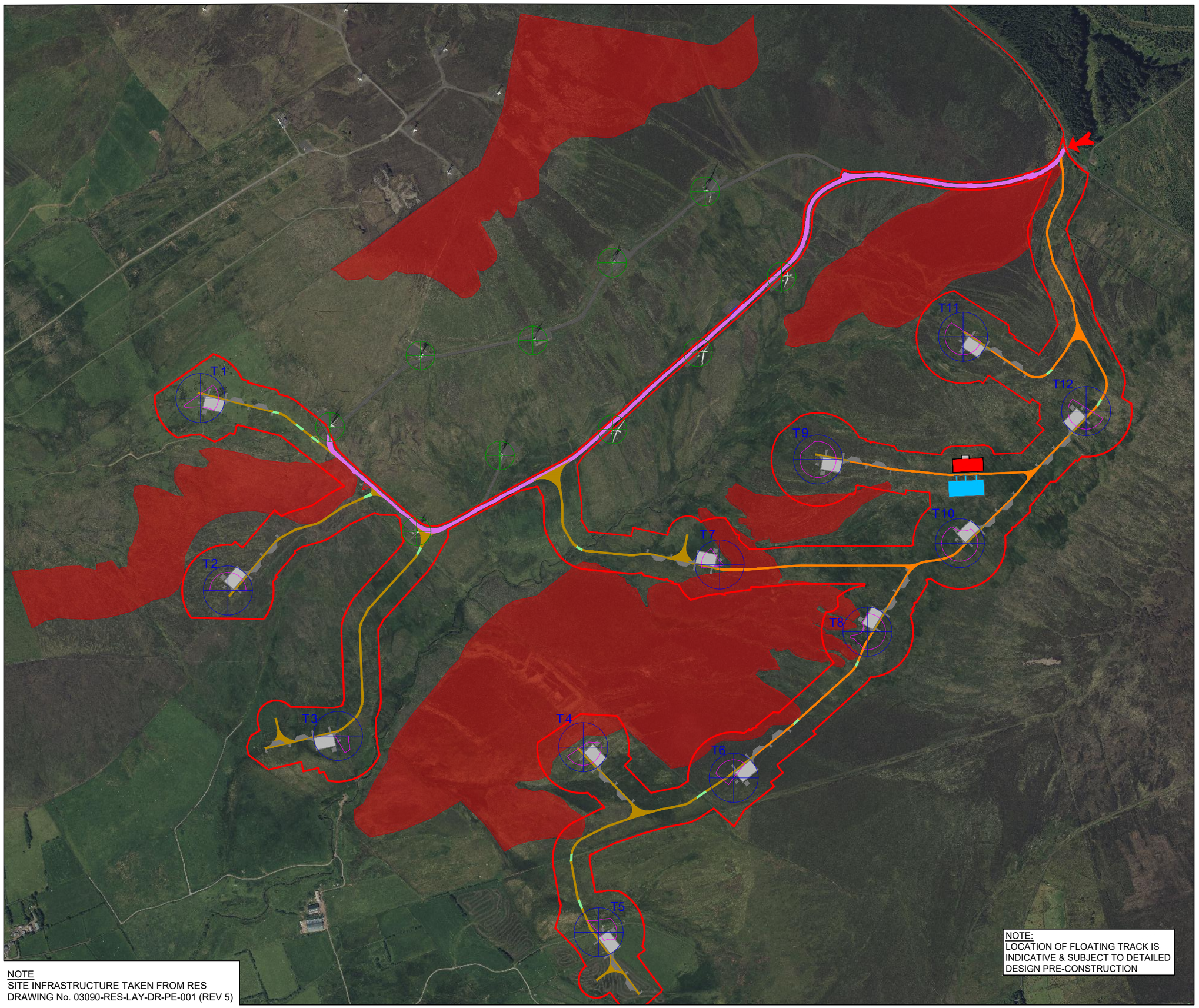
PROJECT TITLE

CARNBUCK WIND FARM

FIGURE 3.2
JNCC PHASE ONE
HABITAT SURVEY MAP
(UPDATED)

CLIENT

res



NOTE
SITE INFRASTRUCTURE TAKEN FROM RES DRAWING No. 03090-RES-LAY-DR-PE-001 (REV 5)

NOTE:
LOCATION OF FLOATING TRACK IS INDICATIVE & SUBJECT TO DETAILED DESIGN PRE-CONSTRUCTION

BING MAPS AERIAL IMAGERY
©2024 MICROSOFT

KEY - INFRASTRUCTURE LAYOUT

- PLANNING APPLICATION BOUNDARY
- WIND TURBINE LOCATION
- TURBINE MICROSITING
- NEW SITE TRACKS
- INDICATIVE FLOATED TRACKS
- EXISTING GRUIG WIND FARM SITE TRACKS - TO BE UPGRADED
- WATERCOURSE CROSSING
- CRANE HARDSTANDING AREA
  - PERMANENT
  - TEMPORARY
- TEMPORARY CONSTRUCTION COMPOUND AND BATTERY STORAGE
- CONTROL BUILDING & SUBSTATION COMPOUND WITH PERMANENT HARDSTANDING AREA
- SITE ENTRANCE LOCATION (SAME AS EXISTING GRUIG WIND FARM SITE ENTRANCE)

GRUIG WIND FARM - EXISTING SITE INFRASTRUCTURE

- TURBINE LAYOUT
- SITE TRACKS & HARDSTANDING
- EXISTING SITE TRACKS - TO BE UPGRADED
- EXISTING MAST
- EXISTING SUBSTATION
- POTENTIAL ACTIVE PEAT

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
0	CT				FIRST ISSUE

PURPOSE: PERMITTING	COORDINATES: TM65 IRISH GRID
SCALE: 1:10,000 @A3	DATUM: N/A
LAYOUT DRAWING: N/A	T-LAYOUT NO: N/A

PROJECT TITLE
CARNBUCK WIND FARM

DRAWING TITLE
POTENTIALLY ACTIVE PEAT AREA

RES DRAWING NUMBER	REV
FIGURE 3.3	0

BEAUFORT COURT,
EGG FARM LANE,
KINGS LANGLEY,
HERTS WD4 8LR. UK
TEL +44 (0) 1923 299200
WWW.RES-GROUP.COM

4

Hydrology

4. Hydrology

4.1 A consultation response was received from NI Water (NIW) on the 20th of April 2023 in relation to the assessment of the water environment.

4.2 This section is intended to address the comments from NIW received in the above mentioned consultation response. It is intended to signpost NIW in its re-consultation to the relevant information to aloe NIW to be satisfied that the matters raised are addressed. This section was completed by McCloys Consulting.

4.3 NIW comments are in bold italics, followed by McCloys responses.

4.4 ***It is noted the actual wind turbines are not in the catchment area for Altnahinch WTW (although some are very close). However, NI Water is concerned that the access roads to the proposed windfarm are within the drinking water catchment boundary. The construction of these access roads could potentially have detrimental implications for water quality discharging into Altnahinch Reservoir. This in turn could result in a deterioration in water quality in terms of sediment, colour and turbidity. There is also a risk that any spillages of oil, chemicals or other pollutants could contaminate the reservoir. The risks would be particularly high during the construction phase.***

4.5 Concerns raised by NIW are addressed in ES Chapter 10: Geology & Water Environment and Technical Appendix 10.1: Surface Water Management Plan that was submitted in support of the planning application.

4.6 EIA Chapter 10 identifies the Bush River (Altnahinch) catchment (including NI Water abstraction) as a sensitive receptor (paragraphs 10.137 – 10.139 of the 'Northern Ireland Infrastructure' section, Table 10.13: Receptor Sensitivity, and Table 10.16: Potential Magnitude and Significance of Impacts to Receptors – Including Effect of Avoidance & Design). The potential risks to the receptor have been identified and mitigated such that the conclusion specific to that (Table 10.17: Mitigated Effects) have been reached and determined as being 'not significant'. NIW's concern is addressed by the existing submission and no further information is required NIW has offered no substantive or technical reason to reach a conclusion that the substantial mitigation proposed in the EIA would not be effective. NIW's concern is addressed by the existing submission and no further information is required.

4.7 ***Page 9 of the Surface Water Management Plan states "The site is not located within a reservoir inundation zone". This is incorrect as the access road is within the catchment area for Altnahinch Reservoir.***

4.8 NIW comment erroneously refers to the Surface Water Management Plan (SWMP). The 'reservoir inundation zone' is discussed on Page 9 of the Flood Risk and Drainage Assessment (FRDA). An inundation zone (flooding from the reservoir) outlined in the FRDA is not the catchment draining to the reservoir. Concerns raised by NI Water are addressed in EIA Chapter 10: Geology & Water Environment and Technical Appendix 10.1: Surface Water Management Plan submitted in support of the planning application.

4.9 ***Page 18 states under the heading Development in Proximity to Reservoirs that Does not apply (see Section 3.1)". This is incorrect as the access road is within close proximity of Altnahinch Reservoir.***

4.10 The report section referred to by NIW refers to the FRDA 'Table 4-2: PPS15 Policy Summary', specifically policy FLD 5 - Development in Proximity to Reservoirs and relates to flooding from reservoirs and not drainage to reservoirs. The proposed development is not located within a reservoir inundation zone as per DfI 'Reservoir Flood Mapping for Emergency Planning' online mapping; therefore, the statement "Does not apply (see Section 3.1)" is correct. As per response #1, EIA Chapter 10 identifies the Bush River (Altnahinch) catchment (including NI Water abstraction) as a sensitive receptor and assesses it accordingly. NIW's over-arching concern in relation to development in the catchment draining to Altnahinch Reservoir is addressed by the existing submission and no further information is required.

4.11 ***NI Water would advise that details should be provided on protecting water quality as specified under heading "Protecting drinking water and NI Water assets during development actives.***

4.12 Details on protecting water quality are provided in EIA Chapter 10: Geology & Water Environment submitted in support of the planning application.

4.13 Chapter 10 identifies the Bush River (Altnahinch) catchment (including NI Water abstraction) as a sensitive receptor (paragraphs 10.137 – 10.139 of the 'Northern Ireland Infrastructure' section, Table 10.13: Receptor Sensitivity, and Table 10.16: Potential Magnitude and Significance of Impacts to Receptors – Including Effect of Avoidance & Design).

4.14 The receptor is assigned a 'National / High' sensitivity as the 'watercourse feeds a public water supply abstraction point located approximately 1.5 km downstream of the Site. Its headwaters are located in the eastern section of the Site.'

4.15 The receptor is assessed cognisant of potential effects arising from changes in runoff and flow patterns, silt / suspended solid pollution of surface waters, and chemical pollution of watercourses.

4.16 Mitigation measures to negate potential adverse effects are outlined in paragraphs 10.210 –10.224 (design mitigation measures) with additional mitigation, including pollution prevention measures, outlined in paragraphs 10.229 – 10.263. Further detail is included in Technical Appendix 10.1: Surface Water Management Plan.

4.17 The EIA Chapter 10 assessment concludes (Table 10.17) that implementation of prescribed mitigation measures would result in a 'Not Significant' residual effect on the Bush River (Altnahinch) catchment (including NI Water abstraction).

4.18 NIW's concern is addressed by the existing submission and no further information is required. NIW has offered no substantive or technical reason to reach a conclusion that the substantial mitigation proposed in the EIA would not be effective.

4.19 ***It should reference actual measures to protect the reservoir. Such measures should be considered and specifically detailed at this stage so that this***

important drinking water source is protected, and any risks are mitigated. NI Water would suggest that a document is produced showing the full details of how drinking water quality will be fully protected during and after the construction phase.

4.20 Please see response provided in points 3.21-3.27. Additional, NIW's concern is addressed by the existing submission and no further information is required. NIW has offered no substantive or technical reason to reach a conclusion that the substantial mitigation proposed in the EIA would not be effective

Conclusion

4.21 In conclusion, the overarching thrust of the NIW consultation reply is that the assessment has failed to consider Altnahinch and the source of public water supply. This is not correct.

4.22 The NIW consultation reply also incorrectly confuses statements in submitted assessments in relation to flooding from reservoirs, reading them as meaning that drainage to reservoirs has not been assessed. This is not correct.

4.23 The assessments consider in detail downstream catchments from the whole proposed development; have assigned and assessed sensitivity of those catchments including taking into account the value of the Altnahinch catchment for reasons of its water supply source; and include substantial and robust method statements and drainage plans to manage water quality and pollution prevention. There is no evidence that NIW has reviewed the full submission in reaching its initial conclusion and we suggest that NIW is offered the opportunity to revise its position in light of these clarifications and the substantial body of evidence and mitigation already in the planning application submission.

5

Site Entrance

5. Site Entrance

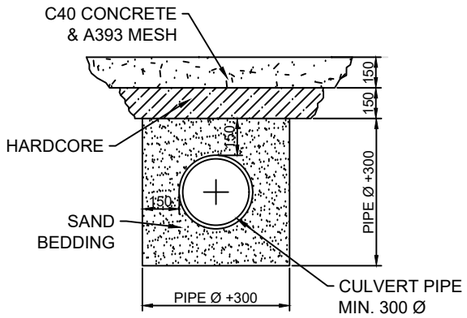
5.1 The Department for Infrastructure Roads (DFI Roads) consultation letter response letter dated the 7th of April 2023 requested further information in relation to the Site Entrance Drg. 34 which should show the following detailed in accordance with DCAN15.

- Indicate access width dimension for existing and proposed.
- Indicate access gradient for existing and proposed with a spot level at edge of carriageway and 10m into the access.
- Indicate radii at access.
- Indicate visibility splays and forward sight distance 2.4m x 90m.
- Indicate drainage provision and outfall location to prevent surface water flowing onto the public road. - This is shown by the two cross channels which will direct surface water flow into the existing drainage swells and into the drainage ditch.

5.2 The previously submitted Site Entrance Drawing (Figure 10, Stamped Drawing 34) has been updated to include the required information above.

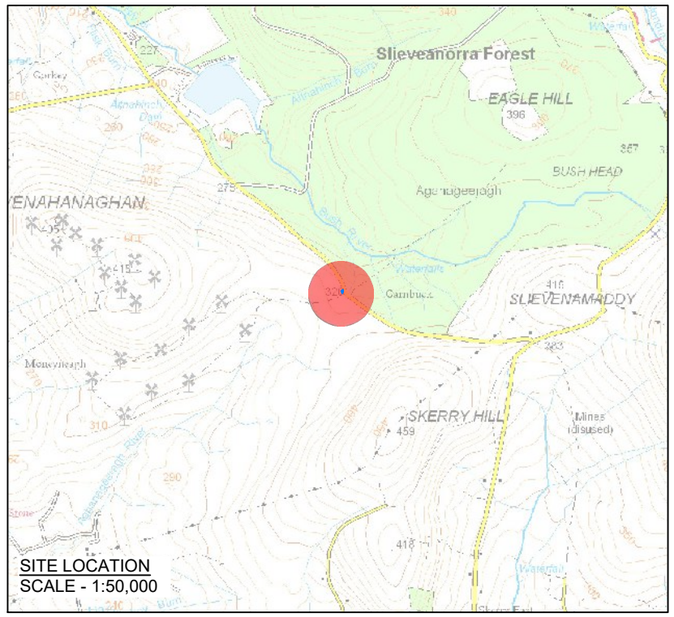
5.3 The updated site Entrance Drawing is included as **Figure 10.1 (Rev 3)**

FIGURE 10.1 (Rev3)

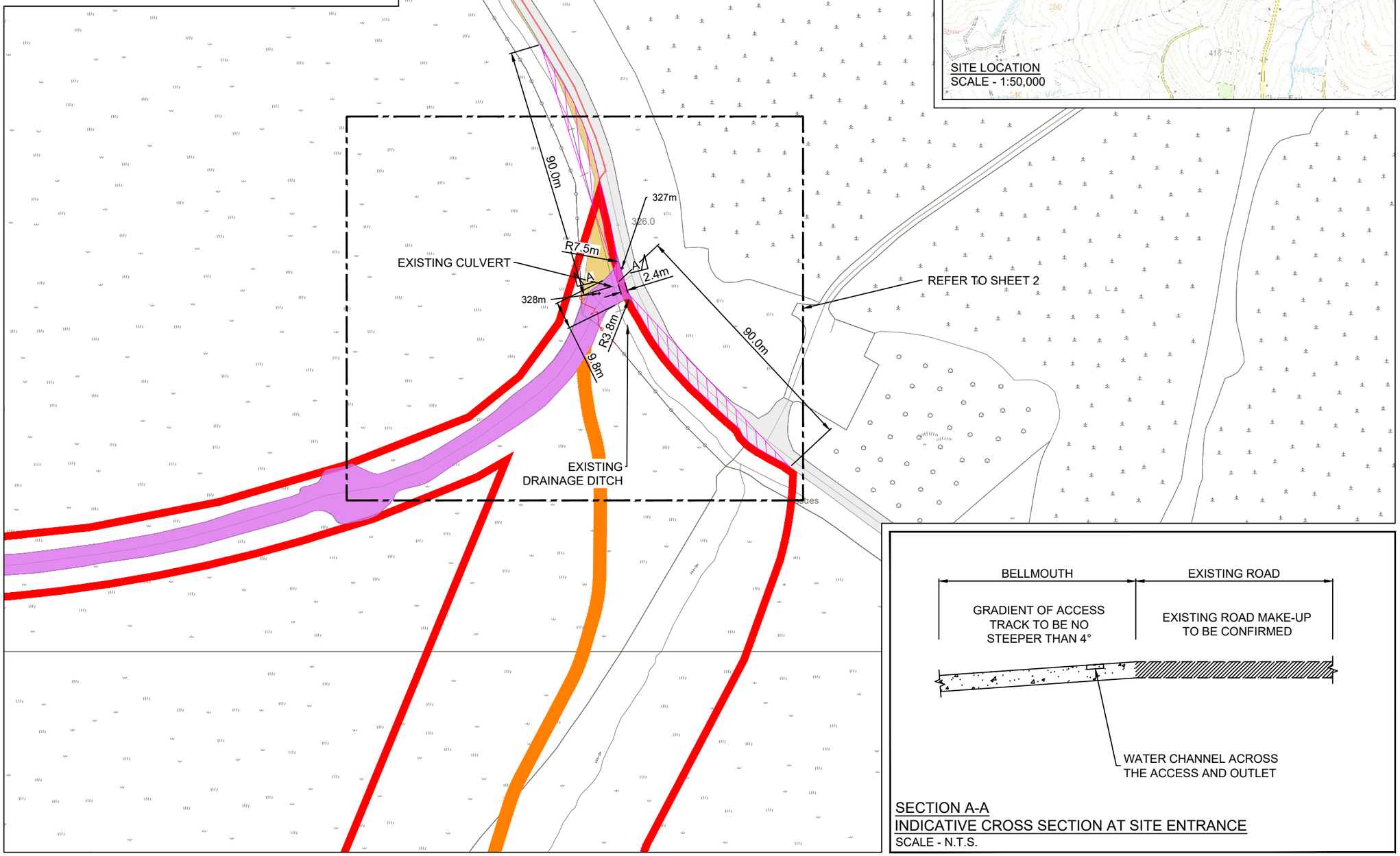


NOTE: CONCRETE FACING REQUIRED AT EITHER END OF CULVERT

SECTION A-A
CULVERT
SCALE - N.T.S.



SITE LOCATION
SCALE - 1:50,000



SECTION A-A
INDICATIVE CROSS SECTION AT SITE ENTRANCE
SCALE - N.T.S.

CARNBUCK WIND FARM

FIGURE 1.10

SITE ENTRANCE

KEY

- EXISTING ROAD/TRACK SURFACE
- VEHICLE OVERRUN (HIGHWAY)
- VEHICLE OVERFLY (HIGHWAY)
- MINIMUM REQUIREMENTS FOR VISIBILITY IN ACCORDANCE WITH THE DESIGN MANUAL FOR ROADS AND BRIDGES.
- VEGETATION TO BE TRIMMED AS NECESSARY TO MAINTAIN VISIBILITY SPLAYS
- EXISTING STOCK PROOF FENCE
- EXISTING SITE ENTRANCE GATE
- PLANNING APPLICATION BOUNDARY
- EXISTING TRACKS TO BE UPGRADED
- INDICATIVE FLOATING TRACKS

NOTES:

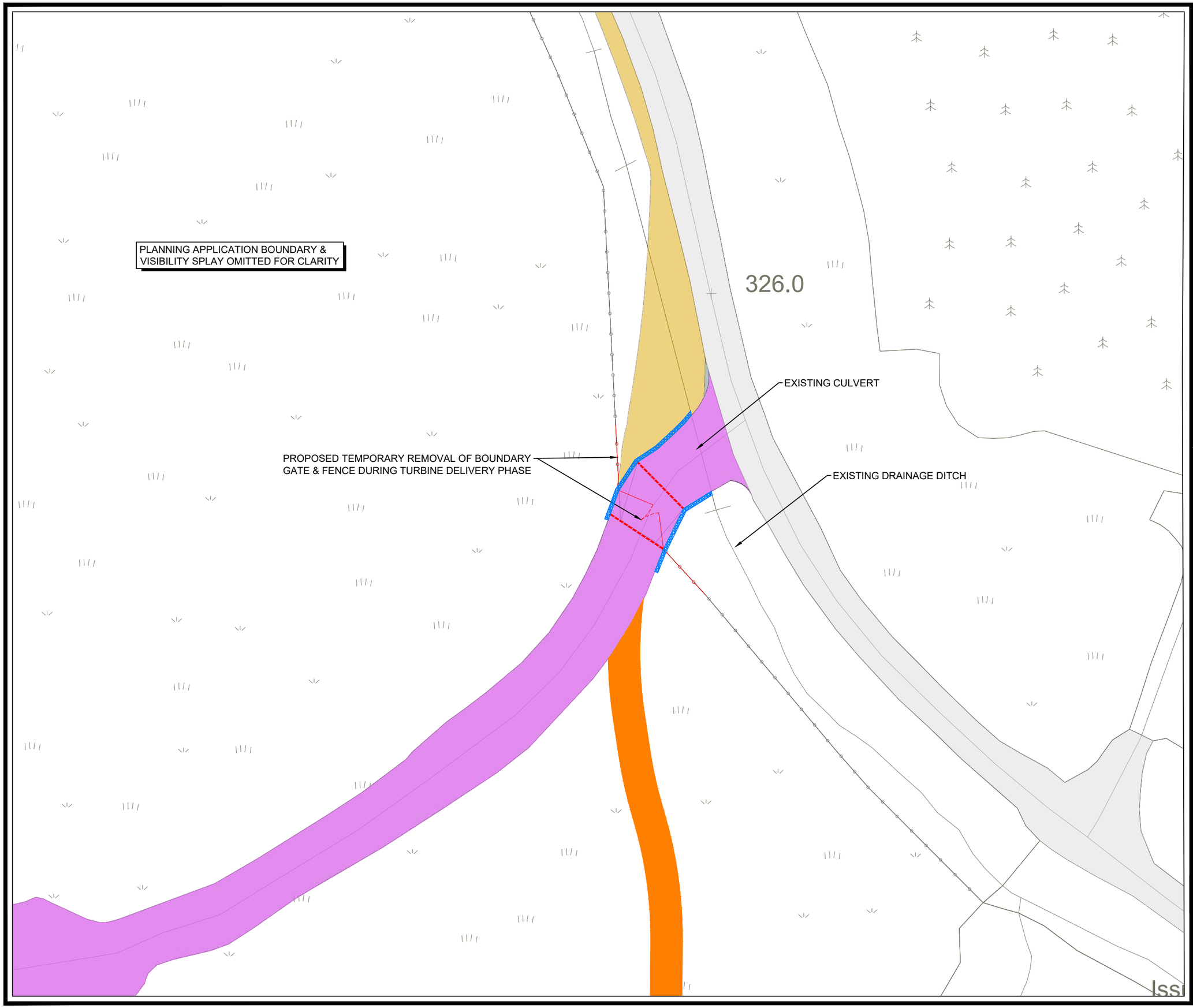
1. APPROPRIATE SUDS DESIGN MEASURES WILL BE EMPLOYED AT DETAIL DESIGN STAGE.
2. ANY SURFACE WATER RUNOFF WILL BE TARGETED USING APPROPRIATE SUDS MEASURES TO BE DESIGN AT A LATER DATE.

SHEET 1 OF 2

LAYOUT DWG: N/A	T-LAYOUT NO.: N/A
DRAWING NUMBER: 03090-RES-ACC-DR-LO-002	REV: 3

SCALE - AS SHOWN @ A3

ENVIRONMENTAL STATEMENT 2024



CARNBUCK WIND FARM

FIGURE 1.10

SITE ENTRANCE

KEY

- EXISTING ROAD/TRACK SURFACE
- VEHICLE OVERRUN (HIGHWAY)
- VEHICLE OVERFLY (HIGHWAY)
- EXISTING STOCK PROOF FENCE
- EXISTING SITE ENTRANCE GATE
- EXISTING TRACKS TO BE UPGRADED
- INDICATIVE FLOATING TRACKS
- EXISTING DRAINAGE CROSS CHANNEL
- PROPOSED DRAINAGE SWALE

LAYOUT DWG	T-LAYOUT NO.
N/A	N/A

DRAWING NUMBER	REV
03090-RES-ACC-DR-LO-002	3

SCALE - AS SHOWN @ A3

ENVIRONMENTAL STATEMENT
2024

6

Telecommunication Links

6. Telecommunication Links

6.1 The Department for Infrastructure (DFI) letter dated the 4th of June 2024 requested Further Environmental Information (FEI) in relation to telecommunications, as summarised below:

PSNI has a technical safeguarding objection to this proposal because the assessment indicates that Wind Turbines of the specified details, located on the proposed T6, T8 and T9 coordinates, would be likely to have an impact on the NI Emergency Services Radio Communications and Public Safety Telecommunications Infrastructure. A reduction in the height of the proposed turbine is unlikely to remove this impact.

JRC indicates that part of the proposed development breaches one or more of the radio systems operated by UK and Irish Energy Industry companies in support of their regulatory operational requirements. The affected links are:

460MHz Telemetry and Telecontrol:

JESIXS1 to JESIXO5 J

ESIASS1 to JESIASO1 J

ESIABS1 to JESIABO2

Operated by: Northern Ireland Electricity Networks

The JRC objection may be withdrawn after simple analysis shows no issues; when a satisfactory coordination has been achieved and the zone of protection is implemented; or when an appropriate mitigation agreement is in place.

6.2 RES commissioned Ai Bridges to evaluate the possible impacts that the proposed wind farm at Carnbuck, Co Antrim could have on existing telecommunications operator networks.

6.3 The Ai Bridges compiled a Telecommunications Impact Assessment Report which is presented in **Appendix 6.1**.

6.4 The following conclusions have been made:

- There are two radio links that pass through the proposed wind farm site: a microwave radio link (operated by the PSNI) and a UHF radio link (operated by SONI).
- From the details provided by the PSNI during consultations, it has been deduced that the radio link they have raised concerns about is a PTP radio link between the telecoms mast-site at Slievanorra and the PSNI Police Station in Ballymena.
- Radio Network analysis indicates that the radio path of the PSNI radio link would be obstructed by Turbine T09. Micro-siting T09 by 50m to the west, would move it away from the PSNI radio link and provide a clearance

distance of over 30m. At this distance, there would be no impact to the PSNI radio link.

- The SONI radio link is a UHF link between Corby Knowe wind farm and Gruig wind farm. Radio Network analysis indicates that this link would not be obstructed by the proposed turbines at Carnbuck. The network analysis also shows that the radio path of the UHF link is already obstructed by terrain. The installation of turbines at Carnbuck would have no additional impacts on the signal degradation of the UHF link that already exists due to terrain blockage.

APPENDIX 6.1 – TELECOMMUNICATIONS IMPACT ASSESSMENT REPORT

Report

Carnbuck Wind Farm
Telecommunications Impact Assessment
Report

Document Number:

Author: DM/PT

Approved for Release: Rev 1.0 KH **Date:** 09/10/24

Document Filename: *Carnbuck Wind Farm Telecommunications Impact Assessment.*

Executive Summary

Ai Bridges was commissioned to evaluate the possible impacts that the proposed wind farm at Carnbuck, Co Antrim could have on existing telecommunications operator networks. During consultations with telecom operators (undertaken by RES), it was found that the PSNI have one microwave radio link that crosses though the proposed wind farm site and SONI have one UHF radio link that crosses though the proposed wind farm site.

The PSNI did not provide specific details regarding their radio link (e.g. site-names, site coordinates, etc), however from the details that were provided, it has been deduced that the radio link in question is a PTP radio link between the telecoms mast-site at Slievanorra and the PSNI police Station in Ballymena. The scope of work for this study included field and desktop surveys to assess the possible impact on this microwave radio link.

Using the information obtained during the field survey assessments and consultation responses, a desktop impact analysis was carried out and the PSNI and SONI radio links were analysed using radio planning \ modelling software (2D and 3D).

Results from the impact analysis indicate that the PSNI radio link between Sleiveanorra and Ballymena would be impacted by Turbine T09. The impact of T09 on the PSNI radio link can be mitigated by micro-siting the turbine to the west. 3D network analysis indicates that moving T09 by 50m to the west would result in a clearance distance of over 30 meters between the blade-tip of the turbine and the Fresnel Zone of the PTP radio link. At this distance, there would be no impacts on the PSNI microwave radio link. This mitigation measure is outlined in Section 6 of this report.

Results from the impact analysis indicate that the SONI UHF radio link between Corby Knowe wind farm and Gruig wind farm would not be impacted by the proposed turbines at Carnbuck. The radio path of the UHF link is already obstructed by terrain and the installation of turbines at Carnbuck would have no additional impacts to the signal degradation that already exists due to the terrain signal blockage. As the proposed turbines would not impact the UHF link, no mitigation measures are required for the SONI radio link between Corby Knowe and Gruig wind farms.

Operator	Link Description	Nearest Turbine(s)	Fresnel Zone Clearance Distance to Blade-tip of Turbine.	Impact of proposed Turbine Layout
PSNI	PTP microwave radio link between Slieveanorra and Ballymena PSNI Station.	T06	107.5 m	No Impacts.
		T08	64.4 m	No Impacts.
		T09	-10.5 m (Infringement into Fresnel Zone)	Impacted. (Mitigation Measures Required)
SONI	PTP UHF radio link between Corby Knowe WF and Gruig WF.	T07	123.9 m	No Impacts.
		T09	108.2 m	No Impacts.

Table 1. Radio links that cross through/near the proposed wind farm.

Sections

Appendix

Section 1 - Wind Farm Site Information

1. Introduction

In this section a brief summary of the wind farm site is provided. Details regarding the site's geographic location and the proposed wind turbine dimensions are presented.

1.1 Wind Farm Site Information

The proposed wind farm development is located in the townlands of Carnbuck, Magheraboy and Moneyneagh, and is approximately 5 km northeast of Cloughmills in Co. Antrim. The development is in the planning stage and exact details regarding the quantity, location and turbine dimension have yet to be finalized.

The coordinates of the turbines assessed in this report are provided in Appendix A. The dimensions of the turbines assessed in this report are provided in Table 2 below.

Wind Farm	Number of Turbines	Turbine Hub Height	Turbine Rotor Radius
Carnbuck	12	112 m	68 m

Table 2. Wind Farm Turbine Details

The location of the proposed wind farm development is shown below in Figure 1.

Figure 1. Location of proposed wind farm.

Section 2 - Methodology

2. Introduction

In this section a brief summary of the Telecommunication Impact Study Methodology is provided.

2.1 Methodology

There are four primary stages in preparing and compiling a communication impact study:

- Telecom Operator Consultations
- Field Surveys
- Desktop Survey Network Modelling and Analysis
- Report Generation

A summary of each of these stages is provided below:

Telecom Operator Consultations

Consultations are commenced with telecom operators who are requested to raise any concerns they have regarding the impact of the proposed wind farm on their networks. The consultation process is used to assist in identifying telecoms infrastructure that could be impacted by the proposed wind farm development.

Field Surveys

Field surveys are undertaken and the co-ordinates of communication masts are recorded. During the field surveys of the communication sites, approximations of antenna size, bearing and height are made for the antennas installed on each of the masts surveyed.

Desktop Survey and Analysis

A desktop survey is carried out to plot the wind turbines in a radio planning tool. The radio planning tool uses GIS and terrain mapping databases to enable accurate modelling. A selection of mast-site coordinates is then obtained and inputs from various operators \ service providers are converted from Irish National Grid (Easting and Northing in meters) to degrees minutes seconds format and then imported into the radio planning tool. This provides a means of graphically showing telecommunications sites in the vicinity relative to the proposed wind farm at Carnbuck. Figure 2 below shows the proposed turbines plotted in the radio planning tool.

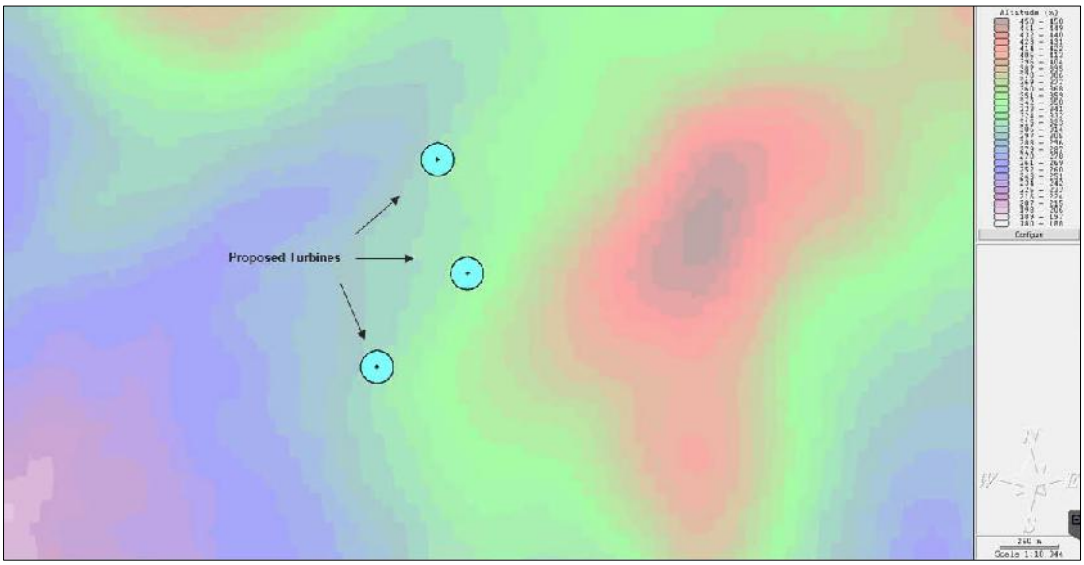


Figure 2. Proposed turbines plotted in Radio Planning Software

The findings from the consultations and field surveys are collated and the communications networks requiring further analysis are identified. Network modeling is used to assess the impact of the turbines on the communications networks. The results from the network modeling are used to determine if mitigation measures are required. Figure 3 below shows an example of a microwave radio link that crosses over/near the wind farm modelled in radio planning software.

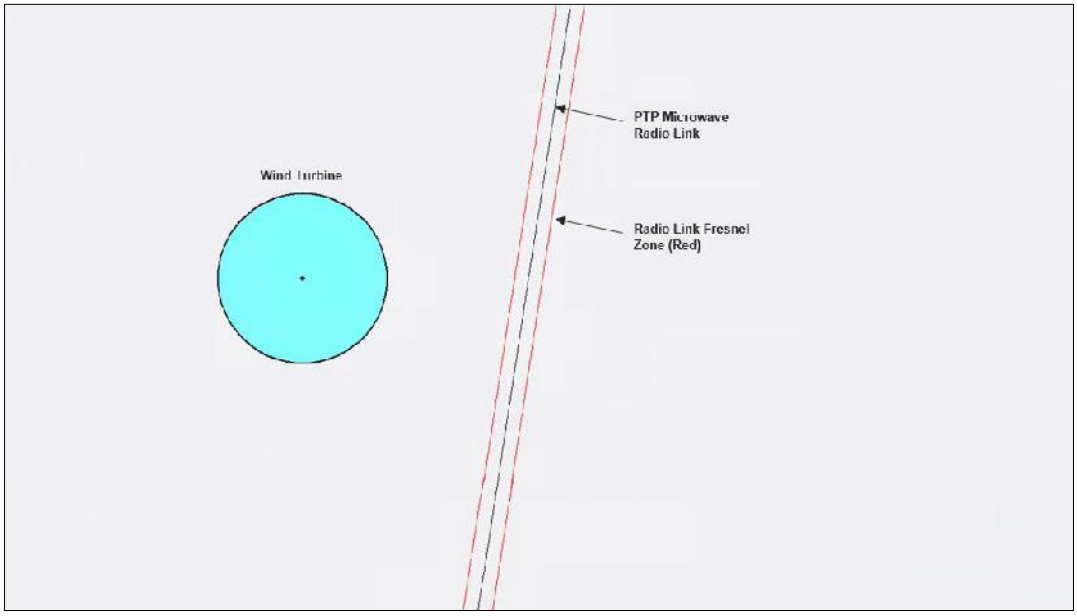


Figure 3. Example of microwave radio link crossing over/near the proposed wind farm modelled in radio planning software.

Report Generation

The final stage of the communications impact study process is to collate the data and present the findings & analysis into a report for submission.

Section 3 - Telecom Operator Consultations

3. Introduction

In this section the consultation process undertaken with telecom operators is described. The response received from each operator is also provided.

3.1 Telecom Operator Consultations

In July 2024, RES contacted the PSNI regarding their consultation response to the Department of Infrastructure regarding Planning Application SPD/2023/0951/F (i.e. the planning application for the proposed wind farm at Carnbuck).

The consultation response from the PSNI indicated that three of the proposed turbines at Carnbuck (T06, T08 and T09), would impact the NI Emergency Services Radio Communications and Public Safety Telecommunications Infrastructure.

A communication response was also received from JRC (Joint Radio Company), on behalf of SONI (System Operator for Northern Ireland), regarding the possible impact on one UHF radio link.

ID	Operator	Issues raised by Operator \ Observations.
1	PSNI	The PSNI raised concerns regarding the possible impact of three turbines (T06, T08 & T09) of the NI Emergency Services Radio Communications and Public Safety Telecommunications Infrastructure.
2	SONI/JRC	JRC raised concerns regarding the possible impact of two turbines (T07 & T09) on the SONI UHF radio link between Corby Knowe wind farm and Gruig wind farm.

Table 3. Telecom Operators with radio links that cross over/near the proposed wind farm

The consultation responses received from the Telecom Operators listed above are provided in Section 3.1.1 and Section 3.1.2 that follow.

3.1.1 Consultations between RES and PSNI

The correspondences between RES and the PSNI are presented below:

03.07.24 - Email from RES to PSNI

"Dear Mr Moore,

I was passed your email address by my colleague David McVeigh. I am contacting you regarding the consultation response to the Department of Infrastructure regarding Planning Application SPD/2023/0951/F, for the proposed Carnbuck wind farm. The consultation response from PSNI details that three turbines of Carnbuck, T6, T8 and T9, are expected to have an impact on the NI Emergency Services Radio Communications and Public Safety Telecommunications Infrastructure.

In first instance, are PSNI able to give guidance on the distances and directions that these turbines would need to move, to remove this risk of impact on PSNI operations?

I attach a table of the turbines' coordinates for reference.

Many thanks for your time.

Best regards,
Judith."

10.07.24 - Email response from PSNI to RES

"Judith

Firstly it's just Roy.
Secondly I'm sorry about the delay, but we are under pressure at the minute.

From memory the micro siting on these turbines caused issues on some of the turbines.
If you could give me the proposed micro siting details I could take a look at these in the morning.

Roy."

11.07.24 - Email from Res to PSNI

"Hi Roy,

Many thanks for your reply. I understand you're very busy – we appreciate you taking the time to work on this with us to find a solution that works for both of us.

I have attached for you a screenshot and shapefile of the micrositing areas we are currently working with. As you will see these are already restricted in some places due to a number of other constraints and we can adjust them further to restrict the movement of the turbines you are worried about.

We would be reluctant to remove micrositing areas entirely from any turbines, simply for reasons of constructability if ground conditions are found challenging, however we can reduce the areas to limit movements towards your link. If you could either provide us with an exclusion zone, or indicate what kind of move of turbines would have to be avoided, we can incorporate this into our design.

Best regards,
Judith."

11.07.24 - Email response from PSNI to RES

"Judith

Have taken a look at these today, I have only looked in 2D at this stage as out link is about the same height of the ground as the turbines.
Also looking through the original assessment it was assessed assuming the micro siting as a circle around the position of the turbine.
Here is what I think

T6 will be ok if there is no micro siting to the east of the position.

T8 from its position would need to move 30m to the east and have no micro siting to the west of its position.

T9 is the most problematic. It would need to move approx. 120m to the west and have no micro siting to the east.

Hopefully this information will assist you and the positions I have quoted are the closest I can see to the originals.
These are a quick guide and will have to be formally checked, but it should give you an idea of our link in this area.

Let me know if you need anything further.

Roy."

11.07.24 - Email from RES to PSNI

"Hi Roy,

Many thanks for the swift response.

T6 and T8 should present no problem, we can reduce the micrositing areas to ensure those don't move any closer than indicated by you.

T9 is more difficult as we have only applied for a 50m micrositing radius so a move by 120m won't be possible under the current application, however we are still looking into the best way to address this internally and would get back to you about this next week if that's okay.

Best regards,
Judith."

20.08.24 - Email from RES to PSNI

"Hi Roy,

I hope you're doing well – apologies for the long silence, we've been doing some internal work to try and solve this issue, which took longer than hoped.
We have spoken to one of our consultants who have a long track record of modelling wind farm interference on utility and communication infrastructure around NI and ROI, and we would like them to take a look at those turbines specifically to see if we can find a solution that would enable you to drop your objection.

For them to be able to carry out a full 3D analysis, if at all possible, would you be able to share:
- *Coordinates of transmitting / receiving masts of the affected links;*

- *Antenna heights of the masts; and*
- *Their operating frequency.*

We understand that this information might be sensitive and both us and our consultant would be happy to sign NDAs if required.

Many thanks and best regards,
Judith."

21.07.24 - Email response from PSNI to RES

"Judith

I'm sorry but we don't give out these details.
We are happy to plot ant co-ordinates you want, but that's all we will do.

Roy."

3.1.2 Consultations between RES and JRC/SONI

The correspondences between RES and the JRC is presented below:

19.01.24 – Impact Assessment Report from JRC

jrc

Joint Radio Company
Making the spectrum and Technology work for your business

WF Coordination - Further Analysis Engineering Notes:
Carnbuck Windfarm

WF / Turbine under consideration:	Carnbuck WF		
Turbine location (as supplied):	T1 310866 421041 T2 310942 420508 T3 311247 420105 T4 311927 420074 T5 311970 419561 T6 312344 419989 T7 312305 420580 T8 312715 420394 T9 312578 420871 T10 312971 420639 T11 312980 421211 T12 313321 421005	*Micrositing value:*	• 50m
Turbine size (hub Height / Blade Radius)	• 112m/69m		
Assigned Engineer:	Jim Barr	*Issue Date:*	19 January, 2024
Brief description of proposal:			

Multiple Turbines with details as above (bold font are those impacting), adjacent to the existing Gruig WF which impacts the UHF link from Corby Knowe to Gruig WF.

Comments from Original test:

	Reflection	Diffraction	Diffraction (MS + LS)
Carnbuck Wind Farm (was Gruig Ext) 5	-12.5	503.6	481.6
Carnbuck Wind Farm (was Gruig Ext) 6	-28.3	128.8	26.8
Carnbuck Wind Farm (was Gruig Ext) 4	-13.5	520.2	428.2
Carnbuck Wind Farm (was Gruig Ext) 8	-25.6	130.9	30.9
Carnbuck Wind Farm (was Gruig Ext) 10	-14.4	423.5	331.5
Carnbuck Wind Farm (was Gruig Ext) 7	-33.6	79.1	-20.9
Carnbuck Wind Farm (was Gruig Ext) 9	-32.2	75.1	-20.9
Carnbuck Wind Farm (was Gruig Ext) 12	-6.4	830.3	710.3
Carnbuck Wind Farm (was Gruig Ext) 11	-13.1	529.4	429.4
		Ruin	
		-43.2	

As can be seen from the table above, the initial results all of the above turbines fail on Reflection criteria with T7 & T9 also failing on Diffraction. Further, more detailed analysis was undertaken with no change to the results. This can be seen in the table below.

Friday, 19 January 2024 Page 1 of 3 Joint Radio Company 2024

jrc

Joint Radio Company
Making the spectrum and Technology work for your business

WF Coordination - Further Analysis Engineering Notes: Carnbuck Windfarm

		Reflection	Diffraction	Diffraction (M1 + LB)
Carnbuck Wind Farm (was Gruig Ext) 5	Y			
Carnbuck Wind Farm (was Gruig Ext) 6	Y			
Carnbuck Wind Farm (was Gruig Ext) 4	Y			
Carnbuck Wind Farm (was Gruig Ext) 8	Y			
Carnbuck Wind Farm (was Gruig Ext) 10	Y			
Carnbuck Wind Farm (was Gruig Ext) 7	Y			
Carnbuck Wind Farm (was Gruig Ext) 9	Y			
Carnbuck Wind Farm (was Gruig Ext) 12	Y			
Carnbuck Wind Farm (was Gruig Ext) 11	Y			
			Sum	

Details of Further engineering analysis:

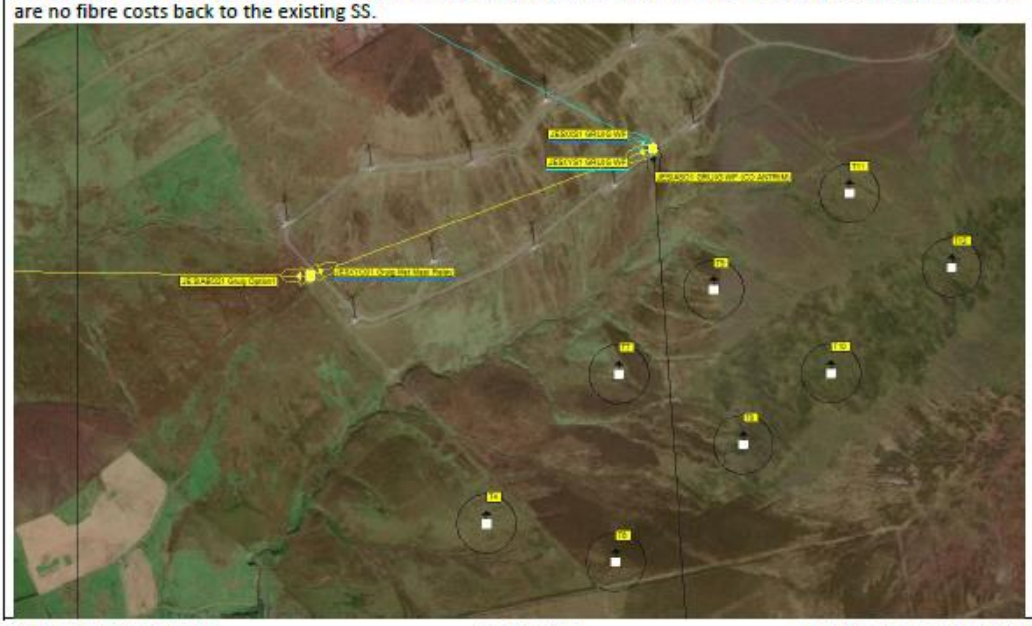
Mitigation Measures:

Given the results above there is no mitigation possible by moving turbines or micrositing, therefore the only viable solution is to reroute the existing UHF link.

There are two options for the Link operator to consider.

Option 1:

Install a short UHF Radio relay from the existing SS to the Met mast at 311305,420803 and from there install a link to a main base site to the west (Temain Hill). This has the advantage of clearing all the turbines in the proposed extension in one go and whilst there will be costs in providing power and accommodation at the Met Mast there are no fibre costs back to the existing SS.



Friday, 19 January 2024 Page 2 of 3 Joint Radio Company 2024

jrc

Joint Radio Company
Making the spectrum and Technology work for your business

WF Coordination - Further Analysis Engineering Notes: Carnbuck Windfarm

Option 2:
A similar option is to install a UHF Relay to the existing WF to the north of Gruig and then onwards to Temain as per option 1. However the relay path is significantly more occluded and although predicted to be acceptable it would of course be subject to Survey and more difficult to provide more antenna height at either end if required.

We are passing these options to the Link operator for their consideration and approval. Once they have had a chance to analyse this, we should be in a better position to advise of indicative costs. Unfortunately until a suitable mitigation solution has been agreed JRCs objection, on behalf of SONI, is still valid.

Engineer's Comments / Conclusion:

We can recommend approval if the following conditions are met.

1. Acceptance by the Link operator of one of the options above.
2. Agreement on Costs by the Developer.
3. Installation and commissioning of one of the above options before Turbine installation commences.

Notes and Caveats:

- *This analysis only applies to the turbine/s and link/s as detailed above.*
- *This analysis only applies at the date of the Analysis as shown in the Footer below.*
- Any changes in micro-siting except as detailed above will invalidate the conclusions of this analysis.

Friday, 19 January 2024 Page 3 of 3 Joint Radio Company 2024

Section 4 - Field Surveys

4. Introduction

To assess the network information (radio link co-ordinates, antenna heights etc.) provided by the telecom operators, field surveys of the telecom-mast sites in the vicinity of the proposed wind farm were carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded.

The telecom mast-sites surveyed for this study (labelled Mast-Site A, B, C & D) are shown relative to the proposed wind farm site in Figure 4 below. The findings from the field surveys of the mast-sites are presented in Appendix B of this report.

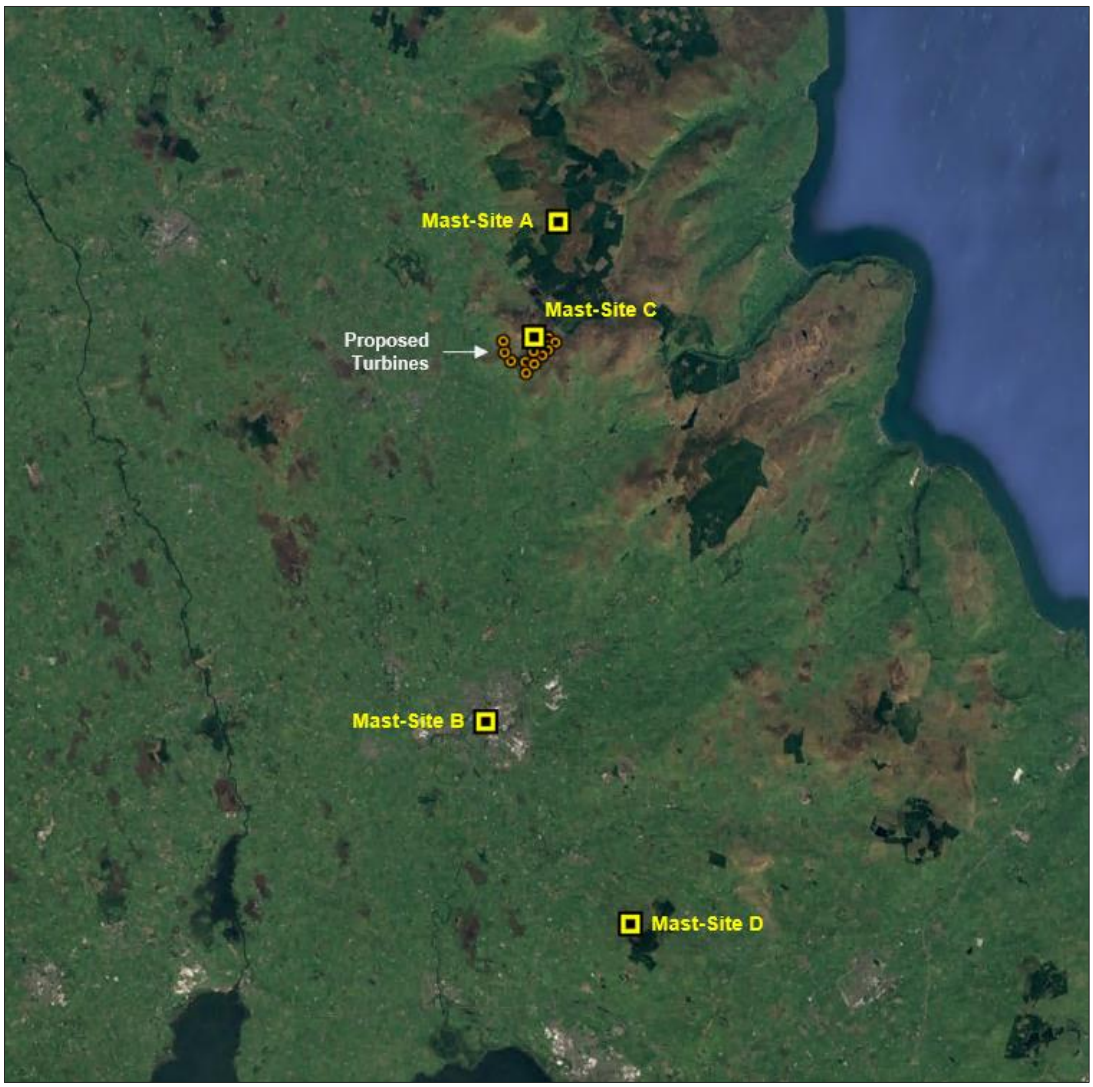


Figure 4. Telecom Mast-Sites Surveyed.

Section 5 - Desktop Survey Analysis

5. Introduction

Based on the findings of the consultation process, there are two Telecom Operators with a network in the vicinity of the proposed development that requires a detailed technical analysis:

- PSNI Network
- SONI Network

Sections 5.1 and 5.2 below outline the desktop survey analysis findings* for the Telecom Operator Networks listed above.

5.1 PSNI Network Analysis

The PSNI network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) microwave radio link. The radio link is listed below in Table 4 and a Plan View of the PSNI network is shown in Figure 5.

Link ID	Operator	Link Description
1	PSNI	PTP microwave radio link between Slieveanorra and Ballymena PSNI Stn.*

Table 4. PSNI Radio Links requiring Analysis

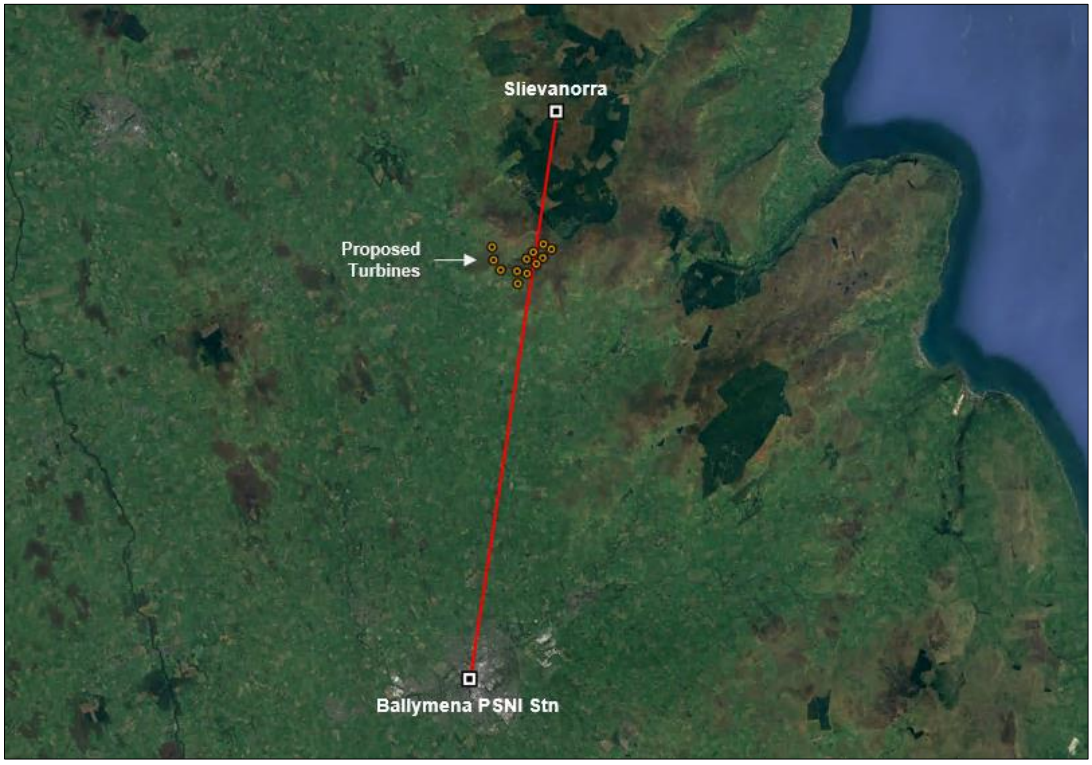


Figure 5. PSNI Radio Network – Plan View

Note: The PSNI did not provide specific details regarding their radio link (e.g. site name, site co-ordinates). However, from the details they did provide, it has been deduced that the link in question is a microwave radio link from the telecoms mast-site at Slievenorra to the PSNI Police Station at Ballymena.

** Radio link details are subject to confirmation from the PSNI.*

Figure 6 below shows a close-up Plan View of the PSNI microwave radio link relative to the proposed wind turbines. The plan view indicates that Turbine T09 is likely to obstruct the radio path of the PSNI link.

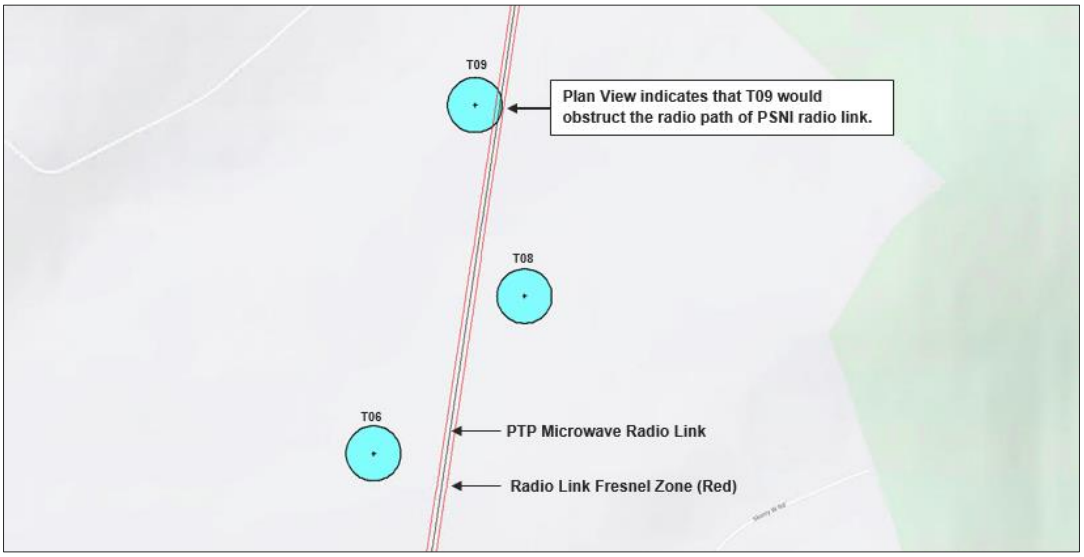


Figure 6. PSNI Network – Close-up Plan View.

To further assess the potential impact of the T09, the radio link has been modelled in 3D and the Clearance Distances between the Fresnel Zone (F1) of the link and the blade-tip of the T09 have been calculated. A 3D view of the microwave radio link relative to the proposed turbines is shown below in Figure 7.

The results of the 3D analysis indicate that T09 would obstruct the Fresnel Zone of the radio link (i.e. the operation of the PSNI radio link would be impacted by T09).

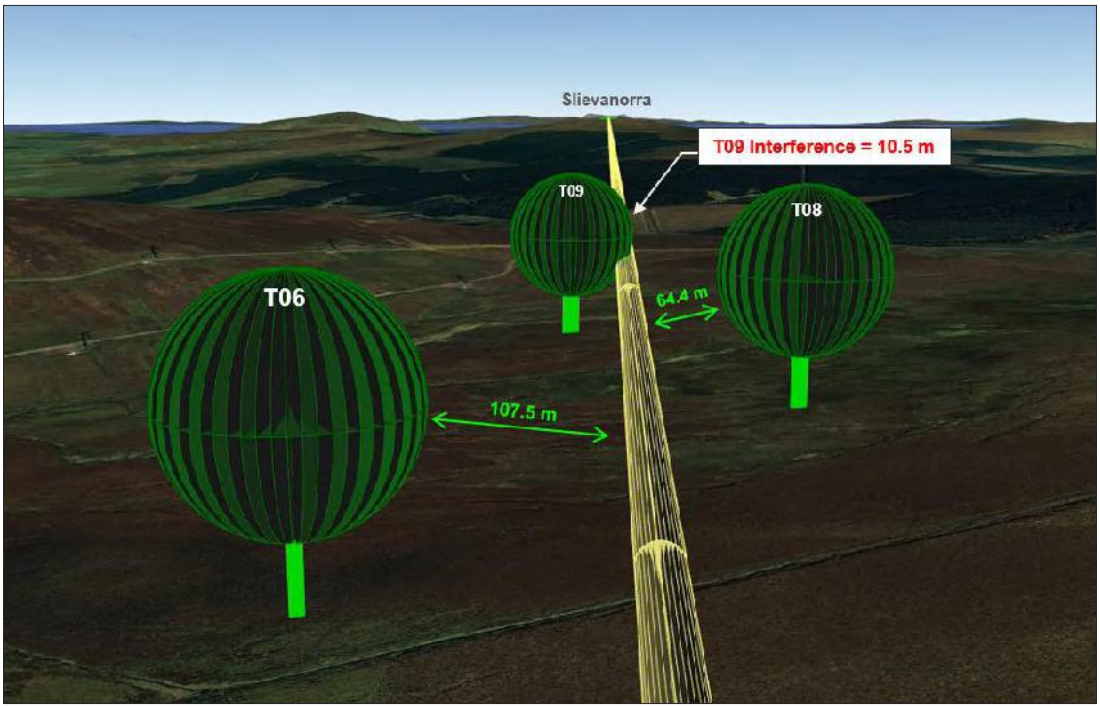


Figure 7. PSNI Network – 3D View.

Table 5 below provides a brief summary of the radio link interference analysis for the closest turbines (T06, T08 & T09) to the PSNI radio link.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F1) Clearance / Interference	Wind Farm Impacts
PSNI Link 1	Slieveanorra to Ballymena PSNI.	T06	107.5 m	No Impacts.
		T08	64.4 m	No Impacts.
		T09	-10.5 m (Infringement into Fresnel Zone)	Potentially Impacted (Mitigation measures required)

Table 5. PSNI Network – Analysis Summary

5.2 SONI Network Analysis

The SONI network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) UHF radio link. The radio link is listed below in Table 6 and a Plan View of the SONI network is shown in Figure 8.

Link ID	Operator	Link Description
1	SONI	PTP UHF radio link between Corby Knowe WF and Gruig WF.*

Table 6. SONI Radio Links requiring Analysis

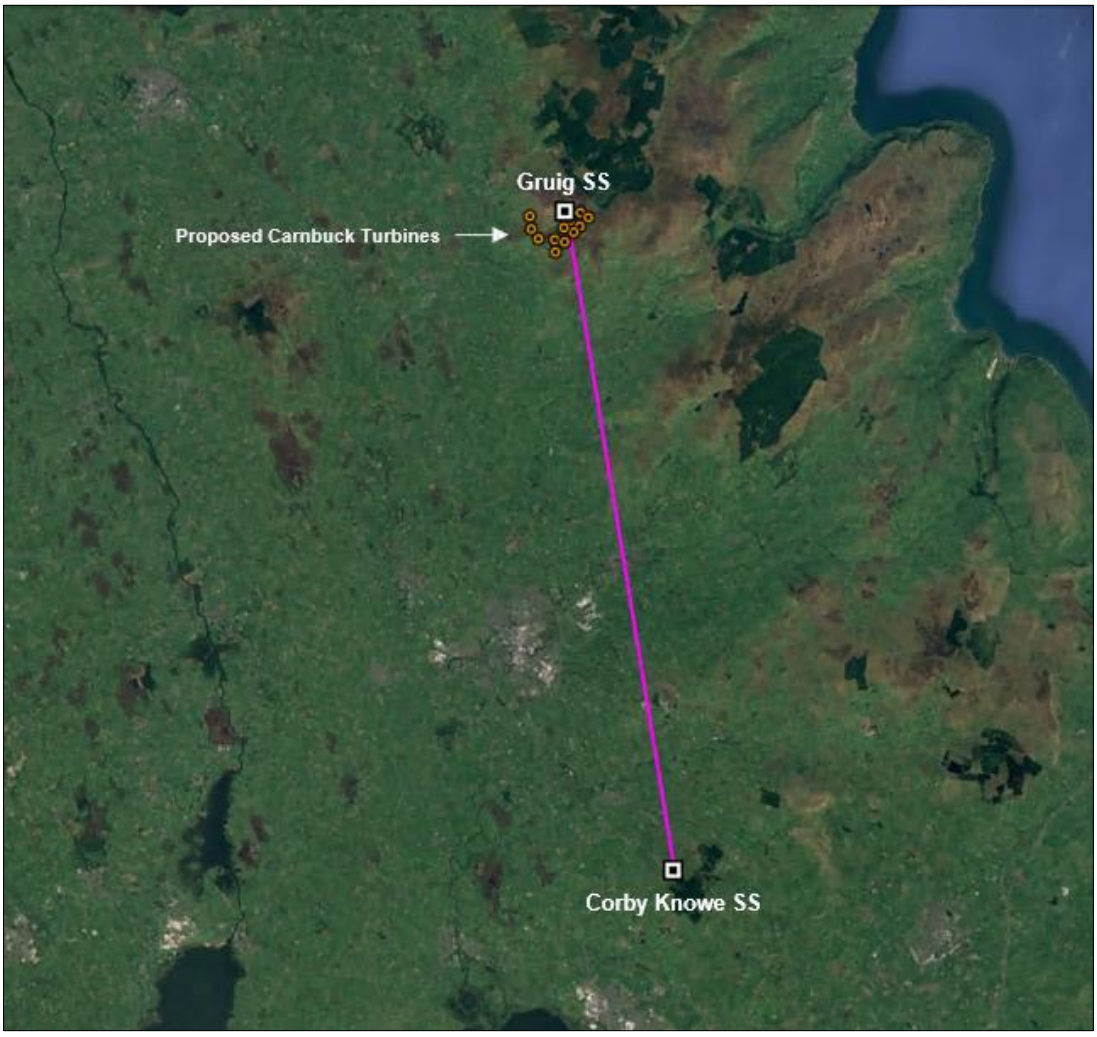


Figure 8. SONI Radio Network – Plan View

Figure 9 below shows a close-up plan view of the SONI UHF radio link relative to the proposed wind turbines at Carnbuck. The plan view indicates that the proposed turbines would not obstruct the SONI radio link.

** Radio link details (e.g. site coordinates, antenna heights, radio frequency) are subject to confirmation from JRC/SONI. The analysis conducted for this study has been based on information obtained from field surveys, desktop surveys and data from previous UHF radio link assessments.)*

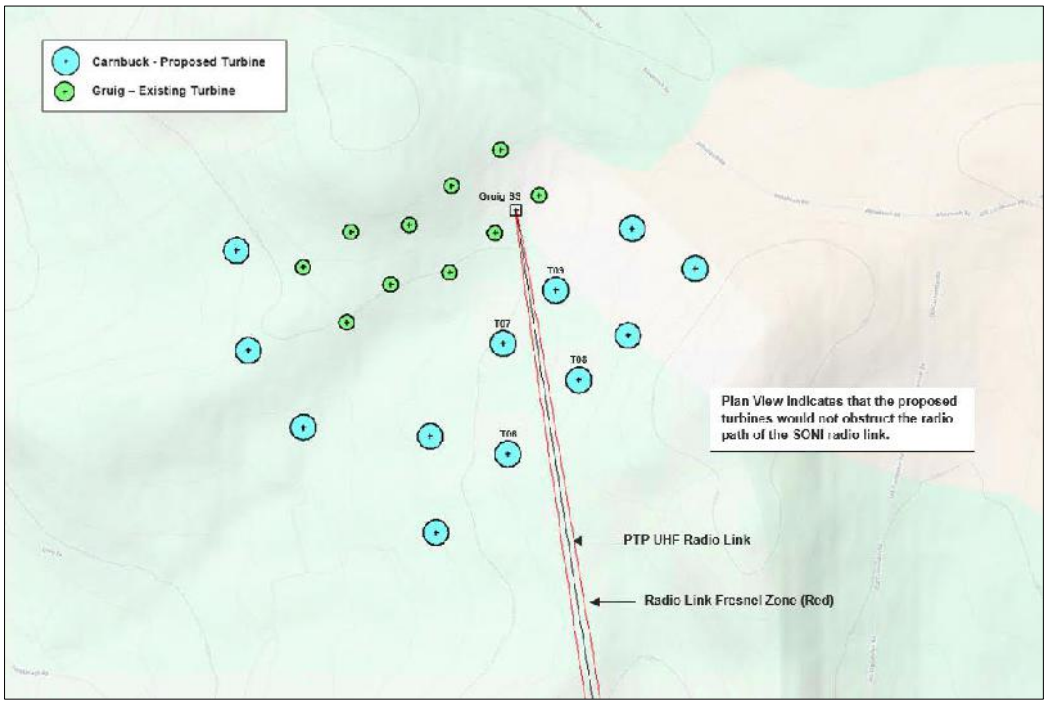


Figure 9. SONI Network – Close-up Plan View.

To further assess the potential impact of the proposed wind farm, the SONI radio link has been modelled in 3D and the Clearance Distances between the Fresnel Zone (0.6F1) of the link and the blade-tip of the nearest of the proposed turbines (T07 & T09) have been calculated. The 3D view of the UHF radio link relative to the proposed turbines is shown below in Figure 11.

Note: The industry standard Fresnel Zone applicable to radio links that are below 1 GHz is 60% of the First Fresnel (0.6F1). As the frequency of UHF radio links are generally between 400 MHz and 500 MHz, the applicable Fresnel Zone for the SONI link is 06.F1

Figure 10 below is an extract from a JRC report (3rd Party Project) in which they state that for UHF links, 60% of the First Fresnel should be used for Clearance Calculations

5.2 Diffraction Clearance zone calculation.

The Diffraction Clearance assessment used by JRC is that the no part of the windfarm turbine should encroach on the appropriate Fresnel clearance zone given in Table 5.1 : Fresnel Clearance Zones.

Frequency	Clearance criteria
UHF	60% of the 1st Fresnel zone
1 to 3 GHz	1st Fresnel zone
Microwave Links > 3 GHz	2nd Fresnel zone

Table 5.1 : Fresnel Clearance Zones

Figure 10. Extract from JRC report stating that the 0.6 F1 Zone should be used for UHF Links

The results of the 3D analysis indicate that there would be a clearance distance of over 100 m between the blade-tip of the nearest of the proposed turbines (T07 and T09) and the Fresnel Zone of the radio link. At this distance there should be no impact on the operation of the radio link.

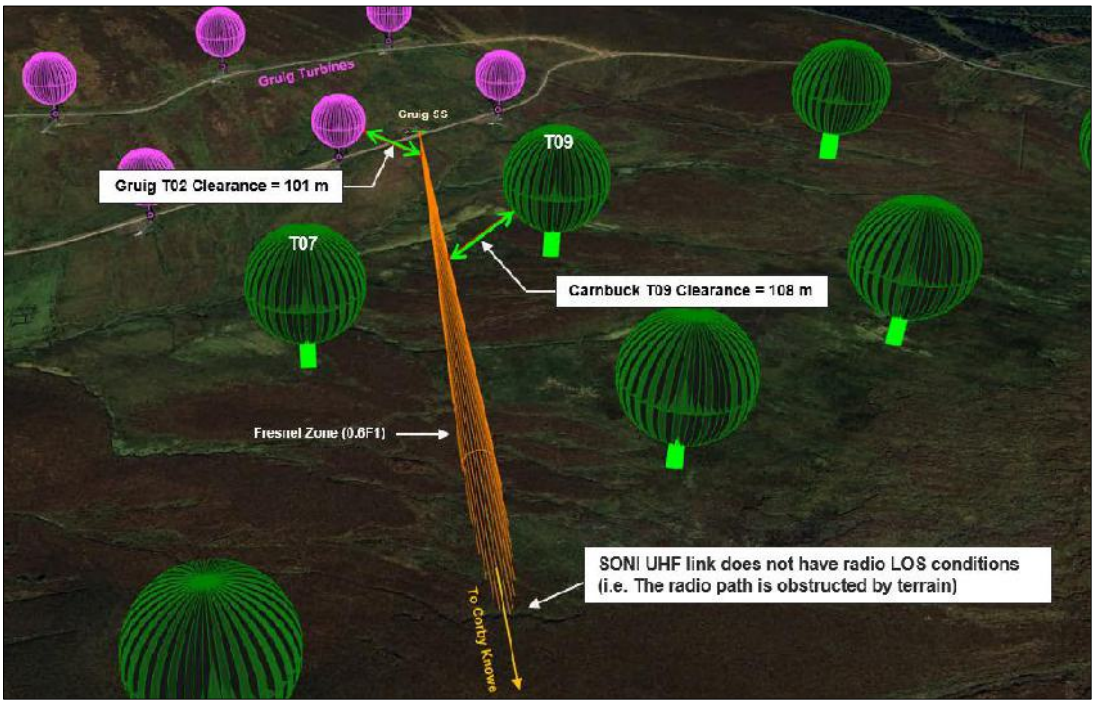


Figure 11. SONI Network – 3D View.

It should be noted that as UHF radio links operate at low frequencies they are relatively robust against interference. For example, the radio path of the SONI link between Corby Knowe and Gruig is obstructed by terrain, but is still operational. It should also be noted that one of existing the turbines at Gruig is located nearer to the UHF radio link than any of the proposed turbines at Carnbuck.

The 3D view shown in Figure 12 and the Radio Path Profile shown in Figure 13, illustrate that the radio path of the SONI link is obstructed by terrain. The installation of turbines at Carnbuck would have no additional impacts on the signal degradation that already exists on the UHF radio link.

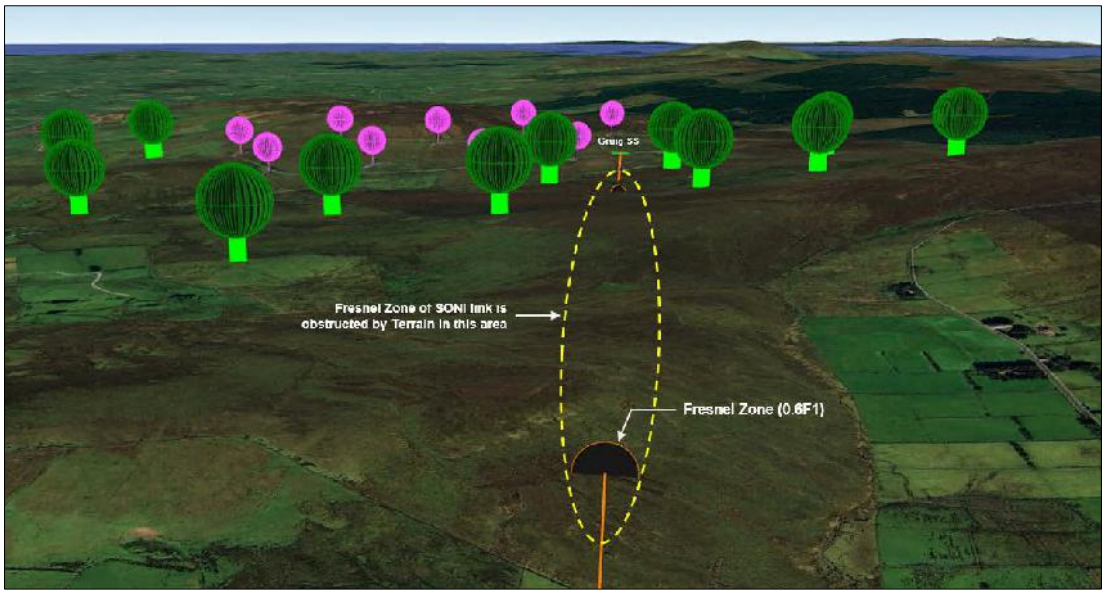


Figure 12. 3D Model showing Fresnel Zone of SONI radio link is already obstructed by terrain

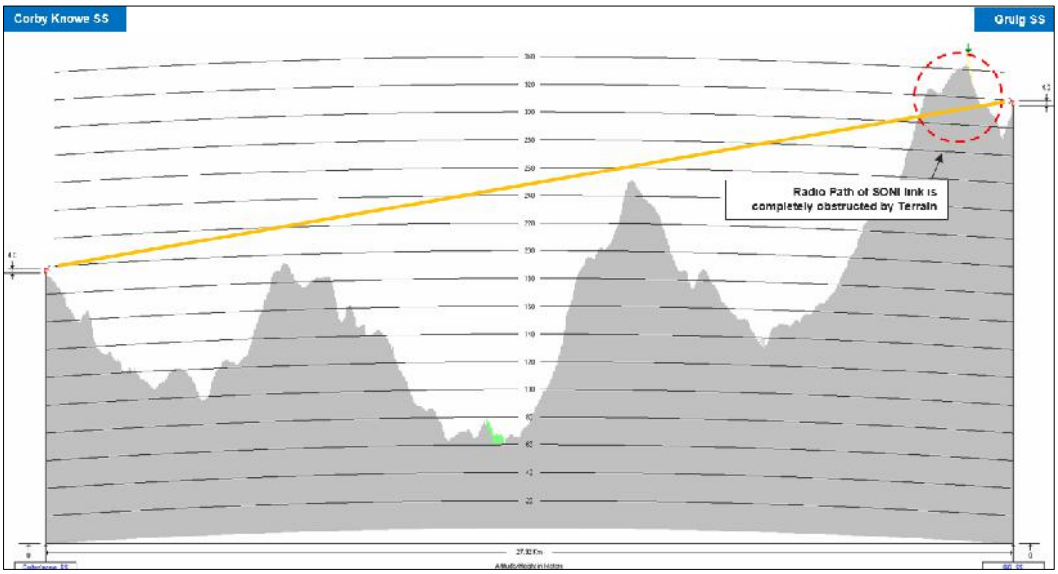


Figure 13. Path Profile showing that the SONI radio link is already obstructed by terrain

Table 7 below provides a brief summary of the radio link interference analysis for the closest of the proposed Carnbuck turbines (T07 & T09) to the SONI UHF radio link.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (0.6F1) Clearance / Interference	Wind Farm Impacts
SONI Link 1	Corby Knowe to Gruig	T07	123.9 m	No Impacts.
		T09	108.2 m	No Impacts.

Table 7. SONI Network – Analysis Summary

Section 6 - Mitigation Measures

6. Mitigation Measures

Section 6.1 and Section 6.2 that follow, describes the mitigation measures available to the wind farm developer to offset the potential impact of the proposed turbines on the PSNI and SONI networks.

6.1 Mitigation Measure Solutions – PSNI Network

To offset the potential impact of T09 on the PSNI radio link between Slieveanorra and the PSNI Police Station at Ballymena the following mitigation solutions are available:

Option 1 – Micro-site Turbine T09

This mitigation measure is described in Section 6.1.1 that follows.

6.1.1 Option 1 – Micro-site Turbine T09

An option of offset the potential impact of T09 on the PSNI radio link between Slieveanorra and Ballymena would be to micro-site the turbine by 50m to the west and away from the radio link. This would result in a clearance distance between the blade-tip of the turbine and the Fresnel Zone of the radio link.

Figure 14 below illustrates how micro-siting T09 by 50m to the west would result in a Clearance Condition of over 30m between the Fresnel Zone (F1) of the PSNI radio link and the blade-tip of T09. At this distance there would be no impact to the PSNI radio link.

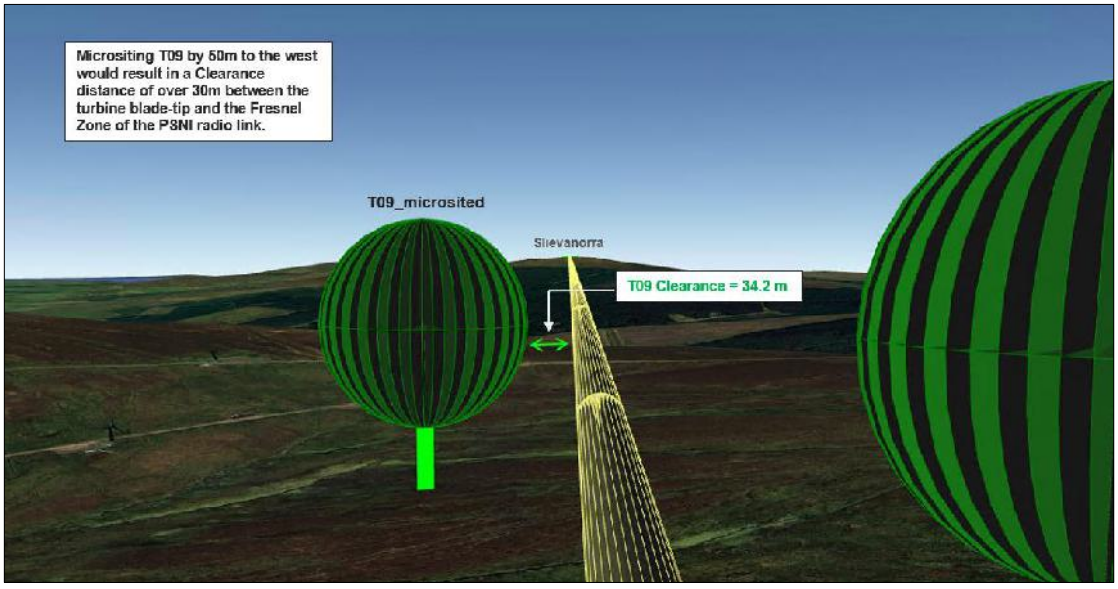


Figure 14. Micro-siting Turbine T09

Note: Micro-siting T09 to the west would move it closer to the SONI UHF radio link. Additional radio analysis/planning may be required to determine a location for T09 that would achieve the desired clearance from the PSNI microwave radio link, whilst maintaining an adequate buffer distance to the SONI UHF link.

6.2 Mitigation Measure Solutions – SONI Network

Results from the radio link analysis show that the proposed turbines at Carnbuck would not obstruct the SONI UHF radio link. The results also show that the radio path of the link is already obstructed by terrain and the installation of turbines at Carnbuck would have no additional impacts on the signal degradation that already exists on the UHF radio link. For these reasons, mitigation measures are not required for the SONI UHF radio link.

Section 7 - Conclusions

7. Conclusions

From the findings made in this report the following conclusions have been made:

- There are two radio links that pass through the proposed wind farm site: a microwave radio link (operated by the PSNI) and a UHF radio link (operated by SONI).
- From the details provided by the PSNI during consultations, it has been deduced that the radio link they have raised concerns about is a PTP radio link between the telecoms mast-site at Slievanorra and the PSNI Police Station in Ballymeena.
- Radio Network analysis indicates that the radio path of the PSNI radio link would be obstructed by Turbine T09. Micro-siting T09 by 50m to the west, would move it away from the PSNI radio link and provide a clearance distance of over 30m. At this distance, there would be no impact to the PSNI radio link.
- The SONI radio link is a UHF link between Corby Knowe wind farm and Gruig wind farm. Radio Network analysis indicates that this link would not be obstructed by the proposed turbines at Carnbuck. The network analysis also shows that the radio path of the UHF link is already obstructed by terrain. The installation of turbines at Carnbuck would have no additional impacts on the signal degradation of the UHF link that already exists due to terrain blockage.

Radio Link ID	Link Description	Nearest Turbines	Impacts of Proposed Layout	Possible Mitigation Measure
PSNI Link 1	Slieveanorra to Ballymena PSNI.	T06	No impact	N.A.
		T08	No impact	N.A.
		T09	Interference Impact (Radio Link Fresnel Zone obstructed by T09)	Micro-site T09 by 50m to the west.
SONI Link 1	Corby Knowe WF to Gruig WF	T07	No impact	N.A.
		T09	No impact	N.A.

Table 8. Radio Links crossing through/near proposed wind farm

Figure 15. Radio Links crossing through/near proposed wind farm.

APPENDIX A – Wind Farm Turbine Coordinates

Appendix A – Wind Farm Turbine Co-ordinates

The development is in the planning stage and the Final Turbine Layout is yet to be finalized. The co-ordinates of the turbine locations considered in this Telecommunications Impact Study are provided below.

Turbine ID	Coordinates (WGS 84)	
	Latitude	Longitude
T01	55° 01' 27.968"N	6° 16' 02.026"W
T02	55° 01' 10.679"N	6° 15' 58.494"W
T03	55° 00' 57.409"N	6° 15' 41.900"W
T04	55° 00' 55.858"N	6° 15' 03.694"W
T05	55° 00' 39.242"N	6° 15' 01.998"W
T06	55° 00' 52.773"N	6° 14' 40.358"W
T07	55° 01' 11.907"N	6° 14' 41.717"W
T08	55° 01' 5.562"N	6° 14' 18.917"W
T09	55° 01' 21.091"N	6° 14' 25.948"W
T10	55° 01' 13.272"N	6° 14' 04.168"W
T11	55° 01' 31.752"N	6° 14' 02.849"W
T12	55° 01' 24.815"N	6° 13' 43.957"W

Table 9. Wind Farm Layout - Turbine Co-ordinates

APPENDIX B – Field Survey Findings

Appendix B – Field Survey Findings

The telecom mast-sites surveyed for this Telecoms Impact Study are shown relative to the proposed wind farm site in Figure 16 below.

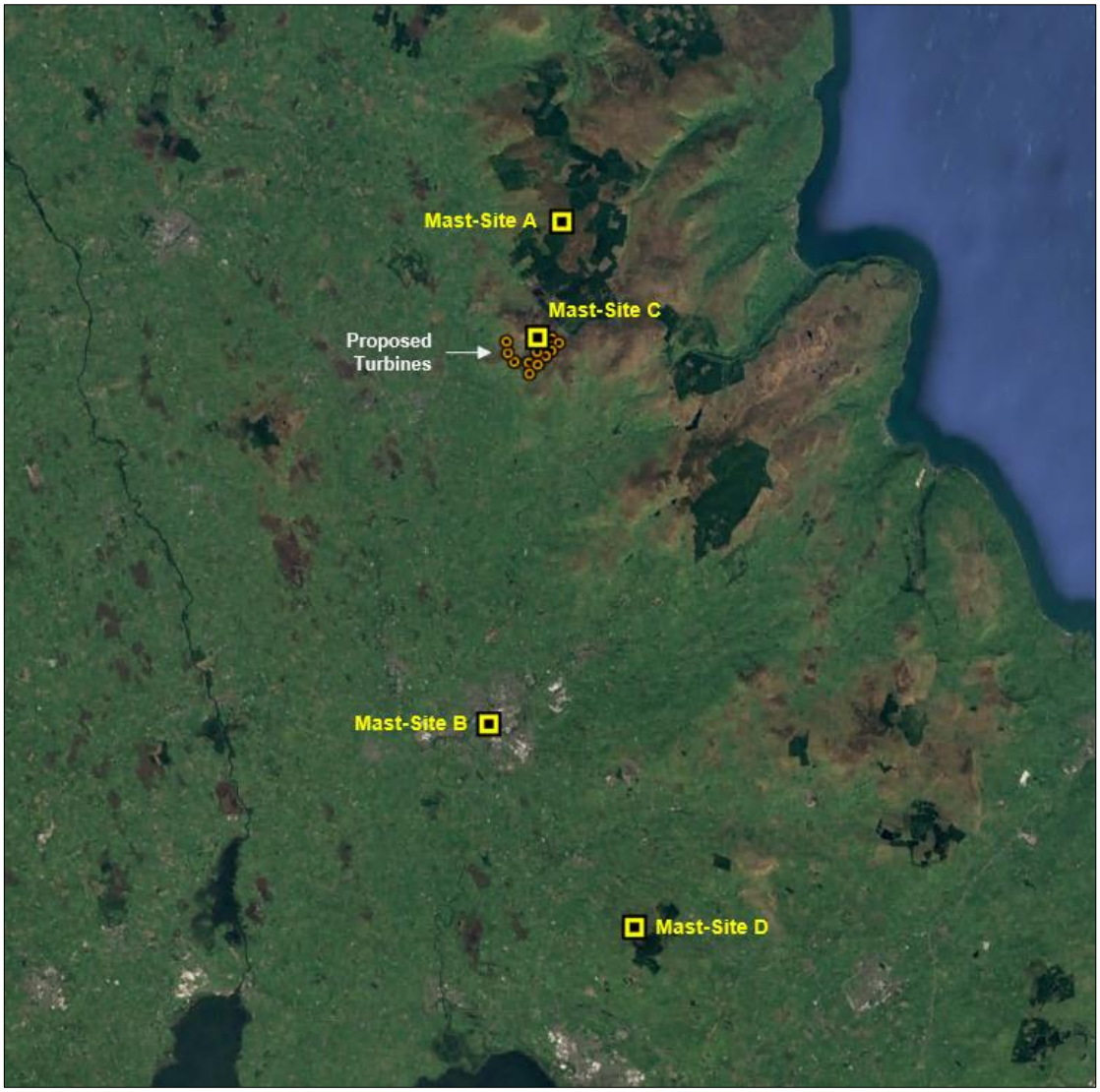


Figure 16. Telecom Mast-Sites shown relative to proposed wind farm.

The findings from the field surveys of each of the mast-sites are presented below.

Mast-Site A (Slieveanorra)

Telecommunications Mast-Site A is located in Slieveanorra Mountain and is approximately 6 km north of the proposed wind farm. A photo of the mast-structure at this location is shown below. The Telecom Operators who have radio links operating from this mast in the direction of the wind farm are listed in Table 10.

Figure 17. Mast-site A

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast A	PSNI

Table 10. Field Survey Summary – Mast-Site A

Mast-Site B (Ballymena PSNI Station)

Telecommunications Mast-Site B is located at the PSNI Police Station in Ballymena and is approximately 17 km south of the proposed wind farm. A photo of the mast-structure at this location is shown below. The Telecom Operators who have radio links operating from this mast in the direction of the wind farm are listed in Table 11.

Figure 18. Mast-site B

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast B	PSNI

Table 11. Field Survey Summary – Mast B

Mast-Site C (Gruig Wind Farm)

Telecommunications Mast-Site C is located at Gruig Wind Farm Substation and less than 1km north of the proposed wind farm. A photo of the mast-structure at this location is shown below. The Telecom Operators who have radio links operating from this mast in the direction of the wind farm are listed in Table 12.

Figure 19. Mast-site C

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast C	SONI

Table 12. Field Survey Summary – Mast C

Mast-Site D (Corby Knowe Wind Farm)

Telecommunications Mast-Site D is located at Corby Knowe Wind Farm and is approximately 26 km south of the proposed wind farm. Access into this mast-site was not possible on the day of survey; however, the substation building at this wind farm can be seen in the aerial view of the site in Figure 20 below.

The Telecom Operators who have radio links operating from this mast in the direction of the wind farm are listed in Table 13.

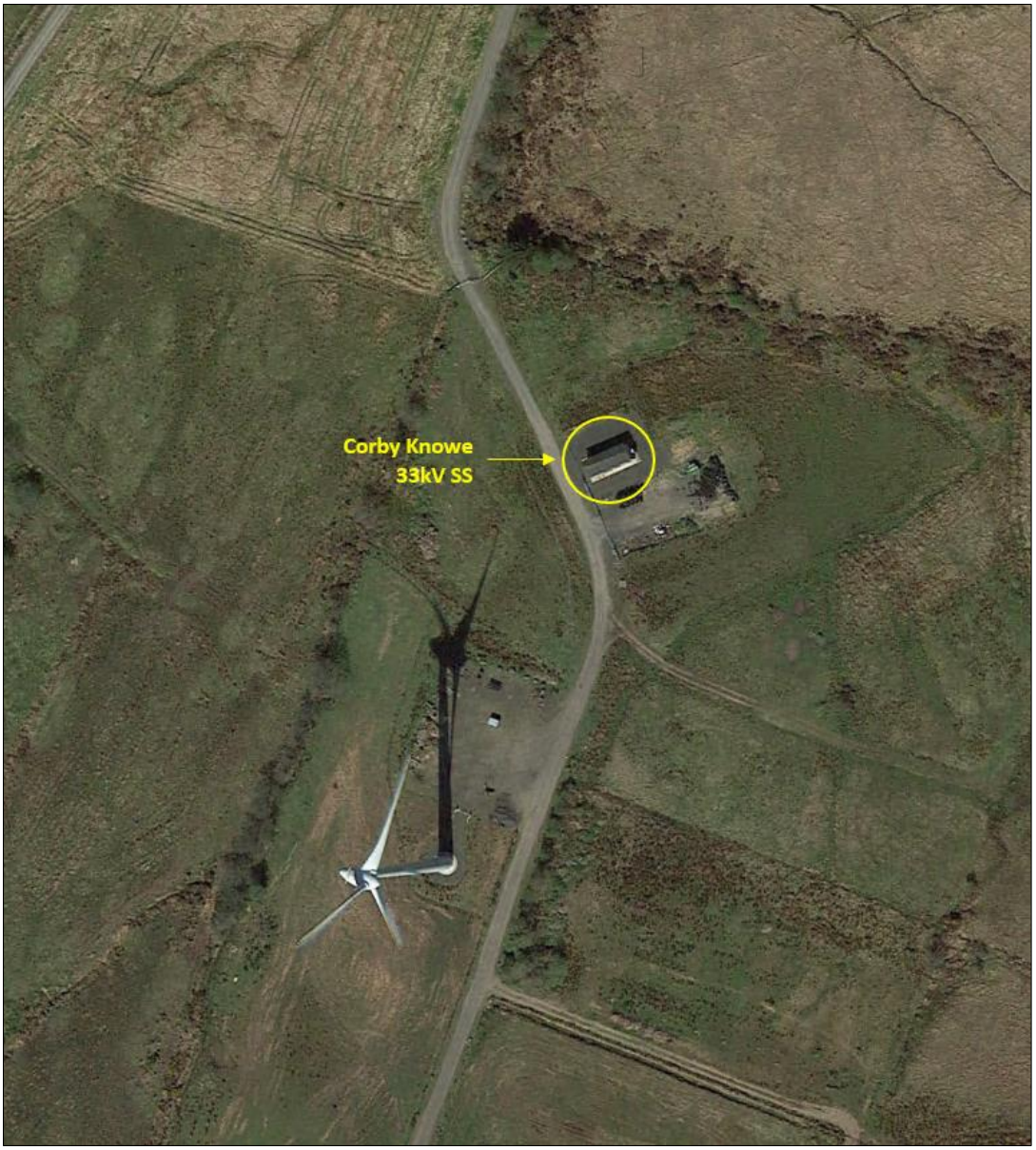


Figure 20. Mast-site D

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast D	SONI

Table 13. Field Survey Summary – Mast D

7

Landscape & Visual

7. Landscape and Visual

7.1 This section of the FEI report provides a response to the NIEA Countryside, Coast and Landscape (CC&L) Landscape Team's revised consultation response on Carnbuck Wind Farm dated 25th October 2023 (original response dated 11th August 2023).

7.2 NIEA Countryside, Coast and Landscape (CC&L) Landscape Team's position on Carnbuck Wind Farm (hereafter referred to as the Proposed Development) is that it would be unacceptable and have an adverse effect on the landscape character, visual amenity and integrity of the Antrim Coast and Glens AONB due to its scale, the nature of the proposal, its proximity to the AONB and the cumulative effects of other wind farms located in the area. They also believe that the proposal is contrary to planning policy.

7.3 In relation to policy, CC&L specifically refer to RDS 2035 policy RG11 which is to "conserve, protect and, where possible, enhance out built heritage and natural environment" by paying proper regard to their existing character and protecting designated landscapes from inappropriate development. They refer also to stipulations within SPPS, highlighting paragraph 6.22 which requires that particular care should be taken when considering the potential impact of all renewable proposals on the landscape and notes that some locations may more easily accommodate wind farms on account of their topography, landform and ability to limit visibility. Similar points are noted in relation to PPS18 and the accompanying best practice guidance and, in relation to the latter they have emphasised BPG paragraphs 1.3.18 – 19 which acknowledge that there are no landscapes into which a wind farm will not introduce a new and distinctive feature but this should not suggest that attempts to lessen the impacts by integrating the development into the surrounding landscape would not be worthwhile. CC&L's comments include a cursory note of the SPG's advice in relation to LCA 118, simply emphasising the point that significant impacts on key views from lowland landscapes to the west should be avoided. Policies from the Local Development Plan, as noted in CC&L's comments, reflect those of PPS 18.

7.4 In response, we note that the physical and visual character of the site and area surrounding the Proposed Development is already strongly defined by a number of different man-made elements. The same is true of the wider Study Area. For example, there are a number of established clusters of operational wind farms, including Gruig to which the Proposed Development would be integral. There are also large swathes of coniferous forestry, single turbines within a managed pastoral landscape across many lowland parts of the Study Area, a reservoir in close proximity to the site, and a number of busy trunk roads. Therefore, the current character of the area is not in fact being changed. Rather, the location of the Proposed Development is in accordance with policy stipulations to recognise and promote the conservation of local identity and distinctive landscape character and it is appropriately located to maintain this character whilst minimising the extent and magnitude of cumulative effects. CC&L's comments ignore the benefits of

clustering wind farms. In the majority of representative viewpoints used in this LVIA other existing wind farms would also be simultaneously visible within the same field of view as the Proposed Development which would therefore appear as part of an established pattern of similar developments rather than as a new standalone feature.

7.5 CC&L's cursory mention of LCA 118 fails to acknowledge the number of ways the Proposed Development responds positively to the guidance contained in the SPG. These are comprehensively analysed in the LVIA, starting at paragraph 4.89 and are not repeated in detail again here. However, in summary, the Proposed Development conforms to broad guidance in relation to the scale and form of underlying topography, clustering and separation distances between wind farms, avoidance of prominent summits in favour of side slopes and the use of convex landform to reduce visibility. The SPG also repeatedly refers to large scale commercial forestry as being detrimental to landscape character and specifically notes that locations within or close to forestry plantations are the least sensitive parts of the Moyle Moorlands and Forests LCA. The Proposed Development would be located in proximity to a large coniferous plantation at Slieveannorra Forest, a waste water treatment works, and three existing wind farms. It would utilise the site entrance and some of the access tracks that are already in place for Gruig wind farm and is therefore deemed to be accordance with this principle in the SPG.

7.6 The Proposed Development is not located within part of LCA 118 which could be regarded as having wild character because it is in relatively close proximity to areas of settlement, roads, quarries, forestry, other wind farms and other man-made influences. It would occupy a lower position than the other wind farms in Gruig cluster, particularly Corkey/ Corkey Re-Power which occupies a prominent skyline location. Corkey/ Corkey Re-Power wind farms would be clearly visible from more locations within the AONB and when travelling through the lowland landscapes to the west. In latter instances these wind farms would be viewed in conjunction with other wind farms in the Gruig cluster and also in the context of a wider pattern of wind farm clusters along other parts of this range of uplands and those on Long Mountain ridge. Although the Proposed Development would be visible from some parts of the lowland landscape in the west of the Study Area it would, in all instances, appear in the context of the existing and consented Gruig cluster of wind farms and, in many instances in the context of the clusters of wind farms elsewhere across the Study Area.

7.7 CC&L's comments on visibility suggest that they do not accept that evidence of an overall lack of visibility of the Proposed Development from the majority of the LVIA Study Area, including the AONB, can be interpreted as meaning that Carnbuck Wind Farm is in an acceptable location in relation to the AONB. Rather, they seem to feel that the mere proximity of the wind farm to the AONB causes unacceptable effects. This argument ignores both the limited nature of visibility from within the AONB, the fact that there are other wind farms within the existing Gruig cluster that are already far more prominently located and visible from the AONB. The AONB covers a large area but the Proposed Development's visibility from key parts

of the AONB, such as the coast and within glens, and also from locations beyond approximately 5 km is particularly limited. It would be located to the west of the central part of the Antrim Coast and Glens AONB on a broadly west-facing side slope. This landform ensures that the Proposed Development would be both physically separate and visually distinct from the majority of the AONB. With the exception of some locations within relatively close range, represented by the 4 viewpoint locations in Category C, there are very few parts of the AONB that would experience effects on landscape or visual character. Viable viewpoints located within the Antrim Coast and Glens AONB were only identified within approximately 5 km to the east of the Proposed Development (Viewpoints 11 – 13) and on elevated ground to the south (Viewpoints 9 and 14). Longer range views were identified in the Causeway Coast AONB (Category E Viewpoints 20 – 22) although all of these would be located in excess of 23 km from the Proposed Development where it would be unlikely to be easily discernible.

7.8 CC&L feel that the movement of the turbines would significantly increase the assessment of visual effects and the LVIA should not rely solely on static images. However, this is accepted best practice and the norm for all LVIA assessment to date. They also note that the rotation of the turbine blades would significantly affect the tranquillity of the AONB landscape because it is less than 1km away. This aspect of CC&L's response ignores the presence of an existing cluster of wind farms in this location, all of which are rotating and some of which are far more visible from within the AONB. Whereas, Carnbuck Wind Farm, although located in proximity to one part of the AONB boundary, would in fact have limited visibility from within the AONB (only theoretical blade tip visibility of 21.37%, reducing to 13.95% if considering hub height visibility, and reducing further if considering more than simply bare ground topography. The screening effects of large swathes of coniferous forestry along the western edges of the AONB would certainly reduce potential visibility even further.

7.9 In summary, whilst the LVIA recognises that the Proposed Development would increase the geographical extent of the existing and consented Gruig cluster of wind farms, it is well located in relation to the underlying topography and takes advantage of the natural screening provided by adjacent upland areas. The layout of the proposed turbines reflects the layouts of some of the other existing wind farms in this cluster and, in views from the wider landscape it would form a well-integrated element of this cluster. Overall visibility is limited, particularly within the AONB, and in locations beyond 5 km. From viewpoints in the wider area, including those from where the site of the Proposed Development forms the setting for the AONB, it would be a less prominent feature. Man-made influences are an established part of the character of the whole Study Area and also the western-facing edge of the AONB. The Proposed Development must be considered in this context.

8

Cultural Heritage & Archaeology

8. Cultural Heritage & Archaeology

Introduction

8.1 This section should be read in conjunction with Chapter 5 of the 2022 Environmental Statement (hereafter 'the ES') and Chapter 12 of the 2022 Environmental Statement: Traffic and Transport.

8.2 This Further Environmental Information (FEI) has been prepared by Headland Archaeology in order to respond to requests for additional information and clarification from Historic Environment Division: Historic Monuments (HED: HM). The requests are summarised in Table 8.1 and addressed in paragraphs 8.12-8.53.

8.3 Further detail has been added regarding potential impacts on heritage assets within the Inner Study Area (ISA), along with further information on the palaeoenvironmental and prehistoric potential of the ISA. Further proposed mitigation measures are also provided where appropriate.

8.4 Additional photomontage visualisations taken from three locations within Lissanoure demesne (AN/049) have been produced (Figures 8.1-8.3). The visualisations have informed additional assessment of the potential impact of the Proposed Development on this asset and Lissanoure Castle (ANT018:011) (contained within the demesne boundary).

8.5 Further information on the location of the proposed road widening works associated with the access route for the Proposed Development is provided. Further detail on the proximity of these proposed works to Armoy scheduled and state care round tower ecclesiastical site ANT013:010, the scheduled earthwork ANT 013:089 and Doonavernon motte and bailey ANT 013:021 is provided in this FEI.

8.6 HED: HM's points pertaining to the ISA and Lissanoure demesne (AN/049) are addressed first. Their point regarding the impact of the proposed access route on three other assets is addressed at the end of the FEI (Armoy scheduled and state care round tower ecclesiastical site ANT013:010, the scheduled earthwork ANT 013:089 and Doonavernon motte and bailey ANT 013:021).

Legislation, Planning Policy & Guidance

8.7 This FEI has been compiled in accordance with the same legislation, regional planning policy and guidance referred to in the ES. The ES was undertaken in accordance with the HED and Cadw guidance documents (ES paragraphs 8.26-8.31), and it is considered that this remains valid.

Table 8.1 HED Requests

Consultee	Summary Response (paraphrased from HED: HM response dated 16/11/23)	Action taken
Historic Environment Division: Historic Monuments (HED: HM)	1. HED: HM stated that the ES does not propose any mitigation for the impacts of any ancillary works such as the excavation of earthing cable trenches, drainage and any upgrading to PowerNI networks associated with the construction of the Proposed Development. They also stated that the proposed route of earthing cable trenches and drainage and any upgrading needed for electricity cable infrastructure would also need to be carefully managed to avoid any impacts upon known/recorded heritage assets. 2. HED: HM stated that the ES does not propose any mitigation for the impact of the Proposed Development on Carnbuck, Gruig and Moneyneagh townland boundaries, which all meet within the ISA. HED: HM also stated that these assets were not identified in the ES nor is any assessment of potential impact presented in the ES. 3. HED: HM stated that they did not agree with the assessment of the ISA's palaeoenvironmental potential presented in the ES. They give their view that the ISA is of higher palaeoenvironmental and archaeological potential than is assessed in the ES and have provided some information. 4. HED: HM stated that assessment of the impact of the Proposed Development upon Lissanoure	1. Paragraph 8.12-8.17 details the proposed mitigation for potential impacts on below ground remains within the footprint of earthing cable trenches, drainage and any other ancillary works. An assessment of potential impacts is provided in paragraph 8.13 of this FEI. 2. Paragraph 8.26-8.28 details the proposed mitigation for potential impacts on the townland boundaries. Gruig and Moneyneagh townland boundaries are now shown on Figure 8.5 which also more fully depicts the location of Carnbuck townland boundary (HA18). An updated assessment of importance of these assets is provided in paragraph 5.22 and an assessment of potential impacts is provided in paragraphs 8.23-8.25. 3. A re-assessment of palaeoenvironmental and prehistoric potential is provided in paragraphs 8.32-8.33 along with proposed mitigation against potential impacts on palaeoenvironmental and prehistoric (and later) remains. 4. Three additional photomontages have been produced from locations within Lissanoure demesne (AN/049). These include the locations required by HED:HM and have informed further assessment of the potential impact of the

Consultee	Summary Response (paraphrased from HED: HM response dated 16/11/23)	Action taken
	demesne (AN/049) and its setting should be supplemented with photomontages taken from several points within the demense including – but not limited to – from: • The front of Lissanoure Castle (ANT018:011) • The edge of Lough Guile at c. 306495, 424220 (marked by a bench) 5. HED: HM stated that the ES missed a potential impact on Armoy scheduled and state care round tower and ecclesiastical site ANT013:010 the scheduled earthwork ANT 013:089 and Doonavernon motte and bailey ANT 013:021 as a result of the proposed access route works.	Proposed Development on Lissanoure demesne (AN/049)/ Lissanoure Castle (ANT018:011) (Figures 8.1-8.3). 5. A review of these heritage assets in relation to the proposed access route works has been undertaken in paragraph 8.46-8.49.

Assessment Methodology

8.8 The methodology employed for assessment of potential impacts remains unchanged from that used in the ES (described in ES paragraphs 8.39 – 8.77).

8.9 In response to HED: HM's requests for additional photomontages for Lissanoure demesne (AN/049), three photomontages have been produced. New photography was taken from three locations within Lissanoure demesne (AN/049):

- Viewpoint 1 (Figure 8.1): 306495, 424220 (shore of Lough Guile, marked by a bench)
- Viewpoint 2 (Figure 8.2): 306598, 424348 (front of Lissanoure Castle (ANT018:011))
- Viewpoint 3 (Figure 8.3): 306471, 424592 (from ground looking towards Lissanoure Castle (ANT018:011)) at north-west of pond)

8.10 The viewpoint locations are shown in Figure 8.4.

Baseline Conditions

8.11 Baseline conditions remain unaltered from those identified in the ES.

Comment 1 (Table 8.1), Cable trenches, drainage and ancillary works.

8.12 HED: HM stated that 'No specific provision for mitigating the impacts of any ancillary works such as the excavation of earthing cable trenches, drainage, any upgrading to PowerNI networks etc associated with the turbines has been included. The proposed route of earthing cable trenches and drainage and any upgrading needed for electricity cable infrastructure would also need to be carefully managed to avoid any impacts upon known/recorded assets.'

8.13 Section 8.155 of the ES states that 'Based on the assessment of known heritage assets within the ISA, any effect resulting from an impact upon archaeological remains discovered during the construction-phase is unlikely to be of greater than minor significance.' As per paragraph 8.33 below, this FEI now considers that this may be of up to moderate significance should any remains of prehistoric date be encountered and directly physically impacted during the construction phase works.

8.14 To mitigate against any potential impacts on below ground remains, it is proposed that archaeological monitoring of ground breaking works associated with the installation of cable trenches, drainage, upgrades to PowerNI networks or other ancillary works is carried out during the construction phase. The scope of the archaeological monitoring will be agreed with HED: HM in advance of the construction phase commencing. A Written Scheme of Investigation (WSI) for the monitoring works (including provisions for fieldwork, post-fieldwork analysis and reporting, archiving and dissemination) will be produced and agreed with HED: HM. The archaeological monitoring will be carried out by a suitably qualified archaeologist.

8.15 The location of all known heritage assets and areas of greatest archaeological potential within the ISA will be provided to the applicant to inform the detailed design stage of the Proposed Development. All heritage assets within the ISA will, as far as reasonably practicable, be avoided. Where unavoidable impacts upon heritage assets are identified, a programme of archaeological excavation and recording prior to construction works commencing will be carried out.

8.16 After mitigation, it is considered that the potential effect of the proposed works outlined by HED: HM on below ground remains would be reduced to negligible adverse significance which is not significant in EIA terms.

8.17 This is considered to adequately address comment 1 of HED: HM's response as outlined in Table 8.1 above.

Comment 2 (Table 8.1) Townland Boundaries

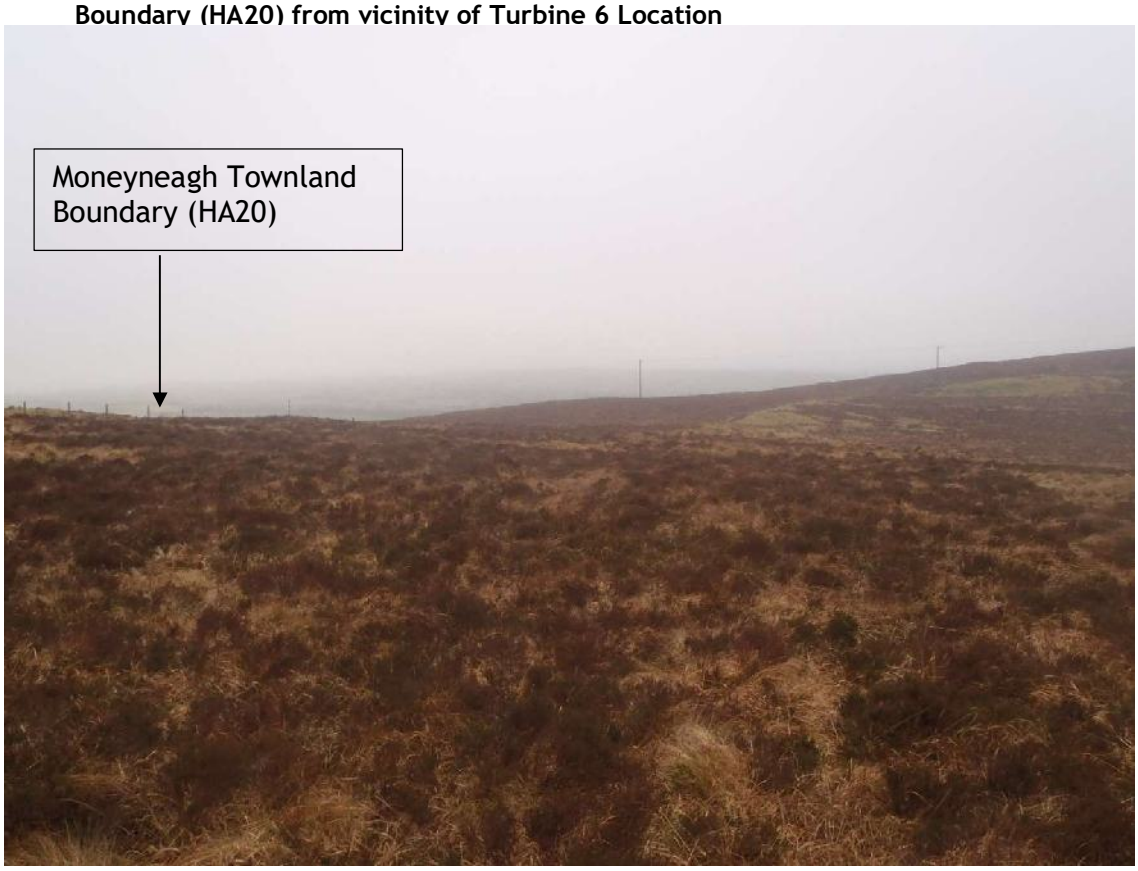
8.18 HED: HM stated that 'Carnbuck, Gruig and Moneyneagh townlands all meet within the application site. Currently no mitigation is proposed for any impacts on the three townland boundaries nor are they identified or any potential impact assessed within the Archaeology and Cultural Heritage Chapter.'

8.19 Moneyneagh and Gruig townland boundaries are identified on Figure 8.5 as HA20 and HA21 respectively. Carnbuck townland boundary was identified in Appendix 8.1

Archaeology and Cultural Heritage as HA19 and was partially depicted on 'Figure 8.1: Heritage Assets within Inner Study Area'. This asset is now more fully depicted on Figure 8.5.

8.20 Moneyneagh townland boundary (HA20) is located at the north-west of the ISA and is characterised by a combination of a modern fence line running north-east to south-west within the ISA (Illus 1), with a drystone wall marking the boundary where it turns and runs roughly east-west outwith the ISA (Figure 8.5).

Illustration 1. View south-west looking towards Moneyneagh Townland Boundary (HA20) from vicinity of Turbine 6 Location



8.21 Gruig townland boundary (HA21) comprises a drystone wall located at the north-west of the ISA; it meets the boundary of HA20 Moneyneagh at its northern extent (Figure 8.5).

8.22 Carnbuck townland boundary (HA19) was considered to be of negligible importance due to its reduced state of preservation, with the asset defined by a combination of a modern fence line and reduced drystone walls. In light of HED: HM's comments and given the asset's function as marking a townland boundary, this FEI considers the asset, along with HA20 and HA21, to be of low (local i.e. townland/parish) importance.

8.23 Moneyneagh townland boundary (HA20) as a whole comprises a length of approximately 7.2 km. Approximately 10 m of the modern fence line which defines

HA20 would be truncated by an access track leading to the proposed Turbine 2 (see Figure 8.5). None of the original fabric of the townland boundary survives in this location although it is acknowledged that below ground remains of the original boundary may survive. A negligible impact is therefore predicted on an asset of low importance, leading to a significance of effect of negligible adverse, which is not significant in EIA terms.

8.24 Gruig townland boundary (HA21) as whole comprises a length of approximately 4.5 km. The asset lies outwith the Proposed Development footprint. Accidental direct impacts upon the asset may arise should activities such as, but not limited to, ancillary drainage works, and uncontrolled plant movement take place in the vicinity of the asset. Approximately 100 m of the length of the asset lies within the ISA. Assuming a worst case scenario that the entirety of this section of the asset is accidentally truncated during construction works, this would result in an impact of up to low magnitude on an asset of low importance, leading to a significance of effect of negligible adverse, which is not significant in EIA terms.

8.25 Carnbuck townland boundary (HA19) as whole comprises a length of approximately 19.5 km. Approximately 5 m of the modern fence line which characterises HA19 would be truncated by an access track leading to the proposed Turbine 4 (Figure 8.5). The proposed grid connection route would also truncate a section of HA19 (Figure 8.5). None of the original fabric of the townland boundary survives in this location although it is acknowledged that below ground remains of the original boundary may survive. A negligible impact is therefore predicted on an asset of low importance, leading to a significance of effect of negligible adverse, which is not significant in EIA terms.

8.26 In order to mitigate potential direct impacts upon potential below ground archaeological remains associated with Carnbuck townland boundary (HA19) and Moneyneagh townland boundary (HA20), archaeological monitoring of ground breaking works for the access tracks leading to the proposed Turbines 2 and 4 is proposed. Archaeological monitoring of ground breaking works for the proposed grid connection route is proposed where this intersects with Carnbuck townland boundary (HA19). Should any earlier remains associated with these assets be identified during the archaeological monitoring works these would be subject to archaeological excavation and recording.

8.27 In order to mitigate any potential accidental direct impacts on Gruig townland boundary (HA21) it is proposed that the asset is fenced off with a suitable buffer prior to the construction phase commencing.

8.28 It is also proposed that the remaining sections of the townland boundaries are preserved in situ in order to ensure their continued visibility within the landscape.

8.29 After mitigation, it is considered that the potential effect of the Proposed Development on Carnbuck townland boundary (HA19), Moneyneagh townland boundary (HA20) and Gruig townland boundary (HA21) would be reduced to none which is not significant in EIA terms.

8.30 This is considered to adequately address comment 2 of HED: HM's response as outlined in Table 8.1 above.

Comment 3 (Table 8.1) Palaeoenvironmental and prehistoric potential

8.31 HED: HM stated that they:

'…do not agree with the author's of [sic] assessment of paleoenvironmental potential at this application site which is based loosely on depths of peat encountered during monitoring to the nearby Gruig wind farm. Depths of peat will vary and depth is not an indicator of potential which is more closely linked to location, type of peat deposit etc. There is also no understanding demonstrated of the setting of the standing stone as potentially part of neolithic or early Bronze age pre-bog landscape- which could be more extensive than is visible and which coupled with pollen evidence from other upland landscapes indicates extensive occupation and land clearance during the neolithic and early bronze age in an environment which was then much more hospitable prior to a climatic downturn and the ensuing growth of peat. This goes against the narrative taken by the author that the uplands were not hospitable for occupation and that the potential for unknown archaeology is therefore low. It is entirely possible that pre-bog landscapes associated with the standing stone or other features could be present under the peat. There is no way of knowing this without extensive survey.'

8.32 This FEI acknowledges the possibility for palaeoenvironmental and prehistoric remains to exist within the ISA. It is acknowledged that the lack of palaeoenvironmental evidence within the ISA is such that it is not possible to confidently predict that no prehistoric remains exist within the ISA. An assessment of effect significance cannot be meaningfully evaluated for unknown palaeoenvironmental or prehistoric remains, as neither the importance of the asset nor the magnitude of the impact can be precisely defined. Consequently, only the likelihood of construction effects based on a worst case scenario is considered.

8.33 It is considered that any previously unknown prehistoric and/ or palaeoenvironmental remains may be of up to medium (regional i.e. county wide) importance. Direct physical impacts on any such remains may be of up to high magnitude which would result in a significance of effect of moderate adverse which is significant in EIA terms.

8.34 In order to better understand the ISA's potential for palaeoenvironmental remains and to mitigate against any potential direct physical impacts upon such remains, a programme of peat coring is proposed. The scope of the peat coring would be agreed with HED: HM in advance of the construction phase.

8.35 Peat cores allows for an understanding of past environments through analysis of plant macrofossils, pollen, molluscs and other organic material. This in turn would allow for an understanding of the potential for prehistoric remains to exist within the ISA. The results of the peat coring would inform the scope of a wider programme of archaeological monitoring of ground breaking works within the ISA. Should any remains of prehistoric (or later) date be identified during archaeological

monitoring these will be subject to excavation and recording. The scope of the archaeological monitoring and a WSI for the proposed works will be agreed with HED: HM in advance of the construction phase.

8.36 After mitigation, it is considered that the potential effect of Proposed Development on palaeoenvironmental and prehistoric remains would be reduced to negligible adverse significance which is not significant in EIA terms.

8.37 This is considered to adequately address comment 3 of HED: HM's response as outlined in Table 8.1 above.

Comment 4 (Table 8.1) Lissanoure demesne

8.38 HED: HM stated that:

'The assessment of the impact of the proposed development upon Lissanoure demesne (AN/049) and its setting should be supplemented with photomontages. Photomontages should be taken from several points within the demense including – but not limited to – from:

1. The front of Lissanoure Castle (ANT018:011)

2. The water's edge at c. 306495, 424220 (view spot marked by bench)'

8.39 Three photomontages have been produced as follow:

- Viewpoint 1 (Figure 8.1): 306495, 424220 (shore of Lough Guile, marked by a bench)
- Viewpoint 2 (Figure 8.2): 306598, 424348 (front of Lissanoure Castle (ANT018:011))
- Viewpoint 3 (Figure 8.3): 306471, 424592 (from ground looking towards Lissanoure Castle (ANT018:011)) at north-west of pond)

8.40 The viewpoint locations are shown in Figure 8.4. The viewpoint locations were chosen to demonstrate areas where maximum visibility of the Proposed Development was possible and to provide context in relation to the extent of screening from policy woodland which characterises much of the demesne.

8.41 Viewpoints 1 (Figure 8.1) and 2 (Figure 8.2) demonstrate that from the northern shore of Lough Guile and from south of Lissanoure Castle (ANT018:011), policy woodland would screen any views of proposed turbines from these locations.

8.42 Viewpoint 3 (Figure 8.3) demonstrates that policy woodland would screen views of the proposed turbines in views towards Lissanoure Castle (ANT018:011) from the pond at the north.

8.43 Viewpoints 1-3 demonstrate views from the more designed elements of Lissanoure demesne (AN/049) focussed on Lissanoure Castle (ANT018:011), the more open ground to the south of the castle overlooking Lough Guile and the pond to the north of the castle. As a result of their intentional design, these areas of the demesne are considered to be most sensitive to visual change within their setting. The surrounding area outwith this is broadly characterised by agricultural land. These

more functional/less aesthetic areas contribute to the demesne's cultural significance as they demonstrate the contrasting functions of different areas of the demesne, with the more recreational area focussed on the centre around the castle, loch and pond, and the more productive areas located outside the policy woodland which characterises the demesne's central area. The differing functions and separation of these areas is clearly defined by the policy woodland. Views from the agricultural land on the outskirts of the demesne relate primarily to their immediate locale, and there are no designed elements within these areas which draw or channel views towards particular parts of the wider landscape. It is possible to view the policy woodland surrounding Lissanoure Castle (ANT018:011) from these areas, allowing for an understand of the division in function of these two areas of the demesne. As such any visibility of the proposed turbines (located c. 4.3 km to the south-east) from these agricultural areas, would not diminish the ability of the visitor to understand, appreciate and experience/enjoy these areas of agricultural land in relation to the wider demesne. The Proposed Development is located considerably outwith the largely inward-looking setting of Lissanoure demesne (AN/049).

8.44 The conclusion stated in paragraph 8.205 of the ES of no effect significance on Lissanoure demesne (AN/049) is considered to remain valid.

8.45 This is considered to adequately address comment 4 of HED: HM's response as outlined in Table 8.1 above.

Comment 5 (Table 8.1) Impacts on Scheduled Monuments

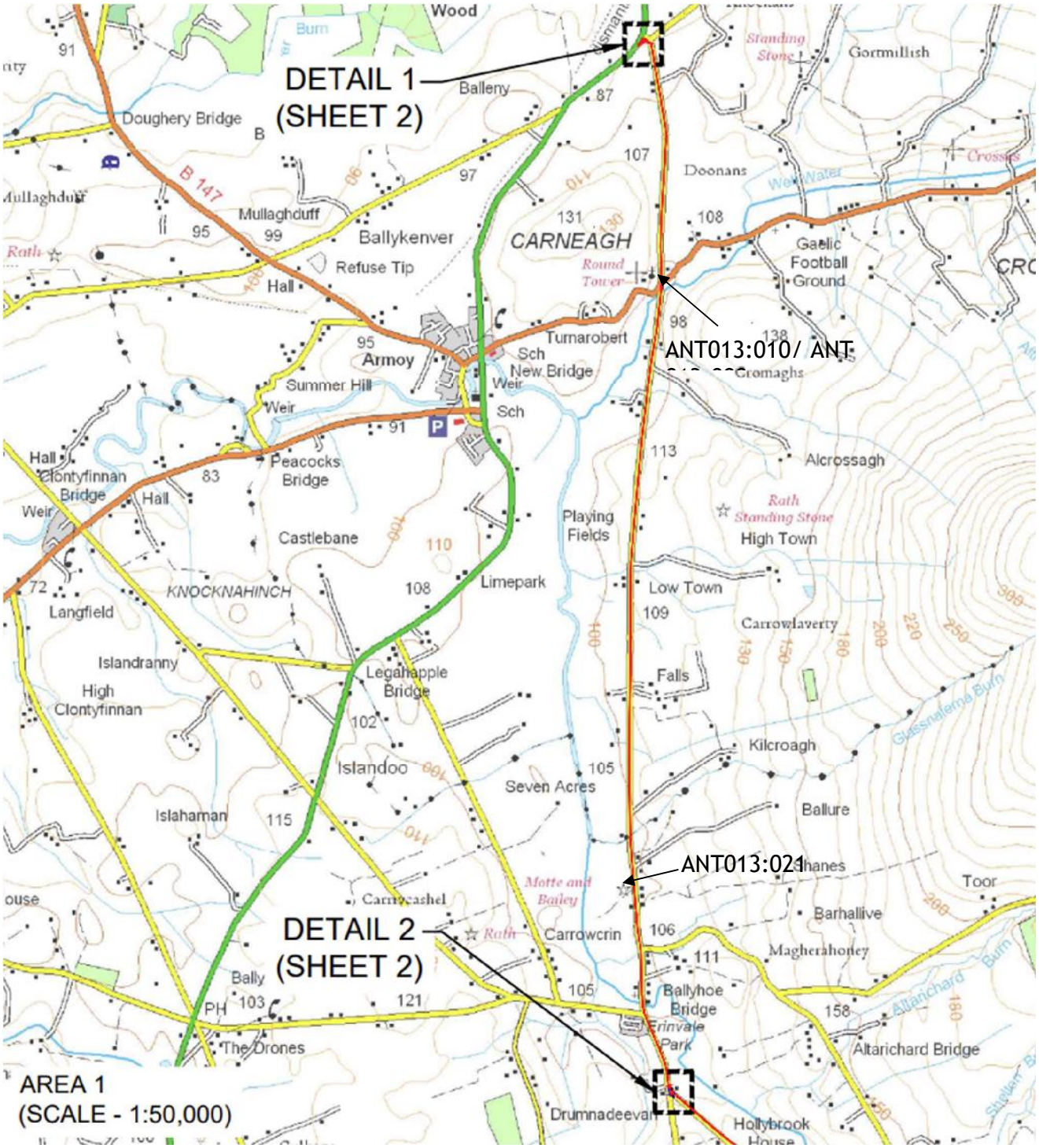
8.46 HED: HM stated:

'An important potential impact along the proposed access route has been missed in the Archaeology and Cultural Heritage Chapter. Detail 1 of Fig 1.2 - Planning Application Boundary indicates an area of road widening which is immediately adjacent to Armoy scheduled and state care round tower and ecclesiastical site ANT013:010 and the scheduled earthwork ANT 013:089. HED (Historic Monuments) would have concerns about the impact of the utilisation and widening of the existing route in its context immediately next to these two significant scheduled sites. There is a clear possibility of a much wider ecclesiastical settlement associated with the round tower which could be impacted by the road widening. There is no identification or assessment of this potential impact nor are there any proposals for mitigation included in the Chapter or Technical Appendix and this would need specific consideration and mitigation proposals in the programme of works. Also it should be considered that any road widening along the route could potentially have an impact on other monuments including Doonavernon motte and bailey ANT 013:021 whose scheduled area is located right up to the edge of the road.'

8.47 There seems to be a misunderstanding on HED: HM's part regarding the location of Detail 1 of Figure 1.2 – Planning Application Boundary. This part of the proposed access route is located approximately 1.5 km north of the location of Armoy

scheduled and state care round tower and ecclesiastical site ANT013:010 and the scheduled earthwork ANT 013:089. Illus 2 below is an extract of Figure 1.2 – Planning Application Boundary which shows the locations of ANT013:010 and ANT 013:089 marked. Doonavernon motte and bailey ANT 013:021 also does not lie within an area of the proposed access route where any road widening is proposed (Illus 2).

Illustration 2. Zoom in of Figure 1.2 Planning Application Boundary showing locations of ANT013:010/ ANT 013:089 in relation to proposed road widening (Detail 1). Location of ANT013:021 is also shown.



8.48 The locations of proposed road widening works are stated in paragraph 12.22 of Chapter 12: Traffic and Transport and shown in Figure Appendix 12.1, Sheets 11, 13, and 14. Table 12.6: Summary of Predicted Environmental Effects of Widening works of Chapter 12 includes a section for the assessment of the potential impact of road widening works on Cultural Heritage and Archaeology. No heritage assets were identified within the areas of road widening and these areas were considered to be of negligible archaeological potential. No impacts were predicted and it is considered this assessment remains valid.

8.49 This is considered to adequately address Point 5 of HED: HM's response as outlined in Table 8.1 above.

Conclusion

8.50 This FEI has responded to and addressed the requests for information raised by HED: HM in their application response of 16th November 2023. The FEI has responded to and addressed points raised by HED: HM regarding potential construction phase impacts upon:

- Carnbuck townland boundary (HA19);
- Moneyneagh townland boundary (HA20);
- Gruig townland boundary (HA21);
- Potential below ground archaeological remains which may be truncated by ancillary works; and
- Potential below ground prehistoric and palaeoenvironmental remains

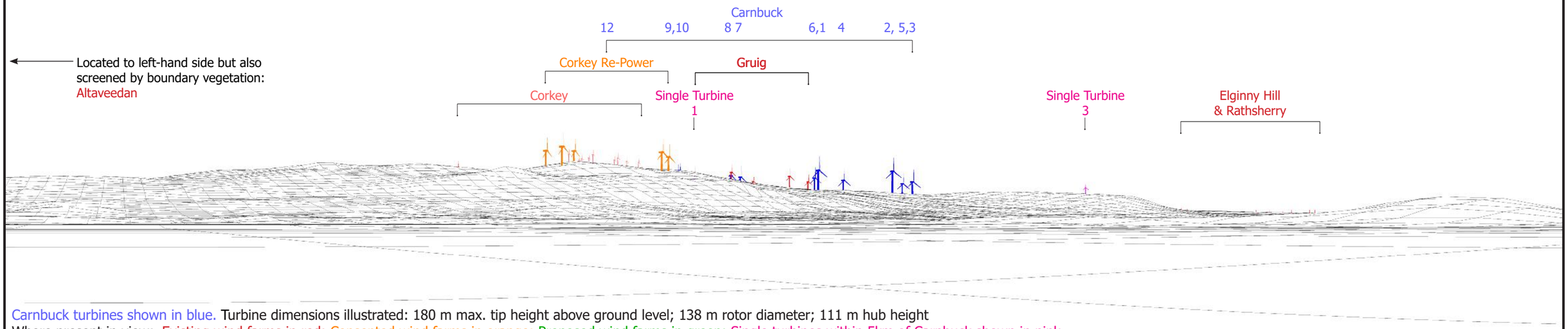
8.51 Appropriate mitigation measures for each of the potential construction phase impacts noted above have been presented. Following mitigation, no significant residual construction phase effects are predicted.

8.52 Three photomontages (Figures 8.1-8.3) have been prepared to illustrate how the Proposed Development would appear in views from three locations within Lissanoure demesne (AN/049) including from Lough Guile, from the south of Lissanoure Castle (ANT018:011) and looking towards Lissanoure Castle (ANT018:011) from the pond to the north-west. The photomontages demonstrate that policy woodland would screen the proposed turbines from view from these locations. This FEI has provided further assessment of the potential impact of the Proposed Development in views from the agricultural land surrounding the policy woodland of Lissanoure demesne (AN/049). It is considered the conclusion stated in paragraph 8.205 of the ES of no effect significance on Lissanoure demesne (AN/049) remains valid.

8.53 Further detail on the location of the proposed road widening works for the proposed access route has been provided. Armoy scheduled and state care round tower and ecclesiastical site ANT013:010 and scheduled earthwork ANT 013:089 are located c.1.5 km south of the proposed road widening works noted by HED: HM. Doonavernon motte and bailey ANT 013:021 is also not located within an area of

proposed road widening. No impacts are predicted on Cultural Heritage or Archaeology as a result of the proposed road widening works.

FIGURES 8.1 – 8.5



Carnbuck turbines shown in blue. Turbine dimensions illustrated: 180 m max. tip height above ground level; 138 m rotor diameter; 111 m hub height
Where present in view: Existing wind farms in red; Consented wind farms in orange; Proposed wind farms in green; Single turbines within 5km of Carnbuck shown in pink.
Notes: Single turbines beyond 5 km may also be visible in the baseline photography. The consented Corkey Re-Power wind farm (5 turbines, shown in orange) would replace the existing Corkey wind farm (10 turbines, shown in pale red).

Shanti McAllister landscape planning and design ltd.
produced for: HEADLAND ARCHAEOLOGY

ARCHAEOLOGY & CULTURAL HERITAGE IMPACT ASSESSMENT

DRAWN / APPROVED:	DATE:	PRINT SIZE:	REVISION:
SMc / FMcF	February 2024	A3	A

TURBINE LAYOUT NO: pNIRgrx047

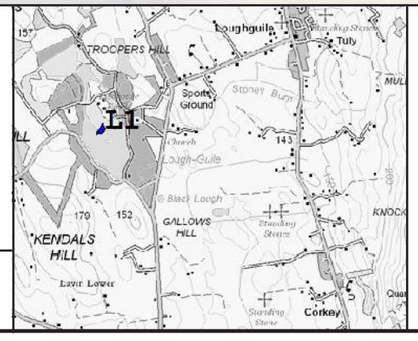
CARNBUCK WIND FARM
FURTHER ENVIRONMENTAL INFORMATION

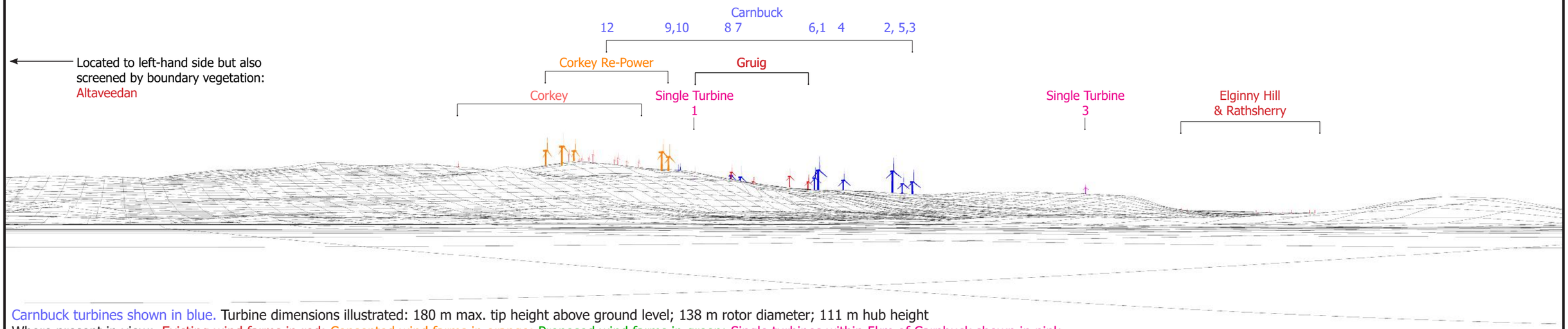
Drawing 8.1 (page 1/2)

Lissanoure Castle Grounds (ANT 018:011)
Bench at water's edge

Easting:	306529
Northing:	424216
Elevation A.O.D	124 m
Bearing:	123.64 °
Approx. Included Angle:	80 °
Approx. distance to nearest turbine:	5.37 km to T1

NOTE: This Figure must be viewed at a comfortable arms length and in conjunction with the analysis of archaeology and cultural heritage effects contained in the Environmental Statement and the detailed methodology for the preparation of visualisations contained in Technical Appendix 4.2, in particular the paragraphs referencing Scottish Natural Heritage Guidance regarding the limitations of visualisations.





Carnbuck turbines shown in blue. Turbine dimensions illustrated: 180 m max. tip height above ground level; 138 m rotor diameter; 111 m hub height
Where present in view: Existing wind farms in red; Consented wind farms in orange; Proposed wind farms in green; Single turbines within 5km of Carnbuck shown in pink.
Notes: Single turbines beyond 5 km may also be visible in the baseline photography. The consented Corkey Re-Power wind farm (5 turbines, shown in orange) would replace the existing Corkey wind farm (10 turbines, shown in pale red).

NOTE: Limited view likely from this location. Wireline has been overlaid on baseline photograph to provide best indication of the location of the proposed turbines.

Shanti McAllister landscape planning and design ltd.
produced for: HEADLAND ARCHAEOLOGY

ARCHAEOLOGY & CULTURAL HERITAGE IMPACT ASSESSMENT

DRAWN / APPROVED:	DATE:	PRINT SIZE:	REVISION:
SMc / FMcF	February 2024	A3	A

TURBINE LAYOUT NO: pNIRgrx047

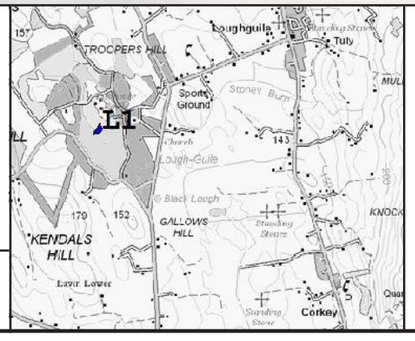
CARNBUCK WIND FARM
FURTHER ENVIRONMENTAL INFORMATION

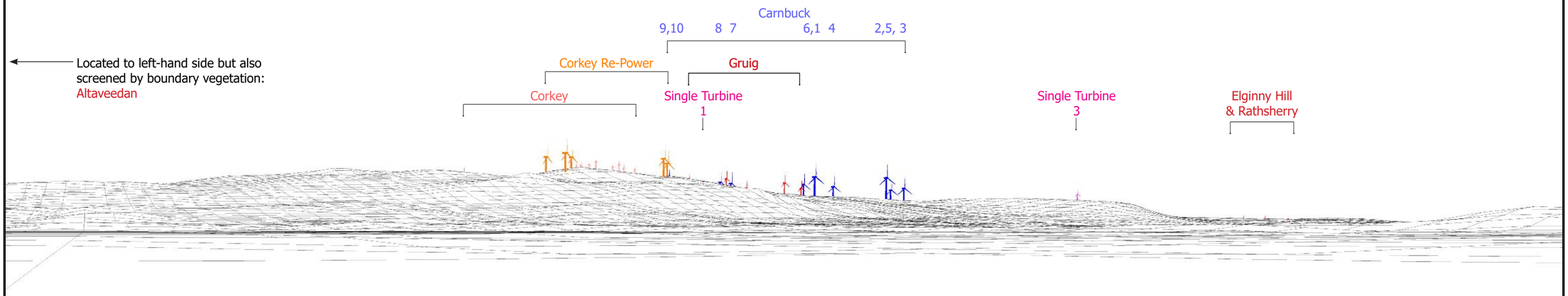
Drawing 8.1 (page 2/2)

Lissanoure Castle Grounds (ANT 018:011)
Bench at water's edge

Easting:	306529
Northing:	424216
Elevation A.O.D	124 m
Bearing:	123.64 °
Approx. Included Angle:	80 °
Approx. distance to nearest turbine:	5.37 km to T1

NOTE: This Figure must be viewed at a comfortable arms length and in conjunction with the analysis of archaeology and cultural heritage effects contained in the Environmental Statement and the detailed methodology for the preparation of visualisations contained in Technical Appendix 4.2, in particular the paragraphs referencing Scottish Natural Heritage Guidance regarding the limitations of visualisations.





Carnbuck turbines shown in blue. Turbine dimensions illustrated: 180 m max. tip height above ground level; 138 m rotor diameter; 111 m hub height
Where present in view: Existing wind farms in red; Consented wind farms in orange; Proposed wind farms in green; Single turbines within 5km of Carnbuck shown in pink.
Notes: Single turbines beyond 5 km may also be visible in the baseline photography. The consented Corkey Re-Power wind farm (5 turbines, shown in orange) would replace the existing Corkey wind farm (10 turbines, shown in pale red).

Shanti McAllister landscape planning and design ltd.
produced for: HEADLAND ARCHAEOLOGY

ARCHAEOLOGY & CULTURAL HERITAGE IMPACT ASSESSMENT

DRAWN / APPROVED:	DATE:	PRINT SIZE:	REVISION:
SMc / FMcF	February 2024	A3	A

TURBINE LAYOUT NO:
pNIRgrx047

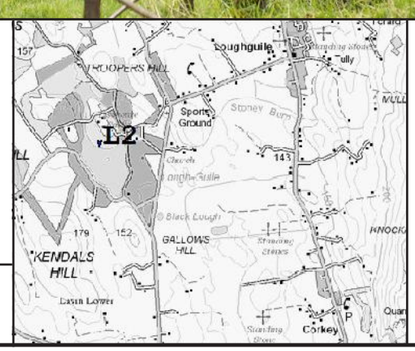
CARNBUCK WIND FARM
FURTHER ENVIRONMENTAL INFORMATION

Drawing 8.2 (page 1/2)

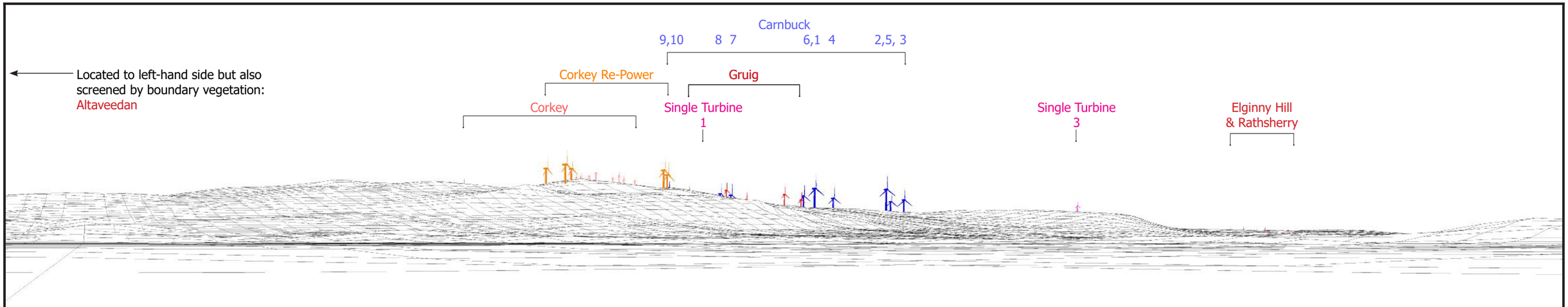
Lissanoure Castle Grounds (ANT 018:011)
Front of Castle

Easting:	306598
Northing:	424348
Elevation A.O.D	137 m
Bearing:	124.75 °
Approx. Included Angle:	80 °
Approx. distance to nearest turbine:	5.39 km to T1

NOTE: This Figure must be viewed at a comfortable arms length and in conjunction with the analysis of archaeology and cultural heritage effects contained in the Environmental Statement and the detailed methodology for the preparation of visualisations contained in Technical Appendix 4.2, in particular the paragraphs referencing Scottish Natural Heritage Guidance regarding the limitations of visualisations.



res



Carnbuck turbines shown in blue. Turbine dimensions illustrated: 180 m max. tip height above ground level; 138 m rotor diameter; 111 m hub height
Where present in view: Existing wind farms in red; Consented wind farms in orange; Proposed wind farms in green; Single turbines within 5km of Carnbuck shown in pink.
Notes: Single turbines beyond 5 km may also be visible in the baseline photography. The consented Corkey Re-Power wind farm (5 turbines, shown in orange) would replace the existing Corkey wind farm (10 turbines, shown in pale red).

NOTE: Limited view likely from this location. Wireline has been overlaid on baseline photograph to provide best indication of the location of the proposed turbines.

Shanti McAllister landscape planning and design ltd.
produced for: HEADLAND ARCHAEOLOGY

ARCHAEOLOGY & CULTURAL HERITAGE IMPACT ASSESSMENT

DRAWN / APPROVED:	DATE:	PRINT SIZE:	REVISION:
SMc / FMcF	February 2024	A3	A

TURBINE LAYOUT NO: pNIRgrx047

CARNBUCK WIND FARM
FURTHER ENVIRONMENTAL INFORMATION

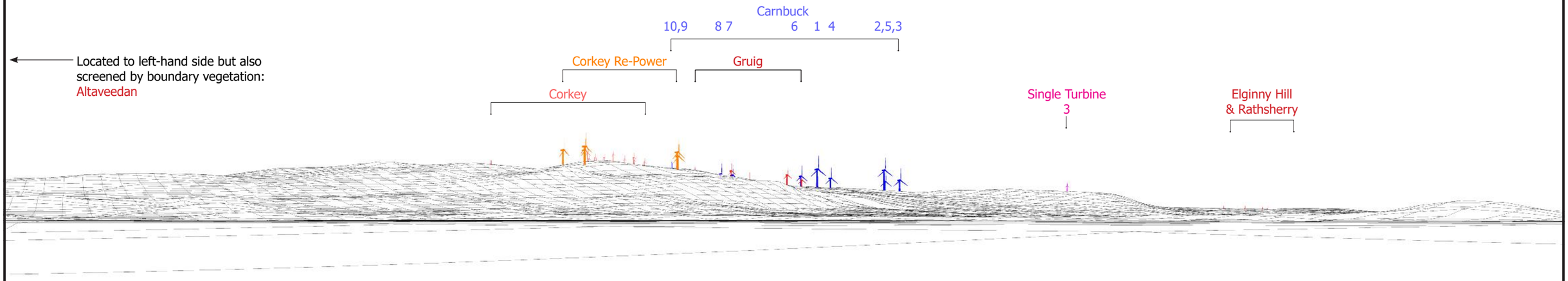
Drawing 8.2 (page 2/2)

Lissanoure Castle Grounds (ANT 018:011)
Front of Castle

Easting:	306598
Northing:	424348
Elevation A.O.D	137 m
Bearing:	124.75 °
Approx. Included Angle:	80 °
Approx. distance to nearest turbine:	5.39 km to T1

NOTE: This Figure must be viewed at a comfortable arms length and in conjunction with the analysis of archaeology and cultural heritage effects contained in the Environmental Statement and the detailed methodology for the preparation of visualisations contained in Technical Appendix 4.2, in particular the paragraphs referencing Scottish Natural Heritage Guidance regarding the limitations of visualisations.

24 053 03/ SMcDwgs...indd



Carnbuck turbines shown in blue. Turbine dimensions illustrated: 180 m max. tip height above ground level; 138 m rotor diameter; 111 m hub height
Where present in view: Existing wind farms in red; Consented wind farms in orange; Proposed wind farms in green; Single turbines within 5km of Carnbuck shown in pink.
Notes: Single turbines beyond 5 km may also be visible in the baseline photography. The consented Corkey Re-Power wind farm (5 turbines, shown in orange) would replace the existing Corkey wind farm (10 turbines, shown in pale red).

BASELINE PHOTOGRAPH

Shanti McAllister landscape planning and design ltd.
produced for: HEADLAND ARCHAEOLOGY

ARCHAEOLOGY & CULTURAL HERITAGE IMPACT ASSESSMENT

DRAWN / APPROVED:	DATE:	PRINT SIZE:	REVISION:
SMc / FMcF	February 2024	A3	A

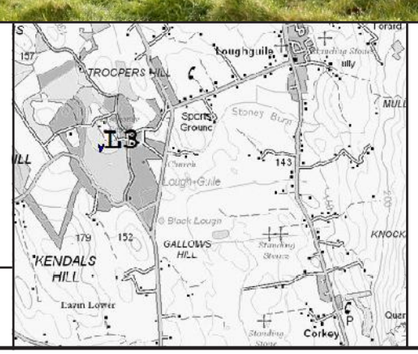
TURBINE LAYOUT NO: pNIRgrx047

CARNBUCK WIND FARM
FURTHER ENVIRONMENTAL INFORMATION

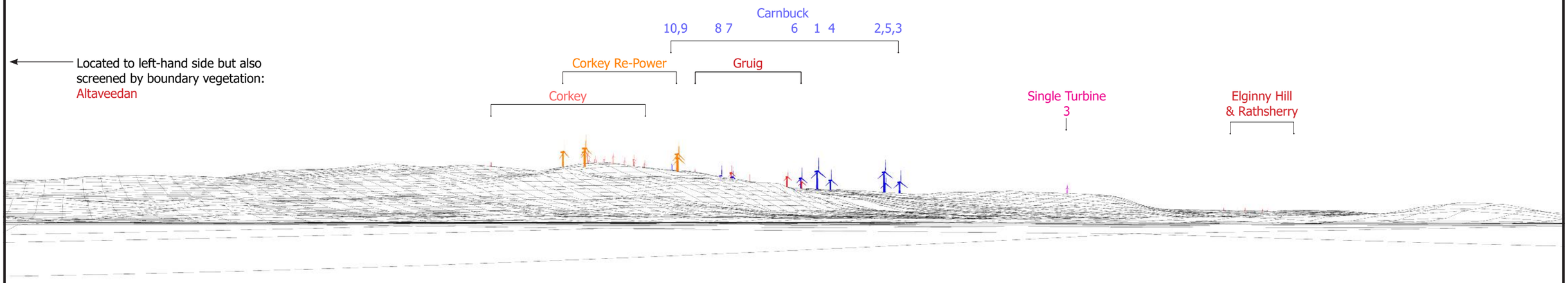
Drawing 8.3 (page 1/2)

Lissanoure Castle Grounds (ANT 018:011)
View towards Castle from pond to north west

Easting:	306471
Northing:	424592
Elevation A.O.D	137 m
Bearing:	125.64 °
Approx. Included Angle:	80 °
Approx. distance to nearest turbine:	5.65 km to T1



NOTE: This Figure must be viewed at a comfortable arms length and in conjunction with the analysis of archaeology and cultural heritage effects contained in the Environmental Statement and the detailed methodology for the preparation of visualisations contained in Technical Appendix 4.2, in particular the paragraphs referencing Scottish Natural Heritage Guidance regarding the limitations of visualisations.



Carnbuck turbines shown in blue. Turbine dimensions illustrated: 180 m max. tip height above ground level; 138 m rotor diameter; 111 m hub height
Where present in view: Existing wind farms in red; Consented wind farms in orange; Proposed wind farms in green; Single turbines within 5km of Carnbuck shown in pink.
Notes: Single turbines beyond 5 km may also be visible in the baseline photography. The consented Corkey Re-Power wind farm (5 turbines, shown in orange) would replace the existing Corkey wind farm (10 turbines, shown in pale red).

NOTE: No view likely from this location. Wireline has been overlaid on baseline photograph to provide best indication of the location of the proposed turbines.

Shanti McAllister landscape planning and design ltd.
produced for: HEADLAND ARCHAEOLOGY

ARCHAEOLOGY & CULTURAL HERITAGE IMPACT ASSESSMENT

DRAWN / APPROVED:	DATE:	PRINT SIZE:	REVISION:
SMc / FMcF	February 2024	A3	A

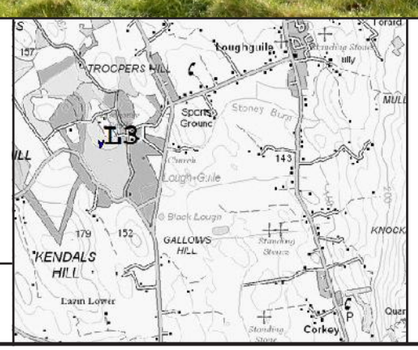
TURBINE LAYOUT NO: pNIRgrx047

CARNBUCK WIND FARM
FURTHER ENVIRONMENTAL INFORMATION

Drawing 8.3 (page 2/2)

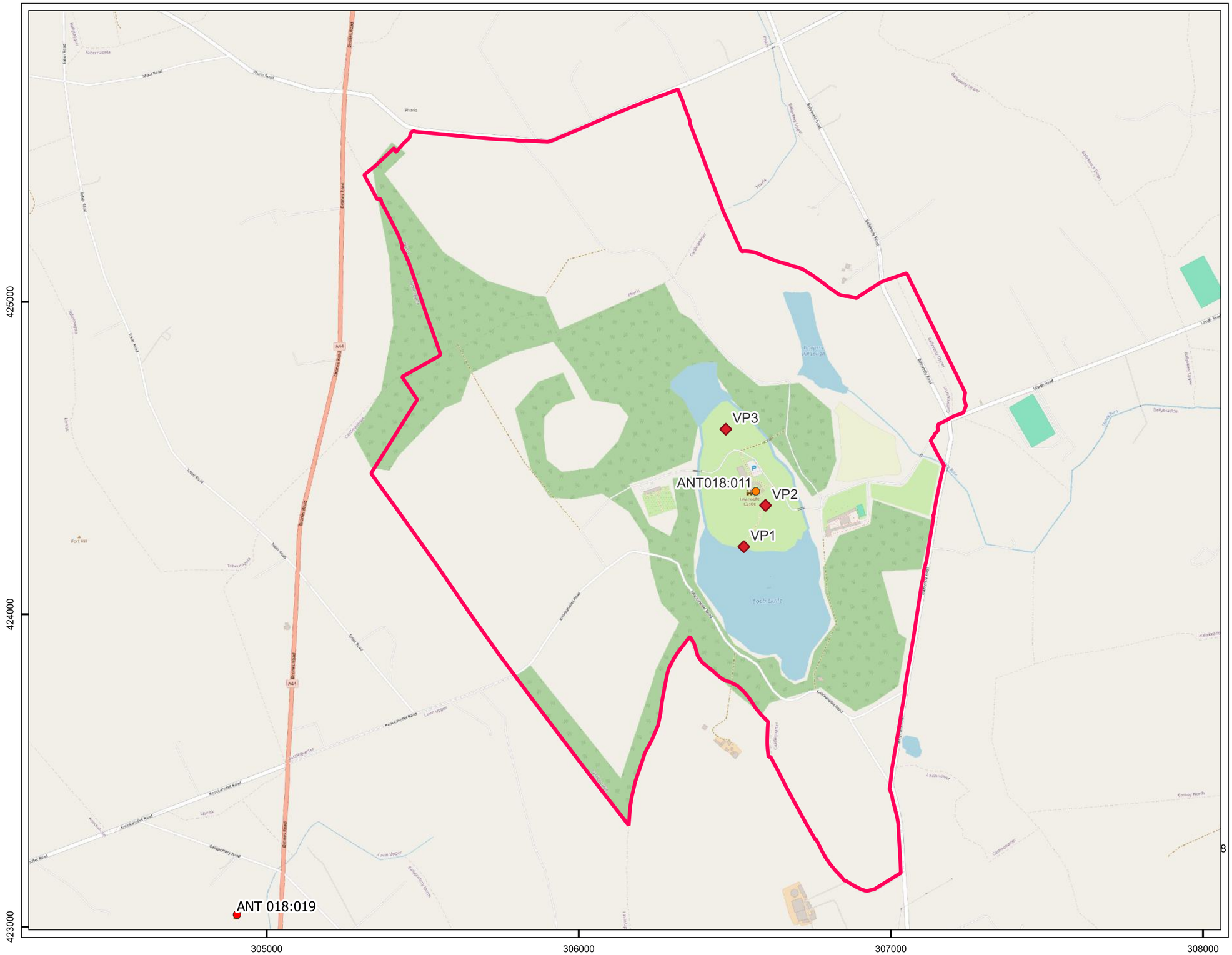
Lissanoure Castle Grounds (ANT 018:011)
View towards Castle from pond to north west

Easting:	306471
Northing:	424592
Elevation A.O.D	137 m
Bearing:	125.64 °
Approx. Included Angle:	80 °
Approx. distance to nearest turbine:	5.65 km to T1



NOTE: This Figure must be viewed at a comfortable arms length and in conjunction with the analysis of archaeology and cultural heritage effects contained in the Environmental Statement and the detailed methodology for the preparation of visualisations contained in Technical Appendix 4.2, in particular the paragraphs referencing Scottish Natural Heritage Guidance regarding the limitations of visualisations.

24 053 03/ SMcDwgs...indd



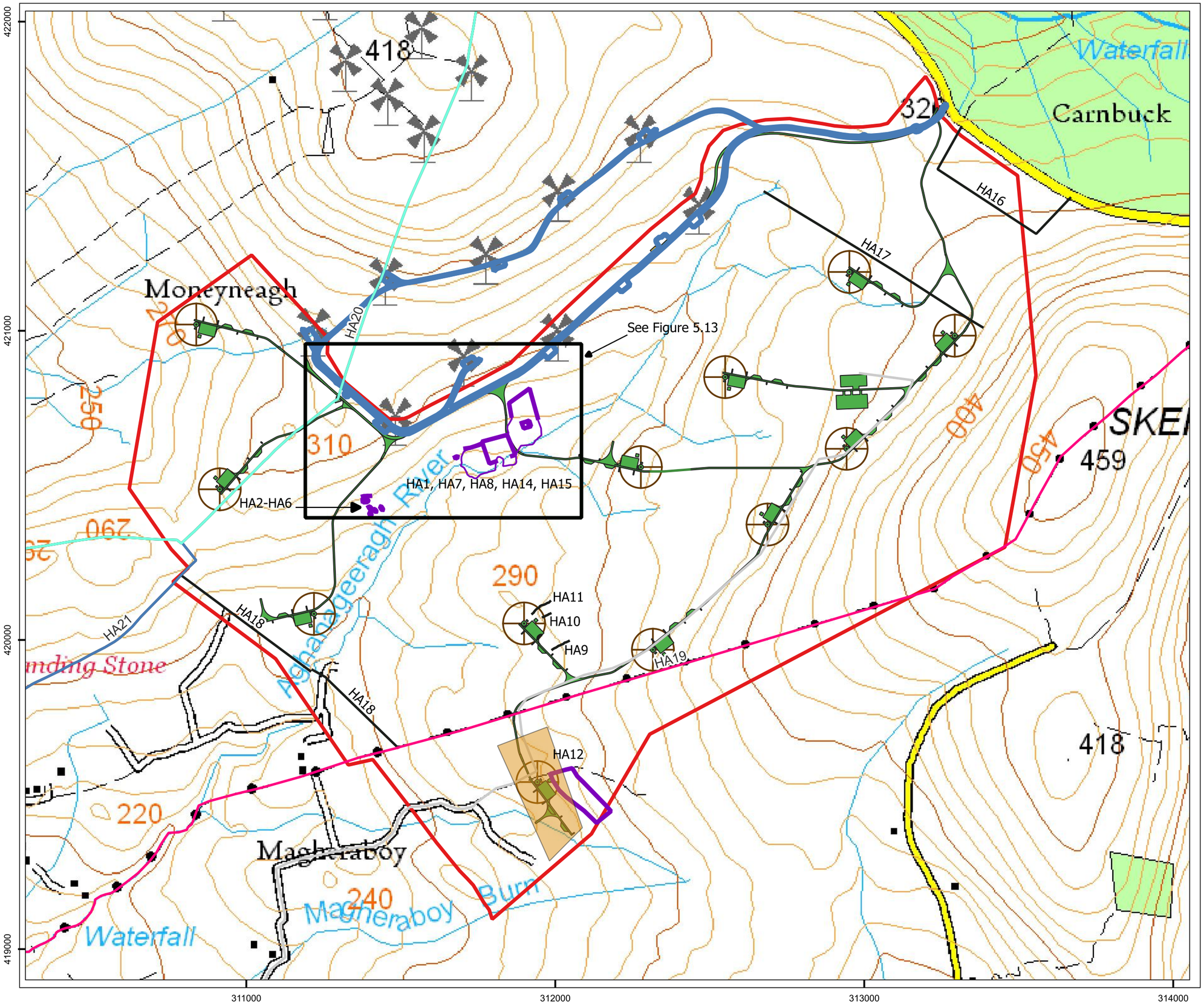
HEADLAND ARCHAEOLOGY
SCOTLAND
13 Jane St,
Edinburgh EH6 5HE,
United Kingdom
+44 131 467 7705
www.headlandarchaeology.com

Key

- Lissanoure Demesne (AN/049)
- Viewpoint Locations
- ANT018-011

0 250 500 m

within Lissanoure Demesne (AN/049)



HEADLAND ARCHAEOLOGY
SCOTLAND
13 Jane Street
Edinburgh
EH6 5HE
0131 467 7705
www.headlandarchaeology.com

Key

- Non-designated Heritage Asset
- Moneyneagh Townland Boundary
- Gruig Townland Boundary
- Carnbuck Townland Boundary
- Sites of Negligible Importance
- Inner Study Area
- Proposed Carnbuck Wind Farm Infrastructure
- Proposed Wind Turbine Location
- Existing Gruig Wind Farm Infrastructure
- Grid Connection Route
- HA12 Watching Brief Area

1:12,000 @ A3

N

0 250 500 m

Inner Study Area

9

Conclusion

9. Conclusion

9.1 The purpose of this FEI is to update and complement, where appropriate, the environmental information previously submitted and has been produced to include a greater level of details to provide clarity for the Strategic Planning Division, based on consultation responses received. FEI was requested on the following topics:

- Noise
- Vegetation and Peatland
- Hydrology
- Site Entrance
- Telecommunication Links
- Landscape & Visual
- Cultural Heritage & Archaeology

9.2 The FEI presents a revised and amended assessment of the noise levels resulting from Carnbuck Wind Farm. In addition, the revised assessment proposes planning controls to ensure that the proposed development would result in noise levels that are considered insignificant in the context of operational noise from other development or that ensures that operational noise from the proposed development would not result in cumulative noise levels that are above the overall limiting requirements of ETSU-R-97 where possible.

9.3 The FEI presents clarifications following queries from DAERA: Natural Environment Division with regards to Vegetation and Peatland, Section 3 presents further relevant information.

9.4 The FEI presents clarifications to Northern Ireland Water to highlight the relevant existing information regarding potential effects to the reservoir catchment, including mitigation measures as stated in the previously submitted Technical Appendix 10.1: Surface Water Management Plan (within the ES), which address concerns raised by NIW.

9.5 The FEI presents an updated Site Entrance Drawing – Figure 10.1(Revision 3) which provides information as requested by DFI Roads.

9.6 The FEI presents a Telecommunications Impact Assessment Report which is presented in Appendix 6.1, which responds to queries raised by PSNI & JRC.

9.7 The FEI reiterates in Section 7 that in terms of Landscape & Visual effects it is concluded that the physical and visual character of the site area surrounding the Proposed Development is already strongly defined by a number of different man-made elements. The layout of the proposed turbines reflects the layouts of some of the other existing wind farms in this cluster and, in views from the wider landscape it would form a well-integrated element of this cluster. Overall visibility is limited, particularly within the AONB, and in locations beyond 5 km. From viewpoints in the wider area, including those from where the site of the Proposed Development forms

the setting for the AONB, it would be a less prominent feature. Man-made influences are an established part of the character of the whole Study Area and also the western-facing edge of the AONB.

9.8 With regard to Built Heritage & Archaeology, the FEI presents in Section 8 and with additional Figures 8.1 – 8.5, that the proposed development has no significant effect on Lissanoure Demesne and no impacts are predicted on Cultural heritage or Archaeology as a result of the proposed road widening works. Appropriate mitigation measures have now been proposed for the potential construction phase impacts to townland boundaries, potential below ground archaeological remains which may be truncated by ancillary works, and potential below ground prehistoric and paleoenvironmental remains. Following mitigation, no significant residual construction phase effects are predicted.

9.9 The potential effects of the Proposed Development have been assessed in accordance with regulatory requirements and good practice. The ES & FEI incorporate technical assessments of the Proposed Development based on the requisite legislation and the relevant planning policy framework. The ES & FEI have demonstrated that significant environmental effects associated with the construction, operation and decommissioning of the Proposed Development have been avoided or minimised through the use of the iterative design process and with the application of mitigation measures.

9.10 The amount of electricity that could be produced by the Proposed Development is estimated at 206.4 GWh per year which is equivalent to the electricity needs of 54,800 homes each year.

9.11 The Proposed Development is also estimated to reduce CO_2 emissions by 90,800 tonnes each year when compared against equivalent generation from non-renewable sources. This equivalent to 57,200 newly registered cars.

9.12 The Proposed Development will result in a reduction in greenhouse gas emissions from the electricity generating industry by harnessing wind as an alternative to the burning of fossil fuels, in line with the Climate Change Act (Northern Ireland) legislative target of 80% of total electricity consumption in Northern Ireland to come from renewable sources by 2030.