thomson ecology

Ecological Impact Assessment

Seven Hills Wind farm Phase I

For

An Bord Pleanála

Project No.: IABP104/001

November 2016

London & South East
Compass House
Surrey Research Park
Guildford
GU2 7AG . UK

t: +44 (0)1483 466 000

North & Borders
Calls Wharf
2 The Calls
Leeds
LS2 7JU . UK

t: +44 (0)113 247 3780

Wales & South West
Williams House
11-15 Columbus Walk
Cardiff
CF10 4BY . UK

t: +44 (0)2920 020 674

Scotland
20-23 Woodside Place
Glasgow
G3 7QF . UK

t: +44 (0)141 582 1333

Enquiries

e: enquiries@thomsonecology.com

w: www.thomsonecology.com

Project Number	Report No.
IABP104/001	002

Revision No.	Date of Issue	Author	Reviewer	Approver
001	10/11/2016	Richard Arnold	Gabrielle Graham	Richard Arnold
002	24/11/2016	Richard Arnold	Gabrielle Graham	Richard Arnold

Contents

1. Introduction

1.1 Background

1.1.1 The Seven Hills Wind Farm comprises two proposed wind farms in Co. Roscommon. The two wind farms are referred to as Phase I and Phase II and are subject to separate planning applications. The connection to the national electricity grid would either be subject to a third application, as stated by the applicant in its Environmental Impact Statement, or, if buried, could be classed as exempted development and therefore not subject to a planning application. The applicant for each phase of the Seven Hills Wind Farm is Galetech Energy Developments Ltd. Due to the nature of the developments, they are the subject of an environmental impact assessment under the European Communities (Environmental Impact Assessment) Regulations 2010.

1.1.2 This report sets out an ecological assessment of the Phase I wind farm under the EIA Regulations. It also includes consideration of Phase II of the wind farm, and other developments, as part of an assessment of cumulative impacts.

1.1.3 The proposed Seven Hills Wind Farm developments have a complex planning history. The current position is that a previous decision to grant consent for the developments was set aside by the High Court because the decision making process did not comply with the Habitats Directive. It is therefore necessary for both applications to be considered again.

1.1.4 There are a number of objectors to the developments. These include the National Parks and Wildlife Service (NPWS), a division of the Department of the Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA[1]). The basic contention of the NPWS is that insufficient information has been collected by the applicant on the behaviour of qualifying bird species for a firm conclusion to be reached that the development will not adversely affect the integrity of any Natura 2000 site[2]. Other objectors have raised similar concerns in relation to the effect of the development on hydrology/ hydrogeology, with potential effects on turloughs, some of which are also designated as Natura 2000 sites.

1.2 Purpose of Report

1.2.1 This report is an ecological impact assessment based upon the information submitted by the applicant in support of the planning application, written submissions made by the NPWS and representations made by others at the Oral Hearing held in Athlone in June 2016.

1.2.2 The purpose of the report is to assist An Bord Pleanála in undertaking its Environmental Impact Assessment of the proposed development.

1.3 Description of the Proposed Development

1.3.1 The general description of the proposed development is given in Chapter 3 of Volume 1 of the Environmental Impact Statement (EIS). In summary, the development comprises:

[1] Previously the Department of the Arts, Heritage and the Gaeltacht (DAHG)
[2] See for example the letter from DAHG dated 19th October 2015.

- Sixteen GE 2.5xl MW wind turbines, with the lowest turbine at 67m above sea level (ASL) to the highest at103m ASL. Each turbine has three blades and a rotor diameter of 100m and a rotor hub height of 85m. The turbine rotors would therefore sweep an area from 35m to 135m above ground level. The turbines rotate at between 5 and 14 revolutions per minute and operate when wind speeds are between 3ms^{-1} and 25ms^{-1}. The turbines are separated by an average distance of approximately 450m.
- A single, permanent (25 year) anemometer mast at 85m high, with a triangular lattice structure.
- Hard-standing and foundations at each turbine location, comprising a hard-standing area of 10m x 18m (0.3ha total for the Phase I site) during the operational phase and a turbine base extending approximately 2.8m underground, occupying an area of approximately 300m^2 (0.5ha in total for the whole Phase I site).
- Internal site access tracks totalling 7750m and 5m wide (3.9ha in total) and 1m deep, constructed in a similar manner to agricultural tracks.
- Underground cabling totalling 6,713m, alongside the access tracks.
- A single storey and control facility with a floor area of 85.5m^2 and a compound area of unspecified size.
- Change of use of an existing residential dwelling to office use.
- Temporary construction compounds and access tracks. The temporary compound is likely to be located close to the proposed switch room to the east of the development (close to turbine no.12).
- Temporary hard-standing areas for cranes next to each turbine which will measure 39m x 18m (1.1ha in total for the Phase I site) and will incorporate the permanent hard-standing at each turbine location (so the temporary hard-standing will be 0.8ha in total for the Phase I site).

1.3.2 The planning application boundary encompasses a 20ha area which includes all the access tracks, turbines and so on. As the turbines are widely spaced, the area encompassed by a loop drawn around the turbines is approximately 200ha. From an ornithological perspective, it is the latter area which matters and therefore references to the Phase I site in this report are generally a reference to the 200ha over which the turbines are located.

1.3.3 The development will be connected to the national electrical grid. The EIS states that this will be subject to a separate planning application. However, it may be exempted development if it is buried. A separate assessment has been provided for the Seven Hills Wind Farm Phase II for the cable route which shows a route alongside the R362/R363 road to the Monksland substation (IWCM, 2015b).

1.3.4 During the construction stage, there will be approximately 13,154 vehicle movements with 'much reduced' vehicle movements (number not specified in the EIS) during the operation stage. The site entrance will be on the R357 to the north of Carrowkeel (approximately 1.6km north of Dysart (Thomas Street) Turlough). The likely access route for construction traffic would be from Athlone to Dysart along the R362/R363 and then northwards from Dysart on the R357 to the site entrance.

1.3.5 The construction period is expected to last 9 – 12 months and the wind farm would be operational for 25 years, with the potential to either (i) continue operation; (ii) refurbish/replace; or (iii) de-commission the wind turbines after this period ends. Options (i) and (ii) would be subject to renewed planning permission

1.4 Study Area and Zone of Influence

1.4.1 The study area and zone of influence of the development are not defined precisely by the applicant. The immediate survey area encompassed the fields within which the turbines and associated infrastructure are proposed and a selection of adjoining fields, as shown in the EIS, Chapter 7, Appendix 7.1. The applicant also undertook surveys for birds at a number of waterbodies up to 8km from the Phase I site. Other designated sites up to 15km away from the Phase I site also received some consideration as part of a desk based assessment of effects on designated sites. The applicant infers that the zone of influence extends about 8km from the Phase I site with this limit defined by hydrological connection of wetland sites and foraging distances of birds from their roost sites.

1.4.2 Ideally, the immediate survey area would have included all land within a loop drawn around the turbines plus a 200m buffer for habitats and protected and important species, as well as the access track and 50m either side. For birds, the survey area should ideally have matched this area to record bird flight lines and extend beyond this area by at least 300m (so 500m beyond the turbines) to record foraging wetland birds and by at least a further 800m (so 1km beyond the turbines) to record roosting birds (SNH, 2014). Given the migratory nature of birds and the propensity for birds to move between wetland sites during the winter, the zone of influence clearly extends beyond the immediate survey area, most obviously to the wetland sites located within 8km or so of the Phase I site, as determined by the applicant, but also further afield. The hydrological connection of wetland sites is clearly also a factor which determines the zone of influence.

1.4.3 In this particular locality, it was important to survey the known roost sites located more than 1km for the wind farm as the applicant has done.

2. Appraisal Methodology

2.1 Consultation

2.1.1 As set out in the EIS (Chapter 7, page 5 and Chapter 8 pages 5 and 6), the applicant undertook some pre-submission consultations on the methodology[3].

2.2 Desk Study

2.2.1 As set out in the EIS (Chapter 7, pages 3 and 4), the applicant undertook a desk study which involved collation of existing records, from NPWS and Birdwatch Ireland, and reference to publications, such as atlases. The information collated includes information on sites designated for nature conservation and records of protected species.

2.3 Field Assessment

Terrestrial Habitats

2.3.1 As set out in the EIS (Chapter 7, page 4), the applicant undertook habitat surveys in August 2008 and June 2010. The habitats on site were classified in accordance with the standard classification system for Ireland (Fossit, 2000). This survey is in line with standard practice and appears to have been adequate, although it may not have led to an adequate description of some habitats. The survey area encompasses all fields within which a turbine is to be located and those through which an access track passes plus some additional fields. In some cases not much land beyond the turbine position was subject to survey.

Invertebrates

2.3.2 During the survey of terrestrial habitats described above, the applicant sampled terrestrial invertebrates by sampling and hand netting. The actual dates of the survey and number of samples collected is unstated. However, the survey results suggest that little more than casual observations were made of invertebrates while also undertaking the habitat surveys.

Mammals other than bats

2.3.3 During the survey of terrestrial habitats described above, the applicant recorded any evidence of mammals. No specific survey methods are described by the applicant so again it seems that little more than casual observations were made of mammals during the habitat surveys.

Bats

2.3.4 A bat activity survey was undertaken at the location of the site entrance on 24th June 2010, commencing at 10pm and continuing for at least one hour. This survey is inadequate as it did not include surveys at the locations of the wind turbines and it took place on only one night. This survey is described in the EIS (Chapter 7, page 10).

[3] There has obviously been a significant amount of correspondence and comment on the survey work and its results since then, as part of the ongoing planning and legal process. This has led to the completion of additional survey work for bats on the Phase I site and additional survey work for birds at wetland sites in the local area but not focussed on the Phase I site itself.

2.3.5 Following a request for further information on bats, the applicant undertook additional bat survey work. This is presented in Appendix F of the Further Information Response (Bat Eco Services, 2011), submitted by the applicant in August 2011. The survey was undertaken between 26th May and 4th June 2011. This survey is more comprehensive than that presented in the EIS. It comprised four survey days during which survey work was undertaken at both dusk and dawn and at the position of each of the turbines, as well as around the farm buildings in the west of the survey area. In addition, static monitoring devices were positioned at the location of each turbine and left in place for a minimum of one night. This survey is clearly an improvement on the survey undertaken in 2010. However, the survey was over a very limited period and with fewer than expected visits to each turbine location. Furthermore the survey work was undertaken at ground level whereas the turbine rotors are between 35m and 135m above ground level.

2.3.6 Further survey work was again conducted in the months of April to September 2012 (Bat Eco Surveys, 2013). For Phase I, the survey comprised the use of a single bat detector placed on the anemometer in the centre of the survey area. This was in place and working for seven survey periods lasting from 2 (or 3) nights to 9 (or 10) nights. The detector was positioned approximately 8m above ground level. The reason given in the report for installing this bat detector was as a control for the work being undertaken on the Phase II site, rather than specifically to inform an impact assessment for Phase I.

2.3.7 Best practice guidelines typically suggest several survey periods through the season which are focused on the turbine locations and potentially at the height of the rotor swept area, which would be between 35m and 135m AGL at the Phase I site (Bat Conservation Ireland, 2012; Hundt, 2012; Rodrigues, Bach, Dubourg-Savage, Goodwin, & Harbusch, 2008). The combined bat surveys fall short of this.

Birds

2.3.8 A desk study was undertaken to collate existing information on birds in the local area. This is described in the EIS (Chapter 8, pages 5 and 6).

2.3.9 Bird surveys were carried out during autumn, winter and spring/summer. These are described in the EIS for Phase I (Chapter 8), the 2012 AA report and the wintering bird survey reports for 2012/13 (ECOFACT, 2013) and 2014/15 (ECOFACT, 2015).

2.3.10 In summary, three broad types of survey method were used: (i) 'walkover' surveys; (ii) vantage point surveys; and (iii) foraging and roosting surveys of waterbodies. These are described and assessed in detail in Appendix 1 of my AA report, with particular reference to the qualifying features of the local SPAs. A number of short comings are identified in this regard and there are further shortcomings in relation to the ability of these surveys to collect the required information for a more general ecological impact assessment. A summary of the shortcomings is set out below:

- The 'walkover' surveys were conducted only in the breeding season rather than in all three seasons, meaning that birds foraging in and around parts of the Phase I site in winter would not have been detected, as not all fields are sufficiently visible from the selected vantage point.
- The 'walkover' surveys did not follow a standard recognised methodology (such as transects, timed-area counts, point counts, territory mapping) meaning that the results are

not comparable to other areas (which is important for evaluation purposes) and the level of survey effort is unclear.

- The survey area for 'walkover' surveys is not shown on any map meaning that it is unclear which areas were surveyed and how much effort was expended in each area.
- Insufficient hours of observation appear to have been made during the migration seasons to record birds on migration to, from or through the local area and no data is presented on this activity.
- There was no survey of the wind farm site at night, which is when lapwing and golden plover are often foraging on grassland and when many species migrate.
- There was just one vantage point (VP) overlooking the wind farm site and that was located in the centre of the Phase I site, whereas to meet good practice standards (SNH, 2014) two VPs were required, both of which should be located outside the wind farm.
- The VP watches were focused on just one species of bird, the whooper swan, when in fact all qualifying species of the local SPAs should have been 'target' species for the survey, as well as other important waterbird species such as curlew and snipe.

2.3.11 The results for all species except whooper swan were presented initially as a simple list, including birds which were recorded both inside the wind farm and birds outside, with no indication of abundance and location, except in Appendix II of Appendix 8.1 of Chapter 8 of the EIS where counts of two species are provided for the winter season only. Some clarification was provided in the Further Information Response (Appendix 1 of Appendix D) which separates the records of species of conservation importance into those which were made from within the Phase I site (although the actual area was not defined by the applicant) from those which are were recorded in the general area. The picture remains somewhat opaque.

2.3.12 The applicant has subsequently carried out further bird surveys in winter 2012/13 (ECOFACT, 2013) and winter 2014/15 (ECOFACT, 2015) at local waterbodies and this has provided useful contextual information[4] however this work has not addressed the shortcomings of the survey work carried out on the Phase I site itself. The installation of the avian radar system, as now proposed by the applicant, as a means of collecting such data *post*-consent does not excuse the applicant from providing an adequate description of the bird fauna *pre*-consent.

2.4 Evaluation of Nature Conservation Interest

2.4.1 The applicant uses an evaluation methodology which was developed in 2004 (which is set out in a now fairly obscure publication) for the assessment of national road schemes in Ireland. Firstly, there were more recent guidelines available in relation to roads in Ireland at the time that EIS was prepared in 2010. These guidelines were published in 2006 and updated in 2009 (NRA, 2009). Secondly, generic, and more appropriate, guidelines on ecological impact assessment were published by the Institute for Ecology and Environmental Management in 2006[5]. Thirdly, the applicant does not explain anywhere what the evaluation categories mean,

[4] This survey work has also shown that some of the dismissive comments made by the applicant in relation to the observations of others in for example Appendix D of its further information response to be wrong.
[5] These have now also been updated but the updated version would not have been available to the applicant when the EIS was prepared.

which renders the assessment unintelligible to anyone without a copy of the 2004 publication mentioned above.

2.4.2 Here, the approach set out in the most recent guidelines produced by the Chartered Institute for Ecology and Environmental Management are followed.

3. Description of the Existing Environment

3.1 Approach

3.1.1 The description of the existing environment is based on a combination of the desk study and field assessment work undertaken by the applicant, as well as observations made during my site visit in May 2016. The environmental conditions are not expected to change significantly between the dates the information was collected and the intended start of construction. Therefore, description here represents the predicted baseline at the time that the project will take place.

3.2 Designated Areas

3.2.1 The applicant identified 12 sites with a designation for nature conservation within 15km of the Phase I site. The nearest is Lough Croan Turlough SAC and SPA which is approximately 1.1km from the nearest turbine. The others are listed in Table 7.4.1 of the EIS (Chapter 7, pages 5 and 6).

3.2.2 SPAs and SACs are protected under the European Communities (Birds and Natural Habitats) Regulations, 2011.

3.3 Non-designated wetlands

3.3.1 There are two non-designated wetlands within 2km of the Phase I site. These are not described at all in the EIS which is serious omission, since both sites are likely to be of high nature conservation value and could be subject to indirect effects as a result of the wind farm development.

Dysart (Thomas Street) Turlough

3.3.2 Dysart (Thomas Street) Turlough is located approximately 900m from the nearest turbines and about one quarter of this turlough lies within 1km of the wind farm site. The precise area of the turlough is ill-defined but it extends up to around 37ha. It regularly supports whooper swan, as well as golden plover, lapwing, wigeon, teal and black-headed gull which are all qualifying species of nearby SPAs. It is likely to be of at least County Importance.

Cuilleenirwan/Coolagarry Turlough

3.3.3 Cuilleenirwan/Coolagarry Turlough is located approximately 1.2km from the nearest turbines. It is approximately 50ha in size. It supports whooper swan, golden plover, lapwing, mallard and black-headed gull, which again are all qualifying species of nearby SPAs, as well as wintering curlew. It is also likely to be of at least County Importance.

3.4 Terrestrial Habitats

3.4.1 A habitat map is provided in Appendix 7.1 of the EIS. This shows indicates that there are five habitat types within the survey area. The habitat map does not actually show that habitats within 50m of the proposed turbines however it is a continuation of the habitat shown in the adjoining fields.

Improved Agricultural Grassland (GA1)

3.4.2 The survey area is mapped by the applicant as being predominantly improved agricultural grassland and it is described in the EIS (Chapter 7, page 7). Certainly, some of grassland is dominated by perennial rye-grass, with little else, and clearly falls into this category[6] but some of the grassland mapped by the applicant as improved grassland is actually better defined as semi-improved grassland, which is described below.

Dry Calcareous and neutral Grassland (GS1)

3.4.3 In the Fossitt classification system, the category of dry calcareous and neutral grassland includes both semi-improved and unimproved grasslands. However, more recent research has demonstrated the need for semi-improved grassland to be more clearly distinguished from both improved and unimproved grassland in Ireland (Sullivan, Skeffington, Gormally, & Finn, 2010).

Semi-improved calcareous grassland

3.4.4 The survey area contains some semi-improved grassland with a high cover of forbs (up to 50%) and moderate diversity of plants, including common bent (*Agrostis capillaris*), sweet vernal grass (*Anthoxanthum odoratum*), crested dog's-tail (*Cynosurus cristatus*), red fescue (*Festuca rubra*), meadow buttercup (*Ranunculus acris*), pignut (*Conopodium majus*), meadow vetchling (*Lathyrus pratensis*), common sorrel (*Rumex acetosa*) and field wood-rush (*Luzula campestris*), with yellow rattle (*Rhiananthus minor*) present in places. The total extent of this grassland within the survey area is not known. However, it is, for example, present in the fields around the location of proposed Turbine 4.

Unimproved calcareous grassland

3.4.5 Unimproved calcareous grassland is mapped by the applicant in one location only, in a field to the north of proposed Turbine 9. This grassland is described in the EIS (Chapter 7, pages 7 and 8). This grassland type is actually slightly more prevalent, it being present amongst the scrub to the north and west of the location of proposed Turbine 8.

3.4.6 In the EIS, the applicant equates the Annex I type 6210 (semi-natural dry grasslands and scrubland facies on calcareous substrates) but apparently not the orchid-rich variant, which is a priority habitat. At the oral hearing in June 2016, the applicant made the case that this grassland was not in fact Annex I type 6210. Certainly the grassland is dry and calcareous, it also contains at least three of the plant species which define the Annex I habitat (kidney vetch (*Anthyllis vulneraria*), carline thistle (*Carlina acaulis*) and cowslip (*Primula veris*)) (EC, 2013). In addition, it supports 12 species which are positive indicators for the Annex I type, including six which are high quality positive indicators[7] (O'Neill, Martin, Devaney, & Perrin, 2013). There

[6] Agricultural improvement of grassland is a on a continuum with complete re-seeding and heavy fertiliser and herbicide application at one extreme, yielding single species swards of perennial rye grass, and light applications of organic fertiliser at the other, yielding swards which are more grass-dominated than unimproved grasslands, but still species-rich. The point along the continuum at which improved grassland becomes semi-improved grassland is ill-defined and somewhat subjective.

[7] Strictly speaking, positive indicators are used to indicate the quality of this habitat type rather than define the habitat type, however, the presence of these species is also evidence that the grassland conforms to the Annex I type.

would seem to be reasonable case that this is the Annex I type 6210 but perhaps not the orchid-rich priority type. The grassland is not included within a designated site so it is not strictly protected[8].

3.4.7 Unimproved calcareous grassland, whether the Annex I type or not, is of high nature conservation value. This particular example is of limited extent and is therefore probably of local or perhaps county value for nature conservation.

Scrub (WS1)

3.4.8 Scrub habitat is in four main locations in the survey area. It is described by the applicant in the EIS (Chapter 7, pages 8 and 9).

Treelines (WL2)

3.4.9 Treelines are present in the west of the survey area. This habitat is described by the applicant in the EIS (Chapter 7, page 9).

Stone walls and other stonework (BL1)

3.4.10 Stone walls make up the majority of the field boundaries within the survey area. This habitat is described in the EIS (Chapter 7, page 9). Stone walls are more extensive than indicated in Appendix 7.1. For example, there are three stone walls evident on the aerial image between the proposed locations for Turbines 3 and 4, whereas the habitat map shows just one.

Ponds (FL8)

3.4.11 Two ponds are present in the south of the survey area. These are not described in the EIS but are described in the bat survey report of 2011 (Bat Eco Services, 2011). The locations are not mapped.

Turloughs/seasonal flooding (FL6?)

3.4.12 Two areas of seasonal flooding were found during my site visit in the northeast of the survey area, close to the locations of proposed Turbines 5 and 6. These waterbodies are not described by the applicant. When dry, the vegetation is equivalent to semi-improved and improved grassland as described above.

Table 1 Value of terrestrial habitats within the Phase I site

Habitat Type	Fossitt Code	Likely Importance (Applicant's Assessment)
Improved Agricultural Grassland	GA1	Negligible (Not stated/Low value for bats)
Semi-Improved Calcareous Grassland	GS1	Local (Not stated)
Unimproved Calcareous Grassland	GS1	Local (Not stated/High value for bats)
Scrub	WS1	Local (D- moderate value, locally important/ Medium Local value for bats)
Treeline	WL2	Local (D- moderate value, locally important/ High value for bats)

[8] However Ireland still has an obligation under the Habitats Directive to maintain the Favourable Conservation Status of Annex I habitats which is likely to mean that there should be no net loss of area of each Annex I type.

Habitat Type	Fossitt Code	Likely Importance (Applicant's Assessment)
Stone walls and other stonework	BL1	Local (Not stated/Medium Local value for bats))
Ponds	FL8	Local (Not stated/Medium value for bats)
Turloughs/ seasonal flooding	FL6?	Local (Not stated)

3.5 Invertebrates

3.5.1 The applicant identified just five species of invertebrates during the survey work. No counts or locations are presented in the EIS. This clearly under-represents the likely diversity of invertebrates present within a survey area which includes unimproved grassland and scrub. The data supplied by the applicant is insufficient for an evaluation of the invertebrate fauna. However, as stated by the applicant, the calcareous grassland and scrub habitats are likely to be of most importance for invertebrates within the survey area.

3.6 Mammals other than bats

3.6.1 The applicant recorded Irish hare, fox and rabbit in the survey area. Four Irish hare and a fox were also observed during my site visit in May 2016. No counts or locations are presented in the EIS for any of these mammal species. The populations of these species are not likely to be of more than local value.

3.6.2 Irish hare is a protected species.

3.7 Bats

3.7.1 In summary, the applicant has recorded a minimum of four species of bat in the survey area for Phase I. These are as follows:

Table 2. Bat species recorded on the Phase I site

Species	Location of Roosts	Location of Activity (Year)
Leisler's bat	None recorded	Near an abandoned farmhouse in the west of the survey area (2010) T1, T2, T3, T6, T8, T9, T10, T11, T12, T14 (2011) Local roads east of T5, T12 and T16 (2011) Farm tracks nr. T5 and T6 (2011) temporary anemometer (2012)
Common pipistrelle	Roost A: Maternity roost at Farm A Roost D: Maternity roost at Farm B Roost E: Satellite roost at Farm C	T1, T2, T3, T4, T5, T6, T8, T9, T10, T11, T12, T13, T14, T15, T16 (2011) Farm track leading to T1 and T2 Lane-way nr. T7 and T13 (2011) Farmyard west of T7 and T13 (2011)

Species	Location of Roosts	Location of Activity (Year)
		Local roads east of T5, T12 and T16 (2011) Farmyard east of T16 (2011) Ponds nr. T16 (2011) Farm tracks nr. T5 and T6 (2011) Farm A and Farm B (2011) temporary anemometer (2012)
Soprano pipistrelle	Roost B: Satellite roost at Farm A	T1, T2, T5, T6, T11 (2011) Farm A (2011) Lane-way nr. T7 and T13 (2011) Farmyard west of T7 and T13 (2011) temporary anemometer (2012)
Myotis spp., most likely Natterer's bat	Roost C: Satellite roost at Farm A	T3, T8, T12, T14 Farm A (2011) Lane-way nr. T7 and T13 (2011) temporary anemometer (2012)

Farm A – west of the survey area at Carrowkeel
Farm B – east of the survey area at Bredagh
Farm C - east of the survey area at Bredagh

3.7.2 The applicant reports a low to high level of bat activity depending on the survey location, and species as set out in Table 6 of the 2011 bat survey report (Appendix F of the Further Information Response for Phase I (Bat Eco Services, 2011)).

3.7.3 The applicant did not offer an evaluation of the bat communities present in the survey area but instead gave an evaluation of bat habitat. The three identified bat species are among the most common and widespread in Ireland and the bat activity recorded within the survey area is probably representative of farmland throughout the country. The populations of these species within the survey area are probably of no more than local value. The fourth type of bat (*Myotis* spp.) has not been identified to species level and so it is not possible to give a value with any confidence. The applicant believes that the most likely candidate is Natterer's bat. This is relatively uncommon and so the population of this bat species on and around the Phase I site could be of more than local value.

3.7.4 All bat species are protected species.

3.8 Birds

Breeding season

3.8.1 As set out in the EIS (Chapter 8, Appendix 8.1, pages 12 and 13), the applicant identified 28 species during the breeding season survey of which 21 were considered to be breeding. Four of the bird species identified were considered to be of conservation concern at the time; these were starling, house sparrow, swallow and black-headed gull. The first three of these were considered to be breeding on site. Since the EIS was produced, the list of birds of

conservation concern has been updated and now includes meadow pipit (red list), as well as greenfinch and robin (both amber list). The locations and numbers of birds recorded during the survey are not given. I also observed sparrowhawk (hunting along stone walls), snipe (close to the proposed location for Turbine 3) and skylark during my site visit in May 2016, all of which are on the amber list.

3.8.2 Despite some of the bird species recorded being of conservation concern, all the bird species recorded during the breeding season away from wetland sites are common and widespread. Taking into account the bird survey results, and the habitat present on the Phase I site, the bird community and the populations of individual species on the Phase I site, are probably of no more than local importance.

3.8.3 Although snipe was recorded on the Phase I site during my site visit in early May 2016, there was no evidence of breeding behaviour and the habitat did not seem to be suitable for breeding snipe. Therefore these birds were perhaps moving through the area rather than breeding.

3.8.4 Significantly, the applicant also recorded curlew during the breeding season at Lough Croan Turlough. Recent survey work indicates that there may now be less than 200 breeding pairs of curlew in the whole of Ireland (Birdwatch Ireland, 2011). If breeding occurs at Lough Croan Turlough then this is clearly a significant population. Lough Croan Turlough also supports, or has supported, two other uncommon breeding species, the shoveler and pochard (Site Synopsis). In contrast to the Phase I site, populations of these three species at Lough Croan Turlough are likely to be of at least county importance. Dysart (Thomas Street) Turlough is likely to be dry during the breeding season so it does not have the same value for breeding waterbirds.

3.8.5 Breeding birds and their nests and eggs are protected by law.

Late summer/autumn season

3.8.6 The bird species recorded during the late summer/autumn season are more or less a subset of those recorded during the breeding season, with no additional birds of conservation concern recorded. However one additional bird of prey was recorded; the common buzzard.

Wintering Birds

3.8.7 Results of the wintering birds surveys are set out in the EIS for Phase I (Chapter 8), the EIS for Phase II (Chapter 8, Appendix A of Appendix 8.1), the June 2012 AA report (Appendix 7), the wintering bird survey report for winter 2012/13 (ECOFACT, 2013) and the wintering bird survey report for 2014/15 (ECOFACT, 2015). The results of these surveys with respect to qualifying species of the local SPAs, including the occurrence of these species are other local wetland sites, such as Dysart (Thomas Street) Turlough, is set out in Appendix 2 of my AA report.

3.8.8 For the Phase I site itself, the applicant reports just one species of conservation concern using the Phase I site during the winter which was starling, with up to 30 recorded. Subsequently, golden plover, also a species of conservation concern, was recorded in fields to the north of the locations of the proposed turbines (Appendix 7 of the June 2012 AA report). Thirty other bird species were recorded including six which were of conservation concern at the time that the survey was carried out. The applicant has no records of these six species on the Phase I site (FERS, 2011). A further three of the species recorded have subsequently been added to the list of birds of conservation concern. However, no information is available on whether

these, or any of the species listed as being not of conservation concern, were found actually on the Phase I site, or nearby. Other than peregrine falcon (for which see below) and waders (also see below), the wintering bird community and the populations of individual bird species present on the not likely to be of more than local importance.

3.8.9 A single peregrine falcon was observed hunting on the Phase I site as well. The peregrine falcon is an uncommon breeding species in Ireland with perhaps no more than several hundred pairs present in the country. This species is more widespread during the winter, when the population may include some birds which breed in Britain, and when this species hunts migratory waterbirds, especially waders. Given the small population size of this species of bird, the local population is likely to be of up to county importance.

3.8.10 The value of the wintering bird populations at Lough Croan Turlough is well established and this is reflected in the designation of this turlough as an SPA. In summary, it regularly supports nationally important numbers of teal, shoveler and pintail and in some years also supports nationally important numbers of wigeon, gadwall, golden plover and lapwing, as well as part of nationally important flock of Greenland white-fronted goose. It also supports a number of other wintering waterbird species populations which are likely to be of more local value, such as curlew.

3.8.11 Dysart (Thomas Street) Turlough and Cuilleenirwan/Coolagarry Lough are less well monitored, but support several of the same species in perhaps lesser numbers. The populations there could be part of the populations which are also found at Lough Croan Turlough in which case they have the same value. Otherwise, the populations of wigeon, teal, golden plover and lapwing at both sites could be of county value.

3.8.12 Given the shortcomings in the survey work, the value of the site for wintering golden plover and perhaps also lapwing has not been fully established. Even though golden plover was observed to the north of the turbines, it is highly mobile (Fuller & Youngman, 1979; Gillings, Fuller, & Sutherland, 2005) and could well use the wind farm site from time to time. These birds are likely to be those which roost at Lough Croan Turlough. Thus, any golden plover and lapwing foraging on or near the Phase I site could well be part of this nationally important population.

4. Construction Stage Impacts

4.1 Approach

4.1.1 To assess the construction effects of the development and their significance, all elements shown as being part of the final design have been taken into account if they are shown on a drawing of the development or can otherwise be determined to be an integral part of the development proposals.

4.1.2 Furthermore, it is assumed that good general construction practice (e.g. waste and pollution control, no fires, etc.) will be followed, in line with commitments made by the applicant.

4.1.3 Other mitigation measures, which cannot or have not been mapped or shown on a plan or are unspecific, have generally been excluded from the initial assessment of the significance of the impacts of the development. These include timing of works or a generic commitment to follow guidelines.

4.2 Designated Areas

4.2.1 As set out in the EIS (Chapter 7, page 12), there would not be any direct effects on designated sites. There is however the potential for indirect effects on designated sites. There are three potential mechanisms for such effects.

4.2.2 Firstly, there are potential effects on the local hydrology/hydrogeology which may in turn affect the operation sites designated for their turlough habitat and that are hydrologically connected in some way to the development sites. A separate assessment is being completed of this impact mechanism. The current position is that insufficient investigation has been completed by the applicant to reach a firm conclusion on whether significant effects are likely. The designated sites potentially affected are Lough Croan Turlough cSAC, Four Roads Turlough cSAC and Lisduff Turlough cSAC.

4.2.3 Secondly, construction traffic which will pass along the R363 road which is about 200m from Ballynamona Bog and Corkip Lough SAC. The additional traffic creates an enhanced risk of pollution, both from air pollution and waterborne pollution from road run-off and accidental spillages. Negative effects from traffic on vegetation can extend up to 200m from the road (Angold, 1997; Bernhardt-Römermann, Kirchner, Kudernatsch, Jakobi, & Fischer, 2006; Bignal, Ashmore, Headley, Stewart, & Weigert, 2007). As the SAC lies just beyond that distance from the road, significant effects are unlikely.

4.2.4 Thirdly, there are potential impacts of the populations of qualifying species which roost within the designated sites as a result of disturbance. These potential impacts are assessed in detail in my AA report. The main site at risk of significant negative effects is Lough Croan Turlough SPA. Based on the currently available information, there is a low risk of significant negative effects on this designated site and any such effects would conventionally be considered to be significant at the international level. Impacts during the construction stage would be expected to occur during one or two winter seasons only.

4.3 Non-designated wetlands

4.3.1 The non-designated turloughs, Dysart (Thomas Street) Turlough and Cuilleenirwan/ Coolagarry Turlough, are potentially at risk from the same type of impacts as described above for designated areas, with Dysart (Thomas Street) Turlough being at most risk as it is the closest turlough to the wind farm site. The potential effect on bird populations are discussed under birds below and, as noted above, the effect of the development on hydrology requires further investigation.

4.3.2 Construction traffic for the Phase I site will pass alongside Dysart (Thomas Street) Turlough and, as this is within 200m, there is a risk of damage to the turlough. There is no botanical survey for the turlough submitted by the applicant on which to base an assessment but as the increase in traffic is temporary, significant effects are unlikely provided that accidental spillages can be avoided.

4.4 Terrestrial Habitats

4.4.1 The total built development area appears to in the order of 6ha, including approximately 1ha of temporary works. The applicant has not provided a breakdown of how this impacts the different habitats found on site. Approximate habitat losses are given in Table 3.

Table 3 Habitat Loss associated with the Phase I wind farm

Habitat Type	Fossitt Code	Area/Length Affected during construction (approx.)	Caused by the construction of..
Improved Agricultural Grassland and Semi-Improved Calcareous Grassland	GA1/ GS1	5.3ha	Trackways and turbines not listed below
Unimproved Calcareous Grassland	GS1	0ha	NA
Scrub/Unimproved Calcareous Grassland	GS1/WS1	0.2ha	Trackway between Turbines 7 and 8
Scrub/Semi-Improved Calcareous Grassland	GS1/WS1	0.2ha	Trackway between Turbines 8 and 9 Trackway between Turbines 8 and 14
Scrub	WS1	0.2ha	Turbines 3 and 8
Treeline	WL2	5m	Site entrance track
Stone walls and other stonework	BL1	Up to 1.9km[9]	Within 55m of all turbine locations except Turbine 6, as mitigation for bats

[9] The exact length is unclear. The mitigation for bats is that the tips of the turbine blades should be no closer than 50m from the nearest edge of a field boundary feature. This is equivalent to turbine bases located 55m from the

Habitat Type	Fossitt Code	Area/Length Affected during construction (approx.)	Caused by the construction of..
Ponds	FL8	0ha	NA
Turloughs/ seasonal flooding	FL6?	0.1ha	Turbine 6

4.5 Invertebrates

4.5.1 The applicant considers this loss of invertebrate habitat to be a minor negative impact (Chapter 7 of the EIS page 13). As set out in Table 3 above, there would be some loss of good invertebrate habitat, with the combined loss of 0.6ha of scrub and mixed scrub and grassland. In the context of the amount of this type of habitat available within the survey area, the effect on invertebrate populations is unlikely to be significant.

4.6 Mammals other than bats

4.6.1 The applicant did not identify any likely effects on mammals other than bats. As with invertebrates, there will be some loss of good habitat but the small scale of that loss and spatial arrangement (i.e. it is spread out over a wide area) mean that negative effects on the populations of Irish hare and other mammals are unlikely to be significant.

4.7 Bats

4.7.1 The re-arrangement of stone walls has the potential to cause temporary disruption to bat commuting corridors and foraging patterns, depending on the way in which the process is managed and the season within which the work takes place. Lighting during the construction period also has the potential disrupt bat foraging behaviour. Any impacts arising from these activities will take place over one or two summers and then cease. They are unlikely to be significant in the medium to long term.

4.7.2 The existing dwelling house which is to be converted to a site office has not been identified as supporting a bat roost. However, the level of survey that has been undertaken of this building is unclear. Given the number of survey locations covered in the survey over the short survey period it seems unlikely that a full investigation of this building has been undertaken. In chapter 3 of the EIS (page 7), it states that no works are required to this structure. Assuming that means that the building will not be re-modelled or substantially refurbished internally, then significant effects on any bat roost which may be present are unlikely.

nearest edge of a field boundary for a field boundary which is 1.5m tall. However, the turbines, excluding Turbine 6, are located an average distance of 17m from a field boundary. To achieve the 55m separation the turbines (micro-siting) or the field boundaries need to be re-located or a combination of both. It seems that for the majority, the required separation cannot be achieved by micro-siting alone. The 1.9km figure stated in the table assumes no micro-siting.

4.7.3 There will be some loss of higher quality bat foraging habitat as a result of the construction of the trackway between proposed Turbines 7 and 8, as well the construction of Turbines 3 and 8, with a total loss of around 0.6ha. This may have a negative effect on the local bat population as high quality foraging habitat is quite limited locally but the area affected is still a small proportion of that available within the survey area and so such effects are unlikely to be significant.

4.8 Birds

Breeding Birds

4.8.1 As with any construction project taking place during the breeding season, there is the potential for breeding birds to be disturbed as a result of construction activity and for nests and eggs to be destroyed during site clearance. However, none of the bird species recorded breeding on or near the Phase I site is especially sensitive to disturbance and, as all the species are common and widespread, no lasting effects on the population would be expected as a result of construction stage impacts. Furthermore, the breeding species at Lough Croan Turlough are probably too distant to be affected by construction activity. Significant effects on breeding birds as a result of disturbance are therefore unlikely during the construction stage.

4.8.2 There will be some loss of higher quality breeding bird habitat as a result of the construction of the trackway between proposed Turbines 7 and 8, as well the construction of Turbines 3 and 8. As for bats, this loss of habitat may have a negative effect on local bird populations but it is unlikely to be significant.

Wintering Birds

4.8.3 As for during the breeding season, the woodland and farmland birds recorded on or near the Phase I site by the applicant are not especially vulnerable to disturbance from human activity and, as the construction activity will be localised and of short duration, there should be not be a significant effect on this group of birds as a result of disturbance. The negative effects of habitat loss would be the same as described for the breeding season.

4.8.4 During the construction stage, there is the potential for wintering waterbirds to be disturbed and displaced when using Dysart (Thomas Street) Turlough. As noted above, the development is around 900m from Dysart (Thomas Street) Turlough. This is a considerable distance which means that such disturbance of the birds present at the turlough is perhaps unlikely. However, the route for the construction traffic is via Dysart which provides an additional source of potential disturbance. Moreover, birds which roost at Lough Croan Turlough, Dysart (Thomas Street) Turlough or Cuillineerwan/Coolagarry Turlough and which forage on or nearer to the Phase I site are likely to be subject to disturbance during the construction stage. Foraging near to the Phase I site in winter has been recorded by the applicant for whooper swan and golden plover. Due to the short duration of the construction period and localised construction activity, such effects are unlikely to be significant in the medium to long term.

5. Operation Stage Impacts

5.1 Approach

5.1.1 As with construction stage impacts, only integral avoidance and mitigation measures have been considered as part of the development.

5.2 Designated Areas

5.2.1 During the operation phase, negative effects on designated sites could occur indirectly as a result of increased mortality of qualifying bird species as a result of displacement, creating a barrier to movement and collisions with turbines. This is assessed in detail in the AA report. In summary, there is a low risk that the conservation objectives are contravened for Lough Croan Turlough SPA, Four Roads Turlough SPA and the River Suck Callows SPA. Negative effects could also occur as a result of changes in hydrology. Again, further investigation is needed to help understand the potential impacts of the development on hydrology.

5.3 Non-designated wetlands

5.3.1 The operational wind farm could have similar effects on the non-designated wetlands as for the designated areas. The risk of negative effects are highest for Dysart (Thomas Street) Turlough as this wetland is the closest to the Phase I site. The effects on wintering birds are described below and, once again, further information is required to understand how changes in hydrology might affect the turlough.

5.4 Terrestrial Habitats

5.4.1 There should be no significant impacts on terrestrial habitats during the operation phase.

5.5 Invertebrates

5.5.1 There should be no significant impacts on invertebrates during the operation phase.

5.6 Mammals other than bats

5.6.1 There should be no significant impacts on mammals other than bats during the operation phase.

5.7 Bats

5.7.1 The applicant provides a fair description of the potential impacts on bats in the 2011 bat survey report, generically from page 22 to page 30 and then more specifically in Table 6 on pages 30 to 34. During the operation stage, the main risk to bats is a result of collision with the turbines (Cryan & Barclay, 2009).

5.7.2 During the short survey period at each wind turbine location, bat activity was recorded at all bar one. Many of the bats recorded were likely to be commuting however foraging behaviour was also apparently recorded. Commuting bats, other than commuting Leisler's bats, were

perhaps navigating along the stone walls and treelines, whereas foraging bats may be doing the same or ranging more widely around the location where recorded.

5.7.3 None of the turbines as shown on the development layout is the requisite 55m[10] distance from a field boundary. The average distance is 19m (minimum 2m and maximum 52m), with three of the turbine locations shown as being less than 5m from the nearest field boundary. This arrangement appears to place commuting bats in these locations at considerable risk. The EIS (Chapter 3, page 7) indicates the potential to move the turbine (micro-siting) up to 20m in any direction. This may enable some of the turbines to be moved further from a field boundary but, in many cases, such a move would not place the turbine at the requisite distance and may even place it closer to a second stone wall.

5.7.4 Moving the turbine to a position further from a field boundary will not do anything to address the risks to bats which are foraging in suitable habitats around the turbine. Turbines 3 and 8 are located in scrub habitat which may be used by foraging bats, while Leisler's bats may also be foraging in open pasture in which the other turbines are located. Micro-siting Turbines 3 and 8 would not remove the turbine 55m from this habitat. Leisler's bat was recorded by the applicant at both of these locations and was possibly foraging (based on the time that the bats were recorded). Given the proposed turbine layout, it seems clear that potential effects on bats was not given much consideration during the design phase.

5.7.5 As set out in Appendix 1, Leisler's bats tend to fly directly from their roost to their foraging area, at height and at speed, without adhering to field boundaries in the same way as other species of bat. Because of its flight behaviour, this species is one of the most frequent victims of collisions with wind turbines. Separating the turbines and field boundaries will not effectively mitigate the risks of mortality for this species.

5.7.6 Without further mitigation (i.e. over and above micro-siting), significant negative effects on the local bat population are considered likely, as result of mortality of commuting and foraging bats, particularly Leisler's bat. Natterer's bat is at low risk of collision due to its flight behaviour.

5.8 Birds

Breeding Birds

Displacement

5.8.1 Birds are less susceptible to displacement from operational wind farms during the breeding season than during the winter. The majority of the breeding species are lowland farmland or woodland passerines which are not likely to be displaced by the presence of the turbines.

[10] The applicant gives a minimum distance of 50m from the **tip** of the turbine blade to the nearest part of the field boundary. Applying the formula presented by the applicant on page 35 of the 2011 bat survey report to the proposed turbines for Phase I yields a minimum distance of 55m between the **base** of the turbine and the nearest part of the field boundary for a field boundary which is 1.5m tall and 58m for a field boundary which is 3.5m tall. See also Appendix 1.

Barrier Effect

5.8.2 Birds migrating to their breeding grounds could be susceptible to the barrier effect, which is where the wind farm interrupts migratory pathways. Lough Croan Turlough is potentially used by breeding shoveler, pochard and curlew, as well as other breeding waterbird species. Any of these birds which migrate from Lough Croan Turlough further to the south and west for the winter and then make the return journey in the spring would most likely encounter the Phase I site. Such birds may then make a detour around the turbines, thereby increasing energy expenditure. However, the overall distance of the detour is not likely to significantly increase the overall journey.

Collision

5.8.3 Breeding birds tend to stay in proximity to the nest, especially those species which are territorial. Therefore, it is only those species which breed on or very near the Phase I site which are vulnerable to collision during the breeding season. Of the birds which have been recorded on the Phase I site (or near it) during the breeding season, the majority[11] have been recorded as victims of collision with wind turbines. As the applicant has not provided distribution maps or numbers, the level of risk for the populations of these species on the Phase I site is hard to ascertain. Any effects on breeding bird population are however likely to be fairly localised and therefore not significant beyond the 200ha or so that make up the wind farm site.

5.8.4 As set out above, birds migrating from the south and west to breed at Lough Croan Turlough could encounter the Phase I wind farm. Such birds may make a detour to avoid the wind farm (known as macro-avoidance) or they may choose to fly through the wind farm. The majority (>98%) of birds flying through the wind farm are likely to avoid the turbines (micro-avoidance) however a very small proportion could collide with a turbine. The applicant has no records of any bird species making this journey and the breeding populations are understood to be relatively small. A small population size means that the risk that any birds collide with a turbine while migrating to breed at Lough Croan Turlough is therefore very low however a small population size also means that loss of any member of the breeding population could have a significant effect.

Wintering Birds

Displacement

5.8.5 As for the breeding season, the farmland and woodland passerines, including starling, which have been recorded on or near the Phase I site are unlikely to be displaced as a result of the presence of the turbines. Birds of prey, such as peregrine, sparrowhawk and buzzard are also not vulnerable to displacement at wind farms.

5.8.6 However, wintering waterbirds are generally vulnerable to displacement as a result of the presence of wind turbines, with the effect varying from species to species and generally

[11] sparrowhawk, snipe, black-headed gull, wood pigeon, cuckoo, skylark, swallow, robin, willow warbler, blackbird, great tit, house sparrow, greenfinch, chaffinch, linnet, starling, jackdaw, magpie, raven, rook, carrion crow and even pheasant. Common buzzard, recorded during the autumn surveys, is a fairly frequent victim of collisions with turbines.

increasing with the height of the turbines. Typically, for this group of birds, there is a zone within and around the turbines within which complete displacement occurs and then there may be a zone beyond that where birds are present but the numbers are reduced. A distance of 1km from the turbines is probably the upper limit for complete displacement for any species for turbines of 85m hub height, while the distances beyond that where numbers are reduced is not well understood (Hötker, Thomsen, & Köster, 2006; Rees, 2012).

5.8.7 Lough Croan Turlough and Cuillineerwan/Coolagarry Turlough are greater than 1km away and therefore complete displacement of any species should not occur at these sites. Dysart (Thomas Street) Turlough is approximately 900m away at its nearest point, although the majority of this wetland is beyond 1km from the nearest turbine as well. Of course, the birds are not restricted to the turloughs with several species also foraging on nearby farmland, including whooper swan, golden plover, lapwing and Greenland white-fronted goose. The first two of these species have been recorded foraging in grassland in proximity to the Phase I site. The wind farm could well displace birds from these areas. Detailed assessments for individual species are provided in my AA report for many of the wetland species recorded at these three turloughs, including whooper swan, wigeon, golden plover, lapwing and Greenland white-fronted goose. In summary, there is a risk of displacement, to varying degrees, for these species and, for some of these species, there are potential knock-on effects for the populations of these species locally but this is uncertain.

5.8.8 As they are not qualifying species locally, my AA report did not include consideration of Bewick's swan, snipe and curlew, which have all been recorded at Dysart (Thomas Street) Turlough and may forage on adjoining grassland areas, although this has not been reported by the applicant. For Bewick's swan, displacement has been recorded at an *average* distance of 560m from wind turbines with a hub height of 90m, while for curlew and snipe displacement distances of *up to* 650m have been recorded. This indicates that, like other species, the birds using the turlough itself would probably not be displaced (at least not fully) but displacement from grassland areas closer to the wind farm is possible. The other bird species recorded at Dysart (Thomas Street) Turlough, such as pintail, are more aquatic and therefore likely to remain at the turlough where they are at very low risk of displacement effects.

Barrier Effect

5.8.9 The farmland and woodland passerines and birds of prey which are resident on the Phase I site are unlikely to experience a barrier effect. However, the small passerines, such as swallow, are vulnerable to barrier effects when migrating. It is not clear what implication this might have for the small number of migratory species recorded in and around the Phase I site but in all probability any detour made to avoid the wind farm site would not add significantly to the migration distance.

5.8.10 Once again, a detailed assessment for the qualifying species of the local SPAs are set out in my AA report. In summary, there is a medium risk the birds which use Lough Croan Turlough and either the River Suck Callows or Dysart (Thomas Street) Turlough experience a barrier effect and a possibility that this would lead on to effects on the population. The other migratory wetland species found at both Dysart (Thomas Street) Turlough and Lough Croan Turlough are also at risk of experiencing a barrier effect which has a significant effect on the journey distance when moving between these two wetland sites. Curlew and pintail have been recorded at both and it is possible that birds move from one site to the other on occasion over

the course of a winter, although this was not recorded by the applicant. Flying around rather than across the Phase I site would add about 1km to the overall journey, an increase of about 30%. As with other species it is unclear if this would have any effect on survival rates or population size but there is a low risk of significant negative effects.

Collision

5.8.11 For woodland and farmland passerines, the risk of collision and associated negative effects is much the same as during the breeding season.

5.8.12 Any birds which move regularly in number from Lough Croan Turlough to either the River Suck Callows or Dysart (Thomas Street) Turlough during the winter are at most risk of collision at the Phase I site. Once again, detailed assessments for the qualifying species of the local SPAs are set out in my AA report. In summary, there is a low to medium risk that a few individuals of these species collide with a turbine over the 25 year period that the wind farm will be operational. It is unclear whether any such mortality would have an effect on the population of wintering birds locally and therefore it is uncertain whether such mortality would be significant.

5.8.13 The wintering wetland birds arrive in the Roscommon area from the north and north east. Any birds migrating from this direction directly to Dysart (Thomas Street) Turlough would probably encounter the wind farm site and would therefore be at risk of collision, and the same would be true if embarking on a migratory flight from the turlough back towards the breeding grounds.

5.8.14 Neither curlew nor pintail are considered to be of particular risk from collision with turbines (EC, 2011) and both species occur at relatively low numbers, up to around 90 birds of each species in some years. The risk of collision is therefore low as is the likelihood of significant effects as a result of collision on the populations of these two species.

6. De-commissioning Stage Impacts

6.1 Approach

6.2 Designated Areas

6.2.1 De-commissioning will again introduce a workforce onto the site with associated activity, including vehicle movements. This re-introduces the risks associated with pollution and waste management but it is expected that these risks can be fully controlled through good construction practice.

6.2.2 During de-commissioning, the activity will be against the background of an operating or still standing wind farm and a degree of existing displacement of wintering birds. The de-commissioning work should not have effects on designated sites beyond that of an operating wind farm.

6.3 Non-designated wetlands

6.3.1 As for designated sites.

6.4 Terrestrial Habitats

6.4.1 Depending on the degree to which the infrastructure is removed, there is the potential for the baseline conditions to be fully restored.

6.5 Invertebrates

6.5.1 As for terrestrial habitats.

6.6 Mammals other than bats

6.6.1 As for terrestrial habitats.

6.7 Bats

6.7.1 As for terrestrial habitats.

6.8 Birds

6.8.1 As for terrestrial habitats.

7. Proposed Avoidance and Mitigation Measures

7.1 Approach

7.1.1 Below is a summary of the mitigation measures put forward by the applicant. It is not necessarily an exhaustive list and if any measures have not been described here, it should not be taken to imply that such measures are not needed.

7.1.2 Any non-specific, vague or unquantified commitments which are not shown on plans have generally been omitted from the list of measures given below. This includes statements like 'will be minimised' or 'retained or replaced where possible' since there is no certainty that anything will be done at all. Similarly references to following guidelines, which can often be interpreted widely, are not considered definite commitments.

7.2 Designated Areas

7.2.1 The following mitigation measures have been put forward by the applicant in relation to designated areas:

- Preparation of an Environmental Management System which will include a Construction Method Statement and a Waste Management Plan, with measures to avoid spillages and contamination during the construction phase (June 2012 AA report).
- A Site Environmental Management Plan to avoid preventable impacts on the ornithological resource of the local area (June 2012 AA report).
- Foundation design and installation to take account of local ground conditions (June 2012 AA report).

- Excavation during construction works to take place only when periods of heavy and persistent rain are not forecast (June 2012 AA report)
- Shallow interceptor drains to capture run-off from access tracks where these have a steep gradient as well as sediment traps and other drainage management measures (June 2012 AA report)
- Installation of a MERLIN avian radar system to prevent bird collisions with turbines (Appendix D of the Further Information Response; June 2012 AA report).

7.3 Non-designated wetlands

7.3.1 No specific measures have been put forward by the applicant in relation to non-designated wetlands, however, those given above under designated areas would also apply to non-designated wetlands.

7.4 Terrestrial Habitats

7.4.1 The following mitigation measures have been put forward by the applicant in relation to terrestrial habitats:

- Access tracks to be within [semi-improved and] improved grassland field margins avoiding treelines. However, one tree line will be bisected and the tracks also pass through scrub and scrub/grassland mosaics so this measure cannot be fully realised (EIS, chapter 7).
- Fencing off 'any' semi-natural habitats adjacent to proposed access routes and turbines to prevent unnecessary damage and degradation as well as clearly defining work areas for the same purpose. The location of the fencing nor how work areas will be demarcated is not specified (EIS, chapter 7).
- Allowing the verges of the proposed access routes to re-colonise naturally by local species in semi-natural grassland sites. This amounts to not re-seeding the disturbed ground next to the access tracks. (EIS, chapter 7).
- Planting native hedgerow species in openings in the field boundaries along the proposed access routes, to replace any lost sections of treeline. The locations of the planting and loss are not specified, nor is the ratio of loss to gain. (EIS, chapter 7).
- Planting native species of tree to 'mitigate' for the loss of trees at the proposed site entrance at Mullaghardagh. (EIS, chapter 7).
- Four hectares of land adjacent to the unimproved calcareous grassland to be set aside to become meadow, with the habitat to be managed following a management plan, with cutting the stated option in the current management plan (Habitat Management Plan, Appendix E of the FIR Response), however at the oral hearing in June 2016 it was suggested that management would be by grazing (Mr. G. O'Donohoe).

7.5 Invertebrates

7.5.1 No specific mitigation measures are proposed however the creation of meadow habitat should be of benefit to invertebrates.

7.6 Mammals other than bats

7.6.1 No specific mitigation measures are proposed however the creation of meadow habitat should be of benefit to mammals

7.7 Bats

7.7.1 The following mitigation measures have been put forward by the applicant in relation to bats:

- Removal of trees at Mullaghardagh during the period October to March to avoid impacts on Leisler's bats (EIS, chapter 7).
- Shaking trees before felling and then leaving felled trees for 24 hours to allow fauna (particularly bats) to escape (EIS, chapter 7) or soft felling trees under supervision of a bat specialist (2011 bat report).
- Turbines 3, 4, 6, 8, 9, 10, 11, 12, 13, 14 and 16 to be relocated to a minimum distance of 50m (rather than 55m?) from a field boundary or increase the cut-in speed of the turbines to 5.5 to 6ms^{-1} from half an hour before sunset and (until?) half an hour after sunrise at turbine locations where Leisler's bats have not been recorded or remove/re-route hedgerows (but not stone walls?) within 50m of a turbine. See Appendix 1.
- Re-routing of linear habitats which are bisected by the access roads in order to provide alternative [or replacement] commuting routes for bats, with these being a minimum of 50m away from the blade tips.

7.8 Birds

7.8.1 The following mitigation measures have been put forward by the applicant in relation to birds:

- Removal of trees and vegetation would [not] be carried out between 1st March and 31st August to avoid impacts on breeding birds.
- An 'emergency procedure' to be followed in case an active bird nest is encountered.
- Continuation of grazing to an appropriate level around the turbines to discourage the use of this habitat by whooper swans (Chapter 8 of the EIS).
- Turbines will be erected over the summer period and be in place when the birds arrive on their wintering grounds in October (June 2012 AA report). This could be contradictory to the construction programme and so may not be achievable. Also some wintering birds arrive before October.
- Use of the MERLIN Avian Radar System to both monitor turbine operation and automatically stop rotors when birds are detected in the wind farm area (Appendix D of the Further Information Response; June 2012 AA report).

8. Predicted Residual Impacts

8.1 Approach

8.1.1 The residual impacts are the likely final position following the implementation of the mitigation measures summarised in Section 6 of this document.

8.2 Designated Areas

8.2.1 Potential impacts from pollution and waste could probably be controlled through good construction practice as set out by the applicant. This should be confirmed as part of a hydrology/hydrogeology assessment.

8.2.2 Unfortunately, the situation with respect to the bird interest of the designated sites is less clear, as set out below under 'birds' and the same is true for impacts on the wetland habitat as a result of potential interference with hydrology/hydrogeology. In a separate assessment (Keohane, 2016), it has been determined that further investigation is required in order to reach a conclusion on the effects of the development on hydrology.

8.3 Non-designated wetlands

8.3.1 As for designated sites.

8.4 Terrestrial Habitats

8.4.1 The development would result in the minor loss of scrub habitat and the proposals do not appear to include replacement of this habitat type. There is therefore a residual negative impact but it is of such small scale that it is not significant.

8.4.2 The creation of four hectares of meadow habitat has the potential to fully mitigate for the loss of grassland habitat during the construction phase and provide a locally significant overall benefit *if* the meadow habitat is designed and managed properly and it will be in place for a sufficient period of time. At the moment, the habitat management plan is very light on detail and clarification on the duration of the management period is required. The management plan will also need to be updated to reflect a change in the proposed method of management from cutting (as set out in the written habitat management plan (Moore Group, 2011)) to grazing (as stated at the oral hearing).

8.5 Invertebrates

8.5.1 The creation of four hectares of meadow habitat also has the potential to fully mitigate for the impacts of habitat loss during the construction phase and provide a locally significant overall benefit for terrestrial invertebrates. Again, more detail on the plans is required to confirm that the effect will overall be beneficial.

8.6 Mammals other than bats

8.6.1 As for invertebrates.

8.7 Bats

8.7.1 The development will result in the loss of small areas of scrub habitat and the applicant is not proposing to replace this habitat. However, as set out above, the applicant is proposing to create 4ha of meadow habitat which should have the effect of increasing the availability of invertebrate prey for bats and overall a locally beneficial effect is possible, depending on the design and management of the meadow.

8.7.2 Re-routing the stone walls or re-locating turbines such that they are located 55m (measured along the ground) or more from the each other has the potential to substantially mitigate the risk that the turbines pose to the bats recorded on site, *except* Leisler's bats. Of concern here is that the new proposed layout of the stone walls is not shown on a plan and is only really set out as a recommendation in the bat ecologist's report. The degree of re-routing required would appear to be considerable and it would presumably have negative effects on a cultural heritage asset. More detail on the proposals on this proposal and its acceptability are therefore required before reaching a firm conclusion. If the stone walls and turbines are not re-repositioned to be 55m distant from each other, then collision mortality is likely to have a locally significant effect on the bat population.

8.7.3 Increasing the cut-in speed also has the potential to substantially mitigate the risk that the turbines pose to the bats recorded on site, *including* Leisler's bats, if the cut-in speeds are high enough and it is applied to all turbines, regardless of the proximity or otherwise to a boundary feature. As set out in Appendix 1, the cut-in speed may need to be increased to 6.5 – 8ms^{-1} to be a fully effective measure for Leisler's bats. However, increasing cut-in speeds to 5.5 to 6ms^{-1} would still be of benefit, particularly to the smaller, slower-flying species such as common pipistrelle but also potentially to Leisler's bat. Currently, the applicant is proposing increasing cut-in speeds for Turbines 3, 4, 8, 11, 13 and 16 but only if monitoring work reveals that bats are being 'impacted' by the windfarm (Further Information Response, August 2011pages 32 and 33). However, Leisler's bat is probably more widespread than the survey results indicate and a clear definition of 'impacted' would need to be established in order to understand what is actually being proposed. If the cut-in speeds are not increased sufficiently and more widely, then collision mortality is likely to have a locally significant effect on the bat population.

8.7.4 Re-routing of linear habitats which are bisected by the access roads has the potential to fully mitigate the impact on commuting bats but no plan has been submitted which sets out how this would be achieved. However, given the small width of the access roads (5m) and the low frequency and speed of the traffic, the effect of removing short sections of hedgerow on the local bat population is not likely to be significant, whether or not alternative routes are provided.

8.8 Birds

8.8.1 Impacts on nesting birds can be avoided during the construction phase through good construction practice.

8.8.2 The applicant has proposed mitigation to deal with collision risk (i.e. installation of turbines before the winter season and the use of MERLIN system) but has not proposed any mitigation measures to deal with the risks associated with displacement and the barrier effect.

8.8.3 The commitment to install the turbines in advance of the winter season seems to be slightly at odds with the construction programme and so further details are required in order to understand if this commitment is achievable. The timing of turbine installation would only influence matters in the first year of operation so perhaps this is a minor point.

8.8.4 The applicant proposes to install and operate the Merlin Avian Radar System to both monitor bird movements and to automatically shut down turbines as birds approach. The applicant describes this system in section 4.3.2.2, pages 80 to 81 of the 2012 AA report and a presentation on this system was given at the June 2016 Oral Hearing. If this system is able to function as described then it has the potential to fully mitigate the risks of collision.

8.8.5 However, the NPWS has not accepted that the efficacy of the Merlin Avian Radar System has been demonstrated (see its October 2015 submission). Moreover, a recent search of the scientific literature reveals no peer reviewed scientific papers which fully demonstrate that the system will work as described by the applicant. Indeed, there is some evidence to the contrary. One research project found that the system was good at tracking large flocks of larger birds, such as geese, but poor at tracking single large birds and small flocks of smaller birds such as ducks (Gerringer, Lima, & DeVault, 2015) and there is anecdotal evidence of a fatality of a single large bird at a wind farm using the Merlin system (Subramanian, 2012). The system can therefore be considered to have the potential to reduce mortality of birds approaching the wind farm but it cannot be considered to fully mitigate the risk of collision. It will of course do nothing to address the risks of displacement and the barrier effect.

8.8.6 There would seem to be a residual risk of displacement, a barrier effect and collision, principally on account of the position of the Phase I site between Lough Croan Turlough and Dysart (Thomas Street) Turlough which are both important sites for the some of the same species of wintering waterbirds. The risk of a significant effect on any of the wintering bird populations is low but if there were to be an effect a feature of considerable, potentially national, importance. In other words, the risks are low but the stakes are high and therefore it would seem prudent to understand and then mitigate the risks as fully as possible.

9. Cumulative Impact Assessment

9.1 Approach

9.1.1 The applicant did not provide an assessment of cumulative impacts in the EIS for the Phase I wind farm or in the Further Information Response of August 2011. There is also no assessment of cumulative impacts on flora and fauna (other than birds) in the EIS for the Phase II wind farm. There is however a brief assessment of cumulative impacts on birds in the EIS for the Phase II wind farm (Chapter 8, page 46) and also the 2012 AA report. The latter did not consider the combined effects of the Phase I and Phase II development and neither did the equivalent document for Phase II.

9.1.2 As the development is a proposed wind farm, a type of development which has quite specific types of impacts, there is clearly the most potential for cumulative effects with other wind farm developments, both existing and proposed. Skrine wind farm, Sliabh Bawn wind farm and

Seven Hills Phase II are all within a 20km radius of the Phase I site and therefore should be considered for cumulative effects. These are characterised in Table 4.

Table 4: Summary of projects considered for cumulative effects

	Seven Hills Phase I	Seven Hills Phase II	Skrine	Sliabh Bawn	TOTAL
No. of Turbines	16	19	2	20	57
Windfarm size*	200ha	400ha	40ha?	833ha	1473ha
Habitat Types	Grassland	Grassland	Grassland	Woodland	-

*based on a loop drawn around the turbines rather than the planning application boundary

9.1.3 In addition, there is the potential from cumulative effects arising from the grid connection. The applicant has made clear that its intention is to bury the cables (IWCM, 2015b).

9.1.4 The wind farm developments in Table 4 and the grid connections for Phase I and Phase II are therefore the developments which are considered for cumulative impacts.

9.2 Designated Areas

9.2.1 None of the developments will directly affect any designated sites.

9.2.2 However, there is the potential for indirect cumulative effects on qualifying species of birds as a result of the Phase I and Phase II developments and potentially also the Skrine wind farm. This is described in more detail in my AA report. Given the proximity of these wind farm sites there is the potential for negative effects on the same populations of birds if they move from site to site during the course of a winter.

9.2.3 There are no SACs with turloughs as a qualifying feature which are likely to be connected by hydrology to more than one of the wind farm sites (Keohane, 2016), meaning that cumulative effects on a single turlough SAC by this mechanism are unlikely.

9.2.4 Construction traffic for both developments would pass about 200m of Ballynamona Bog and Corkip Lough SAC. The risks of pollution are increased compared to considering each development separately however significant cumulative effects are unlikely at this distance.

9.3 Non-designated wetlands

9.3.1 As for designated sites.

9.4 Terrestrial Habitats

9.4.1 All of the wind farms will have an effect on terrestrial habitats however the impact in each case will be limited due to nature of the development. The Skrine wind farm appears to be located improved agricultural grassland and Sliabh Bawn is located in forestry, whereas the Phase I and Phase II wind farms both affect improved agricultural grassland, calcareous grassland and scrub. Impacts on improved agricultural grassland are not significant except perhaps in relation to bats and birds for which see below. The grid connection is proposed to be buried under the public road network and so should not result in additional losses of habitat.

9.4.2 The Phase I development would result in the loss of around 0.6ha of calcareous grassland and scrub while the Phase II would result in the loss of 3.2ha of the same habitats, giving a total loss of 3.8ha, with some restoration post-construction. The applicant is proposing to create and manage 4ha of this habitat at the Phase I site which has the potential to offset the cumulative impact by area however it may not achieve the same quality as the habitat being lost[12]. The cumulative impact is therefore between negligible and a locally significant negative impact depending on the quality of the habitat created and the length of time it is in place compared to the wind farm infrastructure (hard standing and tracks). Note that the potential benefit described in paragraph 8.4.2 above is effectively lost when impacts are considered cumulatively, as there is no equivalent proposal to create habitat for Phase II.

9.4.3 Depending on the approach taken with the bat mitigation, there is also the potential for several kilometres of stone wall to be relocated. However, as the walls in each case will be relocated rather than lost, there should be no significant cumulative negative impact with respect to ecology in the medium to long term.

9.5 Invertebrates

9.5.1 The potential combined loss of habitat for invertebrates, in the context of the amount available, is probably insufficient to result in significant negative effects on any invertebrate populations.

9.6 Mammals other than bats

9.6.1 As for invertebrates.

9.7 Bats

9.7.1 All of the proposed wind farms have the potential to have negative effects on local bat populations.

9.7.2 Sliabh Bawn wind farm is located in forestry. The common pipistrelle was recorded here, at three turbine locations. Significant negative impacts were discounted, however, bat surveys were conducted on a maximum of two nights only and it may well be the case that additional survey work would have revealed more species and more widespread bat activity. Skrine wind

[12] This can be dealt with by creating more habitat than is lost e.g. 2ha created for every 1ha lost.

farm is just two turbines set in low quality bat habitat. The Phase I and Phase II sites support the typical bat fauna of rural Ireland.

9.7.3 Some mortality of bats is likely at all four locations. Recent research in the UK indicates that an average of 6.7 bats are killed per wind farm (n=29) per month (Lintott, Richardson, Hosken, Fensome, & Mathews, 2016) which gives some idea of the likely cumulative effects of the wind farms under consideration here, if appropriate mitigation measures are not put in place. Bats are long lived and produce few young per annum and so such mortality is likely to have an effect on the population.

9.7.4 Leisler's bat is particularly vulnerable to cumulative effects because it is a species at high risk of collision with wind turbines which can forage up to 13.4km from its roost. This puts at least three of these wind farms potentially in range of the same population of Leisler's bats. The Leisler's bat is relatively common and widespread in Ireland and so the cumulative impacts, if unmitigated, are likely to be of local significance.

9.7.5 The common and soprano pipistrelle typically remain within 3km and 2km of their roosts respectively, which makes cumulative impacts on the same population, as a result of the wind farms considered here, less likely.

9.8 Birds

9.8.1 The applicant's assessment in the EIS for Phase II did not identify any negative cumulative impacts on birds as a result of the Phase I and Phase II wind farms but did identify a positive effect of 'more meaningful and useful data' as a result of deploying two MERLIN avian radar systems, one for each wind farm. The assessments set out in the 2012 AA reports for Phase I and Phase II did not consider the cumulative effects of the two wind farms.

Breeding Birds

9.8.2 Breeding birds are not likely to be displaced from the wind farms and the four wind farms are too widely spaced to create a combined barrier for birds which migrate to the area to breed.

9.8.3 All four wind farms are likely to result in some mortality of breeding birds albeit at a low level, with mainly common and widespread species affected in each case. The effect on populations is likely to be localised at each wind farm and not more than locally significant.

Wintering Birds

9.8.4 Cumulative effects on wintering waterbirds associated with the designated sites are set out in my AA report. In summary, the main qualifying species which are at risk from cumulative effects are (i) whooper swan, a qualifying feature of the River Suck Callows, as a result of collision with the turbines at Phase I and Phase II; and (ii) golden plover and lapwing, which are also qualifying features of local SPAs, as a result of displacement from grassland foraging habitat at Phase I and Phase II.

9.8.5 There is also the potential for any wintering waterbird population which makes use of both Dysart (Thomas Street) Turlough and Lough Feacle to experience cumulative effects as a result of displacement since both of these wetland sites are less than 1km from one of the proposed wind farms. The risk of displacement in each case is low or moderate and so is the risk of significant cumulative effects.

10. Summary and Conclusion

10.1.1 The applicant has completed a number of surveys to inform the planning application, with a focus on terrestrial habitat, bats and birds. Unfortunately, the earlier surveys in particular are not of a very high standard. The accompanying reports are sometimes not clear on methodology and the survey effort for the Phase I site appears to have been exaggerated in places. Furthermore, the description of the methods, results set out in the report and responses to further information are all, at times, misleading. The whooper swan surveys were too narrowly focused.

10.1.2 These earlier deficiencies have been somewhat addressed by additional bat surveys on the site and additional bird survey work undertaken at local wetland sites. However, other than in one location, the bat survey work on the Phase I site was of very short duration and the additional bird survey work has not addressed the deficiencies of the bird survey work on the Phase I site itself. These factors have somewhat confounded this ecological impact assessment.

10.1.3 Nevertheless, it is clear that the nature conservation value of the Phase I site is generally low, being for the most part typical semi-improved and improved grassland. The fauna recorded by the applicant, including most of the birds and bats, is representative of that which would be expected in the farmed landscape. There are some better areas of semi-improved grassland and one area of unimproved calcareous grassland, as well as some scrub and scrub/grassland mosaics, which are all of local value. This is a broad category and the unimproved calcareous grassland is clearly the most important habitat present.

10.1.4 The development would result in the loss of 0.6ha of locally important habitats, including some of the unimproved calcareous grassland where it exists amongst the scrub, but this could be more than mitigated by the proposed creation of 4ha of meadow, giving a net benefit for grassland plant species as well as invertebrates and mammals other than bats. This is providing that the design and management of the meadow is done well and it is maintained for the life of the development. The benefit is however lost if cumulative impacts of both the Phase I and Phase II wind farms are taken into account.

10.1.5 With the current layout, the populations of bats are at risk of collision with the turbines. Leisler's bat is at risk almost whatever the layout. If the applicant can re-route the stone walls to 55m away from each turbine base and increase cut-in speeds sufficiently then the risk for all bat species would become negligible (see Appendix 1). Without such re-routing and amendments to the cut-in speed, there is likely to be a locally significant negative effect on the bat population as a result of collision mortality. Leisler's bats may also be at risk of cumulative effects arising from multiple wind farms in the locality.

10.1.6 The effects on the birds that are resident on the Phase I site and those which migrate there to breed are unlikely to be significant. However, there appears to be a low residual risk of significant effects on the wintering bird populations of nearby waterbodies. This because the wind farm site is located directly between two of these sites and about 1km from each, and there are records of flocks of Greenland white-fronted goose and whooper swan flying over the Phase I site. The risks would exacerbated slightly by the operation of several wind farms in the locality. Further survey may help reach a conclusion that these risks are so low that they can

be discounted or perhaps additional mitigation measures or amendments to the layout could reduce the risks to a level for the same conclusion to be reached.

10.1.7 The effect of the development on designated sites is described in my AA report and the assessment for the non-designated wetlands is similar. For both, the effects of the development on hydrology requires further consideration so it is not yet possible to say whether significant effects will arise as result. The other way in which these sites could be affected is through impacts on their bird populations and this is described above.

11. References

Angold, P. G. (1997). The impact of a road upon adjacent heathland vegetation: effects on plant species composition. *Journal of Applied Ecology*, 409-417.

Arnett, E. B., Huso, M. M., Schirmacher, M. R., & Hayes, J. P. (2011). Altering turbine speed reduces bat mortality at wind-energy facilities. *Frontiers in Ecology and the Environment*, 9(4), 209-214.

Bat Conservation Ireland. (2012). *Wind Turbine/Wind Farm Development: Bat Survey Guidelines, Ver. No. 2.8.* Lisduff: Bat Conservation Ireland.

Bat Eco Services. (2011). *Bat Survey: Seven Hills Wind Farm Phase I.* Lisduff: Bat Eco Services.

Bat Eco Surveys. (2013). *Bat Survey: SEven Hills Wind Farm Phases I and II.* Lisduff: Bat Eco Services.

Bernhardt-Römermann, M., Kirchner, M., Kudernatsch, T., Jakobi, G., & Fischer, A. (2006). Changed vegetation composition in coniferous forests near to motorways in Southern Germany: the effects of traffic-born pollution. *Environmental Pollution*, 143(3), 5.

Bignal, K. L., Ashmore, M. R., Headley, A. D., Stewart, K., & Weigert, K. (2007). Ecological impacts of air pollution from road transport on local vegetation. *Applied Geochemistry*, 22(6), 1265-1271.

Birdwatch Ireland. (2011, July). *Catastrophic Curlew declines uncovered*. Retrieved from Birwatch Ireland: http://www.birdwatchireland.ie/Publications/eWings/eWingsIssue22July2011/CatastrophicCurlewdeclinesuncovered/tabid/1189/Default.aspx

Cryan, P. M., & Barclay, R. M. (2009). Causes of bat fatalities at wind turbines: hypotheses and predictions. *Journal of Mammalogy*, 90(6), 1330-1340.

EC. (2011). *Guidance Document: Wind Energy Developments and Natura 2000.* European Commision.

EC. (2013). *Interpretation Manual of European Union Habitats.* European Commision.

ECOFACT. (2013). *Seven Hills Phase 1: Wintering Bird Survey (January to March 2013).*

ECOFACT. (2015). *Proposed Seven Hills (Phase 1) Wind Farm, Co. Roscommon: Wintering Bird Survey October 2014 to March 2015.* Limerick: Ecofact Environmental Consultants Ltd.

FERS. (2011). *Response to issues arising from item (5) of a Request for Further Information (RFI) from Roscommon Co. Council (planning reference no. 10/541). .*

Fossit, J. (2000). *A Guide to Habitats in Ireland.* Herirage Council.

Fuller, R. J., & Youngman, R. E. (1979). The utilisation of farmland by Golden Plovers wintering in southern England. . *Bird Study*, 26(1), 37-46.

Gerringer, M. B., Lima, S. L., & DeVault, T. L. (2015). Evaluation of an avian radar system in a midwestern landscape. *Wildlife Society Bulletin*.

Gillings, S., Fuller, R. J., & Sutherland, W. J. (2005). Diurnal studies do not predict nocturnal habitat choice and site selection of European golden-plovers (Pluvialis apricaria) and Northern lapwings (Vanellus vanellus). *The Auk,*, 122(4), 1249-1260.

Horn, J. W., Arnett, E. B., & Kunz, T. H. (2008). Behavioral responses of bats to operating wind turbines. *The Journal of wildlife management*, 72(1), 123-132.

Hötker, H., Thomsen, K. M., & Köster, H. (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats. In *Facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. .* Michael-Otto-Institut im NABU, Bergenhusen, 65.

Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines. 2nd edition.* London: Bat Conservation Trust.

IWCM. (2015b). *Seven Hills (Phase 2) Wind Farm: Supplementary EIS and NIS Information (Grid Infrastructure. Reg. Ref 11/273 & PL20.244347.* IWCM.

Jones, G., Cooper-Bohannon, R., Barlow, K., & Parsons, K. (2009). *Determining the potential ecological impact of wind turbines on bat populations in Britain.* Bat Conservation Trust.

Keohane, J. (2016). *Seven Hills Wind Farm Phase 1: Report to An Bord Pleanala on Hydrology/Hydrogeology.*

Lintott, P., Richardson, S., Hosken, Fensome, S., & Mathews, F. (2016). Ecological impact assessments fail to reduce risk of bat casualties at wind farms. *Current Biology*, Volume 26 , Issue 21 , R1135 - R1136.

Moore Group. (2011). *Seven Hills Wind Farm Phase I: Habitat Management Plan.* Moore Group in association with FERS.

Natural England. (2009). *Technical Information Note TIN051: Bats and onshore wind turbines - Interim guidance.* Peterborough: Natural England.

NRA. (2009). *Guidelines for Assessment of Ecological Impacts of National Roads Schemes Revision 2.* National Roads Authority.

O'Neill, F. H., Martin, J. R., Devaney, F. M., & Perrin, P. M. (2013). *The Irish semi-natural grasslands survey 2007-2012.* National Parks and Wildlife Service.

Rees, E. C. (2012). Impacts of wind farms on swans and geese: a review. . *Wildfowl*, 2.62(62), 37-7.

Reynolds, D. S. (2006). Monitoring the potential impact of a wind development site on bats in the northeast. *Journal of Wildlife Management*, 70(5), 1219-1227.

Rodrigues, Bach, Dubourg-Savage, Goodwin, & Harbusch. (2008). *Guidelines for consideration of bats in wind farm projects: EUROBATS Publication Series No. 3.* Bonn: UNEP/EUROBATS Secretariat.

Shiel, C. B., Shiel, R. E., & Fairley, J. S. (1999). Seasonal changes in the foraging behaviour of Leisler's bats (Nyctalus leisleri) in Ireland as revealed by radio-telemetry. *Journal of Zoology*, 249: 347-358.

SNH. (2014). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Scottish Natural Heritage.

Subramanian, M. (2012). An ill wind. . *Nature*, 486(7403), 310-311.

Sullivan, C. A., Skeffington, M. S., Gormally, M. J., & Finn, J. A. (2010). The ecological status of grasslands on lowland farmlands in western Ireland and implications for grassland classification and nature value assessment. *Biological Conservation*, 143.

Appendix 1: Bat Mitigation

Separation between Turbines and Boundary Features

Many species of bat use boundary features as commuting corridors between their roosts and foraging areas. Boundary features can themselves be foraging habitat. The level of bat activity declines with distance from the boundary feature, with many species of bats typically remaining within a few metres. There are however exceptions such as Leisler's bat.

One of the mitigation measures proposed by the applicant to reduce mortality of bats as a result of collision with the turbine blades and barotrauma is to ensure that there is sufficient separation between the tips of the turbine blades and the boundary features.

This mitigation measure is described in a Technical Information Note produced by Natural England (Natural England, 2009). Natural England's advice is to maintain a 50m buffer around trees and field boundaries into which no part of the turbine intrudes. To achieve this, the turbine base usually needs to be more than 50m from the tree or field boundary, with the actual distance being dependent on the height of the tree or boundary feature and the design of the turbine. For the Phase I site, the applicant is suggesting a minimum distance of 50m between the field boundary and the turbine but it is not clear whether this means the blade tip or the turbine base. In order to achieve 50m separation between the blade tip and the boundary feature, I have calculated that, for 1.5m boundary feature and the type of turbine proposed, there needs to be a minimum of 55m between the turbine base and the nearest part of the boundary feature. For a 3.5m boundary feature the distance between the turbine base and the nearest part of the boundary feature needs to be a minimum of 58m.

There are clearly two ways of achieving the appropriate level of separation. One is to relocate the turbine and the other is to relocate the boundary feature. The applicant appears to be proposing a combination of both.

Increasing Turbine Cut-In Speeds

Bats restrict their flight activity during periods of rain, low temperatures and strong winds and are most active, and fly higher, during dry, warm and still conditions. Research in the US has demonstrated that increasing cut-in speeds, that is the wind speed at which the turbines begin operating, can reduce mortality rates in bats (Reynolds, 2006; Horn, Arnett, & Kunz, 2008; Arnett, Huso, Schirmacher, & Hayes, 2011). This research indicates that increasing the cut in speed to 5.0ms^{-1} could reduce bat fatalities by 44 to 93% (Arnett, Huso, Schirmacher, & Hayes, 2011).

The second mitigation measure proposed by the applicant is therefore to increase the cut in speed from 3ms^{-1} to 5.5 - 6ms^{-1} from half an hour before sunset and (until?) half an hour after dawn. The research suggests that this would have the effect of reducing overall bat fatalities. However, there is variability among bat species in the response to wind speed, with smaller bats generally stopping flying at lower wind speeds than bigger bats. The applicant is proposing to increase cut-in speeds during the months of May to September only (Further Information Response, August 2011).

MERLIN avian radar system

Although not specifically offered as mitigation for bats in the EIS or Further Information Response, the manufacturers of the MERLIN system say that this system can be used to mitigate the risk of bat mortality at wind farms.

Note that the applicant also suggested the deployment of a 'bat scaring' radar device but this technology was shown to be ineffective and the measure has been abandoned by the applicant.

Applicant's approach to mitigation for Leisler's bat

In Appendix F of the Further Information Response for Phase I, the applicant states that increasing the cut-in speed "*is not suitable for Turbines 6, 9, 10, 12 and 14 due to moderate to high level Leisler's bat activity and relocation of these wind turbines to minimum distance* [of 50m] *from linear and foraging habitats is the best practice option in this case*".

However, in Appendix 7.2 of Chapter 7 of the EIS for Phase II, the applicant states that "*due to the high Leisler's bat activity at T**14** and T**17**, the buffer zone* [i.e. 50m separation between the turbines and a boundary feature] *is unlikely to reduce the impact of the turbine location on this bat species. This species flies in the open and not along hedgerows and treelines to the same extent as common and soprano pipistrelles*". The same document goes onto say that "*increasing the cut-in speed …..is not suitable for Turbines 16, 8, **14**, 15, **17**, 18 and 19 due to high level of bat activity and relocation of these wind turbines to minimum distance from linear and foraging habitats is the best practice option in this case"*. Emphasis added in both cases.

In the 2013 bat report for Phases I and II, the recommendation (for Phase II?) is for relocating turbines with a potential major or moderate negative impact on bats to the a minimum distance of 50m from field boundaries and "*increasing the cut-in speed to 5.5 to 6 m/s from 30 minutes prior to dusk and* [until?] *30 minutes after dawn*".

This is something of confused and contradictory picture.

The foraging ecology of Leisler's bat

Leisler's bat is a large bat which behaves somewhat differently to the smaller bats such as the common pipistrelle. Firstly, it typically commutes directly from its roost to its foraging areas (which can be up to 13.4km distant) rather than along field boundaries. Secondly, it flies at high speed, up to 11ms^{-1}, and up to 100m AGL. Thirdly, it forages in open habitats such as pasture. These factors help to make this species one of the main victims of collisions with wind turbines.

There is limited data available on the wind speeds which this species will tolerate however there is data available for the closely related noctule bat which is a similar size and exhibits similar behaviour. The noctule bat has been observed flying at wind speeds of more than 8ms^{-1}, however it appears that 95% of the population will have stopped flying at this wind speed, about 90% of the population will have stopped flying at a wind speed of 6.5ms^{-1} and about 80% at 5.5ms^{-1} (Jones, Cooper-Bohannon, Barlow, & Parsons, 2009). The smaller bat species generally reduce their flight activity at lower wind speeds than the noctule.

Leisler's bats have a powerful echolocation system which can be detected up to 100m away from the bat. This may mean that some of the records for Leisler's bat made by the applicant were some distance from the location of the bat detector.

Potential to mitigate

It seems that relocating turbines or field boundaries to achieve a minimum separation distance of 50m (or 55m) would not be an effective mitigation measure for Leisler's bat. However, it remains an important measure for the other species of bat found on the Phase I site.

If relocation of turbines is to form part of the strategy for Leisler's bat, it would first be necessary to undertake further survey to determine the roost sites, main foraging areas and commuting routes of the bats. The turbines would then need to be located away from these key areas and routes in order to reduce the risk of collision for Leisler's bats. This has not been put forward as a potential mitigation measure by the applicant.

Increasing the cut-in speed would appear to be an effective measure for Leisler's bat however the cut-in speed proposed by the applicant may not be high enough to achieve the desired reduction in mortality. There is more than likely a diminishing rate of reduction in bat mortality as cut-in speeds increase above 5.5ms^{-1}. However, a cut-in speed of 6.5 - 8ms^{-1} may be necessary to reduce mortality of Leisler's bat to negligible levels. The appropriate cut-in speed, above a set minimum level, could potentially be determined by monitoring at the wind farm post-construction.

It may also be worth exploring varying the cut-in speeds through the night with the highest cut-in speeds at times when Leisler's bat is most likely to be active in a given area and lower cut-in speeds at times when Leisler's bat is less likely to be present. These times would vary from place to place and through the year due to changes in daylight and also the behaviour of the bats (Shiel, Shiel, & Fairley, 1999). Therefore any attempt to mitigate with variable cut-in speeds would need to be based on more data than is available currently.

There is of course no need to increase the cut-in speeds at times when bats are inactive or exhibit low levels of activity. For example, increasing cut-in speeds should not be necessary when temperatures are below 6^{o}C at night, which is likely to be the case from mid-November to mid-March, and when it is raining heavily, in any month of the year. The applicant is not proposing to increase cut-in speeds in the months of March, April, October and November. This could expose bats to higher levels of risk during these months should warm weather occur.