Chapter 8:
Landscape & Visual Assessment

8.1 Introduction

8.1.1 Overview

This chapter describes the landscape context of the proposed development and assesses the likely landscape and visual impacts of the scheme on the receiving environment. Although linked, landscape and visual impacts are assessed separately and in sequential order as the effects to the physical landscape and landscape character resulting from the development form the baseline of the assessment of visual impacts from key receptors.

Landscape Impact Assessment (LIA) relates to changes in the physical landscape, brought about by the proposed development, which may alter its character and how this is experienced. This requires a detailed analysis of the individual elements and characteristics of a landscape that go together make up the overall landscape character of that area. By understanding the aspects that contribute to landscape character it is possible to make judgements in relation to its quality (integrity) and to identify key sensitivities. This, in turn, provides a measure of the ability of the landscape in question to accommodate the type and scale of change associated with the proposed development, without causing unacceptable adverse changes to its character.

Visual Impact Assessment (VIA) relates to changes in the composition of views as a result of changes to the landscape, how these are perceived and the effects on visual amenity. Such impacts are measured on the basis of:

- *Visual Obstruction* (blocking of a view, be it full, partial or intermittent) or;
- *Visual Intrusion* (interruption of a view without blocking).

This assessment report was prepared by Art McCormack and Richard Barker, both Senior Landscape Architect, MosArt Landscape Architects, Wicklow. MosArt have extensive experience at both project level and strategic planning for wind farms in Ireland. A summary of relevant experience is included below:

- Assisted the Department of Environment, Heritage and Local Government (DoEHLG) in drafting the Landscape Section of the revised Wind Energy Development Guidelines (2006);
- Responsible for the landscape section of the national attitude survey to wind farms commissioned by Sustainable Energy Ireland (2003);
- Drafted the DoEHLG Landscape and Landscape Assessment Guidelines (2000);
- Completed a wind farm strategy for Waterford County Council (2004);
- Landscape character and sensitivity classification of County Cork for wind farm planning for Cork County Council (2003);
- Involved in landscape impact assessment of over 100 on-shore wind farm projects;
- Prepared the landscape impact assessment reports for the Arklow Bank, Codling Bank and Oriel offshore wind farm projects;
- Presented papers at numerous national conferences concerning landscape assessment for strategic planning and also for the planning and design of wind farms.

8.1.2 Guidelines

This landscape and visual impact assessment has been carried out with reference to:

- Environmental Protection Agency (EPA) publication 'Guidelines on the Information to be contained in Environmental Impact Statements (2002) and the accompanying Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2003).

- Landscape Institute and the Institute of Environmental Management and Assessment publication entitled Guidelines for Landscape and Visual Impact Assessment (2002);
- Scottish Natural Heritage (SHN) Environmental Assessment Handbook –Guidance on the Environmental Impact Assessment Process Appendix 1: Landscape and Visual Impact Assessment (2011):
- Department of Environment, Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines' (2006):
- Irish Wind Energy Association (IWEA) Best Practice Guidelines for the Irish Wind Energy Industry (2012).

8.1.3 Assessment of Significance

The EPA's Environmental Impact Statement guidelines (2002) provide a multidisciplinary classification of impact significance. A specific landscape and visual classification of significance is utilised in this assessment reflecting examples used in the Landscape Institute (UK) Guidelines for Landscape and Visual Impact Assessment (2002). Whilst the landscape and visual classification also contains a series of additional sub-categories, it accords with the EPA's overarching significance categories and terminology provided in **Table 8.1** below.

Profound Impact	An impact which obliterates sensitive characteristics
Slight Impact	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Moderate Impact	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Imperceptible Impact	An impact capable of measurement but without noticeable consequences

Table 8.1: EPA Impact Significance Categories (Multidisciplinary)

8.1.4 Assessment Methodology

Production of this Landscape and Visual Impact Assessment involved desktop studies and fieldwork comprising professional evaluation by landscape consultants. This entailed the following:

8.1.4.1 Desktop Study

- Establishing an appropriate Study Area from which to examine the landscape and visual impacts of the proposed wind farm;
- Review of a Zone of Theoretical Visibility (ZTV) map, which indicates areas from which the development is potentially visible in relation to terrain within the Study Area;
- Review of relevant County Development Plans, particularly with regard to landscape and scenic view/route designations;
- Selection of potential Viewshed Reference Points (VRP) from key receptors to be investigated during fieldwork for actual visibility and sensitivity;
- Preparation of an initial VRP selection map from which the visualisation consultant can prepare 'wireframe images' at each potential VRP location for use during fieldwork. Wireframe images depict the proposed wind farm within the context of a basic three dimensional view of the terrain as seen from each selected VRP location.

8.1.4.2 Fieldwork

- Recording of a description of the landscape elements and characteristics within the Study Area generally and within view from each VRP;
- Selection of a refined set of VRP's for assessment. This includes the capture of panoramic photography and grid reference coordinates for each VRP location for the visualisation specialist to prepare photomontages.

8.1.4.3 Assessment

- Description of the geographic location and landscape context of the proposed wind farm site;
- General landscape description concerning essential landscape character and salient features of the Study Area, discussed with respect to; landform and drainage; vegetation and land use; centres of population and houses; transport routes and; public amenities and facilities;
- Consideration of design guidance, the planning context and relevant landscape designations;
- Assessment of predicted landscape impacts;
- Assessment of predicted visual impacts using standard ZTV maps and cumulative ZTV maps as well photomontages prepared from selected VRP locations;
- Discussion of mitigation measures;
- Assessment of residual impacts following mitigation.

8.1.4.5 Definition of Study Area

The Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government specify different radii for examining the zone of theoretical visibility of proposed wind farm projects (ZTV). The extent of this search area is influenced by turbine height, on the basis that taller turbines would be visible at greater distances, as follows:

- 15km radius for blade tips up to 100m;
- 20km radius for blade tips greater than 100m.

In the case of this project, the blade tips are 136.5m high, thus, the 20km ZTV radius applies. This 20km radius also defines the extent of the Study Area for this project.

8.2 Description of the Existing Environment

8.2.1 Landscape Baseline

The landscape baseline represents the existing landscape context and is the scenario against which any changes to the landscape brought about by the proposal will be assessed. This also includes reference to any relevant landscape character appraisals and the current landscape policy context (both are generally contained within county development plans).

8.2.1.1 Description of Landscape Context

A description of the landscape context of the proposed development site and wider study area is provided below under the headings of landform and drainage, vegetation and land use, centres of population and houses, transport routes, public amenities and facilities and the site context. Although this description forms part of the landscape baseline many of the landscape elements identified also relate to visual receptors i.e. places and transport routes from which viewers can potentially see the proposed development.

8.2.1.2 Landform and Drainage

The study area is centred on the north-western portion of an upland area known as the Castlecomer Plateau, which is characterised by undulating hills of a similar height and defined by steep escarpments at its fringes. The Castlecomer Plateau extends throughout the south-eastern quarter of the study area and is flanked by lowlands in the north-eastern periphery and throughout the western half of the study area. The Slieveardagh Hills emerge in the south-western extents of the study area and extend in the same direction beyond the study area. Dissecting the lowlands on either side of the Castlecomer Plateau are the River Barrow to the east and River Nore to the west. Several Rivers spring from within this upland spine and the largest of these is the Dinin River, which runs southwards to merge with the River Nore at the southern limit of the study area.

Figure 8.1: Gently undulating, open landscape of the Castlecomer Plateau

8.2.1.3 Vegetation and Land Use

The lowland context is a highly fertile mixture of pasture and tillage with fields defined by mature broadleaf tree lines and hedgerows. Agricultural land uses extend into the upland areas in the form of more marginal grazing with scrubby hedgerow field boundaries. Extensive commercial conifer plantations emerge on higher slopes and throughout the Castlecomer Plateau. There are occasional small patches of woodland associated with demesne landscapes within the lowlands as well as narrow strips of riparian vegetation at the margins of streams and rivers. Otherwise, there is little naturalistic land cover within the study area.

Figure 8.2: Large field pattern, scrubby hedgerows and forest plantations of the site context

8.2.1.4 Centres of Population and Houses

The largest settlement within the study area is Portlaoise some 17km to the north of the proposal site. Other significant size settlements include Stradbally (16km northeast), Abbeyleix (8km northwest), Durrow (11km west-southwest), Ballyragget (12km southwest) and Castlecomer (8km southeast). The nearest settlement to the proposal site is Ballynakill, which is 4km to the west.

As well as the above, there are a number of cross road settlements throughout the study area. In close proximity to the site (<2km) there is a relatively low density of rural dwellings and farmsteads.

8.2.1.5 Transport Routes

The principal transport route within the study area is the new M7 motorway between Dublin and Cork/Limerick. This bypasses to the south of Portlaoise and skirts around the north-western perimeter of the study area. The section of the old N8 national route, which runs between Portlaoise and Durrow is now part of the N77 national secondary road linking to Kilkenny. The N77 is at its closest to the proposal site as it passes through Abbeyleix.

The N78 national secondary road passes through the Castlecomer Plateau in a south-westerly direction as it links between Athy and Kilkenny. It is 8km to the southwest of the proposal site at its nearest point. Running perpendicular to the N78 along the north-eastern base of the escarpment that defines the Castlecomer Plateau is the N80 national secondary road. The intersection of these roads and the nearest point of the N80 to the proposal site is 13km to the northeast.

In addition to the motorway and national roads described above, there are numerous regional roads crisscrossing the study area. The nearest of these to the proposal site is the R430, which is 1km to the north at its closest point and the R432, which passes through Ballinakill 4km to the west.

Figure 8.3: View towards the Castlcomer Plateau from the M7 motorway

8.2.1.6 Public Amenities and Heritage Features

There are a number of important heritage features within the study area and the most notable and most prominently located is the Rock of Dunamase. This elevated and natural defensive position was occupied by a fort as early as the 9th century and the castle (now in ruins) was built in the latter 12th century.

Castle Durrow is an early 17th century stately home, which is currently in use as a hotel and wedding venue. It is situated within the settlement of Durrow. Other heritage features of interest include Aghaboe Abbey (19km west of site) and the Tower of Timahoe (9km north of site).

8.2.2 Site Context

The site itself is located on a fairly flat section of ridgeline at the north-western edge of the Castlecomer Plateau. In terms of land use, it is contained in a mixture of pastoral farming and commercial conifer plantation along with small reverting scrub areas where forest harvesting has taken place.

8.2.2.1 Policy Context and Landscape Designations

The proposed development site is located primarily in County Laois, all 11 no. turbines intended to be within this jurisdiction. Some of the associated access tracks are located in County Kilkenny. Whilst the landscape related designations and policies of County Laois are, therefore, more critical, those in County Kilkenny will also be considered. County Carlow only extends into the south-eastern

periphery of the study area and County Kildare only extends into the north-eastern periphery. Thus, the landscape related designations and policies of the respective development plans are not considered relevant in this instance.

8.2.1.2 Laois County Development Plan 2011-2017

A Landscape Character Assessment has been prepared for County Laois and although this defines the characteristics and vulnerabilities of each landscape type it does not provide a sensitivity rating. The proposal site is located within the extensive 'Hills and Uplands' landscape character area occupying the southeast of the County.

A Wind Energy Strategy has also been prepared for County Laois which identifies three categories of acceptability regarding wind energy development; Preferred Areas; Areas Open for Consideration and; Areas Not for Consideration. The ridgeline containing the subject site is identified as being within a small 'Preferred Area' for wind energy development surrounded by a more extensive area of 'Open for Consideration' on lower slopes. It appears that the majority, if not all, of the proposed turbines are contained within the 'Preferred Area' zoning.

8.2.1.3 Kilkenny County Development Plan 2014-2020

The Kilkenny County Development Plan also includes a Landscape Character Assessment and associated policies for each character area. The character areas are described as Landscape Character Types (LCT's). The proposed site is in the 'Upland Areas' type. In determining the relative sensitivity of landscape units a range of landscape robustness and landscape sensitivity factors are weighed against each other. For the subject site the key sensitivity factor is its elevation above the 250m contour whilst the presence of commercial forest plantations may increase the visual absorption capacity or robustness of the landscape. Overall, the site context is considered to be a sensitive landscape area with relevant policy relating to siting and design of development.

A Wind Energy Strategy has been prepared for County Kilkenny which establishes areas that are 'Preferred, 'Open for Consideration' and 'Unsuitable' with regard to wind energy development. That part of the county closest to the proposed turbines does not lie within any of these three area classes (see Figure 10.2 of the Kilkenny CDP 2014-2020).

8.2.3 Visual Baseline

Given the generally prominent nature of commercial wind energy developments, visual impacts are an important issue. This relates both to the extent of visibility as well as the nature and degree of intrusion into views, particularly those of recognised scenic value. Only those parts of the study area that potentially afford views of the proposed wind farm are of concern to this part of the assessment. Therefore, the first part of the visual baseline is concerned with establishing a 'Zone of Theoretical Visibility' and subsequently identifying important visual receptors from which to base the visual impact assessment.

8.2.3.1 Zone of Theoretical Visibility (ZTV)

GES Ltd. carried out a computer automated study of the zone of theoretical visibility (ZTV). The purpose of this exercise is to identify the 'theoretical' extent and degree of visibility of turbines. This is a theoretical exercise because it is based on topography only at 10m contour intervals and does not allow for intermittent screening provided by, for example, hedgerows, forests or buildings and does not involve the actual height of crests (but using the nearest 10m contour below). Thus the ZTV map, assuming no screening, represents a worse than 'worse-case-scenario' with respect to viewing exposure. For the purposes of this project a radius of 20km was used for the ZTV as discussed earlier.

The following key points should be noted from the ZTV study:

- Theoretical visibility is strongly influenced by the edge of the Castlecomer Plateau with relatively extensive theoretical views extending to the edge of the study area from within the

lowland landscape to the north and west of the plateau perimeter where the proposal is located;

- Relatively consistent views are afforded from the upland landscape of the plateau in all directions within 5km of the site;
- Views from the northeast and south are screened by the crest of the plateau beyond 5km in these directions. This occurs due to the considerable separation distance between the proposal and the crest of the plateau in these directions;
- To the southeast theoretical visibility is consistent out to 10km from the site, but becomes more sporadic beyond this distance.

8.2.3.2 Views of Recognised Scenic Value

Views of recognised scenic value are primarily indicated within county development plans in the context of scenic views/routes designations, but they might also be indicated on touring maps, guide books, road side rest stops or on post cards that represent the area. In this instance there were no recognised scenic views encountered other than those contained within the relevant County Development Plans as set out below.

Table 14 and Map 1.13.4 of the Laois County development plan identify designated views and prospects. None are located in close proximity to the site and those that occur within the wider study area are oriented in the opposite direction to the site or they are outside of ZTV coverage.

Appendix H of the Kilkenny County Development Plan indicate *'views to be preserved and protected as well as areas of high amenity'*. There are two scenic routes shown in relatively close proximity to the proposed development site and although the viewing direction is indicated to be in the opposite direction, views are also afforded in the relevant direction. The two scenic routes are:

- V12 - Views overlooking Castlecomer and Ballyragget on the Castlecomer / Ballyragget Road R694 between its junctions with road nos. 1227 and 250m S.E. of road no. 1063;
- V19 - View west towards the Slieve Bloom Mountains on Road nos. 96 and 110 at the junctions with road nos. LS5839 and LS5846 (Ballymartin Cross Roads).

There are no relevant designated scenic views or scenic routes contained in either the Carlow or Kildare Development Plans.

8.2.4 Identification of Viewshed Reference Points as a Basis for Assessment

The results of the ZTV analysis provides the basis for selection of Viewshed Reference Points (VRP's), which are the locations used to study the landscape and visual impact of the proposed wind farm in detail. It is not warranted to include each and every location that provides a view of this development as this would result in an unwieldy report and make it extremely difficult to draw out the key impacts arising from the project. Instead, the assessors endeavoured to select a variety of location types that would provide views of the proposed wind farm from different distances, different angles and different contexts.

The visual impact of a proposed development is discussed using up to 6 categories of receptor type as listed below;

- Key Receptors - features of national or regional importance;
- Designated Scenic Routes and Views;
- Local Community views;
- Centres of Population;
- Major Routes;

- Amenity and heritage features.

Where a VRP might have been initially selected for more than one reason it will be assessed according to the primary criteria for which it was chosen. The characteristics of each receptor type vary as does the way in which the view is experienced. These are described below.

8.2.4.1 Key Receptors

These VRP's are at features or locations that are significant at the regional, national or even international level, typically in terms of heritage, recreation or tourism. They are locations that attract a significant number of viewers who are likely to be in a reflective or recreational frame of mind possibly increasing their appreciation of the landscape around them. The location of this receptor type is usually quite specific.

8.2.4.2 Designated Scenic Routes and Views

Due to their identification in the County Development Plan this type of VRP location represents a general policy consensus on locations of high scenic value within the Study Area. These are commonly elevated, long distance, panoramic views and may or may not be mapped from precise locations. They are more likely to be experienced by static viewers who seek out or stop to take in such vistas.

8.2.4.3 Local Community Views

This type of VRP represents those people that live and/or work in the locality of the wind farm, usually within a 5km radius of the site. Although the VRP's are generally located on local level roads they also represent similar views that may be available from adjacent houses. The precise location of this VRP type is not critical, however, clear elevated views are preferred, particularly when closely associated with a cluster of houses and representing their primary views. Coverage of a range of viewing angles using several VRP's is necessary in order to sample the spectrum of views that would be available from surrounding dwellings.

8.2.4.4 Centres of Population

VRP's are selected at centres of population primarily due to the number of viewers that are likely to experience that view. The relevance of the settlement is based on the significance of its size in terms of the Study Area or its proximity to the site. The VRP may be selected from any location within the public domain that provides a clear view either within the settlement or in close proximity to it.

8.2.4.5 Major Routes

These include national and regional level roads and rail lines and are relevant VRP locations due to the number of viewers potentially impacted by the proposed development. The precise location of this category of VRP is not critical and might be chosen anywhere along the route that provides clear views towards the proposal site, but with a preference towards close and/or elevated views. Major routes typically provide views experienced whilst in motion and these may be fleeting and intermittent depending on screening by intervening vegetation or buildings.

8.2.4.6 Amenity and Heritage Features

These views can be one and the same given that heritage locations are often important tourist and visitor destinations and amenity areas or walking routes are commonly designed to incorporate heritage features. Such locations or routes tend to be sensitive to development within the landscape as viewers are likely to be in a receptive frame of mind with respect to the landscape around them. The sensitivity of this type of visual receptor is strongly related to the number of visitors they might attract and, in the case of heritage features, whether these are discerning experts or lay tourists. Sensitivity is also heavily influenced by the experience of the viewer at a heritage site as distinct from simply the view of it. This is a complex phenomenon that is likely to be different for every site. Experiential considerations might relate to the sequential approach to a castle from the car park or the view from a hilltop monument reached after a demanding climb. It might also relate to the influence of

contemporary features within a key view and whether these detract from a sense of past times. It must also be noted that the sensitivity rating attributed to a heritage feature for the purposes of a landscape and visual assessment is not synonymous with its importance to the archaeological or architectural heritage record.

VRP No.	Location	Direction of view
DR1	Cromwells Road	NE
DR2	R694 3.5km west of Castlecomer	N
CP1	Ballyroan	SSE
CP2	Ballycolla	E
CP3	Ballinakill	E
CP4	Durrow	E
CP5	Clogh	NW
CP6	Castlecomer	NNW
MR1	M7 – R430 flyover	SE
MR2	M7 at Reid Cross Roads	E
MR3	N77 3km south of Durrow	ENE
MR4	N80 1km west of Stradbally	SSW
MR5	R426 2km north of Swan	W
MR6	N78 at Crettyard	NW
LC1	Local road 2.5km northwest of the proposal site	SE
LC2	R430 1km north of the proposal site	S
LC3	Local road 1.5km southwest of the proposal site	NE
LC4	Local road 2.5km southeast of the proposal site	NW
LC5	Local road 1.05km north of the proposal site	E
LC6	Local road 0.13km west of the proposal site	N
LC7	Local road 0.61km east of the proposal site	N+W
LC8	Local road 0.16km southwest of the proposal site	W+SE
LC9	Local road 0.32km southeast of the proposal site	S+E

Table 8.2: Outline Description of Selected Viewshed Reference Points

8.3 Description of Likely Impacts

8.3.1 Assessment Criteria

When assessing the potential impacts on the landscape resulting from a wind farm development, the following criteria are considered:

- landscape character, value and sensitivity;
- Magnitude of likely impacts;
- Significance of landscape effects.

The sensitivity of the landscape to change is the degree to which a particular landscape receptor (Landscape Character Area (LCA) or feature) can accommodate changes or new features without unacceptable detrimental effects to its essential characteristics. Landscape Value and Sensitivity is classified using the following criteria;

Sensitivity	*Description*
Very High	Areas where the landscape character exhibits a very low capacity for change in the form of development. Examples of which are high value landscapes, protected at an international or national level (World Heritage Site/National Park), where the principal management objectives are likely to be protection of the existing character.
High	Areas where the landscape character exhibits a low capacity for change in the form of development. Examples of which are high value landscapes, protected at a national or regional level (Area of Outstanding Natural Beauty), where the principal management objectives are likely to be considered conservation of the existing character.
Medium	Areas where the landscape character exhibits some capacity and scope for development. Examples of which are landscapes which have a designation of protection at a county level or at non-designated local level where there is evidence of local value and use
Low	Areas where the landscape character exhibits a higher capacity for change from development. Typically this would include lower value, non-designated landscapes that may also have some elements or features of recognisable quality, where landscape management objectives include, enhancement, repair and restoration.
Negligible	Areas of landscape character that include derelict, mining, industrial land or are part of the urban fringe where there would be a reasonable capacity to embrace change or the capacity to include the development proposals. Management objectives in such areas could be focused on change, creation of landscape improvements and/or restoration to realise a higher landscape value.

Table 8.3: Landscape Character, Value and Sensitivity

The magnitude of a predicted landscape impact is a product of the scale, extent or degree of change that is likely to be experienced as a result of the proposed development. The magnitude takes into account whether there is a direct physical impact resulting from the loss of landscape components, or a change that extends beyond the proposal site boundary that may have an effect on the landscape character of the area. The magnitude of landscape impacts is classified using the following criteria.

Magnitude of Impact	Description
Very High	Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
High	Change that would be more limited in extent and scale with the loss of important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
Medium	Changes that are modest in extent and scale involving the loss of landscape characteristics or elements that may also involve the introduction of new uncharacteristic elements or features that would lead to changes in landscape character, and quality.
Low	Changes affecting small areas of landscape character and quality, together with the loss of some less characteristic landscape elements or the addition of new features or elements.
Negligible	Changes affecting small or very restricted areas of landscape character. This may include the limited loss of some elements or the addition of some new features or elements that are characteristic of the existing landscape or are hardly perceivable.

Table 8.4: Magnitude of Landscape Impacts

**Note: This is an indicative structure and may at times need to be interpreted by the Landscape and Visual Consultant in order to qualify an ascribed result based on the specific conditions in an actual view.*

The significance of landscape impacts is based on a balance between the sensitivity of the landscape receptor and the magnitude of the impact. The significance of landscape impacts is arrived at using the following matrix:

	Sensitivity of Receptor				
Magnitude	**Very High**	**High**	**Medium**	**Low**	**Negligible**
Very High	Profound	Profound-significant	Substantial	Moderate	Slight
High	Profound-significant	Substantial	Substantial-moderate	Moderate-slight	Slight-imperceptible
Medium	Substantial	Substantial-moderate	Moderate	Slight	Imperceptible
Low	Moderate	Moderate-slight	Slight	Slight-imperceptible	Imperceptible
Negligible	Slight	Slight-imperceptible	Imperceptible	Imperceptible	Imperceptible

Table 8.5: Landscape Impact Significance Matrix

**Note: This is an indicative structure and may at times need to be interpreted by the Landscape and Visual Consultant in order to qualify an ascribed result based on the specific conditions in an actual view.*

**Note that potential beneficial landscape impacts are not accounted for in the tables and matrix above. This is on the basis that commercial scale wind energy projects are very unlikely to generate beneficial landscape impacts. In the rare instances that this might occur, perhaps by facilitating the rehabilitation of a degraded landscape, the benefits will be discussed in the assessment and the significance of impact would default to the lowest end of the range (negligible).*

8.3.2 Landscape Character, Value and Sensitivity

Effects on landscape character will be considered at both the localised scale of the site and its immediately surrounding landscape as well as the broader scale of the study area.

As described above, the landscape directly surrounding the site is that of rolling slopes in pastoral farming and commercial conifer plantations and small areas of reverting scrub. This is a productive rural area sparingly dotted with farmsteads and rural outbuildings. There is a strong degree of integrity to this landscape due to the small range of land uses and the consistent scale and pattern of fields, hedgerows and forest plantations. Notwithstanding, the landscape character is typical of well drained hilly farmland throughout the country and is not considered unique.

Within the wider study area there is a greater range of land uses and elements, which influence landscape character. The upland areas remain rural and are predominantly in pastoral farmland and with occasional forest plantations on higher slopes and ridges. Within the lowland valleys, fields of highly productive grassland and tillage are defined by mature tree lines and hedgerows with occasional patches of broadleaf woodland. Also contained within the lowland landscape are the more significantly sized settlements and major roads. Therefore, the lowland landscape has a greater intensity of strategic development and a more anthropogenic landscape character. Sites of rural industry such as the substantial scale Glanbia facility at Ballyragget also contribute to the sense of this being a highly productive rural landscape.

There currently is one other wind farms within the study area, namely, the 8 turbine Gortahile development located approximately 14km to the southeast. Whilst wind energy development is not an unfamiliar feature of the wider study area, it is not currently a characteristic feature. Given the separation distance, Gortahile wind farm is unlikely to influence the existing landscape character in the near vicinity of the proposal site.

On balance of the factors outlined above, the sensitivity of the receiving landscape is considered to be **low**.

8.3.3 Magnitude of Landscape Effects

The physical landscape as well as the character of the site and its immediate surrounds is affected by the proposed turbines as well as ancillary development such as access and circulation roads, areas of hard standing for the turbines, the permanent meteorological mast and the substation. By contrast, for the wider landscape of the study area, landscape impacts relate almost exclusively to the influence of the proposal on landscape character.

It is considered that the proposed wind farm development will have only a minor physical impact on landscape components within the site as none of the proposed development features (turbines, substation, anemometer mast, single circuit strain towers) have a significant 'footprint'. The topography of the site will remain largely unaltered with excavation being limited to establishment of access tracks and areas of hard standing for the turbines. Such excavation will tie into the existing ground levels and will be the minimum required for safe working. Any temporary stockpiles of material will be re-graded to marry into existing site levels. Similarly, the land cover of the site will only be interrupted as necessary to create tracks and areas of hard standing for the turbines. The

current mixture of low intensity land uses can continue below the wind turbines without significant disruption following the construction phase.

The principal landscape impact will be the change in character of the immediate area due to the introduction of large scale structures with moving components. The development will be a prominent landscape feature within the local landscape as would be the case for a commercial scale wind farm placed into almost any landscape context. This proposed development represents something of a new landscape element within the local landscape context, but not the wider landscape context of the study area. There is one existing wind farm within the study area at a distance ranging from 14km from the proposal site, which contributes to the landscape character to the southeast. Overall, it is not considered that the proposed wind farm will conflict with the character of this productive rural landscape and is consistent with emerging trends in such landscapes across the country.

A generally low level of site activity will occur during the operational phase of a wind farm development. Site activity will be at its greatest during the construction phase due to the operation of machinery on site and movement of heavy vehicles to and from site. This phase will have a more significant impact on the character of the site, but it is a temporary impact that will cease upon completion of the scheme (1-2 years). The intensity of site work during the construction phase is likely to be comparable to that of forest harvesting operations which take place periodically within the surrounding landscape.

It is important to note that in terms of duration, this wind farm proposal represents a long term, but not permanent impact on the landscape. The lifespan of the project is 25 years, after which time it will be dismantled and the landscape reinstated to prevailing conditions. In this respect a wind farm development has a fairly 'light footprint' on the landscape in comparison to a quarry or road development, for example. Within a couple of years of decommissioning there would be little evidence that a wind farm ever existed on the site.

In summary, the proposed development represents an increased intensity and scale of built development within the immediate landscape context. However, it does not represent an unfamiliar or unexpected form of development in this upland zone and is consistent with the productive qualities of this rural area. The landscape impact will be of a long term, but not permanent nature and will cease upon decommissioning of the development and restoration of the site with little to no enduring effects. On the basis of these reasons the magnitude of the landscape impact is considered to be **low**.

In accordance with the significance matrix (**Table 8.5**), a **low** sensitivity judgement coupled with an impact magnitude of **low** results in a **slight-imperceptible** significance of landscape impact.

8.3.4 Predicted Visual Impacts

Assessment of the visual impact of the proposed development involves consideration of visual receptor sensitivity and then the visual magnitude of the proposal as viewed from each VRP. These are then used together in order to determine the Significance of Visual Impact.

8.3.4.1 Visual Receptor Sensitivity

Visual receptors are human beings whose susceptibility to changes in views and visual amenity is dependent on their occupation or activity at the time of viewing i.e. hill walkers, dwelling occupants, commuters etc. However, this is only one aspect for determining visual receptor sensitivity, the other being the value associated with the particular view on offer. The value of a view may be estimated from, for example, Development Plan designations or highlighted in maps, guidebooks or literary references. Alternatively it may be implied by the clustering and orientation of dwellings or the provision of recreational infrastructure such as picnic benches. This two-sided approach, involving Receptor Susceptibility and Receptor Value, to determining Visual Receptor Sensitivity is presented in **Table 8.6** below.

VRP No.	Location	Direction of view
DR1	Travellers on recognised scenic route	High/medium
DR2	Travellers on recognised scenic route	High/medium
CP1	Community where views do not contribute appreciably to the amenity of residents	Medium/low
CP2	Community where views do not contribute appreciably to the amenity of residents	Medium/low
CP3	Community where views play a modest part in the amenity of residents Local residents at home	High/medium
CP4	Community where views do not contribute appreciably to the amenity of residents	Medium/low
CP5	Community where views do not contribute appreciably to the amenity of residents	Medium/low
CP6	Community where views do not contribute appreciably to the amenity of residents	Medium/low
MR1	Travellers on a Regional Road that does not have (R430)	Medium/low
MR2	Travellers on a Third Class Road contiguous to R433	Medium/low
MR3	Travellers on a major transport route that does not have (N77)	Medium/low
MR4	Travellers on a major transport route that does not have (N80)	Medium/low
MR5	Travellers on a Regional Road that does not have (R426)	Medium/low
MR6	Travellers on a major transport route that does not have (N78)	Medium/low
LC1	Local residents at home	High
LC2	Local residents at home	High
LC3	Local residents at home	High
LC4	Local residents at home	High
LC5	Local residents at home	High
LC6	Local residents at home	High
LC7	Local residents at home	High
LC8	Local residents at home	High

LC9	Local residents at home	High
LC10	Local residents at home	High

Table 8.6: Analysis of Visual Receptor Susceptibility at Viewshed Reference Points

8.3.4.2 Sensitivity of Visual Receptors

Unlike landscape sensitivity, the sensitivity of visual receptors has an anthropocentric basis. It considers factors such as the landscape context of the viewer, the likely activity they are engaged in and whether this heightens their awareness of the surrounding landscape. A list of the factors considered by MosArt in estimating the level of sensitivity for a particular visual receptor is outlined below and used in **Table 8.7** to establish visual receptor sensitivity at each VRP:

- **Recognised scenic value of the view** (County Development Plan designations, guidebooks, touring maps, postcards etc). These represent a consensus in terms of which scenic views and routes within an area are strongly valued by the population because in the case of County Developments Plans, at least, a public consultation process is required;
- **Views from within highly sensitive landscape areas**. Again, highly sensitive landscape designations are usually part of a county's Landscape Character Assessment, which is then incorporated with the County Development Plan and is therefore subject to the public consultation process. Viewers within such areas are likely to be highly attuned to the landscape around them;
- **Primary views from dwellings**. A proposed development might be seen from anywhere within a particular residential property with varying degrees of sensitivity. Therefore, this category is reserved for those instances in which the design of dwellings or housing estates, has been influenced by the desire to take in a particular view. This might involve the use of a slope or the specific orientation of a house and/or its internal social rooms and exterior spaces;
- **Intensity of use, popularity**. This relates to the number of viewers likely to experience a view on a regular basis and whether this is significant at a county or regional scale;
- **Viewer Engagement with the landscape**. This considers whether or not receptors are likely to be highly attuned to views of the landscape i.e. commuters hurriedly driving on busy national route versus hill walkers directly engaged with the landscape enjoying changing sequential views over it;
- **Provision of elevated panoramic views**. This relates to the extent of the view on offer and the tendency for receptors to become more receptive to the surrounding landscape at locations that afford broad vistas;
- **Sense of remoteness and/or tranquillity.** Receptors taking in a remote and tranquil scene, which is likely to be fairly static, are likely to be more receptive to changes in the view than those taking in the view of a busy street scene, for example;
- **Degree of perceived naturalness**. Where a view is valued for the sense of naturalness of the surrounding landscape it is likely to be highly sensitive to visual intrusion by distinctly manmade features;
- **Presence of striking or noteworthy features.** A view might be strongly valued because it contains a distinctive and memorable landscape feature such as a promontory headland, lough or castle:

- **Historical, cultural and / or spiritual significance.** Such attributes may be evident or sensed by receptors at certain viewing locations, which may attract visitors for the purposes of contemplation or reflection heightening the sense of their surroundings;
- **Rarity or uniqueness of the view.** This might include the noteworthy representativeness of a certain landscape type and considers whether the receptor could take in similar views anywhere in the broader region or the country;
- **Integrity of the landscape character.** This looks at the condition and intactness of the landscape in view and whether the landscape pattern is a regular one of few strongly related components or an irregular one containing a variety of disparate components;
- **Sense of place.** This considers whether there is special sense of wholeness and harmony at the viewing location;
- **Sense of awe.** This considers whether the view inspires an overwhelming sense of scale or the power of nature.

Those locations which are deemed to satisfy many of the above criteria are likely to be in the higher order of magnitude in terms of sensitivity and vice versa. No relative importance is inferred by the order of listing in **Table 8.7** below. Overall sensitivity may be a result of a number of these factors or, alternatively, a strong association with one or two in particular.

8.3.4.3 Analysis of Visual Receptor Sensitivity at Viewshed Reference Points

Strong value	Moderate value	Mild value	Negligible value

	DR1	DR2	CP1	CP2	CP3	CP4	CP5	CP6	MR1	MR2	MR3	MR4	MR5	MR6	LC1	LC2	LC3	LC4	LC5	LC6	LC7	LC8	LC9
Visual Receptor Susceptibility to Change	H/M	H/M	M/L	M/L	H/M	M/L	M/L	M/L	M/L	M/L	M/L	M/L	M/L	M/L	H	H	H	H	H	H	H	H	H
Visual Receptor Value																							
Recognised scenic value of the view																							
Views from within highly sensitive landscape areas																							
Intensity of use, popularity (number of viewers)																							
Primary views from residences																							
Provision of vast, elevated panoramic views																							

Sense of remoteness / tranquillity at the viewing location																						
Perceived naturalness																						
Presence of striking or noteworthy features																						
Sense of historical, cultural and / or spiritual significance																						
Rarity or uniqueness of the view																						
Integrity of the landscape character within the view																						
Sense of place at the viewing location																						
Sense of awe																						
Value of view	M	M	M	M	M	M	M	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Overall Visual Sensitivity *(receptor susceptibility vs view value)*	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**

Table 8.7: Scale of Receptor Value

Notes: N=negligible; **L**=low sensitivity; **M**=medium sensitivity; **H**=high sensitivity; **VH**=very high sensitivity.

8.3.4.3 Visual Impact Magnitude

The magnitude of visual effects is determined on the basis of two factors, namely, the visual presence of the proposal and its effect on visual amenity.

Visual presence is something of a quantitative measure relating to how noticeable or visually dominant the proposal is within a particular view. This is based on a number of aspects beyond simply scale in relation to distance. Some of these include the extent of the view as well as its complexity and the degree of movement experienced i.e. within a busy street scene. The backdrop against which the development is presented and its relationship with other focal points or prominent features within the view is also considered. Visual presence is essentially a measure of the relative visual dominance of the proposal within the available vista and is expressed as such i.e. minimal, sub-dominant, co-dominant,

dominant or highly dominant. For wind energy developments a strong visual presence is not necessarily synonymous with adverse impact as might be the case for a factory, a road or electricity pylons, for which the general consensus is likely to be almost wholly negative. Instead, the 2003 SEI funded survey of *'Attitudes Towards the Development of Wind Farms in Ireland'* found that *"wind farms are seen in a positive light compared to other utility-type structures that could be built on the landscape"*. Furthermore, a clear and comprehensive view of a wind farm might be preferable in many instances to a partial and confusing view of turbine components that are not so noticeable within a view.

The visual amenity aspect of assessing impact magnitude is qualitative, considering such factors as the spatial arrangement of turbines both within the scheme and compositionally in relation to surrounding terrain and land cover. It also examines whether the development contributes positively to the existing qualities of the vista or results in distracting visual effects and disharmony.

It should be noted that as a result of this two-sided analysis, a high order visual presence can be moderated by a low level of effect on visual amenity and vice versa. Given that wind turbines do not comprise significant bulk, visual impacts result almost entirely from visual 'intrusion' rather than visual 'obstruction' (the blocking of a view). The magnitude of visual impacts is classified in the **Table 8.8**.

Criteria	Description
Very High	The proposal intrudes into a large proportion or critical part of the available vista and is without question the most noticeable element. A high degree of visual clutter or disharmony is also generated, strongly reducing the visual amenity of the scene
High	The proposal intrudes into a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual clutter or disharmony is also likely to be generated, appreciably reducing the visual amenity of the scene
Medium	The proposal represents a moderate intrusion into the available vista, is a readily noticeable element and/or it may generate a degree of visual clutter or disharmony, thereby reducing the visual amenity of the scene. Alternatively, it may represent a balance of higher and lower order estimates in relation to visual presence and visual amenity
Low	The proposal intrudes to a minor extent into the available vista and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene
Negligible	The proposal would be barely discernible within the available vista and/or it would not detract from, and may even enhance, the visual amenity of the scene

Table 8.8: Magnitude of Visual Impact

The Planning Authority requested in 2015 that the LVIA include an assessment involving a double set of photomontages, one where turbines depicted with full frontal blade sets (perpendicular to the line of view) and the other where blade sets are seen to the side (aligned with the axis of viewing). Having examined each pair of photomontages, this landscape expert has made the following comparative evaluation.

The visual benefit of the full frontal is that the turbines are being viewed more completely in respect of peoples' image-based expectation and are more comprehensible functionally and aesthetically. This may, thus, improve the aesthetic relationship of the turbines to the landscape. However, blade sets must be considered in rotation and may be seen cutting the skyline and/or overlapping, possibly resulting in visual irritation and clutter. By comparison, in the case of the side view of the blade sets, whilst involving the full height of the turbines (tower and blade combined), there will be a tapering of the shaft with ascent. Also, where turbines overlap, there is much less likelihood of visual clutter or

irritation as the blade sets are not seen in rotation cutting against the skyline. However, the nacelle appears slightly awkward at the head of the shaft, without an actual function in relation to the blade set and eccentrically located.

This is certainly a useful methodological exploration but it can be reasonably argued that it does not necessarily add value to the LVIA as a critical assessment of possible impacts of the proposed wind farm, but rather complication. The reality in the field is that turbines are viewed in perspective and the more arced the view in plan, the more likely are turbines will be seen from different angles, i.e. partially frontal/partially side view. The closer the viewer is to the turbines, the more likely it is to be read in this way. Moreover, most viewers are likely to be in transit and, thus, experience continuing change in perspective obviating a pure frontal or side view. On balance, the conventional full frontal representation of turbines would probably prove the more critical basis for the visual assessment.

Commercial coniferous forest plantations are prevalent on the Castlecomer Plateau. The visual assessment using photomontages included in this LVIA study that involve such forestry focus on existing views but also indicate the effects where these forests are cleared. It must be emphasised that grant aided forests have traditionally be required under law to be replanted and, thus, it would seem that under normal circumstances forest cover will be a feature of the anticipated life of the proposed wind farm.

8.3.4.4 Visual Impact Significance

As stated above, the significance of visual impacts is a function of visual receptor sensitivity and visual impact magnitude. This relationship is expressed in the following significance matrix **(Table 8.9)**:

	Sensitivity of Receptor				
Magnitude	**Very High**	**High**	**Medium**	**Low**	**Negligible**
Very High	Profound	Profound-significant	Substantial	Moderate	Slight
High	Profound-significant	Substantial	Substantial-moderate	Moderate-slight	Slight-imperceptible
Medium	Substantial	Substantial-moderate	Moderate	Slight	Imperceptible
Low	Moderate	Moderate-slight	Slight	Slight-imperceptible	Imperceptible
Negligible	Slight	Slight-imperceptible	Imperceptible	Imperceptible	Imperceptible

Table 8.9: Visual Impact Significance Matrix

**Note: This is an indicative structure and may at times need to be interpreted by the Landscape and Visual Consultant in order to qualify an ascribed result based on the specific conditions in an actual view.*

8.3.4.5 Estimation of Visual Impacts at VRPs

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine nacelles visible:
DR1	Cromwells Road	NE	4.59km	11

Representative of:	A designated scenic view/route
Receptor Sensitivity	**Medium**
Existing View	This is an elevated panoramic vista over rolling farmland with intermittent blocks of commercial conifer forest. Hedgerows tend to be of a scrubby nature providing little visual containment. There are few landscape elements and the resultant rural pattern has a high degree of integrity. Whilst there is a sense of remoteness there is little sense of the naturalistic within this anthropogenic landscape.
Visual Impact of Pinewoods Wind Farm	The proposed turbines are a prominent feature of the view and stand out as a distinctive element within the somewhat homogenous landscape pattern. In this broad open vista, the turbines are seen at a reasonable scale from this distance relative to context and are revealed to slightly differing degrees depending on whether they occur on the near or far side of the skyline ridge. In terms of visual presence, the proposal as viewed from here is deemed co-dominant. Aesthetically speaking, the blades sets are seen in silhouette against the sky such that the wind farm is seen in a clear and comprehensible manner. There is a minor degree of overlapping and visual stacking between several of the turbines in perspective. Thematically, the turbines do not appear out of place in this upland vista across a productive rural landscape. Due to the factors of visual presence and amenity outlined above the magnitude of the visual impact is deemed to be **medium.**
Summary	Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
DR2	R694 3.5km west of Castlecomer	N	6.53km	11

Representative of:	A designated scenic view/route
Receptor Sensitivity	**Medium**
Existing View	This is a vast elevated view from within the heart of Castlecomer Plateau. The vista contains gently rolling farmland and commercial forest plantations. Due to the plateau landscape and the low level of the scrubby hedgerows, the spatial character of the view is broad and open. A telecommunications mast is visible on

the ridgetop.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are seen at a modest but noticeable scale from this distance. As structures, they are a relatively distinctive feature in this landscape context, yet they nestle in between raised ground with conifer plantations to the right and higher ground also with conifer plantations to the left. Accordingly, they are deemed sub-dominant.

The turbines are viewed in silhouette above the skyline with the blade sets of two pairs of turbines overlapping that come close to visual stacking and three blade sets close to the skyline. These engender only a modicum of visual irritation due to the distance. The wind farm is generally seen in an unambiguous manner in approximate clusters along the ridge. Nevertheless, they read as a coherent development. The flanking ridges, noted above, create a subtle containment and accommodation of the proposed development in terms of overall composition of form.

On the basis of the reasons described above, the magnitude of the landscape impact is deemed to be **low**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Slight**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*		
CP1	Ballyroan			SSE	7.02km	11

Representative of:

- A settlement
- A recreational facility

Receptor Sensitivity

Medium

Existing View

This is an expansive view across the GAA grounds at Ballyroan. The landscape beyond is that of gently rolling pastoral fields and hedgerows. The southward vista is subtly contained by a series of low ridges of a similar height.

Visual Impact of Pinewoods Wind Farm

Approximately half of the proposed turbines are partially revealed above the skyline between sections of intervening ridge-top vegetation. The remainder are largely obscured by the same vegetation, with only blades being seen. At this distance the visible turbine components are perceived at a relatively noticeable scale. On balance, however, the proposal is considered to be sub-dominant.

Aesthetically speaking, the partial view of turbine components rotating within skyline vegetation may engender a modicum of ambiguity, although at this distance and given the urban context, this is not likely to be critical.

On balance of the above factors of visual presence and visual amenity, the magnitude of the visual impact is considered to be **low**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Slight**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
CP2	Ballycolla	E	12.89km	11

Representative of:

- A settlement
- A graveyard

Receptor Sensitivity

Medium

Existing View

This is a vast view over a broad and open landscape of farming and forestry cloaking gently undulating slopes. The foreground consists of a graveyard and there is some screening of the wider landscape by a hedgerow in the right hand foreground.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are all fully displayed in silhouette above the distant skyline ridge. At this considerable distance these structures are seen at a relatively small scale. Furthermore, atmospheric perspective (the fading of distant objects) and the low level of contrast against the sky will make them readily noticeable only in clear viewing conditions. The visual presence of the wind farm is, therefore, deemed sub-dominant.

In terms of visual amenity, the proposed turbines are randomly spaced with few instances of turbine overlap. The layout is a linear one with a gently undulating profile and these attributes reflect the underlying ridge. The proposal is also considered to be well assimilated into this anthropogenic, rural landscape setting.

Overall, the magnitude of the visual impact is considered to be **low** based on the factors outlined above.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Slight**

Viewshed Reference Point	*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*

CP3	Ballinakill	E	3.68km	11

Representative of:
- A settlement
- A recreational resource

Receptor Sensitivity **Medium**

Existing View This is a relatively contained view from a housing estate in Ballinakill. In the immediate foreground is a pond and amenity area for residents. This is enclosed by a woodland area on the opposite side of the water body which is also responsible for containing the vista at a short distance.

Visual Impact of Pinewoods Wind Farm The proposed turbines are clearly visible above the near wooded skyline and are seen at a relatively prominent scale from this distance. The lateral extent of the turbines also occupies a reasonable portion of the horizon in direct alignment with the pond which is the main focal point of this scene. Considering its proximity but also that fact that it is partially screened, the proposed wind farm is deemed co-dominant.

In terms of aesthetics the wind farm is relatively well presented with a linear layout and even profile that reflects the skyline. A minor degree of ambiguity occurs due to the complete screening of the landscape context within which the turbines are placed.

On balance of the considerations above the magnitude of the visual impact is deemed to be **medium**.

Summary Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
CP4	Durrow	E	11.01km	11

Representative of:
- A settlement

Receptor Sensitivity **Medium**

Existing View This is a westward view along the course of the Erkina River, which skirts the settlement of Durrow. Whist the ridge of the Castlecomer Plateau is intermittently visible from this bridge, mature river side trees in the foreground screen much of

the landscape beyond. Nonetheless, this location represents one of the only places with a potential view of the proposed wind farm from within the immediate vicinity of this settlement.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are visible standing on the skyline ridge, viewed along the road axis. Notwithstanding, at this distance of over 11km they are not particularly visually striking, especially as viewed from an urban context with its many and diverse elements. The visual presence of the scheme is considered to sub-dominant within this vista.

The wind farm is legible as an entity, without ambiguity due to partial exposure that can engender visual tension. A modicum of visual tension results from four turbines partially overlapping, although this is mitigated by the viewing distance. The proposed wind farm is consistent with the urban and productive character of this scene.

For the reasons outlined above the magnitude of the visual impact is deemed **low**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Slight**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
CP5	Clogh	NW	5.20km	11

Representative of:

- A settlement
- A graveyard (place of reflection)

Receptor Sensitivity

Medium

Existing View

This is an expansive view across the gently undulating plateau landscape of the central study area. As with CP2 the immediate context is a graveyard with farmland beyond. This consists of large pastoral fields with generally low scrubby hedgerows between.

Visual Impact of Pinewoods Wind Farm

Most of the proposed turbines are partially visible standing on the skyline ridge, whilst some flanking turbines are screened behind hedgerows. The array of headstones standing in and dominating the immediate foreground create a certain visual absorption capacity. On balance, the visual presence of the scheme

is considered to be sub-dominant.

Whilst the blade sets are mostly legible, a certain ambiguity is engendered due to partial screening of the shafts. Also, a modicum of visual tension results from two turbines partially overlapping, although it is negligible at this viewing distance. However, the proposed wind farm is consistent with the anthropogenic and productive character of this scene.

Based on the factors of visual presence and visual amenity described above, the magnitude of the visual impact is deemed to be **low**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Slight**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
CP6	Castlecomer	NNW	8.44km	11

Representative of:

- A settlement

Receptor Sensitivity

Medium

Existing View

The descending foreground of this vista is mostly screened by the roadside hedgerow, but in the distance a mosaic field pattern on the more distant slopes of the Castlcomer Plateau can be seen. The relatively extensive vista is then subtly contained by the gently undulating ridge that marks the edge of the plateau.

Visual Impact of Pinewoods Wind Farm

The proposed turbines will be faintly visible in silhouette above the distant skyline. Although the scheme represents a reasonable lateral extent along the ridge, the individual turbines are seen at a small scale from this distance. As a result, the visual presence of the development is deemed to be in the order of minimal to sub-dominant within this vista.

In terms of aesthetics, the proposed turbines are perceived to be arranged in a clustered linear layout. This is appropriate to both the linear nature of the underlying landform and informal land use pattern.

Overall the magnitude of the visual impact is deemed to be **low**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Slight**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
MR1	M7 – R430 flyover	SE	16.17km	11

Representative of:

- An intersection of major routes

Receptor Sensitivity

Low

Existing View

This is a slightly elevated and broadly panoramic vista over a flat lowland context. The foreground is dominated by the road infrastructure and embankments associated with the M7 motorway passing over the R430 regional road. Beyond lies a fertile landscape of pasture and tillage defined by mature hedgerows that become stacked in perspective forming a band of vegetation across the middle ground of the vista. The view is contained in the distance by the long, low profile of the Castlecomer Plateau ridgeline.

Visual Impact of Pinewoods Wind Farm

Due to their small perceived scale at this considerable distance and the effects of atmospheric perspective, the proposed turbines will be only faintly visible above the skyline ridge in clear viewing conditions. The lateral extent of the scheme is considerable, but in the context of the broad ridgeline and the overall extent of the vista the visual presence is deemed minimal.

In terms of visual amenity, the scheme is viewed in a linear arrangement along the ridgeline. The turbines are subtly closer in spacing towards the perimeters and more open around the centre, thus creating a balanced composition. Moreover, the correspondence of the wind farm array to a low rising ridge also engenders a compositional balance in the broader landscape context.

For the above reasons the magnitude of the visual impact is considered to be **negligible**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**

Low	Negligible	**Imperceptible**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
MR2	M7 at Reid Cross Roads	E	8.54km	11

Representative of:

- An intersection of major routes

Receptor Sensitivity

Low

Existing View

This vista is remarkably similar to that described in relation to MR1 above. The only minor distinction is the presence of a mature forest plantation at the right hand side of the near middle ground of the view which partially screens the Castlecomer Plateau ridgeline.

Visual Impact of Pinewoods Wind Farm

The view of the proposed wind farm is also very similar to that described for MR1, although the roads, fences and buildings in the foreground increase the visual absorption capacity of the landscape. Accordingly, the magnitude of the visual impact is also deemed **negligible**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Negligible	**Imperceptible**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
MR3	N77 3km south of Durrow	ENE	9.35km	11

Representative of:

- A national secondary route

Receptor Sensitivity

Low

Existing View

This is a slightly elevated vista towards the Castlcomer Plateau from the opposite side of the Nore River Valley. The foreground of this expansive view is occupied by a large tillage field with a patchwork of pastoral fields and forest blocks occurring on the slopes beyond. The ridgeline of the Castlecomer Plateau declines gently from right to left (south to north) across the view.

Visual Impact of Pinewoods Wind

The proposed scheme is seen to straddle the skyline ridge with some turbines fully revealed on the nearside and others partially screened on the far side. The

Farm

turbines are seen at a modest but noticeable scale from this distance and, although the lateral extent of the scheme is considerable, it occupies only a small portion of the visible ridge. As a result the proposal is considered to be sub-dominant in terms of visual presence.

Even though some of the turbines are partially screened, all of the blade sets rotate freely above the skyline ridge in a clear and comprehensible manner. Neveretheless, there are some minor instances of turbine overlap, some of which come close to visual stacking, but the undulating profile accords with the underlying ridge and also the viewing distance proves a mitigating factor. Thematically, the wind farm complements the productive nature of the rural landscape in view.

Overall, the magnitude of the visual impact is judged to be low.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Low	**Slight Imperceptible**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
MR4	N80 1km west of Stradbally	SSW	8.13km	11

Representative of:

- A national secondary road

Receptor Sensitivity

Low

Existing View

This is a vast vista from a slightly elevated section of the N80 just outside the settlement of Stradbally. The southerly vista takes in a landscape context of rolling lowland farmland contained in the distance by a series of low ridges. The most prominent feature of the view is a line of large electricity pylons and associated cables that emerge from the left (northeast) in close proximity to the viewer and diminish in scale as they cross the view to the right (southwest).

Visual Impact of Pinewoods Wind Farm

The proposed turbines will be faintly visible above a distant section of the skyline ridge. Due to the small perceived scale of the turbines and the effects of atmospheric perspective, they are likely to be a noticeable feature of the vista only in the clearest viewing conditions. Furthermore, the line of electricity pylons crossing the foreground create a substantial visual absorption capacity and tend to draw attention to themselves to a much greater degree. Consequently, the visual presence of the turbines is deemed minimal.

In its own right the proposed scheme is relatively well presented in a clustered linear arrangement above the distant skyline. However, the turbines will be seen between the electricity transmission wires and in close association with their supporting pylons when viewed in perspective. This tends to engender a degree of visual clutter that is ameliorated somewhat by the low order visual presence of

the wind farm.

On balance of the above reasons the magnitude of the visual impact is deemed to be **low**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Low	**Slight-imperceptible**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
MR5	R426 2km north of Swan	W	4.08km	11

Representative of:

- A regional road
- Local Community Views

Receptor Sensitivity

Low

Existing View

This is broadly open vista across the gently undulating plateau landscape of the central study area. The network of large fields supports marginal pasture and they are defined by low scrubby hedgerows. Conifer plantations are also prevalent in this vista. There is no distant containment to this vista beyond the edge of the plateau.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are perched on the edge of the plateau and are viewed in silhouette against the sky. At this distance the turbines are seen at a noticeable scale and will be a distinctive feature in the context of the fairly homogenous surrounding landscape pattern. On the basis of these reasons, the visual presence is deemed to be co-dominant.

There are three instances of turbine overlap with one instance of visual stacking and with the four centre-most turbines involving the blade sets crossing one another. These are not considered to be critical given the viewing distance and the likelihood of viewers travelling at speed along the road and so having varying views. The clustered linear arrangement and mildly undulating profile of the scheme accords with the underlying ridge and the informal network of fields in the foreground. Despite its near proximity, the proposal is not considered to dominate the scale of surrounding landscape elements and patterns.

Overall the magnitude of the visual impact is considered to be **medium**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**

Low	Medium	**Slight**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
MR6	N78 at Crettyard	NW	7.85km	11

Representative of:

- A national secondary road

Receptor Sensitivity

Low

Existing View

This is a panoramic vista towards the Caslecomer Plateau on the opposite side of the broad Dinin River Valley. The shallow valley is cloaked in a land cover of fields and hedgerows with some forest plantations on the opposing slopes.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are seen at a noticeable scale from this distance and will be a distinctive feature in this fairly homogenous landscape context. Within this broadly panoramic vista the scheme is considered to be co-dominant in terms of visual presence.

The turbines are seen in a comprehensible manner above the skyline ridge in loose linear arrangement that accords with the underlying terrain and land cover pattern. There is one instance of visual stacking of blade sets. The spacing of turbines relaxes slightly towards the middle and tightens at the peripheries, so creating a relatively balanced composition.

Overall the magnitude of the visual impact is considered to be **low.**

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Low	**Slight-imperceptible**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
LC1	Local road to the northwest of the proposal site	SE	2.54	11

Representative of:

- Views from local roads and dwellings to the northwest of the proposal

Receptor Sensitivity

Medium

Existing View

This is a relatively confined view across an upland valley. The land cover consists

of fields and mature hedgerows with patches of broadleaf woodland in the base of the valley. The pastoral fields on higher slopes and ridges are noticeably larger than those on lower slopes and the scrubby hedgerows that define them provide less enclosure.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are seen at a considerable scale from this distance and the scheme occupies a significant section of the opposing ridgeline. In this somewhat contained vista the turbines will be the most noticeable feature and thus, the visual presence is deemed to be dominant.

Although the scale of the turbines and the lateral extent of the development is considerable, there is little sense that the scheme conflicts with the elements of the surrounding terrain or landscape patterns in terms of scale. The turbines are seen in an unambiguous manner with blade sets rotating freely above the skyline and the undulating profile of the scheme compliments the rolling terrain. However, the turbines will increase the intensity of built development in this relatively undeveloped rural setting.

On balance of the above reasons the visual impact magnitude is deemed to be **high.**

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	High	**Substantial-moderate**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
LC2	R430 to the north of the proposal site	S	1.34km	8

Representative of:

- A regional road
- Views from local roads and dwellings to the north of the proposal

Receptor Sensitivity

Medium

Existing View

This is a relatively contained and slightly uphill view across the farmed landscape that surrounds the site. The foreground hedgerows on the lower slope tend to be more mature than the scrubby hedgerows nearer the skyline ridge. A band of woodland can also be seen to the right hand side of the depicted view.

Visual Impact of Pinewoods Wind Farm

The nearest of the proposed turbines is fully revealed above the skyline ridge, whereas the more distant turbines are fully or partially screened from view by the ridge and ridge-top vegetation. This is due to the alignment of the view with the linear arrangement of the scheme. Thus, the lateral extent of the scheme is perceived from here to be relatively limited. The visual presence of the proposal is deemed to be dominant.

The alignment of this view with the wind farm layout results in some visual ambiguity with all of the turbines overlapping each other and a couple of blade

sets rotating against the vegetated ridgeline. The scale differential between the nearest and furthest turbines produces some sense of perspective or depth separation of the turbines, which somewhat ameliorates the visual confusion caused by overlapping. Due to the screening of part of the development and its relatively modest lateral extent, the wind farm does not dominate the setting in terms of scale. Whilst the overall intensity of built development is perceived to increase, the turbines do not appear out of place in this productive rural setting.

For the reasons outlined above the magnitude of the visual impact is deemed to be **medium**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
LC3	Local road to the southwest of the proposal site	NE	2.03km	11

Representative of:

- Views from local roads and dwellings to the southwest of the proposal

Receptor Sensitivity

Medium

Existing View

This is a reasonably extensive view across the rolling upland plateau near the centre of the study area. The land cover consists of rough grazing and scrub in the foreground, fields hedgerows and patches of woodland across the middle ground and a mixture of farming and commercial forest plantations on the more distant slopes and ridgeline.

Visual Impact of Pinewoods Wind Farm

The proposed turbines are seen at a considerable scale from this short distance with varying degrees of exposure above the skyline ridge. The proposed wind farm will be the most distinctive singular feature in this landscape, which otherwise tends to be read as a rural pattern rather than individual elements. The turbines are perceived from this viewpoint as a compact group. In terms of visual presence the scheme is considered to be dominant within the vista.

Aesthetically, the turbines are presented to the viewer in an unambiguous manner in silhouette above the skyline. However, there are several instances of turbine overlap and blade sets cutting the skyline. From this angle and in such close proximity, the scheme is perceived to have a clustered rather than linear layout. This is not inappropriate in this undulating and informally patterned landscape.

Overall the magnitude of the visual impact is deemed **medium**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
LC4	Local road to the southeast of the proposal site	NW	2.41km	11

Representative of:

- Views from local roads and dwellings to the southeast of the proposal

Receptor Sensitivity

Medium

Existing View

The flat to mildly undulating landscape in this view is typical of the Castlecomer Plateau. So too is the combination of marginal and good quality pastures defined by hedgerows and patches of scrubby woodland. Conifer plantations are also prevalent within this view.

Visual Impact of Pinewoods Wind Farm

The lower portions of the turbines tend to be screened by intervening terrain and vegetation which serves to diminish their relative scale over what is a relatively short viewing distance. The scheme has a considerable lateral extent and occupies much of the visible skyline ridge. However, the three turbines comprising the left hand cluster are substantially screened, thus reducing the perceived width of the development. The two turbines furthest to the right come close to creating a visual stacking effect. In this context the proposal is considered to have a dominant visual presence.

The perceived layout of the scheme, which varies between loosely linear and tightly clustered, may cause some visual ambiguity. There are also several instances of blades rotating on the skyline. The scale of the development is not excessive in the context of the broad nature of the surrounding terrain and land cover patterns. The proposed wind farm also fits well with the anthropogenic rural character of the view.

For the above reasons the magnitude of the visual impact is deemed to be **medium**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine nacelles visible:
LC5	Local road to west of the proposal site	E	1.05km	10

Representative of:

- Views from local roads and dwellings to the west of the proposal

Receptor Sensitivity

Medium

Existing View

This area comprises an undulating landscape that is part of the Castlecomer Plateau. It comprises marginal and good quality pastures defined by hedgerows and patches of scrubby woodland.

Visual Impact of Pinewoods Wind Farm

The lower portions of the turbines tend to be screened by intervening hill-top terrain and vegetation which to some extent diminishes the perceived scale of the turbines. The scheme has a considerable lateral extent and occupies much of the visible skyline ridge. Given the relative proximity of turbines to viewer and their visual exposure, the proposal is considered to have a dominant visual presence.

The fact that turbines are only partially visible may engender some visual ambiguity, although the majority of blade sets are visible above the hill-top. Whilst there is some correspondence in scale between the development and the surrounding terrain and land cover patterns as well as thematically in terms of the anthropogenic rural character of the view, the turbines will increase the intensity of built development in this relatively undeveloped rural setting.

For the above reasons the magnitude of the visual impact is deemed to be **high.**

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine nacelles visible:
LC6	Local road to south of the proposal site	N	1.29km	11

Representative of:

- Views from local roads and dwellings to the south of the proposal

Receptor Sensitivity

Medium

Existing View

The location is typical of that part of the Castlecomer Plateau given to commercial forestry. Conifer plantations are also prevalent within this view.

Visual Impact of Pinewoods Wind Farm

The dense evergreen forests severely curtail visibility, effectively limiting it to the immediate foreground and along straight forest roads. On this basis and considering the viewing distance to the proposed wind farm, visual presence is deemed not to exist.

Should the forest be temporarily cleared, the visual presence would be deemed, at worst, minimal. Note that most commercial plantations are typically required under law to be re-planted.

Due to the obscuring of the proposed wind farm, the visual impact is rendered **negligible**.

Judging by the wireframe rendering, this is unlikely to be different in the event of the forest being temporarily cleared, as some vegetation will remain on the crest of the hill.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Negligible	**Imperceptible**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
LC7	Local road to east and south of the proposal site	N+W	0.61km	11

Representative of:

- Views from local roads and dwellings to the east and south of the proposal

Receptor Sensitivity

Medium

Existing View

The location is typical of that part of the Castlecomer Plateau given to commercial forestry. Conifer plantations are also prevalent within this view.

Visual Impact of Pinewoods Wind Farm

The lower portions of the turbines tend to be screened by intervening forest cover, leaving some blade sets visible. Whilst this screening tends to reduce the visual presence, the turbines are relatively close to the viewer. On balance, though, the proposal is considered to have a co-dominant visual presence.

This would change to dominant in the case of temporary forest clearance.

The fact that three, maybe, four, blade sets cut the skyline created by the forest block should not prove particularly problematic in this context of commercial forestry activity. The road type suggests little use other than for utilitarian purposes, such as farming or forestry.

For the above reasons the magnitude of the visual impact is deemed to be

medium.

This would change to high in the case of temporary forest clearance.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

Viewshed Reference Point		*Direction of View*	*Distance to nearest turbine:*	*Number of turbine nacelles visible:*
LC8	Local road to east and northeast of the proposal site	W+SW	0.16km	11

Representative of:

- Views from local roads and dwellings to the east and northeast of the proposal

Receptor Sensitivity

Medium

Existing View

The location is typical of that part of the Castlecomer Plateau given to both farming and commercial forestry. Conifer plantations and a sense of their commercial use are prevalent within this view. Fields, interspersed among the forest blocks, are used for pasture.

Visual Impact of Pinewoods Wind Farm

Some of the lower portions of the turbines are screened by intervening forest blocks. As viewed presently, the scheme is relatively contained. However, one turbine stands particularly close to the viewer and another (to the left) relatively close. Thus, the proposal is considered to have a highly-dominant visual presence.

Should the forest block be temporarily cleared, another turbine would be filly visible to the right of the view.

Although some visual ambiguity can result from the partial screening of some turbines, the scheme overall is comprehensible in perspective. There are also several instances of blade sets rotating on the skyline. In terms of functionality, there is a thematic relationship between the commercial landuse activities of this context, reflected by the strongly anthropogenic character involving commercial forestry, and that of the proposed development.

For the above reasons the magnitude of the visual impact is deemed to be **high**.

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	High	**Substantial-moderate**

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine nacelles visible:
LC9	Local road to west and north of the proposal site	S+E	0.32km	11

Representative of:

- Views from local roads and dwellings to the west and north of the proposal

Receptor Sensitivity

Medium

Existing View

The flat to mildly undulating landscape in this view is typical of the Castlecomer Plateau. So too is the combination of marginal and good quality pastures defined by hedgerows and patches of scrubby woodland. Conifer plantations are also prevalent within this view.

Visual Impact of Pinewoods Wind Farm

The lower portions of the turbines tend to be screened by intervening forest blocks. The proposed wind farm occupies much of the visible skyline ridge, with one turbine (no. 4) standing in relatively close proximity to the viewer. On balance, the proposal is considered to have a dominant visual presence.

The perceived layout of the scheme may cause some visual ambiguity due to the partial screening of turbines and variations in height. Most of the blade sets, however, are seen above the skyline. In general, the scale of the development is not excessive in the context of the broad nature of the surrounding terrain and land cover patterns. There is a certain thematically functional relationship between it and the utilitarian context involving both commercial forestry and agriculture.

Notwithstanding, the magnitude of the visual impact is deemed to be **high.**

Summary

Based on the assessment criteria and matrices outlined in section 8.9 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	High	**Substantial-moderate**

8.3.5 Cumulative Impacts

The Scottish Natural Heritage (SNH) Guidelines relating to the Cumulative Effects of Wind Farms (2005) identify that cumulative impacts on visual amenity consist of combined visibility and sequential effects.

'Combined visibility occurs where the observer is able to see two or more developments from one viewpoint. Combined visibility may either be in combination (where several wind farms are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various wind farms).

Sequential effects occur when the observer has to move to another viewpoint to see different developments. The occurrence of sequential effects may range from frequently sequential (the features

appear regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints) to occasionally sequential (long time lapses between appearances, because the observer is moving very slowly and / or there are large distances between the viewpoints.)'

Cumulative impacts of wind farms tend to be adverse rather than positive as they relate to the introduction of further moving manmade structures within a landscape and viewing context. Based on guidance contained within the SNH Guidelines relating to the Cumulative Effects of Wind Farms (2005) and the DoEHLG Wind Energy Guidelines (2006) cumulative impacts can be experienced in a variety of ways. In terms of landscape character, additional wind energy developments might contribute to an increasing sense of proliferation. A new wind farm might also contribute to a sense of being surrounded by turbines with little relief from the view of them. The term 'skylining' is used in the SNH Guidelines to describe the effect where *"an existing windfarm is already prominent on a skyline the introduction of additional structures along the horizon may result in development that is proportionally dominant. The proportion of developed to non-developed skyline is therefore an important landscape consideration"*.

In terms of visual amenity, there is a range of ways in which an additional wind farm might generate visual conflict and disharmony in relation to other wind energy developments. Some of the most common include visual tension caused by disparate extent, scale or layout of neighbouring developments. A sense of visual ambivalence might also be caused by adjacent developments traversing different landscape types. Turbines from a proposed wind farm that are seen stacked in perspective against the turbines of nearer or further developments tend to cause visual clutter and confusion. Such effects are exacerbated when, for example, the more distant turbines are larger than the nearer ones and the sense of distance is also distorted. **Table 8.10** below provides criteria for assessing the magnitude of cumulative impacts.

Magnitude of Impact	*Description*
Very High	The proposed wind farm will strongly contribute to wind energy development being the defining element of the surrounding landscape. It will strongly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. Strongly adverse visual effects will be generated by the proposed turbines in relation to other turbines.
High	The proposed wind farm will contribute significantly to wind energy development being a defining element of the surrounding landscape. It will contribute to a significant sense of wind farm proliferation and being surrounded by wind energy development. Significant adverse visual effects will be generated by the proposed turbines in relation to other turbines.
Medium	The proposed wind farm will contribute to wind energy development being a characteristic element of the surrounding landscape. It will contribute to a sense of wind farm accumulation and dissemination. Adverse visual effects might be generated by the proposed turbines in relation to other turbines.
Low	The proposed wind farm will be one of only a few wind farms in the surrounding area and will viewed in isolation from most receptors. It might contribute wind farm development becoming a familiar feature within the

	study area. The design characteristics of the proposed wind farm accord with other schemes within the surrounding landscape and adverse visual effects are not likely to occur in relation to these.
Negligible	The proposed wind farm will most often be viewed in isolation or occasionally in conjunction with other distant wind energy developments. Wind energy development will remain an uncommon landscape feature. No adverse visual effects will be generated by the proposed turbines in relation to other turbines.

Table 8.10: Magnitude of cumulative impact

8.3.5.1 Cumulative Baseline

There is one existing wind farm and two permitted wind farms within the study area. These are outlined in **Table 8.11** below.

Wind Farm	Status	No. of turbines	Location relative to proposal
Gortahile	Constructed	8	14km southeast
Kilcarrig	Consented	5	17km southeast
Lisdowney	Consented	4	17km southwest
Cullenagh	Consented	18	8km north

Table 8.11: Existing and permitted wind farms within the study area

**Note: A single turbine development at Knocklead, Timahoe is currently the subject of a planning application to Laois County Council (Register Reference 15/401).*

8.3.5.2 Department of Environment, Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines' (2006)

The DoEHLG guidelines provide direction on wind farm siting and design criteria for a number of different landscape types. This proposal site is considered to be contained within the 'Hilly and Flat Farmland' landscape type and the guidance with respect to cumulative impact in such areas is:

"It is important that wind energy development is never perceived to visually dominate. However, given that these landscapes comprise hedgerows and often hills, and that views across the landscape will likely be intermittent and partially obscured, visibility of two or more wind energy developments is usually acceptable".

8.3.5.3 Cumulative Zone of Theoretical Visibility

The resultant cumulative ZTV map indicates that;

- There is a vast array of visibility and intervisibility scenarios between the proposed development and the other existing and permitted wind farms due to the nature of the terrain and the wide dispersal of these schemes;
- The proposal would be extensively visible in combination with the consented Lisdowney Wind Farm from the northwest quadrant of the study area;
- The proposal is extensively visible in combination with the constructed Gortahile and consented Kilcarrig Wind Farms from the inner south-eastern quadrant of the study area;
- The proposal is extensively visible in combination with the consented Cullenagh Wind Farm from the inner core of the study area and over the north-western quadrant;

- Intervisibility between the proposal and the Lisdowney and Gortahile/Kilcarrig clusters tends to occur to the outer northwest, outer southwest and outer southeast portions of the study area. In reality atmospheric perspective (fading of distant objects as well as vegetative screening would heavily reduce the potential for intervisibility between these projects. Besides the northwestern quadrant in relation to Cullenagh, intervisibility is evident theoretically around the central portion of the study area.

Table 8:12 identifies the characteristics of the cumulative view of wind farms from each of the VRP's, based primarily upon the photomontages but also referring to mapped analyses in respect of the possibility of sequential views of different developments moving along contiguous roads.

VRP Ref.	*No. of other wind farms potentially in view*	*Nearer or further than proposal*	*Combined view (within a single viewing arc)*	*Succession view (within a series of viewing arcs from the same location)*	*Sequential view (view of different developments moving along a linear receptor)*
DR1	1	Further away	yes	-	yes
DR2	1	Further away	yes	-	yes
CP1	1	Nearer	yes	yes	-
CP2	2	Further away	yes	-	yes
CP3	2	Further away	yes	-	yes
CP4	1	Further away	yes	-	yes
CP5	1 negligible	Further away	yes	-	yes
CP6	1 negligible	Further away	yes	-	yes
MR1	2	Nearer	-	-	yes
MR2	1	Further away	yes	-	yes
MR3	1	Further away	yes	-	yes
MR4	1	Nearer	yes	-	yes
MR5	3	Further away	-	-	yes
MR6	1	Further away	yes	-	yes
LC1	1	Further away	-	-	yes
LC2	1	Further away	-	-	yes
LC3	1	Further away	yes	-	yes
LC4	1	Further away	-	-	yes
LC5	1	Further away	-	-	yes
LC6	1	Further away	-	-	yes
LC7	2	Further away	yes	-	yes

LC8	1	Further away	yes	-	yes
LC9	0	-	-	-	-

Table 8.12: Cumulative view of existing and consented wind farms from VRP's

8.3.5.3 Cumulative Impact Assessment

In all instances the wind farm schemes viewed are within a single viewing arc (maximum 90°). Notwithstanding, views also will be sequential, involving visual exposure of different wind farm developments as one moves along a linear receptor (roads contiguous to each VRP).

Given the considerable separation distance between the proposal site and the other existing and permitted wind farms within the study area, particularly those at Gorthahile, Kilcarricg and Lisdowney, there is likely to be relatively little intervisibility between them. A greater area of intervisibility is indicated in regard to the Cullenagh Wind Farm due to its closer location to the proposal. However, very few of the photomontages used in the above assessment of visual impacts incorporate a view of other permitted or constructed wind energy developments. Only Lisdowney is visible from LC7, but negligibly in theory and probably totally screened in reality, and Gortahile is visible from VRP's CP2 (only one turbine barely evident) and MR1 but, likewise, minimally due to distance and partial screening of intermediate vegetation. Moreover, these wind farms are well separate from the proposed development and, thus, does not engender a sense of proliferation. The exception to this is Gortahile from MR1 where it is theoretically visible as an extension of the proposal scheme but in reality is likely to be screened. These characteristics also generally obtain to the Cullenagh Wind Farm that theoretically is visible from eleven VRP's, as depicted on photomontages. This is certainly true for DR7, CP1, CP4, MR1, MR2, MR3, MR4, MR6, LC3, LC7 and LV8 where, not only distance minimises visibility, but intermediate elements often obscure the development (as in CP4, substantially obscured by vegetation, and MR4, substantially obscured by pylons or cables). While it is located on a ridge as seen in DR1, MR1 and MR2, it is set much further away from the viewer than the proposal scheme and also clearly separated, thus reducing the possibility of a perceived proliferation. In contrast, the view from DR2 depicts this wind farm as an extension of the proposal scheme, albeit much lower in profile due to greater distance and also partial obscuring by forest cover. In this instance, not only do distance and intervening vegetation minimise cumulative visual impact, but in so far as the Cullenagh scheme is visible, the spatial integration of the two wind farms also reduces the possibility of perceived proliferation.

It is considered that the current intensity and dispersal of constructed and consented wind energy development within the study area is such that it is not yet a characteristic landscape feature. Instead, wind energy development is only at a stage that allows new proposals such as this one to represent a familiar form of development. On the basis of these reasons, the additional cumulative impact represented by the proposed Pinewoods Wind Farm is deemed to be **Low**.

8.4 Mitigation & Monitoring Measures

Given the highly visible nature of commercial wind energy developments it is not generally feasible to screen them from view using on-site measures, as would be the primary form of mitigation for many other types of development. Instead, landscape and visual mitigation for wind farms must be incorporated into the early stage site selection and design phases. A principle consideration in this regard was the Department of Environment Heritage and Local Government's Wind Energy Development Guidelines (2006).

8.4.1 Department of Environment, Heritage and Local Government Wind Energy Development Guidelines (2006)

The Wind Energy Development Guidelines (2006) provide guidance on wind farm siting and design criteria for a number of different landscapes, including 'Hilly and Flat Farmland' similar to the context

for the proposed Pinewoods Wind Farm. Recommendations in the guidelines for this landscape type include the following:

- **Location** – "Although hilly and flat farmland type is usually not sensitive in terms of scenery, due regard must be given to houses, farmsteads and centres of population."

  "Location on ridges and plateaux is preferred..."

  "Elevated locations are also more likely to achieve optimum aesthetic effect."

- **Spatial extent** - "This can be expected to be quite limited in response to the scale of fields and such topographic features as hills and knolls"

- **Spacing** - "The optimum spacing pattern is likely to be regular, responding to field pattern...However ... a balance will have to be struck between adequate spacing to achieve operability and a correspondence to field pattern."

- **Layout** - "The optimum layout is linear, and staggered linear on ridges and hilltops but a clustered layout would also be appropriate on a hilltop"

- **Height** - "Turbines will tend not to be tall ... the more undulating the topography the greater the acceptability of an uneven profile."

The design of the proposed wind farm is in accordance with all of the design criteria outlined above except perhaps that relating to spatial extent as this is likely to be considered a medium sized wind farm. However, in this instance it should be noted that the scale of terrain and landscape features, particularly field and forestry patterns, is broad and can easily accommodate a wind farm of this size. For these reasons, the proposed wind farm is considered to comply with the Wind Energy Development Guidelines (2006).

A number of general mitigation measures are also included below:

- Matt non-reflective finishes will be used on all turbine components;
- Transmission lines between individual turbines and the substation will be placed underground;
- Counter rotation of blade sets will be avoided;
- The use of existing forest tracks will be maximised and the number and extent of new access tracks will be kept to a minimum and properly landscaped immediately following completion of works. Such landscaping will include reinstating original vegetation along verges and repairing any wheel ruts;
- Special care will be taken to preserve any features, which contribute to the landscape character of the study area. Any damage to existing hedgerows from transporting the turbines will be rectified;
- A high standard of design will be applied to all structures associated with the substation considering not only its function but also the aesthetic quality, in order to minimise any sense of intrusion. The proposed development will provide colour harmony and adequate screening of the substation using berms covered with scrub and ground vegetation in order to mitigate its impact.

8.4.2 Residual Impacts

Landscape and visual mitigation measures have been incorporated into the design of the scheme from its early stages. Therefore, the proposed wind farm presented as the subject of this application already incorporates any substantial landscape and visual mitigation measures. Unlike for many of the other EIS

topics, the residual impacts of the proposal are essentially the same as assessed in the predicted landscape and visual impacts section above.

8.5 Conclusion

A summary table is provided below, which collates the assessments of landscape and visual impacts. A discussion of the results is provided thereafter.

Landscape Impact		
Landscape Sensitivity	**Landscape Impact**	**Landscape impact Significance**
Low	Low	**Slight-imperceptible**

Visual Impact			
VRP	**Visual Receptor Sensitivity**	**Magnitude of Visual Impact**	**Visual Impact Significance**
DR1	Medium	Medium	**Moderate**
DR2	Medium	Low	**Slight**
CP1	Medium	Low	**Slight**
CP2	Medium	Low	**Slight**
CP3	Medium	Medium	**Moderate**
CP4	Medium	Low	**Slight**
CP5	Medium	Low	**Slight**
CP6	Medium	Low	**Slight**
MR1	Low	Negligible	**Imperceptible**
MR2	Low	Negligible	**Imperceptible**
MR3	Low	Low	**Slight-imperceptible**
MR4	Low	Low	**Slight-imperceptible**
MR5	Low	Medium	**Slight**
MR6	Low	Low	**Slight-imperceptible**
LC1	Medium	High	**Substantial-moderate**
LC2	Medium	Medium	**Moderate**
LC3	Medium	Medium	**Moderate**
LC4	Medium	Medium	**Moderate**
LC5	Medium	High	**Substantial-moderate**
LC6	Medium	Negligible	**Imperceptible**
LC7	Medium	Medium	**Moderate**
LC8	Medium	High	**Substantial-moderate**

LC9	Medium	High	**Substantial-moderate**
Cumulative Impact			**Low**

Table 8.13: Summary Impact Table

8.5.1 Landscape Impacts

The assessment of landscape impacts is based on a comparison of landscape sensitivity against the magnitude of effects on the physical landscape and on landscape character. In this instance the judgement of landscape sensitivity is low. Whilst this landscape has a relatively high integrity in terms of the uniformity of its component features and patterns, these are also fairly unexceptional. Overall, the site and wider study area are considered to have a productive rural landscape character that is relatively robust with respect to absorbing new development.

The magnitude of the landscape impact is also considered to be low on the basis that the proposed wind farm represents a new, but not unfamiliar feature in the immediate landscape context of the site and an emerging characteristic landscape feature within the wider study area. It is also considered that the proposed turbines will not conflict thematically with this productive rural landscape context. Indeed, Scheobel (2012 p31) considers that aesthetically, wind turbines can be a successful component in productive landscapes (such as this).

On the basis of the judgements relating to landscape sensitivity and the magnitude of the landscape impact, the significance of impact on the landscape is deemed 'Slight-imperceptible'.

8.5.2 Visual Impacts

Visual impacts were assessed on the basis of visual receptor sensitivity versus the magnitude of the visual impact. The magnitude itself is the function of the visual presence of the proposal and its effect on visual amenity. Visual impacts were assessed at 23 visual receptors throughout the study area.

As can be seen from the summary table above, visual receptor sensitivity does not vary widely and this reflects the uniform nature of the landscape contained within the study area. In this instance, there is correspondence between receptor type and result whereby those attributed medium are of the Major Route (MR) type and the remainder attributed the low sensitivity ratings, with no other judgements within the full possible range. The majority of VRP's afford broad panoramic views across a gently undulating plateau landscape of uniform ridge heights and shallow upland valleys. The landscape in view generally has a pleasant, but unexceptional rural character. From those locations where the patchwork field pattern can be readily discerned, there is something of a traditional pastoral aesthetic. However, there is not much evidence of receptors within the study area that afford potential views of the scheme from locations where the users are likely to be highly attuned to the landscape around them, such as tourists or hill walkers.

Notably, both relevant scenic routes (DR1 and DR2) are attributed only medium sensitivity ratings. It is considered that the value of these vistas relates directly to the vast nature of the view as opposed to any naturalistic or unique qualities, elements of the picturesque or some strong sense of place. Such views are sensitive to visual obstruction (blocking of the view) but not necessarily visual intrusion (an additional element within the view).

The magnitude of visual impacts ranges between Substantial-moderate and negligible, with the greater majority between Imperceptible or Slight-imperceptible (six VRP's) and Moderate (six VRP's). The viewing scenario for this development is relatively simple with the turbines almost always seen in silhouette above the skyline ridge, whether the view is from within the Castlecomer Plateau or the surrounding lowland landscape. As a result, the visual presence of the development is strongly related to viewing distance. Aesthetically, the simple viewing scenario also makes for an unambiguous view of the turbines. From most locations beyond about 3km the turbine layout is

perceived to be an informal linear one with a gently undulating profile that accords with the underlying ridge. A more clustered layout is perceived at closer proximity. This is also appropriate as the linearity of the ridge is less pronounced in the upland area surrounding the site and the informal arrangement of turbines compliments the less structured field patterns in this zone.

The only aesthetic issues for this wind farm proposal tend to be the occasional overlapping of turbines in perspective and blade sets of partially screened turbines rotating against the skyline in silhouette as well as the visual stacking of blade sets (eg. DR1, DR2, MR3, MR5, MR6 and LC4). Whilst these effects can lead to a sense of visual irritation as well as clutter and disharmony, they are relatively minor issues in this instance given the overriding, unambiguous legibility of the scheme an also because in relation to visual stacking the wind farm is viewed at considerable distance. Whilst some of the local views include cutting of the skyline, the majority of blade sets are clearly legible and the proximity turbines to viewer ensures that the spatial arrangement relative to one another in perspective and of the group as a whole are legible.

Thematically, the turbines compliment the productive rural character that prevails throughout most of this landscape, albeit with an increased intensity and scale of built development. This also obtains in the more heavily forested areas around the proposed wind farm and, thus, proves to some extent a mitigating factor in relation to local views.

The highest magnitude of visual impact is considered to be Substantial-moderate. This occurs at four of the VRP locations, all of which are local views within 5km of the proposal. However, at two of these locations, LC1 and LC5, the proposed development is presented in a legible manner, with all blade sets above the skyline and at the other two, LC8 and LC9, a thematic relationship of utility is established between the proposal and the prevalent commercial mono-culture forestry activity and agriculture. These locations are relatively remote, particularly the latter pair. The level of impact on local views is typically unavoidable with commercial scale wind energy developments, reflecting that the effects on visual amenity are fairly consistent throughout the study area and that the main differentiating factor is the visual presence of the scheme. The majority of these local views have been deemed to result in a dominant visual presence, with one, LC8, highly dominant but another deemed minimal due to substantial screening. As stated above, in this case this is principally a function of scale in relation to distance.

8.5.3 Cumulative Impact

There is only one existing wind farm within the study area and three others have planning permission. Two of these are more than 14km away from the proposal and thus, the contribution to cumulative effects of wind farms within the study area is deemed minimal. A fourth is closer and is seen, at least theoretically, in just less than half of the views. In general, however, its visibility is fairly minimal. The cumulative impact is, therefore, considered to be low. To a greater or lesser extent, the existing Gortahile Wind Farm provides visual precedent in an area that comprises a working farmland and where views are intermittent as one travels the roads. By and large, the generally open expansive landscapes as viewed from most of the VRO's have the capacity to visually accommodate a number of spatially contained wind farms.

8.5.4 Overall Significance of Impact

In terms of the significance of impact, the majority of judgements across all assessment categories are in the mid-to-lower order of magnitude (moderate to minor-negligible). At six locations that are either at or in very close proximity to the proposal the significance of the visual impact is judged to be moderate on the basis of a medium sensitivity rating coupled with a medium visual impact magnitude. For four other local views the visual impact is judged to be substantial-moderate. Whilst this represents the highest level of impact in this assessment, it is only just above the mid- order of magnitude in terms of the visual impact significance matrix. This reflects the robustness of this landscape and the views of it as well as the appropriate siting, scale and design of the proposed wind

farm. This assessment of landscape and visual robustness is consistent with the Wind Energy Strategy of the Laois County development plans, which identify this as a preferred area for wind energy development. Likewise, the design elements of the scheme are consistent with the DoEHLG Wind Energy Development Guidelines (2006).

On the basis of these reasons, it is considered that the proposed development represents an acceptable level of landscape and visual impact across the study area.

Landscape and Visual Statement

Response to Request for Further Information

Proposed Pinewoods Wind farm,

County Laois

By Macro Works

November 2016

Introduction

This statement has been prepared in response to a Request for Further information (RFI) issued by Laois County Council in respect of the proposed Pinewoods Wind Farm development - planning application (Ref: 16/260). Item no. 4 of this request relates to potential visual impacts and states;

> *"Whilst the planning Authority is satisfied with the scope and comprehensiveness of the landscape and visual Impact Assessment contained within the Environmental Impact Statement (EIS), it does not agree with the receptor sensitivity rating 'medium' given to the visual impact of the proposed development from view shed reference point, LC7, in Table 8.13 of the EIS, and has serious concerns in relation to the significance visual impact of turbines no. 6,8,9 and 10, on a number of dwellings on the L-78001 to the south east of the site in County Kilkenny, impacts that would be made even more acute if the forest area were felled or cleared into the future. The Planning Authority therefore requests that the applicant submit a response to this concern and consider the omission or relocation of a sufficient number of turbines to alleviate this issue."*

It is also noted that Kilkenny County Council has submitted comments in respect of the likely visual impact of the proposed development and how it complies with wind energy policy development policies across the county boundary within County Kilkenny. The submission by Kilkenny County Council and, in particular, their conclusion that that the area within County Kilkenny immediately adjacent to the proposed development would be sensitive to and will *"most likely suffer undue visual consequences arising from a grant of permission"* is also considered in the context of this response

Statement of Authority and Background

This Landscape and Visual RFI response statement has been prepared by Richard Barker, Principal Landscape Architect at Macro Works Ltd. Relevant experience includes the landscape and visual impact assessment of over 90 on-shore wind farm proposals throughout Ireland, including five Strategic Infrastructure Development (SID) projects. By way of background, I was involved in the baseline and fieldwork stages of a proposed development at this site several years prior to the current planning application submission whilst working for MosArt Landscape Architects, the project landscape and visual impact consultants. The landscape and visual impact assessment presented in Chapter 8 of the EIS was prepared by Art McCormack, Senior Landscape Architect at MosArt. Although I did not prepare the landscape and visual impact assessment for the proposed development, I am familiar with the site, the study area and the methodology used in the assessment. This response therefore represents an independent peer review of the landscape and visual impact assessment provided in Chapter 8 of the EIS. This approach, and the provision of an independent review, is considered to have significant merit in the context of the concerns expressed by the Planning Authority and Kilkenny County Council in respect of the potential visual impact of the proposed development and adds overall robustness to the assessments presented.

Response to Request Item no. 4

As the Planning Authority will be aware the location of the proposed development is in-line with the Planning Authority's identification of this area as a 'Preferred Area' and 'Areas Open for Consideration' for wind energy development in the adopted Wind Energy Strategy. A key criterion for these designations is a relatively low sensitivity to wind development. It is also noted that the Planning Authority are generally satisfied with the scope and comprehensiveness of the landscape and visual Impact Assessment contained within the EIS. Instead, the main issue raised in Item 4 of the RFI is specifically in relation to the view of the scheme from viewpoint LC7 and its immediate environs along the L-78001 local road. In this respect there are a number of interrelated sub-issues raised and these will be addressed in the following order;

1. 'Medium' sensitivity judgement of viewpoint LC7;
2. 'Significant visual impact' of turbines 6,8,9, and 10;
3. Additional visual impact if intervening forest were felled;
4. Potential omission or relocation of turbines.

The concern in relation to the 'Medium' sensitivity rating applied to viewpoint LC7 by MosArt, is presumably on the basis that it should be higher, which would in-turn generate a higher significance of impact at this receptor location. I also disagree with the 'medium' sensitivity judgement of LC7 contained in the EIS, but not because it should be higher – if anything, it should be lower.

It is important to point out, in the first instance, that the methodology employed by MosArt in determining the sensitivity of viewpoints is entirely consistent with the Guidelines for Landscape and Visual Impact Assessment (IEMA – 3rd Edition, 2013), which have been universally accepted as the relevant benchmark guidelines in the UK and Ireland. That is, the appraisal balances 'viewer susceptibility' against the 'value' of the view on offer using a range of transparent and rational criteria. In this instance a blanket 'susceptibility' judgement of 'High' has been applied, by default, to all of the Local Community (LC) receptors. This is on the basis that such views represent 'Local residents at home' – one category of receptor that the GLVIA (2013) identifies as being amongst the most susceptible. Other categories of susceptible receptors also include the following;

- *"People, whether residents or visitors, who are engaged in outdoor recreation, including use of public rights of way, whose attention or interest is likely to be focussed on the landscape and on particular views;*
- *Visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience;*
- *Communities where views contribute to the landscape setting enjoyed by residents in the area; and*
- *Travellers on road, rail or other transport routes where such travel involves recognised scenic routes and awareness of views is likely to be heightened." (GLVIA 3 p113)*

As can be seen in the list above, there is a clear theme relating to the visual context, the activity the viewer is engaged in and a likely heightened sense of the surrounding landscape and features within it. In the case of viewpoint LC7 there are very few residential receptors in the immediate environs. Those that do exist, occupy working farmsteads within a tranquil but utilitarian landscape of forestry and farmland where the principle visual amenity relates to elevated views over the Dinin River valley to the east. This is in the opposite direction to the proposed wind farm, which occurs upslope to the west. This is not to say that these residential receptors are not susceptible to visual change, just that

there is a spectrum of susceptibility that could have been considered more closely. Applying a 'high' level of susceptibility to local residential receptors by default, as MosArt did, is by no means inappropriate or incorrect. Instead, it represents a very precautionary approach that adds robustness to their overall sensitivity judgement of 'Medium'.

In reviewing the assessment judgements made in respect of each of the 'view value' criteria at Table 8.3.4.3 of the EIS, I would generally concur with the appraisal. However, I do not agree that LC7 'strongly' represents primary views from residences. As described above, the primary views from dwellings in the vicinity (whether they are availed of or not) are the elevated views over the Dinin River valley in the opposite direction to the proposed wind farm. Notwithstanding this minor point of contention, I agree with the 'Low view value' attributed by MosArt. With regard to the overall sensitivity judgement attributed to viewpoint LC7, I would also agree with the 'Medium' assessment or even suggest 'Medium low' as this is a fairly typical upland, rural scene presented to a small number of local residents.

For the reasons outlined above, it is not considered that a receptor sensitivity rating of higher than 'Medium' (as implied by Item 4 of the RFI) is appropriate in this instance. As a general aside, it is also worth noting that there appears to be some degree of misunderstanding present in the Planning Authority's statement that "*...the receptor sensitivity rating 'medium' given to the visual impact of the proposed development...*" as this appears to confuse the separate appraisals of 'receptor sensitivity' and 'visual impact magnitude', which are only combined later to determine the overall 'significance of visual impact' at each viewpoint (See Figure 1 below).

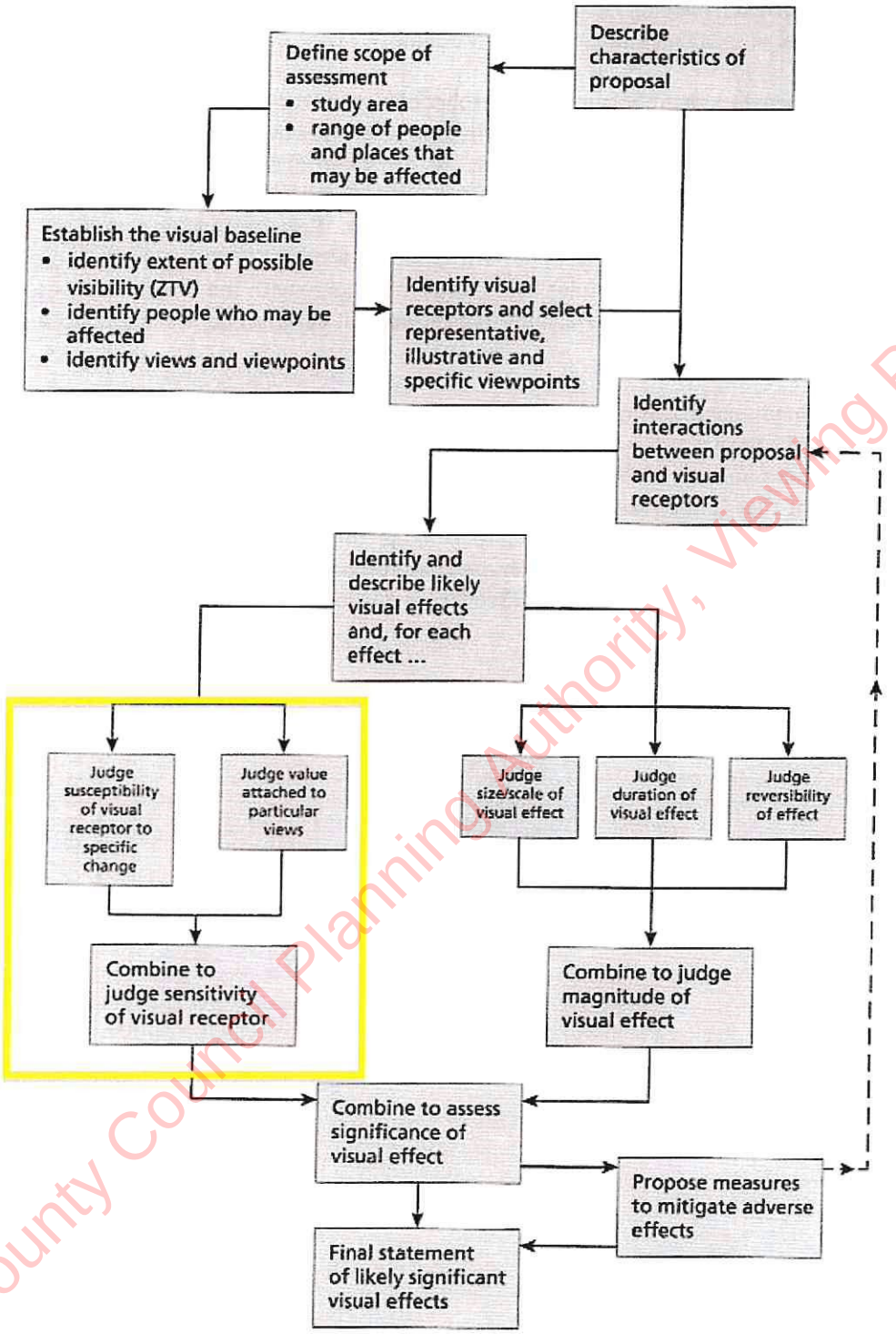

Figure 6.1 Steps in assessing visual effects

Figure 1: Excerpt From The Guidelines For Landscape And Visual Impact Assessment (IEMA - 2013) Outlining The Process Of Visual Impact Assessment – Yellow Box Indicates Relevant Aspects Of Determining Visual Receptor Sensitivity

Turbines 6,8,9, and 10 are the closest and most prominent turbines to viewpoint LC7 even taking account of the fact that an intervening forest plantation in the near middle ground substantially screens them leaving only partial blade sets visible.

The MosArt appraisal for LC7 estimates a co-dominant visual presence for the turbines within this view on balance of their close proximity, but high degree of screening. It then acknowledges the fact that when the intervening conifer plantation is felled, the fully exposed turbines may have a 'dominant' visual presence within the view. It is noted that Volume 2 of the EIS presents photomontages of this viewpoint with and without forestry cover screening. This judgement does not appear to account for the fact that much more extensive views occur in the opposite direction, which has a moderating influence on how 'dominant' the turbines could be in this overall visual context. However this is not the key point to be made here, which is instead that 'visual presence' (something of a quantitative measure) is only one aspect to be considered when determining the magnitude of visual impact, particularly for wind turbines. The other, more qualitative aspect, is consideration of aesthetic effects or effects on visual amenity. This deals with issues of visual harmony versus visual tension, ambiguity versus legibility and whether the proposal is well assimilated within its landscape context in both a spatial and thematic sense. For wind turbines, in particular, visual prominence is not equivalent to visual impact as a close clear view of turbines in an appropriate landscape context are likely to be preferable to partial views of blades sets overlapping with each other or cutting against other intervening landscape elements. This is precisely the balance at play in respect of LC7.

I would concur with MosArt's 'Medium' visual impact magnitude judgement at this location in the current 'forested' scenario. However, once the forest is cleared there will be a much more legible view of the turbines within a broad scale upland landscape context that can readily accommodate them. Furthermore, the perceived scale differential between the nearest and furthest turbines generates a strong sense of perspective, which gives the viewer an understanding of the overall layout of the scheme and generous spacing between turbines. For these reasons, I consider that the 'Medium' magnitude of visual impact would remain valid post-forest clearance, albeit for a different combination of reasons. I do not believe that the view of the proposed turbines (including T6, T8, T9 and T10) represents a significant visual impact under either the 'forested' or 'clear-felled' scenario. Consequently, moving or removing turbines T6, T8, T9 or T10 is not deemed to be warranted in this instance.

Chapter 9:
Archaeology &
Cultural Heritage

9.1 Introduction

9.1.1 Overview

The purpose of this chapter is to assess and define the impacts, if any, on the archaeological, architectural and cultural heritage resource of the proposed development in counties Laois and Kilkenny (Laois OS Sheet 030 and Kilkenny OS Sheet 001, see **Figure 9.1**). It includes mitigation measures designed to avoid, reduce or offset any potential adverse impacts. The following key issues are addressed:

- Direct impacts of the construction phase on recorded and unrecorded archaeological, architectural and cultural heritage features.
- Indirect impacts of the construction phase on recorded and unrecorded archaeological, architectural and cultural heritage features.
- Direct impacts of the operation phase on recorded and unrecorded archaeological, architectural and cultural heritage features.
- Indirect impacts of the operation phase on recorded and unrecorded archaeological, architectural and cultural heritage features.
- Cumulative impacts of the construction phase on recorded and unrecorded archaeological, architectural and cultural heritage features.
- Cumulative impacts of the operation phase on recorded and unrecorded archaeological, architectural and cultural heritage features.

9.1.2 Project Team

This chapter has been prepared by Dermot Nelis who graduated from Queen's University Belfast, and after gaining extensive fieldwork experience undertook postgraduate studies at the University of Oxford in archaeological consultancy and project management. Dermot has carried out numerous walkover surveys, testing and monitoring programmes. He has acted as Senior Archaeologist on several motorway road schemes for various County Councils/National Roads Authority, and has directed large-scale monitoring, test trenching and multi-period excavations associated with those developments. He has completed over 100 licensed fieldwork programmes and over 50 archaeological, architectural and cultural heritage Environmental Impact Assessments.

9.1.3 Assessment Methodology

The study involved detailed interrogation of the archaeological and historical background of the proposed development area. This included information from the Record of Monuments and Places (RMP) of counties Kilkenny and Laois, topographical files of the National Museum of Ireland (NMI), Kilkenny and Laois County Development Plans, cartographic and documentary records and aerial photographs of Ordnance Survey Ireland.

An archaeological study area of 1km has been imposed around the proposed development and associated areas of land take. In addition, an area of approximately 5km around the proposed development has been assessed to record the presence of Protected Structures and any additional statutorily protected archaeological, architectural or cultural heritage features recorded in the Kilkenny and Laois County Development Plans.

An impact assessment and mitigation strategy has been prepared. The impact assessment is undertaken to outline potential adverse impacts that the proposed development may have on the archaeological, architectural or cultural heritage resource, while the mitigation strategy is designed to avoid, reduce or offset such adverse impacts.

Research has been undertaken in two phases. The first phase comprised a paper survey of archaeological, historical and cartographic sources. The second phase involved a field inspection of the proposed development area.

The following sources were examined and a list of sites and areas of archaeological, architectural and cultural heritage potential was compiled:

- Record of Monuments and Places of counties Kilkenny and Laois;
- Topographical Files of the National Museum of Ireland;
- Cartographic and documentary sources relating to the study area;
- Aerial photographs of Ordnance Survey Ireland and Bing aerial photography;
- Laois County Development Plan (2011 – 2017) and Kilkenny County Development Plan (2014 - 2020);
- National Inventory of Archaeological Heritage.

Record of Monuments and Places is a list of archaeological sites known to the National Monuments Service. Back-up files of the Sites and Monuments Record (SMR) provide details of documentary sources and field inspections where these have taken place.

Topographical Files of the National Museum of Ireland is the archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts, but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information in the discovery of sites of archaeological significance.

Cartographic sources are important in tracing land-use development within the proposed area of land take, as well as providing important topographical information on sites and areas of archaeological potential. Cartographic analysis of relevant maps has been made to identify any topographical anomalies that may no longer remain within the landscape. Documentary sources were consulted to gain background information on the historical and archaeological landscape of the proposed development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its potential to contain previously unidentified archaeological remains.

Laois County Development Plan (2011 – 2017) and Kilkenny County Development Plan (2014 – 2020) contain objectives and policies on the preservation and management of archaeological, architectural and cultural heritage features. They were consulted to obtain information on sites within the proposed development area, the 1km study area and the wider 5km study area.

National Inventory of Architectural Heritage (NIAH) is a section within the Department of Arts, Heritage and the Gaeltacht (DAHG). The work of NIAH involves identifying and recording the architectural heritage of Ireland from 1700 to the present day. The NIAH website also contains a non-statutory register of historic gardens and designed landscapes in counties Kilkenny and Laois, and it was assessed to look for the presence of any such features in townlands located within the proposed development area.

Field inspection is necessary to determine the extent, character and condition of archaeological, architectural and cultural heritage features, and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information. Field inspections were carried out on 3rd August 2012 and 26th August 2014, and all areas of proposed land take were walked and visually assessed.

9.1.4 Significance of Criteria

9.1.4.1 Potential Impacts on Archaeological, Architectural and Cultural Heritage Remains

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of resources potentially affected. Wind energy developments can affect the archaeological, architectural and cultural heritage resource of a given landscape in a number of ways:

Permanent and temporary land-take, associated structures, landscape mounding and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape;

Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery, disturbance by vehicles working in unsuitable conditions, burial of sites thus limiting accessibility for future archaeological investigation;

Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or long-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits;

Visual and noise impacts on the historic landscape can arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic structures and historic landscape elements as well as their visual amenity value;

Landscape measures, such as tree planting, can damage sub-surface archaeological features due to topsoil stripping and through the root action of trees and shrubs as they grow;

Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluvium or peat deposits;

Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, service trenches, etc;

Although not widely appreciated, positive impacts can accrue from permitted developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments and the increased level of knowledge of a site or historic landscape as a result of assessment and fieldwork.

9.1.4.2 Predicted Impacts on Archaeological, Architectural and Cultural Heritage Remains

There is no standard scale against which the severity of impacts on the archaeological and historic landscape may be judged. The severity of a given level of land take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost.

Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected.

Assessment of the levels of visual, noise and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

Impacts are defined as:

> *"the degree of change in an environment resulting from a development" (Environmental Protection Agency 2002, 30).*

Impacts are described as indeterminable, negligible, minor, moderate or major on archaeological, architectural and cultural heritage remains. Moderate or major impacts are considered to be significant in Environmental Impact Assessment terms.

Level of Impact	Significance Criteria
Major	An impact which obliterates sensitive characteristics
Moderate	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Minor	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Negligible	An impact capable of measurement but without noticeable consequences
Indeterminable	An impact on a feature of unknown archaeological significance

Table 9.1: Significance Criteria

9.1.5 Legislative & Planning Policy Context

9.1.5.1 Archaeological Resource

The National Monuments Act, 1930 to 2004 and relevant provisions of the National Cultural Institutions Act, 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes.

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Record of Monuments and Places, the Register of Historic Monuments, the placing of Preservation Orders and Temporary Preservation Orders on endangered sites and National Monuments in the Ownership or Guardianship of the Minister for Arts, Heritage and the Gaeltacht or a Local Authority.

The Minister may acquire National Monuments by agreement or by compulsory order. The State or the Local Authority may assume Guardianship of any National Monument (other than dwellings). The owners of National Monuments (other than dwellings) may also appoint the Minister or the Local Authority as Guardian of that monument if the State or Local Authority agrees. Once the site is in ownership or Guardianship of the State, it may not be interfered with without the written consent of the Minister.

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the Register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the Register is illegal without the permission of the Minister. Two months' notice in writing is required prior to any work being undertaken on or in the vicinity of a Registered Monument. The Register also includes sites under Preservation Orders and Temporary Preservation Orders. All Registered Monuments are included in the Record of Monuments and Places.

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage and the Gaeltacht to establish and maintain a Record of Monuments and Places where the Minister believes that such monuments exist. The Record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the State. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994.

Section 12(3) of the 1994 Act provides that:

> *"where the owner or occupier (other than the Minister for Arts, Heritage and the Gaeltacht) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage and the Gaeltacht to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice".*

9.1.5.2 Architectural and Built Heritage Resource

The main laws protecting the built heritage are the Architectural Heritage (National Inventory) and Historic Properties (Miscellaneous Provisions) Act, 1999 and the Planning and Development Act, 2000 (Amended 2010). The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The National Inventory of Architectural Heritage (NIAH) records all built heritage structures within specific counties in Ireland. As inclusion in the Inventory does not provide statutory protection, the document is used to advise Local Authorities on compilation of a Record of Protected Structures (RPS) as required by the Planning and Development Act, 2000 (as amended).

The Planning and Development Act, 2000 requires Local Authorities to establish a Record of Protected Structures to be included in the County Development Plan (CDP). This Plan includes objectives designed to protect the archaeological, architectural and cultural heritage resource during the planning process. Buildings recorded in the RPS can include Recorded Monuments, structures listed in the NIAH, or buildings deemed to be of architectural, archaeological or artistic importance by the Minister. Sites, areas or structures of archaeological, architectural or artistic interest listed in the RPS receive statutory protection from injury or demolition under the 2000 Act. Damage to or demolition of a site registered on the RPS is an offence. The RPS list is not always comprehensive in every county.

The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of a Protected Structure if it considers the building in need of repair. An owner or developer must make a written request to the Local Authority to carry out any works on a Protected Structure and its environs, which will be reviewed within 12 weeks of application. Failure to do so may result in prosecution.

9.1.5.3 Laois County Development Plan (2011 – 2017) & Kilkenny County Development Plan (2014 – 2020)

Laois County Council and Kilkenny County Council have written objectives and policies on the preservation of archaeological, architectural and cultural heritage remains in the face of permitted development. These relate to archaeological monuments and objects, vernacular structures and industrial heritage features amongst others.

9.2 Description of the Existing Environment

9.2.1 Overview

Laois is an inland county in the south midlands covering an area of 1,719 square km, which equates to 2.4% of the national landmass. It is located near the centre of the country and shares borders with Carlow, Kildare, Kilkenny, Offaly and Tipperary. In physical terms, the landmass of Laois consists of a central plain containing most of the productive agricultural land, surrounded by a number of upland areas including the Slieve Bloom Mountains in the north-west, Killeshin Plateau in the south-east and Cullahill Mountain in the south. There are also significant cutaway peatlands in the county, mainly situated between Portlaoise, Mountrath and Abbeyleix.

Kilkenny is the 16th largest county in Ireland and has an area of 2,072 square km. It is bordered by Carlow, Laois, Tipperary, Waterford and Wexford. Brandon Hill at 515m above sea level is the highest

peak and the majority of the county, with the exception of the centre and south of Kilkenny city, is hilly.

During the Mesolithic period (c. 7000-4000 BC) people existed as hunters/gatherers, living on the coastline, along rivers and lakesides. They used flint and other stone to manufacture sharp tools, and locating scatters of discarded stone tools and debris from their manufacture can sometimes identify settlements.

Mesolithic material was recovered from county Kilkenny in 2004 to the north and north east of Waterford city, approximately 65km south of the proposed development area. The Late Mesolithic material was generally recovered from pits or possible natural features and included burnt chert fragments, oak charcoal, a Bann Flake and flint flakes and blades.

The earliest evidence for settlement in county Laois dates from the Neolithic period (c. 4000-2400 BC). During this period the population became more settled with a subsistence economy based on crop growing and stock-raising. While some 1,500 megalithic tombs are recorded in Ireland, they are rare in the midlands and no definite examples are known in county Laois. Five megalithic structures and seven unclassified megalithic tombs are recorded in county Laois (www.archaeology.ie). County Kilkenny contains one court tomb, four passage tombs, nine portal tombs and four wedge tombs. In addition, it contains 14 megalithic structures and nine unclassified megalithic tombs (www.archaeology.ie).

Two megalithic structures (LA024-052 and LA024-055) are located in Knockbaun townland, approximately 1.65km and 2.1km respectively north east of the access track leading to Turbine 1.

The Bronze Age (c. 2400-600 BC) is characterised by the introduction of metalworking technology to Ireland and coincides with many changes in the archaeological record, both in terms of material culture as well as the nature of the sites and monuments themselves. Though this activity has markedly different characteristics to that of the preceding Neolithic period, including new structural forms and new artefacts, it also reflects a degree of continuity. During this period knowledge of metalworking was acquired resulting in changes in material culture such as the introduction of metal tools and artefacts as well as the introduction of a highly decorated pottery called Beaker pottery. In addition to changes in material culture, there were changes in burial rite from communal megalithic tombs to single burial in cists.

Bronze Age monuments from counties Laois and Kilkenny include stone rows and standing stones, cist burials, barrows and fulachta fiadh which are one of the most numerous monument types in Ireland with over 4,500 examples recorded (Waddell 2005, 174).

A segmented cist with cremated bone and some small unclassifiable potsherds (LA030-029), located approximately 850m south of Turbine 10 in Ironmills or Kilrush townland, was discovered during ploughing. No further information is recorded in the SMR file.

A ring barrow (KK001-002001) is located approximately 2.1km south east of Turbine 3 in Aughatubbrid or Chatsworth townland, county Kilkenny.

Three standing stones (LA024-048, LA024-050 and LA024-053) are recorded approximately 1.95km, 2.3km and 1.8km respectively north east of the access track leading to Turbine 1.

A standing stone (LA025-048) and a stone circle (LA024-062) are both recorded in Knockbaun townland, although there is no information recorded on the RMP (www.archaeology.ie) as to the location of these monuments.

During the Iron Age (c. 600 BC-400 AD) new influences came into Ireland which gradually introduced the knowledge and use of iron, although for several centuries bronze continued to be widely used. The Iron Age in Ireland however is problematic for archaeologists as few artefacts dating exclusively to this period have been found, and without extensive excavation it cannot be determined whether several monument types, such as ring barrows or standing stones, date to the Bronze Age or Iron

Age. Most knowledge for this period stems from Irish folklore, the epic poems and legends of warrior kings and queens which are traditionally believed to be Celtic in origin. These stories however come from an oral society and were first recorded by Early Medieval monks. They are based on imagination rather than fact and thus reflect more the times in which they were written than the past they are concerned with.

The Early Medieval period (c. 400-1169 AD) is depicted in the surviving sources as entirely rural, characterised by the basic territorial unit known as túath. Walsh (2000, 30) estimates that there were at least 100, and perhaps as many as 150, kings in Ireland at any given time during this period, each ruling over his own túath.

During this turbulent period roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. They were enclosed by an earthen bank and exterior ditch, and ranged from approximately 25m to 50m in diameter. The smaller sized and single banked type (univallate) was more than likely home to the lower ranks of society, while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords. They are regarded as defended family homesteads and the extant dating evidence suggests they were primarily built between the 7th and 9th centuries AD (Stout 1997, 22-31). Cashels are stone built and are generally situated in coastal or mountainous areas.

The ringfort is considered to be the most common indicator of settlement during the Early Medieval period. Detailed study (ibid., 53) has suggested that there is an approximate total of 45,119 potential ringforts or enclosure sites throughout Ireland.

Souterrains, deriving their name from the French words sous (under) and terrain (ground), are underground structures that are often, though not exclusively, found associated with ringforts. They therefore appear to date to the second half of the first millennium AD. While the distribution of souterrains has yet to fully investigated, it is known the pattern is uneven and some areas, such as north Louth for example, possess a much larger number of sites than elsewhere.

Enclosure sites belong to a classification of monument whose precise nature is unclear. Often they may represent ringforts, which have either been damaged to a point where they cannot be positively recognised, or are smaller or more irregular in plan than the accepted range for a ringfort. An Early Medieval date is in general likely for this site type, though not a certainty.

There is one enclosure recorded within the 1km study area. LA030-016 is located in Knockardagur townland, approximately 800m north-west of Turbine 4 and approximately 230m north east of the proposed substation. It is recorded in the RMP as part of a large subcircular enclosure visible on aerial photographs. This feature does not survive above-ground.

LA030-24 is located in Boleybawn and Ironmills or Kilrush townlands, approximately 1.1km south west of Turbine 11. It is marked on the First Edition Ordnance Survey map as an irregular enclosure measuring approximately 50m north/south x 25m east/west. This monument no longer survives above-ground.

An additional seven enclosures (LA024-049001, LA024-054, LA030-011004, LA030-013, LA030-015, KK001-001001 and KK001-002002) are recorded within approximately 2km of the proposed development area.

The classification of archaeological monuments is often made difficult by their condition, whether it be the result of deliberate destruction, trampling by livestock or natural weathering and erosion. The term "earthwork" is used to denote any monument or feature of artificial origin which cannot be further categorised without excavation. The term "earthwork site" indicates sites which were levelled before detailed archaeological inspection took place. The majority of such sites may be levelled or destroyed ringforts.

An earthwork (LA024-047) is located in Garrintaggart townland, approximately 1.3km north of the access track leading to Turbine 1.

A linear earthwork (LA024-049002) is located in Knockbaun townland, approximately 2.4km north east of the access track leading to Turbine 1. It is recorded in the SMR file as a linear feature recorded through aerial photography. This feature no longer survives above-ground.

The Early Medieval period is characterised by the foundation of a large number of ecclesiastical sites throughout Ireland in the centuries following the introduction of Christianity in the 5th century AD. The early churches tended to be constructed of wood or post-and-wattle, although between the late 8th and 10th centuries mortared stone churches gradually replaced the earlier structures. Many of the sites, some of which were monastic foundations, were probably originally defined by an enclosing wall or bank similar to that found at coeval secular sites. This enclosing feature was probably built more to define the sacred character of the area of the church than as a defence against aggression. An inner and outer enclosure can be seen at some of the more important sites; the inner enclosure surrounding the sacred area of church and burial ground and the outer enclosure providing a boundary around living quarters and craft areas. Where remains of an enclosure survive it is often the only evidence that the site was an early Christian foundation.

A church (LA030-011001), graveyard (LA030-011002) and cross (LA030-011003) are located in Aghnacross townland, approximately 2km north west of Turbine 4. The church is associated with St Monahan who died in 648 and is situated beside a river in undulating countryside. Within a roughly triangular graveyard, which is defined by an earthen bank, is a nave and chancel church built of roughly coursed limestone. All visible headstones post-date 1700.

Medieval Ireland is considered a very turbulent time in Irish history as kings battled each other to obtain the power of the High King of Ireland or Ard Ri. As early as the middle of the 3rd century, the general area surrounding Portlaoise was ranked as a kingdom, and annexed by Conary, King of Ireland, to his native dominion of Munster, instead of being, as formerly, attached to Leinster. In the war waged by Roderic O'Conor, King of Ireland, against Diarmait MacMurrough, King of Leinster, which led to the invasion under Strongbow, the King of Ossory was one of the princes who were specially summoned by the former of those potentates.

The commencement of Viking raids at the end of the 8th century and their subsequent settlement during the following two centuries marked the first ever foreign invasion of Ireland. Viking settlement evidence is scarce and has been found in Dublin and Waterford, however excavations there have revealed extensive remains of the Viking towns. Outside these towns, understanding of Viking settlement is largely drawn from documentary and place-name evidence. In addition to Dublin and Waterford, documentary sources provide evidence for the Viking foundation of the coastal towns of Cork, Limerick and Wexford (Edwards 2006, 179). Other indirect evidence which suggest Viking settlement, or at least a Norse influence in Ireland, is represented by upwards of 120 Viking-age coin hoards, possible votive offerings of Viking style objects and the assimilation of Scandinavian art styles into Irish designs. Whilst the initial Viking raids would have been traumatic, the wealth and urban expansion brought into the country as a result of Viking trading would have eventually benefited the Gaelic Irish and the cultural assimilation in some parts would have been significant.

The district now forming Queen's County (the former name of county Laois) was known by the name of Glenmaliere and Leix. Leix was made a county palatine, and on the division of the immense possessions of William, Earl Marshal, between his five daughters, it was allotted to the youngest, who had married William de Braosa, Lord of Brecknock. Their daughter Maud married Roger Mortimer, Lord of Wigmore, and from this connection the imperial house of Austria, and the royal families of Britain, France, Prussia, Denmark, Holland, Sardinia and Saxony derive their descent. Mortimer, preferring to reside on his English estates, employed one of the O'Mores to defend and manage his Irish property. Within 20 years however, O'More had become so powerful that he held it by himself and became one of the fiercest opponents of the English settlers in that part of the

Pale. So fully was his authority recognised as lord of the district that he was summoned by the English government to oppose Bruce and the Scotch. For two centuries after, the district was the seat of an almost incessant war between the O'Mores and the English. During the same period the Mac Gillypatricks, or Fitzpatricks, maintained their independence in Ossory, but generally adhered to the English.

The later middle ages is a period marked by continuous raids by the Irish on the Pale and retaliation measures taken by the English crown to secure its authority by attempting to control the Irish families living outside its walls. Portlaoise originated as a fort erected in the mid-16th century as part of the English attempts to subdue the territories of the O'Mores and O'Conors during the reign of Edward VI.

In an attempt to limit the devastation caused by raids on the Pale, the region was reduced to shire ground and incorporated under the name of Queen's County. This new arrangement, however, did not immediately tranquillize the country. For security, a number of affluent families of native Irish, Anglo-Irish and English descent alike erected a type of castle known as a tower house. Though they are not castles in a strict military sense, they are designed primarily to repulse attack while displaying the wealth and status of the family. They are typically tall rectangular crenellated towers, of three to five storeys, with defensive features as well as features to enhance the domestic comfort of the building.

This general area was largely under the control of two powerful Irish families, the O'Conors and the O'Mores. Owen MacRory O'More, the chief of the O'More family, was so powerful that Sir George Carew, President of Munster, accompanied by the Earls of Thomond and Ormonde, was induced to hold a parley with him to bring him back to his allegiance to the English crown and halt his raids. Their attempt however to subdue his family's activities was unsuccessful when they were entrapped in an ambush, and the Earl of Ormonde made prisoner, and detained till a ransom of £3000 was paid. The O'More power was not to last and when their chief was killed shortly after this, in a skirmish with Lord Mountjoy, the followers of the O'Mores were driven into the counties of Cork and Kerry, then nearly depopulated.

At this juncture many English families, to whom grants of the land thus forfeited by the O'Mores had been made, settled in the county. Seven of them, whose founders were most influential in securing the new settlements, acquired the names of the Seven Tribes. The families so called were those of Cosby, Barrington, Hartpole, Bowen, Ruish, Hetherington and Hovenden or Ovington. In 1556 the fort within Laois, known to the English as "Fort Protector" was renamed Maryborough in honour of Queen Mary. The fort attracted settlers and a map of 1560 shows a small walled town around a fort. Maryborough (Portlaoise) was granted a market in 1567 and borough status in 1569. In 1580 the town was plundered by John, son of the Earl of Desmond. In 1597 it was burned by Rory O'Mordha and appears to have been burned again the following year. In the reign of Charles I, large grants of land were made to Villiers, Duke of Buckingham, now forming the extensive manor of Villiers. In the same reign, and during the unsettled period of the Commonwealth, the families of Pigott, Coote, Prior, Parnell and Pole settled there; those of Vesey, Dawson, Staples, Burrows and Johnson obtained lands after the Revolution.

There are many theories as to why Portlaoise was chosen in 1556 as the principal town of a new shire. One possibility was that it was built on the site of the Newtown of Leys and that some sort of hamlet might have lingered into the 16th century. This would explain the name of the parish, which almost certainly has a Medieval origin. The street pattern of the 16th century town is quite unusual and offers no apparent explanation for its form. The form of the 16th and 17th century housing within the town remains unknown.

County Laois had its full share of the calamities of the civil war in 1641, at the beginning of which the insurgents secured Maryborough, Dunamase and other places of strength. The Earl of Ormonde, arriving at Athy from Dublin, detached parties for their relief; on his retreat the whole of the county

submitted to General Preston, but was forced again to submit to the royal arms. In 1646 Owen Roe O'Neill seized upon several forts. In 1650 Cromwell's forces entered the county and met with much resistance. In the course of the struggle most of its fortresses were dismantled by his generals, Hewson and Reynolds. During the rebellion of 1699, a victory was gained by the troops of William at a noted togher or bog-pass near Cappard, where they defeated a much superior number of the Irish. After the termination of the war, the country was so harassed by the ravages of the raparees that the resident gentlemen applied to King William to have a force of infantry and dragoons quartered in it, and specified the castle of Lea as one of the principal stations for their reception.

The arrival of the Anglo-Normans in Ireland towards the end of the 12th century resulted in great changes during the following century. Large numbers of colonists arrived from England and Wales and established towns and villages. They brought with them new methods of agriculture which facilitated an intensification of production. Surplus foods were exported to markets all along Atlantic Europe which created great wealth and economic growth. Results of this wealth can be seen in the landscape in the form of stone castles, churches and monasteries.

The political structure of the Anglo-Normans centered itself around the establishment of shires, manors, castles, villages and churches. In the initial decades after the Anglo-Norman invasion a distinctive type of earth and timber fortification was constructed- the motte and bailey. Mottes were raised mounds of earth topped with a wooden or stone tower while the bailey was an enclosure, surrounded by an earthen ditch with a timber palisade, used to house ancillary structures, horses and livestock. There are 11 motte and baileys recorded in county Laois and 10 in county Kilkenny (www.archaeology.ie).

A mote and bailey (LA030-021002) is located approximately 1.35km west of Turbine 7 in Moat townland. The site of a ford (LA030-021003) is located approximately 60m north west of the motte and bailey.

In certain areas of Ireland however Anglo-Norman settlers' constructed square or rectangular enclosures, now termed moated sites. Their main defensive feature was a wide, often water-filled, fosse with an internal bank. As in the case of ringforts, these enclosures protected a house and outbuildings usually built of wood. They appear to have been constructed in the latter part of the 13th century though little precise information is available. Moated sites were also built in Britain and elsewhere in north-west Europe. There are 61 moated sites recorded in county Laois and 69 in county Kilkenny (ibid.).

Three moated sites (LA024-046, LA030-014 and LA030-027) are recorded within approximately 2km of the proposed development area.

More substantial stone castles followed the motte and bailey and moated sites in the 13th and 14th centuries. Tower houses are regarded as late types of castle and were erected from the 14th to early 17th centuries. Their primary function was defensive, with narrow windows and a tower often surrounded by a high stone wall (bawn). An Act of Parliament of 1429 gave a subsidy of £10 to "liege" men to build castles of a minimum size of 20ft in length, 16ft in breadth and 40ft in height (6m x 5m x 12m). By 1449, so many of these £10 castles had been built that a limit had to be placed on the number of grants being made available. The later tower houses were often smaller, with less bulky walls and no vaulting. There are 30 tower houses recorded in county Laois and 69 in county Kilkenny (ibid.).

An unclassified castle (LA030-021001) is located approximately 1.4km west of Turbine 7 in Moat townland, marked in the south west quadrant of a motte and bailey (LA030-021002) on the 1908 Ordnance Survey map. This feature no longer survives above-ground.

The 14th century throughout north-west Europe is generally regarded as having been a time of crisis, and Ireland was no exception. Although the Irish economy had been growing in the late 13th century, it was not growing quickly enough to support the rapidly expanding population, especially when

Edward I was using the trade of Irish goods to finance his campaigns in Scotland and Wales. When the Great European Famine of 1315-17 arrived in Ireland, brought about by lengthy periods of severe weather and climate change, its effects were exacerbated by the Bruce Invasion of 1315-18. Manorial records which date to the early 14th century show that there was a noticeable decline in agricultural production. This economic instability and decline was further worsened with the onset of the Bubonic Plague in 1348.

Before the Tudors came to the throne, the kings of England were also the kings of western France, and so, during the 14th and 15th centuries, the various lords who ruled in Ireland were largely left to themselves. The Tudors however took more of an interest in the affairs of Ireland. They wanted to put a stop to the raids of the Gaelic Irish on the areas under English rule. To do this, they ruthlessly put down any rebellions and even quashed inter-tribal feuds. English settlers were then brought in to settle their lands. The first of these plantations occurred in the mid-16th century in what is now Laois and Offaly. After the Desmond rising in Munster in 1585 came another plantation and parts of south western Tipperary were planted at that time.

From 1593 until 1603 there was a countrywide war between the Gaelic Irish, who were supported by the French, and the Elizabethan English. The Irish were finally defeated and with the "Flight of the Earls" in 1607, Ulster, which had previously been independent of English rule, was planted.

Expansion in the agricultural sector following a period of economic growth in Ireland from the mid-1730s led to rising prices and growth in trade. This increase in agricultural productivity lead to growth in related industrial development throughout the country.

The planned estate town of Abbeyleix, located approximately 7.5km north west of the proposed development area, was founded in approximately 1770 by the second Viscount de Vesci who considered the Oldtown of Abbeyleix to be too close to the river Nore and therefore liable to flooding. He razed the original town and choose a slightly elevated site away from the river which is the location of the modern town.

A field system (KK001-001002) is located in Aughatubbrid or Chatsworth townland, approximately 1.95km east of Turbine 3. There is no further information recorded on this site in the SMR file.

Field systems are regarded as a group or complex of fields which are related and may date to any period from the Neolithic onwards. The practice of enclosing fields in Ireland for agricultural and other purposes dates from the Neolithic period. The enclosed land could have been used for stock-raising, plant husbandry and crop protection. The fields can vary in size and it is possible that many of them are more extensive than currently thought. A wide range of monuments, such as barrows, ringforts, souterrains, hut sites, ecclesiastical remains etc., can be found inside field systems.

A battlefield site (LA024-051), of which there are no above-ground remains, was originally recorded in Knockbaun townland, approximately 2.3km north east of the access track leading to Turbine 1. It is noted (www.archaeology.ie) that it is:

> *"Named 'Battle (Site of)' only on the 1909 edition of the OS 6-inch map. The source of this 'battle' is Daniel O'Byrne's, The History of the Queen's County (1856) where he makes reference to a battle taking place in the vicinity of eight standing stones. An assessment of this source indicates that this battle was mythical and probably developed either to provide an explanation for the standing stones or the requirement to rationalise the 'dissevering of Ossory from the Kingdom of Leinster, and the infliction of the Boromean tribute which subsequently caused so much bloodshed in the country".*

The following townlands are located within the proposed development area: Graiguenahown, Knockardugar, Boleybawn, Ironmills/Kilrush, Garrintaggart in County Laois and Crutt in County Kilkenny.

Boleybawn, Graiguenahown and Knockardagur are in the barony of Cullenagh and parish of Dysartgallen. Crutt is in the barony of Fassadinin and parish of Castlecomer.

Lewis (1837, Vol. I, 593) records the parish of Dysartgallen as containing, along with Ballinakill, 4,018 inhabitants. He notes that the parish contained 10,557 acres and that:

> *"the soil is generally good, and the land in a profitable state of cultivation; there is a small quantity of bog, and grit-stone is quarried for building"* (ibid.).

The parish of Castlecomer is recorded by Lewis as consisting of:

> *"21,708 statute acres, and contains the principal portion of the extensive coal field of the district. The coal is of the kind commonly called Kilkenny coal, which, containing no bitumen, burns without blaze or smoke; the larger pieces alone are applied to domestic purposes, the smaller fragments being chiefly used for burning lime. These collieries have been worked for more than a century. . . A great portion of the coal is conveyed through the southern counties by the rivers Suir and Barrow, and by the Grand Canal to Dublin."* (ibid., 202).

9.2.2 Toponyms

Townland names are an important source in understanding the archaeology, geology, land-use, ownership and cultural heritage of an area. **Table 9.2** sets out the meaning of the local townland names, where known.

Townland	*Derivation / Meaning*
Boleybawn	White booley or dairy
Crutt	Not recorded
Graiguenahown	Village of the river
Knockardagur	Not recorded
Garrintaggart,	Garden of the priest
Ironmills(Kilrush)	Kilrush translates as church of the wood

Table 9.2: Translation or explanation of names from within the proposed development area

9.2.3 Summary of Previous Fieldwork in the Study Area

Reference to Summary Accounts of Archaeological Excavations in Ireland (www.excavations.ie) has shown that no fieldwork has been carried out within the proposed development area or in any townlands located within the development area.

9.2.4 Topographical Files of the National Museum of Ireland

Information on artefact finds and excavations from counties Laois and Kilkenny is recorded by the National Museum of Ireland. Location information relating to such finds is important in establishing prehistoric and historic activity in the study area.

Ploughing in Knockardagur townland on a hillside in approximately 1910 revealed a large flagstone sealing a cist measuring approximately 1.5m long x 0.6m wide x 0.4m deep (no Topographical File reference). The sides of the cist were made of thin flags set on edge and the bottom was floored by small thin flags set on sand. In this grave there was:

> *"nothing at all but a little skin of dust on the floor"*

and at one end:

> *"an earthenware vessel"* (Topographical Files of the National Museum of Ireland).

A double cist with three cremations (no Topographical File reference) was revealed in 1937 when ploughing an uncultivated hillside in Ironmills or Kilrush townland, which is the townland located immediately south of Turbines 10 and 11. There was no surface indication of the site which lay approximately 0.15m below ground level. The cist consisted of two compartments divided by a single flagstone set on edge.

Cist A revealed three fragments of human bone but no further information was revealed regarding the age or sex of the individual. Cist B revealed fragments of bone of a young fully grown adult and a fragment of a newborn infant. A few small sherds of probable Bronze Age pottery were revealed with the cremated bone. This feature is recorded in the RMP as LA030-029.

9.2.5 Cartographic Analysis

*9.2.5.1 Ordnance Survey Map First Edition 1841 (see **Figure 9.4**)*

Four small structures are recorded immediately south of the access track leading to Turbine 1. A single structure is recorded west of the access track leading north to Turbine 1. A single structure is recorded north of the access track leading to Turbine 2. Access tracks leading to Turbines 4 and 6 will truncate a townland boundary. The access track south of Turbine 5 will truncate a townland, parish, barony and county boundary. A structure is recorded north of the access track leading west to Turbine 7. The access track leading west to Turbine 8 will truncate a townland, parish, barony and county boundary. The access track leading west to Turbine 9 will truncate a townland, parish, barony and county boundary. The access track leading west to Turbine 10 will truncate a townland, parish, barony and county boundary. Recent research suggests that:

> *"hoards and single finds of Bronze Age weapons, shields, horns, cauldrons and gold personal objects can all be shown to occur on boundaries"* (Kelly 2006, 28).

The well recorded during the site visit on the south side of the road between Turbines 1 and 2 is not recorded on the First Edition map.

There are no additional archaeological, architectural or cultural heritage features recorded on the First Edition map within any areas of proposed land.

*9.2.5.2 Ordnance Survey Map Second Edition 1890 (see **Figure 9.5**)*

The Second Edition OS map records a more enclosed landscape in the vicinity of the proposed development area than the First Edition map. The four small structures recorded immediately south of the access track leading to Turbine 1 on the First Edition OS map are not recorded on the Second Edition map. Two structures are recorded west of the access track leading north to Turbine 1.

There are no additional archaeological, architectural or cultural heritage features recorded on the Second Edition map within any areas of proposed land take.

*9.2.5.3 Ordnance Survey Map Third Edition 1908 (see **Figure 9.6**)*

There are few changes recorded within the area of proposed land take between the Second and Third Editions of the Ordnance Survey maps. The well noted during the walkover survey (see below) is annotated on the Third Edition map. An Ordnance Survey bench mark is also recorded in this general location. The access track leading to Turbine 1 is partially located on the line of a farm track, with a well at its southern end. This well is outside the area of proposed land take. The access track leading west to Turbine 11 will truncate the line of a farm track and a possible drain as recorded on the Third Edition map.

There are no additional archaeological, architectural or cultural heritage features recorded on the Third Edition map within any areas of proposed land take.

9.2.6 Aerial Photographs

Aerial photographs held by Ordnance Survey Ireland (www.maps.osi.ie) were consulted to look for the presence of previously unrecorded remains within the proposed development area.

The 2000 and 2005 photographs record a similar landscape to that which was noted during the walkover surveys (see below), with Turbines 1 – 11, substation, site compound and access tracks located in either fields with short grass, rushes or forestry plantations and with mature field boundaries. Proposed access tracks are frequently located on existing forestry roads.

More recent aerial photography (www.bing.com/maps) also notes a similar environment as was recorded during the walkover surveys.

There was no evidence of any archaeological, architectural or cultural heritage features recorded on the aerial photographs within the land take of the proposed turbines or access tracks.

9.2.7 County Development Plans

9.2.7.1 Laois County Development Plan 2011 - 2017

It is a Specific Objective (BH 14 / O10) of Laois County Council to:

> *"Secure the preservation (in-situ or by record) of all sites and features of historical and archaeological interest" (Laois County Council 2011, 220).*

It is also a Specific Objective (BH 14 / O13) of Laois County Council to:

> *"Ensure that development in the vicinity of a site of archaeological interest shall not be detrimental to the character of the archaeological site or its setting by reason of its location, scale, bulk or detailing"* (ibid.).

It is a Policy (BH 14 / P26) of Laois County Council to:

> *"Protect the integrity, character, value and settings of Recorded Monuments and Places from inappropriate development"* (ibid., 226).

Table 28 of the County Development Plan (2011) contains a list of National Monuments in State Care in Laois. There are no such monuments within the proposed development area, the 1km study area or the wider 5km study area.

Table 29 of the County Development Plan (2011) contains a list of Monuments protected by Preservation Orders in County Laois. There are no such monuments within the proposed development area, the 1km study area or the wider 5km study area.

The County Development Plan (2011) contains a list of Zones of Archaeological Potential. There are no such Zones within the proposed development area or the 1km study area. There is one Zone of Archaeological Potential within the wider 5km study area:

Location	Distance from nearest Turbine
Ballinakill	c. 3.6km west of Turbine 11

Table 9.3: Zones of Archaeological Potential within the 5km study area

It is an Objective (BH 14 / O04) of Laois County Council to:

> *"Protect all structures listed in the Record of Protected Structures, that are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical character or interest in County Laois"* (ibid., 214).

Appendix 1 of the Laois County Development Plan (2011) contains the Record of Protected Structures for the county. There are no Protected Structures within the proposed development area. There is one Protected Structure within the 1km study area:

RPS Ref. No.:	Address	Town/Townland	Distance from nearest Turbine
374	Saint Lazerian's Catholic Church	Graiguenahown	c. 750m north west of access track leading to T1

Table 9.4: County Laois Protected Structures within the 1km study area

There are 28 Protected Structures within the wider 5km study area:

RPS Ref. No.:	Address	Town/Townland	Distance from nearest Turbine
298	St. Brigid's Catholic Church	Ballinakill	c. 3.6km west of T11
299	All Saints Church of Ireland Church	Ballinakill	c. 3.6km west of T11
300	Ballinakill Old National School	Ballinakill	c. 3.6km west of T11
301 A	Stanhope Bridge	Ballinakill	c. 3.6km west of T11
301 B	Stanhope Arch	Ballinakill	c. 3.6km west of T11
302	J. Jackman façade	Ballinakill	c. 3.6km west of T11
303	McGrath shop and pub façade	Ballinakill	c. 3.6km west of T11
304	House, The Square	Ballinakill	c. 3.6km west of T11
305	Small Tower House	Ballinakill	c. 3.6km west of T11
395	Medieval Castle	Ballinakill	c. 3.6km west of T11
502	Tower Cross Roads Gate Lodge	Haywood Demesne	c. 2.6km west of T7
503	Heywood Obelisk	Haywood Demesne	c. 2.6km west of T7
504	Heywood Marian Grotto	Haywood Demesne	c. 2.6km west of T7
505	Heywood Folly	Haywood Demesne	c. 2.6km west of T7
506	Heywood Ice House	Haywood Demesne	c. 2.6km west of T7
507	Heywood Summerhouse	Haywood Demesne	c. 2.6km west of T7
508	Heywood Stable Complex	Haywood Demesne	c. 2.6km west of T7
509	Heywood Gardens	Haywood Demesne	c. 2.6km west of T7
510	Heywood Boat House	Haywood Demesne	c. 2.6km west of T7
511	Heywood Bridges	Haywood Demesne	c. 2.6km west of T7

512	Tower of the Winds	Haywood Demesne	c. 2.6km west of T7
513	The Black Church	Haywood Demesne	c. 2.6km west of T7
803	Claude's Seat	Haywood Demesne	c. 2.6km west of T7
804	Ballinakill School	Ballinakill	c. 3.6km west of T11
805	Ballinakill Market	Ballinakill	c. 3.6km west of T11
806	House, The Square	Ballinakill	c. 3.6km west of T11
807	Moneycleare House, Ballinakill	Moneycleare	c. 4.2km west of T11
883	Thatched House, Aghnacross, Spink	Aghnacross	c. 1.7km west of T1

Table 9.4: County Laois Protected Structures within the 5km study area

It is a Policy (BH 14 / P12) of Laois County Council to:

> *"Designate ACAs (Architectural Conservation Areas) in the towns of Portlaoise, Abbeyleix, Durrow, Ballinakill, Clonaslee, Timahoe and Castletown"* (ibid., 219).

There are no Architectural Conservation Areas listed to be designated within the proposed development area or the 1km study area. There is one Architectural Conservation Area listed to be designated within the wider 5km study area:

Location	*Distance from nearest Turbine*
Ballinakill	c. 3.6km west of Turbine 11

Table 9.5: Architectural Conservation Areas listed to be designated within the 5km study area

9.2.7.2 Kilkenny County Development Plan 2014 - 2020

It is an Objective (8I) of Kilkenny County Council to:

> *"Protect archaeological sites and monuments (including their setting), underwater archaeology, and archaeological objects, including those that are listed in the Record of Monuments and Places, and in the Urban Archaeological Survey of County Kilkenny or newly discovered sub-surface and underwater archaeological remains"* (Kilkenny County Council 2014, 117).

It is an Objective (8K) of Kilkenny County Council to:

> *"ensure the protection of the architectural heritage of County Kilkenny by including all structures considered to be of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest in the Record of Protected Structures"* (ibid., 119).

Appendix I of the Kilkenny County Development Plan (2014) contains the Record of Protected Structures for the county. There are no Protected Structures within the proposed development area, the 1km study area or the wider 5km study area.

Section 8.3.6 of the Kilkenny County Development Plan (2014) contains a list of Architectural Conservation Areas within the county. There are no Architectural Conservation Areas within the proposed development area, the 1km study area or the wider 5km study area.

9.2.8 National Monuments in State Care

The Department of Arts, Heritage and the Gaeltacht maintains a database on a county basis of National Monuments in State Care. The term National Monument is defined in Section 2 of the National Monuments Act (1930) as:

> *"a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto".*

There are no National Monuments within the proposed development area, the 1km study area or the wider 5km study area.

There are no sites with Preservation Orders or Temporary Preservation Orders within the proposed development area, the 1km study area or the wider 5km study area.

There are no World Heritage Sites or Candidate World Heritage Sites within the proposed development area, the 1km study area or the wider 5km study area.

9.2.9 National Inventory of Architectural Heritage

NIAH (www.buildingsofireland.ie) maintains a non-statutory register of buildings, structures etc. recorded on a county-wide basis. There are no such structures within the proposed development area. There is one such structure within the 1km study area:

Reg No	Name	Rating	Distance from nearest Turbine
12802409	Saint Lazerian's Roman Catholic Church	Regional	c. 750m north west of access track leading to T1

Table 9.6: HIAH structures within the 1km study area

NIAH maintains a non-statutory register of historic gardens and designed landscapes recorded on a county-wide basis. There are no such structures or features within the proposed development area or the 1km study area.

9.2.10 Field Inspection

The field inspections sought to assess the site, its previous and current land use, the topography and any additional environmental information relevant to the report. The inspections took place on 3rd August 2012 and 26th August 2014 and weather at the time of the site visits was dry and bright.

Turbine No.	Description
1	In a large open field with short grass and is damp underfoot. Views are good to north and west and poor to south and east. Access track is through woodland and across short grass which is damp underfoot.
2	Located in a gently undulating field with frequent tall rushes and is wet underfoot. Views are moderate to west and poor in all other directions. Access track is gently undulating with frequent tall rushes and is wet underfoot. A well, measuring c. 0.70m wide x 0.60m high x 1m deep, was recorded south of the east/west oriented road between Turbines 1 and 2 and outside all areas of proposed land take. This feature is in good condition, is moss-covered and is three courses high with a stone lintel. It forms part of a mature field boundary and has standing water measuring 0.20m deep.
3	In a field with short grass and is wet underfoot. Views are moderate to north and poor in all other directions. Access track is gently undulating with short grass and is wet underfoot.

4	In a large open field which is generally dry with short grass but with occasional rushes which are wet underfoot. Views are good to north, moderate to east and poor to south and west. Access track is generally dry with short grass and occasional rushes.
5	In an overgrown area of removed forest and occasional young conifer trees. Views are good to east, moderate to north and poor to south and west. Access track is off a forestry track.
6	In an overgrown area of removed forest and occasional young conifer trees. Views are good to east, moderate to north and poor to south and west. Access track is across an overgrown area of removed trees.
7	In an enclosed field with short grass and mainly dry underfoot. Views are good to north, west and south and poor to east. Access track is off a forestry track and across an area of removed trees.
8	Located in an area of tree cover. Views are poor in all directions and access is off a forestry track.
9	Located in an area of tree cover. Views are poor in all directions and access is off a forestry track.
10	Located in an area of tree cover. Views are poor in all directions and access is off a forestry track
11	In a flat dry field with short grass. Views are very good to south and poor in all other directions. Access track is flat and is a combination of tree cover and short grass.

Table 9.7: Description of receiving environment

No archaeological, architectural or cultural heritage features were revealed within any areas of proposed land take as a result of carrying out the walkover surveys.

9.2.11 Grid Connection

Grid connection will involve construction of a substation and an access track within the proposed development area and creating a connection to the approved 110kV Laois-Kilkenny Grid Reinforcement Project overhead power line (An Bord Pleanála Reference PL11.VA0015). There are no recorded archaeological, architectural or cultural heritage features located in the area of the proposed substation or access track.

9.2.12 Road Widening

Limited road widening will be required in Graiguenahown townland, approximately 900m north west of the proposed development area. In addition, minor works involving the moving of road signs etc. will be required at Newtown Crossroads on N78 turning on to R430. There are no recorded archaeological, architectural or cultural heritage features located in any areas of land take associated with road widening or access works

9.2.13 Overall Assessment of the Existing Environment

There are no RMP sites within the proposed development area. There are no Protected Structures, Architectural Conservation Areas, NIAH structures or NIAH historic gardens or designed landscapes within the proposed development area. There are two RMP sites within the 1km study area. There are no National Monuments within the proposed development area, the 1km study area or the wider 5km study area. There are no sites with Preservation Orders or Temporary Preservation Orders within the proposed development area, the 1km study area or the wider 5km study area. There are no World Heritage Sites or Candidate World Heritage Sites within the proposed development area,

the 1km study area or the wider 5km study area. There is one Protected Structure within the 1km study area. There are 28 Protected Structures within the wider 5km study area. There are no Architectural Conservation Areas within the 1km study area. There is one proposed Architectural Conservation Area within the wider 5km study area. There is one NIAH structure within the 1km study area. There are no NIAH historic gardens or designed landscapes recorded within the 1km study area. Reference to Summary Accounts of Archaeological Excavations in Ireland revealed that no fieldwork exercises have been carried out in townlands located within the proposed development area. There is one entry recorded in the Topographical Files for a townland within the area of proposed land take. Access tracks will truncate six townland boundaries, four parish boundaries, four barony boundaries and four county boundaries as recorded on the First Edition Ordnance Survey map. There was no evidence of any archaeological, architectural or cultural heritage features recorded on aerial photographs within the land take of the proposed turbines, access tracks, substation or site compound. No archaeological, architectural or cultural heritage features were revealed within any areas of proposed land take as a result of carrying out the walkover surveys. There are no recorded archaeological, architectural or cultural heritage features located in the area of the proposed substation. There are no recorded archaeological, architectural or cultural heritage features located in any areas of land take associated with road widening or access works.

9.3 Description of Likely Impacts

9.3.1 Construction Phase

The proposed development will involve the mechanical excavation of topsoil and overburden down to and through geologically deposited strata. As a result of carrying out this assessment, the following potential archaeological, architectural and cultural heritage impacts have been identified:

There are no RMP sites, Protected Structures, Architectural Conservation Areas, NIAH structures or NIAH historic gardens or designed landscapes within the proposed development area. As a result there will be no construction impact on the recorded archaeological, architectural or cultural heritage resource.

There are two RMP sites within the 1km study area. There is an indeterminable potential direct impact on previously unrecorded archaeological remains.

Access tracks will have a direct negligible impact on six townland boundaries, four parish boundaries, four barony boundaries and four county boundaries.

9.3.2 Operational Phase

There are two RMP sites within the 1km study area, neither of which survive above-ground. It is considered there will be a negligible visual impact on the archaeological resource.

There are two RMP sites within the 1km study area, neither of which survive above-ground. It is considered there will be no noise impact on the archaeological resource.

There is one Protected Structure (Saint Lazerian's Catholic Church, Graiguenahown: RPS Ref. No. 374) within the 1km study area. There are an additional 28 Protected Structures within the 5km study area. It is considered there will be a minor visual impact on Saint Lazerian's Catholic Church (RPS Ref. No. 374). Due to the distance of the remaining Protected Structures from the proposed development area, and the nature of the undulating landscape, it is considered there will be a negligible visual impact on the 28 Protected Structures.

9.4 Mitigation & Monitoring Measures

9.4.1 Construction Phase

Due to the presence of two RMP sites within the 1km study area and the discovery of a find from a townland within the development area recorded in the Topographical Files, it is recommended that archaeological monitoring be carried out in all areas of proposed land take. Monitoring will be

carried out under Licence to the Department of Arts, Heritage and the Gaeltacht and the National Museum of Ireland. Provision should be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring;

It is recommended that a written and photographic record be created, well in advance of any development works, where the access tracks truncate the townland, parish, barony and county boundaries. It is also recommended that monitoring be carried out where the access tracks truncate the townland, parish, barony and county boundaries. Provision should be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring.

9.4.2 Operational Phase

There are no mitigation measures available to offset the negligible visual impact on the archaeological resource;

There are no mitigation measures available to offset the minor visual impact on Saint Lazerian's Catholic Church (RPS Ref. No. 374). There are no mitigation measures available to offset the negligible visual impact on the additional 28 Protected Structures within the 5km study area.

Potential Impact	*Significance*	*Proposed Mitigation*	*Residual Impact*
Potential direct impact on previously unrecorded archaeological remains	Indeterminable	Monitoring, and full-scale excavation if required	None
Direct impact on six townland boundaries, four parish boundaries, four barony boundaries and four county boundaries	Negligible	Written and photographic record. Monitoring, and full-scale excavation if required	None
Visual impact on the archaeological resource	Negligible	None	Negligible
Visual impact on one Protected Structure (Saint Lazerian's Catholic Church, Graiguenahown, RPS Ref. No. 374)	Minor	None	Minor
Visual impact on 28 Protected Structures	Negligible	None	Negligible

Table 9.8: Summary of Impacts

References:

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Walsh, J.R. (2000). "The early Church", in Jefferies, H.A. and Devlin, C. (eds.). History of the Diocese of Derry from Earliest Times. (Dublin). Four Courts Press.

Cartographic Sources

Ordnance Survey	Map Editions 1841, 1842, 1890, 1902 and 1908
Internet Sources	
www.archaeology.ie	National Monuments Service
www.bing.com/maps	Bing aerial photography
www.buildingsofireland.ie	National Inventory of Architectural Heritage
www.excavations.ie	Database of Irish Excavation Reports
www.kilkennycoco.ie	Kilkenny County Council
www.laois.ie	Laois County Council
www.logainm.ie	Placenames Database of Ireland
www.maps.osi.ie	Ordnance Survey Ireland aerial photographs
www.pleanala.ie	An Bord Pleanála

Appendix 9.1: RMP Sites within the 1km Study Area

RMP No.:	LA030-016
Location:	Knockardagur
Classification:	Enclosure
Distance from proposed development area:	800m north west of Turbine 4
Description:	Part of a large subcircular enclosure visible on aerial photographs. No visible surface remains.
Reference:	www.archaeology.ie
RMP No.:	LA030-029
Location:	Ironmills or Kilrush
Classification:	Cist
Distance from proposed development area:	850m south of Turbine 10
Description:	A segmented cist with cremated bone and some small unclassifiable pot sherds.
Reference:	www.archaeology.ie

Appendix 9.2: Mitigation Measures and the Archaeological Resource

Potential Mitigation Strategies for Archaeological Remains

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative impacts.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse impacts can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse impacts is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved in situ.

Definition of Mitigation Strategies

The ideal mitigation for all archaeological sites is preservation in situ. This however is not always a practical solution, and a series of recommendations are therefore offered to provide ameliorative measures where avoidance and preservation in situ are not possible.

Archaeological excavation involves the scientific removal and recording of all archaeological features, deposits and objects to the level of geological strata or the base level of a given development. Full archaeological excavation is recommended where initial investigation has uncovered evidence of archaeologically significant material or structures and where avoidance of the site is not possible.

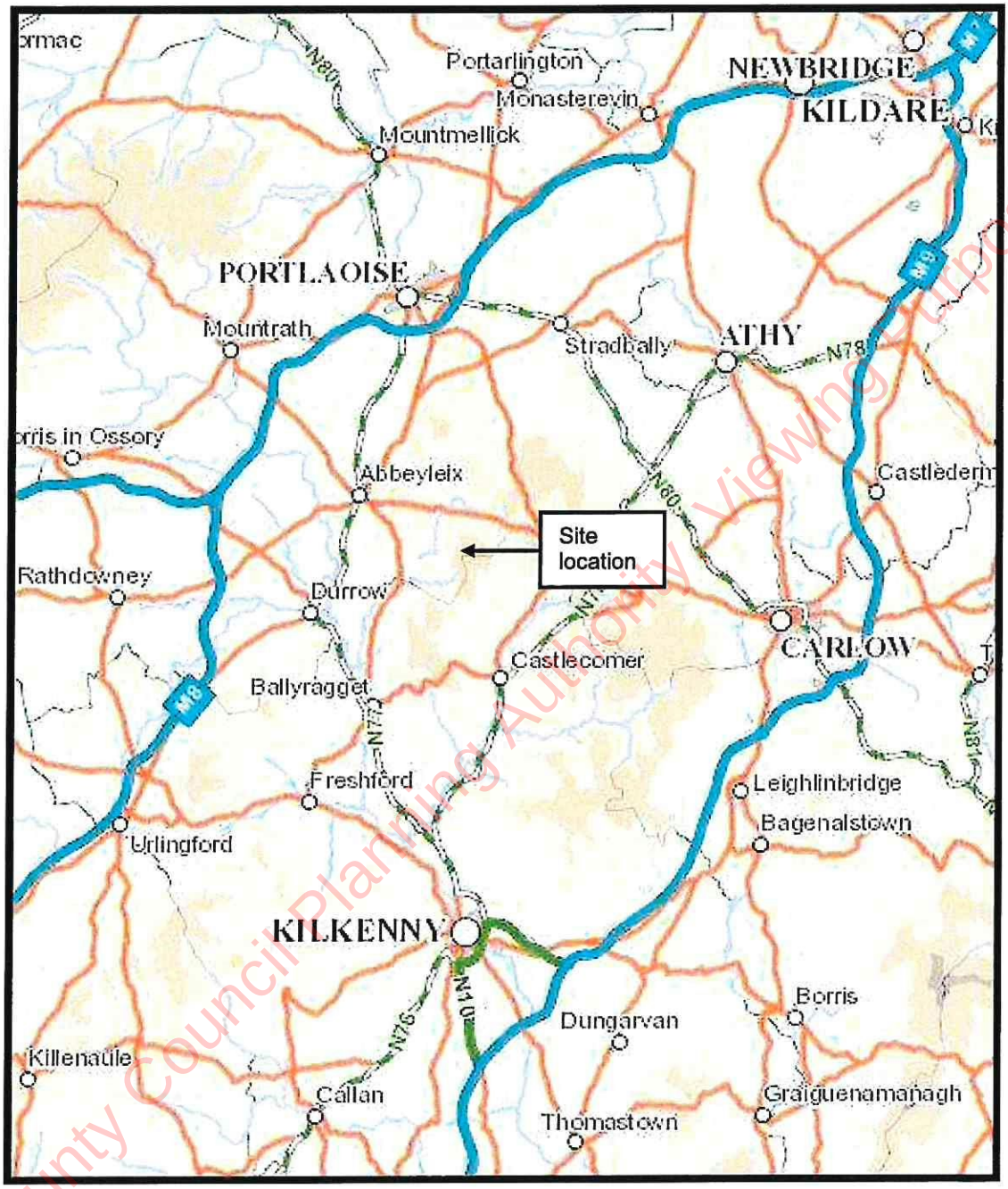
Archaeological test trenching is defined as:

"that form of excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development" (DAHGI 1999a, 27).

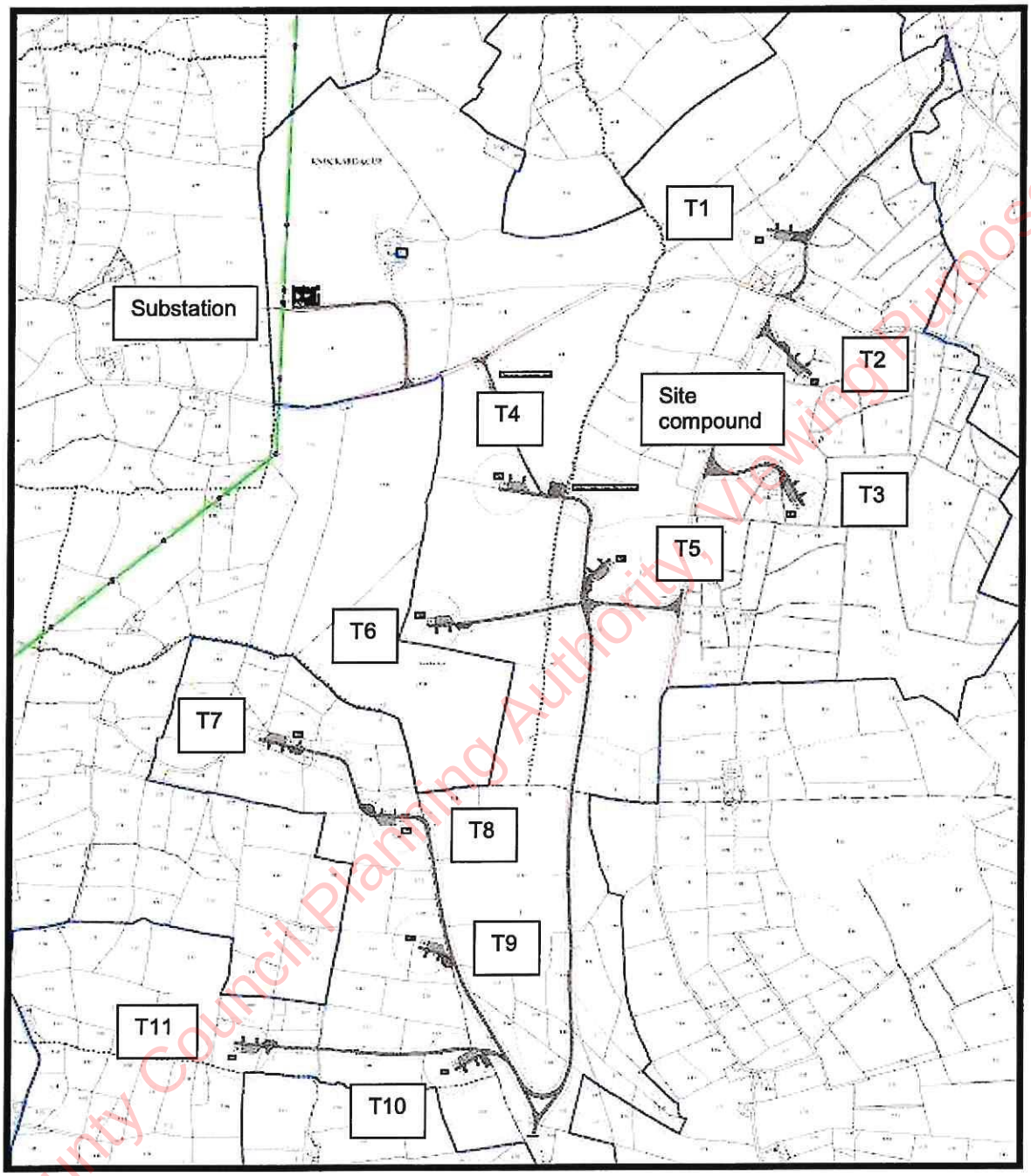
Archaeological monitoring:

"involves an archaeologist being present in the course of the carrying out of development works (which may include conservation works), so as to identify and protect archaeological deposits, features or objects which may be uncovered or otherwise affected by the works" (DAHGI 1999a, 28).

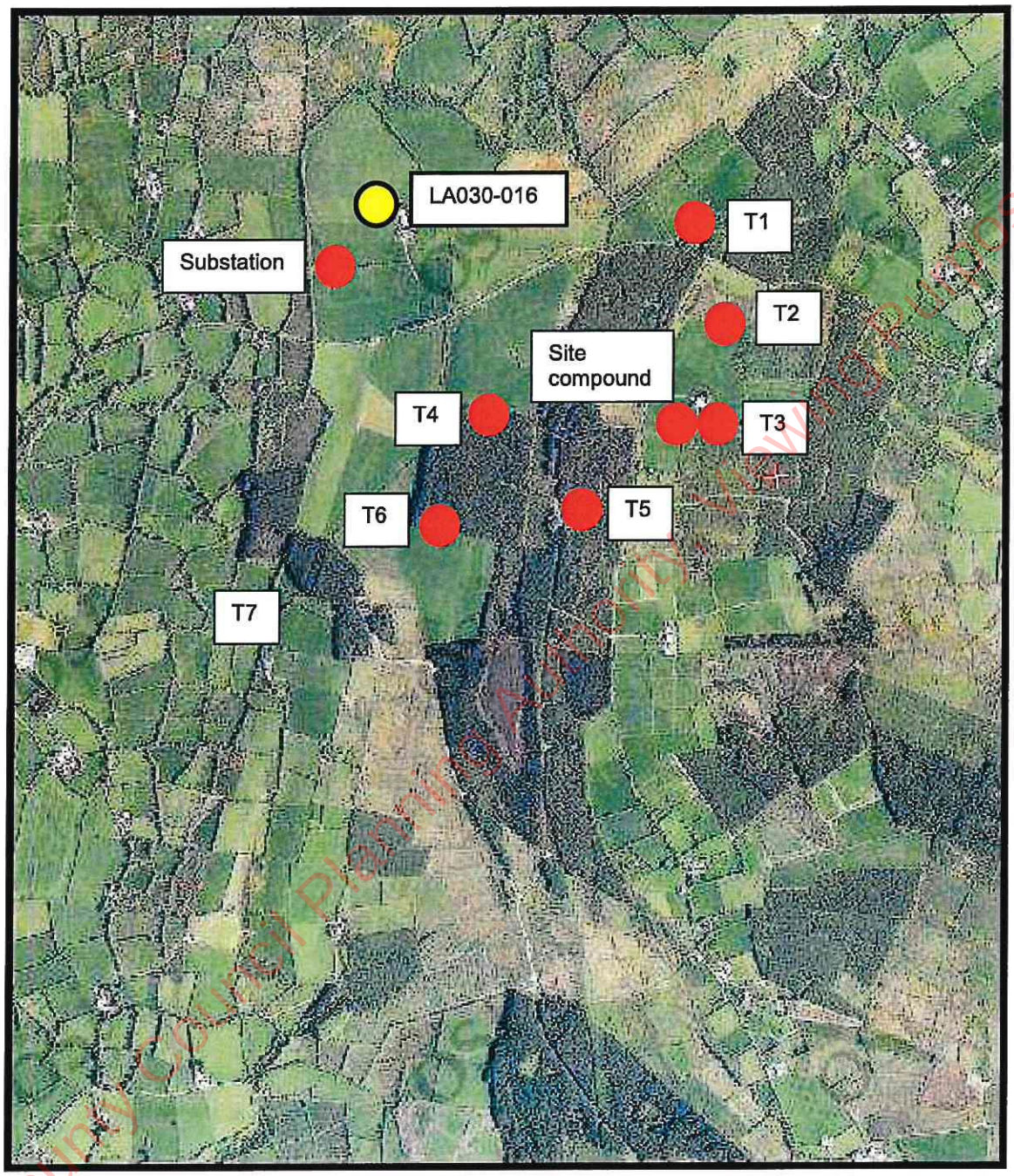
Appendix 9.3: Figures



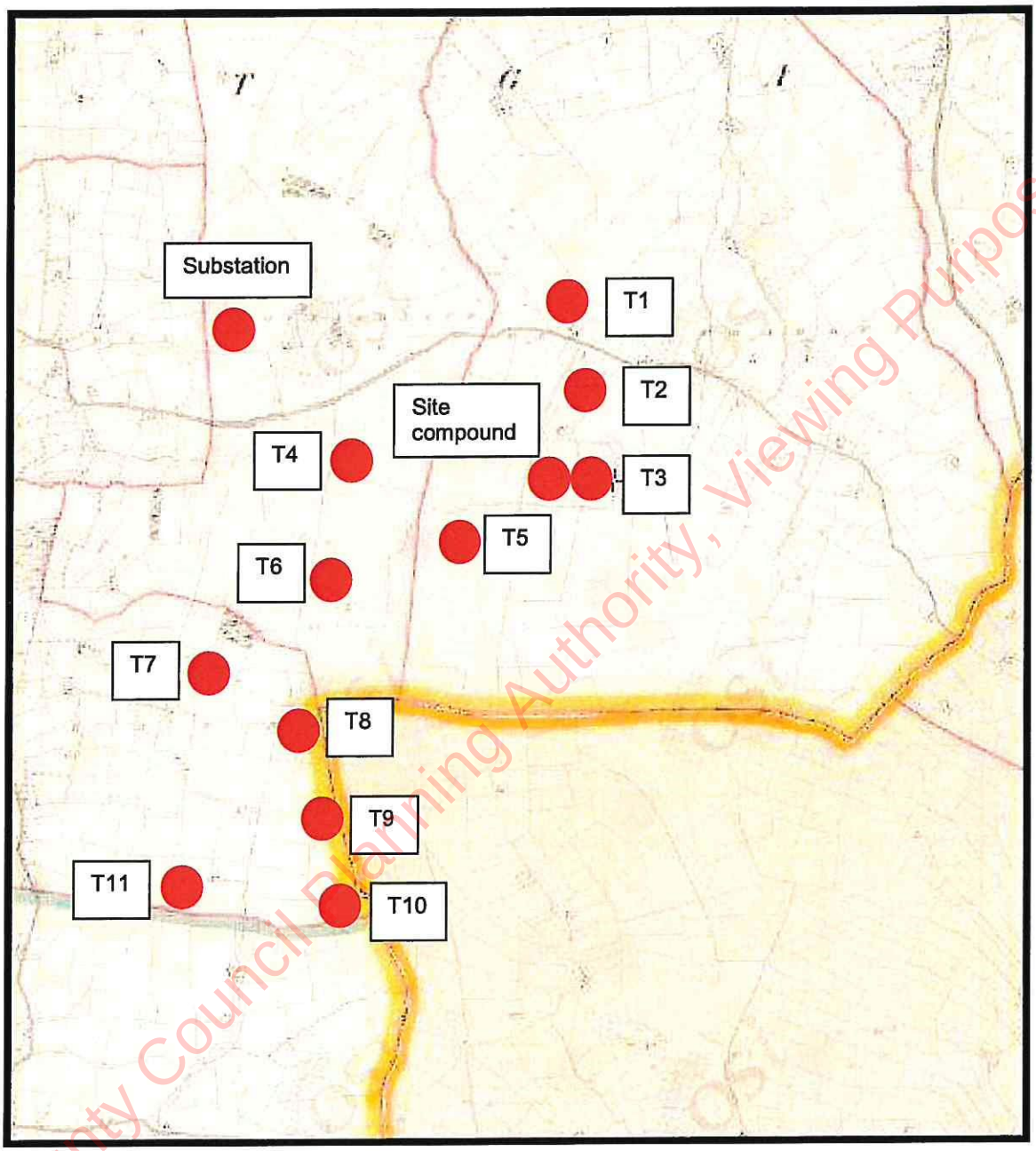
Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** Site location	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Figure:** 9.1



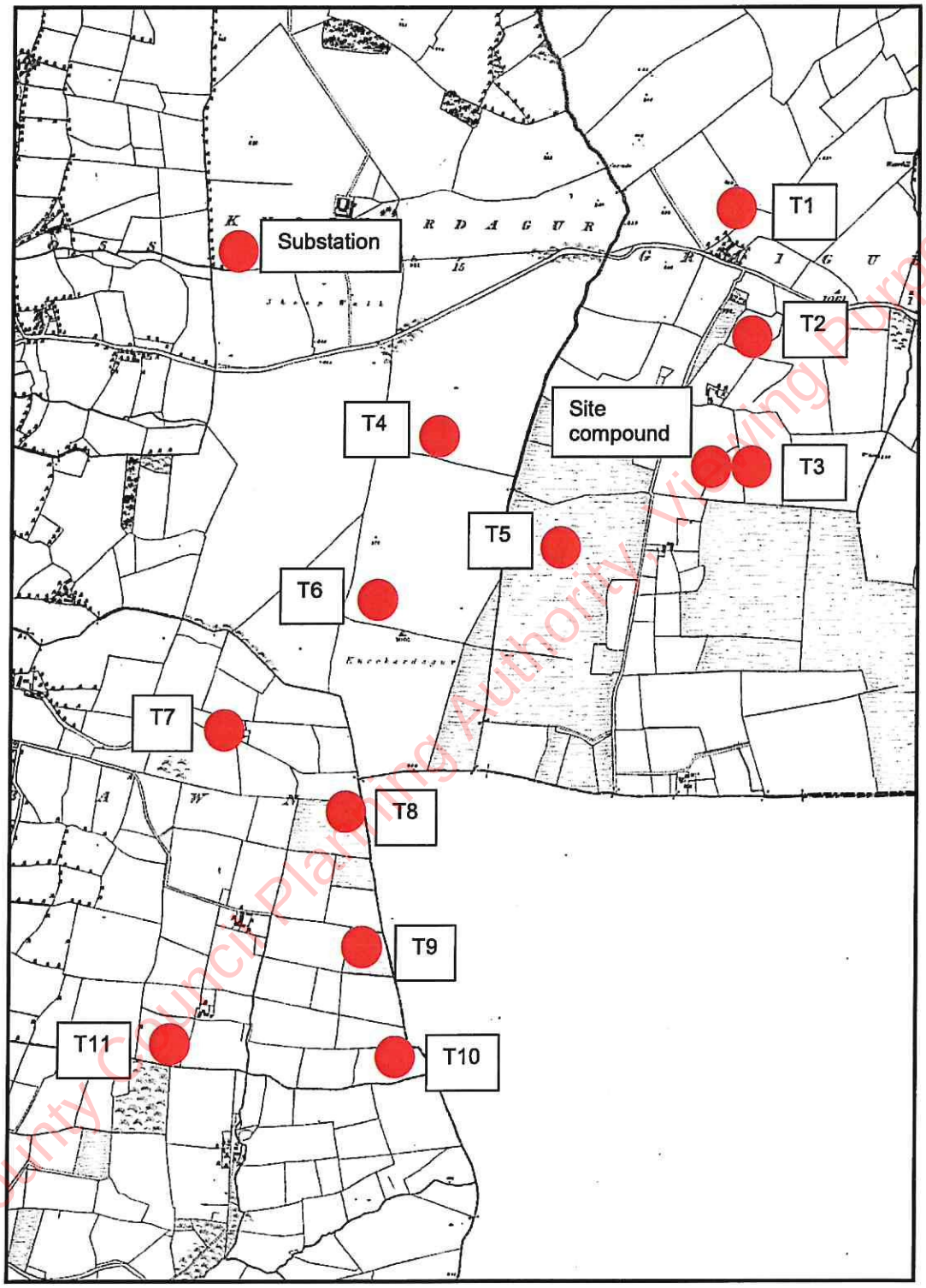
Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** Site layout showing Turbines 1 – 11, substation and site compound	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Figure:** 9.2



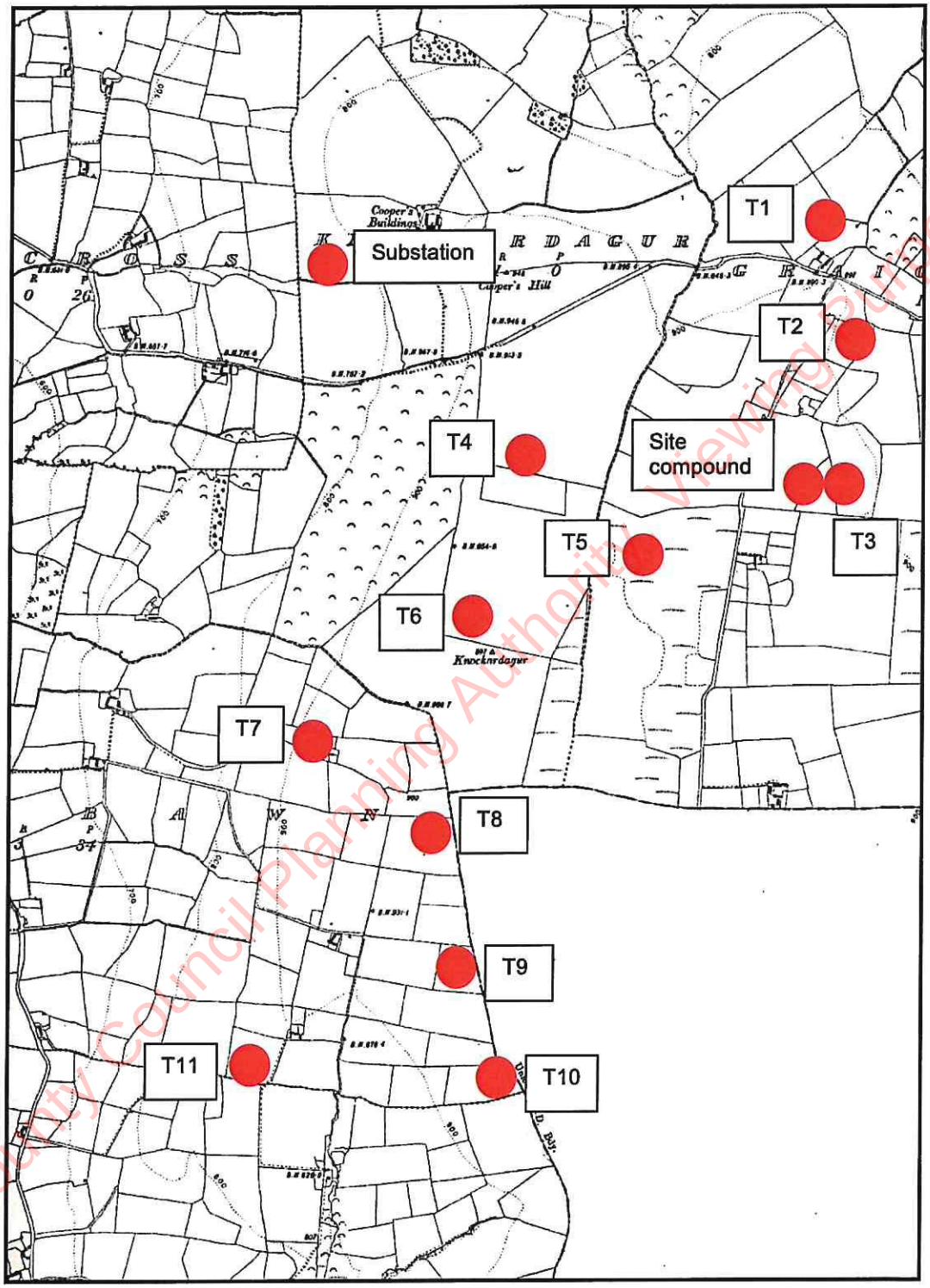
Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** Aerial photograph showing Turbines 1 – 11, substation, site compound and RMP sites within the 1km study area	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Figure:** 9.3



Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** Extract from First Edition OS map (1841) showing Turbines 1 – 11, substation and site compound	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Figure:** 9.4



Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** Extract from Second Edition OS map (1890) showing Turbines 1 – 11, substation and site compound	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Figure:** 9.5



Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** Extract from Third Edition OS map (1908) showing Turbines 1 – 11, substation and site compound	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Figure:** 9.6

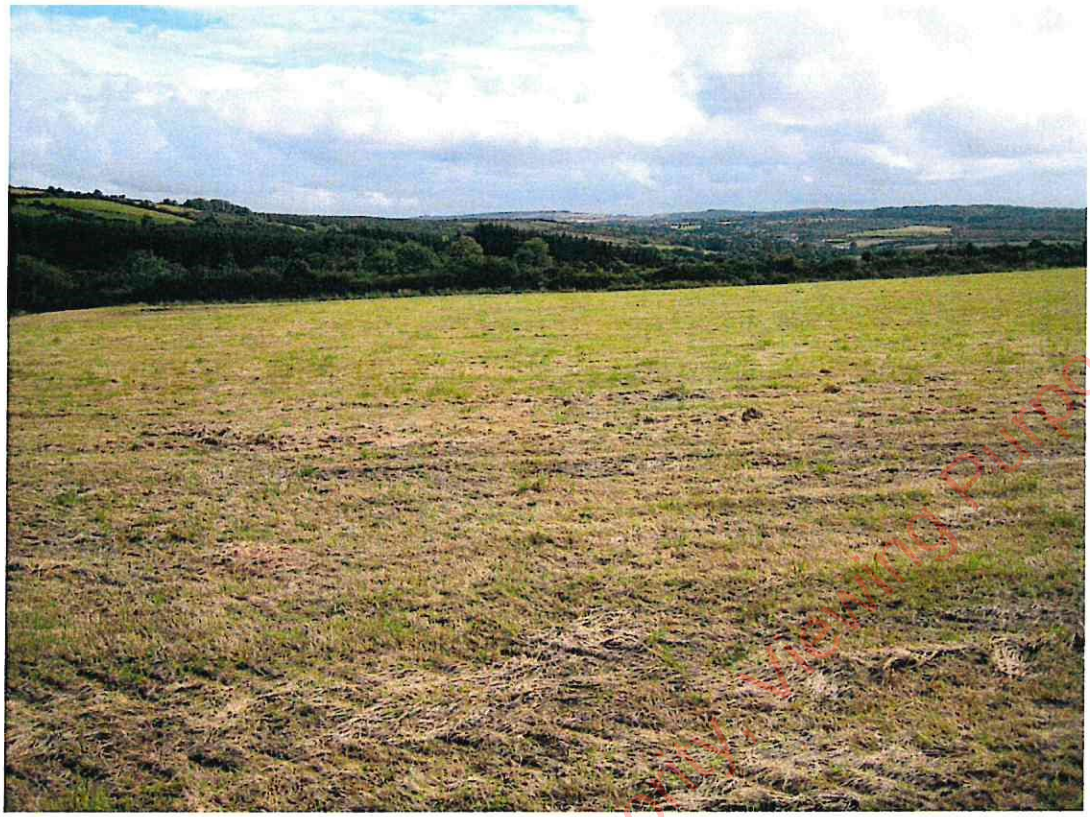
Appendix 9.4: Plates

Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** North east of Turbine 1, looking south west West of Turbine 2, looking east	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Plates:** 9.1 and 9.2

Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** South of Turbine 3, looking north East of Turbine 4, looking west	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Plates:** 9.3 and 9.4

Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** West of Turbine 5, looking east West of Turbine 7, looking east	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Plates:** 9.5 and 9.6

Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** General location of Turbine 9, looking west General location of Turbine 10, looking west	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Plates:** 9.7 and 9.8



Project: Pinewoods Wind Farm, Counties Laois and Kilkenny		**Title:** North of Turbine 11, looking south Well located south of road between Turbines 1 and 2, looking south	
Date: 12/5/2015	**Scale:** N.T.S.	**Client:** Pinewoods Wind Ltd.	**Plates:** 9.9 and 9.10

Chapter 10:
Noise

10.1 Introduction

10.1.1 Overview

This Chapter of the EIS assesses the potential noise impacts generated by the proposed wind farm development on the noise-sensitive locations in the vicinity of the site. GES Ltd. in association with Mr. Mike Simms, Acoustic Consultant, conducted an assessment into the likely noise impact associated with this proposed development during both the construction and operational phases.

During the operation of the wind farm, the principal source of noise will be generated from the blades rotating in the air (aerodynamic noise) and from internal machinery, to a lesser extent, and the generator (mechanical noise). Calculations in this assessment are based on an 11 no. turbine layout with each turbine modelled with an 85m hub height and a 103.0m rotor diameter. All receptors within 1,030m (10 rotor diameters) of a proposed turbine are assessed for noise impact. As the prevailing wind direction in Ireland is south-westerly, it is considered that receptors located north-west of the wind farm are potentially more sensitive to noise.

In assessing the noise impact of a wind development on the existing environment, information from the turbine manufacturer on operating noise sound levels is required. In addition, the existing baseline noise levels in the receiving environs of the subject lands must be established. In undertaking a baseline noise survey, acoustic data must be correlated with wind speed in order to provide a comprehensive assessment.

10.1.2 Purpose of the Noise Impact Assessment

The purpose of the noise impact assessment is to quantify the generated noise levels at nearby noise-sensitive locations resulting from the construction and operational phases of the wind farm to ensure compliance with the recommended guidance set out in the Wind Energy Development Guidelines for Planning Authorities, DoEHLG[1].

Predictions of 'worst-case' noise levels were carried out based on the proposed site layout and the manufacturer's guaranteed noise levels for turbines for the site. 'Worst-case' noise levels in this instance means that all receptors are considered to be downwind of all wind turbines, which clearly cannot happen in practice at all houses simultaneously.

10.1.3 Noise Criteria & Guidance

10.1.3.1 Noise in the Environment

Wind farms are generally situated in rural environments where there are few sources of noise. When wind speeds are high, noise tends not to be a problem since any noise generated is masked by wind induced noise effects, particularly that of the trees and vegetation being blown. However, at lower wind speeds or in particular sheltered locations, the wind induced background noise may not be sufficient to mask any noise generated by wind turbines. At these low speeds, the generated noise levels may be so low as to generate very little impact. The prevailing wind direction in Ireland is south-westerly, therefore receptors located to the north-west of a wind farm development are potentially sensitive, in that exposure to wind farm noise may be more prevalent.

Noise levels are normally expressed in decibels. Noise in the environment is measured using the dB(A) scale which includes a correction for the response of the human ear to noises with different frequency content. As a general rule, for noises of the same nature, a change of 3dB(A) is the minimum perceptible under normal conditions, and a change of 10dB(A) corresponds roughly to halving or doubling the loudness level of a sound[1].

All measurements are based on L_{A90} levels rather than L_{Aeq}. L_{A90} is the 90th percentile noise level which is exceeded for 90% of the time. As wind turbines will be operating continuously throughout its particular range the L_{A90} level is more useful in identifying noise which may be attributed directly

to the wind farm rather than L_{Aeq} which will be affected by short term influences such as a passing car or localised agricultural activities.

10.1.3.2 Construction Phase

There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Planning authorities normally control construction activities by imposing noise limits and restrictions on the hours of operation.

In the absence of statutory noise limits, appropriate criteria relating to permissible construction noise levels for a development proposal of this scale may be found in the National Roads authority (NRA) publication '*Guidelines for the Treatment of Noise and Vibration in National Road Schemes*'[1]. **Table 10.1** sets out the maximum permissible noise levels at the facade of dwellings during construction as recommended in the NRA guidelines. The majority of the construction activity in this instance is expected to occur during the normal working hours.

Days and Times	*Noise Levels (dB re. $2x10^{-5}$ Pa)*	
	$L_{Aeq(1hr)}$	L_{Amax}
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75*
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

Table 10.1: Maximum Permissible Noise Levels at the Facade of Dwellings during Construction Source: National Roads Authority

Note: Construction activity outside of these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

10.1.3.3 Operational Phase

Noise is generated by wind turbines as they rotate to generate power. This only occurs above the 'cut-in' wind speed and below the 'cut-out' wind speed. Below the cut-in wind speed there is insufficient strength in the wind to generate efficiently and above the cut-out wind speed the turbine is automatically shut down to prevent any malfunctions from occurring. The cut-in speed at turbine hub height is normally 3m/sec and the cut out wind speed is normally around 25 m/sec at hub height (85m) on the GE 3.2-103 turbine model, which is anticipated to be installed on-site. The principal sources of noise resulting from wind turbines are aerodynamic noise and mechanical noise.

10.1.3.4 Aerodynamic Noise

Aerodynamic noise is caused by blades passing through the air and it is generally broadband in nature which can have a swishing character. This noise is a function of many factors including blade design, rotational speed, and wind speed and inflow turbulence. Aerodynamic noise has been substantially reduced over time due to improvements in turbine design.

As a result, aerodynamic noise is wind speed dependant, and the sound power output from a turbine must be measured and quoted relative to wind speed. The reference sound power output from a turbine is typically provided by the manufacturer over a range of wind speeds.

Careful design of the rotor blades ensures that aerodynamic noise is minimised. Special consideration is given to the blade tips which, due to their relatively high velocities, generate the most noise. Nevertheless, it should be noted that aerodynamic noise is an unavoidable by-product of wind generated electricity. The use of sufficient separation distances is therefore the fundamental design option available to wind farm developers for the control of noise at residential properties.

10.1.3.5 Mechanical Noise

Mechanical noise is generated by components inside the turbine nacelle (usually the gearbox and generator) and can be radiated by the shell of the nacelle, blades and the tower structure.

Unlike aerodynamic noise, mechanical noise tends to be tonal in nature, i.e. it is concentrated at a few discrete frequencies. Mechanical noise can be successfully controlled at the design stage of the turbine, using advanced gearbox design and anti-vibration techniques. As mentioned above technological developments in engineering practices have in general limited mechanical noise output.

10.1.3.6 Wind Energy Planning Guidelines for Local Authorities, (DoEHLG), 2006

The noise impact guidance for wind energy development is set out in the Wind Energy Development Guidelines for Planning Authorities (2006)[2]. The recommendations put forward in the Guidelines state:

> *"In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of the $L_{A90,\ 10min}$ of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A)."*

The guidelines explain *'A-weighted decibel'* as:

> *"a measure of the overall noise level of sound across the audible frequency range (20Hz-20 kHz) with A- frequency weighting to compensate for the varying sensitivity of the human ear to sound at different frequencies. The decibel scale is logarithmic. A 10 dB(A) increase in sound level represents a doubling of loudness. A change of 3 dB (A) is the minimum perceptible under normal circumstances"*

The Guidelines further recommend that:

> *"Separate noise limits should apply for day-time and for night-time. During the night the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43dB(A) will protect sleep inside properties during the night.*

The Guidelines consider that *noise is considered unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500 metres. Planning authorities may seek evidence that the type(s) of turbines proposed will use best current engineering practice in terms of noise creation and suppression"*

10.1.3.7 "The Assessment and Rating of Noise from Wind Farms" – ETSU-R-97 September 1996, published by the UK Department of Trade and Industry[3]

The Irish guidelines discussed in the previous section are broadly based on ETSU-R-97 document, which also comments, in respect of houses where the occupant has an interest in the development:

> *"... that both day- and night-time lower fixed limits can be increased to 45dB(A) and that consideration should be given to increasing the permissible margin above background where the occupier of the property has come financial involvement in the wind farm."*

The suggested noise limits take into account the fact that all wind turbines exhibit the character of noise described as blade swish to a certain extent. ETSU-R-97 recommends that a penalty should be

added, however, to the predicted noise levels, where any tonal component is present. The level of this penalty is related to the level by which any tonal components exceed audibility.

10.1.3.8 Decommissioning Phase

There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the decommissioning phase of a project. Planning authorities normally control construction and decommissioning activities by imposing noise limits and restrictions on the hours of operation.

In the absence of statutory noise limits, appropriate criteria relating to permissible noise levels for a development of this scale may be found in the National Roads authority (NRA) publication *'Guidelines for the Treatment of Noise and Vibration in National Road Schemes'*[4]. **Table 10.1** above sets out the maximum permissible noise levels at the facade of dwellings during construction as recommended in the NRA publication. The majority of the decommissioning activity in this instance is expected to occur during the normal working hours.

10.1.4 Methodology

10.1.4.1 Survey Instruments and Personnel

Mr. Mike Simms (Acoustic Consultant) directed the background noise surveys and the meteorological survey.

Wind data was obtained from the 80m high meteorological mast which has been erected for wind energy evaluation purposes. This mast has anemometers at three heights, 80m, 65m, and 50m. From this, standardised wind speeds at 10 m height have been calculated.

The equipment used in the noise survey was two Svantek 955 Sound Level Meters, each equipped with an outdoor microphone kit, mounted at a height of 1.2 m. Each unit was calibrated before and after the surveys. The meters were configured to measure L_{A90} values over 10-minute intervals, synchronised with the meteorological mast.

10.1.4.2 Receptor Survey

A receptor survey was conducted in order to quantify the number of properties within 1,030 m (10 rotor diameters) of the proposed turbines. In total, 33 receptors were found.

In addition to the on-site survey, a planning history search was carried out in the environs of the subject site using the on-line planning database of Laois County Council and Kilkenny County Council to identify any lands within 1,030 m of a proposed turbine that had received planning permission for development or had applied for planning permission. No additional properties were found.

On this basis, a set of noise-sensitive locations was selected based both on the proximity to the proposed development site and on the variation in ambient noise environments that is expected in the surroundings of the proposed development site. 4 no. houses in the vicinity of the subject site were selected to carry out a survey of background noise.

A noise level meter was installed at each location, taking into account a number of considerations, from ETSU-R-97, which are in turn based on BS4142[4]:

- the microphone should be at least than 10m from a building facade, in order to correlate the results to a free-field noise level;
- where possible, the location selected should represent that used by the residents for outdoor amenity;
- the microphone should be no less than 1.2m above the ground, so that a representative level can be measured, but yet the microphone itself is not overly exposed to the wind.

Measurements were carried out in terms of the $L_{A90,\ 10min}$ parameter, which is the 'A'-weighted, background noise level measured over consecutive 10-minute periods.

10.1.4.3 Meteorological Survey

The wind survey consists of measuring the wind speed at a representative location on the wind farm site, to run concurrently with the noise surveys. The meteorological mast currently in place for the evaluation of wind resource was used.

As rainfall can also affect measured background noise level, rain data was also analysed, so that data during periods of significant rainfall could be removed at a later stage.

The location chosen for the meteorological survey was at the following coordinates:

Description	National Grid Coordinates	
	Easting	Northing
80m Met Mast	250886	181921

Table 10.2: Location of Meteorological Masts

Due to the nature of the wind farm site and surrounding area, it is considered that wind speed behaviour at this location is representative of the general conditions on the wind farm site, thus data obtained is valid for comparison with any of the locations selected for noise surveys.

10.1.4.4 Noise Survey Locations and Dates

The noise survey locations are presented in **Table 10.3** below and are also shown in **Figure 10.1.**

House ID	Locality	National Grid Coordinates		Dates
		Easting	Northing	
H03	Graiguenahown	251992	183032	25/2 to 10/3/2011
H11	Graiguenahown	252557	182147	10/3 to 23/3/2011
H13	Knockardagur	251492	181109	28/1 to 23/2/2011
H27	Boleybawn	249788	180473	25/2 to 10/3/2011

Table 10.3: Noise Survey Locations

- House 03 is along a local road to the northeast of the site. The meter was located in a lawn area to the side of the house;
- House 11 is along a local road to the northeast of the site. The meter was located in an open area to the front of the house;
- House 13 is at the end of a lane off a local road to the east and south of the site. The meter was located in a open lawn area to the front of the house;
- House 27 is along a local road to the west. The meter in an open field to the rear of the house.

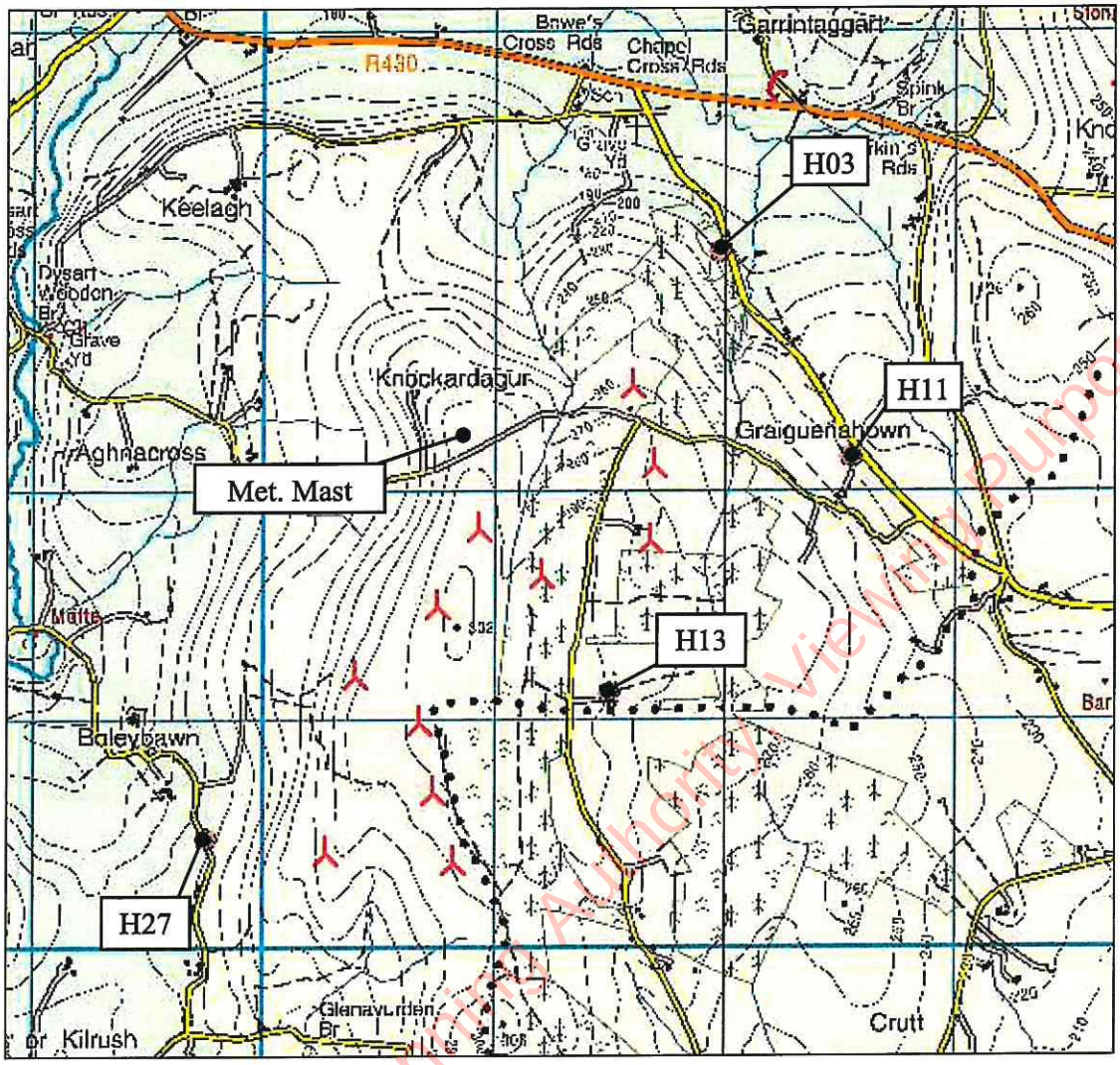


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Figure 10.1: Noise Survey Locations

10.2 Description of the Existing Environment

10.2.1 Survey Results and Discussion

The noise levels at the survey locations over a range of wind speeds are presented in **Table 10.4** and **Table 10.5** below, for daytime and night-time respectively. These are the noise levels which result by averaging the wind and noise samples by fitting a curve to the measured data, as best allowed by the data captured during the survey. Please refer to **Appendix 10.1** for a graphical representation of the data.

Wind Speed, m/s at 10m height	Noise Level L_{A90}, dB(A) re $2x10^{-5}$Pa, at House			
	H03	H11	H13	H27
4	30.6	23.9	22.2	20.8
5	31.4	25.8	22.9	22.2
6	32.2	27.8	24.2	24.2
7	33.1	29.6	26.1	26.6
8	34.1	31.4	28.4	29.2
9	35.0	32.9	31.0	31.8
10	35.7	34.1	33.8	34.4
11	36.4	35.0	36.7	36.8
12	36.7	35.5	39.6	39.2

Table 10.4: Daytime prevailing noise levels at the survey locations at various wind speeds

Wind Speed, m/s at 10m height	Noise Level L_{A90}, dB(A) re $2x10^{-5}$Pa, at House			
	H03	H11	H13	H27
4	27.3	19.5	18.1	18.7
5	27.3	19.5	18.2	18.8
6	28.2	19.7	20.7	20.5
7	29.0	20.5	23.0	22.1
8	30.1	21.8	25.7	24.1
9	31.3	23.9	28.8	26.4
10	32.6	26.8	32.1	28.9
11	33.9	30.6	35.4	31.5
12	35.3	35.4	38.8	34.2

Table 10.5: Night-time prevailing noise levels at the survey locations at various wind speeds

10.3 Description of Likely Impacts

10.3.1 Noise Prediction Model

10.3.1.1 Overview

There are 33 no. properties located within 1,030m of a proposed turbine (10 rotor diameters). To predict the noise generated at these properties, noise modelling was conducted using WindPRO software, Version 2.8.579. Please refer to **Appendix 10.2** for the results of the prediction model.

The noise prediction model was run from 4 to 12 m/s at 1 m/s intervals. All criteria are based on L_{A90} levels rather than L_{Aeq}. L_{A90} is the 90th percentile noise level which is exceeded for 90% of the time. As wind turbines will be operating continuously throughout its particular operating range the L_{A90} level is much more useful in identifying noise which may be attributed directly to the proposed

development rather than L_{Aeq} which will be affected by short term influences such as a passing car or plane or short-term noise from external influences including wildlife or man-made sources.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the frequency characteristics of human hearing. All sound pressure levels are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

The Noise prediction model implements the International Standard ISO 9613-2, Acoustics – Attenuation of Sound during Propagation Outdoors[5]. The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based on conditions favourable to noise propagation.

The ISO propagation model calculates the predicted sound pressure level by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors according to the following:

Predicted Octave Band Noise Level =

$$L_w + D - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$$

These factors are discussed in detail below. The predicted octave band levels from each of the turbines are summed together to give the overall 'A' weighted predicted sound level from all the turbines acting together.

10.3.1.2 L_W - Source Sound Power Level

The proposed development consists of 11 no. GE 3.2-103 turbines. The parameters of this turbine type are as follows:

Turbine Elements	*GE 3.2-103*
Rotor diameter	103.0m
Hub height	85m
Cut-in wind speed (at hub height)	3m/s
Cut-out wind speed (at hub height)	25m/s

Table 10.6: Wind Turbine Parameters of the GE 3.2-103 Turbine Model

**Note: The final turbine modem to be installed on site maybe subject to minor immaterial deviations*

The sound power level of a noise source is normally expressed in dB re:1pW. Noise predictions for this site have been based on sound power levels of the GE 3.2-103 turbine, at a hub height of 85m, using the values in **Table 10.7** below.

Wind Speed at 10m Height (m/s)	*Sound Power Level , dB(A) re 10^{-12}W*
4	98.0
5	101.7
6	104.9
7	106.7
8	107.0
9	107.0
10	107.0
11	107.0

Wind Speed at 10m Height (m/s)	Sound Power Level , dB(A) re 10^{-12}W
12	107.0

Table 10.7: Wind Turbine Sound Power Levels

10.3.1.3 Directivity Factor

The directivity factor allows for an adjustment to be made where the level of sound radiates from the source in a non-uniform manner. In this case the sound power level is measured in a down wind direction, corresponding to the worst case propagation conditions considered and needs no further adjustment.

10.3.1.4 A_{geo} – Geometrical Divergence

The geometrical divergence accounts for spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to:

$$A_{geo} = 20 \times \log (d) + 11$$

where d = distance from the turbine

Each of the wind turbines may be considered as a point source beyond distances corresponding to one rotor diameter.

10.3.1.5 A_{atm} – Atmospheric Absorption

Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. The attenuation depends on distance according to:

$$A_{atm} = d \times \alpha$$

where d = distance from the turbine and

α = atmospheric absorption coefficient in dB/m

Values of 'α' from ISO 9613 Part 1, corresponding to a temperature of 15ºC and a relative humidity of 70% have been used for these predictions, which give relatively low levels of atmospheric attenuation and correspondingly worst case noise predictions, as given below.

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Atmospheric Absorption Coefficient (dB/m)	0.0001	0.0004	0.0011	0.0023	0.0041	0.0087	0.0264	0.0937

Table 10.8: Assumed Octave Band Atmospheric Attenuation Coefficients

10.3.1.6 A_{gr} – Ground Effect

Ground effect is the interference of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depends on the source height, receiver height, propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable G, which varies between 0 for 'hard' ground (includes paving, water, ice, concrete & any sites with low porosity) and 1 for 'soft' ground (includes ground covered by grass, trees or other vegetation). The predictions have been carried out using a source height corresponding to the proposed height of the turbine nacelle, a receiver height of 4 m and an assumed ground factor G = 0.5.

10.3.1.7 A_{bar} – Barrier Attenuation

The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise. The barrier attenuations predicted by the ISO 9613 model have, however, been shown to be significantly greater than that measured in practice under down wind conditions. The results of a study of propagation of noise from wind farm sites carried out for ETSU concludes that an attenuation of just 2 dB (A) should be allowed where the direct line of sight between the source and receiver is just interrupted and that 10 dB (A) should be allowed where a barrier lies within 5m of a receiver and provides a significant interruption to the line of sight. It should be noted that no barrier attenuation has been used in any of the noise predictions for this site.

10.1.3.8 A_{misc} – Miscellaneous Other Effects

ISO 9613 includes effects of propagation through foliage, industrial plant and housing as additional attenuation effects. These have not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

10.3.2 Prediction of likely Noise Impacts

When considering a development of this nature, the potential noise impact on the surroundings must be considered for each of two distinct stages: (i) the short term impact of the construction phase; (ii) the longer term impact of the operational phase; and (iii) the short term duration of the decommissioning phase. Given the nature of the proposed development, it is unlikely that there will be any significant overlap of these phases.

10.3.2.1 Construction Phase

A variety of items of plant will be in use, such as excavators, lifting equipment, dumper trucks, compressors, and generators. There will be vehicular movements to and from the site that will make use of existing roads.

Due to the nature of the activities undertaken on a large construction site, there is potential for generation of significant levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of noise levels. The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works and lorry movements on uneven road surfaces. Due to the proximity of sensitive locations to the site access point, the more significant of these is likely to be uneven road surfaces.

Typical sound levels at 10m from construction equipment are found in 'BS5228:2009 *Code of practice for noise and vibration control on construction and open site's*, values from which are presented in **Table 10.9** below. Due to the fact that the construction program has been established in outline form only, set out in **Chapter 2** of the EIS, it is difficult to calculate precisely the actual magnitude of noise emissions to the local environment. However, the nearest noise-sensitive location to the proposed construction works is House H03, at a distance of approximately 100m from the proposed entrance at the north end of the site. The construction noise levels at this location have been predicted by applying a correction for the additional distance to the house also shown in the table.

Noise Source	*BS5228 Ref.*	*dB(A) $L_{Aeq,10m}$*	*dB(A) L_{Aeq} at house H03*
Excavator (22t)	C2.3	78	58
Dozer	C2.12	81	61
Dump Truck (tipping fill)	C2.30	79	59
Roller (rolling fill)	C2.37	79	59

Noise Source	BS5228 Ref.	dB(A) $L_{Aeq,10m}$	dB(A) L_{Aeq} at house H03
Concrete Mixer Truck	C4.20	80	60
Mobile Telescopic Crane	C4.39	77	57
Mini Tracked Excavator (5t)	C4.68	74	54

Table 10.9: Typical Sound Levels from Construction Equipment

**Source: BS5228:2009 Code of practice for noise and vibration control on construction and open sites*

As can be seen, the expected noise levels are below the criteria in **Table 10.1** for weekdays and Saturdays. It should also be noted that most houses are considerably further away from any part of the proposed works and as such the scenario described above is very much a worst case. Additionally, the construction works will progress around the site, thus any construction noise impact on any particular house will be transitory and temporary

10.3.2.2 Operational Phase

The noise levels due to the proposed operation of the wind farm over a range of wind speeds, are presented in **Table 10.10** below.

Wind Speed, m/s at 10m height	Noise Level LA90, dB(A) re 2x10-5Pa, at House			
	H03	H11	H13	H27
4	29.6	29.4	34.4	32.2
5	33.3	33.1	38.1	35.9
6	36.6	36.4	41.4	39.2
7	38.6	38.4	43.3	41.2
8	38.7	38.6	43.5	41.4
9	38.7	38.6	43.5	41.4
10	38.7	38.6	43.5	41.4
11	38.7	38.6	43.5	41.4
12	38.7	38.6	43.5	41.4

Table 10.10: Wind turbine noise levels at the survey locations at various wind speeds.

The comparison of the wind turbine noise levels against the prevailing background noise at survey locations is presented in graphical and tabular form in **Appendix 10.1.** The points represented as small circles are individual samples of background noise versus wind speed, with day and night presented on separate graphs for each of the 4 no. locations. In order to average these samples, a curve fit using a polynomial regression is shown. The dotted line on each graph illustrates a planning criterion based on guidance in the Wind Energy Development Guidelines for Planning Authorities 2006.

Each survey location is now discussed in turn:

- *House H03:* At this location, the noise levels at all wind speeds are within both the daytime lower limit of 45dB L_{A90} and the night-time lower limit of 43dB L_{A90}, and therefore comply with the adopted criteria;

- *House H11:* At this location, the noise levels at all wind speeds are within both the daytime lower limit of 45dB L_{A90} and the night-time lower limit of 43dB L_{A90}, and therefore comply with the adopted criteria;
- *House H13:* At this location, the noise levels at all wind speeds are within both the daytime lower limit of 45dB L_{A90} and the night-time lower limit of 45dB L_{A90}, which applies for houses with financial involvement in the project and therefore comply with the adopted criteria;
- *House H27:* At this location, the noise levels at all wind speeds are within both the daytime lower limit of 45dB L_{A90} and the night-time lower limit of 43dB L_{A90}, and therefore comply with the adopted criteria.

The above deals with the properties included in the set of noise survey locations. As it is not practicable to survey noise levels at all houses, a method is required to assess the impact at the remaining houses in the study area.

Noise levels for 29 no. additional houses in the vicinity of the site have been predicted for the wind speed of 12 m/s at 10m height. The results for all houses are re-produced in **Table 10.11** below. It should be noted that these predictions represent downwind propagation in all directions, which clearly cannot happen at all locations simultaneously.

ID	*Predicted Noise Level L_{A90}*	*Applicable lower fixed noise limit, L_{A90}, see text.*	*Complies with Limit?*
H01	36.5	43.0	Yes
H02	37.9	43.0	Yes
H03	38.7	43.0	Yes
H04	40.5	43.0	Yes
H05	38.7	43.0	Yes
H06	39.8	43.0	Yes
H07	39.2	43.0	Yes
H08	39.2	43.0	Yes
H09	39.0	43.0	Yes
H10	40.0	43.0	Yes
H11	38.6	43.0	Yes
H12	39.1	43.0	Yes
H13	43.5	45.0	Yes
H14	43.3	45.0	Yes
H15	39.9	43.0	Yes
H16	39.9	43.0	Yes
H17	38.7	43.0	Yes
H18	38.5	43.0	Yes
H19	37.6	43.0	Yes
H20	36.8	43.0	Yes

ID	Predicted Noise Level L_{A90}	Applicable lower fixed noise limit, L_{A90}, see text.	Complies with Limit?
H21	37.2	43.0	Yes
H22	40.8	43.0	Yes
H23	37.9	43.0	Yes
H24	36.6	43.0	Yes
H25	38.0	45.0	Yes
H26	40.2	45.0	Yes
H27	41.4	45.0	Yes
H28	39.4	43.0	Yes
H29	38.7	43.0	Yes
H30	40.6	43.0	Yes
H31	41.2	43.0	Yes
H32	37.9	43.0	Yes
H33	38.6	43.0	Yes

Table 10.11: Predicted Noise generated at all properties located within 1,030m of a proposed turbine

The lower fixed noise level limit is 43dB L_{A90} for non-involved houses (based on the night-time criteria in the DoEHLG guidelines), and the lower fixed noise level limit for involved houses is 45dB L_{A90}. The predicted noise level therefore lie within the adopted criteria in all cases. The noise impact of the wind farm is considered acceptable.

10.3.2.3 Decommissioning Phase

The decommissioning phase will involve similar operations to those outlined for the construction phase. It is logical therefore that a similar noise impact is predicted for the decommissioning phase. In reality, however, it is likely that the noise impact from decommissioning will have a lesser noise impact than that of the construction phase. This is due to the fact that some of materials which were imported to the site will not be removed.

10.4 Mitigation & Measures

10.4.1 Construction Phase

Construction activities will give rise to noise on site from the increased traffic as well as the construction activity.

To ensure that construction noise remains below 'nuisance' levels, reference will be made to BS 5228: Part 1: 1997 (Noise Control on Construction and Open Sites – Part 1. Codes of Practice for Basic Information and Procedures for Noise Control) which offers detailed guidance on the control of noise from demolition and construction activities.

Accordingly all construction traffic to be used on site should:

- Have effective well-maintained silencers;
- Operators of all mobile equipment will be instructed to avoid unnecessary revving of machinery;

- Where possible the contractor will be instructed to use the least noisy equipment;
- With efficient use of well-maintained mobile equipment considerably lower noise levels than those predicted can be attained;
- The construction phase on-site project engineer will closely supervise all construction activity;
- Construction activity due to its nature is a temporary activity and thus any impacts will be short term typically 12-18 months.

The following mitigation measures for control of construction noise will be implemented, as recommended in BS 5228: Part 1:1997 and as part of the Construction Management Plan:

- The hours of construction activity will be limited to between 08.00 hours and 20.00 hours Monday to Friday and 08.00 hours and 18.00 hours on Saturdays. It should be noted that it may be necessary to commence turbine base concrete pours from 06.00 due to time constraints incurred by the concrete curing process. Additional emergency works may also be required outside of normal working hours as quoted above;
- Communication links will be established and maintained between the developer, contractor, Local Authority and local residents;
- Equipment and technology with generation of low noise levels will be selected where possible;
- Noise generating equipment will be located as far as possible away from local noise sensitive areas identified;
- In the unlikely event that irregularities or complaints arise, the source of the problem will be sought and dealt with;
- Temporary barriers or screens can be erected if necessary around noisy equipment such as generators and compressors.

10.4.2 Operational Phase

Mitigation of noise from the proposed development consists of the following measures:

- Site layout design to ensure minimal disruption to sensitive receptors;
- It is recommended that, additional post development noise monitoring in accordance with international noise standards and in particular ISO 1996: "Description and measurement of environmental noise" be carried out to monitor accurately the acoustic impact of development according to site atmospheric conditions and corrected for background speeds at any potentially sensitive locations.

Mitigation by design measures have already been put in place by siting the wind turbines in an appropriate position in order to have the minimum impact at the nearest noise sensitive location and also by choosing a turbine size that is appropriate to the demands of power generation and noise impact.

A warranty agreement will be drawn up with the manufacturer of the turbines for this site to ensure that the noise output will not contain any significant audible tones.

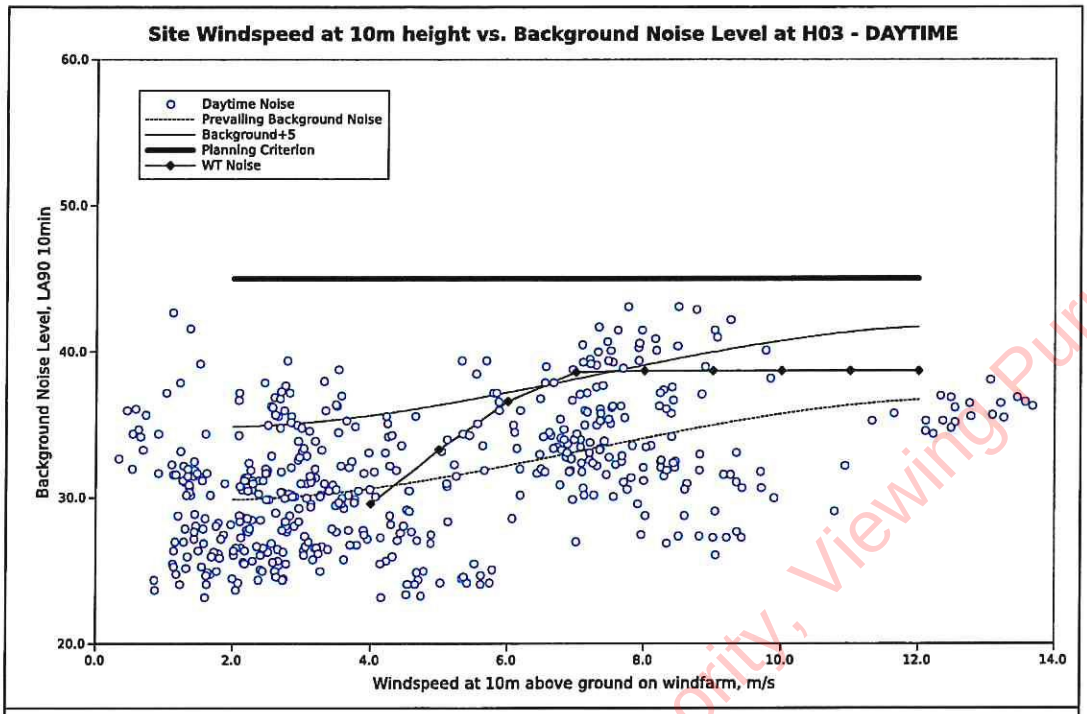
10.4.3 Decommissioning Phase

The mitigation measured outlined above for the construction phase are also proposed to reduce the impact of noise from the decommissioning phase.

References:

1. National Roads Authority, 2004. *Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*
2. DoEHLG's (2006) *Wind Energy Development Guidelines for Planning Authorities.*
3. ETSU-R-97: UK Department of Trade and Industry, 1996. *The Assessment and Rating of Noise from Wind Farms.*
4. British Standards Institution, 1997. BS 4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas.* London: BSI
5. International Organization for Standardization, 1996. ISO 9613-2, *Acoustics – Description, Measurement and Assessment of Environmental Noise:* Parts 1 and 2.

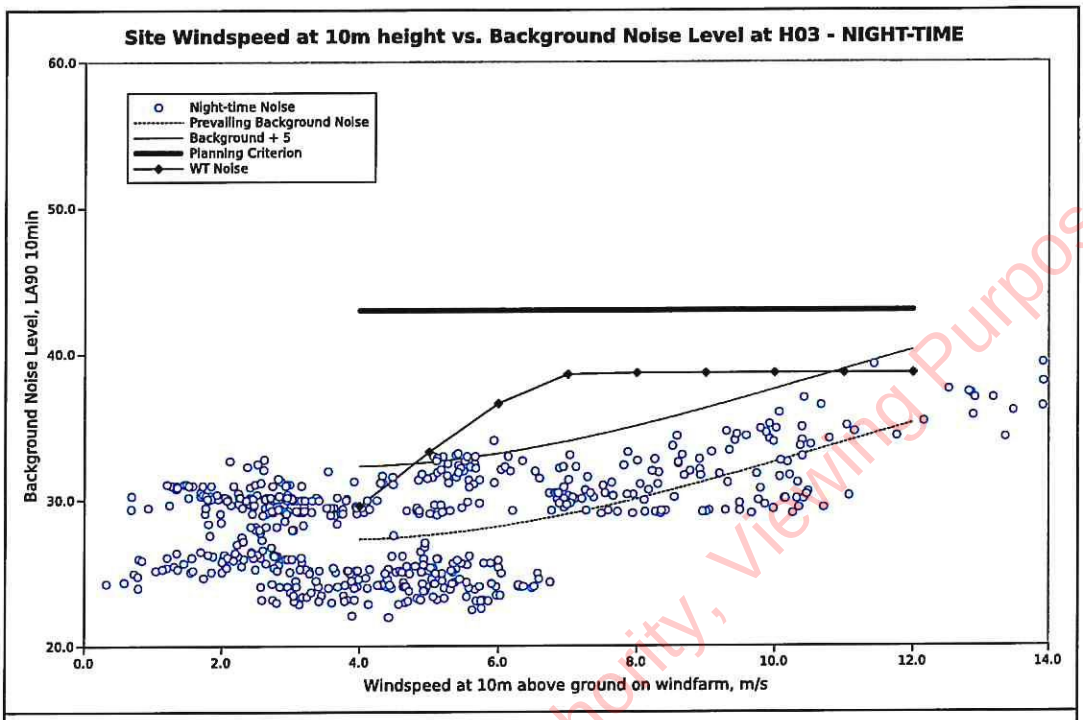
Appendix 10.1: Noise Survey Results



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E251992, N183032
Date of Noise Survey: 25/02/2011 to 10/03/2011

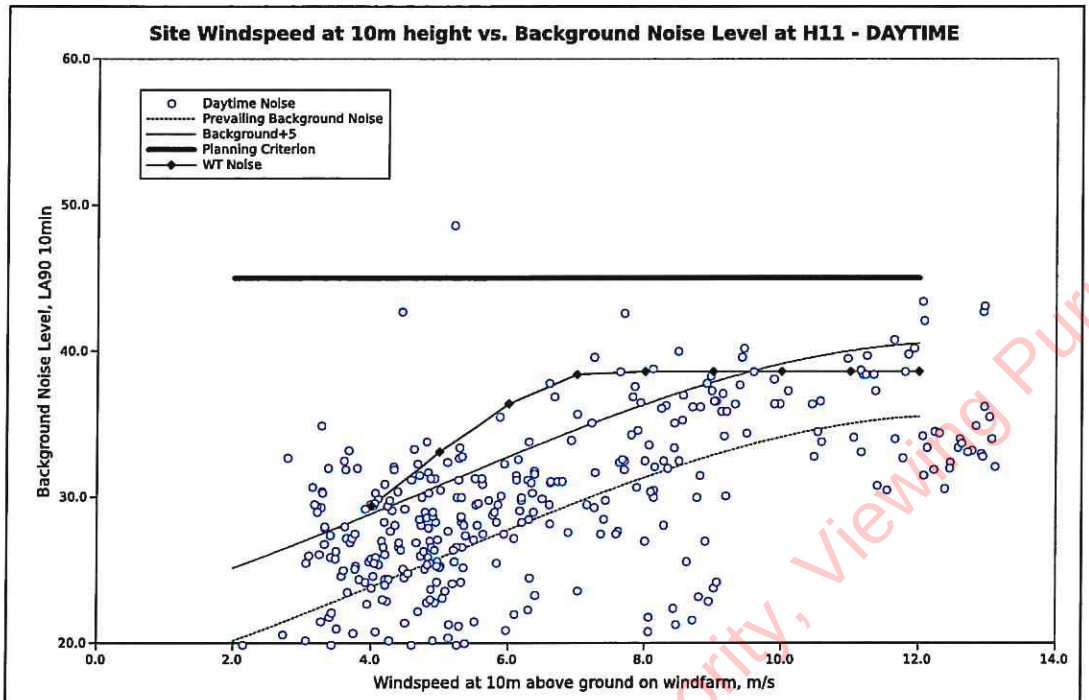
Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	30.6	29.6	45.0	−15.4	No
5	31.4	33.3	45.0	−11.7	No
6	32.2	36.6	45.0	−8.4	No
7	33.1	38.6	45.0	−6.4	No
8	34.1	38.7	45.0	−6.3	No
9	35.0	38.7	45.0	−6.3	No
10	35.7	38.7	45.0	−6.3	No
11	36.4	38.7	45.0	−6.3	No
12	36.7	38.7	45.0	−6.3	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E251992, N183032
Date of Noise Survey: 25/02/2011 to 10/03/2011

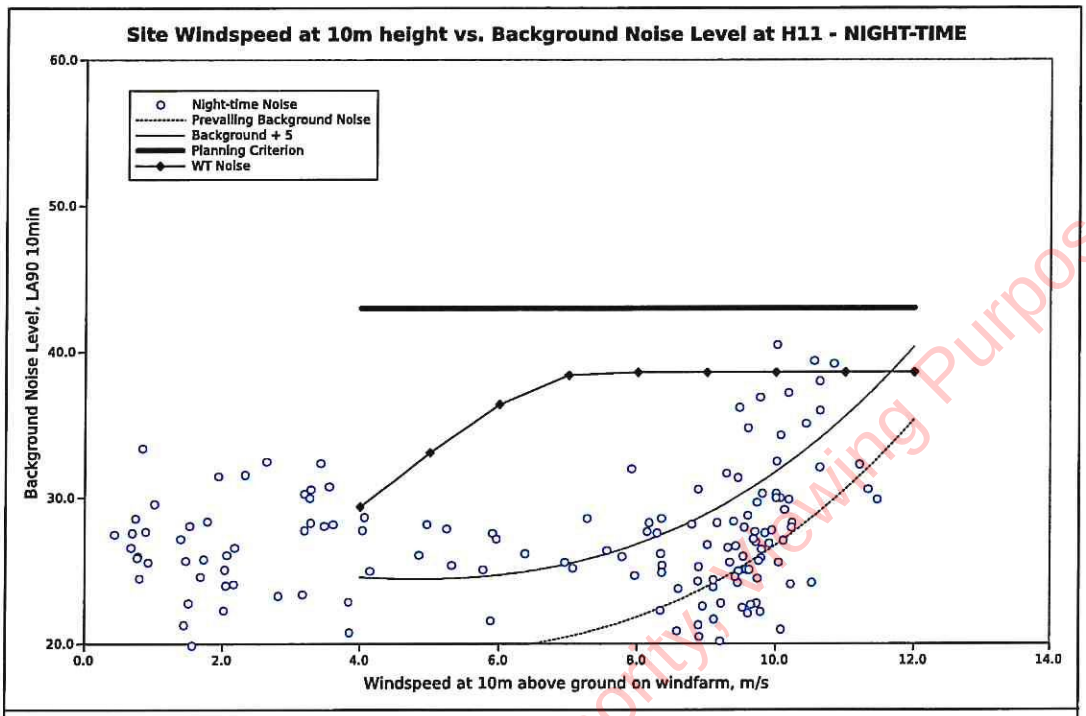
Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	27.3	29.6	43.0	−13.4	No
5	27.3	33.3	43.0	−9.7	No
6	28.2	36.6	43.0	−6.4	No
7	29.0	38.6	43.0	−4.4	No
8	30.1	38.7	43.0	−4.3	No
9	31.3	38.7	43.0	−4.3	No
10	32.6	38.7	43.0	−4.3	No
11	33.9	38.7	43.0	−4.3	No
12	35.3	38.7	43.0	−4.3	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E252557, N182147
Date of Noise Survey: 10/03/2011 to 23/03/2011

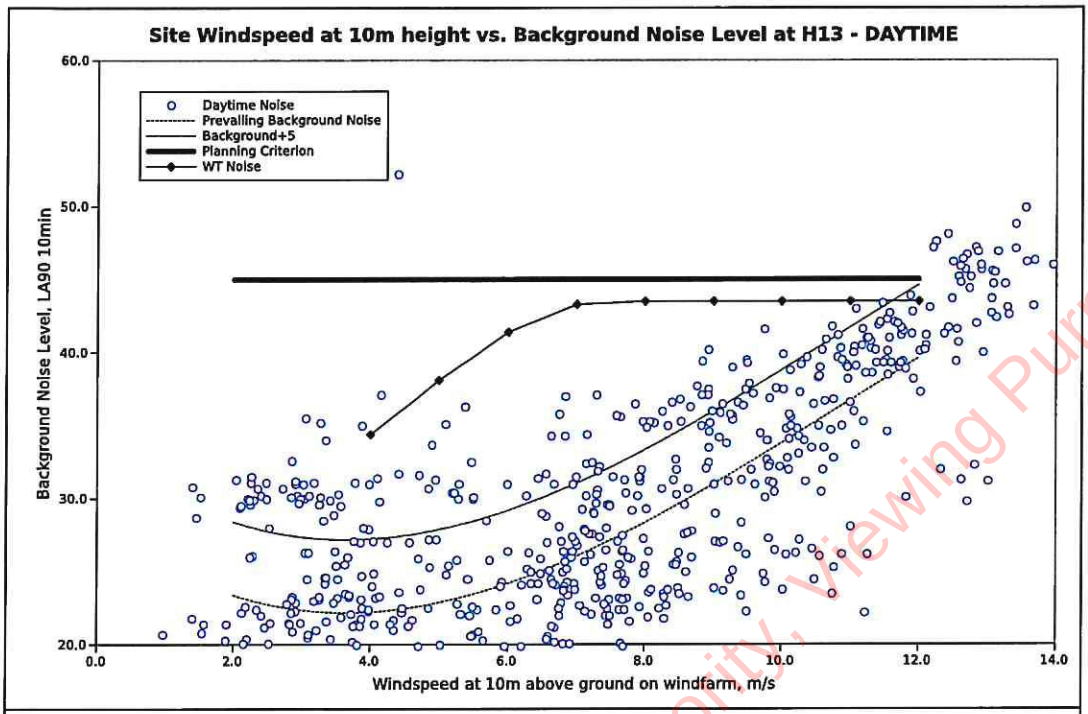
Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	23.9	29.4	45.0	−15.6	No
5	25.8	33.1	45.0	−11.9	No
6	27.8	36.4	45.0	−8.6	No
7	29.6	38.4	45.0	−6.6	No
8	31.4	38.6	45.0	−6.4	No
9	32.9	38.6	45.0	−6.4	No
10	34.1	38.6	45.0	−6.4	No
11	35.0	38.6	45.0	−6.4	No
12	35.5	38.6	45.0	−6.4	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E252557, N182147
Date of Noise Survey: 10/03/2011 to 23/03/2011

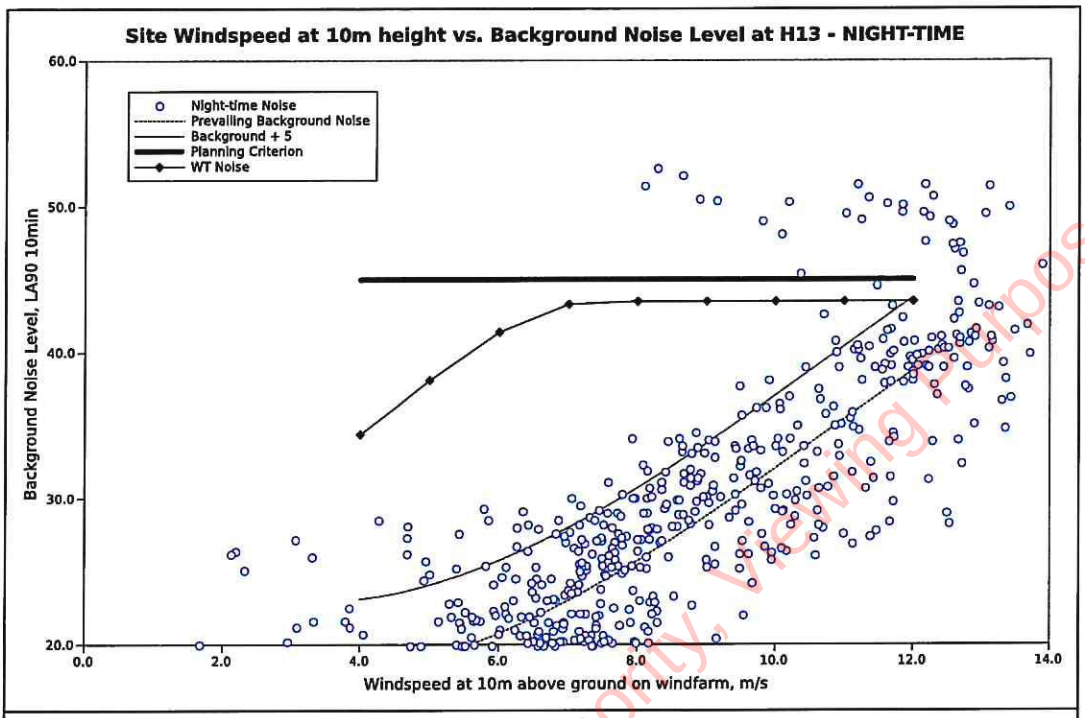
Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	19.5	29.4	43.0	−13.6	No
5	19.5	33.1	43.0	−9.9	No
6	19.7	36.4	43.0	−6.6	No
7	20.5	38.4	43.0	−4.6	No
8	21.8	38.6	43.0	−4.4	No
9	23.9	38.6	43.0	−4.4	No
10	26.8	38.6	43.0	−4.4	No
11	30.6	38.6	43.0	−4.4	No
12	35.4	38.6	43.0	−4.4	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E251492, N181109
Date of Noise Survey: 28/01/2011 to 23/02/2011

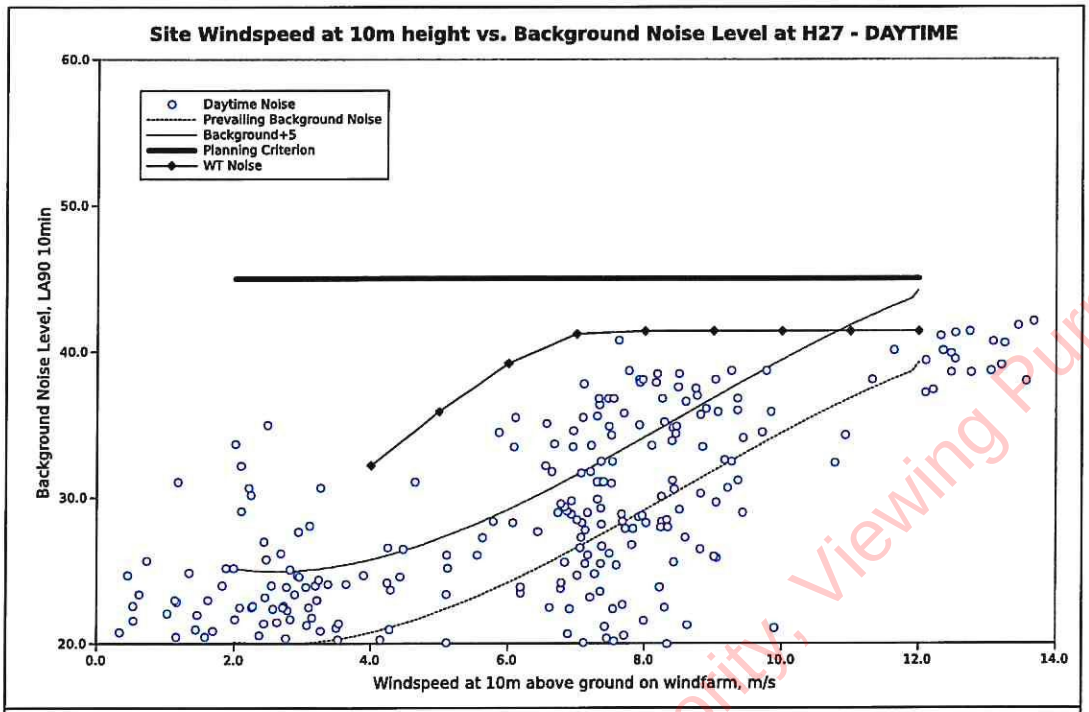
Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	22.2	34.4	45.0	−10.6	No
5	22.9	38.1	45.0	−6.9	No
6	24.2	41.4	45.0	−3.6	No
7	26.1	43.3	45.0	−1.7	No
8	28.4	43.5	45.0	−1.5	No
9	31.0	43.5	45.0	−1.5	No
10	33.8	43.5	45.0	−1.5	No
11	36.7	43.5	45.0	−1.5	No
12	39.6	43.5	45.0	−1.5	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E251492, N181109
Date of Noise Survey: 28/01/2011 to 23/02/2011

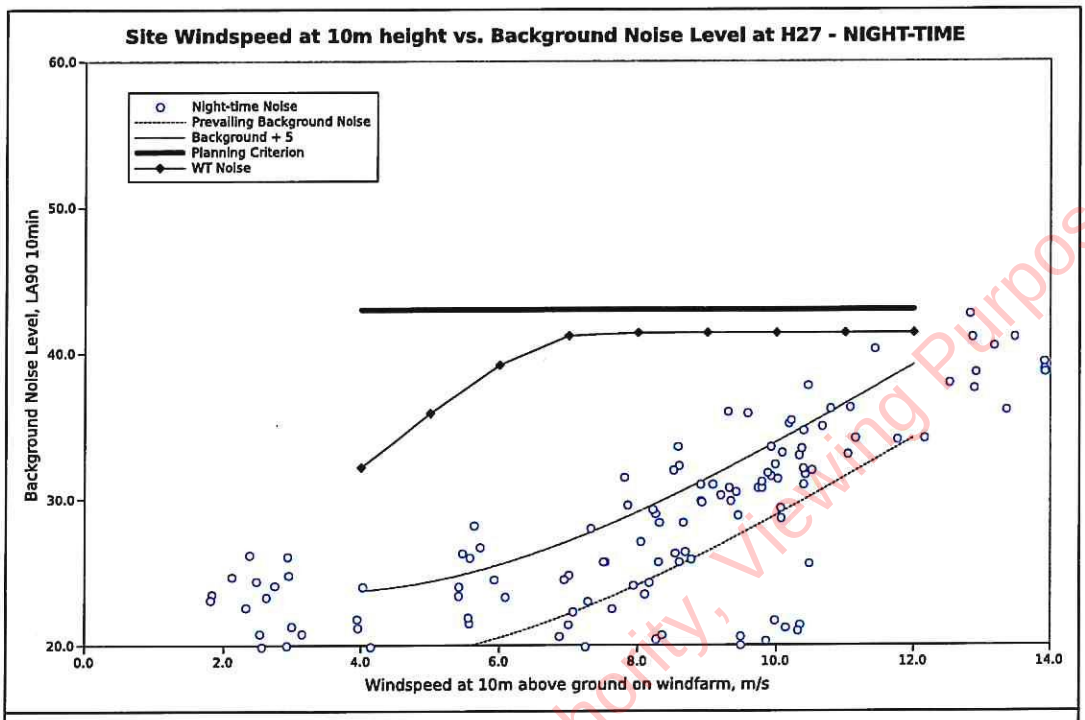
Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	18.1	34.4	45.0	−10.6	No
5	18.2	38.1	45.0	−6.9	No
6	20.7	41.4	45.0	−3.6	No
7	23.0	43.3	45.0	−1.7	No
8	25.7	43.5	45.0	−1.5	No
9	28.8	43.5	45.0	−1.5	No
10	32.1	43.5	45.0	−1.5	No
11	35.4	43.5	45.0	−1.5	No
12	38.8	43.5	45.0	−1.5	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E249788, N180473
Date of Noise Survey: 25/02/2011 to 10/03/2011

Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	20.8	32.2	45.0	−12.8	No
5	22.2	35.9	45.0	−9.1	No
6	24.2	39.2	45.0	−5.8	No
7	26.6	41.2	45.0	−3.8	No
8	29.2	41.4	45.0	−3.6	No
9	31.8	41.4	45.0	−3.6	No
10	34.4	41.4	45.0	−3.6	No
11	36.8	41.4	45.0	−3.6	No
12	39.2	41.4	45.0	−3.6	No



Noise/Windspeed Analysis
Site: Pinewoods

Noise Meter Location: E249788, N180473
Date of Noise Survey: 25/02/2011 to 10/03/2011

Windspeed	Background Noise based on Curve Fit dB, LA90	Wind Turbine Noise at House dB, LA90	Planning Criterion dB	Difference dB	Exceeds?
4	18.7	32.2	43.0	−10.8	No
5	18.8	35.9	43.0	−7.1	No
6	20.5	39.2	43.0	−3.8	No
7	22.1	41.2	43.0	−1.8	No
8	24.1	41.4	43.0	−1.6	No
9	26.4	41.4	43.0	−1.6	No
10	28.9	41.4	43.0	−1.6	No
11	31.5	41.4	43.0	−1.6	No
12	34.2	41.4	43.0	−1.6	No

Appendix 10.2: Noise Modelling Output

Project:
Pinewoods Wind Farm

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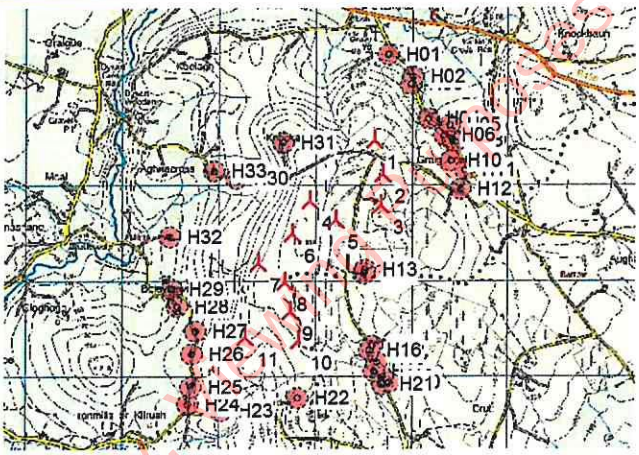
Licensed user:
Galetech Energy Services Limited
Clondargan, Stradone
IE-CO. Cavan

Calculated:
12/04/2016 12:24/2.8.579

DECIBEL - Main Result

Calculation: April 2016 GE 3.2 103.0 m RD 85 m HH

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 m/s, step 1.0 m/s
Ground attenuation:
General, Ground factor: 0.5
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are 90% exeedance values (L90)
Pure tones:
Pure and Impulse tone penalty are added to WTG source noise
Height above ground level, when no value in NSA object:
4.0 m Don't allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)



WTGs

	Irish Grid (IG)-IRELAND65 (IE) East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]	
1	251,604	182,460	258.7	T1	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
2	251,693	182,105	267.5	T2	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
3	251,676	181,781	273.2	T3	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
4	250,937	181,833	297.7	T4	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
5	251,205	181,628	299.3	T5	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
6	250,756	181,489	302.7	T6	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
7	250,403	181,186	278.9	T7	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
8	250,682	180,984	292.8	T8	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
9	250,742	180,675	291.0	T9	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
10	250,826	180,372	287.6	T10	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f
11	250,276	180,413	260.8	T11	Yes	GE WIND ENERGY	3.2-3,200	3,200	103.0	85.0	USER	Normal Operation	4.0	98.0	12.0	107.0	0 dB f

f) From other hub height

Calculation Results

Sound Level

Noise sensitive area No.	Name	Irish Grid (IG)-IRELAND65 (IE) East	North	Z [m]	Imission height [m]	Demands Max Noise [dB(A)]	Sound Level Max From WTGs [dB(A)]	Demands fulfilled ? Noise
H01	H01	251,747	183,345	179.5	4.0	43.0	36.5	Yes
H02	H02	252,003	183,118	189.9	4.0	43.0	37.9	Yes
H03	H03	251,985	183,038	196.4	4.0	43.0	38.7	Yes
H04	H04	252,171	182,682	208.9	4.0	43.0	40.5	Yes
H05	H05	252,389	182,614	212.0	4.0	43.0	38.7	Yes
H06	H06	252,334	182,504	217.9	4.0	43.0	39.8	Yes
H07	H07	252,407	182,475	217.6	4.0	43.0	39.2	Yes
H08	H08	252,419	182,452	218.8	4.0	43.0	39.2	Yes
H09	H09	252,443	182,442	219.0	4.0	43.0	39.0	Yes
H10	H10	252,398	182,245	230.0	4.0	43.0	40.0	Yes
H11	H11	252,554	182,144	226.2	4.0	43.0	38.6	Yes
H12	H12	252,505	181,946	240.1	4.0	43.0	39.1	Yes
H13	H13-Landowner	251,509	181,108	286.4	4.0	45.0	43.5	Yes
H14	H14-Landowner	251,504	181,064	286.4	4.0	45.0	43.3	Yes
H15	H15	251,584	180,317	281.7	4.0	43.0	39.9	Yes
H16	H16	251,563	180,264	282.8	4.0	43.0	39.9	Yes
H17	H17	251,638	180,140	276.5	4.0	43.0	38.7	Yes
H18	H18	251,603	180,046	273.4	4.0	43.0	38.5	Yes
H19	H19	251,691	179,992	270.9	4.0	43.0	37.6	Yes
H20	H20	251,763	179,930	266.8	4.0	43.0	36.8	Yes
H21	H21	251,697	179,912	266.9	4.0	43.0	37.2	Yes

To be continued on next page...

Project:
Pinewoods Wind Farm

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Galetech Energy Services Limited
Clondargan, Stradone
IE-CO. Cavan

Calculated:
12/04/2016 12:24/2.8.579

DECIBEL - Main Result

Calculation: April 2016 GE 3.2 103.0 m RD 85 m HH

...continued from previous page

Noise sensitive area No.	Name	Irish Grid (IG)-IRELAND65 (IE) East	North	Z [m]	Imission height [m]	Demands Max Noise [dB(A)]	Sound Level Max From WTGs [dB(A)]	Demands fulfilled ? Noise
H22	H22	250,816	179,769	278.8	4.0	43.0	40.8	Yes
H23	H23	250,021	179,640	215.1	4.0	43.0	37.9	Yes
H24	H24	249,684	179,702	193.7	4.0	43.0	36.6	Yes
H25	H25-Landowner	249,712	179,885	196.4	4.0	45.0	38.0	Yes
H26	H26-Landowner	249,723	180,232	200.3	4.0	45.0	40.2	Yes
H27	H27-Landowner	249,755	180,471	197.1	4.0	45.0	41.4	Yes
H28	H28	249,570	180,722	179.3	4.0	43.0	39.4	Yes
H29	H29	249,506	180,906	170.2	4.0	43.0	38.7	Yes
H30	H30	250,173	182,064	215.9	4.0	43.0	40.6	Yes
H31	H31	250,665	182,436	264.8	4.0	43.0	41.2	Yes
H32	H32	249,491	181,450	162.4	4.0	43.0	37.9	Yes
H33	H33	249,951	182,134	198.5	4.0	43.0	38.6	Yes

Distances (m)

	WTG										
NSA	1	2	3	4	5	6	7	8	9	10	11
H01	896	1241	1565	1715	1800	2103	2542	2589	2852	3111	3279
H02	769	1059	1376	1669	1690	2051	2508	2509	2748	2987	3208
H03	692	977	1294	1597	1611	1977	2435	2432	2669	2906	3131
H04	609	749	1028	1497	1429	1850	2315	2258	2463	2672	2955
H05	800	862	1096	1648	1540	1982	2445	2360	2543	2732	3050
H06	731	755	977	1549	1429	1876	2337	2244	2424	2611	2933
H07	803	804	1008	1604	1470	1922	2382	2279	2451	2630	2964
H08	815	804	1001	1606	1467	1921	2380	2274	2443	2619	2957
H09	839	822	1012	1624	1481	1937	2395	2286	2452	2626	2968
H10	822	719	858	1518	1343	1807	2258	2129	2281	2445	2803
H11	1001	862	950	1646	1444	1913	2354	2202	2332	2474	2860
H12	1037	827	845	1572	1338	1807	2235	2061	2173	2301	2704
H13	1355	1014	693	923	602	844	1108	836	881	1004	1415
H14	1399	1058	737	955	638	860	1107	826	855	968	1389
H15	2142	1791	1466	1648	1364	1435	1466	1121	915	760	1311
H16	2196	1845	1521	1689	1410	1466	1481	1137	918	745	1295
H17	2320	1965	1641	1832	1549	1611	1618	1275	1043	844	1389
H18	2413	2060	1736	1907	1631	1673	1655	1314	1066	842	1376
H19	2469	2112	1789	1989	1706	1764	1756	1415	1169	945	1476
H20	2534	2175	1852	2074	1787	1855	1851	1509	1264	1036	1563
H21	2549	2192	1869	2065	1785	1836	1815	1476	1222	985	1506
H22	2803	2494	2187	2067	1899	1721	1476	1222	909	603	840
H23	3233	2978	2705	2376	2313	1989	1592	1497	1261	1088	814
H24	3360	3131	2878	2471	2453	2083	1649	1624	1437	1324	925
H25	3194	2974	2729	2300	2294	1913	1473	1465	1298	1215	772
H26	2915	2717	2492	2009	2035	1627	1171	1218	1111	1112	582
H27	2715	2534	2324	1803	1854	1427	965	1059	1008	1075	524
H28	2675	2533	2357	1761	1869	1412	953	1142	1173	1303	770
H29	2610	2493	2339	1705	1845	1379	939	1178	1257	1423	914
H30	1484	1520	1529	798	1120	819	907	1194	1501	1813	1654
H31	939	1080	1204	661	972	951	1277	1452	1762	2070	2059
H32	2341	2297	2209	1495	1723	1265	949	1279	1471	1715	1300
H33	1684	1742	1760	1031	1352	1031	1050	1362	1659	1967	1751

Chapter 10(a):
Vibration

10(a).1 Introduction

10(a).1.1. Overview

Vibration may be defined as regularly repeated movement of a physical object about a fixed point. The magnitude of vibration is expressed in terms of Peak Particle Velocity (PPV) expressed in millimetres per second (mm/s). It is characterised, like noise, in terms of its frequency and amplitude of the motion. Vibration can be continuous, such as that experienced close to certain large industrial machinery, or transient, such as that caused by a passing train movement. The effects of vibration can vary according to a number of factors including: the magnitude of the vibration source, the particular ground conditions, path distance between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of age and design (e.g. dimensions, materials, type and quality of construction, and footing conditions). The intensity, duration, frequency and number of occurrences of a vibration all play an important role in both the annoyance levels caused and the strains induced in structures.

People's sensitivity to and tolerance of vibration depends on the setting. Vibration is noticed sooner and tolerated less in a person's home than in for example a large commercial building or warehouse. Vibration is rarely experienced as annoying in the outdoor environment. Building vibrations caused by road traffic are not a health and safety concern; they are more a problem of annoyance. Vibrations may be unacceptable to occupants because of annoying physical sensations produced in the human body, interference with activities such as sleep and conversation, rattling of window panes and loose objects, and fear of damage to the building and its contents. Experience has shown that people living in houses are likely to complain if vibration levels are only slightly above the perception threshold, the major concern being fear of damage to the building or its contents. The tolerance level varies widely from person to person and from area to area.

Ground vibration effects may:

- Disturb occupants of buildings – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed (human exposure)
- Disturb contents of buildings – vibration where the building contents may be affected (i.e. rattling, shaking or movements)
- Affect structural integrity of the building – vibration in which the integrity of the building or structure itself may be compromised.

Any movement of ground or structures which can potentially cause structural damage, nuisance or a deterioration of amenities or quality of life is examined in this chapter. Where the main effect of transmitted vibration is the generation of audible sound in or at a sensitive location, this topic is addressed under **Chapter 10 - Noise**.

10(a).2.2 Guidelines and Criteria

There is no published Irish guidance relating to vibration during construction or operational activities. Common practice in Ireland has been to use guidance from internationally recognised standards. Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, the magnitude of vibration is expressed in terms of Peak Particle Velocity (PPV) in millimetres per second (mm/s).

In the case of nominally continuous sources of vibration such as traffic, vibration is perceptible at around 0.5mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration. For example, intermittent blasting and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 12mm/s and 2.5mm/s respectively. This guidance is

applicable to the day-time only; it is unreasonable to expect people to be tolerant of such activities during the night-time.

Guidance on the relationship between the magnitude of vibration and peoples' reaction to it is contained *in BSI Standards BS5228-2:2009 - Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration Table B1*, and reproduced in **Table 10(a).1** below.

Vibration level	*Effect*
0.14 mm/s	**Threshold of Perception:** Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	**Barely Noticeable:** Vibration might be just perceptible in residential environments.
1.0 mm/s	**Noticeable:** It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	**Strongly Noticeable:** Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Table 10(a).1: Guidance on effects of vibration levels (reproduced from Table B.1 of BS5228)

Vibration is principally a cause of perceived concern in residential environments, as the occupants may fear that property damage could result. House dwellers may complain about damage induced by traffic vibrations, such as cracks in walls and ceilings, separation of masonry blocks, and cracks in the foundation. However, vibration levels are rarely high enough to be the direct cause of this damage, though they could contribute to the process of deterioration from other causes. Limits for transient vibration, above which cosmetic damage could occur are shown in **Table 10A.2** (reproduced from Table B.2 of BS5228).

Type of building	*Peak component particle velocity in frequency range of predominant pulse*	
	4 Hz to 15 Hz	*15 Hz and above*
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Un-reinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Table 10(a).2: Transient vibration guide values for cosmetic damage (reproduced from Table B.2 of BS5228)

The National Roads Authority (NRA) publication 'Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes' (NRA, 2009) outlines mitigation for badgers during construction and mitigation therein is deemed appropriate for a development of the size of a wind farm such as the Pinewoods Wind Farm. In general, a survey of setts within 150m of where piling or blasting will be undertaken no more than 10-12 months in advance of construction (NRA, 2009).

The Northern Ireland Environment Agency (NIEA) has published an advisory document in relation to badgers, 'Badgers - Advice for planning officers and applicants seeking planning permission for developments which may impact on badgers' (NIEA, 2015). NIEA (2015) recommend that loud noises or vibrations from heavy machinery that might disturb badgers occupying a sett should be avoided or limited near a sett. An NIEA licence is required for blasting or piling within 100m of a sett.

SNH (2001) point out that there are some activities that can cause disturbance at much greater distances (e.g blasting or pile driving) and generally recommended that such activities are avoided within 100 metres of the closest sett entrance.

10(a).2 Description of the Existing Environment

It is unusual for vibration from sources such as buses and trucks to be perceptible, even in locations close to major roads. Some common sources of ground borne vibration are trains, buses or heavy goods vehicles on rough roads, and construction activities such as blasting, pile-driving and operating heavy earth-moving equipment.

The existing environment in the vicinity of the subject site does not display any significant vibration source features. All of the dwellings within the study area of the proposed development are not located along major transport routes or other vibration generating sources. There are a number of quarries approximately 2 km distant from the subject site. However, vibration resulting from normal quarry operations is not likely to be perceptible at this distance. There is a church (and adjacent dwelling) and a school located approximately 1 km north of Turbine 1. There is also a horse training facility approximately 600-800m south of Turbine 11. These locations are also considered vibration sensitive locations. **Map 10(a).1** below indicates all of the dwellings and other potentially sensitive receptors in the study area.

Taking the above into account, and the fact that the site and its environs contain no significant vibration features, it was not considered necessary to undertake baseline vibration surveys. No buildings or structures were identified which may be particularly susceptible to vibration damage such as premises with machinery that is highly sensitive to vibration or historic buildings that may be in poor repair, including residential properties. House 02 (H02) and St. Lazerian's Church (and adjacent dwelling) are located immediately adjacent to the construction access route along the L7800 and considered potentially sensitive to vibration from traffic movements.

Ecology

There are two inactive badger setts within the land boundary of the proposed development site but both are outside of the application boundary (areas directly affected by the proposed development). Both of these setts are in the townland of Boleybawn at the south western extent of the proposed development. Proposed Turbine 7 is located approximately 200m east-north-east of one of these inactive setts. Turbine 11 and is approximately 360m to the east of the other sett. Neither of these inactive setts would be directly impacted by the proposed development due to geographical separation. No other vibration sensitive fauna were identified within the study area.

10(a).3 Description of Likely Impacts

10(a).3.1 Construction Phase

Construction Traffic

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air or ground of low frequency energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle.

Ground borne vibration from traffic on arterial roads is not normally of a level that affects residents or buildings and is commonly confused with high levels of low frequency airborne noise. **Chapter 13** of the EIS and the Traffic Impact Assessment submitted presents the expected number and type of vehicle movements during the construction phase. All construction traffic will enter and exit the subject site along the designated L7800/R430 route. Although the construction activity will generate additional traffic for a temporary period, it is not considered a significant source of vibration. LGVs and HGVs, including aggregate and cement lorries, are not expected to give rise to perceptible ground borne vibration in houses along the designated construction traffic route or in the vicinity of the proposed development site. A HGV over normal (smooth) or irregular road surfaces would result in 0.01 to 0.2 mm/s at the footings of buildings located 10 to 20 m from a roadway. As indicated in **Table 10(a).1**, this is below the threshold of barely perceptible.

Abnormal loads to be transported to the subject site are of unusual size but are not considered to be of unusual weight. They will also travel at slow speeds. Vibration levels decrease with distance from the road as a result of geometrical spreading of the vibration energy and its dissipation by soil viscosity and/or friction. As part of the proposed development the developer proposes to strengthen the L7800 and the L78001 along the length of the haul route to the junction with the R430, which will include a new pavement surface. The R430 is also of generally good pavement condition. There are significant forestry activities on the subject site such that HGV movements along these routes are not unusual. Dwellings and St. Lazerian's Church (a protected structure) along the haul route are generally set back in excess of 20m from the L7800 and R430. The Knock Community School is also sufficiently setback from the road and there is unlikely to be any significant impact in terms of vibration. It is noted that H02 is located immediately adjacent to the L7800 (within 5m) and vibration levels could theoretically rise to a noticeable levels at this distance. The small dwelling adjacent to St. Lazerian's Church is also close to the L7800. Vibration would have to rise above 15 mm/s or above to cause any structural damage, which is not possible from transient passing vehicle movements of the scale proposed. Given the nature and alignment of the access road, together with the proposed road strengthening and pavement works, construction vehicles will be moving at low speed along smooth road conditions and with a generally low frequency for a temporary period. Moreover, specific speed limits will be put in place to ensure no impact in terms of vibration. Once the construction traffic travels at appropriate modest speeds, and given the proposed strengthening of the haul road pavements, vehicle movements will not likely be a significant sources of vibration and is unlikely to be perceptible or cause a nuisance or damage.

Construction Works

Sources of ground vibration during construction include pile drivers, bulldozers (ripping), hydraulic rock breakers and vibratory rollers etc. Vibration generated from construction activities is characteristically an order of magnitude greater than that generated from operational activities. The following list provides an indication of the approximate vibration levels that may be expected for various common construction vibration sources:

- Vibratory rollers: Up to 1.5 mm/s at distances of 25m
- Hydraulic rock breakers: 4.5 mm/s at 5m; 1.3 mm/s at 10m; 0.4 mm/s at 20 m; 0.1 mm/s at 50m
- Compactor: 20 mm/s at 5m; 1 mm/s at 15m; 0.3 mm/s at 30m
- Piling: 1-3 mm/s at distances of 25m – 50m depending on soil conditions
- Bulldozer: 1-2 mm/s at 5m. At distances greater than 20m, vibration is below 0.2 mm/s
- Air track drill: 4-5 mm/s at 5m; 1.5 mm/s at 10m; 0.6 mm/s at 25m; 0.1 mm/s at 50m

Depending on the geotechnical make-up of the ground at the proposed turbine locations, rock breaking and piling may be necessary during the construction of the foundations. Trial pitting was undertaken at various locations throughout the proposed development site, with the results demonstrating that bedrock can be found between 0.3m and 2m below the surface. Further detailed geotechnical investigations shall also be carried out prior to the commencement of construction. If rock breaking or piling is required at the proposed development site, such activity would only be required to facilitate the provision of turbine foundations and not for the construction of site access tracks. Rock blasting shall not be necessary. Given that all proposed turbines are set back in excess of 500m from any sensitive receptors, vibration from construction activities is not likely to be perceptible.

The nearest badger sett to the proposed development was found to be 200m away from a turbine, and as no component of the works are envisaged within 150m of a badger sett there is unlikely to be any impact. No other vibration sensitive fauna were identified within the study area.

10(a).3.2 Operational Phase

The operation of the proposed development will not give rise to any ground borne vibration source.

10(a).3.3 Decommissioning Phase

The decommissioning phase will involve similar operations to those outlined for the construction phase, but the requirements for ground breaking will be clearly be less intensive than for construction. The decommissioning of the project will also involve a fewer number of vehicle movements than the constructions stage, the impacts of which have been discussed above.

10(a).4 Mitigation Measures

10(a).4.1 Construction Phase

As part of the Construction Environment Management Plan (CEMP), the developer will monitor pavement conditions along the construction access route. If any irregularities, cracks or potholes are identified, they will be immediately brought to the attention of the local authority and repaired in conjunction with the Local Authority at the developer's expense.

The Traffic Management Plan will apply strict speed limits for construction traffic along the construction access route including signage.

All construction activities will be undertaken in accordance with *BSI Standards BS5228-2:2009 - Code of Practice for Noise and Vibration Control on Construction and Open Sites* and the *National Roads Authority Guidelines for the Treatment of Noise and Vibration in National Road Schemes 2004* (as applicable).

The hours of construction activity should be generally limited to between 08.00 hours and 20.00 hours Monday to Friday and 08.00 hours and 18.00 hours on Saturdays, except for emergency works.

As all sensitive locations are in excess of 500m from a proposed turbine, there will be no impact in terms of vibration arising from construction activities, even in the 'worst-case' scenario that all vibration control measures fail. However, a liaison officer will be appointed as part of the CEMP to which residents can address any vibration related complaints arising from the construction phase. If any rock breaking or piling activity is required which may, even in an unlikely event, give rise to perceptible vibration, then the residents will be regularly updated and informed in advance of the timing and duration of such works. The contact details of the liaison officer will be distributed to the residents within 1,030m of a proposed turbine as part of ongoing project updates.

In the event of piling, minimisation of piling energy (i.e. reduced hammer drop distance), as necessary, will be applied.

The nearest badger sett to the proposed development was found to be 200m away from a turbine and no component of the works are envisaged within 150m of a badger sett. From an examination of the literature, there is no requirement for additional mitigation with reference to that contained in the EIS for the proposal.

10(a).4.2 Operational Phase

Operation of the proposed development itself is not a source of ground borne vibration. Mitigation measures are therefore not required.

10(a).4.3 Decommissioning Phase

The mitigation measures outlined above for the construction phase are also applicable to the decommissioning phase.

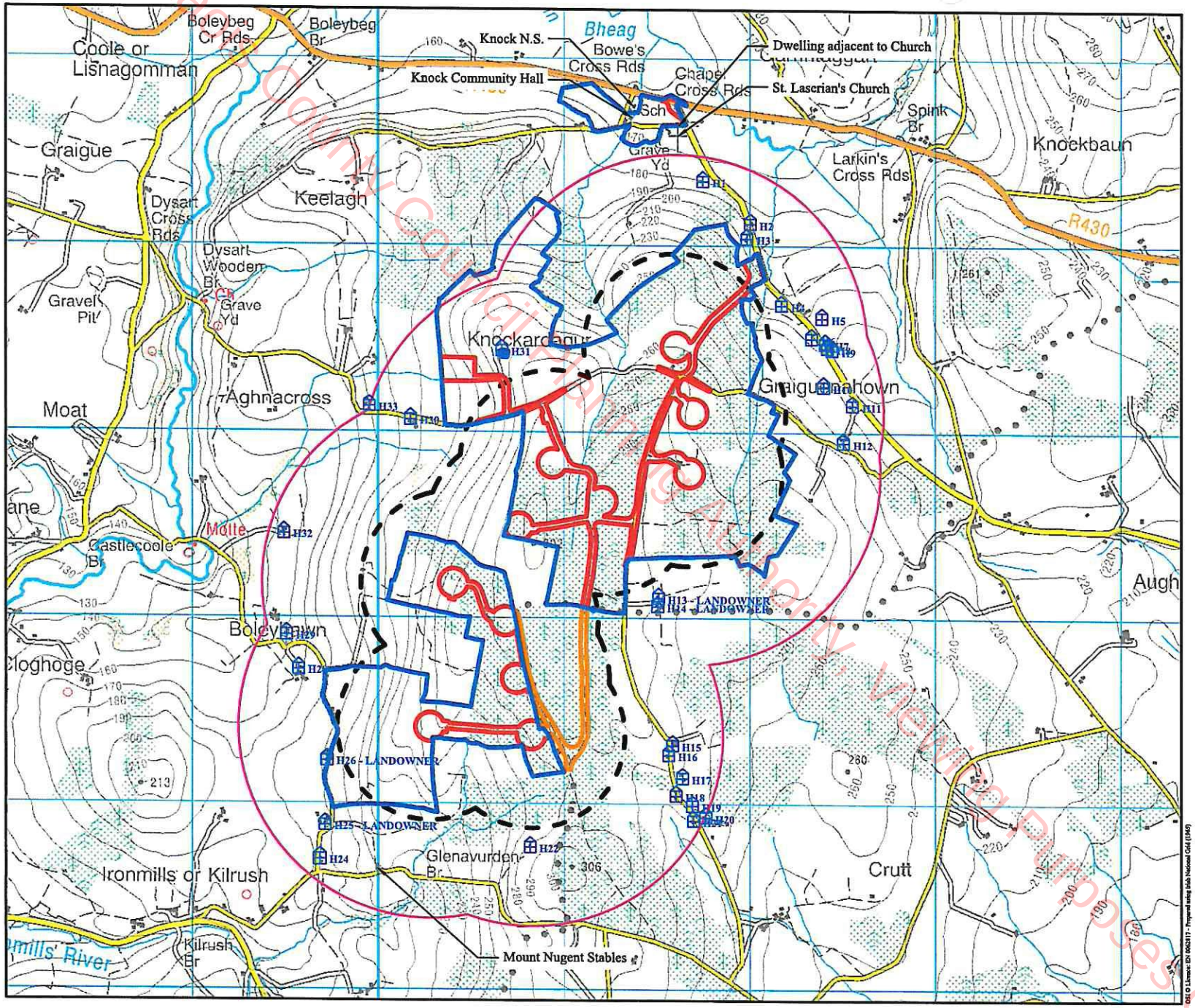
References:

NRA (2006) Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes. National Roads Authority, Dublin, Ireland.

NIEA (2015) Badgers - Advice for planning officers and applicants seeking planning permission for developments which may impact on badgers. NIEA Planning Response Team, Klondyke Building, Cromac Avenue, Malone Lower, Belfast, BT7 2JA.

SNH (2001) Scotland's Wildlife: Badgers and Development. ISBN 1 85397 1375 NP4K0601. Scottish Natural Heritage, Battleby, Redgorton, Perth, PH1 3EW.

Appendix 10(a).1: Map indicating vibration sensitive receptors



Legend:

- Ownership Boundary
- Application Boundary (Co. Laois)
- Application Boundary for concurrent application made in Co. Kilkenny
- Dwellings within 1030m
- 1030m Boundary
- 500m Boundary

Date:	Rev:	Amendments:	Drawn By:

Prepared by:

GALETECH ENERGY SERVICES
Galetech Energy Services
Clondargan
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Client:

Pinewoods Wind Ltd.

Job Title:

Pinewoods Wind Farm - Further Information Request

Drawing Title:

Noise and Vibration

Regarding Item 11d(iii) of Further Information Request

Drawing No.:	Revision No.:
5220-1/IB/PD/008	00
Scale: (A3) 1:20,000	Date: 23/01/2017
Drawn By: J.B.	Checked By: C.M.F.	Confirmed By: D.S.

Chapter 11:
Shadow Flicker

11.1 Introduction

11.1.1 Overview

This chapter addresses the potential impact of shadow flicker impacts to nearby properties within 1, 030 metres (Ten rotor diameters) from the proposed development. The assessment was carried out based the proposed 11 no. turbine layout with each turbine modelled for a hub height of 85meters and a rotor diameter of 103 meters.

GES Ltd was commissioned to undertake the shadow flicker assessment. The assessment has been carried in accordance with all statutory guidelines and uses methods which are recognised as best practice by the relevant environmental health organisations.

As with all tall structures, wind turbines can cast shadows on the neighbouring area when the sun is low in the sky. During sunny conditions under certain combinations of geographical position, meteorological conditions and the time of day, the sun may pass behind the moving rotor blades and cause a shadow to flicker on and off on neighbouring properties. This is known as shadow flicker. Nearby dwellings/buildings maybe affected by shadow flicker (i.e. when a turbine blade shadow passes an open door or window within a flicker zone) as the sunlight comes from one source. Shadow flicker is not as obvious outside as sunlight comes from all directions. The shadow flicker effect lasts only for a short period and happens only in certain specific combined circumstances such as when:

- The sun is shining and is at a low angle in the sky (after dawn and before sunset);
- The turbine is located directly between the sun and the affected property;
- The wind speed is high enough to move the turbine blades.

11.1.2 Methodology

11.1.2.1 Guidelines

The Wind Energy Development Guidelines for Planning Authorities 2006 state in respect of shadow flicker:

"Careful site selection, design and planning, and good use of relevant software, can help avoid the possibility of shadow flicker in the first instance. It is recommended that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day. At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times"

11.1.2.2 Passing Frequency

A periodic change in the light produced by the sun occurs at a particular location because of the rotating rotor. This is referred to as a pulsating light level. Research has shown that the consequences of the pulsating light level are dependent on the frequency. The frequency is determined by the speed of the rotor and the number of rotor blades in the case of wind turbines. From this research, including research done into the lighting of traffic tunnels, that most people tested experience the frequencies between 5 and 10 Hz virtually no nuisance is experienced. The proposed turbines to be installed have a typical rotational speed of 14.8rpm (revolutions per minute) and three rotor blades. The maximum passing frequency is, therefore 0.74Hz (44.4 times per minute), which is well below nuisance level. The effects of passing frequencies have, therefore, not been considered in this assessment.

11.1.2.3 Receptor Survey

The location of all properties near the proposed development was recorded using Ordnance Survey Ireland (OSI) data, a detailed planning registry search and a physical survey of the area. A total of 33

no. receptors within 1,030m radius (10 rotor diameters) of the proposed wind turbines were identified. The topography of the development and the elevation of nearby receptors was also modelled using OSI data.

11.1.2.4 Impact Prediction Model

WindPRO software, a detailed computer model which can estimate the possible occurrence of shadow flicker, was used to predict the likely impact of the proposed development. The calculations measured the minimum sun height of three degrees. The model is based on the proposed turbine specification, the exact co-ordinates of each receptor location relative to the proposed development and on historical meteorological data for this location.

It is important to note that each receptor is modelled in 'greenhouse' mode. This effectively assumes a conservative 'worst case' impact where each receptor is constructed entirely of glass (windows on all elevations) and that no intervening screening is afforded by walls, vegetation or other opaque objects.

11.1.2.5 Model Assumptions

Shadow flicker does not occur if the sun is not shining, therefore the probability of sunshine must be considered as part of this assessment. Historical metrological data from 1969 to 1993 from Kilkenny Met Station was used to assess the number of sunshine hours (20km from the proposed development site) (see **Table 11.1**)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.68	2.2	3.08	4.72	5.31	4.94	4.67	4.36	3.78	2.74	2.15	1.32

Table 11.1: Sunshine probability (Average daily sunshine hours)

A simple calculation using the above recorded data shows that the probability of sunshine is approximately 3.4 hours per day when averaged over a 12 month period. This will result in a significant decrease in the potential impact of shadow flicker when the 'worst case' scenario is adjusted.

There is a great difference in light level between a shadow at a short distance and a shadow at a long distance from the wind turbine. The potential impact is greatest at a short distance since the rotor blade screens the whole of the sun at a short distance. Shadows at a greater distance from the wind turbine have a low intensity since the blades no longer cover the sun completely and, therefore, the light contrast is strongly reduced. If an observer experiences shadow from the sun when it is lower than three degrees above the horizon, the distance to the wind turbine will be of such a great length that it is likely that the consequences of the intensity of the shadow can be ignored. Sunshine is, moreover, tempered by mist, cirrus clouds, vegetation growth or buildings in the surrounding area when the position of the sun is lower than three degrees. To account for this, the sun's minimum angle has been set at three degrees in the shadow flicker model.

The GE3.2-103 wind turbine, which is anticipated to be used on the site, has a cut in wind speed of 3m/s and cut out of 25m/s. According to the wind atlas, the average adjusted wind speed over the site is approximately 8.25m/s at 85 metres. Typically in Ireland, this wind speed is between 3 and 25m/s for 85% of the time (based on an average of 8m/s). Therefore the turbines are likely to be operational for 85% of the year.

The shadow flicker model assumes that the turbine rotor is rotating 100% of the time. Therefore, the model is conservative and it does not account for the turbine rotor not rotating due to grid unavailability, turbine maintenance and turbine breakdown. The turbine is likely to be non-operational for 4% of the time due to the above conditions.

Wind direction also plays an important role in the occurrence of shadow flicker. A wind turbine directs the rotor at right angles to the wind direction (turns the rotors to face the wind) when there is sufficient wind. The wind direction is, therefore, the determining factor for the position of the

rotor and also for the position of the rotor in relation to the sun. It is unlikely that the wind turbines will consistently fall to the 'worst case' scenario where the wind turbine is facing directly into or away from the sun. This factor has not been calculated into the assessment.

In summary, the 'worst case' shadow flicker calculation makes a number of conservative assumptions. For example, the model assumes a situation where the sun is always shining, there is adequate wind speed constantly, and when the wind and that the turbine rotor tracks the sun by yawing the turbine exactly as the sun moves. Model assumptions also include the following:

- The model uses Ordnance Survey Ireland digital data as its only topographical reference. Simulations are run on a "lunar landscape" without allowing for the obscuring effect of vegetation between the location of the residence and the position of the sun in the sky. Nor does the model consider any obscuring features around residences itself, which would minimise views of the site and hence reduce the potential for shadow flicker;
- The model operates on the assumption that sunny conditions coincide with the times of which shadow flicker will occur at each dwelling. During periods of cloudy, over-cast conditions shadow flicker will not occur;
- An assumption is made that the windows of the rooms where the effects may occur directly face the development and that the rooms are occupied and that the curtains or blinds if present are open;
- There will be no downtime for any of the turbines as a result of a mechanical fault, grid availability or routine maintenance.

It is important to stress that over the course of a year, it can be assumed in the model that it will be sunny a percentage of the year and to de-rate the 'worst case' predictions accordingly to find the 'expected' shadow flicker hours. However, over the course of a day, it cannot be assumed that it will only be sunny for a percentage of the day (it may be sunny all day). Therefore, it is not possible to de-rate the 'worst case' predictions to find the 'expected' shadow flicker hours over the course of a day. Therefore, the values presented in this chapter show conservative 'worst case' hours per day (in accordance with a precautionary approach) and 'expected' hours per year.

The 'worst case' calculations (hours per day) necessarily significantly over estimate the number of hours of shadow flicker per day experienced at any location. On the other hand, the 'expected' values (hours per year) consider the probability of sunshine at the proposed development site and therefore is more representative of the actual levels of shadow flicker which may be experienced. The percentage probability of sunshine is based on historical meteorological records for the area. Notably, the expected values cannot consider all of the variables which contribute to reduced levels of shadow flicker and as such these values also represent an over-estimation of the actual impact.

11.2 Description of the Existing Environment

The receiving baseline environment is rural and remote and as a result, the area is sparsely populated. Receptors in this area consist mainly of 'one-off' houses and isolated farm out-buildings. A total of 33 no. receptors have been identified within 1,030 metres of a proposed wind turbine (ten rotor diameters) (see **Figure 11.1**).

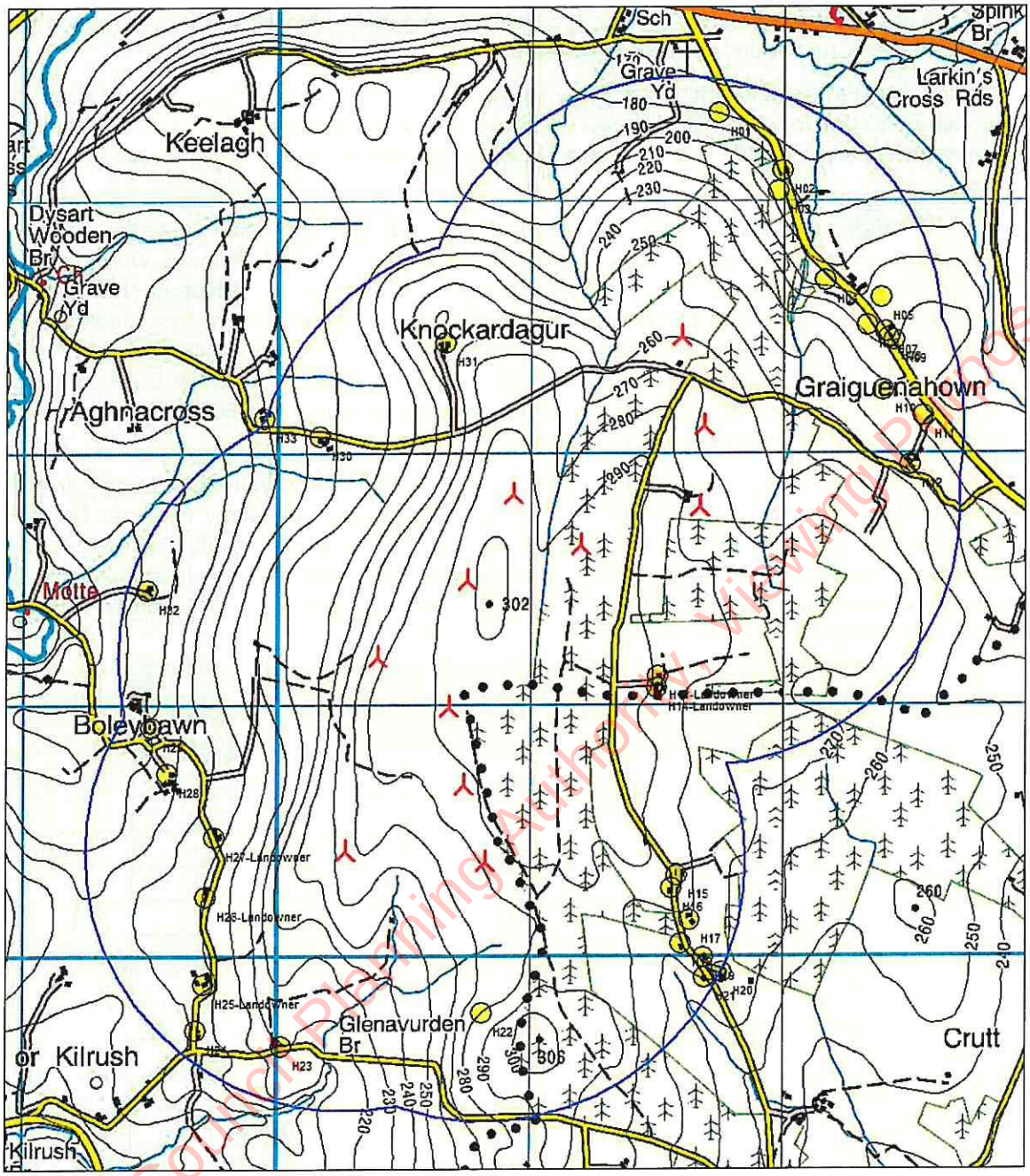


Figure 11.1: Setback map to dwellings/properties within 1,030m radius (10 rotor diameters) of proposed wind turbines

11.3 Description of Likely Impacts

11.3.1 Construction Phase

As the proposed turbines will not be operational during the construction phase there shall be no impact from shadow flicker.

11.3.2 Operational Phase

The 'worst case' results indicate that 21 no. receptors out of 33 no. receptors within a ten rotor diameter exceed 30 minutes per day. However, as explained above, it is reiterated that this calculation is a 'worst case' scenario and not representative of actual conditions. As explained above, this 'worst case' scenario will only occur under specific exceptional and circumstances when

the sun is at a certain position in the sky, the sun is shining, the turbines rotor is rotating and the turbine rotor is perpendicular to the shadow receptor.

Following this analysis, the variables outlined above were considered to calculate a more accurate expected prediction for shadow flicker over the course of a year. This de-rated calculation produced significantly different results and, as would be expected, predicts much lower levels of shadow flicker.

The shadow flicker results are detailed in **Table 11.2** and **Appendix 11.1** which shows the results of both shadow flicker calculations, indicating all receptors within ten rotor diameter which may be affected by shadow flicker. The table shows that none of the 33 no. receptors surveyed are predicted to experience shadow flicker in excess of 30 hours per annum. The highest predictions of shadow flicker relates to H26, H13 and H14 at approximately 18:07 hours, 15:49 hours and 14:46 hours per annum respectively. Notably all of these receptors are economically involved in the proposed development. All the remaining receptors will experience less than 30 hours per year, with 21 no. dwellings experiencing less than 10 hours per year.

As the predicted impact of shadow flicker will not exceed the allowable limits of 30 hours per year, mitigation by design has therefore reduced the potential impact of shadow flicker as far as is reasonably possible and the location of each proposed turbine has been carefully chosen to reduce the potential impact in relation to shadow flicker. A small amount of turbine curtailment may be required to ensure no dwellings experience more than 30 minutes per day. This can be achieved through accepted technological mitigation.

Dwelling ID	Max Shadow hours per day ('Worst Case')	Shadow hours per year ('Expected')
H01	00:15	00:24
H02	00:33	04:54
H03	00:50	06:25
H04	00:42	12:11
H05	00:30	08:16
H06	00:48	10:56
H07	00:36	08:48
H08	00:36	08:46
H09	00:36	08:22
H10	00:46	11:35
H11	00:30	07:48
H12	00:41	12:01
H13-Landowner	00:31	15:49
H14-Landowner	00:31	14:46
H15	00:32	08:23
H16	00:33	10:12
H17	00:30	08:34
H18	00:30	06:33
H19	00:27	05:32
H20	00:25	04:47
H21	00:27	06:07
H22	00:00	00:00
H23	00:00	00:00

H24	00:20	02:33
H25-Landowner	00:21	03:00
H26-Landowner	01:04	18:07
H27-Landowner	00:47	13:45
H28	00:48	08:43
H29	00:40	13:02
H30	00:44	09:12
H31	01:06	10:22
H32	00:25	08:15
H33	00:42	06:30

Table 11.2: Shadow Flicker Results

11.3.3 Decommissioning Phase

As the proposed turbines will not be operational during the decommissioning phase, there shall be no impact from shadow flicker.

11.4 Mitigation & Monitoring Measures

11.4.1 Construction Phase

No mitigation measures are required for the construction phase.

11.4.2 Operational Phase

Should it be required, effective technological solutions exist for shadow flicker monitoring and mitigation and are routinely included as conditions of consent for wind energy developments by Planning Authorities and An Bord Pleanála. Technological mitigation involves fitting a sensor to a turbine in a central location of the proposed development. Sensors may also be fitted to nearby properties. A number of site visits will then be carried out by a suitably qualified consultant at times to monitor the site when shadow flicker is predicted to occur. This on-site monitoring and data collection is then used to validate the accuracy of the shadow flicker model and the predicted impact at nearby receptors. The data collected will include:-

- The date, time, location (turbine ID) and duration of the measurement;
- Sunlight intensity;
- Wind speed;
- Wind direction/rotor angle.

Details of the equipment calibration will be noted to ensure accurate readings are taken. This will include the time and date of the calibration, the calibration level and the result.

Where shadow flicker levels are proven to be in excess of the recommended limits, the turbines can be simply programmed to automatically shut down where excessive shadow flicker levels occur. This approach will be implemented, as necessary, to ensure that the 20 no. dwelling predicted in the 'worst case' scenario do not exceed 30 minutes per day. The amount of turbine curtailment required to ensure this will have a negligible impact on the overall energy output of the wind farm.

As a consequence, routine technological mitigation measures exist to entirely exclude any adverse impact from shadow flicker on residential properties in the environs of the subject site.

11.4.3 Decommissioning

No mitigation measures are proposed during the decommissioning phase.

Appendix 11.1: Shadow Flicker Results

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

Printed/Page
13/04/2016 17:54 / 1
Licensed user:
Galetech Energy Services
Cootehill Enterprise Park, Cootehill
IE-CO. Cavan
+353 86 8222803

Calculated:
13/04/2016 17:53/2.8.579

SHADOW - Main Result

Calculation: Shadow Flicker Predictions

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [KILKENNY]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.68	2.20	3.08	4.72	5.31	4.94	4.67	4.36	3.78	2.74	2.15	1.32

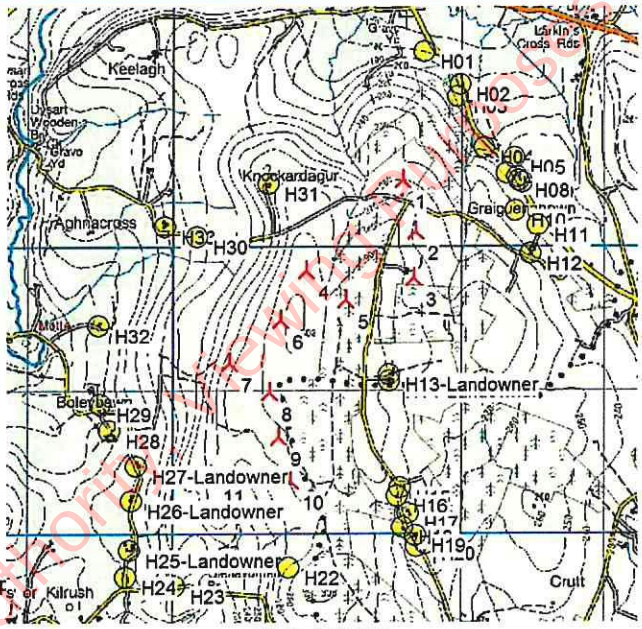
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
205	237	241	239	162	254	897	481	739	775	838	1,100

W	WNW	NW	NNW	Sum
1,051	812	440	289	8,760

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_ONLINEDATA_0.wr
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10.0 m



Scale 1:50,000

New WTG Shadow receptor

WTGs

	Irish Grid (IG)-IRELAND65 (IE) East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	251,604	182,460	258.7	T1	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
2	251,693	182,105	267.5	T2	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
3	251,676	181,781	273.2	T3	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
4	250,937	181,833	297.7	T4	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
5	251,205	181,628	299.3	T5	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
6	250,756	181,489	302.7	T6	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
7	250,403	181,186	278.9	T7	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
8	250,682	180,984	292.8	T8	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
9	250,742	180,675	291.0	T9	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
10	250,826	180,372	287.6	T10	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
11	250,276	180,413	260.8	T11	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8

Shadow receptor-Input

No.	Name	Irish Grid (IG)-IRELAND65 (IE) East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	H01	251,747	183,345	179.5	2.0	2.0	0.5	0.0	90.0	"Green house mode"
B	H02	252,003	183,118	189.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
C	H03	251,985	183,038	196.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
D	H04	252,171	182,682	208.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
E	H05	252,389	182,614	212.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"
F	H06	252,334	182,504	217.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
G	H07	252,407	182,475	217.6	2.0	2.0	0.5	0.0	90.0	"Green house mode"
H	H08	252,419	182,452	218.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
I	H09	252,443	182,442	219.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"
J	H10	252,398	182,245	230.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"
K	H11	252,554	182,144	226.2	2.0	2.0	0.5	0.0	90.0	"Green house mode"
L	H12	252,505	181,946	240.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"

To be continued on next page...

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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SHADOW - Main Result

Calculation: Shadow Flicker Predictions

...continued from previous page

No.	Name	Irish Grid (IG)-IRELAND65 (IE) East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
M	H13-Landowner	251,509	181,108	286.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
N	H14-Landowner	251,504	181,064	286.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
O	H15	251,584	180,317	281.7	2.0	2.0	0.5	0.0	90.0	"Green house mode"
P	H16	251,563	180,264	282.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
Q	H17	251,638	180,140	276.5	2.0	2.0	0.5	0.0	90.0	"Green house mode"
R	H18	251,603	180,046	273.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
S	H19	251,691	179,992	270.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
T	H20	251,763	179,930	266.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
U	H21	251,697	179,912	266.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
V	H22	250,816	179,769	278.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
W	H23	250,021	179,640	215.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"
X	H24	249,684	179,702	193.7	2.0	2.0	0.5	0.0	90.0	"Green house mode"
Y	H25-Landowner	249,712	179,885	196.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
Z	H26-Landowner	249,723	180,232	200.3	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AA	H27-Landowner	249,755	180,471	197.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AB	H28	249,570	180,722	179.3	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AC	H29	249,506	180,906	170.2	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AD	H30	250,173	182,064	215.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AE	H31	250,665	182,436	264.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AF	H32	249,491	181,450	162.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AG	H33	249,951	182,134	198.5	2.0	2.0	0.5	0.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
A	H01	3:54	20	0:15	0:24
B	H02	37:54	86	0:33	4:54
C	H03	47:08	97	0:50	6:25
D	H04	80:29	164	0:42	12:11
E	H05	51:56	146	0:30	8:16
F	H06	64:30	152	0:48	10:56
G	H07	50:27	133	0:36	8:48
H	H08	49:39	131	0:36	8:46
I	H09	47:09	125	0:36	8:22
J	H10	63:05	153	0:46	11:35
K	H11	40:01	114	0:30	7:48
L	H12	62:16	161	0:41	12:01
M	H13-Landowner	91:34	252	0:31	15:49
N	H14-Landowner	85:05	248	0:31	14:46
O	H15	40:53	130	0:32	8:23
P	H16	50:58	140	0:33	10:12
Q	H17	43:38	130	0:30	8:34
R	H18	32:49	115	0:30	6:33
S	H19	27:51	109	0:27	5:32
T	H20	24:14	104	0:25	4:47
U	H21	31:38	96	0:27	6:07
V	H22	0:00	0	0:00	0:00
W	H23	0:00	0	0:00	0:00
X	H24	13:05	48	0:20	2:33
Y	H25-Landowner	14:29	55	0:21	3:00
Z	H26-Landowner	88:28	124	1:04	18:07
AA	H27-Landowner	67:08	141	0:47	13:45
AB	H28	45:53	135	0:48	8:43
AC	H29	67:59	196	0:40	13:02
AD	H30	53:47	154	0:44	9:12

To be continued on next page...

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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SHADOW - Main Result

Calculation: Shadow Flicker Predictions

...continued from previous page

No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
AE	H31	78:53	157	1:06	10:22
AF	H32	51:01	194	0:25	8:15
AG	H33	48:10	127	0:42	6:30

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	T1	191:17	34:06
2	T2	134:37	23:28
3	T3	110:10	16:44
4	T4	83:32	12:20
5	T5	70:18	10:17
6	T6	97:33	17:47
7	T7	60:59	11:07
8	T8	70:36	12:48
9	T9	133:35	25:32
10	T10	185:27	35:17
11	T11	154:15	28:56

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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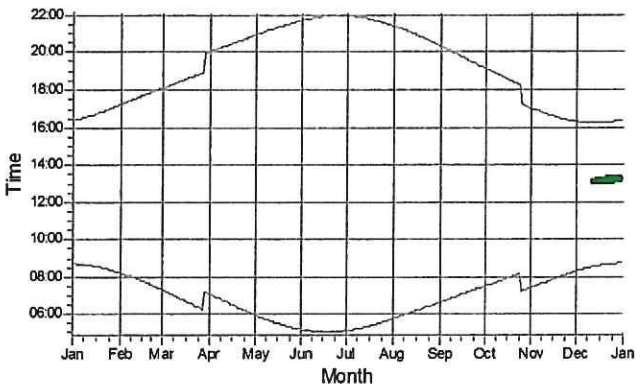
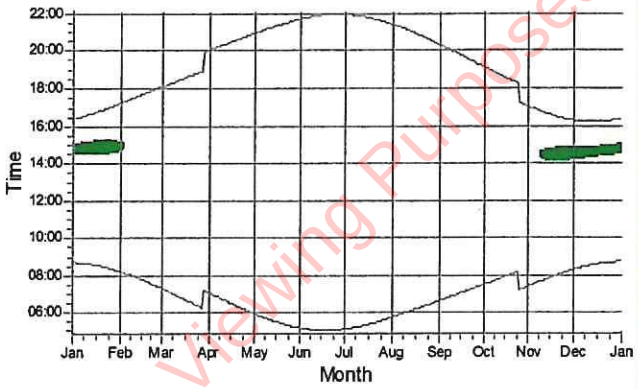
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions

A: H01



B: H02



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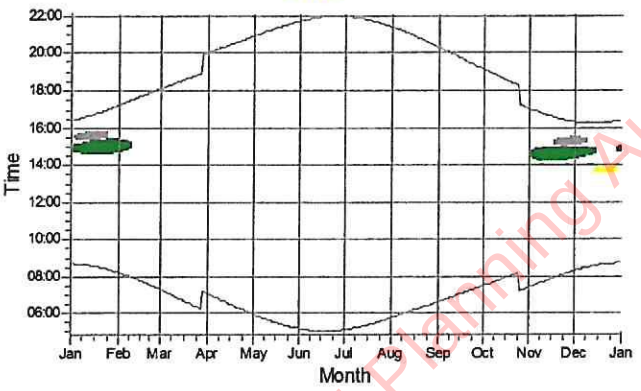

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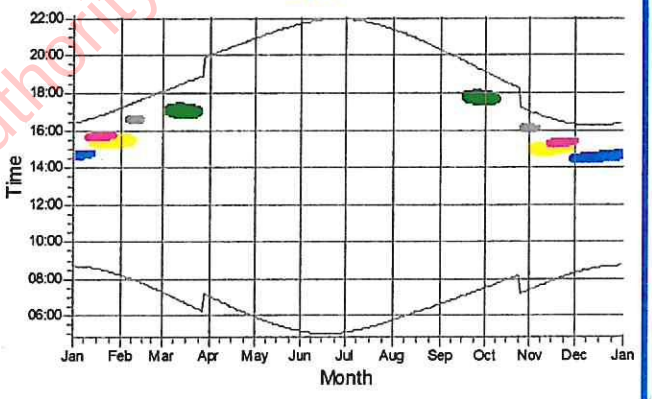
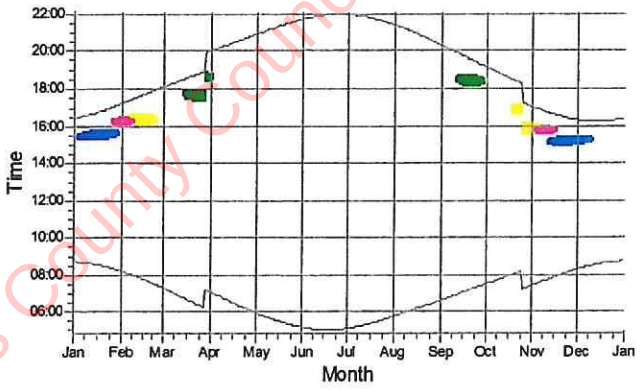
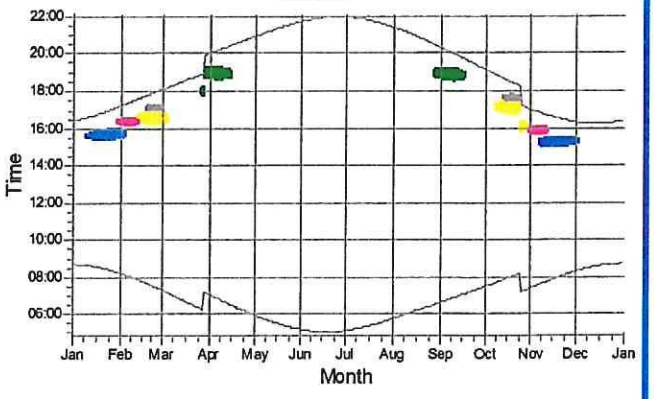


E: H05



F: H06



WTGs

1: T1
2: T2
3: T3
4: T4
5: T5

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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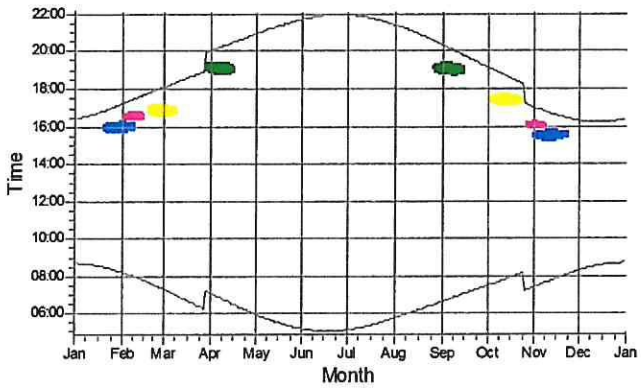
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions

G: H07



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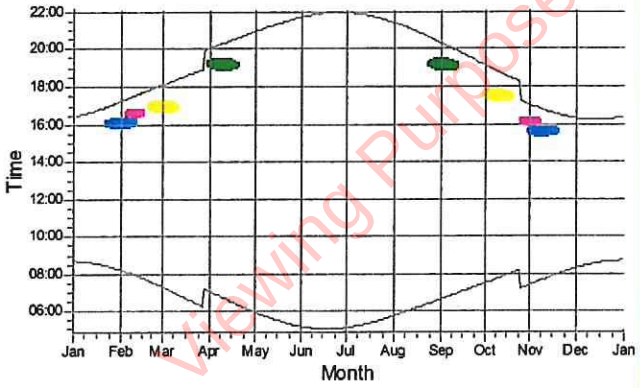
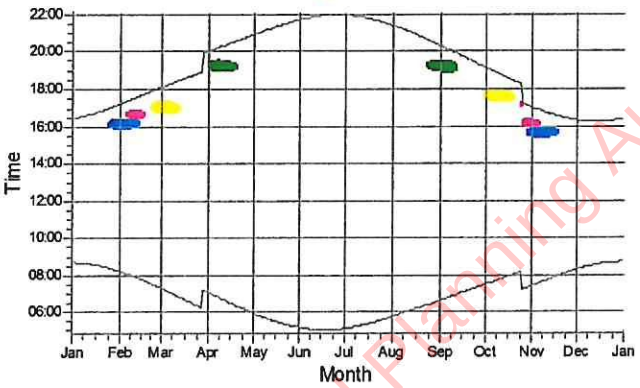


I: H09



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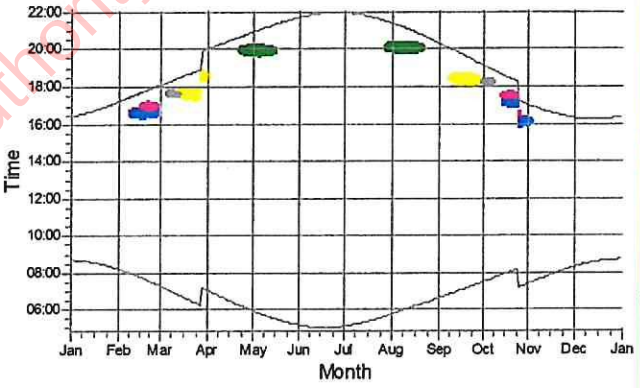
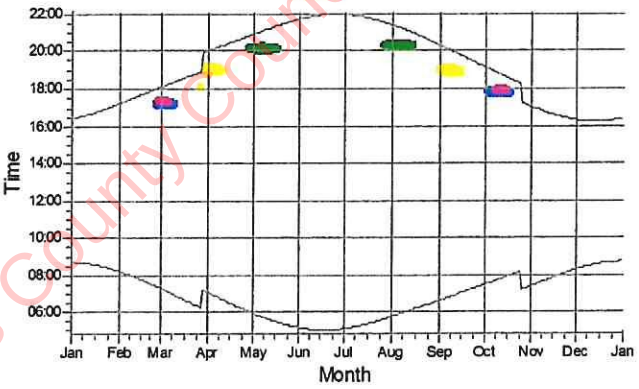
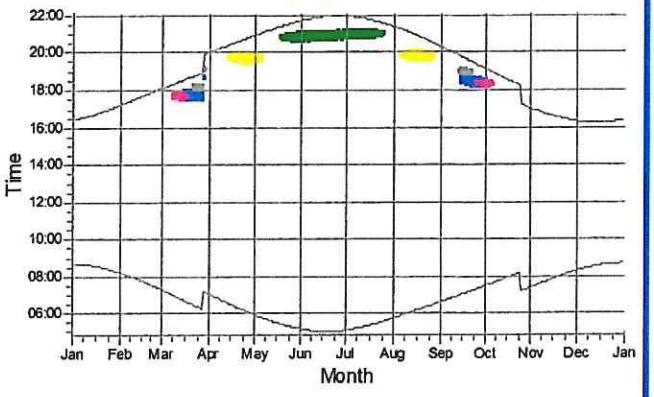


K: H11



L: H12



WTGs

1: T1
2: T2
3: T3
4: T4
5: T5

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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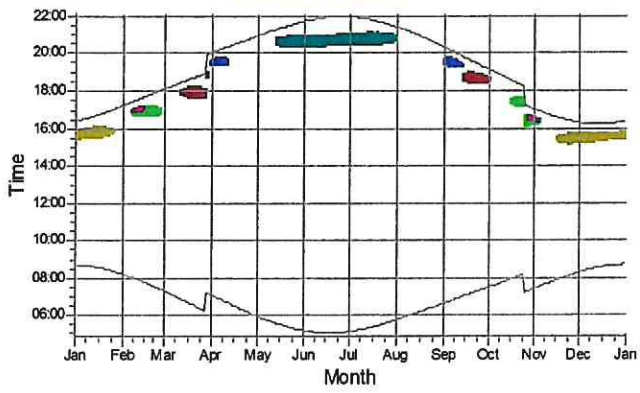
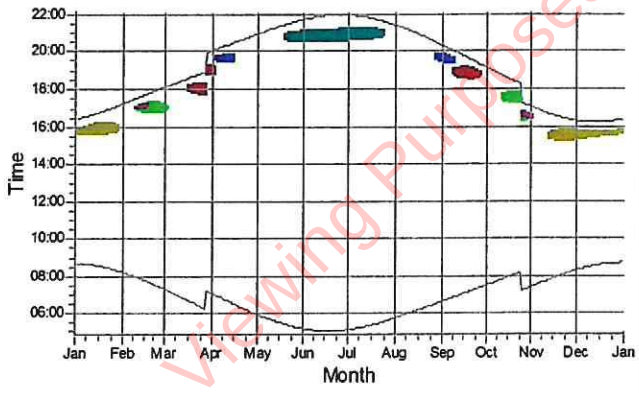
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions

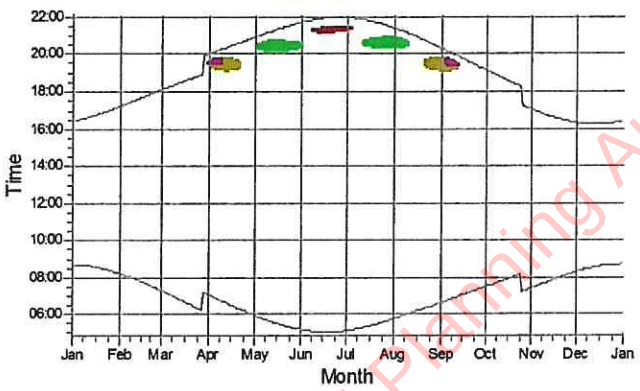
M: H13-Landow ner



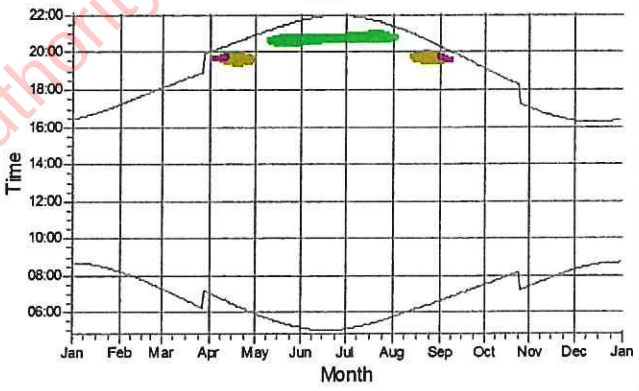
N: H14-Landow ner



O: H15



P: H16



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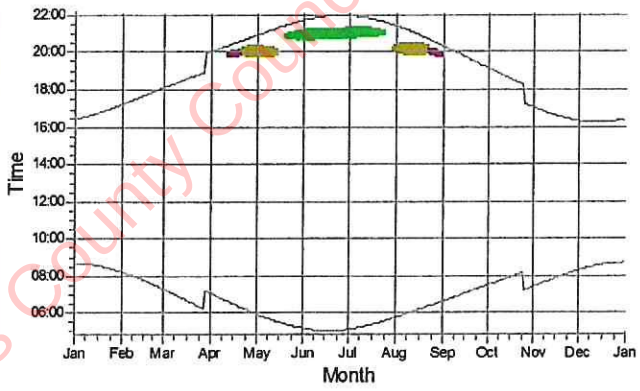

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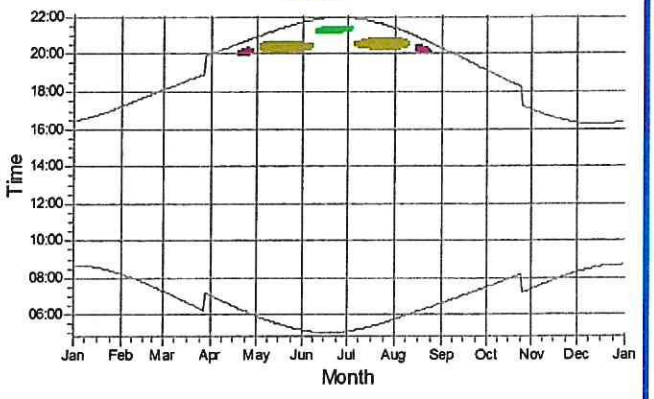

WTGs

6: T6
7: T7
8: T8
9: T9
10: T10
11: T11

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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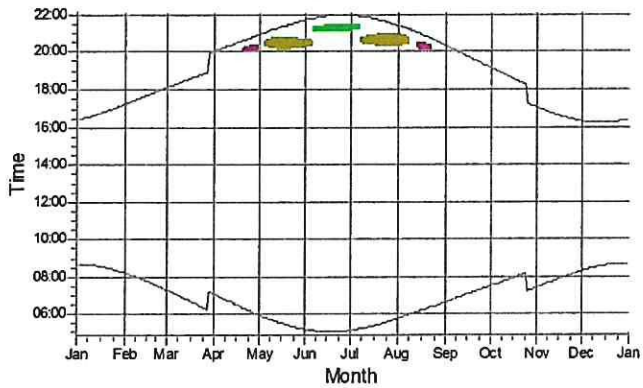
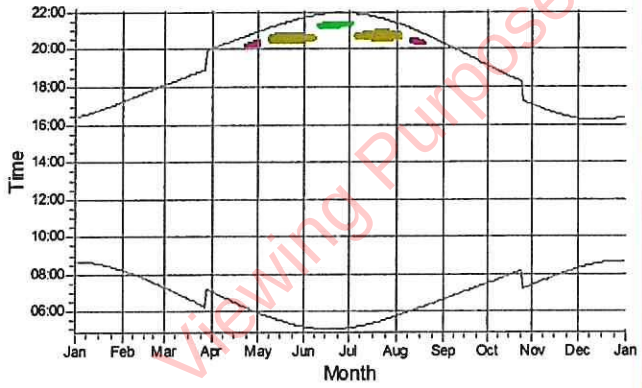
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions

S: H19



T: H20



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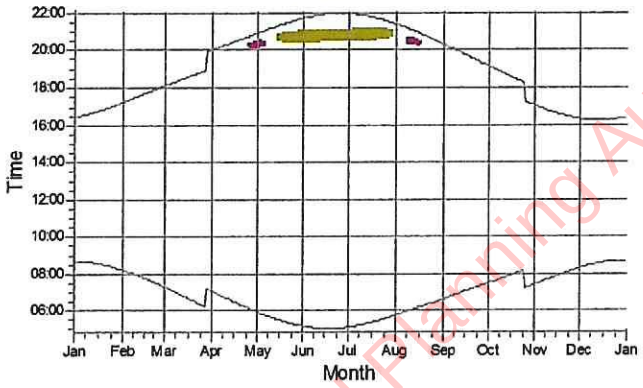

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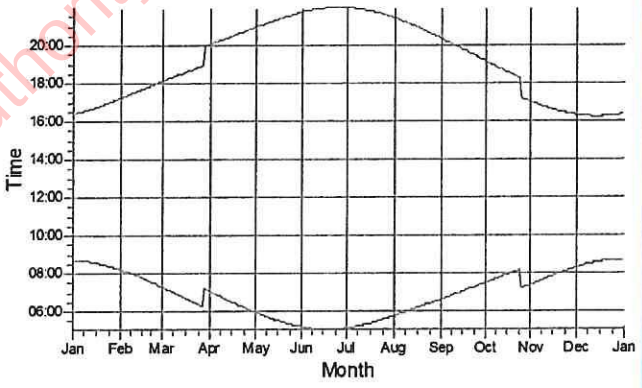

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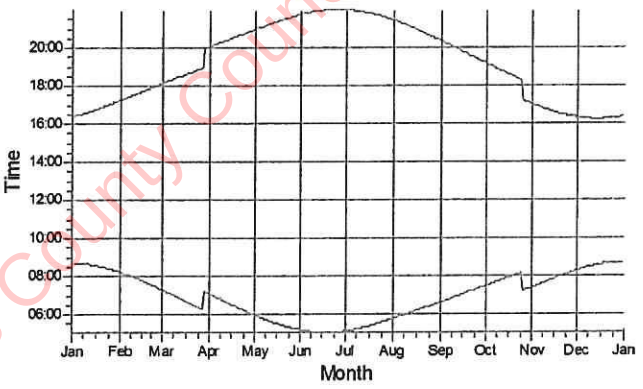

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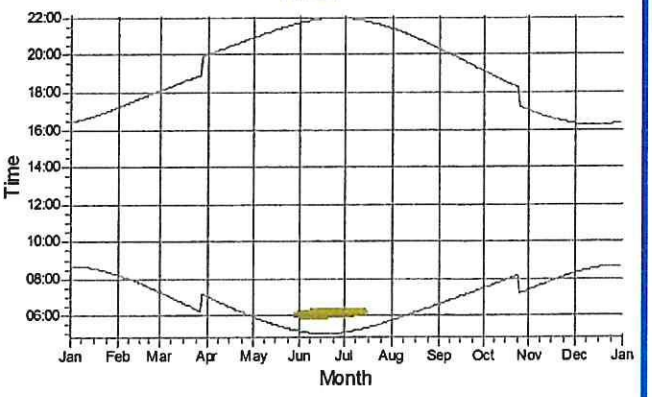

WTGs

9: T9 10: T10 11: T11

Project:
Pinewoods Wind Farm

Description:
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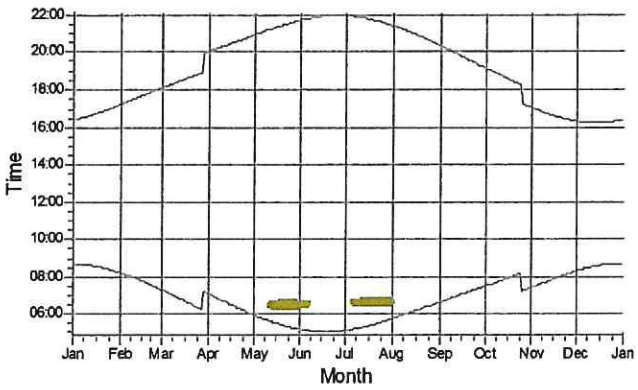
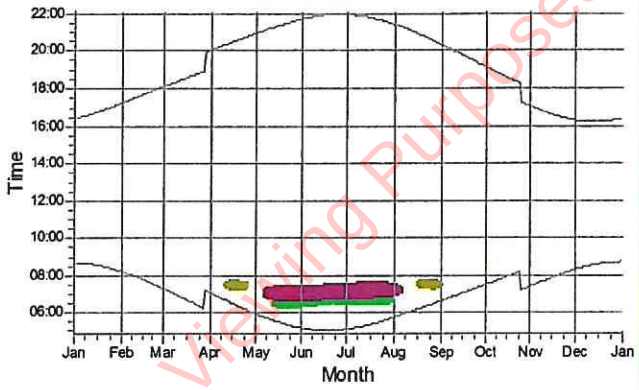
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions

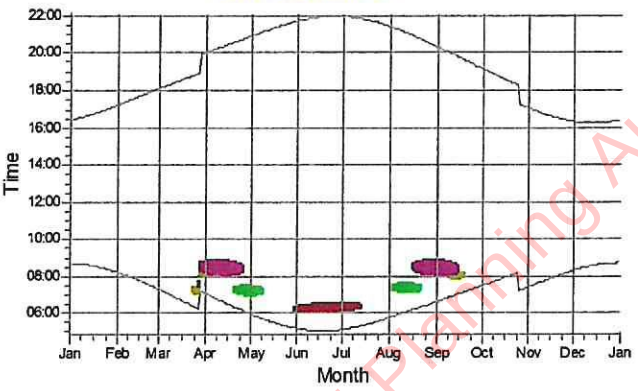
Y: H25-Landow ner



Z: H26-Landow ner



AA: H27-Landow ner



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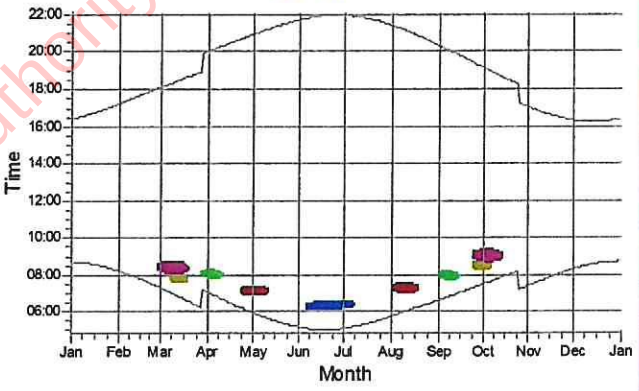

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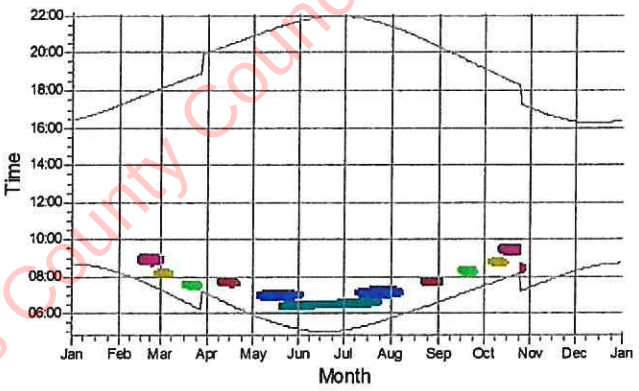

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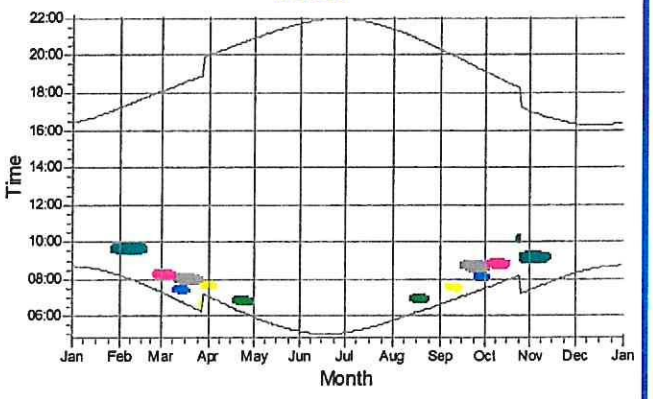

WTGs

1: T1	4: T4	7: T7	10: T10
2: T2	5: T5	8: T8	11: T11
3: T3	6: T6	9: T9	

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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Cootehill Enterprise Park, Cootehill
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SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions

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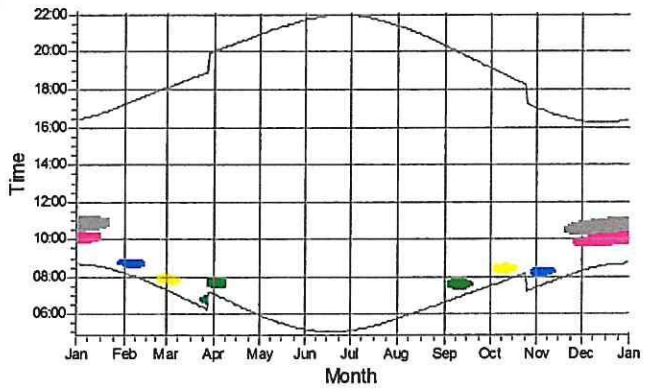

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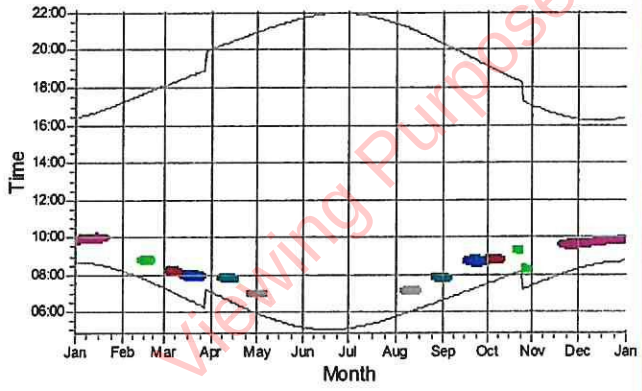

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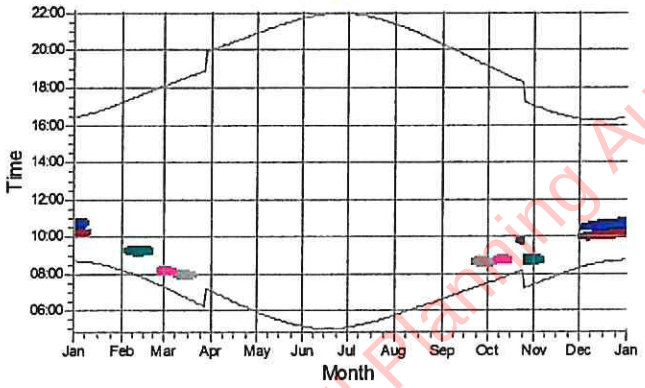

WTGs

1: T1	4: T4	7: T7	11: T11
2: T2	5: T5	8: T8	
3: T3	6: T6	9: T9	

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Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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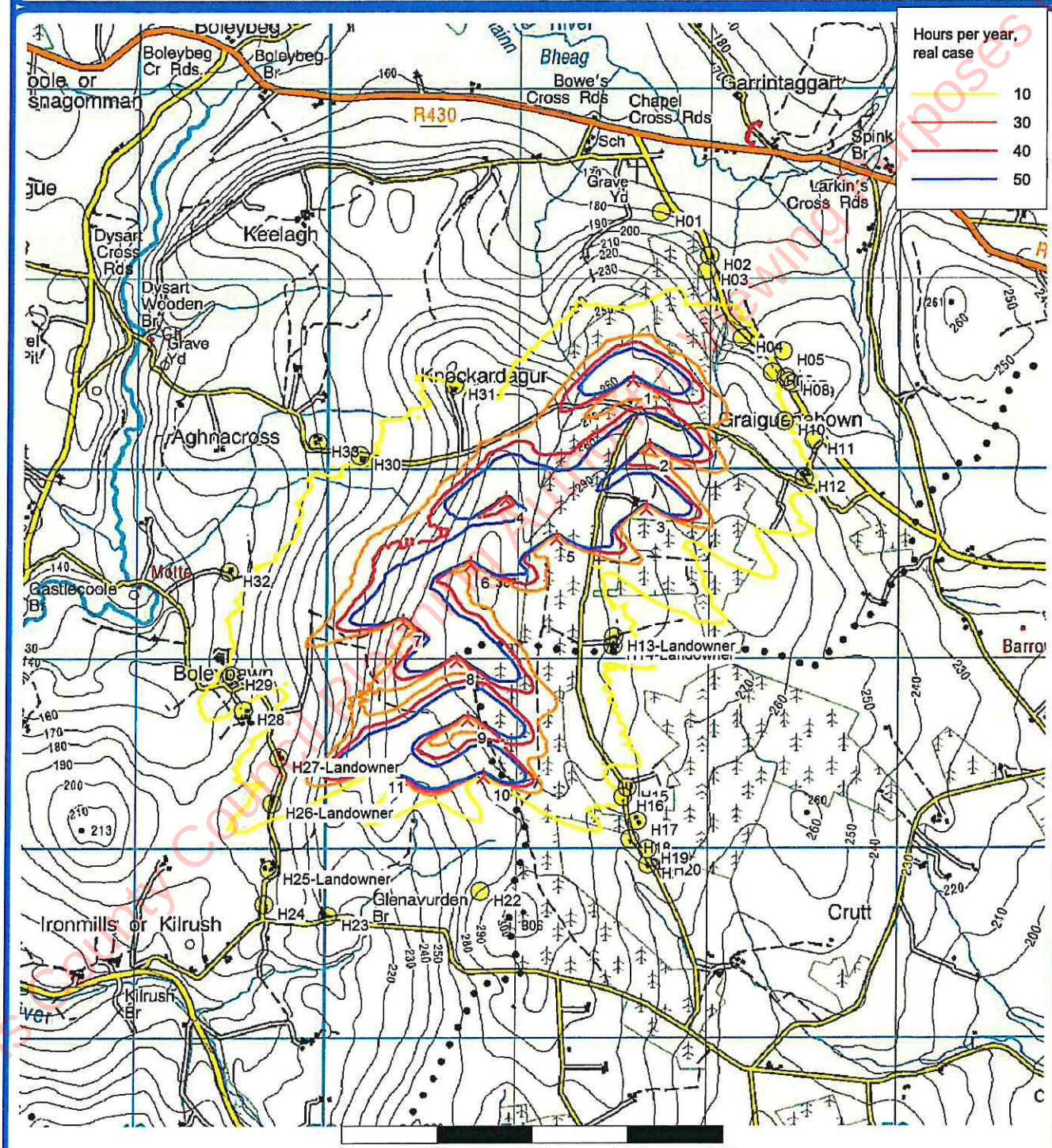
SHADOW - Map

Calculation: Shadow Flicker Predictions



Map: 50,000 Map , Print scale 1:30,000, Map center Irish Grid (IG)-IRELAND65 (IE) East: 251,060 North: 181,400

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)

Chapter 12:
Telecommunications

12.1 Introduction

12.1.1 Overview

As noted in the Wind Energy Development Guidelines for Planning Authorities (2006), wind turbines, like all electrical equipment, produce electromagnetic radiation, and this can interfere with broadcast communications. This chapter considers the potential impacts of the proposed development upon a range of communications infrastructure, including telecommunications networks, civil and military aviation, broadcast radio and television and fixed infrastructure such as telecommunication masts. As part of this assessment, GES Ltd carried out various consultations with all relevant statutory bodies (see **Chapter 1**).

12.1.2 Methodology

12.1.2.1 Desk Based Research

Desk based research was undertaken to identify:

- Locations of known telecommunications facilities;
- Known telecommunications fixed links;
- Known television broadcast and re-broadcast facilities;
- Known civil aviation safeguarding areas;
- Known military aviation infrastructure and training areas;
- Known locations and routes of fixed infrastructure, such as broadband masts.

12.1.2.2 Consultations

During the design stage of the propose development, a series of telecommunication companies and statutory bodies were consulted regarding the proposed turbine locations and potential impacts on transmission signal paths and aeronautical infrastructure. This included the forwarding of proposed grid co-ordinates, dimensions and elevations of the proposed turbines to the relevant bodies. A summary of the consultation responses is included in **Table 12.1.** Where no response was received, it is assumed that there are no issues of concern in respect of the proposed development.

Irish Aviation Authority (IAA)	No response.
An Garda Síochána	No response.
Eircom/TETRA Ireland	Confirmed that the proposed development should not interfere with the Eircom microwave radio.
RTE	No response.
Department of Defence	No objection to this proposed development. Air Corps request that the following is applied: • Turbines delineating corners of the wind farm should be illuminated by high intensity obstacle lighting. • Obstruction lighting elsewhere in a wind farm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight. • Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-red (IR) range of the electromagnetic spectrum specifically at or near 850nanometres (nm) of wavelength. Light intensity to be of similar value to that emailed in the visible spectrum of light.

Meteor, Vodafone, 3G, National Ambulance Service, and Vodafone	No response.

Table 12.1: Summary of Consultation Responses

12.2 Description of the Existing Environment

A combination of desktop research and a site visit was undertaken to determine the extent of telecommunication and other infrastructure in the environs of the subject site. This included an analysis of the online mapping provided by Comreg. No telecommunications infrastructure likely to be impacted by the proposed development was identified. There is a micro-light flight centre located in Aughnacross, which is 0.8km from the proposed substation and 1.46km from Turbine 4.

12.3 Description of Likely Impacts

12.3.1 Construction Phase

There will be no sources of electromagnetic interference of sufficient strength emitted during the construction phase to impact on telecommunications infrastructure and, therefore, there is no likely impact.

12.3.2 Operation Phase

Radio waves and microwaves are used for a wide variety of telecommunication purposes. The rotating blades of wind turbines can potentially scatter electromagnetic signals causing interference. It is possible that wind turbines can also impact line-of-sight signals. UHF- and VHF-type signals such as the radio services operated by RTÉ can occasionally be affected by turbines. However, with the switchover to a digital television, the likelihood of any impact is negligible.

Having consulted with the telecommunication service providers and statutory bodies, and with reference to the unconstrained nature of the subject site, it is not anticipated that there will be any likely impacts on telecommunications resulting from the proposed development.

12.4 Mitigation & Monitoring Measures

12.4.1 Construction Phase

No mitigation required.

12.4.2 Operational Phase

The developer shall continue monitor the impact of the proposed development on telecommunications. In the unlikely event that any interference arises, this can be overcome by the installation of signal amplifiers, active deflectors or relay transmitters.

All electrical components, equipment, apparatus and systems are required by Irish and European law to comply with the EMC Directive 89/336/EEC. This will ensure that the levels of electromagnetic emissions from these devices will be well below those specified in the ICNIRP 1998 Guidelines and in the EU Council Recommendation 1999/519/EC.

The developer will keep all operators and statutory bodies informed of any changes to the layout, should these occur following conditions of consent, immaterial design/dimension changes or micro-siting. As is standard practice, the developer will consult with the IAA to ensure compliance with all requirements. The developer will also adhere to the requirements of the Department of Defence.

The developer to sign a protocol with RTÉ NL and will assume responsibility for any remedial measures which may be required as a result of any impact on RTÉ's network.

Chapter 13:
Transport & Access

13.1 Introduction

13.1.1 Overview

This chapter assesses the likely impact of the proposed development in respect of traffic conditions, transport routes and general traffic safety. The assessment also identifies the proposed haul route for turbine component delivery and any secondary and indirect impacts of the proposed development on the road network.

13.1.2 Methodology

A high level review of all potential transport routes, road conditions and access points was undertaken by GES Ltd. Desk-based research included:

- Activities that may potentially give rise to significant traffic movements;
- Views from relevant statutory consultees and local authorities;
- Access to and within the proposed development site.

13.2 Description of the Existing Environment

13.2.1 Location

The subject site is located approximately 3km east of Ballinakill, Co. Laois and adjacent to, and south of, the R430 regional route (see **Figure 13.1**).

The site is currently predominantly used for forestry and agricultural purposes. On-site access is via existing forestry tracks from the network of local roads (L7800, L78001 and L77951).

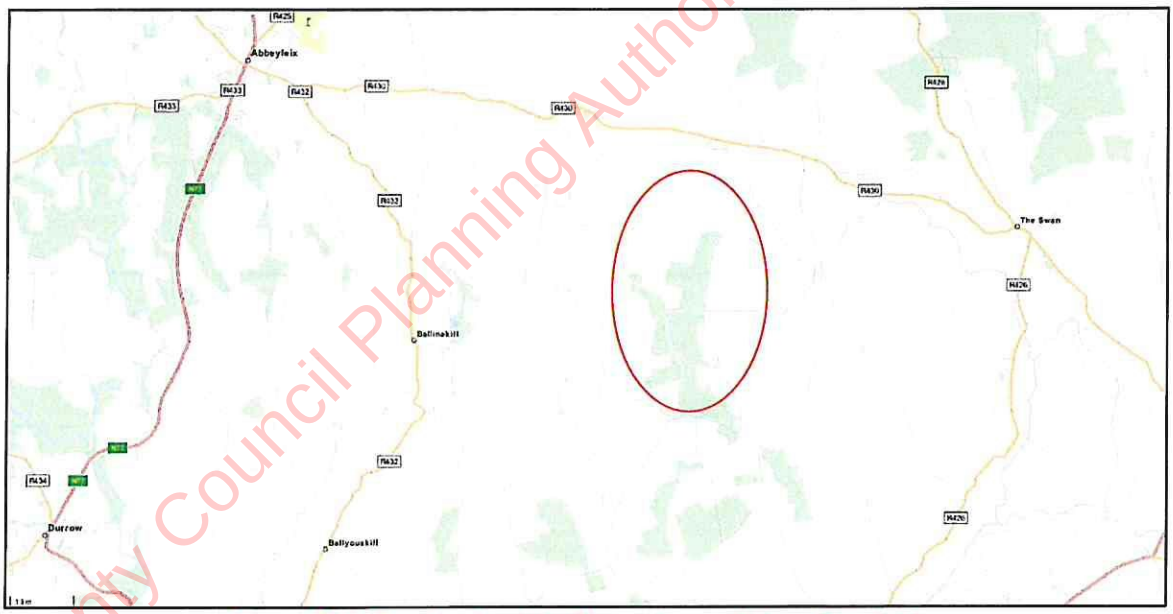


Figure 13.1: Road network in the environs of the subject site

13.3 Description of Likely Impacts

13.3.1 Construction Phase

The proposed development will require the transportation of large turbine components together with associated construction plant and general construction traffic during the 12–18 month construction phase.

It is estimated that approximately 176 trips (both in and out) of abnormal oversized loads will be required to transport turbine components, including with cranes, to the site. Some temporary access

restrictions will therefore need to be put in place during the construction phase to facilitate the safe delivery of turbine components to the site. It is further estimated that a total of 3252 HGV trips and 4683 LGV van trips will occur during the construction phase. The intensity of trips will vary during the construction phase depending on the stage of the construction process (see **Table 13.1**)

Construction Works	*Oversized Loads*	*HGV*	*LGV*
Site works	176	2789	1320
Electrical cables	0	214	337
Substation	0	131	904
Site set-up and management	0	118	2122
Totals	176	3252	4683

Table 13.1: Predicted vehicle trips during the construction phase

The assumptions used in estimating the number of vehicle trips required during the construction phase are provided in **Table 13.2**.

Construction Works	*Details*
Length of new access tracks	7.4km
Depth of access tracks	0.5m
Oversized components per turbine	16
HGV movements per turbine	296
LGV movements per turbine	426
Underground cabling	7.4km
Aggregate required for on-site access track (m^3)	18,500m^3
Tonnage of aggregates for on-site access track	37,500 tonnes
HGV loads	1,875
Aggregates required for turbine hardstands and site entrances (m^3)	5,500m^3
Tonnage of aggregates for turbine hardstands and site entrances	11,165 tonnes
HGV Loads	559
Aggregates required for turbine foundations (m^3)	3,740m^3
HGV loads	499
Total HGV movements	3,252

Table 13.2: Construction phase vehicle trip assumptions

The haulage of all construction materials and aggregates to the site and the movement of personnel will be undertaken in accordance with the principles of sustainable transport. Deliveries shall, where possible, be undertaken along national and regional routes. The suppliers of construction materials have not yet been identified and will be selected by way of a competitive tendering process at the time of construction. As such confirmation of the exact haul routes for construction materials is not

possible at this time. However, it is anticipated that local suppliers will be preferred in order to minimise vehicle movements. **Figure 13.2** provide details of potential local suppliers of ready-mix concrete and aggregates for the proposed development. The transport routes as illustrated may not represent the most direct route to the site but have been chosen because they allow use of roads best suited to the volume and size of vehicles likely to be used. They also avoid the need to use narrower local roads as far as is possible. All quarries used for the proposed development will have the appropriate planning consent, license and registration, including as required by the EIA and Habitats Directives.

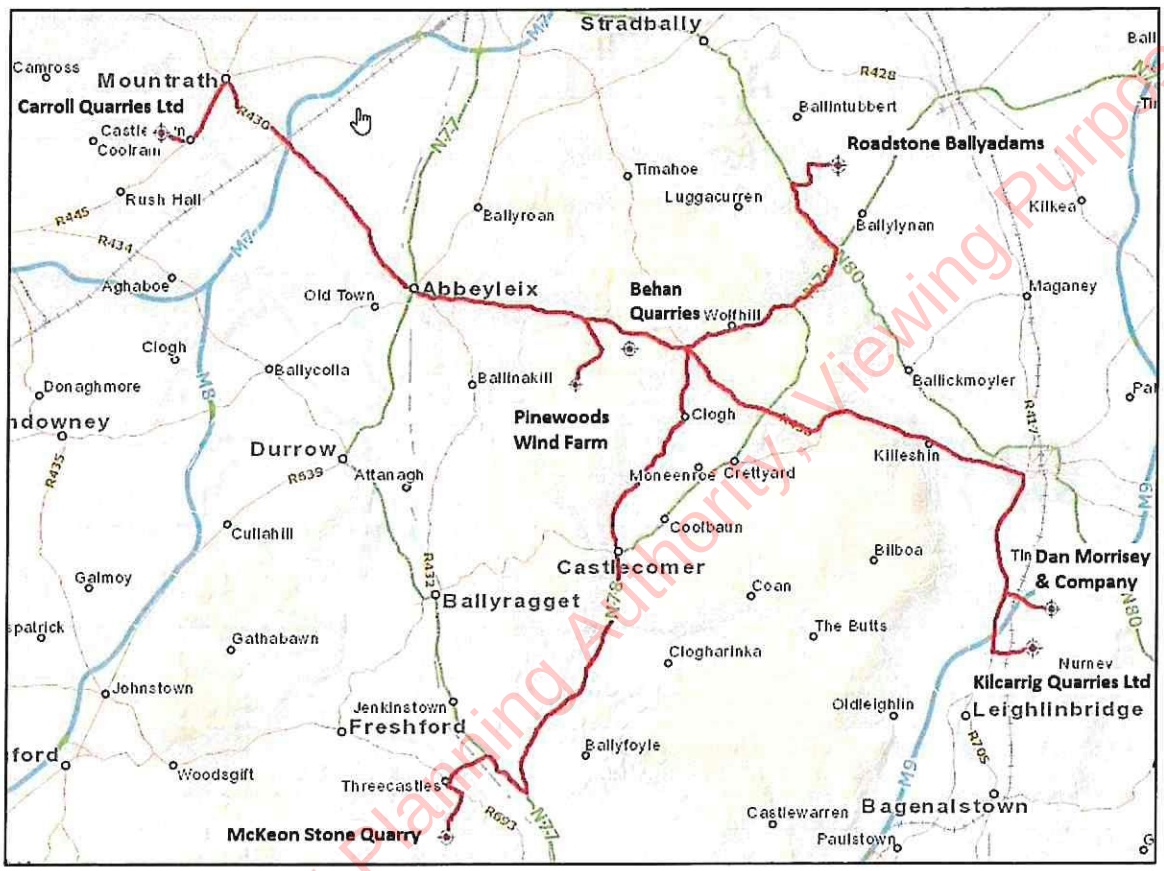


Figure 13.2: Potential suppliers and haul routes for aggregates, stone etc.

A transport study of the proposed haul route to the site was carried out to assess suitability for the transportation of oversized loads of wind turbine components including blades and their associated tower sections. **Figure 13.3** illustrates the type of vehicles that will be used in the transportation of the turbines to site.

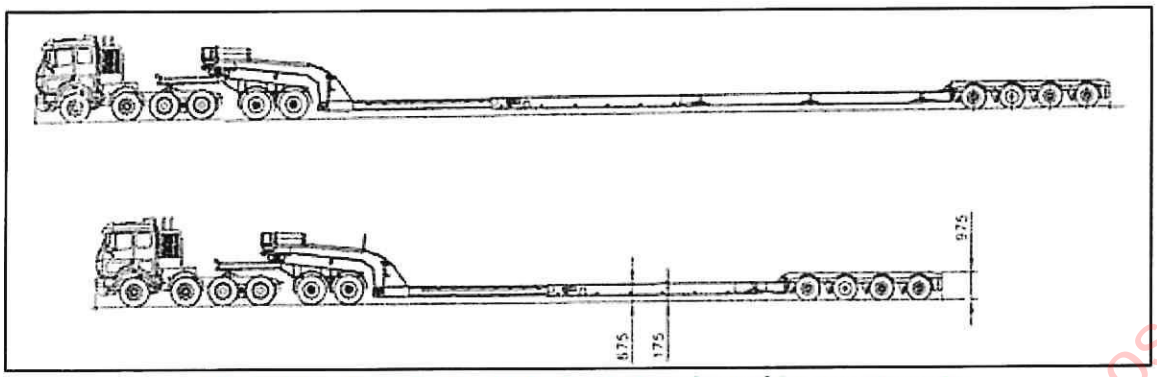


Figure 13.3: Transport vehicle dimensions for turbine components

The fully laden load will be somewhat longer than that illustrated above in that the components will overhang the rear of the truck. **Figures 13.3** and **13.4** provides an illustration of the typical dimensions of a truck fully laden with a turbine blade. Various components of the turbine will fit differently on the truck, including the tower sections.

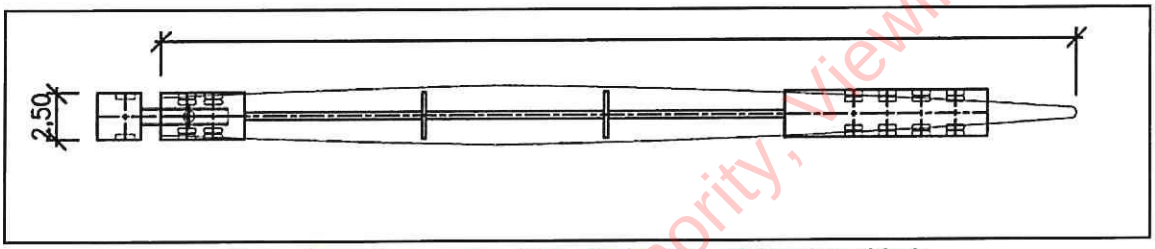


Figure 13.4: Transport vehicle dimensions with turbine blade

There are a number of sea ports on the island of Ireland which can accommodate the landing and handling of turbine components of the size and type of those to be used in the proposed development. Many of these ports have direct access to the national motorway network. Accordingly, given the proximity of the subject site to the motorway network, transport of turbine components from the port to the proposed development site should not present any significant difficulties.

Figure 13.5 illustrates the likely haul route of turbine components. From the M9, the haul route continues onto the N78 at Exit 3 and proceed towards the R430 junction where it turns right towards the village of Swan. Some temporary removal of road signage will be required at Exit 3 to facilitate the swept path of the transport vehicle. From the R430, the haul route will turn left onto the L7800 local road which connects to the subject site. Some temporary junction upgrades will be required at this location to facilitate turning movements.

The proposed development will use existing forestry access points, where available. Within the subject site, approximately 7.4km of access tracks will be required. The proposed development layout has been designed to make best use of these existing forestry tracks, where possible. However, these tracks are not sufficiently wide to accommodate loads associated with the proposed turbines and will therefore be widened to a typical running width of approximately 5 metres.

Figure 13.5: Proposed haul route from Dublin Port to the proposed development site

13.3.2 Operation Phase

During the operation phase, vehicle trips to and from the site will be greatly reduced with typically 1-2 trips per week for routine inspections, servicing and maintenance activities using a van (see **Table 13.3**).

Operation Works	Oversized Loads	HGV	LGV
Routine inspections, servicing and maintenance activities	0	0	2,600 (104 per annum)

Table 13.3: Predicted vehicle trips during the operation phase

In the event that a major turbine component requires replacing, it may be necessary to bring larger vehicles onto the site during the operation phase to facilitate these works.

13.3.2 Decommissioning Phase

Vehicle trips for the decommissioning phase will be similar to the construction phase. However, given the nature of decommissioning works and the reuse of materials on site, the intensity of trips is predicted to be lower (see **Table 13.4**)

Decommissioning Works	Oversized Loads	HGV	LGV
Site works	176	188	590
Electrical cables	0	0	0
Substation	0	40	236
Site set-up and management	0	0	0
Totals	176	228	826

Table 13.4: Predicted vehicle trips during the decommissioning phase

13.4 Mitigation & Monitoring

13.4.1 Construction Phase

- A traffic management plan shall be agreed with the local authority as part of the Construction Management Plan in advance of the commencement of works;
- All works to the public road shall be undertaken in consultation with, and agreed in advance with, the local authority;
- All reasonable steps shall be taken to ensure that only national and regional routes are used to transport materials to the site, in so far as is possible.
- Before and after pavement and bridge surveys will be undertaken along access routes;
- Adequate signage shall be provided at entrances providing access, safety and warning information;
- Traffic restrictions shall be kept to minimum duration and extent;
- Diversions shall be implemented to facilitate continued public use of roads where temporary traffic restrictions have to be put in place;
- The timing of oversized loads shall be agreed with the relevant local authorities and An Garda Síochána;
- A wheel wash facility will be located at each site entrance. Water spraying for dust suppression will also be used, as required;
- A designated contact point and coordinator will be put in place to manage all access arrangement and to interface with the public and the local authority;
- No hedgerows or potential breeding habitats to be removed during the summer breeding season;
- The site shall be closed to the public during the construction phase.

13.4.2 Operation Phase

Given the infrequency of traffic movements resulting from the proposed development during the operation phase, no specific mitigation measures are required.

13.4.3 Decommissioning Phase

Mitigation measures for the decommissioning phase will be similar to the construction phase and will be agreed with the local authority at that time as part of the Decommissioning Management Plan.

Chapter 14:
Interactions of the Foregoing

14.1 Introduction

This chapter summarises the critical results and conclusions of each impact and to ascertain how those impacts may interact. Reference should be made to Chapter 2, which addresses site selection and design alternatives. As the design of a wind farm is an iterative process, the final proposed development integrates numerous mitigation measures, these *a priori* respond directly to many of the potential impacts identified in this EIS.

14.2 Interactions

Interactions are considered by a means of a matrix are set out in **Table 14.1** examining each aspect of the receiving environment which is considered in detail in the appropriate chapters of this EIS and cross-tabulated against all other aspects that have also been considered.

Where an interaction is considered to be both likely and significant, it is given a reference number in the matrix and detail of the interaction is discussed below. The most common interactions for a proposed wind farm are between human beings and noise, human beings and shadow flicker, visual perceptions, construction impacts, biological resources and landscape.

Interactions	Human Beings	Flora & Fauna	Soil & Geology	Water	Noise	Shadow Flicker	Landscape & Visual Impact	Transport & Access	Climate & Air Quality	Archaeology & Cultural Heritage	Telecommunications
Human Beings					1	2	3	5			4
Flora & Fauna			8	7							
Soil & Geology		8								9	
Water		7									
Noise	1										
Shadow Flicker	1										
Landscape & Visual Impact	3									6	
Transport & Access	5									10	
Air Quality & Climate											
Archaeology & Cultural Heritage			9				6	10			
Telecommunications	4										

Table 14.1: Matrix of Interaction

14.2.1 Interaction 1: Human Beings/Noise

In terms of the construction phase, this noise will be generated through a number of normal on-site construction activities and can be considerably mitigated through appropriate mitigation and good-practice operational controls. Impacts will be short-term and temporary in nature and a perceptible increase in noise which is sufficient to cause a significant impact to residential amenity is not likely given the distance of the existing properties in the area from the subject site.

In terms of the operation phase, noise predictions have been carried out at 33 no. receptors within ten rotor diameters (1,030m) from each proposed turbine. The predictions confirm that the proposed development will not increase noise levels above the applicable lower fixed limits (see **Chapter 10**).

14.2.2 Interaction 2: Human Beings/Shadow Flicker

Once the proposed wind farm is operational there is potential for shadow flicker to occur depending on certain conditions as explained in detail in **Chapter 11**. All properties within ten rotor diameters (1,030metres) of the proposed wind turbines have been assessed for shadow flicker. Thus 33 no. properties were identified and assessed.

It is predicted that, under the 'worst case' scenario, 21 no. of the 33 no. receptors identified would exceed 30 minutes per day. However, this calculation is a 'worst case' scenario and not representative of actual conditions and a very significant over-estimation of likely impact.

A more realistic projection is the 'expected' hours per year. Under this scenario, none of the 33 no. receptors surveyed are predicted to experience shadow flicker in excess of 30 hours per annum.

With ongoing monitoring, in the event that shadow flicker exceeding minimum thresholds identified in the Wind Energy Development Guidelines for Planning Authorities 2006, technological mitigation can be simply introduced to fully eliminate any impact on human beings and residential amenity as a result of shadow flicker.

14.2.3 Interaction 3: Human Beings/Landscape & Visual Impact

The landscape and visual impacts of the proposed development have been discussed in **Chapter 8** of this EIS. In terms of wind farm developments, the landscape and visual impact can be considered the most significant impact. Viewshed Reference Points (VRPs) consisting of views from key receptors were identified and a detailed analysis of each is discussed in **Chapter 8**. A series of photomontages is also presented in **Volume II**.

14.2.4 Interaction 4: Human Beings/ Telecommunications

Generating electricity from wind energy has the potential to interfere with the quality of radio waves and microwaves used for communication purposes – analogue TV signals, radio signals, aircraft and navigation systems and microwave links.

As outlined in **Chapter 12**, a range of bodies were consulted regarding the proposed development. To date, none of the organisations which were consulted have raised any concerns in relation to potential interference or conflict with their existing operations.

Due to the recent change to digital broadcasting, the proposed wind farm will not impact upon television signal reception. In the unlikely event that interference radio signals should occur, the developer will remedy any issues with technological mitigation. This is standard procedure for such developments.

14.2.5 Interaction 5: Human Beings/Traffic & Access

The proposed development will generate construction traffic during the initial development phase. In terms of vehicle movements during the construction stage of the proposed development, it is estimated that approximately 3,250 trips (includes both in and out) of HGVs will be required, including abnormal loads transporting turbine components. This will require a temporary upgrade to the R430/L7800 junction. All traffic management measures will be agreed with the Planning Authority in relation to these abnormal loads prior to commencement.

The increase in traffic volumes on the surrounding road network will be temporary in nature as the expected duration of the construction phase is 12-18 months. Once turbines are in operation, traffic movements to and from the site will be very light, probably averaging one visit a week by a light

commercial vehicle or car for maintenance purposes. All trips to and from the site will be undertaken in accordance with the principles of sustainable transport and all traffic management measures will be prepared and implemented to the satisfaction of the Planning Authority

14.2.7 Interaction 6: Landscape & Visual Impact/ Archaeology & Cultural Heritage

As outlined in **Chapter 9**, the site is relatively benign in terms of archaeological and cultural heritage resource. There are 28 no. protected structures within the wider study area. However, the visual impact of the proposed development on these structures and other archaeological features is considered negligible.

14.2.8 Interaction 7: Flora & Fauna / Water

As outlined in **Chapter 5**, the excavated soil and exposed area during the construction phase may lead to the sedimentation of nearby watercourses and downstream impacts on protected habitats. A suite of substantial mitigation measures is proposed which will be fully implemented in order to exclude the potential for the generation of silt laden runoff. Mitigation measure proposed during the construction phase will also ensure that the proposed wind farm development does not result in a noticeable or significant negative impact on soils or the geological environment.

14.2.9 Interaction 8: Flora & Fauna / Soils & Geology

The excavation and removal of soils for the construction of permanent features such as hardstands, access route, and substation may potentially lead to habitat loss. However as discussed in **Chapter 4**, the proposed development is not located within an ecologically sensitive area and will be appropriately managed to ensure no likely significant impacts, including significant mitigation by design measures

14.2.10 Interaction 9: Archaeology & Cultural Heritage / Soils & Geology

As discussed in **Chapter 9**, the assessment of the archaeological, architectural and cultural heritage was carried out on the subject site and it is recommended that a licensed archaeologist be present to monitor topsoil stripping across the site. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed.

14.2.10 Interaction 10: Archaeology & Cultural Heritage /Transport & Access

As discussed in **Chapter 9**, there are no recorded archaeological, architectural or cultural heritage features within the land take of the haul route along the local routes to the proposed development. As a result there will be no adverse impact on the recorded archaeological resource.

The removal of all topsoil and overburden within the proposed area of land take down to geologically deposited strata, including all junction improvement land take identified in **Chapter 13** will be monitored under licence from the Department of Environment, Community and Local Government. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed.

14.3 Summary of Impacts

Overall, it is concluded that the impact of the proposed development on the receiving environment will not likely to be significant. Negative impacts from the proposed development vary in significance but are generally in the minor to negligible range. A number of positive impacts have also been identified such as community/population benefits; a reduction in the use of fossil fuels; and a significant contribution towards satisfying national and European targets for energy production from renewable sources. On balance, the combined impacts which have been identified with this EIS show that the proposed development will not result in an unacceptable adverse impact on the environment.