4 POPULATION AND HUMAN HEALTH

4.1 INTRODUCTION

4.1.1 Background and Objectives

This Chapter of the EIAR assesses the impacts of the Development (**Figure 1.2**) on population and human health. The Development refers to all elements of the application for the construction of Gortyrahilly Wind Farm (**Chapter 2: Project Description**). Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Development:

- Construction of the Development
- Operation of the Development
- Decommissioning of the Development

This Chapter of the EIAR is supported by Figures in **Volume III** and the following Appendix document provided in **Volume IV**:

- **Appendix 4.1: Shadow Flicker Assessment**

4.1.2 Statement of Authority

This chapter has been prepared by Jennings O'Donovan & Partners Limited. It was prepared by Mr. David Kiely and Ms. Sarah Moore, with the assistance of Ms. Shirley Bradley.

Mr. David Kiely has undertaken EISs/ EIARs for wind farms throughout Ireland. He has 39 years' experience in the civil engineering and environmental sector and has obtained a Bachelor of Engineering Degree in Civil Engineering and a Master of Science degree in Environmental Protection. David has overseen the development of over 50 wind farms from feasibility, planning and environmental assessment through to construction, including the preparation of population and human health chapters for other wind farms.

Ms. Sarah Moore is a Senior Environmental Consultant and holds a Bachelor (Hons.) Degree in Environmental Science from University of Limerick and a MSc (Dist) in Environmental Engineering from Queen's University, Belfast. She has worked in environmental consultancy for over fourteen years and has prepared AA Screenings, Environmental Reports and EIARs.

Ms. Shirley Bradley is a Graduate Environmental Scientist with a First-Class Honours Degree (BSc. Hons) in Environmental Science from the Institute of Technology, Sligo. She was also awarded with the Governing Body award for a BSc in Environmental Protection. Shirley's key capabilities are in report writing, assisting Senior Consultants and GIS.

4.1.3 Relevant Legislation and Guidance

The population and human health section of this EIAR is carried out in accordance with legislation and guidance contained in **Chapter 1: Introduction** and **Planning Statement**. The design and construction of the Development including the installation of associated equipment such as switchgear and substations is governed by the 2005 Safety, Health and Welfare at Work Act, The Safety, Health and Welfare at Work (General Application) Regulations 2021 and also by S.I. 291 The Safety, Health and Welfare at Work (Construction) Regulations, 2013 as amended.

The Revised EIA Directive Consultation (revised EIA Directive 2014/52/EU) (Section 1.2.2) states that:

"*It is intended that the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, disasters, and not requiring a wider consideration of human health effects which do not relate to the factors identified in the Directive*".

4.1.4 Assessment Structure

In line with the EIA Directive as amended and current (draft) EPA guidelines the structure of this chapter is as follows:

- Assessment Methodology and Significance Criteria – a description of the methods used in desktop surveys and in the assessment of the significance of effects
- Baseline Description – a description of the socio-economic profile of the local area of the Development, i.e., of local electoral areas and of County Cork and based on a desk-based study using Central Statistics Office (CSO) data
- Assessment of Potential Effects – identifying the ways in which the population and human health of the area could be affected by the Development
- Mitigation Measures and Residual Effects – a description of measures recommended to avoid, prevent, reduce or, if necessary, offset any potential significant adverse effects and a summary of the significance of any residual effects of the Development after mitigation measures have been implemented
- Cumulative Effects – identifying the potential for effects of the Development to combine with those from other existing, permitted and/or proposed projects to affect the population and human health
- Summary of Significant Effects
- Statement of Significance

With respect to the EIA Directive as amended, Section 1.2.2 (outlined in Section 4.1.3), amalgamates the findings of other assessments undertaken as part of the EIA process. Limited interactions with Human Health are possible and consideration has been given to the findings of the following assessments:

- Soils and Geology: Chapter 8
- Hydrology and Hydrogeology: Chapter 9
- Air and Climate: Chapter 10
- Noise: Chapter 11
- Traffic and Transportation: Chapter 15
- Major Accidents and Natural Disasters: Chapter 16

Where appropriate, mitigation measures have been proposed to avoid, prevent, reduce or, if necessary, offset any identified significant adverse effects.

All activities carried out by the appointed Contractor of the Development will be in accordance with the requirements of the Safety, Health and Welfare at Work Act 2005 as amended and Regulations made under this Act.

4.1.5 Scope of the Assessment

The effect of a development on population and human health includes the following broad areas of investigation:

- Population and Settlement Patterns
- Economic Activity and Tourism
- Employment
- Topography and Land Use
- Health Impacts of Wind Farms
- Property Value
- Natural Disaster and Major Accidents

Where a significant negative impact can be foreseen, it is prevented, reduced, avoided or, if necessary, offset by way of practical mitigation measures.

This assessment considers the following criteria:

- Sensitive receptors in the area
- Existing land use in the area
- General amenities in the area
- Potential effects from water, noise, shadow flicker, air quality and traffic

4.2 ASSESSMENT METHODOLOGY

In line with the EIA Directive as amended and current (draft) EPA guidelines, this Chapter includes the following elements:

- Details of Methodologies utilised in the context of legal and planning frameworks
- Baseline Descriptions
- Assessment of Potential Effects (construction, operational and decommissioning stages)
- Detailed Mitigation Measures
- Assessment of Cumulative Impacts
- Summary of Significant Effects and Statement of Significance

A desk study was undertaken using the Central Statistics Office (CSO) data along with a review of the Cork County Development Plan 2022-2028. Consideration was also given to the 2015[1] report produced by the EPA entitled 'Investigation into the Assessment of Health Impacts within National Environmental Regulation Processes' that outlines how human health impacts are dealt with, throughout the European Union (EU) by environmental regulators with an emphasis on the role at the planning / environment interface.

4.2.1 Definition of Study Areas

Three geographical Study Areas have been outlined for this assessment. While the greater geographical Study Area (3) provides a baseline of statistical data for this chapter, it is not considered for local impacts of this assessment. Note: Study Area 1 lies within Study Area 2 and information outlined for Study Area 2 incorporates data for Study Area 1. The three Study Areas as shown in **Figures 4.1, 4.2** and **4.3** are outlined below:

Study Area 1: The Site and Environs – District Electoral Divisions (DEDs) Derryfineen, Gortnatubbrid and Cleanrath (87km^2). In order to make inferences about the population and other statistics in the vicinity of the Site, DEDs were analysed. The entire Site comes under one Municipal Division (MD), Macroom and electoral divisions (ED) Derryfineen, Gortnatubbrid and Cleanrath that can be separated into distinct townlands, Derree, Gortyrahilly, Fuhiry, Rath West, Derryfineen, Gortnabinna, Derragh and Cahernacaha.

Study Area 2: **Cork County** (7,316km^2).
Study Area 3: **Kerry County** (4,807km^2)

Descriptive terminology for impact assessment follows the systematic method of description of the EPA Guidelines (2017), as outlined in **Chapter 1: Introduction**, **Table 1.4**.

[1] Golder Associates (2015) *Investigation into the Assessment of Health Impacts within National Environmental Regulation Processes*. Available online at: http://www.epa.ie/pubs/reports/research/health/assessmentofhealthimpactsreport.html, [Accessed on 20/04/21]

4.2.2 Consultation

Consultation with relevant organisations was initiated during the initial stage of the EIA to identify any effects that could be initiated by the Development. A summary of the findings is detailed in **Table 4.1**.

Table 4.1: Summary of Consultation response on Human Health

Consultation response on Human Health		
Health Service Executive	Letter in Response to Scoping Report received on 10th December 2020	**Opportunity for Health Gain**: "*The proposed development should be assessed with a view to the potential to include opportunities for health gain within the site of the proposed wind farm by including greenways, cycle-paths or walking trails within the development site.*".

4.3 BASELINE DESCRIPTION

4.3.1 Population and Settlement Patterns

Study Area 1: The Site and Environs (DEDs Derryfineen, Gortnatubbrid and Cleanrath)

The extent of Study Area 1 can be seen in **Figure 4.1**. There are no defined community settlements with a population greater than 2,500 within the 10km radius of the Development. Macroom, which has a population of 3,765 persons is approximately 16km distant east of the Development. The nearest centres of population to the Site are Killarney, Co. Kerry, 39km distant to the north-west which has a population of 14,504 residents and Cork City, 58km distant east which has a population of 208,669 persons. The surrounding area is largely rural, with a mixture of agricultural grassland, commercial forestry plantations, private roads and public roads. Isolated residences and farmsteads are also scattered throughout the area. Nearby settlements include the villages of Coolea 6km north, Reananerree 2km east, and Ballyvourney 7km north-east.

Over the last five years, Cork County Council have granted planning permissions in the Derryfineen, Gortnatubbrid and Cleanrath electoral division areas which include one off housing, alterations to existing dwelling houses, development of new housing, agricultural buildings, a school extension and commercial developments including a wind farm, meteorological masts and a substation[2]. The 2016 Census statistics note 330 occupied residences and a total population of 919 in these three electrical division areas.

[2] Cork County Council. *Planning Map Search* Available online at: https://www.corkcoco.ie/en/planning/planning-enquiry-online-submissions. [Accessed 10th May 2021]

There are a cluster of two residential buildings located 225m from T12. This can be seen in **Figure 2.1**. In the event that planning consent is achieved, these buildings will be in control of the applicant and will not be inhabited for the operational period of the Development. These buildings are uninhabited and the landowner is in agreement with the above terms, therefore, these dwellings have been removed from the EIAR assessment.

All inhabited dwellings are located at a distance of over 750m from the proposed turbines. There are 106 properties within 2km of the turbines. The total population in the Cleanrath ED was 225, of which Males numbered 117 and Females were 108, in Derrfyfineen was 243, of which Males numbered 132 and Females were 111 and in Gortnatubbrid was 451, of which Males numbered 225 and Females 226. The population density of Study Area 1 is 10.6 persons per square kilometre. The total number of households was recorded as 767 across the three EDs. The Site and its wider environs are classified as a 'Transitional Rural Area' in the Cork County Development Plan 2022-2028[3]. Although population concentrations are lower in these areas, there is a more stable population base and less evidence of population decline than other parts of the County. These ED areas also exhibit characteristics of a weaker economic structure and have higher levels of environmental sensitivity.

Study Area 2: Cork County

The total population in the 2016 CSO for County Cork was 417,211, of which Males numbered 206,953 and Females were 210,258. There has been a 4.4% increase in the population since 2011. The population density is 256 persons per km^2. The total number of households was 146,442 in 2016, a 2.7% increase since 2011. Average size of households (in persons) has generally remained the same at approximately 2.8-2.9 persons per household over the past three census reports.

Cork is the largest county in Ireland with a land mass of 7,500km^2 including Cork City. The economic performance of Cork is strong and plays a critical role in both our regional and national economies. Cork contributes 19% to the national GDP.

The extent of County Cork can be seen in **Figure 4.2**. There are a number of medium sized towns and villages geographically spread throughout County Cork. These settlements number 102 and provide essential services for the local communities and the rural hinterlands. The different settlement tiers perform differing roles with the result that no area in the county is significantly peripheral or isolated.

[3] Cork County Development Plan 2022-2028 Available online: https://www.corkcoco.ie/en/cork-county-development-plan-2022-2028 [Accessed 28th August 2022]

The increase in rural population over a 5-year period from 2011 to 2016 in Cork County was 6,946. The towns of Carrigaline (15,770), Cobh (12,800), Midleton (12,496) and Mallow (12,459) are the most populated within the County.

Carrigaline, the largest town in County Cork, is significant for health, social and cultural activities. According to the Census 2016 there are 6,971 people residing in the Carrigaline settlement area who are classed as being 'At Work'. It has the largest number of workers (3,369) commuting into Cork city and suburbs. Carrigaline is 72km distant from the Site to the south-east.

Study Area 3: Kerry County

The extent of County Kerry can be seen in **Figure 4.3**. The total population in the 2016 CSO for County Kerry was 147,707, of which Males numbered 73,055 and Females were 74,652. There has been a 1.5% increase in the population since 2011. The population density is 31 persons per km^2. The total number of households was 54,493 in 2016, a 2.2% increase since 2011. Average size of households (in persons) has decreased over the period 2011 to 2016 from 2.8 to 2.6 persons.

There are a number of large and medium sized towns and villages geographically spread throughout County Kerry. These are broken down into Hub Towns, Regional Towns, District Towns, Villages, Small Villages and Development Nodes. The key element of the County Kerry Core Strategy and Settlement Strategy is to continue to focus growth into the Hub Towns and to relate growth of the smaller towns and villages to the availability of infrastructure such as water supply and wastewater treatment. The overall aim for development nodes in rural areas is to retain their rural service centre function and develop sustainably as attractive locations for residents and visitors and that any future development preserves their existing character[4].

The towns of Tralee and Killarney are considered Hub Towns. These are key destinations, along transportation corridors and are economically active in the surrounding area. According to the Census 2016 the population of Tralee is 23,691 persons and Killarney is 14,504 persons. Tralee is 68km distant from the Site to the north-west. Killarney is 39km distant from the Site to the north-west.

[4] Kerry County Development Plan 2015 -2021, http://atomik.kerrycoco.ie/ebooks/devplan/pdfs/vol1.pdf, accessed 12/05/2021

4.3.2 Economic Activity

4.3.2.1 Primary Sectors

Study Area 1: The Site and Environs (DEDs Derryfineen, Gortnatubbrid and Cleanrath)

The main sectors in this Study Area are agriculture and commercial forestry. These ED areas also exhibit characteristics of a weaker economic structure and have higher levels of environmental sensitivity.

Study Area 2: Cork County

The economy of County Cork is broadly based and diverse with strengths in the areas of agriculture/agri -tech, marine, food production, tourism, services, energy and in technology-based manufacturing in sectors such as electronics and life sciences. The Cork Region has the largest life sciences sector in employment terms in the country with almost 10,000 permanent full-time jobs in the sector in 2016. Seven of the top ten global pharmaceutical companies have a presence in the county.

Cork also has a very significant agriculture and food sector. It has the most people employed in agriculture in the state. In 2010, the recorded numbers on farms in Cork was 14,222. This was 5.5% higher than the next highest at 13,445 in Galway[5]. with a number of indigenous enterprises having a significant international presence including Dairygold and Midleton Distillery. Danone and Kerry Foods are also present in Cork and together produce approximately 8% of the world infant milk formula[6].

4.3.3 Employment

4.3.3.1 Study Area 1: The Site and Environs (DEDs Derryfineen, Gortnatubbrid and Cleanrath)

Although population concentrations are lower in these areas, there is a more stable population base and less evidence of population decline than other parts of the County. Detailed information on employment for such a small area is unavailable. It is assumed that the majority of those residing within this area would travel outside of it for employment. Please see Section 4.3.3.2 for more information on employment within the county.

[5] Life in 1916 Ireland: Stories from statistics https://www.cso.ie/en/releasesandpublications/ep/p-1916/1916irl/economy/ag/ [Accessed online 24/01/2022]

[6] County Development Plan Review, Economy and Employment, Background Document No.6, Planning Policy Unit, Cork County Council (2019), https://www.corkcoco.ie/sites/default/files/2019-12/Background%20Document%20no%206%20Economy%20and%20Employment.pdf, [Accessed online 12/05/2021]

4.3.3.2 Study Area 2: Cork County

According to the CSO 2016 there were 198,177 persons over 15 years of age in the labour force in Cork County and 91% were in employment. The Professional Services, the Manufacturing Industry and Commerce and Trade industries employ 110,842 persons. Of the 123,443 persons aged 15 years and over who were outside the labour force, 29% were students, 23% were looking after the home/family and 37%were retired. **Table 4.2** sets out employment by Industry in Cork County in 2016.

The live register figures show Cork County has seen a 42% decrease in registered unemployment since 2016. Between 2019 and 2020, numbers on the live register have risen, likely due to the economic downturn associated with the COVID-19 pandemic and Cork County has experienced a 4.3% rise in unemployment during that time.

Table 4.2: Cork County Employment by Industry (2016)

Principal Economic Status	No. Persons
At work	179,890
Looking for first regular job	1,827
Unemployed having lost or given up previous job	16,460
Student	35,933
Looking after home/family	27,965
Retired	45,612
Unable to work due to permanent sickness or disability	12,926
Other	1,007
Total	**321,620**

4.3.3.3 Study Area 3: Kerry County

CSO 2016 recorded 69,923 persons over 15 years of age in the labour force in County Kerry and 88% were in employment. The Professional Services, Commerce and Trade and Other industries employ 40,515 persons. Of the 48,993 persons aged 15 years and over who were outside the labour force, 24% were students, 20% were looking after the home/family and 45% were retired. **Table 4.3** sets out employment by Industry in County Kerry in 2016.

The live register figures show County Kerry has seen a 34% decrease in registered unemployment between 2011 and 2016. Between 2019 and 2020, numbers on the live register have risen slightly, likely due to the economic downturn associated with the COVID-

19 pandemic. Based on the figures for January 2021 to May 2021, the live registers have fallen below the 2019 figure.

Table 4.3: Kerry County Employment by Industry (2016)

Principal Economic Status	No. Persons
At work	61,222
Looking for first regular job	835
Unemployed having lost or given up previous job	7,866
Student	11,849
Looking after home/family	9,585
Retired	21,855
Unable to work due to permanent sickness or disability	5,238
Other	466
Total	**118,916**

4.3.4 Land Use

4.3.4.1 Study Area 1: The Site and Environs (DEDs Derryfineen, Gortnatubbrid and Cleanrath)

County Cork is located in the Southern Region and is bordered by counties Waterford, Tipperary, Limerick and Kerry.

The Site is located within the electoral areas of Derryfineen, Gortnatubbrid and Cleanrath, which supports 141 farm holdings; 92% are greater than 10ha. 45% of the area is farmed under pasture and 38% under rough grazing. The main livestock farmed are sheep[7].

Arc GIS Pro was used to calculate an area 600ha forestry within Study Area 1. Cleanrath was calculated to have 157ha (26%), Gortnatubrid was calculated to have 73ha (12%), the townland of Gortyrahilly has 202ha (34%) and Derryfineen has 167ha (28%). The majority of the forestry within Study Area 1 was classed as 'Coniferous forest' according to CORINE Land Cover (Copernicus)[8].

[7] Census of Agriculture 2010, CSO, agri@cso.ie, Accessed 14/05/2021.
[8] Environmental Protection Agency Maps https://gis.epa.ie/EPAMaps/ [Accessed Online_22/06/2022]

4.3.5 Tourism

4.3.5.1 Tourist Attractions

Study Area 1: Development Site and Environs (10km)

The Beara to Breifne Way, Ireland's longest national waymarked walking/cycling trail runs through part of the Site. The Way runs almost the length of the country and takes the walker and cyclist to some of its most beautiful and least explored areas; along the coast of the Beara Peninsula, across six mountain ranges, along the banks of the River Shannon and through the lake regions of Roscommon and Leitrim.

The section of the route which traverses the Site is not classed as a Scenic Route under the Cork County Development Plan 2022-2028 Parts of southern and the western Site boundaries are Scenic Routes as shown in **Figure 4.4**.

Gougane Barra located 7.6km south-west of the Site is a popular tourist village famous for its small 11th century St Finbarrr's Oratory built on a peninsula. The area around Gougane Barra is part of the Múscraí Gaeltacht. The village is set in a spectacular landscape known for its tranquillity, the beauty of the Gougane Lake and its numerous walking trails. Coillte Forest Park at Gougane Barra offers numerous walks for all ability levels, among the Sitka Spruce, beside the winding River Lee or past waterfalls tucked into the mountainside[9].

Coillte operates an Open Forest policy, which allows foot access to virtually all Coillte's forest estate of over 10,000,000 acres[10]. The existing Coillte forestry tracks throughout the Site are currently used by walkers for recreation purposes. The Beara to Breifne Way also traverses the Site. Walkers/cyclists will be able to avail of these tracks entirely, post construction. During the construction phase, sections of the tracks will be closed to the public while work is being completed on them. Walkers/cyclists will be diverted to a track which bypasses the section under construction.

Taking into account the availability of existing tracks and their proximity to the Site, it is considered that the main tourism and recreation in Study Area 1 is trail walking, hiking and cycling.

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[9] Failte Ireland, West Cork Digital Brochure (2021), Accesses 11/08/2021.

[10] Coillte Forest Access, https://www.coillte.ie/coillte-faqs/access-allowed-coillte-property/#:~:text=Coillte%20is%20very%20proud%20of,protect%20you%20and%20our%20forests., Accesses 12/05/2021.

Study Area 2: Cork County

Tourism in County Cork is an important industry based on its rich natural and built heritage. Many areas that are important to the tourist industry of County Cork owe their attraction to the exceptional quality of the landscape or particular features of the built environment[11]. There are a number of policies in the Cork County Development Plan 2022 which seek to promote tourism in the county. Policy TO 1-2: Promotion of Sustainable Tourism in County Cork is '(a) *Promote a sustainable approach to the development of the tourism sector within Cork County* ….." and Policy TO 7-1: Walking/Cycling and Greenways is "*Promote the development of walking and cycling routes throughout the County as an activity for both international visitors and local tourists…*"

Study Area 3: Kerry County

Kerry attracts 13% of all overseas visitors to Ireland. Kerry is more dependent on tourism than any other county with over 20% of its workforce employed in tourism-related enterprises. There are over 9,000 people directly employed in the accommodation and hospitality sectors in Kerry. It has the greatest concentration of tourist accommodation outside of Dublin – up to 50,000 beds in the approved and unapproved sectors.

Kerry County Council published a tourism strategy in 2016 for the period 2016 to 2022. The plan has a number of objectives including "*Increase the number of visitors to the county, their length of stay and their spend, and to do so in a manner that is sustainable*." The strategy will be achieved by the implementation of 273 individual actions.[12]

4.3.5.2 Tourism: Numbers and Revenue

Study Area 2: Cork County

The South-West Region which includes the Counties of Cork and Kerry has consistently been the most popular region in Ireland outside Dublin for overseas tourist and domestic visitors. Regional Tourism performance figures for 2018 for the South-West Region show overseas tourist numbers for the South-West Region totalled 2,225,000 in 2019 and tourist revenue accounted for €970,000,000 from overseas tourists. Domestic visitors from Ireland and Northern Ireland accounted for 2,354,000 visits to the region in 2019, with €536,000,000 in revenue generated from domestic visitors[13].

[11] County Development Plan 2022, Section 10, https://www.corkcoco.ie/sites/default/files/2022-06/volume-1-main-policy-material.pdf, [Accessed Online_27/06/2022]
[12] County Kerry Tourism and Action Plan 2016 – 2022, Kerry County Council & Destination Tourism Forum, 2016,
[13] Key Tourism Facts 2019, Failte Ireland, March 2021, http://docstore.kerrycoco.ie/KCCWebsite/Tourism/TourismStrategy.pdf, accessed 12/05/2021https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/Key-Tourism-Facts-2018.pdf?ext=.pdf, accessed 12/05/2021

County Cork is home to a number of nationally renowned visitor attractions including; Blarney Castle and Blarney Stone, Ballycotton Cliff Walk, Cobh, Doneraile Park and Spike Island. Doneraile Park was one of the top free of charge attractions visited in 2019 with 490,000 visitors. Blarney Castle and Stone was one of the top fee charging attractions with 460,000 visitors.

Cork is also included in 'Wild Atlantic Way" which is one of the longest defined coastal routes in the world. It was devised as a new 'experience' and 'destination' by Fáilte Ireland to present the West Coast of Ireland as a compelling international tourism product. It is an over-arching brand which individual destinations and businesses can trade collectively with much greater potential visibility and clarity of message in the international marketplace[14].

Study Area 3: Kerry County

As previously stated, the South-West Region which includes the County Kerry has consistently been the most popular region in Ireland outside Dublin for overseas tourist and domestic visitors. Some of the top visitor attractions in Ireland are located in Kerry including Muckross House, Dingle, The Ring of Kerry, Carrauntoohil, Ross Castle as well as Blasket Island and Skellig Michael. In 2018 Muckross House was one of the top visited fee charging attractions with 550,649 visitors.

4.3.5.3 Visitors Attitudes to Wind Farms

The first wind farm in Ireland was completed in 1992 at Bellacorrick, Co. Mayo and since then wind farms have elicited a range of reactions from Irish people (Failte Ireland, 2012). In 2002, Sustainable Energy Ireland (SEI) now the Sustainable Energy Authority of Ireland (SEAI) commissioned a survey aimed at identifying public attitudes to renewable energy, including wind energy in Ireland[15]. The 2002 survey found that, in general, Irish people are positively disposed towards the development of wind farms. However, the survey also indicated that people will not accept wind farms everywhere and that special care should be taken so that wind farms respond to contextual landscape characteristics.

Ireland's scenery has been a cornerstone of international tourism marketing campaigns for decades. In 2012, 91% of overseas holidaymakers to Ireland rated scenery as an important part of a destination with natural/unspoilt environment also rated highly at 91%. The future sustainability of Ireland's tourism industry is therefore inextricably linked to the maintenance of the character and scenic qualities of the Irish landscape.

[14] Wild Atlantic Way1 Operational Programme 2015-2019, Failte Ireland, August 2015, https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/2_Develop_Your_Business/Key%20Projects/Wild-Atlantic-Way-Operational-Programme_1.pdf, accessed 12/05/2021

[15] Sustainable Energy Ireland (2003), Attitudes towards the Development of Wind Farms in Ireland, Dublin

Fáilte Ireland, in association with the Northern Ireland Tourist Board (NITB), decided in 2007 (67 wind farms established) to survey both domestic and overseas holidaymakers to Ireland to determine their attitudes to wind farms. The survey drew on many aspects of the original SEI survey including the photomontages of wind farms, and in particular, the landscape types that were used to elicit a reaction from respondents. The purpose of the survey was to assess whether or not the development of wind farms would impact on the visitors' enjoyment of Irish scenery. In 2012, this research was updated by Millward Browne Landsdowne on behalf of Fáilte Ireland to determine if there was any change in visitor attitudes during this period.

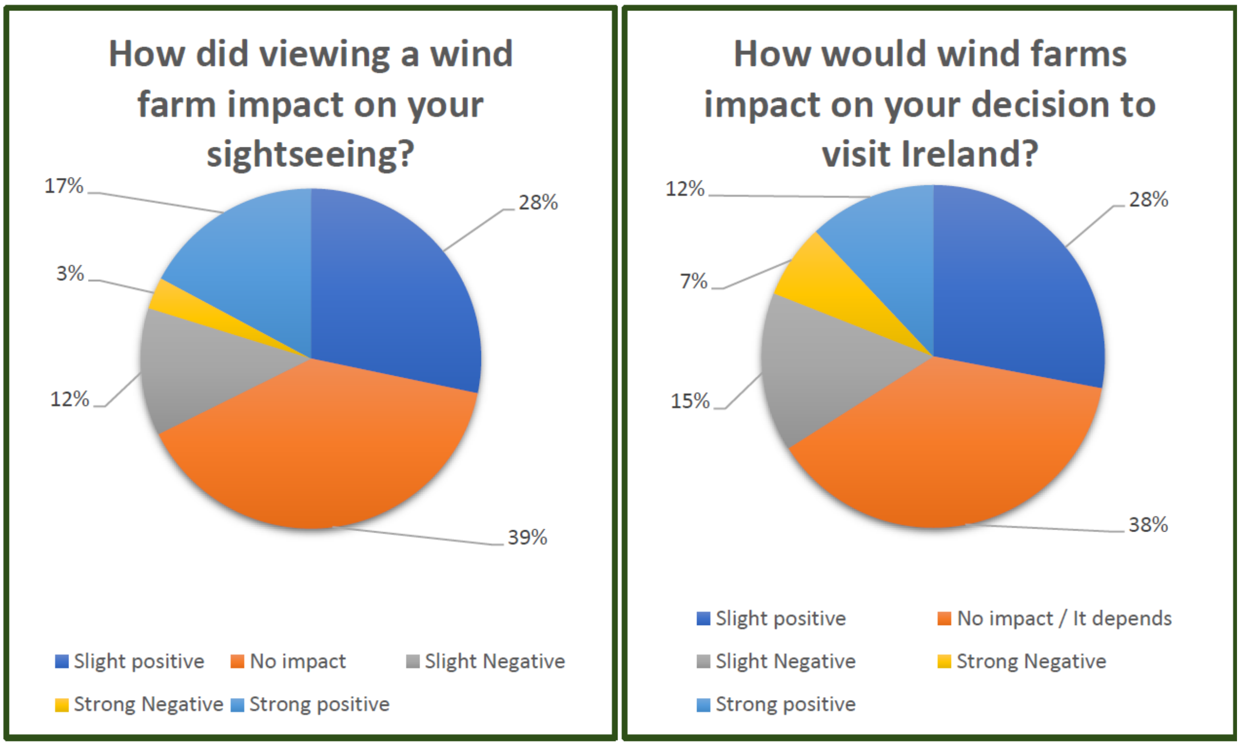
The 2012 research indicated that 47% of visitors felt an increased positive impact on landscape, compared to 32% in 2007. Negative responses also increased, showing 30% in 2012 against 17% in 2007. However, 49% of visitors felt that wind farms had no impact on the landscape in 2007 in comparison to 23% in 2012. It was notable that those interviewed who did not see a wind farm during their trip held more negative perceptions and opinions on wind farms to those that did. Of the wind farms viewed, the majority (59%) contained less than ten turbines in 2012, which was quite similar to 2007 (63%).

Despite the fact that there has been an increase in the number of visitors who have seen at least one wind farm on their holiday, there was also a slight increase (from 45% in 2007 to 48%) in the number of visitors who felt that this had no impact on their sight-seeing experience. Importantly, and as has been seen in the previous research, the type of landscape in which a wind farm is sited can have a significant impact on attitudes. Although 21% feel that wind farms have a fairly or very negative impact on sight-seeing, this figure increases substantially for wind farms in coastal areas (36%).

Visitors were again asked to rate the beauty of five different yet typical Irish landscapes: coastal, mountain, farmland, bogland and urban industrial land, and then rate the scenic beauty of each landscape and the potential impact of siting a wind farm in each landscape. As in 2012, the results indicate that each potential wind farm and site must be assessed on its own merits, due to the scenic value placed on certain landscapes by the visitor and the preferred scale/ number of wind turbines within a wind farm. Looking across all landscapes, wind farms are seen to have an enhancing effect on the landscapes seen as less beautiful, particularly urban/ industrial and bogland.

Coastal areas (91%) followed by mountain moorland (83%) and fertile farmland (81%) continue to be rated as the most scenic, and unsurprisingly resistance is greatest to wind farms in these areas. For instance, there was a greater relative negativity expressed about potential wind farms on coastal landscapes (40%), followed by fertile farmland (37%) and mountain moorland (35%). On the other hand, less than one in four were negatively disposed to the construction on bogland (24%) or urban industrial land (21%). The majority of visitors also still favour large turbines (47%) over small turbines (28%), and in smaller numbers, with the option of five turbines proving the most popular, followed by two clusters of ten and finally wind farms of 25 turbines.

Seven out of ten (or 71%) visitors claim that potentially greater numbers of wind farms in Ireland over the next few years would have either no impact or a positive impact on their likelihood to visit Ireland (**Graph 4.1**). Of those who feel that the potentially greater number of wind farms would impact positively on future visits, the key driver is support for renewable energy, followed by potential decreased carbon emissions. Given the scenario where more wind farms will be built in Ireland in the future, the most widely held view is that this will not impact their likelihood to visit the area again, with a slightly greater majority saying that this would have a positive rather than a negative impact.



Graph 4.1 Visitors Attitudes on the Environment – Wind Farms. Source: Fáilte Ireland (2008)

Fáilte Ireland carried out research on Overseas Holidaymakers Attitudes to Ireland in 2018. It noted holiday makers choice is based largely on *beautiful scenery* (93%), followed closely by *plenty to do and see* (91%) and *friendly people* and *natural attractions* (88%). BiGGAR

Economics carried out research in Scotland on 28 wind farms and tourism trends (2017)[16]. No pattern emerged that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at a very local level. No relationship was identified between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level nor in the areas immediately surrounding wind farm development.

4.3.6 Human Health

Common concerns around wind farms in terms of human health are generally associated with electromagnetic fields, shadow flicker and noise. These topics are considered in this assessment in addition to air quality and water contamination.

4.3.6.1 General Health of Population

Human health of communities can vary greatly owing to a number of factors including susceptibility to disease, location, income inequality, access to health care etc. In 2019 the Department of Health published "Health in Ireland – Key Trends 2019" which shows population health at the national level presents a picture of decreasing mortality rates and high self-perceived health over the past ten years. Ireland has the highest self-perceived health status in the EU, with 82.9% of people rating their health as good or very good.

The 2016 census data for the general health of the population as shown in **Table 4.4** indicates the health status across all four study areas is "Very Good" to "Good". The health status of the Site and Environs is very similar to that of County Cork. Both these areas are above the national average. The "Very Good" health status for County Kerry at 56% is slightly below the national average of 59%.

Table 4.4: Population by General Health (2016)

General Health	The Site & Environs (10km)	County Cork	County Kerry	Ireland
	Percentage (%)			
Very good	62	63	56	59
Good	28	26	30	28
Fair	6	7	9	8

[16] BiGGAR (2017) Wind Farms and Tourism Trends in Scotland. Available online at: https://www.lyrewindfarm.com/web/cms/mediablob/en/3949334/data/3878350/2/windfarm-lyre/Wind-farms-and-tourism-trends-in-Scotland.pdf [Accessed on 13/11/2019]

General Health	The Site & Environs (10km)	County Cork	County Kerry	Ireland
	Percentage (%)			
Bad	1	1	1	1
Very bad	0	0	0	0
Not stated	3	2	4	3

4.3.6.2 Electromagnetic Interference

Electromagnetic fields ("EMF") are invisible lines of force that surround electrical equipment, power cords, wires that carry electricity and outdoor power lines. Electric and magnetic fields can occur together or separately and are a function of voltage and current. When an electrical appliance is plugged into the wall, an electric field is present (there is voltage but no current); when that appliance is turned on, electric and magnetic fields are present (there is both voltage and current). Both electric and magnetic fields decrease with distance. Electric fields are also dissipated by objects such as building materials. On a daily basis, people are exposed to extremely low frequency ("ELF") EMF as a result of using electricity.

National and international health and scientific agencies have reviewed more than 35 years of research including thousands of studies. None of these agencies has concluded that exposure to ELF-EMF from power lines or other electrical sources is a cause of any long-term adverse effects on human, plant, or animal health. The International Commission on Non-Ionising Radiation Protection (ICNIRP) Guidelines give a limit of 100µT for sources of AC magnetic fields. This compares to 0.13µT that arises from a 110kV underground cable when directly above it; 1.29µT that arises from a 220kV underground cable when directly above it and 11.4µT that arises from a 400kV AC underground cable that is one metre deep and measured directly above it. This is detailed in information booklet published by ESB in 2017 called "EMF & You" which provides information about Electric & Magnetic Fields and the electricity network in Ireland[17].

In 2014 a study was undertaken in Canada[18], measuring electromagnetic fields around wind farms and the impact on human health. The study found that:

[17] EMF & You, ESB, 2017 - https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0, accessed 14/05/2021

[18] Lindsay C McCallum, *et al*. (2014) *Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?*

"there is nothing unique to wind farms with respect to EMF exposure; in fact, magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices and were well below any existing regulatory guidelines with respect to human health".

From the limit of 100µT for sources of AC magnetic fields given by the ICNIRP, a comparison of between 0.02µT and 0.41µT arises when turbines operate under "high wind" scenarios.

4.3.6.3 Shadow Flicker

The Department of Energy and Climate Change for England stated in its report Update of UK Shadow Flicker Evidence Base (2011) that it is considered that the frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health.

Section 4.6 provides the full assessment of shadow flicker for this EIAR.

4.3.6.4 Noise

A study by the EPA in South Australia on low frequency noise near wind farms and in other environments found that *'Overall, the study demonstrates that low frequency noise levels near the wind farms in the study are no greater than levels in urban areas at comparable rural residences away from wind farms'.*

The turbine rotor blades will be fitted with a serrated extension of the trailing edge which will mitigate noise emission by design by effectively breaking up turbulence. Baseline noise measurements were carried out from 6th August to 3rd September 2020. A number of predictions were prepared for layout of the 14 turbine Development. Based on layout, potential noise-sensitive receptors including occupied and un-occupied were identified from maps. Receptor locations were verified through visits to the area. **Chapter 11: Noise** provides an assessment of noise in relation to the Development.

4.3.6.5 Air Quality

Environmental Protection Agency (EPA, 2016), EU and World Health Organisation (WHO, 2014) reports estimate that poor air quality accounted for premature deaths of approximately 600,000 people in Europe in 2012, with 1,200 Irish deaths attributable to fine particulate matter (PM2.5) and 30 Irish deaths attributable to Ozone (O3)[19] [20]. These emissions, along

[19] *www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe- new-who-global-report,* accessed 10th May 2021
[20] Irelands Environment 2016 – An Assessment', EPA, 2016, accessed 10th May 2021

with others including nitrogen oxides (NO_x) and sulphur oxides (SO_x) are produced during the burning of fossil fuels for energy generation, transport or home heating. There are no such emissions associated with the operation of wind turbines.

Traffic disruption to the public during the construction and decommissioning phases of the Development is likely. Transport accounts for a significant portion of pollutants in the atmosphere. Potential impacts are discussed in Section 4.4.6.

Chapter 10: Air and Climate provides an assessment of air quality in relation to the Development.

4.3.6.6 Water Contamination

Contaminants such as sediments arising from the Development have the potential to contaminate water bodies designated for drinking water purposes and may cause ecological damage as well. Mitigations as set out in **Chapter 9: Hydrology and Hydrogeology** will prevent and reduce risk of contamination of waterbodies. The drainage design and surface water network are considered in terms of assimilative capacity, that is to dilute contaminants in receiving waterbodies as a 'last line of defence'. Any contaminants will be treated when water is abstracted for drinking water purposes.

Consultation with GSI well database indicates there are no mapped wells within the Site boundary. Governing industry guidelines stipulate a buffer zone of 250m is required of from boreholes used for drinking water abstraction. The closest mapped wells are more than 500m from the boundary of the Site. All houses are over 750m from the Site, therefore can be considered outside the 250m buffer.

Chapter 9: Hydrology and Hydrogeology provides an assessment of the hydrological impacts in relation to the Development, including the potential for water contamination.

4.3.6.7 Traffic

It is proposed that the turbine nacelles, tower hubs and rotor blades will be landed at Ringaskiddy Port, County Cork and will be transported on the N22 and will travel across a temporary crossing over the Sullane River. The route will then follow local road infrastructure until it meets private tracks and on to the site entrance.

Receptors considered as having 'high' sensitivity are primarily premises which are directly on the N28, N22, L3400-79 and L-3402 which have significant potential to generate traffic.

The sensitive receptors are assessed in **Chapter 15: Traffic and Transportation**.

4.3.6.8 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live near Operational wind farms there is no peer reviewed scientific research in support of these views. Several peer reviewed scientific research publications are outlined below.

Frontiers in Public Health published a study[21] in 2014 on wind turbines and human health. This review summarised and analysed the science in relation to this issue specifically in terms of noise (including audible noise, low-frequency noise, and infrasound), EMF, and shadow flicker. The study noted that:

"*Based on the findings and scientific merit of the research conducted to date, it is our opinion that the weight of evidence suggests that when sited properly, wind turbines are not related to adverse health effects. This claim is supported (and made) by findings from a number of government health and medical agencies and legal decisions*".

The National Health and Medical Research Council, Australia's leading medical research body, concluded that there is no reliable or consistent evidence that wind farms directly cause human health problems as part of their Systematic Review of the Human Health Effects of Wind Farms published in December 2013. The review was commissioned to determine whether there is a direct association between exposure to wind farms and negative effects on human health or whether the association is casual, by chance or bias.

Objectors to wind farms often refer to wind turbine syndrome as a condition that can be caused by living in close proximity to wind farms. The symptoms allegedly include sleep deprivation, anxiety, nausea and vertigo. It has been rejected by the wind industry as there is no scientific backing to these claims. This review began in late 2012 and included a literature and background review of all available evidence on the exposure to the physical emissions produced by wind turbines. These emissions were noise, shadow flicker and electromagnetic radiation produced by wind turbines. The review concludes that the evidence considered does not support any direct association between wind farms and human health problems and that confounding bias could be possible explanations for any reported association.

[21] L. D. Knopper, *et al*. (2014) *Wind turbines and human health*.

In general, there are no specific health considerations in relation to the operation of a wind turbine. The area surrounding the turbine base will still be available for use. Noise and Shadow Flicker are operational Health and Safety issues, which have been addressed in **Chapter 11: Noise** and **Section 4.6**.

4.3.6.9 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s '*Wind Energy Development Guidelines for Planning Authorities 2006'* state that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations. People or animals can safely walk up to the base of the turbines. The DoEHLG Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or material from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will prevent the turbine from operating until the blades have been de-iced.

Turbine blades are made of fibre-reinforced polymer or unsaturated polyester, a non-conducting material which will prevent lightning strikes. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. In extremely high wind speed conditions, (usually at Beaufort Storm Force 10 or greater) the turbines will shut down to prevent excessive wear and tear, and to avoid any potential damage to the turbine components.

4.3.7 Property Value

There are currently no Irish studies undertaken to assess the impact of wind farms on property prices. However, a number of studies have been undertaken in the UK, with findings set out in **Table 4.5**.

A study on 'the effect of wind farms on house prices' was undertaken in 2014 by the Centre of Economic Research. The study found that house prices were driven by the property market and not the presence or absence of wind farms [22]. Another study on 'Valuing the Visual Impacts of Wind turbines through House Prices' was undertaken in 2014 by the London School of Economics and it found the presence of wind farms negatively impacted property values within 2km of very large wind farms[23]. However, in 2016, following on from the contrasting results of the two 2014 studies, ClimateXChange carried out their own research in Scotland. The ClimateXChange study found no significant effect on the change in price of properties within 2km or 3km, and found the effect to be positive[24]. This study also found that some wind farms can provide economic and amenity benefits to an area. The Development will include for the upgraded tracks that can be used by walkers within the Site and will provide a significant community benefit fund for the local area.

Table 4.5: Summary of Research findings between Wind Farms and Property Values

Year	Country	Research Group	Finding
2014	UK	Centre of Economic Research	In summary the analysis found that country-wide property market drives local house prices, not the presence or absence of wind farms; and The econometric analysis established that construction of wind farms at the sites examined across England and Wales has not had a detectable negative impact on house price growth within a 5km radius of the sites.
2014	UK	London School of Economics	There was an average reduction in the value of houses (based on 125,000 house sales between 2000 and 2012) of between 5% and 6% within 2km of very large wind farms.
2016	UK (Scotland)	ClimateXChange	Following a wide range of analyses, including results that replicate and improve on the approach used in the 2014 study by London School of Economics, the study did not find a consistent negative effect of wind turbines or wind farms when averaging across the

[22] https://cdn.ymaws.com/www.renewableuk.com/resource/resmgr/publications/reports/ruk-cebr-study.pdf [Accessed 27/01/2022]
[23] http://eprints.lse.ac.uk/58422/1/__lse.ac.uk_storage_LIBRARY_Secondary_libfile_shared_repository_Content_SERC%20discussion%20papers_2014_sercdp0159.pdf [Accessed 27/01/2022]
[24] Heblich, D. S., Olner, D. D., Pryce, P. G. & Timmins, P. C., 2016. *Impact of wind turbines on house prices in Scotland,* Scotland: ClimateXChange. [Accessed 27/01/2022]

Year	Country	Research Group	Finding
			entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km, or find the effect to be positive. Some wind farms provide economic or leisure benefits (e.g. community funds or increasing access to rural landscapes through providing tracks for cycling, walking or horse riding)

4.3.8 Natural Disasters and Major Accidents

A wind farm is not a recognised source of chemical pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during both the construction and operational phases are limited. Sources of chemical pollution with the potential to cause significant environmental pollution and associated negative effects on health include bulk storage of hydrocarbons or chemicals and storage of wastes. Spills and leaks can occur if they are not mitigated against which may cause negative effects to human health, if contamination of food or water occurs. The occurrence of such spills and leaks is unlikely as bunding and safe storage practices will be complied with. **Chapter 16: Major Accidents and Natural Disasters** and **Appendix 2.1: Construction Environmental Management Plan** discusses this in more detail. The Site is not regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO sites and so there is no potential effect from this source. All SEVESO sites are located approximately 40km or more from the Development.

There is limited potential for significant natural disasters to occur at the Site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to peat-slide, flooding and fire.

With reference to **Chapter 8: Soils and Geology, Section 8.3.3.** The proposed infrastructure will be located on a variation of Devonian sandstone and siltstone, namely Bird Hill Formation, Caha Mountain Formation and Gortanimill Formation. Sandstone is usually within the range of Weak (5-25 Mega Pascals) to Medium Strong (25-50MPa). Siltstone is usually within the range of Very Weak (1-5MPa) to Weak (5-25MPa).

Geological features and destructive fault lines associated with the above-mentioned Formations give rise to the character of the topography at the Site. This has resulted in areas with steep slopes and/or complex topography densely populated with bedrock outcrops. Bedrock proximal to these fault lines will likely be fractured and/or weathered.

The Peat Stability Assessment Risk Ranking ranged from *'Very Low with isolated pockets associated with localised elevated stability risk'* to *'Moderate'*. The risk of peat-slide is further addressed in **Chapter 8: Soils and Geology**. A Peat and Spoil Management Plan has been prepared in **Appendix 2.1**.

There are no recorded localised flood events within the immediate area of the Site. A Surface Water Management Plan has been put in place and can be found in **Appendix 2.1**. The risk of flooding is addressed in **Appendix 9.1: Flood Risk Assessment**.

A 2020 article in Wind Power Engineering Magazine estimated that 1 in 2,000 wind turbines catch fire each year[25]. Overall, the data shows that wind turbine fires are relatively rare[26]. It is therefore considered that the risk of significant fire occurring, affecting the wind farm and causing the wind farm to have significant environmental effects is limited.

As described earlier, there are no significant sources of pollution in the wind farm with the potential to cause environmental or health effects. Also, the spacing of the turbines and distance of turbines from any properties limits the potential for impacts on human health. The issue of turbine safety is addressed in **Section 4.3.6.9**.

In the highly unlikely event that the stability of peat is compromised, an Emergency Response Plan has been prepared and can be found in **Appendix 2.1: Construction Environmental Management Plan, Management Plan 1**. Accidents and disasters are fully assessed in **Chapter 16: Major Accidents and Natural Disasters**.

4.4 ASSESSMENT OF POTENTIAL IMPACTS

4.4.1 Population and Settlement Patterns

The Development does not contain a housing or services element and is not considered to have any direct, long term, positive or negative impact on the local or regional population levels. However, construction workers who are not based locally may temporarily relocate to the region, this is more likely for the initial construction and decommissioning phase than for

[25] https://www.windpowerengineering.com/is-rope-based-descent-emergency-evacuation-at-the-end-of-its-tether/ [Accessed 27/01/2022]
[26] https://www.firetrace.com/fire-protection-blog/wind-turbine-fire-statistics [Accessed 27/01/2022]

the operational phase. The overall impact is considered to be imperceptible in terms of population.

The predicted effect on the immediate settlement patterns and social patterns is also slight to non-existent. There is however, the benefit which will accrue to the region in terms of the ability to provide electricity to industry and business via a high-quality supply. This will lead to the region becoming more attractive to business with the subsequent benefit of increased employment opportunities in the region. A renewable, green energy supply could potentially be attractive for companies looking to develop in County Cork.

During the construction phase there is the potential for limited impacts on the residential amenity of the local population. These will be short-term impacts relating primarily to an increase in construction traffic causing noise, dust, and an increase in traffic volume. The impacts of each on nearby properties have been found to be slight negative in the construction and decommissioning phases and imperceptible in the operational phase.

While the Development is not likely to result in a marked increase in settlement in the area, or a change in social patterns in the area, it will provide a renewable energy source which will prove attractive to certain types of industry depending on national and global economic conditions.

The overall impact of the construction phase on population and settlement patterns is predicted to be slight positive and short-term in nature should construction workers relocate to the area for the duration of these phases. The overall impact is predicted to be slight positive at the local level in terms of settlement patterns where increased business is attracted to the region during the operational phase.

4.4.2 Economic Activity

During the construction phase, there will be economic effects resulting from the expenditure on items such as Site preparation, Site Access Roads, purchase and delivery of materials, plant, equipment and components. Information provided by the Developer on experience at other wind farms indicates that there is expected to be a peak onsite workforce of maximum 50-workers. Some of these workers will be sourced from the local labour market where possible in Study Area 2 and Study Area 3, but professional and skilled personnel may be required to be sourced from areas inclusive of Ireland or even further afield.

During the initial decommissioning and construction phase, jobs are likely to be created. Local employment will be provided, as well as employment on local, national and international levels both directly and indirectly. Throughout the project lifetime, employment will be both created and maintained on local, regional, national and international levels.

It is envisaged that labour and materials will be sourced from the local area during construction where possible. Ready-mix concrete will also be sourced from a local supplier, again subject to authorisation, and to quality and quantity being available.

Employees involved in the construction of the Development will most likely use local shops, restaurants and hotels/accommodation. Therefore, overall there will be a slight, positive impact on employment in the locality. Employees also involved in the subsequent operation and decommissioning of the Development will use local shops, restaurants and hotels/accommodation.

BVG Associates carried out extensive assessments on the economic benefits from eight onshore wind farms in Southwest Scotland[27]. Each contract value was assigned to one or more relevant elements of a supply chain. Capital expenditure (CAPEX) was found to relate to turbine, civil works and electrical works supply chains, whereas the operational expenditure (OPEX) relates to transmission operations, maintenance and service (OMS) supply chain, the wind farm OMS and also the decommissioning supply chain.

Based on this research and the largest 92.4MW capacity proposed, the CAPEX for the Development is estimated to be approximately €90 million. This expenditure will result in economic benefit at a national, regional and local level. The OPEX (based on a conservative 24-year period) in nominal terms is estimated to be €105 million. The BVG report found, for the eight projects studied, that 66% of the total project spend (CAPEX & OPEX) was retained within the National economy, 17% of the total was retained in the local region hosting the project.

Cork County Council will benefit from payments under both the Development Contribution Scheme and from the annual rate payments. The Applicant is also committed to a 'Community Benefit' package. This package will be advertised annually and managed by the local community or an independent body on behalf of the local community. The purpose of the community fund is to enable the local community to share in the benefits of the

[27] Economic Benefits from onshore wind farms, September 2017, BVG Associates, accessed 18/05/21

Development. FuturEnergy Ireland and SSE's community benefits funds typically support local projects, with funds allocated to projects from all aspects of the community.

The overall impact on economic activity is predicted to be a moderate, positive, short-term impact during the construction phase of the Development and moderate, positive and long-term during the operational phase. There will be similar effects to the construction phase during decommissioning.

4.4.3 Employment

The employment effects that are attributable to the Development can be outlined as direct, indirect and induced.

Direct: Employment and other economic outputs that are directly attributable to the delivery of the Development. These include any new jobs that are created to manage and supervise the construction phase, operational and decommissioning phases of the Development and that are filled by employees of the Developer or the appointed Contractor (or sub-contracted employees).

Indirect: Employment and other outputs created in other companies and organisations that provide services to the Development, (i.e. procurement and other supply chain effects). Most manufactured materials like towers, blades and subcomponents are assumed to be imported (import intensity of 66%) with major infrastructure delivery through Ringaskiddy Port; fewer indirect manufacturing jobs will be generated domestically in Ireland.

Induced: Additional jobs and other economic outputs that are created in the wider economy, as a result of the spreading of employee incomes and other ripple effects that occur as a result of the direct and indirect effects of the Development.

Sustainable Energy Authority of Ireland (SEAI) researched the flow of investment and sales revenue from onshore wind and the transmission grid through the different industrial sectors in the supply chain required for input–output macro-analysis (**Table 4.6**).

Table 4.6: Capital Investment breakdown for onshore wind supply (Source SEAI, 2015 [28])

€192 million average annual capital investment to reach 2020 NREAP/NEEAP targets	**Industrial Sectors**
	Manufacturing (70%): turbines, blades, towers, gearbox, generator, electrical equipment, transformer etc.
	Construction (12%)
	Electricity Supply Services (10%)
	Transport (2.5%)
	Finance (2.5%)
	Professional Services (3%)

In terms of its capacity to capture capital investment domestically, Ireland has strong indigenous feasibility, planning, foundations and engineering expertise, with the skills and knowledge base to potentially supply niche markets in controls and instrumentation, albeit the bulk of heavy manufacturing (blades, towers) is imported. Similarly, the Irish supply chain is very well positioned in all of the preliminary design and operational aspects of the electricity grid, providing a significant boost to national employment. However, some manufactured materials such as cables, underground pipes, insulators and conductors are sourced from abroad.

According to SEAI, there are approximately 0.34 new long-term jobs per MW, which falls in line with European Wind Energy Association (EWEA) estimates for direct employment in Europe. In the case of the Development, this translates to 26-31 new long-term jobs for a 78.4 – 92.4 MW powered installation.

According to Institute for Sustainable Futures document (2015)[29], 3.2 jobs are created per MW of wind energy development during the construction and installation phase, the report assumes a 2 year construction period. Based on this employment estimate and an approximate two-year construction phase, between 250 and 295 jobs could be created during the construction phase (for an installed capacity of between 78.4 – 92.4 MW).

[28] A Macroeconomic Analysis of Onshore Wind Deployment to 2020 An analysis using the Sustainable Energy Economy Model, SEAI, 2015. [Accessed Online 29/06/2022] Available at: https://www.seai.ie/publications/A-Macroeconomic-Analysis-of-Onshore-Wind-Deployment-to-2020.pdf

[29] Institute for Sustainable Futures, Calculating Global Energy Sector Jobs – 2015 Methodology Update, 2015. [Accessed Online_27/06/2022] Available:https://opus.lib.uts.edu.au/bitstream/10453/43718/1/Rutovitzetal2015Calculatingglobalenergysectorjobsmethodology.pdf

According to the European Wind Energy Association's (EWEA) Report 'Wind at Work' (2009)[30], 1.2 jobs per MW are created during installation of wind energy projects based on 1 year construction period. Using this figure, a projection of between 188 and 221 jobs could be created as a result of the construction of the Development (for an installed capacity of between 78.4 – 92.4 MW and a construction period of 2 years).

The Sustainable Energy Authority of Ireland' 2015 report 'A Macroeconomic Analysis of Onshore Wind Deployment to 2020'[31] puts direct construction jobs from wind farm developments at 1.07 jobs per MW based on 1 year of construction. Using this figure, a projection of between 167 and 197 jobs could be created as a result of the construction of the Development (for an installed capacity between 78.4 – 92.4 MW and a construction period of 2 years). Therefore, considering the minimum and maximum figures, it is estimated that between 188 and 295 direct and indirect jobs could be created during the construction phase of the proposed project. It is not expected that all of these jobs will be based at the wind farm Site, however, the employment of tradespeople, labourers, and specialised contractors for the construction phase will have a direct, short-term significant, positive impact on employment in the study area.

An estimated breakdown of the potential construction employment is as follows:

Table 4.7: Estimated Employment breakdown during the construction phase of the Development

Occupation/Task	No. of People	Employment Period
Foundation team	eight	20 weeks
Roads (truck drivers)	eight	40 weeks
Plant drivers	four	60 weeks
Foreman	one	64 weeks
Engineer	one	64 weeks
Engineer	two	15 weeks
Substation Civils	ten	10 weeks
Substation electrical	fourteen	16 weeks
Foreman	two	15 weeks
General operatives	two	64 weeks

[30] European Wind Energy Association (EWEA) (2009), Wind at Work, - Wind Energy and Job Creation in the EU [Accessed Online: 27/06/2022] available at: http://www.ewea.org/fileadmin/files/library/publications/reports/Wind_at_work.pdf

[31] Sustainable Energy Authority Ireland (SEAI) (2015), A Macroeconomic Analysis of Onshore Wind Deployment to 2020. [Accessed Online: 27/06/2022]. Available at: https://www.seai.ie/publications/A-Macroeconomic-Analysis-of-Onshore-Wind-Deployment-to-2020.pdf

Approximately 50 persons will be employed on site during the peak of the construction phase of civil engineering of access Roads, crane hardstand, turbine foundation, and substation construction. These numbers will be somewhat less for the turbine delivery, assembly and commissioning activities. A mixture of skills will be required, including unskilled/semi-skilled/skilled manual (construction labour and machine operators), non-manual (administration roles), managerial and technical (civil, electrical, mechanical technical and engineering) and professional roles (scientific, engineering, legal, business and accounting). The manual roles will be Site-based with the other roles being predominately office-based, with Site visits as and when required. During construction, personnel will be at the Site over a number of months and during these times will likely use local accommodation and restaurants and other facilities.

Anecdotal evidence received by the Developer on other wind farm construction projects shows that local businesses such as accommodation providers welcome the enhanced level of occupancy that is achieved due to the construction contractors using their accommodation on a year-round basis, including periods of the year that are traditionally considered 'low season'. This is supported by the Edf-re.uk study which found that:
"*using local contractors, developing businesses to build wind farm technology, and supporting the workforce with food, accommodation and amenities*"[32]

The benefits of increased business, although temporary, can allow businesses to invest in improvements that would not otherwise be affordable, leading to a long-term enhancement.

Whilst overall effects on the tourism economy are considered in **Section 4.4.5** to be negligible and not significant, the benefits to individual businesses will be substantial and significant.

The Development will create approximately two full-time jobs during the operational phase. In addition to these jobs, various personnel will be required for the successful and continued operation of the wind farm. During the operation phase of the wind farm, the operation and reliability, maintenance (turbines, civil works and electrical infrastructure) finance, ongoing compliance with permissions and permits, safety, security, community relations and benefits and land-owner agreements must be continually managed. These requirements are widely distributed over various employment sectors and are an integral part of the ongoing operation of the Development and will provide continuous employment for the lifetime of the wind farm.

[32] Edf-re.uk [accessed 29/06/2022] available at: https://www.edf-re.uk/local-community/community-benefits#economy

A general outline of the employment associated with the operational phase of the wind farm is outlined in **Table 4.8.**

Table 4.8: Parties involved during the operational phase[33]

Maintenance Contracts	Financial and Services Contracts	Other Stakeholders
Project Manager	Lenders	Local Community
Asset Management	PPA Provider	Local Authority (incl. rates payments)
Turbine Contractor • Transport Companies • Crane Hire • Plant and Vehicle Hire • Site Facilities	Landowner Agreements	Construction and Maintenance material suppliers: • Local shops • Food providers • Accommodation providers
	Insurance	Plant Hire companies
	Accountancy	Telecom provider
	Safety Consultants	
	Community Liaison Officer	
Electrical Works Contractor	Environmental Monitoring • Noise • Ornithology • Habitat Management	
Civil Works Contractor		
Utility		

The persons fulfilling these roles may live and work anywhere in Ireland, visiting the Site as and when required, to operate and maintain the plant and equipment. During major service operations, personnel may be at the Site over several days and during these times may use local accommodation and restaurants.

Overall, there will be a slight positive short-term impact on employment in the area during construction and decommissioning.

4.4.3.1 Embedded measures

The Developer has a long track record of developing wind farms in Ireland and experience from previous wind farm construction projects is that expenditure in local goods and services is widely spread and makes a difference to existing businesses. A study by KPMG on behalf of Wind Energy Ireland in 2021 confirms this[34]. The Developer is committed to employing good practice measures with regard to maximising local procurement and will adopt

[33] Irish Wind Energy Association (2019) *Life-cycle of an Onshore Wind Farm.* Ionic Consulting. Available online at: https://www.iwea.com/images/files/iwea-onshore-wind-farm-report.pdf [Accessed 13/11/2019]

[34] Economic impact of onshore wind in Ireland, KPMG for Wind Energy Ireland, 2021. [Accessed Online: 29/06/2022] Available at: https://windenergyireland.com/images/files/economic-impact-of-onshore-wind-in-ireland.pdf

measures such as those set out in the Renewable UK Good Practice Guide, 2014: 'Local Supply Chain Opportunities in Onshore Wind' (Renewable UK, 2014).

The Developer will work with a variety of contractors who will be actively encouraged to develop local supply chains throughout the local area, and work with subcontractors to invest in training and skills development.

At this stage in the development process, it is not possible however, to quantify economic benefits in respect of individual supply chain companies, as contracts would not be let until consent is granted. However, it is evident from the Developer's recent experience that local and regional suppliers of a wide range of goods and services will benefit from such a Development (in this case, Cork, Kerry and Ireland as a whole).

4.4.4 Land Use

With reference to **Chapter 8: Soils and Geology**, there was no deep or very deep peat observed at the Site and the Factor of Safety (Adjusted) at peat probe locations was acceptable. This was with the exception of marginally stable/unstable point locations associated with deeper peat and/or steeper inclines. The Risk Ranking at peat probe locations is generally Very Low to Low with the exception of Moderate or High risk point locations associated with deeper peat and/or steeper inclines and/or close proximity to sensitive receptors. Similarly, the Risk Ranking for Subsoil Stability at trial pit locations is generally Very Low to Low. An Emergency Response Plan has been included in **Appendix 2.1**.

Terrestrial Ecology

The construction of the proposed development will result in the permanent loss of habitat, changes to existing habitats and disturbance to habitat.

The effect of the loss of 28 ha of wet heath, which includes areas of dry heath, outcropping rock and blanket bog (all Annex I listed habitats), is considered Significant and of Permanent duration.

The effect of the loss of a very small area of uncut blanket bog at T3 location is considered, at most, a Slight effect as this bog is very much a remnant and is not considered active.

The effect by the losses of mature conifer plantation, immature conifer plantation, semi-improved acid grassland and improved/semi-improved agricultural grassland is considered

Not significant as these habitats have low intrinsic ecological interest and are not of conservation importance.

The effect of disturbance on habitats is expected to range from not significant (in areas of semi-improved / improved grassland) to significant (in areas of wet heath / blanket bog). The duration of the effect is likely to be mostly short-term (1-7 years) though for intact wet heath and bog this could be long-term (15-60 years) due to the slow growth of peatland vegetation.

Aquatic Ecology

The most pertinent potential sources of impact on the aquatic environment are considered to be:

- The loss of natural watercourses due to watercourse crossings and the placement of bridges and culverts. Land use such as agriculture may be impacted in this instance.
- Water quality degradation in surface and groundwater.

All works, including turbine locations are located a minimum of 65m from the nearest watercourse, while the borrow pit location is over 500m from the nearest watercourse. No works will take place within a 65m buffer zone of watercourses except for on the seven watercourse crossings on the access track network. Mitigation measures have been put in place to minimise the effects of these works and can be found in **Appendix 2.1**.

4.4.5 Tourism

Fáilte Ireland published guidelines in 2011 for the treatment of tourism in an EIS, which describes the effects of wind farm projects on tourism. Many of the issues covered in the report are similar to those covered in this EIAR, for example, scenery is assessed in **Chapter 12: Landscape and Visual Amenity**.

Fáilte Ireland published a study on 'Visitor Attitudes on the Environment' in 2012[35] to assess the perceived impacts of wind farms on potential future visits to an area. The study found that 12% of those surveyed, responded that wind farms would have 'a strong positive impact' on their decision to visit Ireland, with 27% responding it would have a 'slight positive impact', whilst 38% said it would have 'no impact'. 7% of respondents stated it would have a 'strong negative impact' and 15% stated it would have a 'slight negative impact'. The survey also found that wind farms were noted as more favourable than other forms of development such as housing, mobile phone masts or electricity pylons.

[35] Fáilte Ireland (2012) Visitors Attitudes on the Environment – Wind Farms - https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/WindFarm-VAS-(FINAL)-(2).pdf?ext=.pdf [Accessed on 13/11/2019]

Based on historical examples and findings of the BiGGAR Economics report (mentioned in **Section 4.3.5.3**) there is not expected to be any direct relationship between the tourism sector growth and this Development.

Due to the distance and the intervening landscape, there will be no impact from the Development to tourists visiting Gougane Barra.

The Project is located within the Múscraí Gaeltacht area. While the construction phase will see the arrival of construction workers to the area, this will be a short term occurrence and will not result in permanent settlement of the area by non-Irish speakers. The Project is, therefore, predicted to result in a negligible, indirect, not significant impact on the Irish language during the construction phase. Please see **Chapter 14: Cultural Heritage** for more details.

Sections of the Beara to Breifne Way located within the Site will be temporarily closed during the construction and decommissioning phases. A diversion through the wind farm site will be in place during the works. The Beara to Breifne Way will be fully reopened to the public following completion of construction works. It is also proposed that waymarking and public information signage will be installed to facilitate the public use of existing routes in and around the Site. The upgrading of existing roads and the development of new roads will allow improved access to the area for walkers/cyclists. Coillte's Open Forest policy also means walkers will have full access to the forestry and tracks once construction work is complete.

Based on the findings of the collective assessments, it was considered that the Development will not give rise to any significant effects on tourism. Overall effects of the Development with regards to tourism are considered to be short-term, slight, negative during both construction and decommissioning phases due to temporary closures and diversions of walking and cycling routes. There will be a long-term, slight positive impact during operation due to improved tracks, information boards and waymarking.

4.4.6 Human Health

4.4.6.1 Electromagnetic fields

Electromagnetic fields from wind farm infrastructure, including the grid connection and substation, are very localised and are considered to be an imperceptible, long-term impact.

4.4.6.2 Shadow flicker

Section 4.6 provides an impact assessment of shadow flicker from the Development.

4.4.6.3 Noise

There is likely to be some noise and vibration from traffic within the vicinity of the Haul Route which may cause disturbance to residents. However, the effects are not predicted to be significant.

Operational noise, designed to meet the limits in the 2006 Wind Energy Development Guidelines will have a residual effect within the guideline limits and can be described as Not Significant.

Noise effects during decommissioning of the Development are likely to be of a similar nature to that during construction but of shorter duration. Existing roadways and turbine bases (excluding plinths) will be left in place and naturally vegetated over. Any legislation, guidance or best practice relevant at the time of decommissioning will be complied with.

A baseline assessment of the existing background noise conditions was carried out, the results of which are presented in **Chapter 11: Noise**.

4.4.6.4 Air Quality

Chapter 10: Air and Climate provides an assessment of air quality in relation to the Development. The impact assessment concludes that:

The effect of the Development on air quality will be imperceptible over the short-term period in which there will be an increase in traffic movements during construction and decommissioning. There will be slight, long term, positive effects on air quality because of the wind farm during operation.

4.4.6.5 Water Contamination

Chapter 9: Hydrology and Hydrogeology provides an assessment of the hydrological impacts of the Development, including the potential for water contamination.

Water contamination could potentially occur during the construction and the decommissioning phases from the release of suspended solids, accidental spillages of cement, hydrocarbons or HDD fluid. Once mitigation measures are implemented the risk of water contamination will be significantly reduced. However, there remains a level of risk and therefore both precautionary measures and emergency response protocols have been established and specified in Management Plans 1 and 3 of the CEMP, **Appendix 2.1**.

4.4.6.6 Traffic

Chapter 15 provides an assessment of the traffic impacts in relation to the Development. The assessment concludes that: the Development has generally been assessed as having the potential to result in effects of a negative, slight/moderate, direct, short-term, high probability effect or lower during the initial decommissioning and construction phase only. After mitigation, the residual effects have been assessed as imperceptible/slight, negative and short-term in nature.

There will be a positive residual effect from local roads and junctions having been widened along the turbine component haul route during operation of the Development.

It is possible that a blade (or set of blades) could require replacement if damaged by lightning on the Grousemount or Derragh Wind Farms. Should this coincide with the construction period for the Development, then there is the potential for cumulative transport affects. However, these are considered as being of low probability, slight impact and of short duration.

4.4.7 Property Value

Based on the available published studies the operation of a wind farm at the Site will not significantly impact on property values in the area. The Development will have a long-term imperceptible impact on property values.

4.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

Although no negative potential impact of significance has been established, there are a number of measures, which may be implemented for the safety of workers and the public during the construction, operational and decommissioning phases.

4.5.1 Embedded Mitigation

The Development, as described in **Chapter 2: Project Description**, incorporates good practice measures for limiting the adverse effects of the construction works. The principal potential effects arising from works tend to relate to construction traffic affecting the use of National roads, local primary roads and access roads by the general public and drainage. Measures are set out in **Chapter 15: Traffic and Transportation** relating to how delivery of goods and services will be managed during works to minimise impacts and details of mitigations and the use of Sustainable Drainage Systems can be found in **Chapter 9: Hydrology and Hydrogeology**. The proposed mitigation measures have been further developed in the **Construction and Environmental Management Plan (CEMP)** (**Appendix 2.1**).

4.5.2 Population and Settlement Patterns

Given that no negative impacts have been identified, no mitigation measures are proposed.

4.5.3 Economic Activity

Allowing for the implementation of embedded mitigation, no significant effects have been identified in respect of socio-economic receptors arising from the construction of the Development and therefore no mitigation measures are required to reduce or remedy any adverse effect.

4.5.4 Employment

Given that potential impacts of the Development at construction, operation and decommissioning phases are predominantly positive in respect of socio-economics, employment and economic activity, no mitigation measures are considered necessary.

4.5.5 Land Use

Mitigation measures for land use have been incorporated into the preliminary design stage. This has allowed for the prevention of unnecessary or inappropriate ground works or land use alterations to occur. The construction and operational footprint of the Development has been kept to the minimum necessary to avoid impact on existing land uses.

Existing forestry tracks have been incorporated into the design to minimise the construction of new Site Access Roads and minimise the removal of forested areas. New Site Access Roads have been sensitively designed to minimise impact on forestry. Electricity cables will be installed underground in or alongside Site Access Roads to avoid and minimise negative impact. The construction and decommissioning works will be planned and controlled by a Construction and Environmental Management Plan (CEMP). This provides details on day to day works and methodologies. As part of these works, the public and other stakeholders will be provided with updates on construction activities which will affect access to lands. This will be communicated to members of the public through a community liaison officer employed for the duration of the construction period.

Prior to the grid connection installation works within public roads, it is proposed that all access points (domestic, business, farm) are considered when finalising the temporary road closures and diversions, to maintain local access as much as possible and avoid impacts on various land uses. **Chapter 15: Traffic and Transportation** will be referred to for all proposed works and deliveries along the turbine delivery route to avoid undue impact to adjacent land uses.

4.5.6 Tourism

Mitigation measures for recreation, amenity and tourism are primarily related to the preliminary design stage of the Development, which has allowed for the prevention of unnecessary or inappropriate development to occur that will significantly affect any recreational or tourist amenity. In designing the Development, careful consideration was given to the potential impact on landscape amenity.

The most significant potential for tourism and recreation activity at the Site and surrounding area was identified as trail walking and hiking.

In providing for public safety, appropriate signage and safety measures will be put in place where forestry tracks will be closed to the public due to construction and decommissioning activities.

During the construction and decommissioning phases, periodic closures of the Beara to Breifne Way will be required, during these times, a diversion through the wind farm site will be in place. This will direct walkers to an alternative route adjacent existing access tracks for walkers to bypass the construction activity. Appropriate signage will be put in place to direct walkers. Notification of this diversion will be provided to Sport Ireland, Failte Ireland and Cork County Council to provide online information for walkers and hikers in advance of their recreation activity.

4.5.7 Human Health and Safety

4.5.7.1 *Construction and Decommissioning*

To maintain safety and avoid health impacts on construction workers and the general public, best practice site safety and environmental management will be maintained. The proposed development will be designed, constructed, operated and decommissioned in accordance with the following:

- Safety, Health & Welfare at Work (Construction) Regulations 2013 Safety
- Health & Welfare at Work Act 2005 Safety
- Health & Welfare at Work (General Applications) Regulations 2007

All construction staff will be adequately trained in health and safety and will be informed and aware of potential hazards.

All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be followed. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project.

Safe Pass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The Developer is required to ensure a competent contractor is appointed to carry out the construction works. The Contractor will be responsible for the implementation of procedures outlined in the Safety & Health Management Plan.

In relation to COVID-19, up to date Health Service Executive guidance will be consulted regularly in line with Health and Safety Authority recommendations and all reasonable on-site precautions will be taken to reduce the spread of COVID-19 on construction sites, should the virus be prevalent at the time of construction.

Once mitigation measures and health and safety measures are followed, the potential for impact on human health on the construction site during construction and decommissioning is expected to be not significant and temporary to short-term.

Public safety will be addressed by restricting access to the public in the vicinity of the site works during the construction and decommissioning stage. The construction site and associated recreation trails will be temporarily closed in sections to the public for the 18-24 month construction period as well as the decommissioning period. This measure aims to avoid potential injury to members of the public as a result of construction activities.

Where recreational trail sections are temporarily closed to the public during construction and decommissioning, signage will be provided indicating alternative routes for walkers within the main construction site. This aims to avoid potential confusion and disorientation to recreation users as well as maintaining public safety in proximity to the construction site.

Appropriate warning signage will be posted at the construction site entrance, directing all visitors to the site manager. Appropriate signage will be provided on public roads approaching site entrances and along haul routes.

In relation to the turbine delivery route, extra safety measures will be employed when large loads are being transported, for instance, Garda escort will be requested for turbine delivery and a comprehensive turbine delivery plan will be utilised to avoid potential impact to human safety for road users and pedestrians.

For the installation of the grid connection cable in the public road, a traffic management plan has been developed (**Appendix 2.1**) in discussion with locals who will be directly impacted by the works, and in agreement with the Local Authority. Public consultation will be conducted along the grid cable route to inform local residents ahead of construction and decommissioning works.

Once mitigation measures and health and safety measures are implemented and followed, the potential for impact on human health for members of the public during construction and decommissioning of the proposed project is expected to be not significant and temporary to short-term.

4.5.7.2 Operation

For operation and maintenance staff working at the proposed wind farm, appropriate site safety measures will be utilised during the operational phase by all permitted employees. All personnel undertaking works in or around the turbines will be fully trained and will use appropriate Personal Protective Equipment (PPE) to prevent injury.

Equipment within high voltage substations presents a potential hazard to health and safety. The proposed substation will be enclosed by palisade fencing and equipped with intruder and fire alarms in line with ESB and EirGrid standards.

All electrical elements of the proposed development are designed to ensure compliance with electro-magnetic fields (EMF) standards for human safety.

All on-site electrical connections are carried by underground cable and will be marked out above ground where they extend beyond the track or hardstanding surface. Details of cables installed in the public road will be available from ESBN.

Lightning conductors will be installed on each turbine as all structures standing tall in the sky require this protection. Turbines specifically require this to prevent power surges to electrical components. Turbines will be fitted with ice detection systems which will stop the turbine from rotating if ice is forming on a turbine blade. This aims to prevent ice throw.

Rigorous statutory and engineering safety checks imposed on the turbines during design, construction, commissioning and operation will ensure the risk posed to humans is negligible. 24-hour remote monitoring and fault notifications are included as standard in the Turbine Operations and Maintenance Contracts. A Supervisory Control and Data Acquisition

("SCADA") system will monitor the Development's performance. If a fault occurs, then a message is automatically sent to the operations personnel preventing emergency situations. In addition to scheduled maintenance, the maintenance contracts will allow for call out of local engineers to resolve any issues as soon as they are picked up on the remote monitoring system.

Access to the turbines inner structure will be locked at all times and only accessed by licenced employees for maintenance.

In line with the Health Service Executive's Emergency Planning recommendations, any incident which may occur at the site which requires emergency services, incident information will be provided in the 'ETHANE' format:

- Exact location
- Type of incident
- Hazards Access and egress
- Number of casualties (if any) and condition
- Emergency services present and required

The design of the Development has considered the susceptibility to natural disasters. The proposed site drainage will mitigate against any potential flooding risk due to run off with the use of Sustainable Drainage Systems (SuDS). Construction drainage will be left in-situ for the lifespan of the project through to decommissioning.

The Contractor's fire plans are reviewed and updated on a regular basis. A nominated competent person shall carry out checks and routine maintenance work to ensure the reliability and safe operation of firefighting equipment and installed systems such as fire alarms and emergency lighting. A record of the work carried out on such equipment and systems will be kept on site at all times.

Shadow flicker detection systems will be installed on all turbines to manage occurrence of shadow flicker on nearby receptors.

To ensure the proposed wind farm is compliant with noise limits, some of the turbines may need to be operated in noise reduced modes of operation to protect residential amenity. The wind farm system shall include a kill switch that can be operated at any time with an overriding manual shutdown system in case of an emergency.

4.5.7.3 Residual Risk

Once the above mitigations are taken into account, the residual risk on population and human health is assessed to be an imperceptible, long-term effect.

4.6 SHADOW FLICKER

This section comprehensively assesses the potential shadow flicker effects of all scenarios within the Turbine Range of the Development. The potential impacts that could arise from the Development during the construction, operation and decommissioning phases relate to potential shadow flicker impacts during operation. No shadow flicker will occur during the construction or decommissioning phases.

The study area is defined as 10 times the widest potential rotor diameter within the range (10 x 155m = 1,550m). A study area of 2,000m is used for completeness. A shadow flicker computer model was used to calculate the occurrence of shadow flicker at relevant receptors to the Development. The output from the calculations is analysed to identify and assess potential shadow flicker impacts. Wind turbines, like other tall structures, can cast long shadows when the sun is low in the sky.

The 2018 Review of the 2006 Guidelines confirms that:
"Shadow Flicker occurs when the sun is low in the sky and the rotating blades of a wind turbine casts a moving shadow which, if it passes over a window in a nearby house or other property results in a rapid change or flicker in the incoming sunlight. The time period in which a neighbouring property may be affected by shadow flicker is completely predictable."

In order to ensure the full extent of the moving shadow which would be created by the Turbine Range is considered in the assessment the following scenarios were modelled:

- Specimen Turbine – 107.5m hub, 155m rotor diameter (longest rotor), 185m tip height
- Alternative Scenario 1 – 102.5m hub (lowest hub), 155m rotor diameter (longest rotor), 180m tip height
- Alternative Scenario 2 – 110.5m hub (tallest hub), 149m rotor diameter (shortest rotor), 185m tip height

The three distinct scenarios were included in the assessment along with the cumulative impacts of nearby Derragh Wind Farm (0.189m distant) in order to fully assess the range of turbine parameters discussed in **Chapter 2: Project Description**.

Where negative effects are predicted, this section identifies appropriate mitigation strategies. The assessment considers the potential effects during the operational phase of the Development.

A shadow flicker computer model was used to calculate the occurrence of shadow flicker at relevant receptors to the Development. The output from the calculations is analysed to identify and assess potential shadow flicker impacts. This is further detailed in **Appendix 4.1**.

Shadow flicker lasts only for a short period and happens only in certain specific combined circumstances. The circumstances require that:

- the sun is shining
- the turbine is directly between the sun and the affected property, and
- there is enough wind energy to ensure that the turbine blades are moving.

If any one of these conditions is absent, shadow flicker cannot occur.

The recently published 2019 Draft Revision of the Wind Energy Development Guidelines (WEDG) also added the circumstance where:

- *"there is sufficient direct sunlight to cause shadows (cloud, mist, fog or air pollution could limit solar energy levels)" and note that*
- *"Generally only properties within 130 degrees either side of north, relative to the turbines, can be affected at these latitudes in the UK and Ireland – turbines do not cast long shadows on their southern side".*

Shadow flicker may have the potential to cause disturbance and annoyance to residents if it affects occupied rooms of a house.

Careful site selection, design and planning, and good use of relevant software to control the turbine operation can help reduce the possibility of shadow flicker. Modern wind turbines have the facility to measure sunlight levels and to reduce or stop turbine rotation if the conditions that would lead to excess shadow flicker at any neighbouring property.

The distance and direction between the turbine and property is of significance because:

- The duration of the shadow will be shorter the greater the distance (i.e., it will pass by quicker)
- The shadow flicker cast by rotating wind turbine blades will be reduced, the further a dwelling is from an operating turbine

The path of the sun varies over the seasons resulting in a changing potential for a shadow to be cast throughout the year. Similarly, the sun's position in the sky over the course of a day is changing such that the shadow cast by a turbine is constantly changing. Shadow flicker is more likely to occur on sunny winter days, when the sun is lower in the sky and shadows are cast a greater distance from the turbine. Shadow flicker is more likely to occur to the west or south-west of the Site with some occurrences also predicted to the north or north-east and south-east. This can be seen in **Appendix 4.1**.

Persons with photosensitive epilepsy can be sensitive to flickering light between 3 and 60 Hertz (Hz)[36]. This is supported by research in recent years asserting that flicker from turbines must interrupt or reflect sunlight at frequencies greater than 3 Hz to pose a potential risk of inducing photosensitive seizures. The frequencies of flicker caused by modern wind turbines are less than 1 Hz[37], and are well below the frequencies known to trigger effects in these individuals. Therefore, any potential shadow flicker effect from the Development is considered an effect on residential amenity, rather than having the potential to affect the health of residents.

4.6.1.1 Relevant Guidance

The relevant Irish guidance for shadow flicker is derived from the 'Wind Energy Development Guidelines for Planning Authorities' (Department of the Environment, Heritage and Local Government (DoEHLG), 2006) and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2012).

The Department of Environment, Community and Local Government in its Wind Energy Development Guidelines (2006) (the 2006 Guidelines) considers that:

"*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".*

The 2006 Guidelines also state that:

"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".

[36] Epilepsy Action (2012) *Other Possible Triggers of Photosensitive Epilepsy*. Available online at: http://www.epilepsy.org.uk/info/photosensitive-epilepsy [Accessed on 27 November 2019]
[37] Harding, G., Harding, P., & Wilkins, A. (2008). *Wind turbines, flicker, and photosensitive epilepsy*. *Epilepsia* (49) 6, pp. 1095-1098.

There are a cluster of two residential buildings located 225m from T12. In the event that planning consent is achieved, these buildings will be in control of the applicant and will not be inhabited for the operational period. These buildings are uninhabited and the landowner is in agreement with the above terms, therefore, this dwelling has been removed from the EIAR assessment.

A significant minimum separation distance from all other occupied dwellings of 750m has been achieved with the Project design. There are 16 No. occupied dwellings within 1km of any proposed wind turbine location.

The DoEHLG guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e., just after dawn and before sunset; and
- the turbine is located directly between the sun and the affected property; and
- there is enough wind energy to ensure that the turbine blades are moving; and
- the turbine blades are positioned so as to cast a shadow on the receptor.

Although the DoEHLG thresholds apply to dwellings located within 500 metres of a proposed turbine location, for the purposes of this assessment, the guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters (i.e., assumed at 1,550 metres as the widest potential roto diameter within the range (155m) and 2,000 metres for completeness) of the proposed turbines within the Site (as per IWEA guidelines, 2012). The DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the 'Draft Revised Wind Energy Development Guidelines' in December 2019. The revised draft of Wind Energy Development Guidelines 2019 provides for zero shadow flicker.

The Draft 2019 Guidelines are based on the recommendations set out in the 'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review' (December 2013) and the 'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach' (June 2017).

The assessment herein is based on compliance with the current DoEHLG Guidelines limit (30 hours per year or 30 minutes per day). However, it should also be noted the Development can be brought in line with the requirements of the 2019 draft guidelines, should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined herein.

Taking the above into consideration, JOD examined maps and aerial photographs to identify receptors (dwellings) up to and including ten rotor diameters (1,550m) of all turbines with a rotor diameter of a maximum of 155m of the Development. The house survey was ground truth-ed to confirm there are 76 dwellings within this radius of the turbines and a total of 106 dwellings within 2km of any turbine. A distance of 2km was used to assess the effects of shadow flicker for completeness. Once the properties within 2km were identified shadow flicker was assessed for a range of turbines. Derragh Wind Farm was also included in the assessment as it is located 189m from the Site Boundary. The following scenarios were assessed:

- Derragh Wind Farm on its own to establish baseline
- Specimen Turbine – 107.5m hub, 155m rotor diameter, 185m tip height with Derragh Wind Farm
- Alternative Scenario 1 – 102.5m hub, 155m rotor diameter, 180m tip height with Derragh Wind Farm
- Alternative Scenario 2 – 110.5m hub, 149m rotor diameter, 185m tip height with Derragh Wind Farm

4.6.1.2 Shadow Flicker Modelling

An industry standard wind farm assessment software package, WindPRO from EMD International Version 3.5 was used to prepare a model of the Development. The programme facilitates the analysis of a wind farm for possible shadow flicker occurrence at nearby houses. It allows for the production of maps, and shadow flicker prediction. The data output from the programme has been analysed and the receptors potentially vulnerable to shadow flicker were identified. The significance of shadow flicker effects were assessed.

Generic windows of 2m width, 2m height and 0.5m from bottom line above ground are applied in the model to each side of the house. The model assumes the receptor will not face any particular direction, but instead will face all directions. These windows represent an approximation of the existing windows on the houses facing north, south, east and west and provide an estimate of potential shadow flicker to a window on each side of the house. The software determines the times of day/year when the sun will be in line with the rotational components of the turbine and the house/receptor, thereby having the potential to cause shadow flicker. The software outputs details of potential shadow flicker, in this case by mean and maximum duration of the shadow flicker events, days per year and times of occurrence and maximum hours per year and maximum minutes per day of shadow flicker.

The following data inputs were required and used to produce an estimate of the effect of shadow flicker from the wind farm:

- Digital elevation model of the Development and areas around all properties within the model (10m resolution – OS X, Y, and Z data points)
- Turbine locations
- Turbine dimensions (rotor diameter and hub height)
- Receptor locations (i.e. property locations)
- Bottom line height above ground 'window' (0.5m above ground level)
- Wind speed and direction for the site to determine the period that the wind turbines will be in operation from the different wind directions during the year

The software creates a mathematical model of the Development and its surroundings and uses this information to calculate specific theoretical times and durations of flicker effects for the identified properties. The following 'worst-case' assumptions were initially incorporated into the shadow flicker modelling:

- there are no clouds and sunlight is always bright and direct
- the turbines are always rotating whereas this might not be the case due to maintenance works or break downs
- there is no intervening structures or vegetation (other than topography) that may restrict the visibility of a turbine, preventing or reducing the effect
- a limit to human perception of shadow flicker is not considered by the model

The model operates by simulating the path of the sun during the year. The results of the model provide a calculation of theoretical specific times and durations of flicker effects for the identified properties. As previously stated, given the assumptions incorporated into the model, the calculations overestimate the duration of effects. The worst-case assumption is considered to be sufficient for the purposes of this assessment as it assumes the sky is always clear, the turbines are always aligned face-on to each window and that there is a clear and undisturbed line of sight between the windows of the receptors and the turbines (except where this is prevented due to topography). In reality, this will not occur; the turbines will not always be orientated as described, clouds will obscure the sun and line of sight may also be obscured (for example, from leaves on trees). The flicker effects will be substantially less than this and will not meet the results of the worst-case assumption.

The model also outputs a more realistic scenario, or "expected values". In this scenario, the only change in assumptions is that the statistically likely monthly sunshine frequency and wind direction frequency data is assessed. This assessment only changes the annual hours per year metric and is not applied to the daily data. 'This is because it could be sunny, with the wind coming from the relevant direction, on any individual day The data used in the model was the:

- Long-term sunshine probability data from the Met Éireann synoptic station in Valentia
- Long-term wind rose data for the onsite met mast

4.6.1.3 Baseline Description

Taking the above into consideration, JOD examined maps to identify receptors (dwellings) in the local area within a study area, a distance ten times the maximum proposed rotor diameter of the proposed turbines (10 x 155m = 1550m). A range of turbine parameters was assessed, however, a maximum rotor diameter of 155m was used to calculate this distance which was then rounded up to 2km to allow for a complete assessment. This dimension will give the most significant outcome as smaller rotor diameters will cast less shadow. The properties were identified using a combination of Ordnance Survey of Ireland (OSI) Maps, AutoCAD drawings and from internet mapping resources including *Eircode Finder, Google Street View*, *Google Earth*, *Bing Maps,* a planning permission search using the Cork County Council web resource and from a visit to the Study Area. There are 106 properties within the shadow flicker study area radius. The majority of houses are located to the east, north and south of the Development. The coordinates of each dwelling and its distance to the closest proposed turbine are listed in **Table 4.9** and are shown in **Figure 4.5**.

Table 4.9: Properties within the shadow flicker study area

Current House ID	East_ITM	North_ITM	Elevation (AOD m)	Closest Turbine	Closest Distance to Turbine (m)
H1	517410	571864	254.5	T5	753
H2	517402	573794	210.2	T13	756
H3	517734	572119	250.3	T14	756
H4	515736	571186	296.3	T3	759
H5	515395	574092	216	T9	763
H6	517462	571790	234.1	T5	804
H7	517467	571806	236.2	T5	809
H8	515487	574211	217.3	T9	833
H9	516372	574046	234.7	T12	859
H10	517533	571990	257	T11	874

Current House ID	East_ITM	North_ITM	Elevation (AOD m)	Closest Turbine	Closest Distance to Turbine (m)
H11	515143	574094	215.6	T9	915
H12	515896	574342	196.8	T9	924
H13	517811	571946	218.8	T11	942
H14	514534	572878	305.6	T8	957
H15	516142	574318	209.2	T9	966
H16	514510	572872	306.8	T8	982
H17	516223	574321	211.1	T9	1003
H18	514997	574130	212.9	T9	1044
H19	515702	570880	296.7	T3	1056
H20	514411	572890	315.4	T2	1072
H21	518556	572363	233	T14	1085
H22	517923	573934	204.3	T14	1122
H23	517883	573984	196	T13	1146
H24	514830	574098	207.1	T9	1154
H25	517613	571154	192.5	T5	1163
H26	514887	574194	223.2	T9	1169
H27	514265	570703	232.6	T1	1203
H28	518705	572403	235.1	T14	1204
H29	514728	570617	256.9	T1	1216
H30	517670	571142	196.7	T5	1216
H31	514223	570697	230.2	T1	1224
H32	518774	572454	239.9	T14	1250
H33	518384	573830	215.6	T14	1251
H34	514633	570556	244.4	T1	1277
H35	514379	570581	225	T1	1287
H36	514814	570551	250.4	T1	1288
H37	514777	570545	248.8	T1	1291
H38	515088	570586	257.9	T1	1311
H39	514187	570609	220.4	T1	1319
H40	514433	570535	223.6	T1	1320
H41	517124	574610	192	T12	1332
H42	518824	572353	223.4	T14	1333
H43	518107	574098	177.9	T14	1339
H44	516773	574652	186.8	T12	1340
H45	517869	574232	179.2	T13	1346
H46	514750	570477	235.2	T1	1357
H47	518434	573927	210.8	T14	1358
H48	517605	574420	191.1	T12	1358
H49	516256	574698	198.5	T9	1361

Current House ID	East_ITM	North_ITM	Elevation (AOD m)	Closest Turbine	Closest Distance to Turbine (m)
H50	517850	571155	205.2	T5	1363
H51	517890	571229	190.8	T5	1365
H52	514698	570464	232.4	T1	1368
H53	517210	574625	194.8	T12	1369
H54	514485	570469	217.6	T1	1377
H55	514590	570438	221.8	T1	1397
H56	518528	573917	219.1	T14	1410
H57	515290	570548	246.2	T3	1411
H58	514512	570431	214	T1	1411
H59	518930	572410	225.3	T14	1412
H60	516878	574725	190	T12	1413
H61	517955	571250	190.6	T5	1416
H62	514394	573903	230.9	T8	1419
H63	514059	570556	212.9	T1	1420
H64	518941	572403	223.9	T14	1425
H65	518321	574087	175.3	T14	1426
H66	518957	572447	229.2	T14	1427
H67	518976	572514	232.9	T14	1427
H68	518097	574217	178.9	T14	1446
H69	518989	572432	225.7	T14	1462
H70	519003	572456	227.1	T14	1468
H71	518987	572390	220.5	T14	1473
H72	519042	572577	229.9	T14	1478
H73	519032	572454	225.3	T14	1497
H74	518159	574273	188.6	T14	1521
H75	517248	574791	194.7	T12	1539
H76	514292	570334	200.8	T1	1548
H77	519031	572269	210.4	T14	1556
H78	514600	574467	239.8	T9	1565
H79	519083	573399	197.8	T14	1585
H80	518088	574393	211.1	T13	1599
H81	514828	574738	256.7	T9	1614
H82	515800	575045	228.9	T9	1618
H83	514232	574023	197	T8	1621
H84	516832	574974	226.9	T12	1661
H85	515011	570183	215	T1	1682
H86	516572	574987	243.2	T12	1692
H87	514991	574930	242	T9	1692
H88	516684	575011	243.9	T12	1703

Current House ID	East_ITM	North_ITM	Elevation (AOD m)	Closest Turbine	Closest Distance to Turbine (m)
H89	518743	574118	179.2	T14	1704
H90	514914	574938	236.3	T9	1736
H91	514204	570162	194.9	T1	1737
H92	514308	574396	209.6	T9	1753
H93	515847	575193	208.9	T9	1768
H94	517147	575057	191.9	T12	1775
H95	514310	574440	217.8	T9	1776
H96	516360	570045	235.8	T5	1797
H97	515285	570118	238.6	T1	1817
H98	517237	575083	187.4	T12	1819
H99	518853	574198	159.1	T14	1837
H100	514172	569993	196.1	T1	1908
H101	514126	574409	191.4	T9	1914
H102	519337	573772	183.8	T14	1968
H103	515882	575406	186.2	T9	1982
H104	519423	572097	200.1	T14	1984
H105	515128	575313	171.4	T9	1992
H106	519384	571987	200.5	T14	1994

No shadow flicker is experienced at 17 No. dwellings, (**Table 4.10**) due to the orientation of these dwellings with respect to the proposed turbines in all scenarios assessed and these are therefore ruled out for further assessment.

Table 4.10: Dwellings with no shadow flicker experienced

Dwellings with no shadow flicker experienced	
H39	H91
H63	H93
H75	H94
H82	H98
H84	H99
H86	H100
H87	H103
H88	H105
H90	

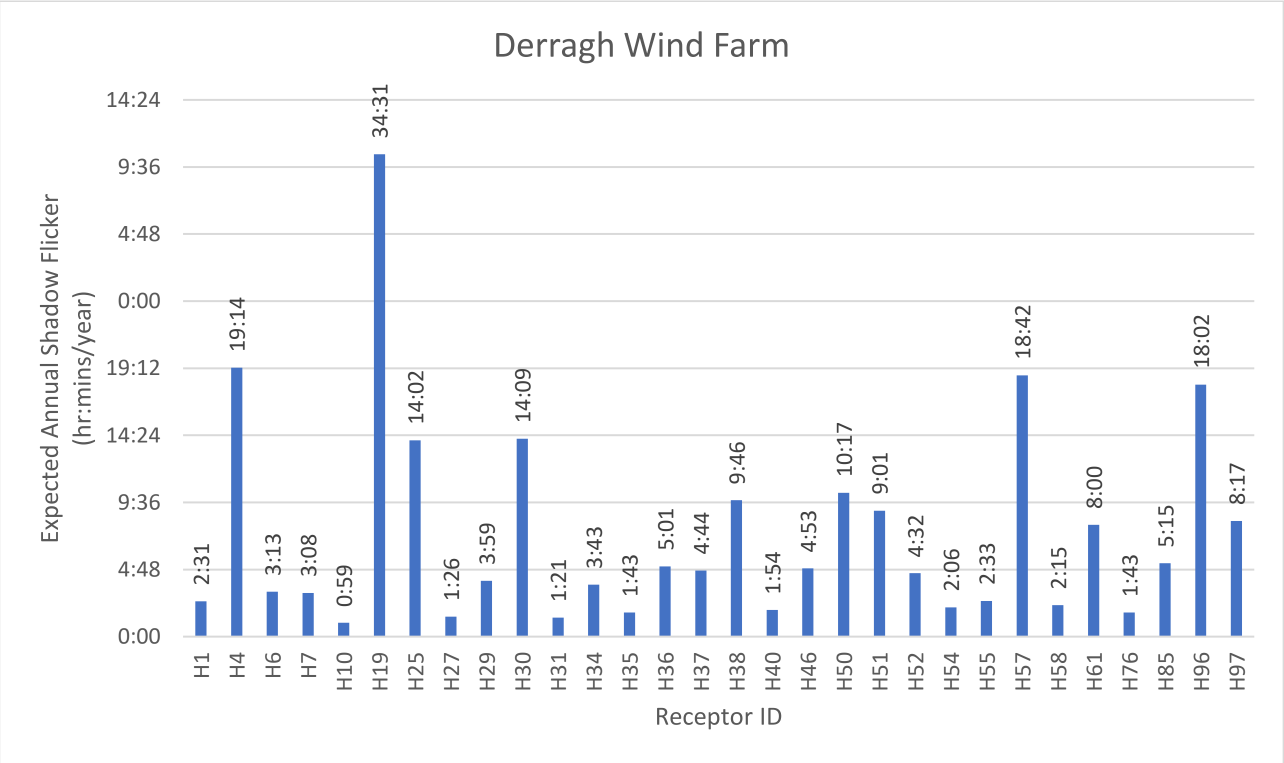
4.6.1.4 Assessment of Potential Effects

This assessment considers the potential shadow flicker impact of the Development on the remaining surrounding properties in terms of:

- Predicting and assessing the extent of shadow flicker experienced by all properties within the shadow flicker study area
- Specifying mitigation measures, where deemed necessary

Other developments within ten rotor diameters were then considered in the assessment of the Development. Derragh Wind Farm is located 189m from the Site Boundary.

Graph 4.2 shows the baseline expected annual shadow flicker to be experienced by receptors from the nearby Derragh Wind Farm. Full details of this can be seen in **Appendix 4.1**. The calculation of the potential total hours of shadow flicker per year, the number of days per year that shadow flicker is possible, the maximum hours of shadow flicker per day and the predominant contributing turbine for each receptor from the Development and the Derragh Wind Farm is shown in **Table 4.11** and discussed under cumulative effects in **Section 4.6**. Full assessment outputs are in **Appendix 4.1** of the EIAR.



Graph 4.2: Summary of Potential Shadow Flicker Listing for Receptors from Derragh Wind Farm

Derragh Wind Farm is located within ten rotor diameters of the Site Boundary. Shadow Flicker analysis has shown that this development already has some impact on 30 No. receptors as can be seen in **Graph 4.2**. The analysis has shown that 20 No. receptors are impacted solely by Derragh Wind Farm as can be seen in **Table 4.11**.

The following scenarios were assessed:

- Derragh Wind Farm on its own to establish baseline
- Specimen Turbine – 107.5m hub, 155m rotor diameter, 185m tip height with Derragh Wind Farm
- Alternative Scenario 1 – 102.5m hub, 155m rotor diameter, 180m tip height with Derragh Wind Farm
- Alternative Scenario 2 – 110.5m hub, 149m rotor diameter, 185m tip height with Derragh Wind Farm

Table 4.11: Summary of Potential Cumulative Shadow Flicker Listing for All Properties

*Solely impacted by Derragh Wind Farm

Receptor ID	Derragh Wind Farm		Specimen Turbine		Alternative Scenario 1		Alternative Scenario 2	
	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]
H1	27:23:00	02:31	*75:21:00*	12:30	*75:02:00*	12:23	*72:41:00*	11:58
H2	**00:00**	**00:00**	*125:08:00*	13:36	*107:20:00*	11:55	*104:08:00*	11:32
H3	**00:00**	**00:00**	*104:33:00*	20:54	*103:55:00*	20:48	*98:11:00*	19:38
H4	*158:42:00*	19:14	*166:19:00*	20:45	*170:28:00*	21:33	*161:22:00*	19:47
H5	**00:00**	**00:00**	*97:45:00*	10:47	*98:27:00*	10:48	*90:55:00*	10:04
H6	*33:44:00*	03:13	*80:53:00*	13:20	*80:09:00*	13:10	*76:05:00*	12:18
H7	*33:04:00*	03:08	*79:01:00*	12:57	*76:16:00*	12:21	*74:04:00*	11:53
H8	**00:00**	**00:00**	*82:16:00*	08:19	*79:50:00*	08:03	*78:41:00*	07:56
H9	**00:00**	**00:00**	*189:18:00*	19:04	*186:19:00*	18:42	*178:12:00*	18:00
H10	12:11	00:59	*57:54:00*	09:21	*60:58:00*	09:55	*51:11:00*	08:04
H11	**00:00**	**00:00**	*58:46:00*	06:52	*55:59:00*	06:37	*42:39:00*	04:55
H12	**00:00**	**00:00**	*48:37:00*	04:42	*44:46:00*	04:21	*46:11:00*	04:27
H13	**00:00**	**00:00**	*63:35:00*	12:57	*65:11:00*	13:15	*58:16:00*	11:51
H14	**00:00**	**00:00**	*135:24:00*	21:19	*131:15:00*	20:38	*121:13:00*	19:15
H15	**00:00**	**00:00**	*92:08:00*	08:52	*90:04:00*	08:39	*87:40:00*	08:27
H16	**00:00**	**00:00**	*129:22:00*	20:17	*125:34:00*	19:42	*109:47:00*	17:05
H17	**00:00**	**00:00**	*109:51:00*	10:29	*106:33:00*	10:08	*90:34:00*	08:36
H18	**00:00**	**00:00**	*39:26:00*	04:35	*43:37:00*	05:17	*36:38:00*	04:15
H19 *	*175:36:00*	*34:31:00*	*175:36:00*	*34:31:00*	*175:36:00*	*34:31:00*	*175:36:00*	*34:31:00*
H20	**00:00**	**00:00**	*101:26:00*	15:44	*96:55:00*	15:06	*81:30:00*	12:28
H21	**00:00**	**00:00**	*57:21:00*	11:42	*57:23:00*	11:43	*48:55:00*	10:14
H22	**00:00**	**00:00**	*60:13:00*	06:30	*60:28:00*	06:30	*48:18:00*	05:09
H23	**00:00**	**00:00**	*58:42:00*	06:13	*58:27:00*	06:10	*50:28:00*	05:16
H24	**00:00**	**00:00**	*49:59:00*	05:53	*49:07:00*	05:47	*42:51:00*	04:58
H25	*131:42:00*	14:02	*155:11:00*	18:40	*155:27:00*	18:43	*153:44:00*	18:22

Receptor ID	Derragh Wind Farm		Specimen Turbine		Alternative Scenario 1		Alternative Scenario 2	
	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]
H26	**00:00**	**00:00**	*30:48:00*	03:35	29:36:00	03:28	28:26:00	03:19
H27 *	06:41	01:26	06:41	01:26	06:41	01:26	06:41	01:26
H28	**00:00**	**00:00**	*31:11:00*	06:48	29:56:00	06:31	24:04:00	05:19
H29 *	18:35	03:59	18:35	03:59	18:35	03:59	18:35	03:59
H30	*131:15:00*	14:09	*154:10:00*	18:42	*153:59:00*	18:41	*152:52:00*	18:27
H31 *	06:21	01:21	06:21	01:21	06:21	01:21	06:21	01:21
H32	**00:00**	**00:00**	26:05:00	05:38	24:58:00	05:24	19:55	04:26
H33	**00:00**	**00:00**	*51:54:00*	05:37	*51:00:00*	05:31	*49:08:00*	05:18
H34 *	17:22	03:43	17:22	03:43	17:22	03:43	17:22	03:43
H35 *	08:01	01:43	08:01	01:43	08:01	01:43	08:01	01:43
H36 *	23:30	05:01	23:30	05:01	23:30	05:01	23:30	05:01
H37 *	22:08	04:44	22:08	04:44	22:08	04:44	22:08	04:44
H38 *	*46:39:00*	09:46	*46:39:00*	09:46	*46:39:00*	09:46	*46:39:00*	09:46
H39	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H40 *	08:53	01:54	08:53	01:54	08:53	01:54	08:53	01:54
H41	**00:00**	**00:00**	11:12	01:08	11:26	01:09	10:13	01:02
H42	**00:00**	**00:00**	20:41	04:35	20:00	04:26	19:48	04:23
H43	**00:00**	**00:00**	*34:15:00*	03:43	*35:42:00*	03:49	*30:38:00*	03:21
H44	**00:00**	**00:00**	23:41	02:06	23:37	02:05	22:35	02:00
H45	00:00	00:00	*34:32:00*	03:24	*33:32:00*	03:17	*32:54:00*	03:14
H46 *	22:56	04:53	22:56	04:53	22:56	04:53	22:56	04:53
H47	**00:00**	**00:00**	*43:50:00*	04:41	*43:03:00*	04:35	*41:32:00*	04:25
H48	**00:00**	**00:00**	*30:01:00*	02:45	*30:00:00*	02:44	28:14:00	02:36
H49	**00:00**	**00:00**	02:31	00:12	00:56	00:04	02:24	00:12
H50	*94:53:00*	10:17	*121:45:00*	15:41	*122:56:00*	15:55	*107:55:00*	12:48
H51	*84:26:00*	09:01	*120:16:00*	16:15	*121:08:00*	16:26	*108:27:00*	13:44
H52 *	21:17	04:32	21:17	04:32	21:17	04:32	21:17	04:32

Receptor ID	Derragh Wind Farm		Specimen Turbine		Alternative Scenario 1		Alternative Scenario 2	
	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]
H53	**00:00**	**00:00**	09:59	01:02	10:06	01:02	**00:00**	**00:00**
H54 *	09:54	02:06	09:54	02:06	09:54	02:06	09:54	02:06
H55 *	12:01	02:33	12:01	02:33	12:01	02:33	12:01	02:33
H56	**00:00**	**00:00**	*44:14:00*	04:41	*43:37:00*	04:37	*35:24:00*	03:29
H57 *	*93:36:00*	18:42	*93:36:00*	18:42	*93:36:00*	18:42	*93:36:00*	18:42
H58 *	10:40	02:15	10:40	02:15	10:40	02:15	10:40	02:15
H59	**00:00**	**00:00**	16:54	03:46	16:14	03:37	13:34	03:01
H60	**00:00**	**00:00**	21:13	01:52	21:08	01:51	20:15	01:47
H61	*74:23:00*	08:00	*112:45:00*	15:49	*112:55:00*	15:51	*102:20:00*	13:34
H62	**00:00**	**00:00**	*35:05:00*	04:42	*35:12:00*	04:41	*32:34:00*	04:22
H63	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H64	**00:00**	**00:00**	16:40	03:43	16:08	03:36	13:22	02:58
H65	**00:00**	**00:00**	*32:50:00*	03:29	*31:40:00*	03:23	*30:50:00*	03:16
H66	**00:00**	**00:00**	16:03	03:33	15:24	03:24	12:05	02:39
H67	**00:00**	**00:00**	15:47	03:27	15:09	03:19	10:59	02:23
H68	**00:00**	**00:00**	*37:25:00*	03:46	*37:15:00*	03:44	*35:12:00*	03:33
H69	**00:00**	**00:00**	15:25	03:25	15:00	03:19	11:41	02:34
H70	**00:00**	**00:00**	15:14	03:21	14:41	03:13	11:10	02:26
H71	**00:00**	**00:00**	15:42	03:30	15:13	03:24	12:27	02:46
H72	**00:00**	**00:00**	15:09	03:18	14:32	03:10	09:42	02:07
H73	**00:00**	**00:00**	14:44	03:14	14:14	03:07	10:41	02:19
H74	**00:00**	**00:00**	*33:45:00*	03:20	*33:12:00*	03:17	*31:55:00*	03:09
H75	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H76 *	08:11	01:43	08:11	01:43	08:11	01:43	08:11	01:43
H77	**00:00**	**00:00**	15:01	03:20	14:33	03:14	13:19	02:57
H78	**00:00**	**00:00**	15:01	01:45	14:53	01:44	13:43	01:36
H79	**00:00**	**00:00**	08:57	01:19	09:04	01:20	08:22	01:14

Receptor ID	Derragh Wind Farm		Specimen Turbine		Alternative Scenario 1		Alternative Scenario 2	
	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]	Worst Case Shadow [h/year]	Expected Shadow [h/year]
H80	**00:00**	**00:00**	20:10	01:57	19:08	01:51	18:50	01:49
H81	**00:00**	**00:00**	08:33	00:46	07:29	00:40	08:14	00:44
H82	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H83	**00:00**	**00:00**	08:07	01:18	08:08	01:17	07:28	01:11
H84	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H85 *	25:18:00	05:15	25:18:00	05:15	25:18:00	05:15	25:18:00	05:15
H86	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H87	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H88	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H89	**00:00**	**00:00**	29:40:00	02:53	08:08	00:59	20:36	01:48
H90	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H91	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H92	**00:00**	**00:00**	28:00:00	03:08	27:57:00	03:07	08:06	01:09
H93	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H94	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H95	**00:00**	**00:00**	26:10:00	02:52	25:47:00	02:49	08:10	01:07
H96 *	*89:23:00*	18:02	*89:23:00*	18:02	*89:23:00*	18:02	*89:23:00*	18:02
H97 *	*42:22:00*	08:17	*42:22:00*	08:17	*42:22:00*	08:17	*42:22:00*	08:17
H98	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H99	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H100	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H101	**00:00**	**00:00**	18:59	02:20	19:04	02:20	**00:00**	**00:00**
H102	**00:00**	**00:00**	06:31	00:54	06:29	00:53	**00:00**	**00:00**
H103	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H104	**00:00**	**00:00**	07:42	01:43	07:28	01:40	**00:00**	**00:00**
H105	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**	**00:00**
H106	**00:00**	**00:00**	09:14	02:01	08:50	01:56	**00:00**	**00:00**

It can be demonstrated from **Table 4.11**, that in the case of the Specimen Turbine where a hub height of 107.5m and a rotor diameter of 155m are used for the proposed turbines, there will be 89 receptors out of 106 that will experience some degree of shadow flicker and 17 receptors that will experience no shadow flicker.

In Alternative Scenario 1, where a hub height of 102.5m and a rotor diameter of 155m are used for the proposed turbines, there will be 89 receptors out of 106 that will experience some degree of shadow flicker and 17 receptors that will experience no shadow flicker.

In Alternative Scenario 2, where a hub height of 110.5m and a rotor diameter of 149m are used for the proposed turbines, there will be 84 receptors out of 106 that will experience some degree of shadow flicker and 22 receptors that will experience no shadow flicker.

However, in all scenarios assessed, 20 No. of the shadow flicker receptors are impacted solely by the Derragh Wind Farm and not by the Development. The worst affected receptor is H19 which is expected to experience 34 hours and 31 minutes of shadow flicker in a year.

In the first scenario of the Specimen Turbine, the worst impacted receptor is H14, which will experience 21 hours and 19 minutes of shadow flicker per year. In Alternative Scenario 1, the worst impacted receptor is H4, which is expected to experience up to 21 hours and 33 minutes of shadow flicker in a year. In the third scenario, Alternative Scenario 2, the worst impacted receptor is H4, which is expected to experience 19 hours and 47 minutes of shadow flicker per annum.

The calculated worst-case shadow flicker occurrences in the **Table 4.11** assumes the sun is always shining, that there is no cloud cover and the dwelling is always occupied. As previously stated, this calculation is based on topography alone and excludes vegetation, buildings and other man-made structures. As can be seen in the shadow flicker assessment attached as **Appendix 4.1** all of the proposed turbines give rise to some degree of cumulative shadow flicker, if unmitigated.

4.6.1.5 Assessment of Expected Shadow Flicker Impact

In order to calculate more realistic and 'real world' occurrences of shadow flicker for the receptors that are identified as potentially vulnerable to shadow flicker (**Table 4.11**), it is necessary to identify the likely meteorological conditions which are expected to be experienced at the Site. To estimate the likely duration of sunshine occurrence at the Site, historical meteorological data from the Met Éireann is automatically uploaded by the software.

Data from Valentia Meteorological Observatory was used as this Met Éireann observatory is the closest to the Site and also measures multiple environmental parameters. This gives a good representation of data for the Development. This data was utilised to consider the probability of sunshine occurrence, and thus allow the determination of 'projected' values for shadow flicker occurrence.

The worst-case predicted hours for shadow flicker are reduced by the average time the weather is cloudy annually. As discussed above, to estimate the impact of sunshine occurrence, historical meteorological data is utilised to consider the likelihood of sunshine (the sunshine probability) at different times of the year. This allows the determination of 'expected' values for shadow flicker occurrence. This is achieved by applying a reductive factor to the worst-case total hours per year of shadow flicker. 'Long term average sunshine hours' refers to data collected by Met Éireann.

Table 4.11 shows the potential and the expected shadow flicker values per year which are likely to be experienced by each receptor. 'Potential sunshine hours' refers to the intervening time period between modelled sunrise and sunset. Although the projected duration of shadow flicker is reduced substantially for each dwelling, they are not eliminated entirely for all of the 106 receptors within the shadow flicker study area of the Development. The Draft Revised Wind Energy Development Guidelines, December 2019, recommend that shadow flicker should not impact any dwelling, therefore the relevant turbine or turbines must be shut down on a temporary basis until the potential for shadow flicker ceases.

4.6.1.6 Cumulative Effects

Cumulative shadow flicker impacts could arise if dwellings are at risk from potential shadow flicker impacts as a result of more than one wind farm. While separate wind farms are not likely to cause effects simultaneously, they could increase the cumulative total hours where a receptor is impacted. In this instance, there is one consented wind farm (Derragh Wind Farm) within a 2km range of the turbines that may cause cumulative effects.

The assessment showed 20 houses will be impacted by Derragh Wind Farm and not the Development (**Table 4.11**). There are ten receptors (H1, H4, H6, H7, H10, H25, H30, H50, H51and H61) that will be affected by cumulative shadow flicker effects. The installation of a blade shadow control system on all wind turbines will eliminate shadow flicker impacts from the Development, therefore, removing cumulative shadow flicker impacts.

4.6.1.7 Mitigation Measures & Residual Effects

Due to the potential for shadow flicker to affect receptors within the shadow flicker study area, it is proposed that a shadow control system will be installed on each of the wind turbines. The control system will calculate, in real-time:

- Whether shadow flicker has the potential to affect nearby properties, based on pre-programmed co-ordinates for the properties and turbines
- Wind speed (can effect how fast the turbine will turn and how quickly the flicker will occur)
- Wind direction
- The intensity of the sunlight
- When the control system detects that the sunlight is strong enough to cast a shadow, and the shadow falls on a property or properties, then the turbine will automatically shut down; and will restart when the potential for shadow flicker ceases at the affected properties.

It is intended that the measures outlined above, subject to safe shut down time of approximately 60 seconds, will eliminate the potential for shadow flicker to affect any of the properties within the study area, this will be the case regardless of which turbine is selected within the turbine range. In the event that complaints of shadow flicker are received by the Developer / Site Operator or by Cork County Council, an investigation will take place and the complaints frequency, duration and time of complaints will be considered and specialist modelling software will be used to confirm the occurrence(s). Should the complaint persist, a shadow flicker survey involving the collection of light data will also be carried out at the property in which the complaint was made. Further refinement of the blade shadow control system will be conducted to eliminate the shadow flicker occurrence. This could result in the shutting off turbines at specific times of day.

4.6.1.8 Summary of Significant Effects

This assessment has identified the potential for shadow flicker to affect between 84 No. and 89 No. out of 106 No. receptors within the shadow flicker study area. Of these, 20 No. receptors will be solely impacted by Derragh Wind Farm. It is proposed that a shadow control system be installed to eliminate the potential for shadow flicker from the Development. Such systems are common in many wind farm developments and the technology has been well established. A case study in Scotland found that the use of turbine shut-down control modules for turbines which were causing shadow flicker at nearby offices was successful[38].

[38] Update of UK Shadow Flicker Evidence Base, Parsons Brinckerhoff for Department of Energy and Climate Change, United Kingdom. Accessed Online_27/06/2022]
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48052/1416-update-uk-shadow-flicker-evidence-base.pdf

4.6.1.9 Statement of Significance

This assessment has identified that by installing a blade shadow control system on the proposed turbines, there will be no significant impacts. Given that only effects of significant impact or greater are considered "significant" in terms of the EIA Regulations, the potential effects of the Development as a result of shadow flicker, when mitigated, are considered to be not significant.

4.7 CUMULATIVE EFFECTS

As per **Appendix 2.3**, the nearest operational wind farm to the Site is Derragh Wind Farm, comprising six wind turbines located 189m to the south of the Site Boundary. The Development along with Derragh Wind Farm and other Irish renewables generation is considered to be a fundamental change in the climate effects of Ireland's energy supply, which is an important, positive effect that is significant under the EIA regulations and will contribute to Ireland's legally binding reduction targets.

The Development will contribute to the offset of burning of fossil fuels which has the potential to positively impact human health. The cumulative impact of the Development can be predicted to be a small, short-term negative impact on tourism and amenity during construction. There is predicted to be a short-term, moderate positive impact in terms of employment from the Development.

4.8 SUMMARY OF SIGNIFICANT EFFECTS

The assessment has not identified any likely significant effects from the Development on population and human health.

4.9 STATEMENT OF SIGNIFICANCE

This chapter has assessed the significance of potential effects of the Development on population and human health. The Development has been assessed as having the potential to result in effects of a slight positive, long-term impact overall. Through the implementation of mitigation measures, the cumulative effects associated with the Development are predicted to be not significant.