Energy for generations

Derrybrien Wind Farm Project

Gort Windfarms Ltd.

Remedial Environmental Impact Assessment Report
Chapter 4 -Population and Human Health

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Contents

Table of appendices

Table of figures

Table of tables

4 Population and Human Health

4.1 Introduction

4.1.1 Chapter Scope

This chapter provides an assessment of the environmental impact of the Wind Farm Project from baseline date prior to project construction, project operation through to decommissioning with respect to population and human health.

As set out in Chapter 1, the project comprises:

1. Derrybrien Wind Farm and all associated works
2. Grid connection comprising Derrybrien-Agannygal 110kV Overhead line and Agannygal substation and all associated works
3. Peat slide and works undertaken in response to peat slide

The requirement to consider human health was introduced in the 2014 EIA Directive.

Impacts on population and human health are considered throughout this report in relation to environmental factors. Factors affecting human beings typically include audibility, shadow flicker, visibility, and traffic. These issues are addressed in detail in other specific chapters of the rEIAR, (Chapters 5 Noise, Chapter 6 Shadow Flicker, Chapter 9 Landscape and Chapter 14 Traffic and Transport). In addition, site stability issues are addressed in Chapter 10 Land, Soils and Geology.

4.1.2 Statement of Authority

The assessments with this chapter were undertaken by Dr. Paddy Kavanagh (BSc Hons Chemistry, PhD Chemistry), ESB Engineering and Major Projects. Dr. Kavanagh has over 36 years of experience in the field of chemistry, environment and environmental assessment both in Ireland and internationally. He has led and been involved in the preparation of environmental impact statements/environmental impact assessment reports and environmental management for power generation, transmission systems including the Donegal and Connemara 110 kV overhead lines and substations, the North South 400kV Interconnector and wind farm projects including Oweninny, Grousemount, Lissycasey wind farms for example.

4.1.3 Difficulties Encountered

Population and health information has been obtained from historic reports, records and Census data which cover the relevant time periods relating to the baseline year (1998), the construction period 2003 to 2006 and the operational period 2007 to 2020 to varying degrees. Given the period of time involved, a number of minor changes to the format of data from different Census years occurred. Overall the data available is adequate to provide a picture of the population prior to construction, during construction and operation in the general area and the changes which have occurred over time.

Similarly, employment information in consistent format was not always available at ED level but a general picture of employment and trends has been obtained from data available for the West Region and for Galway County indicating the range and changes in the nature of employment in rural county Galway which was similar to available ED information where available. Health data was also limited for the ED areas and reference was made to available information at West Region and Galway County level which again correlated generally with available ED information. Overall sufficient information was available to allow a robust assessment of the Project impact on Population and Human Health to be made.

4.2 Population

4.2.1 Methodology

The EPA draft "Guidelines on the Information to be contained in Environmental Impact Assessment Reports" (EPA, 2017) has been used to describe effects and impacts where they occur.

The Ordinance Survey historic aerial views of the area (http://map.geohive.ie/mapviewer.html) dating from 1995 to 2012 have been used online to assess the nature of land use change in the area together with the description of the windfarm development provided in Chapter 2.

The nature of employment in the county and local DEDs has been sourced from Central Statistics Office (CSO) census data and CSO reports.

Tourism information has been obtained from Bord Fáilte publications and community benefit information obtained from Gort Wind Farm Ltd.

The main sources of data used are provided in Appendix 1 and are summarised as follows:

- CSO Census Data, 1996, 2002, 2006, 2011 and 2016
- CSO Quarterly National health Surveys
- Department of Health, Health in Ireland Key Statistics Reports
- National Labour Force Survey for Q4, 2019
- Fáilte Ireland Key Tourism Facts 2004 to 2018
- Fáilte Ireland Tourism Barometer 2019
- Gort tourism website
- Renewable Energy Technologies: Cost Analysis Series, June 2012, Wind Power
- The Value of Wind Energy to Ireland, A Report to the Irish Wind Energy Association, March 2014,Poyry and CE (Cambridge Econometrics)
- IWEA, Economic Benefits of Wind Energy.
- All Island Generation Capacity Statement, 2018-2027, EirGrid Group
- Galway County Development Plan 1997-2003
- Ordinance Survey historic aerial views of the area (http://map.geohive.ie/mapviewer.html)

4.2.2 Population and Socio-economic Baseline

4.2.2.1 Land use prior to construction

Prior to construction of Derrybrien wind farm the site had been previously used for commercial conifer forestry over the central and western parts of the site, and turf cutting in turbary plots on the east side. Land use along the grid connection route and at Agannygal substation was also dominated by commercial forestry.

This can be seen from the Ordinance Survey historic aerial views of the area (http://map.geohive.ie/mapviewer.html) dating to 1995 to 2012. The 1995 and 2000 series aerial views show forest plantation and turbary on the wind farm site and peat slide area as the main land use at that time representing the baseline receiving environment and just prior to construction. Prior to the peat slide and response works, the upper slopes of Cashlaundrumlahan Mountain, where the slide originated, were used for forestry, which extended downslope to above the Black Road Bridge where some agricultural grass land is present. Below the Black Road Bridge, there is a mix of forestry and agricultural land. The mix of forestry and agricultural land is typically classed as transitional woodland (scrub) by the EPA Corine mapping dataset.

4.2.2.2 Population

An analysis of the population and population changes is provided in this section. Data is derived from the Central Statistics Office Census data from 1996 to 2016 covering the pre-construction phase baseline period (1998), construction phase (2003 to 2006) and the project operational period to 2016.

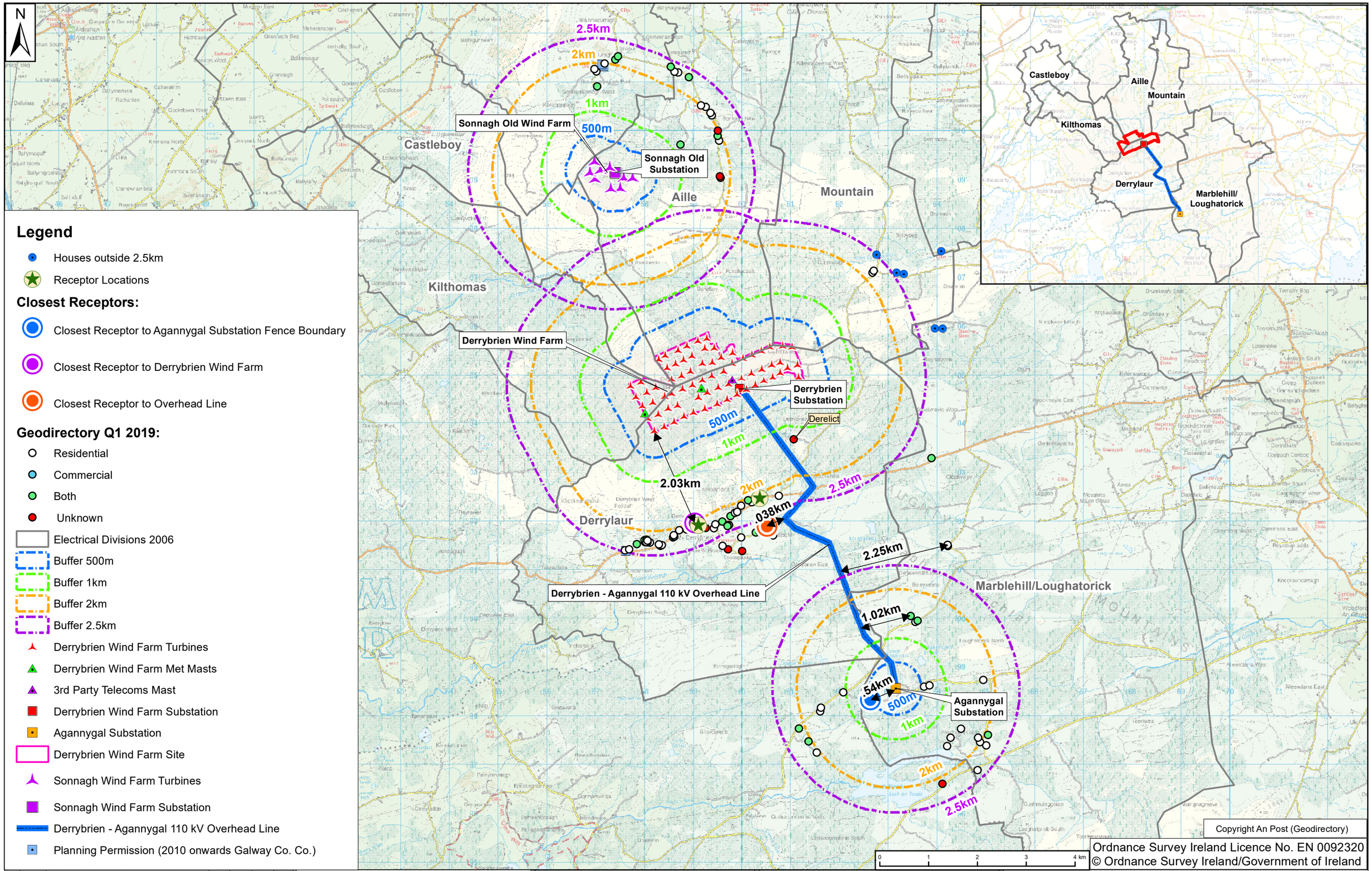
According to the 2016 census, County Galway has a population of over 258,000 persons, which has increased at a steady rate since 1996, the baseline census year for the project. Changes to population at National, County and District Electoral Division Level are set out in Table 4-1. Nationally, the population increased by 31.3% to 4,781,865 persons over the period and is currently estimated at 4,921,500 persons due to a combination of both positive net migration and natural increase. During the same period, 1996 to 2016 the population of Galway as a whole (County and City) grew by 36.6 % and Galway County by 31.3%. The growth in population has mainly been in the areas closest to Galway City and the area of the County identified as the Galway Transportation and Planning Study boundary. More rural parts of County Galway have experienced mixed growth with some electoral divisions in the extreme north east, south east, western, and upland areas of the County experiencing population decline. Approximately 75% of private households in the county are located in rural areas. As noted elsewhere, the wind farm site is in a remote upland location.

As shown in Figure 4.1, the project is mainly located in rural County Galway, within the Electoral Divisions (EDs) of Derrylaur (southern part of wind farm site and the 110kV overhead line), Aille (northern part of wind farm site), Kilthomas (north western

part of wind farm site) and Marblehill/Loughatorick ED (110kV overhead line and Agannygal substation). Itis noted that the population of Loughatorick is so low that it is combined with Marblehill for statistical purposes. The boundaries of the Electoral Divisions of Castleboy and Mountain are immediately adjacent to the wind farm site. The nearest concentration of houses to the wind farm is within and in the vicinity of the village of Derrybrien just over 2km to the south of the wind farm, which is within Derrylaur ED. Population trends in these Electoral Division areas are also provided in Table 4-1. Between 1996 and 2016 significant declines in population occurred in Derrylaur (-27.1%), Kilthomas (-28.8%) and Loughatorick (-29.8%) with a modest decline in the population of Marblehill (-3.2%). By contrast the populations in the Aille (8.1%), Castleboy (23.7%) and Mountain (34.8%) areas showed significant increases. Overall, since 1996, there has been a slight increase in population (6.4%) living in these seven Electoral Division areas

An analysis of the GIS database for the area, see Chapter 2, indicates that there are no occupied houses within 2km of the site, with the nearest occupied dwelling located at 2.03km from the nearest turbine, though there is one derelict house circa 1.2km from the wind farm itself. The nearest occupied dwelling to the 110kV overhead transmission line is 0.38km distance and the nearest dwelling to the Agannygal substation is 0.54 km, see Figure 4-1.

The village of Derrybrien has limited services but has a national school, a catholic church and a protestant church. There is a scattered rural population in the wider area.



Legend

- Houses outside 2.5km
- Receptor Locations

Closest Receptors:

- Closest Receptor to Agannygal Substation Fence Boundary
- Closest Receptor to Derrybrien Wind Farm
- Closest Receptor to Overhead Line

Geodirectory Q1 2019:

- Residential
- Commercial
- Both
- Unknown
- Electrical Divisions 2006
- Buffer 500m
- Buffer 1km
- Buffer 2km
- Buffer 2.5km
- Derrybrien Wind Farm Turbines
- Derrybrien Wind Farm Met Masts
- 3rd Party Telecoms Mast
- Derrybrien Wind Farm Substation
- Agannygal Substation
- Derrybrien Wind Farm Site
- Sonnagh Wind Farm Turbines
- Sonnagh Wind Farm Substation
- Derrybrien - Agannygal 110 kV Overhead Line
- Planning Permission (2010 onwards Galway Co. Co.)

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PROJECT: Derrybrien Wind Farm
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**Figure 4.1-
Population and Human Health**

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Table 4-1 Population Trends Nationally, in County Galway and the Electoral Division Areas

Period	ROI	Galway (County and City)	Galway County excluding Galway City	100 Aille, Co. Galway	106 Castleboy, Co. Galway	110 Derrylaur, Co. Galway	096 Kilthomas, Co. Galway	130 Mountain, Co. Galway	126 Loughatorick, Co. Galway	129 Marblehill, Co. Galway
Population 1996	3,626,087	188,854	136,613	356	434	144	118	207	47	349
Population 2002	3,917,203	209,077	143,245	394	472	129	96	246	34	363
Population 2006	4,239,848	231,670	158,256	412	491	113	90	256	34	371
Population 2011	4,588,252	250,653	175,124	389	550	108	83	307	36	361
Population 2016	4,761,865	258,058	179,390	385	537	105	84	279	33	338
1996 2016 % change	31.3%	36.6%	31.3	8.1%	23.7%	-27.1%	-28.8%	34.8%	-29.8%	-3.2%
1996 2002 % change	8.0%	10.7%	8.8%	10.7%	8.8%	-10.4%	-18.6%	18.8%	-27.7%	4.0%
2002 2006 % change	8.2%	10.8%	11.2%	4.6%	4.0%	-12.4%	-6.3%	4.1%	0.0%	2.2%
2006 2011 % change	8.2%	10.8%	10.0%	4.6%	4.0%	-12.4%	-6.3%	4.1%	0.0%	2.2%
2011 2016 % change	12.3%	11.4%	2.4%	-6.6%	9.4%	-7.1%	-6.7%	9.0%	-2.9%	-8.9%

The data demonstrates the low population numbers in the vicinity of the Derrybrien wind farm site. The low populations in the area like other rural areas is reflective of a number of processes at work. These influences include the lack of locally based employment opportunities, lack of access to services and the movement of population, particularly younger persons, towards the larger urban centres.

4.2.2.3 Employment and socio-economics

The economic standing of the area is discussed in this section and is reflected by the employment statistics relating to the West Region, Galway County and the electoral divisions themselves. Information regarding the nature of employment in the Western Region, Galway County and local EDs has been sourced from the Central Statistics Office (CSO) census data from 1996 to 2016.

The CSO data related to industry and employment is currently reported in accordance with the current standard classification system for economic activity used in the European Community NACE[1]. This provides statistics related to key sectors of economic activity such as agriculture, forestry, fishing, mining and construction for example. The term “industry” used for Census of Population purposes is not confined to manufacturing industry. It is synonymous with the term “sector of economic activity”.

A number of different versions of NACE have been used since the original version NACE 70 was introduced in 1970. For example, in 2002 it underwent a minor update as Rev. 1.1 with a major revision, NACE Rev. 2, occurring between 2000 and 2007. This latter revision incorporated significant changes and introduced new sectors for 'Water Supply, Sewage, Waste Management and Remediation', 'Information and Communication', 'Professional, Scientific and Technical Activities', 'Administrative and Supportive Service Activities' and 'Arts, Entertainment and Recreation'.

The Industry sector was first coded using the NACE classification system in the 2002 Census and also applied to 2006 with additional categories added in the 2011 Census and 2016 Census due to Rev 2. This is reflected in the socio economic data for the period 1996 to 2016 which is provided in Table 4-2 for the West Region in general and in Table 4-3 for the EDs in the development area, Table 4-4.

[1] NACE is a Statistical Classification of Economic Activities developed in the European Community and is an acronym derived from the French title 'Nomenclature générale des Activités économiques dans les Communautés Européennes'

4.2.2.4 Employment during the baseline period

In the baseline period, circa 1996, employment in the West Region occurred mainly in the sectors of agricultural, forestry and fisheries, manufacturing, financial and insurance and professional services followed by lower employment in the construction industry, public administration and defence sectors (see Table 4-2). Employment in the Galway County Area (excluding Galway City) (Table 4-3) occurred mainly in the agricultural, forestry and fisheries sectors, followed by wholesale and retail, construction, public administration, transport and storage and other general services. Significantly fewer people were indicated as being employed in manufacturing or financial or insurance services reflecting the more rural nature of the activities in the county.

Data for the Electoral Divisions areas adjacent to Derrybrien has been obtained from the CSO Small Area Population Statistics which provides employment by industry on a broad scale, (Table 4-4). Employment in 1996 in these EDs is dominated by the agricultural, forestry and fisheries sector followed by commerce, professional services, manufacturing, transport and construction similar to the county area.

A total of 122,639 people was employed in the West Region in 1996 with some 12.6% of the total labour force unemployed. Galway County employment stood at 41,296 for the same period with a slightly higher unemployment rate of 13.5%. In the seven ED areas at Derrybrien the total numbers at work was recorded as 596 in 1996 with an overall unemployment rate of 11.4% (see Table 4-5) which is slightly better than the county area as a whole.

An overview of tourism and employment in this sector is provided in Appendix 4.1 and summarised here. In terms of tourism this is frequently concentrated in areas which lack an intensive industry base and is generally focused on a particular theme or location, hence it is credited by Fáilte Ireland as having a significant regional distributive effect. It is particularly important to rural economies. However, the Derrybrien Wind Farm Project is in a remote location away from any major tourist area. There are however a number of local amenity and tourism attractions as discussed in Chapter 13-Material Assets. Although no specific reports relate to the Electoral Division areas tourist information relating to the West Region has been identified from specific CSO reports and from published Fáilte Ireland and earlier reports and is discussed here. The CSO published a report on tourism and travel in Ireland in 1999 (published in 2000) which also references the baseline year, 1998. This indicated that there were 6,068,000 overseas visits to Ireland by non-residents in 1999, compared with 5,716,000 in 1998, an increase of 6.2%. Travel on transatlantic routes accounted for 19.9% of this increase. The total expenditure by tourists in 1998 was 1,828 million pounds with Irish carriers earning an additional 470 million pounds (a total tourism revenue of 2,297 million pounds). A significant portion of visitors would have been expected to have visited the West Region and this may have benefitted the general area of Gort to some extent.

4.2.2.5 Employment during the construction period

During the construction and peat slide period of the development (2003 to 2006) the national economic boom which occurred at that time was also reflected in the West Region. The total number employed increased to 151,244 in 2002 and then to 182,661 in 2006, some 49% higher than the baseline number in 1996. Significant increases in employment occurred across all sectors in this period, with the exception of agriculture, forestry and fisheries and are reflected mainly in the building and construction sector, manufacturing, wholesale, retail and trade sector, public administration, education, health and real estate sectors. Unemployment during this period was lower than 1996 ranging from 8.2 to 8.5% in the West Region. This pattern of increased employment also occurred in the Galway County area where numbers employed increased to 70,617 by 2006 an increase of circa 71% on the baseline year. Again, increases in employment occurred across all sectors except agriculture, forestry and fisheries where a decline occurred. Unemployment had also dropped to 6.6% by 2006.

Numbers at work also increased in the ED areas with 751 people at work in 2006, an increase of circa 26% on the baseline year. The main increases in employment occurred in the commerce area, construction and professional services similar to the county and regional area. Employment in the agricultural, forestry and fisheries sector declined in the period. Unemployment in the EDs dropped from 11.4% in 1996 to 5.7% in 2006.

Tourist numbers and expenditure in the West Region drawn from available Fáilte Ireland annual Tourism Fact reports for the period 2004 to 2006 indicates an overall increase in tourist numbers in the West Region in the period 2004 to 2006 of circa 6% with an increase in tourism revenue and a slight increase in employment in the sector (1.4% in 2006).

4.2.2.6 Employment during the operational period to mid-2020

In the initial operational period of Derrybrien Wind Farm from 2006 to 2011, changes in employment in the West Region reflected the economic collapse mainly related to the building and construction sector and related services. Overall numbers of people at work in the region reduced by circa 4.6% from 2006 to 2011 but unemployment in 2011 was some 18.8% of the region's labour force. Although the total labour force increased, the percentage unemployed more than doubled. Significant changes in employment in the industry sectors also occurred with major reductions in those employed in the construction sector occurring (circa 60% reduction compared to the boom period of 2006) and a near total collapse of the real estate sector (95). Numbers in the wholesale and retail sectors, the Public administration, education and health sectors and other professional services continued to rise. By 2016 numbers at work had returned to the peak period of 2006 with unemployment reduced to 12.8%. Increases in employment occurred mainly in the manufacturing, education, health, public administration accommodation and food sectors with some growth in the construction sector.

The pattern in employment changes in the Galway County area (excluding Galway City) reflect those occurring in the West Region with significant collapses in

employment in the construction, real estate, mining, quarrying and transportation sectors (Table 4-3) between 2006 and 2011. Unemployed increased from 6.6% in 2006 to 18.1% in 2011. Significant increases in employment in public administration, education and health occurred during this period also reflecting the West Region in general. Again by 2016, growth in employment was recorded in nearly all sectors with the exception of agriculture, forestry and fisheries and finances with the unemployment rate dropping to circa 12%.

Similar changes to employment occurred in the ED areas with the total number at work indicated at 722 in 2011 but increasing to 775 by 2016. Unemployment increased to 15% in 2011 and had reduced down to 10.9% by 2016, still double that of the boom years but close to the 1996 level (11.4%). Employment showed increases mainly in the commerce and trade, professional services sectors with manufacturing remaining steady and with relative increases in the agricultural. forestry and fisheries sector.

The period 2007 to 2011 proved challenging for tourism due to the significant downturn in the world and Irish economies which occurred at that time. In the period 2007 to 2010 tourist numbers and tourism revenue to the West Region decreased and a significant reduction in national employment in the sector also occurred. Significant decreases were recorded in 2011 and 2012. Tourist numbers and revenue to the West Region increased steadily in the period 2012 to 2018 with increased national employment also in the sector. Recent years have seen significant changes to tourism in Ireland brought about by brand marketing, such as the Wild Atlantic Way, The Ancient East and Ireland's Hidden Heartlands initiatives and the real and perceived challenges from Brexit and Government policy changes. The CSO data indicates that the numbers employed in accommodation and food service sectors rose from 169,600 in Q1, 2018 to 175,000 in Q1 2019. Fáilte Ireland estimated that all jobs in the tourism and hospitality industry based on their past surveys indicates total employment in the sector at approximately 260,000. This estimate includes an additional category of tourism services and attractions which is not covered by the CSO.

The impact of the COVID-19 pandemic on the tourist sector and particularly on the national and regional areas has been highlighted by EY (Ernst and Young), with significant job losses occurring from March 2020 onward. https://www.ey.com/en_ie/covid-19/potential-impact-of-covid-19-on-irish-tourism

Table 4-2 Population at Work in the West Region by Broad Industrial Activity (Source CSO)

West Region Industrial Activities	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2016	% Change 2002 to 2016	% Change 1996 to 2016
Agriculture, forestry and fishing (A)	22879	14503	13328	13835	12374	-36.6	-8.1	3.8	-10.6	-14.7	-45.9
Mining and quarrying (B)	854	1035	1142	752	818	21.2	10.3	-34.2	8.8	-21.0	-4.2
Manufacturing (C)	21160	23176	25189	21326	25159	9.5	8.7	-15.3	18.0	8.6	18.9
Electricity, gas, steam and air conditioning supply (D)	854	961	960	880	994	12.5	-0.1	-8.3	13.0	3.4	16.4
Water supply; sewerage, waste management and remediation activities (E)				884	1005				13.7		
Construction (F)	8990	16259	24635	9507	10355	80.9	51.5	-61.4	8.9	-36.3	15.2
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)		19029	22869	24471	24296		20.2	7.0	-0.7	27.7	
Accommodation and food service activities (I)		8927	11194	11283	12520		25.4	0.8	11.0	40.2	
Transportation and storage (H)	5217	6382	7177	5185	5320	22.3	12.5	-27.8	2.6	-16.6	2.0
Financial and insurance activities (K)	21157	3657	4739	4721	4076	-82.7	29.6	-0.4	-13.7	11.5	-80.7
Real estate activities (L)		9714	12399	666	688		27.6	-94.6	3.3	-92.9	
Public administration and defence; compulsory social security (O)	6105	7898	8397	10694	9755	29.4	6.3	27.4	-8.8	23.5	59.8
Administrative and support service activities (N)				4657	4786				2.8		
Education (P)		11200	13420	17172	17766		19.8	28.0	3.5	58.6	
Human health and social work activities (Q)		15144	20010	20407	24015		32.1	2.0	17.7	58.6	
Arts, entertainment and recreation (R)				2347	2802				19.4		
Professional, scientific and technical activities (M)				7084	7720				9.0		

West Region Industrial Activities	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2016	% Change 2002 to 2016	% Change 1996 to 2016
Professional Services	22491					-100.0					-100.0
Information and communication (J)				4866	5954				22.4		
Other service activities (S)		5299	7031	3659	4024		32.7	-48.0	10.0	-24.1	
Industry not stated	12932	8060	10111	9675	12696	-37.7	25.4	-4.3	31.2	57.5	-1.8
Activities of households as employers producing activities of households for own use (T)				151	182				20.5		
Activities of extraterritorial organisations and bodies (U)				8	20				150.0		
Total Employed	122639	151244	182601	174230	187325	23.3	20.7	-4.6	7.5	23.9	52.7
Unemployed looking for first regular job			2808	3182	2750			13.3	-13.6		
Unemployed, having lost or given up previous job	17659	13471	14067	37085	24801	-23.7	4.4	163.6	-33.1	84.1	40.4
Total in labour force	140298	164715	199476	214497	214876	17.4	21.1	7.5	0.2	30.5	53.2
% Unemployed	12.6	8.2	8.5	18.8	12.8						

Table 4-3: Industrial Activity in the Galway County Area (excluding Galway City)

Galway County Industrial Activities	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2016	% Change 2002 to 2016	% Change 1996 to 2016
Agriculture, forestry and fishing (A)	10124	6415	5749	5908	5505	-36.6	-10.4	2.8	-6.8	-14.2	-45.6
Mining and quarrying (B)	259	348	389	274	315	34.4	11.8	-29.6	15.0	-9.5	21.6
Manufacturing (C)	7924	9171	10329	9117	11071	15.7	12.6	-11.7	21.4	20.7	39.7
Electricity, gas, steam and air conditioning supply (D)	245	295	338	320	389	20.4	14.6	-5.3	21.6	31.9	58.8
Water supply; sewerage, waste management and remediation activities (E)				428	464				8.4		
Construction (F)	3789	6835	10383	4275	4681	80.4	51.9	-58.8	9.5	-31.5	23.5
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	7357	6721	8329	9057	9024	-8.6	23.9	8.7	-0.4	34.3	22.7
Transportation and storage (H)	1831	2305	2777	2140	2230	25.9	20.5	-22.9	4.2	-3.3	21.8
Accommodation and food service activities (I)		2851	3422	3511	3977		20.0	2.6	13.3	39.5	
Information and communication (J)				2064	2450				18.7		
Financial and insurance activities (K)		1241	1736	1858	1684		39.9	7.0	-9.4	35.7	
Real estate activities (L)		3320	4528	270	280		36.4	-94.0	3.7	-91.6	
Professional, scientific and technical activities (M)				2903	3145				8.3		
Administrative and support service activities (N)				1700	1812				6.6		
Public administration and defence; compulsory social security (O)	1927	2490	2669	3724	3452	29.2	7.2	39.5	-7.3	38.6	79.1
Education (P)		4343	5452	7278	7652		25.5	33.5	5.1	76.2	

Galway County Industrial Activities	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2016	% Change 2002 to 2016	% Change 1996 to 2016
Human health and social work activities (Q)		5504	7651	8294	9739		39.0	8.4	17.4	76.9	
Arts, entertainment and recreation (R)				853	988				15.8		
Other service activities (S)	7840	1976	2712	1312	1435	-74.8	37.2	-51.6	9.4	-27.4	-81.7
Activities of households as employers producing activities of households for own use (T)				61	59				-3.3		
Activities of extraterritorial organisations and bodies (U)				2	9				350.0		
Industry not stated		3207	4153	3858	4755		29.5	-7.1	23.3	48.3	
Unemployed looking for first regular job				1188	936				-21.2		
Unemployed, having lost or given up previous job	6428	4815	4965	14123	9002	-25.1	3.1	184.5	-36.3	87.0	40.0
Total Employed	41296	57022	70617	69207	75116	38.1	23.8	-2.0	8.5	31.7	81.9
Total Labour Force	47724	61837	75582	84518	85054	29.6	22.2	11.8	0.6	37.5	78.2
% Unemployed	13.5	7.8	6.6	18.1	11.7						

Table 4-4: Employment in Electoral Divisions adjacent to Derrybrien by broad Industrial Activities 1996 to 2016

Electoral Division	Industry	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2006	% Change 2002 to 2016	% Change 1996 to 2016
Aille	Agriculture forestry and fishing	40	18	24	24	21	-55.0	33.3	0.0	-12.5	16.7	-47.5
	Electricity & Gas	2					-100.0					-100.0
	Building and construction	10	17	31	10	9	70.0	82.4	-67.7	-10.0	-47.1	-10.0
	Mining	1					-100.0					-100.0
	Manufacturing industries	18	19	14	15	25	5.6	-26.3	7.1	66.7	31.6	38.9
	Commerce and trade	28	41	43	36	41	46.4	4.9	-16.3	13.9	0.0	46.4
	Transport and communications	8	6	5	4	2	-25.0	-16.7	-20.0	-50.0	-66.7	-75.0
	Public administration	10	16	12	12	13	60.0	-25.0	0.0	8.3	-18.8	30.0
	Professional services	21	20	32	37	37	-4.8	60.0	15.6	0.0	85.0	76.2
	Other	10	11	11	20	21	10.0	0.0	81.8	5.0	90.9	110.0
	Total	148	148	172	158	169	0.0	16.2	-8.1	7.0	14.2	14.2
Castleboy	Agriculture forestry and fishing	64	38	33	45	34	-40.6	-13.2	36.4	-24.4	-10.5	-46.9
	Electricity & Gas	2					-100.0					-100.0
	Building and construction	9	20	34	12	6	122.2	70.0	-64.7	-50.0	-70.0	-33.3
	Mining	0										
	Manufacturing industries	22	34	35	35	32	54.5	2.9	0.0	-8.6	-5.9	45.5
	Commerce and trade	31	39	44	44	48	25.8	12.8	0.0	9.1	23.1	54.8
	Transport and communications	10	8	4	9	11	-20.0	-50.0	125.0	22.2	37.5	10.0
	Public administration	5	10	5	4	7	100.0	-50.0	-20.0	75.0	-30.0	40.0
	Professional services	10	20	29	44	58	100.0	45.0	51.7	31.8	190.0	480.0

Electoral Division	Industry	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2006	% Change 2002 to 2016	% Change 1996 to 2016
	Other	8	25	24	19	39	212.5	-4.0	-20.8	105.3	56.0	387.5
	Total	161	194	208	212	235	20.5	7.2	1.9	10.8	21.1	46.0
Derrylaur	Agriculture forestry and fishing	11	7	11	7	6	-36.4	57.1	-36.4	-14.3	-14.3	-45.5
	Electricity & Gas	1					-100.0					-100.0
	Building and construction	4	7	12	6	7	75.0	71.4	-50.0	16.7	0.0	75.0
	Mining	0										
	Manufacturing industries	6	4	4	5	4	-33.3	0.0	25.0	-20.0	0.0	-33.3
	Commerce and trade	3	5	3	3	4	66.7	-40.0	0.0	33.3	-20.0	33.3
	Transport and communications	3	1	1	2	0	-66.7	0.0	100.0	-100.0	-100.0	-100.0
	Public administration	1	6	8	3	5	500.0	33.3	-62.5	66.7	-16.7	400.0
	Professional services	1	9	7	7	10	800.0	-22.2	0.0	42.9	11.1	900.0
	Other	6	3	2	4	9	-50.0	-33.3	100.0	125.0	200.0	50.0
	Total	36	42	48	37	45		14.3	-22.9	21.6	7.1	25.0
Kilthomas	Agriculture forestry and fishing	13	11	8	8	9	-15.4	-27.3	0.0	12.5	-18.2	-30.8
	Electricity & Gas	0										
	Building and construction	3	5	7	2	1	66.7	40.0	-71.4	-50.0	-80.0	-66.7
	Mining	0										
	Manufacturing industries	2	6	4	5	3	200.0	-33.3	25.0	-40.0	-50.0	50.0
	Commerce and trade	3	6	9	5	9	100.0	50.0	-44.4	80.0	50.0	200.0
	Transport and communications	3	1	2	1	2	-66.7	100.0	-50.0	100.0	100.0	-33.3

Electoral Division	Industry	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2006	% Change 2002 to 2016	% Change 1996 to 2016
	Public administration	1	1	1	1	1	0.0	0.0	0.0	0.0	0.0	0.0
	Professional services	3	5	6	11	13	66.7	20.0	83.3	18.2	160.0	333.3
	Other	4	5	2	2	4	25.0	-60.0	0.0	100.0	-20.0	0.0
	Total	32	40	39	35	42	25.0	-2.5	-10.3	20.0	5.0	31.3
Mountain	Agriculture forestry and fishing	18	8	8	11	12	-55.6	0.0	37.5	9.1	50.0	-33.3
	Electricity and gas	1					-100.0					-100.0
	Building and construction	5	4	14	10	9	-20.0	250.0	-28.6	-10.0	125.0	80.0
	Mining	0										
	Manufacturing industries	7	24	25	22	20	242.9	4.2	-12.0	-9.1	-16.7	185.7
	Commerce and trade	13	23	32	32	33	76.9	39.1	0.0	3.1	43.5	153.8
	Transport and communications	6	4	3	6	8	-33.3	-25.0	100.0	33.3	100.0	33.3
	Public administration	3	7	6	9	2	133.3	-14.3	50.0	-77.8	-71.4	-33.3
	Professional services	23	24	22	26	29	4.3	-8.3	18.2	11.5	20.8	26.1
	Other	11	9	10	15	18	-18.2	11.1	50.0	20.0	100.0	63.6
	Total	87	103	120	131	131		16.5	9.2	0.0	27.2	50.6
Marblehill	Agriculture forestry and fishing	53		20	28	26		-62.3	40.0	-7.1		-50.9
	Electricity & Gas	0										
	Building and construction	10		37	10	14		270.0	-73.0	40.0		40.0
	Mining	0										
	Manufacturing industries	17		20	22	22		17.6	10.0	0.0		29.4

Electoral Division	Industry	1996	2002	2006	2011	2016	% Change 1996 to 2002	% Change 2002 to 2006	% Change 2006 to 2011	% Change 2011 to 2006	% Change 2002 to 2016	% Change 1996 to 2016
	Commerce and trade	12		22	20	25		83.3	-9.1	25.0		108.3
	Transport and communications	2		5	3	4		150.0	-40.0	33.3		100.0
	Public administration	8		6	7	5		-25.0	16.7	-28.6		-37.5
	Professional services	9		23	32	31		155.6	39.1	-3.1		244.4
	Other	8		31	27	26		287.5	-12.9	-3.7		225.0
	Total	119		164	149	153		37.8	-9.1	2.7		28.6
	Note 2002 data amalgamated with Loughatorick for this period											
Marblehill/ Loughatorick	Agriculture, forestry and fishing	66	33	20	28	26	-50.0	-39.4	40.0	-7.1	-21.2	-60.6
	Electricity & gas	0										
	Building and construction	10	26	37	10	14	160.0	42.3	-73.0	40.0	-46.2	40.0
	Mining	0										
	Manufacturing industries	20	29	20	22	22	45.0	-31.0	10.0	0.0	-24.1	10.0
	Commerce and trade	13	29	22	20	25	123.1	-24.1	-9.1	25.0	-13.8	92.3
	Transport and communications	2	4	5	3	4	100.0	25.0	-40.0	33.3	0.0	100.0
	Public administration	3	3	6	7	5	0.0	100.0	16.7	-28.6	66.7	66.7
	Professional services	10	21	23	32	31	110.0	9.5	39.1	-3.1	47.6	210.0
	Other	8	11	31	27	26	37.5	181.8	-12.9	-3.7	136.4	225.0
	Total	132	156	164	149	153		5.1	-9.1	2.7	-1.9	15.9
	Note 1996 data combined from individual Marblehill and Loughatorick 1996 years											

Table 4-5: Percentage Unemployment in the Electoral Divisions

Electoral Division	1996	2002	2006	2011	2016
Aille	9.2	4.12	1.1	13.2	6.1
Castleboy	7.5	2.25	6.3	14.5	8.2
Derrylaur	26.5	19.30	11.1	24.5	27.5
Kilthomas	15.8	4.65	11.4	20.5	8.7
Marblehill Loughatorick	13.2	5.26	8.4	18.1	18.1
Mountain	6.5	1.68	2.4	9.0	7.1
Total EDs	11.4	4.35	5.7	15.0	10.9

Data is also available from the CSO relating to employment in the West Region for the periods 2017, 2018 and 2019 based on the National Labour Force Survey (LFS) published at the end of each quarter. The LFS is the official source of labour market statistics for Ireland including the official rates of employment and unemployment and is based on the International Labour Organisation (ILO) concepts and definitions. Employment levels by broad industry type in the West Region are provided in Table 4-6 below and based on data from the end of the fourth quarter of each year.

(https://statbank.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=QLF07&PLanguage=0).

Total numbers at work have grown year on year, circa 4%, with some decline in agriculture forestry and fisheries occurring between 2017 and 2018 but showing an increased number between 2018 and 2019. Numbers in construction also show fluctuation, showing an increase of some 5.4% between 2017 and 2018 but reducing by circa 16% between 2018 and 2019. Numbers working in the information and communication sector and accommodation and hotel sectors also showed decline with other sectors showing increases such as health, education and wholesale and retail.

No data is available during this intercensal period (2016 to 2021) for the Electoral Divisions but changes in employment pattern would likely reflect the West Region in general.

Data from the CSO was available for the first quarter of 2020 with respect to employment in the West Region in general (https://www.cso.ie/en/releasesandpublications/er/lfs/labourforcesurveylfsquarter12020/). This is provided in Table 4-6 also. However, the CSO have caveated this data as, although it has been produced in line with international requirements, it does not reflect the impact that the Coronavirus COVID-19 is having on employment with the impact manifesting towards the end of the quarter. The data would indicate that a modest increase in the numbers employed in the West Region of 0.6% occurred to the end of the first quarter. In reality a reduction in the employment of the labour force would likely have occurred. The CSO indicate that national labour force survey data for Q1 of 2020 using the standard methodology for recording and reporting, would indicate an unemployment rate of 4.7% nationally. However, when this is adjusted

for the impact of COVID 19 which impacted towards the end March 2020 the figure is estimated to be 15.5%

(https://www.cso.ie/en/releasesandpublications/er/lfs/labourforcesurveylfsquarter12020/)

Numbers employed in the County and ED areas would likely also be similarly impacted by the COVID-19 pandemic.

4.2.2.7 Operational period to end of the development (mid-2020 to 2040)

Given the rural nature of the Electoral Divisions adjacent to Derrybrien employment of the workforce in these areas is likely to remain associated with agriculture and forestry activities, manufacturing, commerce and trade and professional services. These sectors will continue to be impacted by the effects of the COVID -19 pandemic Similarly, in terms of the tourist industry in Ireland the impact of the COVID 19 pandemic is expected to continue to heavily impact on employment and revenues in this sector.

Table 4-6: Persons aged 15 years and over in Employment (Thousand) in the West Region

NACE 2 Industry Sector	2017Q4	2018Q4	2019Q4	2020Q1	%Change Q4 2017 to Q4 2018	%Change Q4 2018 to Q4 2019	%Change Q4 2019 to Q4 2020
Agriculture, forestry and fishing (A)	16.2	12.4	15.4	15.7	-23.5	24.2	1.9
Industry and Construction (B to F)	51.3	52.6	46.5	49.3	2.5	-11.6	6.0
Industry (B to E)	37.7	38.3	34.5	36	1.6	-9.9	4.3
Construction (F)	13.5	14.3	12	13.3	5.9	-16.1	10.8
Services (G to U)	136.6	147.1	159.7	158.4	7.7	8.6	-0.8
Wholesale and retail trade, repair of motor vehicles and motorcycles (G)	28.7	28	32.5	33.1	-2.4	16.1	1.8
Transportation and storage (H)	4.9	5.7	6.6	6.1	16.3	15.8	-7.6
Accommodation and food service activities (I)	18.6	17.2	16.7	18	-7.5	-2.9	7.8
Information and communication (J)	9.2	8.3	7.4	7.6	-9.8	-10.8	2.7
Financial, insurance and real estate activities (K,L)	4	5.7	5.7	6.2	42.5	0.0	8.8
Professional, scientific and technical activities (M)	8.4	11.1	12.6	9.9	32.1	13.5	-21.4
Administrative and support service activities (N)	5.5	7.5	7.1	7.9	36.4	-5.3	11.3
Public administration and defence, compulsory social security (O)	8.6	10.9	9.8	10.5	26.7	-10.1	7.1
Education (P)	15	16.2	18	17.1	8.0	11.1	-5.0
Human health and social work activities (Q)	24.1	27.9	32.5	32.1	15.8	16.5	-1.2
Other NACE activities (R to U)	9.7	8.7	10.8	10	-10.3	24.1	-7.4
Not stated	..	..	..	..			
All NACE economic sectors	**204.8**	**213.1**	**222.1**	**223.5**	**4.1**	**4.2**	**0.6**

4.3 Impact of the Development

This section outlines the impacts of the project on population and socio- economics which have occurred between 1998 (year planning the baseline year of 1998 and circa 2040. Impacts are assessed in three phases Impacts which have occurred - Construction , Impacts which are occuring and Impacts which are likely to occur.

4.3.1 Impacts which have occurred

4.3.1.1 Construction period 2003 to 2006

Population: There is no residential component in that there was no additional housing development required as part of the wind farm development which would lead to permanent increase in the general population of the area. Therefore, no direct impact on the composition of the population in the immediate area. No effect on population.

Employment: As set out in project description Chapter 2, Section 2.7.1.3, numbers employed during project construction are described here and summarised in Table 4-7.

The Gort Windfarms Ltd. team on the Project site varied in size through the construction phase and typically consisted of between 4-10 representatives on site.

The main civil works contractor had a team of circa 60 staff on site during the peak construction activities. In the immediate aftermath of the peat slide wind farm construction was halted and the contractor staff were redeployed to undertake works in response to the peat slide.

The Electrical (EBOP) Contractor had up to circa 30 personnel on site and the Wind Turbine Generator (WTG) supplier had up to circa 50 staff on site at peak workload erecting and commissioning the turbines.

Forest clearance operations were undertaken by Coillte who employed tree felling workers at the site to carry out the felling activities. These consisted of a number of teams totalling up to circa 10 staff/operatives during peak periods.

Changes to personnel numbers were fairly evenly distributed across the Project duration of 34 months. As tree felling and civil works' personnel numbers reduced on site, numbers increased in relation to electrical and wind turbine works.

Table 4-7 Construction Personnel – General

Phase & Personnel	Peak Personnel Numbers
All construction phases – Gort Windfarms Ltd. and agents	Approximately 4 – 10
Coillte tree felling	Up to 10
Civil works contractors	Up to 60
Electrical works contractors	Up to 30

Phase & Personnel	Peak Personnel Numbers
Wind turbine supply & installation	Up to 50

During the construction phase there was an increase in employment generally which effect was **positive, slight and short term** in nature. Contractor staff would have travelled to the area and did not reside generally in Derrybrien. It is likely that civil works contractor staff may have resided in the general Gort area or come from an area within 30km of the site.

Socio-economics:

The estimated cost of constructing the wind farm was circa €62 million. The International Renewable Energy Association (IRENA) published a [2]working paper on cost analysis of wind farms in 2012. This considers wind farm development costs to include:

- The turbine cost: including blades, tower and transformer;
- Civil works: including construction costs for site preparation and the foundations for the towers;
- Grid connection costs: This can include transformers and substations, as well as the connection to the local distribution or transmission network; and
- Other capital costs: these can include the construction of buildings, control systems, project consultancy costs, etc.

IRENA indicated that the cost of installing a wind farm is dominated by the upfront capital costs and provided a breakdown of the cost of the various elements in broad terms as follows:

- Wind turbine generator costs 64%
- Planning and Miscellaneous costs 9%
- Civil foundation cost 16%
- Grid connection costs 11%

[2] Renewable Energy Technologies: Cost Analysis Series, June 2012, Wind Power https://www.irena.org/documentdownloads/publications/re_technologies_cost_analysis-wind_power.pdf

Referencing this IRENA Report Poyry and Cambridge Econometrics[3] in their 2014 Report indicate that there are no wind turbine manufacturing facilities in Ireland and wind turbines themselves are all imported from abroad (64% of the installation costs) but the remaining capital investment required (36%) is met by domestic suppliers creating a direct stimulus to the Irish economy. This would likely have been the case in 2003 to 2006 when Derrybrien was constructed and there would have been a significant direct economic benefit to Ireland associated with the internal supply chain.

As stated in the report there would also be significant economic benefit derived from indirect effects:

"*It would also lead to an increase in demand further down the supply chain, referred to as the 'indirect effect'. For example, the construction sector would require more cement and building materials in order to install the wind turbine, and demand from the other sectors for intermediate goods and services would also increase. This indirect effect would lead to a further increase in output and jobs. This increase in economic activity and employment would lead to an increase in average household incomes, which would, in turn, lead to an increase in consumer demand and thus to further increases in output and employment in the economy (the 'induced effect'). In these ways, the increase in domestic production from the investment in wind generation has a multiplier effect*".

The Report also references the fact that the domestic construction sector would likely receive circa 19% of total wind investment and is a relatively labour intensive sector Hence, the wind farm development at Derrybrien would likely have had a relatively large impact on employment and real incomes at the time.

This is also supported by the Irish Wind Energy Association (IWEA) who have published a brief note on the economic benefits of wind energy[4] referencing the fact that it creates jobs and local expenditure and provides sustainable income for landowners.

It is estimated that 50% of the civil construction work force at Derrybrien would have come from areas within 30km of the site with an additional 50% influx to the general

[3] The Value of Wind Energy to Ireland, A Report to the Irish Wind Energy Association, March 2014,Poyry and CE (Cambridge Econometrics) https://www.iwea.com/images/files/9660bd6b05ed16be59431aa0625855d5f7dca1.pdf

[4] IWEA, Economic Benefits of Wind Energy. https://www.iwea.com/images/files/9660bd734c2de1df55463e89e7000d26828791.pdf

region. In the latter case local accommodation in Loughrea, Gort and the local area would have been utilised and the local economy would have benefited from accommodation costs, food and beverages and fuel purchases, particularly as the workforce would have travelled to site via private vehicle.

The construction of Derrybrien Wind Farm occurred over a period extending up to three years. Much of the material required to construct the wind farm internal road structure, hard stand areas and compounds was sourced on site. However, some locally sourced material was utilised for the construction of the Project as set out in Chapter 2, specifically ready mix concrete, some rock and crushed stone, reinforcement steel, and general building materials. Materials sourced in the region would have an added indirect benefit in employment in quarries, fabrication industries and transport deliveries. Indirect employment would also have occurred as a result of tree felling activities with felled saw logs delivered to Irish timber mills for processing for the construction industry.

Construction of the OHL and Agannygal substation would also have benefited the local economy through material supply such as concrete, related products and fill material although wood poles and steel towers would likely have been imported at the time.

Tourism

The Derrybrien area was not a tourist destination at the time of construction and there were no designated recreational or amenity activities at the site area. No impact on tourism would therefore have occurred.

4.3.1.2 Summary of Construction period impacts

In summary during project construction, the following impacts occurred on the population and socio-economics:

- There has been *no direct impact* on the composition of the population in the immediate area.
- An increase in employment occurred generally, which effect was positive, slight and short term in nature.
- Overall, there would have been **significant socio economic benefit** domestically and locally from the construction of the wind farm, from Commercial Rate Payments and annual maintenance costs, which would have been **positive, moderate in effect and temporary in duration**

4.3.1.3 Peat slide & related works: Oct 2003-end 2005

Population:

As a result of the peat slide, access to an existing unoccupied house downslope of the wind farm site, was blocked as the access road was temporarily inundated with peat. However, this house was not occupied at the time of the slide. There was no

change in the population in the Derrybrien area during the peat slide and no significant impact occurred.

Employment and Socio economics

At the time of the peat slide, construction work on the wind farm site itself was halted but the workforce transferred directly to remedial works to address the peat slide that occurred. Employment levels remained generally the same with additional personnel from Hibernian Wind and ESB International becoming involved in the stabilisation works at the peat slide site, in evaluating the impact of the slide and in undertaking remedial actions.

There would also have been some negative economic impact as the peat slide led to the temporary closure of the Black Road and the Gort to Portumna Road, damage to field boundaries, inundation of some lands with peat deposits and damage to private bridges. There would have been an associated economic loss to road users landowners through diversions and loss of access to their farmland and associated farming activities. The effect of this would have been **negative, moderate and temporary** in nature.

4.3.1.4 Summary of impacts -peat slide and related works

In summary, during the response to the peat slide the following impacts would have occurred:

- **No significant** impact on population occurred.
- Impact on employment and socio economics would have been **negative, moderate and temporary in nature**.

4.3.1.5 Operation Phase: 2006 – Mid-2020

Population:

There is no residential component and therefore no direct impact on the composition of the population in the immediate area has occurred as a result of the wind farm. Fluctuation in population numbers has occurred within the electoral division areas at Derrybrien as can be seen from Table 4-4 above with a net increase in population numbers overall in the ED areas to the end of 2016. However, there is no evidence from Ireland or elsewhere that the presence of a wind energy development in an area has an effect on population numbers. There is **no effect** of the wind farm or its continued operation on the population in the area and changes are likely due to wider economic factors

Employment

The Operation and Maintenance (O&M) sub-contractor, Vestas, has a maintenance crew of 4-6 technicians stationed full-time on the site for operation and maintenance of the turbines.

ESB staff undertake supervisory operational and monitoring activities remotely using a Supervisory Control and Data Acquisition (SCADA) system with the aid of computers connected via a telephone modem link. In addition, ESB staff are engaged in administration and engineering duties.

The impact on employment during the operational phase has been **positive, slight and moderate** in duration.

Socio-economic

The SEAI Energy in Ireland Report 2019 indicates that renewable electricity generation displaced circa €430 Million in fossil fuel imports to generate electricity. Circa 92% of renewable generation came from wind. Derrybrien wind farm has contributed 228,500 MWh of renewable electricity into the grid since it became fully operational in 2006 contributing to the displacement of imported fossil fuel cost. For example, based on a five year average capacity factor EirGrid indicated that the normalised annual energy from wind has grown from 4,200 GWh in 2012 to 7600 GWh in 2017[5], accounting for approximately 25% of total electricity demand in 2017. In 2017 Derrybrien wind farm contributed circa 3% of the renewable energy generation and 3% of the savings from displaced fossil fuel. This figure would have been higher in the earlier years but decreases as the quantity of wind energy on the system increases. The contribution of the wind farm to the national economy in terms of fossil fuel import and associated cost displacement has been **positive, moderate and medium term in nature.**

Derrybrien Wind Farm generates annual Local Authority Rates for Galway County Council which provides indirect long-term benefit for the broader community. In 2020 this is expected to be €393,613. In addition, the annual maintenance costs of the project varies between €6,000 and €18,000 depending on the maintenance activities undertaken. The impact from rates and maintenance can be said to be **positive, moderate and medium term in nature.**

Community Benefit

The ESB Renewable Strategy recognises that achieving a transition to a Low carbon economy can only occur through responsible development with includes genuine community engagement. ESB with its joint venture partners established the Wind Farm Community Benefit Funds (CBF) during the operational period with the intention of helping the communities neighbouring ESB wind farms to become more sustainable through the support of positive local initiatives and activities. The Wind Farm Community Benefit Funds are available to support projects that are aligned with local needs and opportunities such as the purchase of equipment, building or refurbishment work. Support for larger projects over a multi annual basis may also be considered. The community benefit fund for Gort Wind Farm (Derrybrien), which

[5] All Island Generation Capacity Statement, 2018-2027, EirGrid Group

forms part of ESB's overall portfolio wind farm community fund was established in 2016.

The community benefit fund is administered by SECAD Partnership CLG on behalf of Gort Windfarms Ltd; SECAD is an independent Grant Management Organisation are based in Middleton Co. Cork. The annual community benefit fund of €59,500, based on a contribution of €1,000 per MW installed, prioritises projects from local community groups and organisations that benefit the wind farm communities within a specified area of benefit i.e. within 10km from the wind farm. Applications from outside the area of benefit can be considered if their project directly addresses a current or prospective need/issue/opportunity relating to the wind farm communities within the area of benefit. Information on how to apply for the fund and the guidelines is available at the following website https://www.windfarmcommunityfunds.ie/

To date a total community benefit fund of €297,500 has been made available by Gort Windfarms Ltd since the fund was introduced in 2016. A sample list of the project recipients of grants from the annual wind farm community benefit funds is presented in Table 4-8.

Table 4-8 Community Benefit Recipient Groups

30th Galway Abbey Duniry Scout Group
Abbey Community Development Association
Ballinakill community development
Ballinakill N.S. Board of Management
Davitts Camogie Club
Derrybrien Development Society
East Galway Family History Society
Friends of Woodville Walled Garden
Hope It Rains / Ciotóg Teo. (a Galway 2020 Flagship Project)
Irish Red Grouse Association
Leitrim National School
Mighty Oaks Arch Club Portumna
Portumna Golf Club
Shannonside Community Group
St Columba's NS Parents Association Committee
St Thomas GAA Club
St. Brendan's Community Nursing Unit
Tommy Larkins GAA Club
Woodford Historical Group
Woodford Playground Committee

The effect of the Community Benefit Fund to date has been **positive, locally significant and of medium term**.

4.3.1.6 Summary operational impacts 2007 to mid- 2020

In summary, during operational period 2007 to June 2020 the following impacts would have occurred:

- **No impact** on the population in the area has occurred
- Impact on employment during the operational phase has been **positive, slight and moderate in duration.**
- The contribution of the wind farm to the national economy in terms of fossil fuel import and associated cost displacement has been **positive, moderate and medium term in nature.**
- The Commercial Rate contribution to Galway County Council has been **positive, moderate and medium term**.
- The effect of the Community Benefit Fund to date has been **positive and locally significant**

4.3.2 Impacts which are occurring

Employment

Maintenance continues to be carried out by the Operation and Maintenance (O&M) sub-contractor, Vestas by the 4-6 technicians stationed full-time on the site.

ESB staff continue to undertake supervisory operational and monitoring activities remotely using a Supervisory Control and Data Acquisition (SCADA) system and ESB staff continue to be engaged in administration and engineering duties.

The impact on employment during the ongoing operational phase is **positive, slight and moderate** in duration.

Community Benefit

The Derrybrien Wind Farm Community Benefit fund is currently closed for funding considerations and will re-open in January 2021:

(https://www.windfarmcommunityfunds.ie/the-funds/derrrybrien-wind-farm/)

4.3.3 Impacts which are Likely to Occur

The impacts which are likely to occur from the continued operation of the Project from 2020 to circa 2040 and from its decommissioning which is likely to occur in the period 2040 to 2042 are discussed here.

4.3.3.1 Operational phase mid-2020 to circa 2040

This section sets out the operational impacts which are likely to occur in the period mid- 2020 to 2040.

Population:

Some population growth in the Galway County and Electoral division areas around Derrybrien will likely occur but these will not be related to the continued operation of the Project. **No impact** on population will occur

Employment and Socio-economics:

Operation and Maintenance (O&M) activities will continue on site to the end of 2040 providing employment to 4-6 technicians which will be stationed there full-time.

ESB staff will continue to undertake supervisory operational and monitoring activities remotely using a Supervisory Control and Data Acquisition (SCADA) system and will continue to provide administration and engineering inputs to the Project.

The impact on employment during the operational phase between 2020 and 2040 will continue to be **positive, slight and moderate in duration.**

The Project will continue to generate renewable electricity into the national grid, thereby displacing electricity generation from fossil fuel sources, likely to be gas throughout the period 2020 to 2040. The contribution of the wind farm to the national economy in terms of displacement of fossil fuel import by its renewable electricity generation will continue to be **positive, moderate and medium term in nature.**

Derrybrien Wind Farm will generate annual Local Authority Rates for Galway County Council which provides indirect long-term benefit for the broader community. Rates will continue to be paid until the wind farm ceases operation. The impact can be said to be **positive, slight and medium term in nature.**

Community Benefit

Continued operation of the Community Benefit Fund could potentially generate circa €1.2 million in funds between 2020 and 2040 which would be available to support projects from local community groups and organisations within the specified area of benefit for use. The fund will continue to provide positive support to worthwhile projects during its operational lifetime and its impact would continue to be **positive, locally significant and of medium term**.

4.3.3.2 Summary of operational impacts likely to occur

In summary, during the operational period 2020 to circa 2040 the following impacts are likely to occur:

- **No change** in population is likely to occur.
- The impact on employment during the operational phase between 2020 and 2040 will continue to **positive, slight and moderate in duration.**
- The contribution of the wind farm to the national economy will continue to be **positive, moderate and medium term in nature**
- Continued contribution of commercial rates to Galway County Council will be **positive, slight and medium term in nature.**
- Continued operation of the Community Benefit Fund will be a **positive significant benefit to the area in the medium term**.

4.3.3.3 Decommissioning 2040 to 2042

This section sets out the decommissioning impacts that are likely to occur at the end of the project. As stated in Chapter 2, decommissioning will involve the removal of above ground structures including wind turbine generators, substation buildings and overhead line structures. The duration of the decommissioning phase is expected to be approximately 24 months and requires a reduced workforce as compared to the construction phase.

Population

There will be no significant impact on population during the decommissioning phase of the Project.

Employment and Socio-economics

The employment levels will increase over the short term decommissioning period 2040 to 2042 and all employment will cease thereafter. There will therefore be a **positive, slight and temporary effect** on employment and on the local economy during the decommissioning process. Thereafter, there will be no employment associated with O&M activities or routine engineering and administrative inputs to the Project. The impact will be **negative, permanent and slight in nature**.

The contribution of renewable energy into the grid will cease and there will be no contribution to displacement of imported fossil fuel related electricity generation costs which effect **will be slight, negative and permanent**.

Rate payments to Galway County Council will cease which impact will be **negative, locally significant and permanent.**

Community Benefit

The Community Benefit Fund will likely cease operation and funding will no longer be available to support projects that would benefit the community. The impact of this will be **negative, significant and permanent**.

4.3.3.4 Summary of Decommissioning impacts

In summary, decommissioning of the project between circa 2040 and 2042 will likely give rise to the following impacts:

- **No significant impact** on population will occur
- Initially employment will increase but post decommissioning all employment will cease, **a permanent negative impact**
- There will be no contribution to displacement of imported fossil fuel costs and the impact **will be slight, negative and permanent**
- Commercial Rate payments to Galway County Council will cease,. The impact will be **negative, locally significant and permanent.**

4.3.4 Cumulative Impacts which have occurred

Based on consideration of the receiving environment the projects which could be relevant for cumulative effects assessments, as described in Chapter 2, from a population perspective are described here as well as the potential for cumulative impact to occur.

4.3.4.1 Turbary within and immediately adjacent to wind farm site

Turf from turbary cutting is a locally important fuel source forming part of the economy of some local households. Extraction of peat has occurred on turbary lands within an area occupying approximately 67ha of the eastern part of the wind farm site. Turbary lands also extend immediately beyond the site to the east covering an area of

approximately 15ha. It is understood that turf cutting activities on the turbary lands within the wind farm site were not intense in 1998 and up to circa 2014/2015, turf cutting by hand was carried out on a small number of plots, normally in late Spring/early Summer. More recently mechanical turf cutting by Contractors has occurred with an increase in the number of plots where turf cutting has been carried out. Turbary provides an economic benefit to the turbary rights holders in the area and as such there would be a small but **positive cumulative** economic benefit effect during the wind farm operation when the overall socio economic benefits of the Community Benefit fund are taken into account.

4.3.4.2 Peat extraction outside Project site

No peat extraction activities subject to a development consent have been identified in the vicinity of the Project but turbary turf cutting occurs in the vicinity of the project. This would have a small but positive economic benefit to the local community which would be cumulative with the wind farm construction and operational period.

4.3.4.3 Wind Farms in Slieve Aughty Mountains

The construction activity for Sonnagh Old Wind Farm located adjacent to Derrybrien would have coincided with construction activity for Derrybrien Wind Farm in 2003 and 2004. There would therefore have been some potential for a **positive** employment and socio-economic cumulative impact which would have been **slight in effect and short term** in duration. During its operation Sonnagh old windfarm would have **a positive significant** effect cumulatively in the **medium term** in displacing imported fossil fuel for electricity generation.

Internal access roads were constructed circa 2007 for Keelderry Wind Farm but the rest of the development was never built out. There was limited (during road construction) or no cumulative effect from this project.

4.3.4.4 Adjacent thermal power generation

Tynagh 400MW Power Station in the townland of Derryfrench County Galway at the site of Tynagh Mines was granted planning permission in 2003 (GCC Reg. Ref. 03/2943). The main construction activity for the Power Station took place in 2004-2006.

The Tynagh 220kV grid connection to the ESB Oldstreet to Cashla Line was granted planning permission in 2003 (GCC Reg. Ref. 04/1974). The main construction activity for the Power Station grid connection took place in 2004-2006.

As the construction activities of Tynagh power station and the Project occurred at the same time it is likely that positive, short term impacts on employment and socio economic benefits to the general area would have occurred.

4.3.4.5 Adjacent coniferous forestry plantations

The Slieve Aughty Mountains has some of the largest concentrations of coniferous forest in the country which was mainly planted in the 1960s and 1970s. Forest plantation has not changed appreciably since prior to project construction and prior to construction represented and currently represents over 50% of land use in the immediate vicinity of wind farm. Due to its age profile, much of the forestry estate has over the last number of years, and will over the next decade, require felling. Forestry

operations provide employment through normal forestry activities such as thinning, harvesting, including extraction and transport to sawmills, planting and replanting activities which has been and will continue to be **cumulative, positive, locally significant and medium term** in nature.

4.3.4.6 Adjacent transmission lines

The Moneypoint - Oldstreet 400 kV Overhead Line was developed prior to the development of the Derrybrien Wind Farm Project and no cumulative impact will have occurred during the construction phase. Refurbishment of this line in 2020 may give rise to some **cumulative positive** employment benefits but these would be **slight and temporary** in nature.

The Derrybrien-Agannygal 110kV line passes under the Moneypoint to Woodlands 400kV line (at co-ordinates Easting - 562119, Northing -700626) and required works at this crossing point to be undertaken to avoid conflict with the major transmission line but no cumulative impacts would have occurred.

The Ennis-Shannonbridge line was installed in 1952 with some further structures installed in 1968. The construction of Agannygal Substation for the Derrybrien Wind Farm Project resulted in the line being split into two circuits: Agannygal - Shannonbridge (Galway West) and Agannygal - Ennis (Galway West). There would have been temporary disruption to electricity supply of **short duration** to tie in the Agannygal substation with **negligible negative** impact on the economics of the general area.

4.3.4.7 M18 Motorway Project

The M18 motorway project was planned and constructed after the Derrybrien Wind Farm Project was developed. **No cumulative** impacts occurred.

4.3.4.8 Quarries/Sand extraction

Planning permission for sand extraction at Cloghvoley was granted (GCC Ref. Ref. 08/1664) in May 2008 after the wind farm project was developed. **No cumulative** impact with this quarry occurred.

There is a registered Coillte Quarry just east of the junction between the R353 and the Black Road, to the south-east of the Derrybrien wind farm site. The quarry was registered in 2005 with Galway County Council. It is a relatively small (1.8 ha) aggregate quarry with an extraction area of 1.3 ha, the aggregate being used for forest road repairs. Some aggregate from this quarry may have been used historically on the Derrybrien wind farm site. The effect on population would **be slight from the employment aspect and temporary in nature.**

Ballinakill Quarry is operated by Ballinakill Quarries Ltd at Cregg on the R353. The quarry operates in accordance with its substitute consent permission granted by An Bord Pleanála for works and operations undertaken prior to August 2012 (Ref. 07.SU0038). A remedial Environmental Impact Statement (rEIS) and remedial Natura

Impact Statement (rNIS) was submitted with the application. Although it supplied material for construction of the Derrybrien wind farm **no significant cumulative impacts** with this quarry will have occurred.

4.3.4.9 Works to Beagh Bridge

Repair works to the privately owned four-span Beagh Bridge at the outlet of Lough Cutra were undertaken in January 2005. This would have given rise to a **slight, positive** cumulative impact on employment and socio-economics.

4.3.5 Cumulative impacts which are occurring

4.3.5.1 Turbary within and immediately adjacent to wind farm site

Turf from turbary cutting continues to occur giving but **no cumulative** impact is occurring.

4.3.5.2 Peat extraction outside Project site

Turbary turf cutting occurs in the vicinity of the project but there are no cumulative impacts.

4.3.5.3 Wind Farms in Slieve Aughty Mountains

The ongoing operation of Sonnagh old windfarm continues to have **a positive significant** effect cumulatively in the **medium term** in displacing imported fossil fuel for electricity generation.

4.3.5.4 Adjacent thermal power generation

No cumulative impacts with Tynagh power station are occuring

4.3.5.5 Adjacent coniferous forestry plantations

Forestry operations continue to provide employment through normal forestry activities such as thinning, harvesting, including extraction and transport to sawmills, planting and replanting activities which continue to be **cumulative, positive, locally significant and medium term** in nature.

4.3.5.6 Adjacent transmission lines

Refurbishment of the Moneypoint - Oldstreet 400 kV Overhead Line in 2020 may give rise to some **cumulative positive** employment benefits but these would be **slight and temporary** in nature.

4.3.5.7 M18 Motorway Project

No cumulative impacts occurred.

4.3.5.8 Quarries/Sand extraction

No cumulative impacts the Coillte Quarry or Ballinakill Quarry are occurring.

4.3.5.9 Works to Beagh Bridge

No cumulative impact on employment and socio-economics is occurring.

4.3.6 Cumulative impacts which are likely to occur

4.3.6.1 Turbary within and immediately adjacent to wind farm site

Turbary will likely continue to provide an economic benefit to the turbary rights holders in the area and will possibly give rise slight but **positive cumulative** economic benefit effect during the wind farm operation to circa 2020 in conjunction with any economic benefots from the Community Development Fund.

4.3.6.2 Peat extraction outside Project site

Turbary turf cutting likely to occur in the vicinity of the project would potentially have a slight but positive economic benefit to the local community.

4.3.6.3 Wind Farms in Slieve Aughty Mountains

During its operation Sonnagh old windfarm would likely continue to have **a positive significant** effect cumulatively in the **medium term** in displacing imported fossil fuel for electricity generation.

4.3.6.4 Adjacent thermal power generation

No cumulative impact with the Tynagh 400MW Power Station is likely to occur

4.3.6.5 Adjacent coniferous forestry plantations

The impact of forestry operations will continue to be **cumulative, positive, locally significant and medium term** in nature.

4.3.6.6 Adjacent transmission lines

Ongoing activities with the refurbishment of the Moneypoint Oldstreet 400kV overhead line in 2020 may give rise to some **cumulative positive** employment benefits but these would be **slight and temporary** in nature.

During decommissioning there will likely be a temporary disruption to the Ennis-Shannonbridge line electricity supply of **short duration** to due to decommissioning of the substation with **negligible negative** impact on the economics of the general area.

4.3.6.7 M18 Motorway Project

No cumulative impacts occurred.

4.3.6.8 Quarries/Sand extraction

No cumulative impact with any of the quarries is likely to occur.

4.3.6.9 Works to Beagh Bridge

No cumulative impact on employment and socio-economics will occur.

4.3.6.10 Conclusion on Population cumulative impacts

In conclusion the following cumulative impacts have or will occur

Construction: There has not been any negative cumulative impact on the population in the general area but there has been a slight temporary positive impact from coincidental construction employment.

Operation and decommissioning: There has been and will be no significant negative cumulative impacts on the population arising from the presence of Derrybrien Wind Farm Project. A **significant positive** effect of medium term is the generation of renewable electricity coincidental with Sonnagh Old Wind farm which cumulatively reduces the fossil fuel import requirement to meet electricity generation demand.

4.3.7 Remedial (Mitigation) Measures and Monitoring

4.3.7.1 Remedial Measures for significant effects

Significant negative impacts to the population or socio economics of the area have not occurred and are not predicted to arise. Therefore, no remedial measures or mitigation measures were required or will be required.

In general mitigation of impacts on human beings has been considered in the context of mitigation of other aspects of this development in the relevant Sections of the Remedial Environmental Impact Assessment Report.

4.3.8 Residual Impacts on Population

No residual negative impacts on population are predicted to occur

4.3.9 Conclusions on population

The wind farm gives rise to positive social impacts resulting from employment, community benefit and rates provided to local authority. It also contributes significantly to the displacement of imported fossil fuel cost of economic benefit to the Irish economy and will continue to do so throughout the lifetime of the project.

In summary, the operation of the wind farm to date has not and future operation will not result in significant adverse impacts on population.

4.4 Human Health

4.4.1 Health and Safety

This section describes the baseline health of the population prior to the construction of Derrybrien, during its construction and the peat slide incident and during the operational period to date. It also provides an assessment of the impacts which have occurred (construction, peat slide and operation to date), which are occurring at the present time and the impacts which are likely to occur to the end of the project circa 2040 continued.

Health and Safety are core values in ESB and its subsidiary companies. ESB is fully committed to protecting the safety, health and welfare of its employees, contractors, customers, members of the public and others who may be affected by its activities.

The technology employed at the wind farm is well understood and has a proven safety record. The wind turbine model used at Derrybrien Wind Farm has a proven track record of safe operation. According to Vestas, the company has erected more V52 wind turbines than any other turbine on its portfolio-approximately 1,500 turbines worldwide.

Derrybrien Wind Farm currently operates a Safety Management System (SMS) which meets the requirements of OHSAS 18001.

Derrybrien Wind Farm operates an emergency procedure. This covers procedure in event of accidents, lone working, persons falling into water, forest/gorse fire, fire in wind turbine towers and procedure in event of landslide. Contact details are provided for emergency services, including the local authority and An Garda Síochána.

Decommissioning will be carried out in accordance with legislation and best practice with respect to Health and Safety. This will involve site inductions, risk assessment and method statements.

4.4.2 Methodology

There is no specific guidance in relation to Human Health in the context of the EIA Directive but there is reference to Human Health in relation to the Strategic Environmental Assessment Directive (Directive 2001/42/EC). The 2017 Draft guidance on EIA references Human Health on page 4 specifically stating that:

"The Commission's SEA Implementation Guidance states 'The notion of human health should be considered in the context of the other issues mentioned in paragraph (f)'.58 (Paragraph (f) lists the environmental factors including soils, water, air etc.) This is consistent with the approach set out in the 2002 EPA Guidelines where health was considered through assessment of the environmental pathways through which it could be affected, such as air, water or soil, viz:' These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides

robust and reliable health protectors [protection criteria] for analysis relating to the environment.'

In particular, the 2017 draft EPA guidelines also note that in an EIAR

"*the assessment of impacts on population & human health should refer to the assessments of those factors under which human health effects might occur, as addressed elsewhere in the EIAR e.g. under the environmental factors of air, water, soil etc" and that* "*assessment of other health & safety issues are carried out under other EU Directives, as relevant. These may include reports prepared under the Integrated Pollution Prevention and Control, Industrial Emissions, Waste Framework, Landfill, Strategic Environmental Assessment, Seveso III, Floods or Nuclear Safety Directives*. *In keeping with the requirement of the amended Directive, an EIAR should take account of the results of such assessments without duplicating them*".

The assessment of human health impacts has been based on the Source, Pathway Receptor model, see Table 4-9. For an impact to occur all three elements, Source, Pathway and Receptor must occur together. In the absence of any of the three elements no plausible health impact can occur.

Table 4-9 Example of Source-Pathway-Receptor model for health effects

Source	Pathway	Receptor	Plausible Health Impact	Explanation
No	Yes	Yes	No	There is not a clear source from where a potential health impact could originate.
Yes	No	Yes	No	The source of a potential health impact lacks a means of transmission to a population.
Yes	Yes	No	No	Receptors that would be sensitive or vulnerable to the health impact are not present.
Yes	Yes	Yes	Yes	Identifying a source, pathway and receptor does not mean a health impact is a likely significant effect; health impacts should be assessed (describing what effect will occur and its likelihood) and likely health effects are then evaluated for significance.

Factors affecting human health typically include emissions affecting air quality, water supplies and land, audibility, shadow flicker and traffic. These issues are addressed in Chapters 5, 6, 8, 11, 12 & 14 of the EIAR, which deal with Noise, Shadow Flicker,

Aquatic Ecology, Hydrology and Hydrogeology, Air and Climate and Traffic and Transport. Site stability issues are addressed in Chapter 10 Land, Soils and Geology and Major Accidents and Disasters in Chapter 16.

In the case of Derrybrien wind farm project, the Source can be described as the wind farm project development and peat slide including its construction phase (air quality, noise, water quality, traffic and transport, major accidents and disasters), its operational phase (noise, shadow flicker, visual impact, electric and magnetic field effects (EMF)) and its decommissioning phase (noise, air quality and traffic and transport). The key pressure-pathway-receptor considerations are set out in Table 4-10.

The wind farm is in a remote location and the nearest occupied houses are located just over 2.0km from the wind turbines at wind farm site.

Table 4-10 Potential Pressure Pathway Receptors considered

Source	Pathway	Receptor	Comment
Construction Phase			
Air pollution from dust during site excavations and site construction	Movement of air	Population in residential dwellings in the vicinity of Derrybrien construction site.	The most important air pollutant that could impact on human health is airborne dust, particularly dust particles of ten microns in size or less (PM_{10}) as these can enter the lungs and give rise to respiratory problems. Their dispersion through the air is dependent on wind speed and impact on potential receptors is dependent on wind direction.
Air Pollution – Combustion emissions from construction equipment	Movement of air	Population in residential dwellings in the vicinity of Derrybrien construction site.	Combustion emissions such as nitrogen oxides and sulphur oxides from construction equipment at high concentration can also impact on human health, giving rise to respiratory problems.
Pollution of surface water quality by sediment and hydrocarbons from the site	Surface water runoff from the construction site to tributaries of the Owendalulleegh River and then to Lough Cutra	Consumers through the Gort Regional Water Supply or local surface water abstraction	Where surface water is used as a source of drinking water, pollution due to run off from the wind farm site, overhead line construction and Agannygal Substation carrying sediment and hydrocarbons could give rise to health impacts from drinking contaminated water. This could arise from the contaminant load itself or through interference with water treatment processes resulting in poor disinfection for example.

Source	Pathway	Receptor	Comment
Pollution of groundwater quality by sediment and hydrocarbons from the site	Groundwater quality and abstraction for drinking water purposes.	Consumers using groundwater as a source of drinking water.	Similarly, where groundwater is used as a source of drinking water, pollution due to run off from the project construction which results in contamination by sediment and hydrocarbons health impacts from drinking contaminated water could arise. Again, this could arise from the contaminant load itself or through interference with any water treatment process.
Pollution of surface and groundwater from wastewater generated by site facilities.	Contamination of surface and groundwater with wastewater from site facilities.	Consumers using groundwater or surface water as a source of drinking water.	Temporary sanitary and canteen facilities are provided on site during construction to facilitate the workforce. Contamination from untreated sanitary waste could enter either the surface water or groundwater leading to contamination of these potential sources of drinking water.
Construction equipment Noise & Vibration	Via the air and ground	Human beings in noise sensitive locations	Although construction related noise is focused, occurs mainly during the normal working day and for a short period of time the World Health Organisation recognises that excessive noise seriously harms human health and interferes with daily activities. It can give rise to sleep disturbance, cause cardiovascular and psychophysiological effects, reduce performance and

Source	Pathway	Receptor	Comment
			provoke annoyance responses and changes in social behaviour[6].
Traffic and Transport	Accidents involving construction traffic within the Derrybrien Project site and on local and national roads	Road users	Collision risks could occur resulting in injury or loss of life. Traffic and transport are also major drivers of air pollution and also transport associated noise where the concentration of such activities, such as major cities, is high[7]. This would not be the case in the rural area of Derrybrien but other potential health risks could occur such as a lack of safe walking and cycling networks and

[6] WHO, http://www.euro.who.int/en/health-topics/environment-and-health/noise

[7] WHO, http://www.euro.who.int/en/health-topics/environment-and-health/Transport-and-health/data-and-statistics/air-pollution-and-climate-change2

Source	Pathway	Receptor	Comment
			traffic injuries also pose a significant burden to public health.
Major Accidents and Disasters	Major peat slide in the form of land movement downslope from a peat failure area and following valley and river paths.	Workers on the wind farm site and the general population living and working downslope from a peat slide location.	Part of the workforce constructing the Derrybrien Project could be caught in the pathway of the peat slide which could result in loss of life or injury. Similarly, private dwellings, forest plantations and agricultural areas including their access could be impacted by a peat slide with potential loss of life or injury occurring.
Construction related workplace accidents	Direct impact of equipment use or hazardous occurrences (slips, trips and falls e.g.) on workers.	Workers on the wind farm site, the overhead line grid connection and the Agannygal substation construction sites.	Construction workplaces by their nature present many health and safety hazards, such as moving heavy equipment, delivery loads, open excavations, electricity supply, uneven ground, working at heights, confined spaces, working with caustic materials (concrete) and others. Incidents can occur which can impact on the health and wellbeing of the workforce and people accessing the construction site.
Operational Phase			
Wind Turbine Noise	Via the air as a function of wind speed and direction	Noise Sensitive locations	Potential health impacts from operational wind farms which is continuous in nature or which may have particular noise components such as tones or amplitude modulation have received considerable consideration in the literature. Wind farm operating noise can occur throughout the day and will vary dependent on wind

Source	Pathway	Receptor	Comment
			speed and direction in terms of its perception at any noise sensitive location (dwelling) where people reside. Again, the World Health Organisation recognises that excessive noise seriously harms human health and interferes with daily activities. The WHO has published noise guidance for Europe which includes wind farm noise and recommends that for average noise exposure, noise levels produced by wind turbines should be below 45 dB Lden, as wind turbine noise above this level is associated with adverse health effects. No recommendation [8] is made for average night noise exposure Lnight of wind turbines. The quality of

[8]World Health Organisation, Environmental Noise Guideline for the European Region, 2018

Source	Pathway	Receptor	Comment
			evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.
Shadow flicker	Visual pathway when the sun is in direct alignment with a dwelling window and there are intervening turbine blades which give rise to the shadow flicker effect	Dwellings with windows where shadow flicker effects could occur.	Shadow flicker is a flickering effect which is caused when rotating wind turbine blades cast shadows through windows of neighbouring properties. The effect occurs periodically. In general shadow flicker can give rise to residential amenity impacts but could potentially give rise to health effects such as photosensitive epilepsy depending on the operating frequency of the wind farm[9].

[9] Update of UK Shadow Flicker Evidence Base, prepared by Parsons Brickenhoff for the UK Department of Energy and Climate Change, Department of Energy and Climate Change

Source	Pathway	Receptor	Comment
			There have been no shadow flicker complaints recorded to date during the operational period of Derrybrien.
Visual Impact	Visible perception of the wind farm by an observer	Observers of the wind farm with continuous views.	Visual annoyance impact arising from the continuous view of the wind farm.
Pollution of groundwater by wastewater.	Contamination of groundwater quality.	Consumers of groundwater as a source of drinking water supply.	Untreated wastewater would have the potential to contaminate groundwater with harmful bacteria and other potential pathogens. The wind farm is provided with sanitary facilities for use by the maintenance staff. The welfare facilities in the control building of Derrybrien Substation consists of one toilet and two sinks. Wastewater from this facility is treated using a proprietary wastewater treatment system (Envirocare P6) with treated water subsequently discharged to ground. The wastewater from the wind farm control room is treated by a Biocycle wastewater treatment system which also discharges subsequently to ground (see Chapter 2).
Electric and Magnetic Fields	Through the air	Human beings in close proximity to the wind turbine generators, 110kV Overhead Line grid connection and the Agannygal substation	Electric and magnetic fields (electromagnetic fields (EMF)) around wind farms can originate from the grid connection lines, wind turbine generators, electrical transformers, and underground network cables.

Source	Pathway	Receptor	Comment
Major Accidents and Disasters	Major peat slide in the form of land movement downslope from a peat failure area and following valley and river paths.	Workers on the wind farm site and the general population living and working downslope from a peat slide location.	Part of the workforce operating the Derrybrien Project could be caught in the pathway of the peat slide which could result in loss of life or injury. Similarly, private dwellings, forest plantations and agricultural areas including their access could be impacted by a peat slide with potential loss of life or injury occurring. No significant construction works are planned during the operational phase but there would be some upgrade of the wind farm roadways which could increase loading on the roads.
Decommissioning Phase			
Air pollution from dust arising from decommissioning activities	Movement of air	Population in residential dwellings in the vicinity of Derrybrien construction site	Airborne dust, particularly dust particles of ten microns in size or less (PM_{10}) can give rise to health impacts as particles of this size can enter the lungs and give rise to respiratory problems. Their dispersion through the air is dependent on wind speed and impact on potential receptors is dependent on wind direction.
Air pollution from equipment emissions during decommissioning.	Movement of air	Population in residential dwellings in the vicinity of Derrybrien construction site	Combustion emissions such as nitrogen oxides and sulphur oxides from construction equipment at high concentration can also impact on human health, giving rise to respiratory problems.

Source	Pathway	Receptor	Comment
Noise and Vibration from equipment used during decommissioning	Via the air and ground	Human beings at noise sensitive locations	Noise and vibration associated with the operation of decommissioning equipment could give rise to direct impact in the audible range and to annoyance disturbance.
Pollution of surface water quality by sediment and hydrocarbons from the site	Surface water runoff from the construction site to tributaries of the Owendalulleegh River and then to Lough Cutra	Consumers through the Gort Regional Water Supply or local surface water abstraction	During decommissioning contaminated surface water could flow to the main Owendalulleegh River and into Lough Cutra which is a regional drinking water supply source.
Pollution of groundwater quality by sediment and hydrocarbons from the site.	Groundwater quality and abstraction for drinking water purposes.	Consumers using groundwater as a source of drinking water.	Ground disturbance during decommissioning could give rise to contamination of groundwater with sediment and hydrocarbons which could impact on groundwater abstraction sources in the area.
Pollution of groundwater by wastewater	Groundwater quality and abstraction for drinking water.	Consumers using groundwater as a source of drinking water.	Untreated wastewater would have the potential to contaminate groundwater with harmful bacteria and other potential pathogens.
Construction related workplace accidents	Direct impact of equipment use or hazardous occurrences (slips, trips and falls e.g.) on workers.	Workers on the wind farm site, the overhead line grid connection and the Agannygal substation construction sites.	Construction workplaces by their nature present many health and safety hazards, such as moving heavy equipment, delivery loads, open excavations, electricity supply, uneven ground, working at heights, confined spaces, working with caustic materials (concrete) and others. Incidence can occur which can result on the

Source	Pathway	Receptor	Comment
			health and wellbeing of the workforce and people accessing the construction site.
Major Accidents and Disasters	Major peat slide in the form of land movement downslope from a peat failure area and following valley and river paths.	Workers on the wind farm site during decommissioning and the general population living and working downslope from a peat slide location.	Part of the workforce decommissioning the Derrybrien Project could be caught in the pathway of the peat slide which could result in loss of life or injury. Similarly, private dwellings, forest plantations and agricultural areas including their access could be impacted by a peat slide with potential loss of life or injury occurring. Although decommissioning will be confined largely to above surface structures decom missioning activities such as Heavy vehicle movements on the wind farm roads and some foundation removal (substation) could increase loading on the roads.
Traffic and Transport	Accidents involving construction traffic within the Derrybrien Project site and on local and national roads	Road users	Collision risks could occur resulting in injury or loss of life.

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Baseline information on the general health of the population has been obtained from the CSO statistics on health where available, from special module reports of the Quarterly National Household Survey Reports on Health, the 2015 Irish Health Survey Report, HSE Health Status in Ireland reports and the HSE Health in Ireland Key Trends Report 2018 . Limited data is available from the CSO with regard to Health in individual Electoral Divisions, but data was available for the years 2011 and 2016.

Surveys and polls by the Department of Health and by the CSO collect data on self-perceived health. Self-perceived health is seen as a good proxy indicator of actual health as stated in the CSO publication "The Wellbeing of the Nation 2017"

https://www.cso.ie/en/releasesandpublications/ep/p-wbn/thewellbeingofthenation2017/hlt/) which states:

"*An individual's perception of their own health is important as it provides an opportunity to look at aspects of health that are difficult to measure clinically. These include the severity of a condition, or feelings such as tiredness etc. Self-perceived health is seen as a good proxy indicator of actual health*."

Self-perceived health status has been sourced and provided here where available. The reports in general also indicate a clear link between socio economic circumstances and perception of health.

4.4.3 Human Health Baseline

This section sets out the baseline information on human health at National, West Region and at Electoral Division level based on self-perceived health in the population and also key causes of mortality. In general Ireland is seeing greater longevity in its population, which is also growing, with longevity being associated with better lifestyles, better health care provision and with earlier intervention in key diseases leading to better outcomes.

General Health information has been obtained from the Quarterly National Household Surveys on Health Status and Health Service Utilisation, Health in Ireland key Trends Reports and Electoral Division Data where available. A summary of health information based on these reports is provided in Appendix 4.2. and further summarised here in this section.

4.4.3.1 Baseline Year 1998

Although no specific health data for the year 1998 was available, the Quarterly National Household Survey Health issue (Third Quarter 2001) provides general health data both nationally and on a regional basis which reflects the period before construction of the Project commenced. The survey indicated that in the West Region (Galway, Mayo and Roscommon) some 87.1% of adults surveyed in 2001 reported their health as being good to excellent. With 10.3% stating it was "fair" and 2.4% stating it as "bad". This was similar to the national picture.

4.4.3.2 Construction period

Some data on health in 2005 was reported in the Health in Ireland Key Trends Report , 2007 based on CSO data from 2005. This would be reflective of the construction period and indicated that at that time 83.7% of Males and 82.2% of Females regarded their health as Very good/ Good with 16.3% of males and 17.9% of females reporting their health the Fai/Bad/Very Bad categories.

4.4.3.3 Operational period 2006 to July 2020

A general overview of the self-perceived health status of people in the State and in the West Region is provided by the Quarterly National Household Survey (QNHS) module reports relating to health, produced in 2002, 2007 and 2010 and from health in Ireland, Key Trends in Ireland Reports 2007-2019 . Although designed primarily to produce quarterly labour force estimates the QNHS also periodically conducts special modules on different social topics each quarter including health. The QNHS is a large-scale, nationwide survey of households in Ireland. Self-perceived health status continued to indicate high percentage levels of very good to good status nationally, above the European average, with only circa 2% stating their health was bad or very bad

Electoral Division self-perceived health status for the years 2011 and 2016 is available from the CSO and is provided in Table 4-11. This indicates that in 2011 between 79.6% and 93.8% of the adult population within the EDs associated with the wind farm area perceived their health to be good or very good with the lowest levels recorded in Derrylaur and Kilthomas. The percentage recording fair health ranged from 3.9% to 19.3% again with Derrylaur and Kilthomas rating the highest. The percentage rating bad to very bad ranged from 0% to 2.6% with the highest percentage in Aille ED.

In 2016 between 83.9% and 90.9% of the adult population within the EDs perceived their health to good or very good with the lowest levels recorded in Aille and Castleboy. The percentage recording fair health ranged from 5.8% to 15.5% again with Derrylaur and Kilthomas rating the highest. Whilst between 0% to 2.6% indicated bad to very bad with the highest percentage in Aille ED.

4.4.3.4 Summary of baseline health

In summary, although specific health status data relating to the baseline year 1998 was not available, the Quarterly National Household Survey Health issue (Third Quarter 2001) provided general health data both nationally and in the West Region which reflects the period before construction of the Project commenced. At that time, nearly 90% of adults surveyed reported their health as being good to excellent, with 10.3% stating it was “fair” and 2.4% stating it as “bad”. This was similar to the picture nationally. Self-perceived health status continued to indicate high percentage levels of very good to good status nationally, above the European average, with only circa 2% stating their health was bad or very bad.

The main causes of mortality nationally in the period 2005 and 2007, which is during and immediately after the construction period of Derrybrien Wind Farm, were circulatory system diseases, cancer, respiratory diseases, death from injury and poisoning and other causes. The main causes of mortality, for the period 2014 to 2018 remained similar. However, it was noted that significant differences in causes of mortality occur with age profile with increased

levels of circulatory system and respiratory diseases in the over 64 age group. The prevalence of death by injury or poisoning is significantly less in this age group also.

A recent survey conducted in 2019 indicated a similar health status picture to that in 2015 with 84% perceiving their health to be very good or good, 3% perceive it to be bad or very bad. The gap in self-reported good health between men and women changes as age increases.

Although, only limited data at Electoral Division level is available the data indicates a similar picture to that nationally with respect to self-perceived health for the period available. In 2011 between 79.6% and 93.8% of the adult population within the EDs of interest perceived their health to be good or very good the percentage recording fair ranged from 3.9% to 19.3% and the percentage rating bad to very bad ranged from 0% to 2.6%. In 2016 between 83.9% and 90.9% of the adult population within the EDs perceived their health to good or very good with the percentage recording fair health ranging from 5.8% to 15.5% and those indicating bad between 0% to 2.6%. The health status at National and in the West areas would likely reflect that in the ED areas in general with some minor variations.

Table 4-11: Self-perceived health status in the Electoral Divisions 2011 and 2016 (%)

General Health	Aille		Castleboy		Derrylaur		Kilthomas		Marblehill/ Loughatorick		Mountain	
Year	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**	**2011**	**2016**
Very good	244	219	342	339	59	44	44	42	202	172	207	173
Good	107	118	148	149	27	43	23	29	138	137	81	78
Fair	24	38	44	31	20	14	16	13	48	47	12	20
Bad	9	2	7	7	2	2	0	0	6	7	4	3
Very bad	1	2	1	0	0	0	0	0	2	0	0	0
Not stated	4	6	8	11	0	2	0	0	1	8	3	5
Total	389	385	550	537	108	105	83	84	397	371	307	279
% Very Good/Good	90.2	87.5	89.1	90.9	79.6	82.9	80.7	84.5	85.6	83.3	93.8	89.9
% Fair	6.2	9.9	8.0	5.8	18.5	13.3	19.3	15.5	12.1	12.7	3.9	7.2
% Bad/Very Bad	2.6	1.0	1.5	1.3	1.9	1.9	0.0	0.0	2.0	1.9	1.3	1.1

4.4.3.5 Drinking Water Supply

As set out in Chapter 11, Hydrology and Hydrogeology, Section 11.2.7 Searches of the GSI well database and the EPA WFD database indicate that there are no known groundwater abstraction wells within 5 km of the wind farm site boundary. The nearest mapped well is located 7 km to the south-west of the site boundary.

However, given the location of the project (Windfarm, Grid connection and Agannygal substation) in a rural setting it is possible that many dwellings source their drinking water supply from private wells or in some cases possibly surface water streams. The 2016 census showed the percentage of private supplies to houses in the surrounding Electoral Divisions (EDs) is in the order of 20-40%.

Part of Derrybrien village is served by a group water supply scheme (10 houses), while others have their own independent wells and some others harvest rainwater from their roofs. The local church gathers its own water supply from its roof.

Gort Regional Water Supply

At the time of the Derrybrien construction and peat slide, the town of Gort was served by a combination of groundwater abstraction wells and surface water abstracted form the Canahowna River. Drainage from the Slieve Aughty Mountains flows into the Owendalulleegh River, which in turn enters Lough Cutra flowing out as the Beagh River. This river sinks underground at the Punchbowl, emerging as the Cannahowna River to the southwest of Gort where water was abstracted as part of the Gort supply. Circa two thirds of the Gort supply came from this surface water source, see Chapter 8, Section 8.4.1.8. Treatment afforded to the Gort water supply at that time comprised coarse screening and slow sand filtration followed by disinfection using chlorine. Historic records on water supply obtained from the EPA SAFER[10] database, indicate that from 2004 onward the total population served by the Gort Regional Water Supply was 4,775 people with a surface water abstraction of circa 904 m^3/day and subsequently a surface water abstraction of 1,404 m^3/d from 2007 on (EPA[11]).

The public water supply for Gort continues to be the Gort Regional Water Supply Scheme sourced from the Gort/Cannahowna River. The supply now receives full

[10] EPA, Drinking Water Monitoring Results and Water Supply Details for Ireland - Year 2004, http://erc.epa.ie/safer/downloadValidityCheck.jsp

[11] EPA, Drinking Water Monitoring Results and Water Supply Details for Ireland - Year 2007, http://erc.epa.ie/safer/downloadCheck.jsp?isoID=265&rID=10417&atID=2963

treatment at the Rindifin Water Treatment Plant comprising, coagulation, filtration, chlorination and UV treatment.

4.4.3.6 Electromagnetic fields (EMF)

All electricity, both natural and man-made, produces two types of fields: electric fields and magnetic fields collectively termed electromagnetic fields or EMF. Electric and Magnetic Fields occur both naturally and from man-made sources.

For example, the Earth's magnetic field, which is due mainly to currents circulating in the outer layer of the Earth's core, varies between about 30μT (microtesla, 1000μT = 1mT, millitesla) at the Equator and about 60uT at the poles. There is also a natural electric field at the Earth's surface created by electric charges high up in the ionosphere and varying between 100 and 150 Volts per metre (V/m) in fine weather. This field can intensify below a storm cloud containing large quantities of electric charge reaching intensities up to 20kV/m over flat surfaces.

Electric and magnetic fields (electromagnetic fields (EMF)) from wind farms can originate from the wind turbine generators, electrical transformers, underground network cables and the grid connection line itself.

Electric fields reduce in strength rapidly with distance from the source. For example, for power transmission lines such as the Derrybrien - Agannygal 110kV Overhead line the electric field is strongest directly beneath the line where the conductors carrying electricity are nearest the ground, typically near the middle of the span between two adjacent support structures. By moving away from a power line the strength of the electrical field decreases rapidly. The magnitude of an electric field is measured in volts (or thousands of volts – kilovolts) per metre. This is written as V/m or kV/m. The normal maximum electric field strength at ground level 30m from the centre of the110 kV line is **0.077kV/m.**

Magnetic fields are produced where electric current is present and its strength at a given location depends on the level of current flowing in the conductor or wire and the distance from it. Magnetic fields are normally expressed in terms of a quantity called the magnetic flux density, expressed in terms of tesla (T). This relatively large unit is often expressed in submultiples such as microtesla (μT – one millionth T). Magnetic fields produced by power lines are also strongest directly under the line. The typical magnetic flux densities at 50m from a 110 kV transmission lines is **0.1μT** (EirGrid, The Electricity Grid and Your Health).

EMFs from the electricity grid are non-ionising, which means that they do not have enough energy to cause damage to human or animal cells in the same way ionising radiation, such as X-rays for example does. The EMFs from electricity lines are in the extremely low frequency end of the electro-magnetic spectrum and occur in the home, in the workplace, or anywhere we use electricity. Domestic electrical appliances can generate much higher magnetic and electric fields in their close proximity than transmission lines at a nominal 50m distance away. A comparison of typical magnetic and electric fields from a transmission line and the fields generated by domestic appliances is shown in **Figure 4-2**.

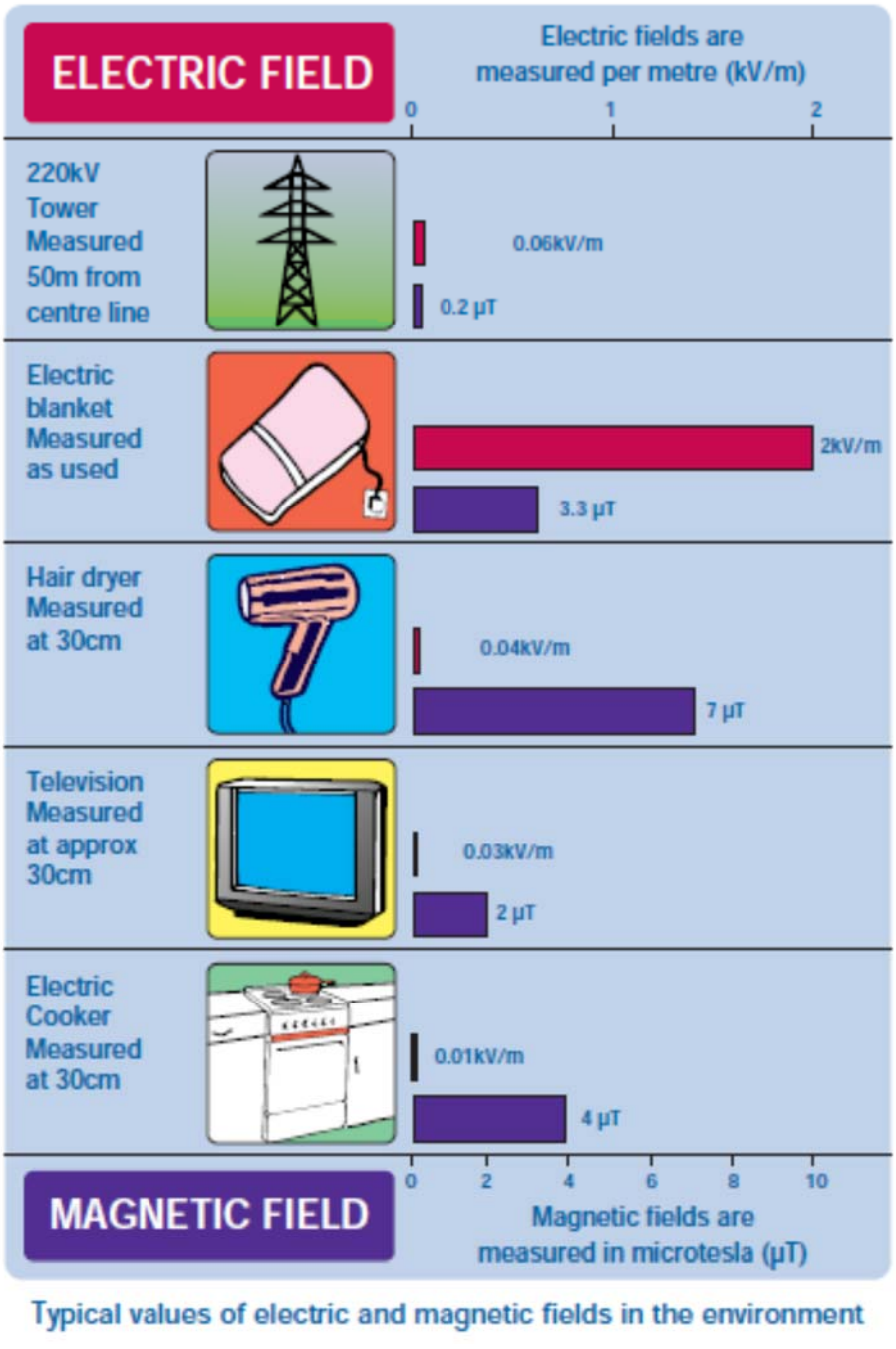

Figure 4-2: Typical values of electric and magnetic fields

Considerable scientific study has been undertaken to investigate the potential health effects of extremely low frequency EMFs and Guidelines on exposure to EMF have been produced by the International Commission on Non-Ionising Radiation Protection (https://www.icnirp.org/), a non-governmental organisation which is recognised by the World Health Organization. The ICNIRP, evaluates the scientific peer-review literature on EMF and health and produces recommendations on exposure reference levels. The Guidelines have been referenced by the EPA https://www.epa.ie/radiation/emf/health/guidelines/ as follows:

"*National guidelines on exposure to electromagnetic fields (EMF) are based on advice from the ICNIRP*".

The current ICNIRP Guidelines, approved in 1998 were re-confirmed in 2009 and have been recommended by the European Commission. In 2018, after an updated review of the most up-to-date scientific literature, ICNIRP initiated a review of the 1998 guidelines, including a public consultation. The results of this new review have not been released yet.

The current ICNIPR Guidelines for electric fields are 5,000 V/m and for magnetic flux density are 100uT. The maximum electric field strength at ground level 30m from the centre of the110 kV line of 0.077kV/m is well below the ICNIRP guideline as is the magnetic flux density of 0.1**µ**T.

The EPA also state that current scientific evidence does not support long-term health effects, such as cancer due to exposure to EMF of either low or high frequency. This is also supported by the Danish National Institute of Public Health and the Environment study (Hall et al. 2015) on electromagnetic fields in the Irish context. The study was commissioned by the Irish Government to report on the current scientific knowledge on the possible health effects of exposure to electromagnetic fields with a focus on electromagnetic fields from high-voltage overhead power lines and from base stations for mobile telecommunication.

Additionally, a study on potential health effects associated with EMF from wind farms was undertaken in Canada and published in 2014 (Lindsey C McCallum et al., 2014). The study indicated that detected magnetic fields at the base of wind turbines, above buried electricity cables and from the transmission lines were very low and when compared to the ICNIRP guidelines and were all well below levels known to cause harm to human health. The levels also diminished rapidly with distance.

The study concluded that

"*The results suggest that 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*. "

Given the above and the distances between the wind farm, transmission line and substation to the nearest occupied dwellings there is **no negative impact** from EMF arising from the operation of the Project.

4.5 Impact of the Development

This section of the report discusses the impacts which have occurred, both during the construction phase of the Project (2003 to 2006) and operational phase of the project to date 2007 to end 2019), the impacts which are occurring during the operational phase and the impacts which are likely to occur, from 2020 to the end of the Project circa 2040 as well as the decommissioning phase.

4.5.1 Impacts which have occurred

4.5.1.1 Construction phase: circa June 2003 to October 2006

An assessment of potential impacts on human health that have occurred in the construction phase is provided in Table 4-12.

Table 4-12 Impacts which have occurred during the Construction Phase 2003-2006

Source	Potential Pathway and Receptor	Impact Assessment
Air pollution from dust during site excavations and site construction	The most important air pollutant that could impact on human health is airborne dust, particularly dust particles of ten microns in size or less (PM_{10}) as these can enter the lungs and give rise to respiratory problems. The potential for impact from this source is dependent on the distance to the receptor, size and scale of the construction site and area of activities giving rise to dust, weather conditions and dispersion through the air which is dependent on wind speed and wind direction.	As indicated by the assessment undertaken in Air & Climate in Section 12.4.2.1 the nearest occupied dwellings to the wind farm site itself are located over 2km distance from the site and there are no human receptors within 500m of the site entrance hence the risk of air borne dust or dust deposition on human receptors based on the Institute of Air Quality Guidance **is negligible and no significant** impact would have occurred during the construction phase of the wind farm site. The nearest construction location on the 110kV overhead line is located 380m from the nearest occupied dwelling and construction would have been for a very short duration with limited excavation and earth moving at a small focused site. The location of construction along the overhead line would also have been variable occurring at different sites in a progressive manner. The impact from dust arising from construction of this line would therefore have been of **negligible risk and no significant impact would have occurred**. The nearest dwelling to the Agannygal site construction is located circa 540m from the site, with the site entrance also located more than 500m from any dwelling. The potential risk of dust impact on the nearest dwelling is therefore **negligible and no significant impact would have occurred.**
Air Pollution – Combustion emissions from	Combustion emissions such as nitrogen oxides and sulphur oxides from construction equipment at high concentration can also	Exhaust emissions from construction and delivery vehicles during construction would have been localised at the individual construction sites and would have quickly dispersed in the atmosphere. Given that the nearest occupied dwellings to the wind farm site itself are located

Source	Potential Pathway and Receptor	Impact Assessment
construction equipment	impact on human health giving rise to respiratory problems.	over 2km distance **no significant** impact would have occurred during the construction phase of the wind farm site. The nearest construction location on the 110kV overhead line is located 380m from the nearest occupied dwelling and construction would have been for a very short duration with limited excavation and earth moving at a small focused site and **no significant impact would have occurred**. The nearest dwelling to the Agannygal site construction is located circa 540m from the site, with the site entrance also located more than 500m from any dwelling and **no significant impact would have occurred.**
Pollution of surface water quality by sediment and hydrocarbons from the site	Where surface water is used as a source of drinking water, pollution due to run off from the wind farm site, overhead line construction and Agannygal Substation carrying sediment and hydrocarbons could give rise to health impacts from drinking contaminated water. This could arise from the contaminant load itself or through interference with water treatment processes resulting in poor disinfection for example.	A detailed assessment of the potential impact of construction activities on surface water is provided in Chapter 11, Hydrology and Hydrogeology, Section 11.3.21 (Felling of Forestry and Suspended Solids – Wind Farm, OHL Route and Grid Connection). The assessment of construction activities indicated that they could have resulted in the release of suspended solids to surface watercourses, increased sediment load with downstream water quality impacts in downstream waterbodies. This in turn could impact on the quality of water abstracted for drinking water Potential impacts would have been **Locally Significant, Negative and Brief** throughout the construction stage if not adequately mitigated against. However, silt traps were installed at all main drainage points and additional measures were also implement which resulted in the mitigation of the potential effects. Following mitigation, the risk arising from

Source	Potential Pathway and Receptor	Impact Assessment
		suspended solids is **reduced from locally Significant to Not Significant. No significant impact on Human Health will have occurred.** The potential impact of spills was Slight to Moderate and Negative on the Local environment and Brief throughout the construction stage. Again, following the implementation of mitigation measures the risk arising from hydrocarbon spills was reduced from **Slight to Moderate to Not Significant. No significant impact on human health will have occurred.**
Pollution of groundwater quality by hydrocarbons from the site	Similarly, where groundwater is used as a source of drinking water, pollution due to accidental release of hydrocarbons on human health could arise from drinking contaminated water. Again, this could arise from the contaminant load itself or through interference with any water treatment process.	A detailed assessment of the potential impact of construction activities on groundwater is provided in Chapter 11, Hydrology and Hydrogeology, Section 11.3.2.1 (Hydrocarbons and Cement) The potential impact of hydrocarbon spills was assessed as **Slight to Moderate and Negative on the Local environment and Brief** throughout the construction stage. Again, following mitigation, the implementation of mitigation measures the risk arising from suspended solids was reduced **to Not Significant. No significant impact on human health will have occurred.**
Pollution of surface and groundwater from wastewater generated by site facilities.	Temporary sanitary and canteen facilities were provided on site during construction to facilitate the workforce. Contamination from untreated sanitary waste could enter either the surface water or groundwater leading to contamination of these potential sources of drinking water.	An assessment of the potential pollution from wastewater generated by site facilities is provided in Chapter 11, Hydrology and Hydrogeology, Section 11.3.2.1 (Wastewater). The assessment indicated that without appropriate mitigation the impacts from discharging untreated wastewater from these facilities would be expected to be **Slight to Moderate but Brief** on the environment throughout construction. However, the site compound was serviced by sanitary facilities with a holding tank with

Source	Potential Pathway and Receptor	Impact Assessment
		subsequent collection and removal of foul waste from site. Portable toilet facilities were also provided around the site and with this mitigation in place no significant impact on surface or groundwater is predicted. Hence, **no significant** impact on human health would have occurred from this source.
Construction equipment Noise & Vibration	Although construction related noise is focused, occurs mainly during the normal working day and for a short period of time the World Health Organisation recognises that excessive noise seriously harms human health and interferes with daily activities. It can give rise to sleep disturbance, cause cardiovascular and psychophysiological effects, reduce	An assessment of the noise effects on the noise sensitive locations within 3km of Derrybrien Wind Farm arising from the construction equipment used and the construction activity (blasting) during the construction period is presented in Chapter 5, Section 5.6.1.1. A summary of the effects is presented here. With regard to vibration the assessment indicates that due to the distance of the construction works from noise sensitive locations significant vibration impacts would not have been perceptible and would have been significantly below levels where cosmetic or structural damage would occur. With regard to noise from borrow pit blasting the effect was indicated as being **slight negative and temporary** in nature. Audible noise from the construction of the grid connection would have arisen at the nearest noise sensitive locations but would have lasted for a period of 2 – 3 days only. The effect has been assessed as **slight negative and temporary** in nature.

Source	Potential Pathway and Receptor	Impact Assessment
	performance and provoke annoyance responses and changes in social behaviour[12].	No significant impact on human health occurred during the construction period from noise or vibration.
Construction related workplace accidents	Construction workplaces by their nature present many health and safety hazards, such as moving heavy equipment, delivery loads, open excavations, electricity supply, uneven ground, working at heights, confined spaces, working with caustic materials (concrete) and others. Incidence can occur which can result in impact on the health and wellbeing of the workforce and people accessing the construction site. Construction workplaces must be operated in	A number of Contractor construction related incidents, which resulted in injury to workers on site or to incidents with potential to cause injury, occurred during the construction period as follows: • Minor injuries, twisted ankle, fractured fingers, minor cuts and bruises • One lost time incident from a hand injury • One lost time injury from dislocated shoulder • Equipment failure leading to a temporary eye irritation. • Construction equipment leaving/coming off turbary road (1 crane, 1 concrete delivery, 1 HGV delivery vehicle), 1 roller at Black Road bridge during resurfacing, 1 Fuel delivery vehicle leaving access

[12] WHO, http://www.euro.who.int/en/health-topics/environment-and-health/noise

Source	Potential Pathway and Receptor	Impact Assessment
	accordance with Irish Legislation relating to Health Safety and Welfare at Work.	road. These were attributed to operator error and not to any structural failure of wind farm roads or external roads. • Construction equipment catching fire (drilling rig) – which was localised and extinguished rapidly on site. The rig had been recently used on investigation work on the peat deposits on the Corrib Gas Terminal project. Investigation indicated that dry peat attached to the exhaust took fire. • Collisions (1 on site: truck reversing into jeep) no injuries. • Damage claims to private vehicles due to external road conditions on the Black Road • Blade transport trailer went off the "Black Road" and there were no injuries. The Black Road was blocked for circa half a day and road diversions were put in place.“ • Impact to wind turbine construction workers hand due to entrapment by door at the base of the tower during a windy day lead to a Lost Time injury and was notified to the Health and Safety Authority None of the incidents resulted in permanent health injuries to the various contractor(s) work force or to members of the public. To mitigate against serious accident and health impact the site operated under Health & Safety Plans which were periodically revised and updated as different aspects of the construction were undertaken (e.g. civil works would differ from wind turbine erection). In the absence of a dynamic Health & Safety Plan potential risk for incidents to effect human health would be high.

Source	Potential Pathway and Receptor	Impact Assessment
		Incidents did occur which were negative, slight in nature and temporary in duration. Key mitigation contained in the Health & Safety Plans included the following: • Contractors must attend the site induction course and be familiar with this Project Specific Health and Safety Plan. Contractors must also present all their employees for Site Induction by Site Safety Advisor prior to commencement of work on site. • Controlled copies of new revisions to the Safety and Health Plan issued by ESBI Eng. Ltd. Project Supervisor Construction or his representative on site to Gort Windfarm Holdings, Project Supervisor Design, Construction, and each Contractor as the project proceeds. • Risk Assessment must be carried out prior to commencement of work. A Method Statement and Safe Plan of Action Completed Forms should be completed for all sections of the work posing additional hazards. • Personal Protective Equipment - All contractors to make available personal protective clothing and equipment for its employees. • Site Safety Committee Meetings A Site Safety Committee comprising all levels of the site management team, site operatives, representatives and sub-contractor representatives to be established on site.

Source	Potential Pathway and Receptor	Impact Assessment
		• Safety Audits: Audits of the Contractors safety compliance on site to be undertaken continuously by ESBI Eng. Ltd.'s Site Safety Advisor. The Company Safety Officer to carry out site inspections at regular intervals as required, and report on findings. Any shortcomings in site safety to be brought to the immediate attention of the Project Supervisor Construction, or representative on site, for immediate action and resolution. • Contractors own Safety Inspections Contractors to supply a 2 weekly safety inspection report relating to their own operations on the lines indicated in Appendix 8 - copy to the ESBI Eng. Ltd. Site Safety Advisor. The frequency may be increased if appropriate. • A speed limit of 15mph to be enforced • FIRST AID Each contractor required to have at least one trained and currently certified First Aider on site establishment. • Safety Awareness Toolbox and Safety and Health presentations to be held fortnightly by contractors on site in order to maintain awareness of safety Post incident occurrence Contractor staff went through updated training and induction to ensure lessons learned from incidents were disseminated and understood.

Source	Potential Pathway and Receptor	Impact Assessment
		With the implementation of the updated Health & Safety Plan the risk of incidents decreased and impacts on Human Health would **not have been significant.** One fatality, due to natural causes, occurred on site to a machine operator, believed to be a cardiac arrest. In an unrelated incident a tragic helicopter accident occurred adjacent to the wind farm construction site resulting in two fatalities and one serious injury. This was attributed to poor weather conditions. The Air Accident Investigation Report can be viewed here (http://www.aaiu.ie/sites/default/files/report-attachments/REPORT%202006_019.PDF)
Traffic and Transport	Traffic and transport are major drivers of urban air pollution and also transport associated noise where the concentration of such activities, such	An assessment of potential impacts from Traffic and Transport is provided in Chapter 14. Section 14.3.1. These related to increased traffic on the roads, upgrading of existing roads, three bridges and some new road construction. Disruption of road use also occurred during wind turbine blade delivery necessitating specialist vehicles. No significant impacts on public health were recorded with minor delays to road users arising when a blade transporter went off-road blocking the Black Road.

Source	Potential Pathway and Receptor	Impact Assessment
	as major cities, is high[13]. This would not be the case in the rural area of Derrybrien but other potential health risks could occur such as a lack of safe walking and cycling networks and traffic injuries also pose a significant burden to public health.	

[13] WHO, https://www.who.int/sustainable-development/transport/health-risks/en/

4.5.1.2 Summary of construction phase impacts

In summary, construction phase impacts were as follows

- The risk of Impacts of dust on air quality and human health **would have been negligible and no significant impact would have occurred**
- The risk of Impacts of vehicle exhaust emissions on air quality and human health **would have been negligible and no significant impact would have occurred**
- **No significant impact on** Human Health will have occurred from the risk of suspended solids entering surface waters
- **Not Significant impact** on human health will have occurred from polluting materials entering groundwater.
- **No significant impact** on human health from sanitary facilities located on site will have occurred
- Site incidents did occur which were **negative, slight in nature and temporary** in duration but **no significant** impact on human health occurred
- **No** impacts on public health were recorded.

4.5.1.3 Peat slide & related works: Oct 2003-end 2005

The peat slide which occurred in 2003 originated within the wind farm site close to its southern boundary. It is described in Chapter 2, Section 2.2.2.2 and in detail in Chapter 10 Land. Soils and Geology, Section 10.1.2 It extended a distance of circa 1.65 km to the Black Road Bridge in the townland of Derrybrien North. Resulting from the slide additional construction works were undertaken within and external to the wind farm site, including the rebuilding of short sections of floating road within the wind farm site which also acted as containment barrages and the installation of eight barrages along and downslope of the route of the slide between the wind farm and downstream of Flaggy Bridge of which four remain in-situ in 2020. Accumulated peat from the slide was removed and deposited in peat repositories, one immediate upslope of the Black Road Bridge, one between Black Road Bridge and Flaggy Bridge and one beside barrage-2. An assessment of the impacts of the peat slide on human health is provided in **Table 4-13**.

Table 4-13 Impacts which have occurred during the peat slide

Source	Potential Pathway and Receptor	Impact Assessment
Air pollution from dust during peat slide incident and barrage construction.	Air pollution impacts could occur through movement of dust in air. In the case of Derrybrien wind farm residential dwellings are located well in excess of 350m from the peat slide area and there were no human receptors located within 500m of the works associated with the peat slide remediation.	As indicated by the assessment undertaken in Air & Climate in Section 12.3.1.2 the peat slide material consisted of wet peat and did not give rise to air quality impacts. The measures undertaken in response to the peat slide included the rebuilding of short sections of road within the wind farm site at two locations (one in the vicinity of T68 and the second at T23-T70) and the installation of eight barrages (three temporary earthen barrages, one temporary rockfill barrage and four extant boulder barrages) along and downslope of the route of the slide between the wind farm and downstream of Flaggy Bridge. Peat from the slide area was also removed and deposited in peat repositories. There would therefore have been some potential for air borne dust and vehicle emissions to impact on air quality. However, the distance from the nearest construction site associated with the slide area to an occupied dwelling was more than 500m and based on the Institute of Air Quality Management Guidance the impact from dust would therefore have been of negligible risk and **no significant impact** would have occurred.
Air Pollution – Combustion emissions from construction equipment used for remedial works	Combustion emissions such as nitrogen oxides and sulphur oxides from equipment used to undertake the remedial works arising from the peat slide could also impact on human health giving rise to respiratory problems.	The exhaust emissions from remedial construction and delivery vehicles would have been very localised at the peat deposition areas and at the barrage sites and would have quickly dispersed in the atmosphere. Given that the nearest occupied dwellings from these locations are well in excess of 500m **no significant** impact human health would have occurred during these remedial works.

Source	Potential Pathway and Receptor	Impact Assessment
Pollution of surface water quality by sediment and hydrocarbons associated with the peat slide	The peat slide generated a very large volume of peat solids and debris which entered the Owendalulleegh River during a period of heavy rains. This river flows to Lough Cutra, a distance of circa 22 km downstream of the slide area. The outflow of Lough Cutra, the Beagh River, sinks underground at the Punchbowl, emerging to form the Cannahowna River. At this location water was abstracted forming 70% of the Gort Water Supply. Significant potential therefore existed for impact on the Gort water supply and subsequently human health to occur.	An assessment of the impact of the peat slide on the Lough Cutra water supply is provided in Chapter 8, Section 8.3.2.2. In the period after the peat slide the colour and level of suspended matter in the raw water increased. This was evidenced by Galway County Council's increased monitoring of the River water, Lake water, abstraction raw water and treated water. However, there was a noticeable trend in the reduction of suspended solids along the length of the rivers and lake system from the peat slide area to the abstraction point. A very high raw water colour (454^{o} Hazen at Gort Water Supply intake (Cannahowna River) on the 05/11/03) was observed and the colour of the treated water in the Gort supply was recorded as 58^{o} Hazen). The drinking water standard for water colour is indicated in SI 122 of 2014 (European Union (Drinking Water) Regulations 2014 and as amended.) as "Acceptable to consumers and no abnormal change". High colour in the drinking water supply would have given rise to complaint re the drinking water quality. However, it should be noted that the treatment afforded the Gort water supply at the time was basic sand filtration and high treated water colour was common in the supply. Increased cleaning of the sand bed filters, with Galway County Council indicating an increase in the frequency of the back-wash cycle for the rapid sand filters in the treatment plant, was also required. This high colour and increased cleaning persisted at the time for several weeks. However, at no time was the supply interrupted. The raw water sources currently supplying the town remain the same as in 2003 but now receive a higher level of treatment. The drinking water impact would have been **Locally Significant, Negative and Brief**

Source	Potential Pathway and Receptor	Impact Assessment
		throughout the peat slide period but remedial works including construction of barrages along the peat slide course significantly reduced the potential for peaty material and suspended solids to enter the Owendalulleegh river preventing and longer term impact. No impact was reported on the Group water supply scheme in Derrybrien. Overall **no significant impact on Human Health will have occurred.** The potential impact of hydrocarbon spills was Slight to Moderate and Negative on the Local environment and Brief throughout the spill period. Again, following the implementation of mitigation measures the risk arising from hydrocarbon spills was reduced **Not Significant. No significant impact on human health will have occurred.**
Pollution of groundwater quality by hydrocarbons from the site.	The peat slide impacted surface water only and did not impact on groundwater.	**No significant impact on human health will have occurred.**
Construction equipment Noise & Vibration	Works associated with the peat slide involving the construction of the barrages and extraction of material from borrow pit 3 generated noise from the equipment used at these locations with potential to impact on human health.	An assessment of the noise effects relating to the remedial works is provided in Chapter 5, Section 5.6.1.2. The predicted noise levels were below the construction noise criterion identified in Section 5.4.1.1 (i.e. 65dB $L_{Aeq,1hr}$) which indicated that these construction activities did not give rise to significant noise impact. The predicted levels of construction noise at the nearest noise sensitive properties were below the evening, night time and weekend criteria outlined in Section 5.4.1.1 also. The

Source	Potential Pathway and Receptor	Impact Assessment
		potential noise effects are described as **negative, slight and temporary** in nature. With regard to vibration the assessment indicates that due to the distance of the construction works from noise sensitive locations significant vibration impacts would not have been perceptible and would have been significantly below levels where cosmetic or structural damage would occur. **No significant impact** on human health occurred during the remedial works period associated with the peat slide from noise or vibration.
Major Accident and Disaster	The peat slide which occurred in October 2003 resulted in a large plug of peat and debris (trees, rocks silt) being swept down along the river course which flows under the Black Road Bridge and the Flaggy Bridge on the Gort to Portumna Road before entering the Owendalulleegh River and continuing down to Lough Cutra. The road bridges were damaged and the public roads were closed with diversions put in place. Along the river route, field boundaries were damaged, peat and debris was deposited on farmlands and some private access bridges were damaged also. One private house which was unoccupied at the time was cut off by the peat slide. The magnitude of the peat slide was such that it	No injury or loss of life occurred as a result of the peat slide event . However, in the aftermath of the peat slide there was significant anxiety in the population in Derrybrien regarding their health, wellbeing and safety related to the slide which had occurred and the potential for additional peat slides to occur. To mitigate against the impact of the existing and potential additional peat slides a series of barrages were constructed down along the course of the slide to halt the movement of any additional peat, (see Chapter 2 and Chapter 10). In addition, all construction works on the wind farm site were halted until a full review of peat stability was undertaken and the site works were assessed and approved by an engineering team. Additional remedial and mitigation measures were also developed for the construction activities post the peat slide event (see Chapter 10, Section 10.5.2) which included increased geotechnical supervision and certification of works, instrumentation and monitoring of the site, additional

Source	Potential Pathway and Receptor	Impact Assessment
	could have resulted in significant human health impact with potential for serious injury or loss of life. The workforce on the Derrybrien project could also have been impacted with potential loss of life or injury.	geotechnical site investigations, further assessments of floating roads, wind turbine foundation areas and crane hardstandings, spoil management and disposal, drainage improvements and tree felling management as well as other project construction areas. With the implementation of the mitigation measures to reduce the impact of the peat slide and protect against potential additional slides the risk of incidents decreased and impacts on Human Health would not have been significant.
Traffic and Transport	The peat slide which occurred in 2003 originated within the wind farm site and close to the boundary affected the local and national road infrastructure (Black Bridge area and the internal road structure within the wind farm)	An assessment of potential impacts from Traffic and Transport is provided in Chapter 14. Section 14.3.1.2 and are summarised as follows - Temporary closure of local and regional roads during the response to the peat slide. - Movement of materials from on-site and off-site borrow pits / quarries to the location of barrages and the construction of barrages. - New access track (approximately 300 m long) to Barrage No. 2. - Replacement of existing track adjacent Barrage No. 1. - Repairs to Black Road Bridge and Flaggy Bridge, both located on public roads. - Tree felling at repositories. - Bridge repairs on private land.

Source	Potential Pathway and Receptor	Impact Assessment
		Although a potential for injury or accident to occur existed on local roads, diversions were put in place to ensure avoidance of the impacted road network and **no impact** on human health associated with Traffic and Transport occurred as a result of the peat slide

4.5.1.4 Summary of impacts peat slide

In summary impacts on human health associated with the peat slide are as follows:

- **No significant** impact from air borne dust would have occurred
- **No significant** impact from vehicle exhaust emissions would have occurred
- The drinking water impact from Lough Cutra would have been **Locally Significant, Negative and Brief** throughout the peat slide period but overall **no significant impact on Human Health will have occurred.**
- **No significant** impact on human health from hydrocarbon spills will have occurred.
- Noise effects were negative, slight and temporary in nature and **no significant impact** on human health occurred
- Although potential impacts existed from the effects of the peat slide no health or safety incidents occurred during the peat slide itself and **no impact** on human health occurred.
- **No impact** on human health occurred as a result of temporary road closures Impacts which are occurring.

4.5.1.5 Operational phase 2006 – mid -2020

An assessment of the impacts which have occurred during the operational phase to mid-2020 is presented in Table 4-14.

Table 4-14 Operational impacts which have occurred to mid 2020

Source	Potential Pathway and Receptor	Impact Assessment
Air Quality	The operation of the wind farm will generate renewable electricity displacing fossil fuel greenhouse gas generation contributing towards a stabilisation/reduction in global temperature rise and climate change effects. The displacement of fossil fuel will also see a reduction in transboundary gases such as SOx, NOx, NMVOC and a reduction of emission related dust pollutants entering the air. Poor air quality can give rise to health impacts such as stroke heart disease, lung cancer, respiratory ailments and is estimated to contribute to 1,100 premature deaths in Ireland[14]. Elevated summer temperatures resulting from	The operational impacts on air quality are described in Chapter 12, Section 12.4.2.3. The project will not give rise to adverse air quality impacts and has had a beneficial effect in providing for energy without emissions through displacement of fossil fuel electricity production with clean renewable energy. Section 12.4.2.4 describes the impacts on transboundary gas emissions, predicting an annual reduction of circa 3.9 tons of Nitrogen oxides, 17 tons of carbon monoxide, 1 ton of Sulphur Oxides and 0.4 tons of dust ($PM_{2.5}$). Considering that the WHO and the EPA regard NOx and particulate matter (dust) as key air pollutants for human health a reduction in these emissions

[14] EPA, Air Quality in Ireland Report 2018, published in 2019. https://www.epa.ie/pubs/reports/air/quality/Air%20Quality%20In%20Ireland%202018.pdf

Source	Potential Pathway and Receptor	Impact Assessment
	climate change can also give rise to premature mortality rates.	can be seen as **a moderately positive benefit in the medium** term**.** Climate change impacts are described in Section 12.3.3. The Project will has generated circa 121,800 MWh of renewable electricity annually displacing circa 48,700 tCO_{2eq} annually from thermal electricity generation. **The effect on climate change will be positive, of moderate significance and medium in term.** Overall, a **positive impact** on human health during the operational period of the wind farm occurred.
Wind Turbine Noise	Potential health impacts from operational wind farm noise which is continuous in nature or which may have particular noise components such as tones or amplitude modulation have received considerable consideration in the literature. Wind farm operating noise can occur throughout the day and will vary dependent on wind speed and direction in terms of its perception at any noise sensitive location (dwelling) where people reside. Again, the World Health Organisation recognises that excessive noise seriously harms human health and interferes with daily activities[6]. The WHO has published noise guidance for Europe which includes wind farm noise and recommends that for average noise exposure, noise levels produced by wind turbines should be below 45 dB Lden, as wind turbine	An assessment of noise impacts which are occurring is provided in Chapter 5 Noise, The assessment of predicted noise levels, Section 5.6.1.4.3, identified no exceedances at any occupied noise sensitive locations with consideration of noise criteria curves derived considering the Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006). A slight 1.8dB excess is predicted at 7m/s at the long-term derelict property R39 during daytime periods.

Source	Potential Pathway and Receptor	Impact Assessment
	noise above this level is associated with adverse health effects. No recommendation [15]is made for average night noise exposure Lnight of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.	The predicted operational noise effects are indicated as being **negative, slight and long term** at the closest noise sensitive locations to the site Section 5.6.2. refers to actual compliance monitoring and concluded that the site is operating comfortably within the relevant daytime and night-time noise criteria. As the noise assessment indicates that the levels of noise are well within noise limits set out in the 2006 wind energy guidelines **no significant impact** on human health is predicted to have occurred.

[15]WHO Noise Guidance for Europe, http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018

Source	Potential Pathway and Receptor	Impact Assessment
		Predicted noise levels were also compared to the limits proposed in the Draft Wind Energy Development Guidelines 2019 and were found to be in compliance with these, **hence no impact** on human health will have occurred.
Shadow flicker	Shadow flicker is a flickering effect which is caused when rotating wind turbine blades cast shadows through windows of neighbouring properties. The effect occurs periodically. In general shadow flicker can give rise to residential amenity impacts but could potentially give rise to health effects such as photosensitive epilepsy depending on the operating frequency of the wind farm. There have been no shadow flicker complaints recorded to date during the operational period of Derrybrien. In terms of shadow flicker the UK updated evidenced based report states that (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48052/1416-update-uk-shadow-flicker-evidence-base.pdf) *"The operating frequency of a wind turbine will be relevant in determining whether or not shadow flicker can cause health effects in human beings. The National Society for Epilepsy advises that only 3.5 % of the 1 in 200 people in the UK who have epilepsy suffer from*	An assessment of shadow flicker effects is provided in Chapter 6. Shadow flicker potential impact assessments are normally carried out to assess the effect on sensitive locations (dwellings) within 10 rotor diameters of the nearest wind turbine. The rotor diameter of the Derrybrien wind turbines is 52m which equates to 520m distance for shadow flicker effect assessment. It is acknowledged by industry that shadow flicker dissipates rapidly with distance and is imperceptible beyond 10 rotor diameters. There are no dwellings within the 520m rotor diameter at Derrybrien and no occupied dwellings within 2km. However, there is one unoccupied house within 2km and the assessment indicated that the shadow flicker effect at this location would be within the allowable values as set out in the 2006 Wind Energy Guidelines. In terms of effects giving rise to Epilepsy the general specification for the Vestas V52 850kW machine erected at Derrybrien indicates that the variable rotor speed range is 14.0 - 31.4 revolutions per minute (RPM). For the three blade wind turbine this gives rise to a range of 42 to 94.2 blade flickers per minute. This equates to 0.7 to 1.57 flickers per

Source	Potential Pathway and Receptor	Impact Assessment
	photosensitive epilepsy. The frequency at which photosensitive epilepsy may be triggered varies from person to person but generally it is between 2.5 and 30 flashes per second (hertz). Most commercial wind turbines in the UK rotate much more slowly than this, at between 0.3 and 1.0 hertz. Therefore, health effects arising from shadow flicker will not have the potential to occur unless the operating frequency of a particular turbine is between 2.5 and 30 hertz and all other pre-conditions for shadow flicker effects to occur exist." (Page 22)	second (Hertz) which is below the trigger level for photosensitive epilepsy. Overall there has been **no significant impact** on human health during the operational phase of the wind farm.
Visual Impact	Visual annoyance impact arising from the continuous view of the wind farm.	An assessment of the Landscape and visual effects of the project is presented in Chapter 9 and summarised in Section 9.4.1.4. In summary the visual effects arising from the development of the wind farm in the landscape range from Imperceptible to Moderate. **No impact** on human health is predicted.

Source	Potential Pathway and Receptor	Impact Assessment
Electric and Magnetic Fields	Adverse health effects, such as heating of body parts and the stimulation of nerves are well known effects of some electric and magnetic fields (termed EMF). Concerns have also been raised by the general public about increased risks of cancer through exposure to mobile phones, telecommunication masts and high voltage electrical transmission systems although little evidence exists to support the latter. Electric and Magnetic Fields (electromagnetic fields (EMF)) around wind farms can originate from the grid connection lines, wind turbine generators, electrical transformers, and underground network cables.	Electric and magnetic fields are discussed in Section 4.4.3.6 above. Electric fields reduce in strength rapidly with distance from the source. For example, for the Derrybrien power transmission overhead line the electric field is strongest directly beneath the line where the conductors carrying electricity are nearest the ground, typically near the middle of the span between two adjacent support structures. By moving away from a power line the strength of the electrical field decreases rapidly. The current ICNIPR (International Commission on Non-Ionising Radiation Protection (https://www.icnirp.org/), a non-governmental organisation which is recognised by the World Health Organization) Guidelines for electric fields are 5kV/m and for magnetic flux density are 100uT. The maximum electric field strength at ground level 50m from the centre of the110 kV line of 0.077kV/m is well below the ICNIRP guideline as is the magnetic flux density of 0.1uT. Based on the ICNIRP Guidelines on exposure to EMF, the typical electric and magnetic fields on the 110kV transmission line and distance of human receptors from the source of these fields **no impact on** human health is predicted to have occurred.

Source	Potential Pathway and Receptor	Impact Assessment
Major Accidents and Disasters	No significant construction works took place as part of the Derrybrien Project during the operational period to mid-2020 but maintenance and ancillary works occurred which could have given rise to a potential peat instability, with the potential to impact on human beings. These included maintenance and repair of turbines, substation and access tracks, cables and ducting improvements, drainage Improvements, forestry (tree felling) and some remedial works. The works lead to increased load on access tracks from vehicle traffic (live load surcharge) and deposition of new road materials, excavations into peat potentially impacting intact areas and lowering of water table by drainage improvement. These works and their impacts are described in detail in Chapter 10, Section 10.3.2.2.	Th significance of the effect of the impacts of these activities is described in Chapter 10, Section 10.3.2.1.2.1 also as ranging from not significant/imperceptible to slight with the improvement in drainage effect on groundwater described as moderate and positive. In addition, mitigation measures as set out in Chapter 10, Section 10.5 were implemented which included continued instrumentation and monitoring of the site, geotechnical supervision of maintenance works and site inspections, maintenance and repair of infrastructure and drainage improvement and maintenance. No peat failure occurred during this operational period from the wind farm activities and **no impact on human health** occurred.
Pollution of groundwater by wastewater.	Untreated wastewater would have the potential to contaminate groundwater with harmful bacteria and other potential pathogens.	The wind farm is provided with sanitary facilities for use by the maintenance staff. The welfare facilities in the control building of Derrybrien Substation consists of one toilet and two sinks. Wastewater from this facility is treated using a proprietary wastewater treatment system (Envirocare P6) with treated water subsequently discharged to ground. The wastewater from the control room at Agannygal Substation is treated by a Biocycle wastewater treatment system which also discharges subsequently to ground (see Chapter 2).

Source	Potential Pathway and Receptor	Impact Assessment
		No significant impact on groundwater and hence no significant impact on human health from this source and pathway will have occurred.
Ice throw.	In cold climates or at high altitude, ice can potentially build up on the blades or other parts of a wind turbine. This does not arise when a turbine is in operation but rather where it has been stopped, following a grid failure for example, and the ambient temperature is very low, allowing ice to build up. Any ice formation during operation would be likely to cause a dynamic imbalance on the rotating blades that would automatically result in a shut-down of the wind turbine. Occasions of ice throw, that is where ice is shed from the blade and thrown some distance have been	To minimise the potential risk from falling ice, the design of the wind farm ensured that turbines are located a safe distance from potential receptors. For example, Wind Energy Production in Cold Climate (Tamelin et al.) [16] , recommended by Germanischer Lloyd and the Deutsches Windenergie Institut (DEWI) provides the following formula for calculating a safe distance: 1.5 x (hub height + rotor diameter). In the case of Derrybrien the turbines have a maximum overall dimension of 75 m and a maximum safe distance requirement

[16] Tammelin, B., Böhringer, A., Cavaliere, M., Holttinen, H., Morgan, C., Seifert, H., Säntti, K., & Vølund, P. (2000). Wind energy production in cold climate (WECO). Finnish Meteorological Institute. https://backend.orbit.dtu.dk/ws/portalfiles/portal/167477321/26134.pdf

Source	Potential Pathway and Receptor	Impact Assessment
	known to occur at high altitude in cold climates presenting a safety hazard to people in the vicinity of the turbine.	of 151.5 m (1.5 x (49 + 52)). All potential receptors are located well in excess of this calculated safe distance from the turbines at Derrybrien Wind Farm an **no impact** has occurred.

4.5.1.6 Summary of Operational Impacts which have occurred 2020 to end 2019

In summary impacts which occurred during the operational period of the wind farm to 2020 are as follows:.

- A **positive, medium term significant benefit** on transboundary air quality will have occurred with an overall **moderate positive impact** on human health from the displacement of NOx and particulate matter emissions .
- **No significant impact** on human health is predicted to have occurred from operational noise.
- **No significant impact** on human health from Shadow flicker has occurred.
- Visual effects arising from the development range from Imperceptible to Moderate and **no significant impact** on human health was predicted.
- **No impact** on human health is predicted to have occurred from EMF (electric and magnetic fields)
- **No significant impact** on groundwater and hence no significant impact on human health from sanitary facilities has occurred..
- **No impact** on human health from a major accident related to a peat instability on site occurred.
- **No impact** on human health from potential ice throw from turbine blades has occurred.

4.5.2 Impacts which are occurring

Impacts which are occurring are in general similar to those described for the operational phase 2006 to mid-2020. However, peat stability issues are discussed in more detail here as this is a key issue for the project.

In terms of the potential for Major Accidents or Disasters such as a peat slide to occur, this is discussed in Chapter 10, Section 10.3.2.2 which indicates that due to an improvement in site conditions there is a reduced likelihood of a peat slide occurring on the site in 2020 based on the site characteristics and the activities that are likely to be carried out as part of the wind farm project. By the end of Q2 2020 primary consolidation of the peat would be complete under the existing dead load surcharge of the floating roads, material sidecast areas and peat repositories that were stable and intact at the end of construction. Therefore, with the corresponding increase in undrained shear strength in the underlying peat, the likelihood of a peat slide under the surcharge loads has reduced to **Negligible,** so that by now the effect of the surcharge on the peat with regard to site stability is **Not Significant**.
In addition, the improved drainage network that was constructed on the site for the wind farm is a **Permanent** and **Sustained** impact on groundwater levels that has had a **positive** stability impact on the peat relative to the baseline conditions on site in 1998, prior to construction. The effect of the drainage improvements on the stability of the peat has been assessed as **Medium,** and of **Moderate** significance. Although it will take many years for the groundwater in the peat to stabilise at new equilibrium levels across the site, the majority of the groundwater lowering would have occurred by the end of 2020 and any further changes would be expected to be minor. Mitigation measures implemented during the operational period to date will continue

to be implemented to the end of the project operational period. This would indicate that no significant impact on human beings from a peat slide is or is occurring or is likely to occur.

4.5.3 Impacts which are Likely to Occur

4.5.3.1 Operational impacts which are likely to occur; 2020 to circa 2040

This section provides an assessment of impacts which are likely to occur from the on-going operation of the wind farm, Table 4-15.

Table 4-15: Operational impacts which are likely to occur between mid-2020 and circa 2040

Source	Potential Pathway and Receptor	Impact Assessment
Air Quality	As per Table 4-14	The operational impacts of the project on air quality, transboundary gas emissions and climate change through displacement of greenhouse gas emissions and emissions of NOx and particulate will remain positive and moderately significant to the end of the operational period with a continued **positive impact** on human health.
Wind Turbine Noise	As per Table 4-22	The assessment of predicted noise levels, Section 5.6.1.4.3, identified no exceedances at any occupied noise sensitive locations with consideration of noise criteria curves derived considering the Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006). The compliance monitoring also concluded that the site is operating comfortably within the relevant daytime and night-time noise criteria and **no significant impact** on human health is predicted to occur. Predicted noise levels were also compared to the limits proposed in the Draft Wind Energy Development Guidelines 2019 and were found to be in compliance with these, hence **no impact** on human health is likely to occur
Shadow flicker	As per Table 4-22	In terms of the future operation of the wind farm, given the distances to the nearest occupied dwelling **no significant impact** on human health would be likely to occur. The Draft Wind Energy Guidelines 2019 were published for consultation and the consultation period is now closed These call for zero shadow flicker. The occupied dwellings would be

Source	Potential Pathway and Receptor	Impact Assessment
		outside the area where significant shadow effects would likely occur and **no significant impact** on human health is likely to occur.
Visual Impact	As per Table 4-22	The landscape impact of the development is expected to be similar to that described for the operational period to date. Into the future, the landscape in the vicinity of the turbines is expected to continue to change over time, with forestry operations (felling, timber removal and replanting) expected to continue on a cyclical basis as in the past. **No impact** on human health is predicted.
Electric and Magnetic Fields	As per Table 4-22	The electric and magnetic field strengths will remain well below the International Commission on Non-Ionising Radiation Protection Guidelines for electric fields and given the distance of human receptors from the source of these fields **no impact** on human health is predicted to occur to the end of the Project.
Major Accident and Disasters	Works activities on site from mid-2020 to circa 2040 will be similar to those described in the operational period to date and will generally comprise maintenance and ancillary works occurred which could give rise to a potential peat instability, with the potential to impact on human beings. The works could lead to increased load on access tracks from vehicle traffic (live load surcharge) and deposition of new road materials,	The assessment of stability impacts for the operational phase to circa 2040 provided in Chapter 10, Section 10.3.2.3.1.3 indicates that the effects of the activities likely to occur on site range from not significant to slight with the positive effect of drainage on site stability being moderate. Additional mitigation measures are proposed in Chapter 10, Section 10.5.2.4. including periodic inspections by a qualified geotechnical engineer, geotechnical assessment of any modification to site access for heavy equipment, continued monitoring and supervision of site works by a geotechnical engineer also. These measures have

Source	Potential Pathway and Receptor	Impact Assessment
	excavations into peat potentially impacting intact areas and lowering of water table by drainage improvement. These works and their impacts are described in detail in Chapter 10, Soils Geology and Land, Section 10.3.2.3	been incorporated into standard operating procedures for the site. It is therefore unlikely that a peat stability issue will arise and **no impact** on human health would be likely to occur.
		To reduce potential for accidents access restrictions are in place for mobile cranes on the narrow turbary road near turbine T40 between turbine T31 and T45
Pollution of groundwater by wastewater.	As per Table 4-22	Sanitary facilities using proprietary wastewater treatment systems (Envirocare P6 and Biocycle) will continue to be provided, operated and maintained through the lifetime of the project and **no significant impact** on groundwater and hence no significant impact on human health is likely to occur.
Ice throw.	As per Table 4- 22	As dwellings are located outside the calculated impact distance for ice throw from the turbine blades at Derrybrien no impact is predicted to occur and no impact on human health is predicted to occur also from Ice throw the ongoing operation of the wind farm to circa 2040.

4.5.3.2 Summary of Operational impacts which are Likely to Occur

The continued operation of the Project will likely result in similar impacts as those which occurred during the operational period to date, described in Table 4-14 above and which are summarised here.

- An overall continued **positive benefit** on air quality and on human health in the **medium term**.
- **No significant** noise impact on human health would be likely to occur .
- **No significant** shadow flicker impact on human health is likely to occur.
- **No significant** impact on human health from landscape impacts is likely to occur.
- **No EMF** impact on human health is likely to occur.
- **No impact** on human health from a major accident related to a peat instability on site is likely to occur.
- **No significant** impact on groundwater and hence no significant impact on human health is likely to occur.
- **No impact** from ice throw from the turbine is likely to occur and no impact on human health is likely to occur.

4.5.3.3 Decommissioning phase impacts which are Likely to Occur

The potential for impact on human health during the construction period will be significantly less than during the construction phase as it is not intended to remove structure foundations and to confine decommissioning to above ground structures. An assessment of the impacts that are likely to occur during the decommissioning phase of the wind farm is presented in Table 4-16.

Table 4-16 Decommissioning Phase Impacts

Source	Potential Pathway and Receptor	Impact Assessment
Air pollution from dust arising from decommissioning activities	Decommissioning of the wind farm, overhead line grid connection and substation is described in detail in Chapter 2. Decommissioning of the wind farm will involve the removal of the above ground elements, including dismantling of the wind turbines and meteorological mast and demolition of the substation structure above ground. The reinforced concrete turbine bases; site access tracks crane, substation and control building hardstanding area, site drainage network; and underground cables will all be left in-situ. On-site peat repository/storage areas from the construction stage; and borrow pits will also be left in-situ. The OHL infrastructure between the Derrybrien and Agannygal substations would be removed. The decommissioning operations will give rise to dust generation to a limited extent, mainly from the demolition of the substation and control building with potential to impact on air quality and thus on human beings.	As it is not intended to remove structure foundations and to confine decommissioning to above ground structures the potential for generation of dust related emissions will be low and confined mainly to the demolition of the substation and control building at the wind farm site. Given the distances to the nearest occupied dwellings (over 2km) the risk of air borne dust or dust deposition on human receptors is **negligible and no significant impact** will likely occur during the decommissioning phase of the wind farm site. Similarly, decommissioning of the OHL will be confined to removal of conductors, towers and intermediate pole sets. The nearest decommissioning location is located 380m from the nearest occupied dwelling and the process will be of very short duration at a small focused site. The impact from dust arising from decommissioning of this line will be of **negligible risk and no significant impact** will likely occur. The nearest dwelling to the Agannygal site construction is located circa 540m from the site. The potential risk of dust impact on the nearest dwelling is therefore negligible **and no significant impact** will likely occur.

Source	Potential Pathway and Receptor	Impact Assessment
Air pollution from equipment emissions during decommissioning.	There will be limited number of vehicles involved in the decommissioning of the wind farm, overhead line and Agannygal Substation. Exhaust emissions will occur such as nitrogen oxides and sulphur oxides from equipment used in the decommissioning. These will contribute to greenhouse and transboundary gases nationally but on a very minor level.	Exhaust emissions from decommissioning will be localised and short term at any given location and will quickly disperse in the atmosphere. Given that the nearest occupied dwellings to the wind farm site (over 2km) **no significant** impact will likely occur. Similarly, given the distance of the nearest decommissioning location on the 110kV overhead line to an occupied dwelling (380m) **no significant impact will likely occur**. The nearest dwelling to the Agannygal site construction is located circa 540m from the site, **no significant impact will likely occur.** **There will be no significant impact on human health from decommissioning operations.**
Noise and Vibration from equipment used during decommissioning	Noise and vibration associated with the operation of decommissioning equipment could give rise to direct impact in the audible range and to annoyance disturbance.	Noise and vibration impacts from decommissioning are described in Chapter 5, Section 5.6.3.2 and are considered to be comparable to the construction noise. As such potential noise effects from decommissioning will be **negative, slight and temporary** in nature. No vibration effects on human health will occur. **No significant impact** on human health occurred during the remedial works period associated from noise or vibration.

Source	Potential Pathway and Receptor	Impact Assessment
Pollution of surface water quality by sediment and hydrocarbons from the site	Decommissioning of the project will involve the demolition of the substations and control building and also the removal of Barrages 3 and 4. These operations have the potential to result in contaminated surface water in the absence of mitigation which could flow to the main Owendalulleegh. River and into Cannahowna River which is a regional drinking water supply source.	An assessment of the impacts from decommissioning is referred to in Chapter 8, Section 8.3.4.2 with the effect described as a **slight, temporary adverse impact** on water quality. Mitigation measures are described in Section 8.5.1 which will minimise the potential impact of decommissioning activities and in particular the removal of post slide barrages 3 and 4 and ensure no effect on Lough Cutra and therefore no effect on the Cannahowna River which is downstream of Lough Cutra There will **no impact** on human health from this aspect of the project decommissioning.
Pollution of groundwater by sediment and hydrocarbons from the site.	Ground disturbance during decommissioning could give rise to contamination of groundwater with sediment and hydrocarbons which could impact on groundwater abstraction sources in the area.	As stated in Chapter 2, Section 2.8 no subsurface structures will be removed during decommissioning and all foundations will be left in-situ. No impact on groundwater will occur and hence no potential impact on human health will occur .
Pollution of groundwater by wastewater	Untreated wastewater would have the potential to contaminate groundwater with harmful bacteria and other potential pathogens.	The wastewater treatment facilities will remain in place until final decommissioning and will be supplemented by suitable mobile sanitary facilities as appropriate to ensure no contamination of groundwater from this source. **No impact** on human health will occur.
Major accident or disaster	The primary works that are likely to be carried out on the site during decommissioning that could have an impact on	The assessment of effects of stability impacts is provided in Chapter 10, Section 10.3.2.3.2.3 indicates that the

Source	Potential Pathway and Receptor	Impact Assessment
	soils, geology and land (Chapter 10, Section 10.3.2.3.2) include de-energising the substation and electrical cables, and removing all of the buried cables, widening the turbary road between Turbines T31 and T45, dismantling the turbines, substation and anemometers and transporting the components off-site, demolition of the control building and transporting the demolition waste off-site for disposal. These could give rise to direct impacts on land, soils and geology which could give rise to site instability and peat movement, which could impact on human health.	decommissioning activities will give rise to effects ranging from not significant to slight .indicating a low likelihood of an instability event occurring. Mitigation measures have also been developed and set out in Chapter 10, Section 5.2.5 based on the proposed decommissioning plan. These include detailed design works by a qualified geotechnical engineer, stability analyses in advance of works, limiting heavy equipment do not exceed the design load for floating roads and direct pulling of electric cables where possible. All works will be supervised by a qualified geotechnical enginee. With the implementation of mitigation measures no impact on human health **would be likely to occur**.
Construction related workplace accidents	Similar to the construction period, workplace accidents could occur on the project site during decommissioning as the health and safety hazards would be similar (moving heavy equipment, delivery loads, electricity supply, uneven ground, working at heights, confined spaces, and others. Incidence can occur which can result in impact on the health and wellbeing of the workforce and people accessing the construction site. Construction workplaces must be operated in accordance with Irish Legislation relating to Health Safety and Welfare at Work.	Derrybrien Wind Farm operates a Safety Management System (SMS) which meets the requirements of OHSAS 18001 and this will continue to be implemented throughout the decommissioning period.. Derrybrien Wind Farm also operates an emergency procedure. The emergency procedure will be maintained throughout the lifetime of the wind farm. To reduce potential for accidents access restrictions are in place for mobile cranes on the narrow turbary road near turbine T40 between turbine T31 and T45.

Source	Potential Pathway and Receptor	Impact Assessment
		Decommissioning will be carried out in accordance with legislation and best practice with respect to Health and Safety. This will involve site inductions, risk assessment and method statements.
Traffic and Transport	Localised air pollution could occur from fossil fuel combustion emissions. Potential impacts could occur such as a lack of safe walking and cycling networks and traffic injuries.	Decommissioning effects on Traffic and Transport have been assessed in Chapter 14, Section 14.3.3.2. In summary there will be **temporary, significant, negative impacts** on the surrounding local road network and **temporary, imperceptible, negative impacts** on the national road network and no significant impacts on human health are likely to occur

4.5.3.4 Summary of decommissioning phase impacts of the project

In summary impacts that are likely to occur during the decommissioning phase are as follows:

- The risk of air borne dust impacting on human health will be negligible and **no significant** impact on human health will occur.
- **No significan**t impact on human health from noise and vibration will likely occur
- **No impact** on human health from surface water pollution is likely to occur.
- **No impact** on groundwater will occur and no potential impact on human health will likely occur also.
- **No impact** on human health from a major accident related to a peat instability on site is likely to occur
- **No impact** on human health will occur from sanitary facilities
- **No significant impacts** from traffic and transport are likely to occur.

4.5.4 Cumulative Impacts on Human Health

Based on consideration of the receiving environment the projects which could be relevant for cumulative effects assessments are set out in Section 4.3.4 above and potential cumulative impacts on human health arising from these projects are assessed here.

4.5.4.1 Turbary within and immediately adjacent to wind farm site

Turf from turbary cutting within the wind farm site is ongoing as described in Section 4.3.4.1 above. An assessment of the effects of turbary turf cutting on the stability of the site is provided in Chapter 10, Section 10.4.5. The assessment indicates that there are significant areas of the turbary plots where the likelihood of a peat failure due to mechanical peat harvesting under uncontrolled conditions without appropriate mitigation measures is Very Possible to Likely. These zones are located in areas where there are compounding risk factors in relation to peat instability. Although no large or very large scale peat failures have occurred in the turbary area at the east end of the Derrybrien Wind Farm site to date there two areas where localised peat instability has occurred associated with turbary. Cumulative site stability impacts arising from peat extraction in turbary plots on the wind farm site and adjacent to it could therefore potentially occur where specific peat harvesting methodologies are utilised. The potential impact will not arise as a direct result of wind farm continued operational activities or decommissioning activities but relate primarily to the use of mechanical peat harvesting equipment on turbary plots and could range from localised instability to potentially a large scale peat slide in the worst case scenario. In the absence of mitigation this **could impact** on human health through a peat slide occurring. However, mitigation measures have been developed to be implemented by the Wind Farm and by the turbary holders (Chapter 10, Section 10.4.5.2.4) which when implemented would reduce the likelihood of a peat failure to low with **a low likelihood of cumulative impact** on human health.

4.5.4.2 Peat extraction outside Project site

No peat extraction activities subject to a development consent have been identified in the vicinity of the Project but turbary turf cutting occurs in the vicinity of the project. Turf cutting has likely been carried out and will continue to be carried out in many of these areas under turbary rights. The cumulative impact of the turbary turf cutting on the Derrybrien Wind Farm site is assessed in Chapter 10, Section 10.4.5. With the exception of the turbary plots just outside the site boundary at the east end of the wind farm, all of the areas of cutover bog outside the site are remote to the site and separated from it by conifer plantations. Therefore, the site activities related to the turf cutting will not give rise to significant cumulative direct or stability impacts on the receiving soils, geology and land in the Project area and no cumulative impact on human health is likely to occur.

4.5.4.3 Wind Farms in Slieve Aughty Mountains

Given the separation distances and short duration of overlap of construction between Sonnagh Old Wind farm and Derrybrien there would have been **no cumulative** impact during the construction phase.

Similarly with Keelderry Wind Farm **no cumulative** effect from this project with Derrybrien would have occurred.

During the operation phase there would be a **slight positive, medium term effect** on human health due to cumulative reduced transboundary air quality emissions in general.

4.5.4.4 Adjacent coniferous forestry plantations

There would have been no cumulative impact on human beings from forestry operations given the separation distance of dwellings from forestry activities during the construction stage of Derrybrien. Ongoing forestry operations as part of the natural forestry cycle will likely continue in the area to the end of the Project . Again given the separation distances from decommissioning works to the nearest occupied dwellings cumulative health impacts with forestry activities are unlikely to occur.

4.5.4.5 Adjacent transmission lines

No cumulative impact is predicted with the Moneypoint - Oldstreet 400 kV Overhead Line during construction but there is some cumulative electromagnetic field potential for impact where the Derrybrien-Agannygal 110kV line passes under the Moneypoint to Woodlands 400kV line. However, given the distance to the nearest occupied dwelling no cumulative health impact is likely to occur.

Likewise, no cumulative health impacts is likely to occur with the Ennis-Shannonbridge line.

4.5.4.6 M18 Motorway Project

No cumulative health impacts have occurred or are likely to occur with this motorway.

4.5.4.7 Quarries/Sand extraction

No cumulative human health impacts have occurred with the sand extraction at Cloghvoley which was granted permission subsequent to Derrybrien construction.

Given the small scale (1.8 Ha) of the Coillte aggregate quarry and the remoteness of the Derrybrien and quarry sites **no significant cumulative** impact is predicted to occur.

The Ballinakill Quarry operates in accordance with its substitute consent permission granted by An Bord Pleanála for works and operations undertaken prior to August 2012 (Ref. 07.SU0038). A rEIS and rNIS was submitted with the application. Implementation of any conditions set out in the substitute consent will ensure no significant cumulative effect will occur from operation of this quarry on human health..

4.5.4.8 Conclusion on Human Health cumulative impacts

In conclusion the following cumulative impacts have or will occur

Construction: There has not been any negative cumulative health impact arising from cumulative projects in the general area.

Operation and decommissioning: There has been no significant negative cumulative impacts on human health arising from the presence of the Derrybrien Wind Farm Project with existing projects and activities. The assessment of cumulative impacts with turbary activity within and adjacent to the wind farm site has identified the likelihood of an instability event occurring when mechanical peat cutting and harvesting in certain areas is employed in the absence of mitigation (Chapter 10.4.5). Mitigation measures have been identified to be implemented by the wind farm itself and by those implementing turbary rights which when implemented would reduce the likelihood of instability to low and also reducing the likelihood of an impact on human health.

A **slight positive** cumulative effect of medium term on human health will likely occur with Sonnagh Old Wind farm through cumulatively reducing the transboundary emissions of NOx and particulate matter, identified by the WHO and EPA as significant air pollutants.

4.5.5 Remedial (Mitigation) Measures and Monitoring

Significant negative impacts to the health of the population in the area have not occurred but potentially could have occurred or could occur from site instability in the absence of mitigation.

Mitigation for noise has been included in Chapter 5 for all project phases. Chapter 10, Section 10.5 sets out detailed remedial and mitigation measures, described above, which were implemented during construction and operation to date, which will be implemented during the operation period to circa 2040 and also during the project decommissioning. Mitigation has also been developed for potential cumulative impacts with turbary cutting. These mitigation measures will be key to ensuring that peat instability on site does not arise and that no impact on human health will occur. Chapter 12 on air and climate includes mitigation for decommissioning to ensure no impact from particulate matter on air quality and human health also.

Derrybrien Wind Farm operates a Safety Management System (SMS) which meets the requirements of OHSAS 18001 and this will continue to be implemented throughout its operational life.

Derrybrien Wind Farm also operates an emergency procedure. This covers procedure in event of accidents, lone working, persons falling into water, forest/gorse fire, fire in wind turbine towers and procedure in event of landslide. Contact details are provided for emergency services, including the local authority and An Garda Siochána. The emergency procedure will be maintained throughout the lifetime of the wind farm.

To reduce potential for accidents access restrictions are in place for mobile cranes on the narrow turbary road near turbine T40 between turbine T31 and T45.

Decommissioning will be carried out in accordance with legislation and best practice with respect to Health and Safety. This will involve site inductions, risk assessment and method statements.

In general mitigation of impacts on human health has been considered in the context of mitigation of other aspects of this development in the relevant Sections of the Environmental Report which when fully implemented will ensure no likely impact on human health.

4.5.6 Residual Impacts on Human Health

No residual negative impacts on human health are predicted to occur.

4.5.7 Conclusions on Human Health

The distance between wind turbines and occupied buildings is always greater than that necessary to meet safety requirements. The turbines in use for Derrybrien Wind Farm have a proven record in terms of safety and reliability.

In summary, the operation of the wind farm to date has not and future operation will not result in significant adverse impacts on human health.

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