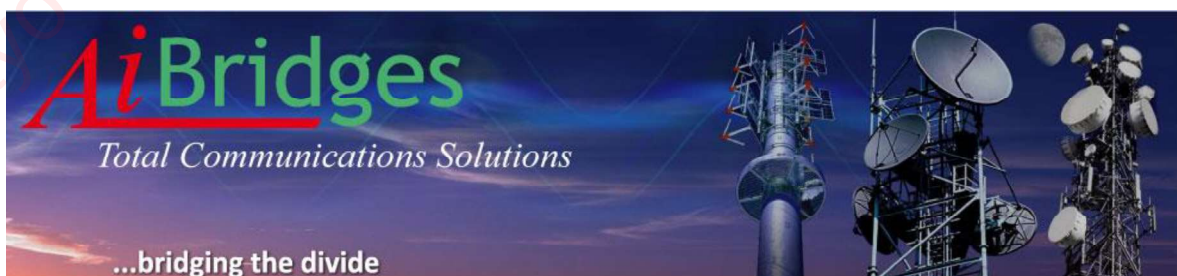


9.0 Aviation, Telecommunications & Electromagnetic Interference

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9.1 Introduction

Ai Bridges Limited was commissioned to evaluate and assess the possible effects that the proposed Keerglen Wind Farm (herein referred to as the proposed development) in County Mayo could have on the following communications system types:

- Aviation Communications, Navigation and Surveillance Systems
- Telecommunications \ Electromagnetic Interference (EMI)

Radio waves, including microwave radio waves, are used for a wide variety of communication purposes. The rotating blades of wind turbines can cause radio wave reflections causing interference across a range of telecommunication radio technologies. The radio signals can be reflected from turbine blades so that nearby telecommunications receivers may pick up both the direct and the reflected signals.

The purpose of this chapter was to identify network infrastructure that could be impacted by the proposed development, and to propose possible mitigation measures where applicable. The proposed wind farm consists of eight wind turbine generators. The turbine dimensions will be dependent on the selected turbine model. The proposed co-ordinates of the turbines are listed below in Table 9.1.

Table 9.1 Keerglen Turbine Co-ordinates (IRENET95 / ITM)		
Turbine_ID	Easting	Northing
WTG01	505565	832360
WTG02	505470	831909
WTG03	505827	831743
WTG04	505920	832214
WTG05	506383	832271
WTG06	506344	831817
WTG07	506978	831969
WTG08	507325	832404

9.2 Statement of Competence

Ai Bridges is a leading supplier of telecommunications solutions and software services for the telecommunications industry in the Irish marketplace. We provide comprehensive turnkey solutions and have extensive experience and knowledge of network design, implementation and deployment of telecommunications software modelling and design solutions. We have designed and commissioned telecommunications projects for clients throughout Ireland and abroad and have worked successfully with leading vendors to bring telecommunications software solutions to market for the renewable energy sector.

Ai Bridges has been supplying telecommunications solutions to the wind farm industry throughout the Republic and Northern Ireland since 2007. We have undertaken aviation, telecommunications and Electromagnetic Interference impact study reports on behalf of wind farm operators on the potential impact on telecommunications networks and transmission networks of proposed wind farm developments. Ai Bridges has also developed a 3D software prediction model that can predict the impact of a wind farm development on television transmission and aviation.

This chapter for the proposed development was prepared by the Engineering Department which has an excess of 100 man years of experience in aviation, telecommunications\electromagnetic interference EIAR Studies. Ai Bridges Ltd extensive experience in the wind farm industry and has previously worked with many utility companies under Framework Agreements for Telecommunications Signal Interference Surveying and Remediation Services.

9.3 Relevant Legislation and Guidance

This chapter had been guided by IWEA's Best Practice Guidelines for the Wind Energy Industry Chapter 6.3.10 of the Irish Wind Energy Association Best Practice Guidelines for feasibility studies states the following ...

"Telecommunications signals can occasionally be affected by wind turbines. This can arise from a signal being blocked or interrupted by turbine towers and/or blades in the case of point to point signals or more general interference in the case of point to multi-point signals and radar.

Current best practice

Each of the main telecommunications service providers will need to be contacted. In order to determine if there are telecommunications links going through any potential site, the telecommunications service providers should be issued a consultation letter with the site boundary details. The locations of any links in the vicinity of a potential site should be mapped at an early stage to inform the site layout design. It is often necessary to survey the precise location of telecommunications masts to ensure that telecommunications constraints are mapped correctly. Where telecommunications service providers have masts in the vicinity of the proposed wind farm, enquiries should be made about other parties who could be utilising the mast for private telecommunications networks."

For aviation, a number of references have been used including the European Organization for the Safety of Air Navigation EUROCONTROL Guidelines as well as UK Civil Aviation Authority (UK CAA) guidelines on the impact of wind turbines on aviation. (See Appendix 7.11)

9.4 Methodology

A brief summary of the methodology used in the Aviation and EMI studies is provided in Sections 9.4.1 to 9.4.2 that follow.

9.4.1 Aviation Study Methodology

There are three primary stages in preparing and compiling an aviation impact study:

- Consultations with relevant Aviation Authorities
- Field Surveys of the Receiving Environment
- Desktop Survey Network Modelling and Analysis

9.4.1.1 Aviation Consultations

Consultations are commenced with relevant aviation operators who are requested to raise any concerns they have regarding the impact of the proposed wind farm development on their communications networks.

9.4.1.2 Aviation Field Surveys

Field surveys of the nearest airports/aerodromes and telecom sites are undertaken to assess aviation communications infrastructure (e.g. presence of radar surveillance or VOR systems).

9.4.1.3 Aviation Desktop Survey and Analysis

Desktop surveys are carried out and relevant aviation infrastructure is plotted in a specialized radio planning tool and shown relative to the wind farm. The radio planning tool uses GIS and terrain mapping databases to enable accurate 3D modelling. An assessment can then be made to determine if there will be any impacts on aviation communication networks due to the wind farm.

9.4.2 EMI Study Methodology

There are three primary stages in preparing and compiling an EMI impact study:

- Telecom Operator Consultations
- Field Surveys of the Receiving Environment
- Desktop Survey Network Modelling and Analysis

A summary of each of these stages is provided below.

9.4.2.1 EMI Telecom Operator Consultations

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

9.4.2.2 EMI Field Surveys

Field surveys of telecom mast-sites in the vicinity of the wind farm are undertaken. During the field survey, antenna size, bearing and height on each of the telecom masts are surveyed and recorded.

9.4.2.3 EMI Desktop Survey Network Modelling and Analysis

A desktop survey is carried out to plot the wind turbines using a specialised radio planning tool. The radio planning tool uses GIS and terrain mapping databases to enable accurate modelling. The findings from the consultations and field surveys are collated and the communications networks requiring further analysis are identified. 3D network modeling is then used to assess the impact of the turbines on the communications networks. The results from the network modeling are used to determine if mitigation measures are required.

9.5 Description of the Environment

A brief summary of the receiving environment for the Aviation and EMI Studies is provided in Sections 9.5.1 to 9.5.2 that follow.

9.5.1 Aviation Receiving Environment

The nearest IAA Aviation Radar Surveillance Site is located at Dooncarton, Co Mayo and the nearest aviation facilities to the proposed development are:

- Dooncarton Radar Surveillance Site.
- Crossmolina Airfield, Co Mayo.
- Ballina Airfield, Co Mayo.

A brief description of the IAA Radar Site at Dooncarton and the Crossmolina and Ballina Aerodromes are provided in Sections 9.5.1.1 to 9.5.1.3.

9.5.1.1 IAA Radar Surveillance Site – Dooncarton

The radar surveillance site at Dooncarton consists of an MSSR Radar system as shown in Figure 9.1. This aviation site is located approximately 25 km west of the proposed Keerglen wind farm development.



Figure 9.1. IAA Radar Surveillance Site – Dooncarton

9.5.1.2 Crossmolina Airfield

Crossmolina Airstrip is located approximately 11 km southeast of Keerglen Wind Farm. The aerodrome consists of a grass-strip runway and is used for light aircraft only. During field surveys, no radar systems or ATS communications facilities were observed at the aerodrome. Details regarding any ATS (Air Traffic Services) communication facilities located at the airfield are not publicly available, as the aerodrome is unlicensed and privately owned.



Figure 9.2. Crossmolina Airfield relative to Keerglen Wind Farm

9.5.1.3 Ballina Airstrip

Ballina Airstrip is located approximately 22 km southeast of Keerglen Wind Farm. The aerodrome consists of a grass-strip runway and is used for light aircraft only. During field surveys, no radar systems or ATS communications facilities were observed at the aerodrome. Details regarding any ATS (Air Traffic Services) communication facilities located at the airfield are not publicly available, as the aerodrome is unlicensed and privately owned.



Figure 9.3 Ballina Airstrip relative to Keerglen Wind Farm

9.5.2 EMI Receiving Environment

To assist in identifying telecommunication infrastructure that could potentially be impacted by the proposed wind farm, consultations were undertaken with the relevant telecommunications network operators. The operators were requested to raise any concerns they may have regarding impacts to their networks due to the proposed wind farm development. Table 9.2 lists the telecom operators contacted and the issues raised by the operators.

Note: Only Telecom Operators that operated telecommunications networks/services in the vicinity of the proposed wind farm development were contacted during the consultation process. Telecom Operators who are known not to have network infrastructure in the area were not contacted.

Table 9.2 Telecom Operators Consulted			
ID	Operator	Response Received	Issues raised by Operator
1	Enet	Yes	No issues.
2	An Garda Síochána	N/A	No issues. An Garda Síochána no longer provide responses to consultations requests.
3	Broadcast Authority of Ireland (BAI)	Yes	No issues.
4	BT Ireland	Yes	No issues. (BT have confirmed that they do not operate radio links in Co Mayo.)
5	Eir	Yes	No issues.
6	ESB Services	Yes	No issues.
7	Irish Aviation Authority (IAA)	No	Response Pending
8	Imagine Broadband	Yes	No issues.
9	Mayo County Council	Yes	No issues.
10	2RN	Yes	No issues. 2RN have stated their transmission network will not be impacted. However they have recommended that a protocol be put in place between 2RN and the developers to mitigate for possible impacts to TV service reception in the area.
11	Tetra Ireland (TI)	Yes	No issues.
12	Three Ireland	Yes	No issues.
13	Virgin Media	Yes	No issues.
14	Viatel	No	Response Pending
15	Vodafone	Yes	No issues.
16	Dept. of Defence	No	No response. (DoD is a statutory consultee and have previously stated that they will only respond to the Planning Authority under an RFI at Planning Application Stage.)
17	ComReg	No	Response Pending

In addition to the information obtained during the consultation process, field surveys of the telecom mast-sites in the vicinity of the proposed wind farm were carried out. Figure 9.4 below shows the telecom mast-sites relative to the proposed wind farm site boundary.

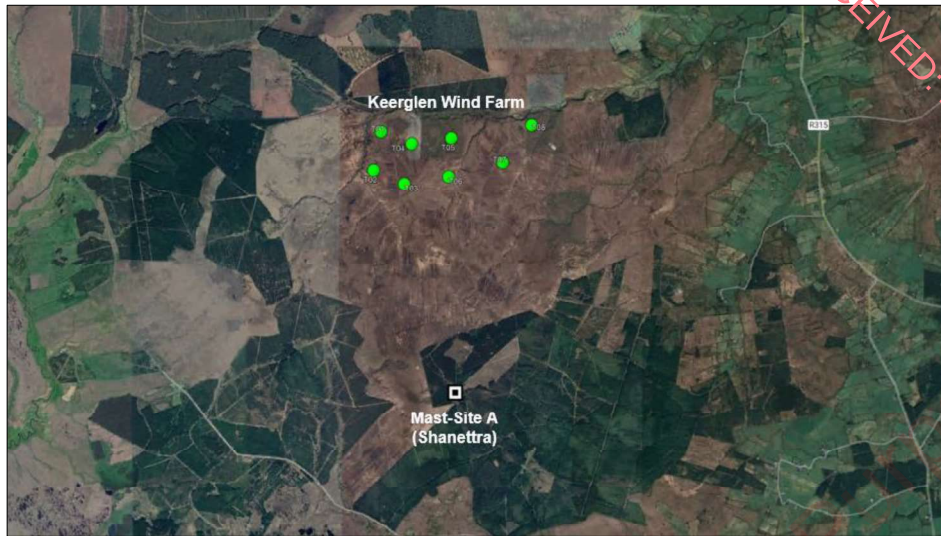


Figure 9.4. Telecom Mast-Sites in vicinity of proposed Wind Farm Site at Keerglen

Sections 9.5.2.1 that follows outlines the findings from the field survey of this telecom mast-site.

9.5.2.1 Mast-Site A (Shanettra, Co Mayo)

Telecommunications Mast-Site A is located in the townland of Shanettra 2 km south of the proposed wind farm site. The mast-site consists of three communications mast structures (ID: Mast A1, Mast A2 and Mast A3). A summary of the field survey findings of this mast-site is provided below.



Figure 9.5. Shanettra - Mast A1



Figure 9.6. Shanettra - Mast A2



Figure 9.7. Shanettra - Mast A3

Table 9.3 Summary of Field / Desktop Survey Findings		
Mast ID	Radio links observed with a bearing in direction of proposed wind farm.	Additional Comments
Mast A1	0	None
Mast A2	0	None
Mast A3	0	None

9.6 Statement of Potential Impacts

A summary of the potential impacts of the development on Aviation and EMI is provided in Sections 9.6.1 to 9.6.2 that follow.

9.6.1 Impacts of the Development on Aviation

The following aviation infrastructure was assessed to determine if there could be any impacts due to the proposed Keerglen Wind Farm Project.

- IAA Radar Surveillance System – Dooncarton.
- Crossmolina Airfield
- Ballina Airstrip

9.6.1.1 Impacts on IAA Radar Surveillance System – Dooncarton

When safeguarding surveillance systems from the possible impacts of wind farms, the IAA utilises guidance material prepared by The European Organisation for the Safety of Air Navigation (EUROCONTROL) titled '*How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors*'. In the EUROCONTROL document the following four zones are defined:

Zone 1: Safeguarding Zone (PSR and SSR).

An initial restrictive or safeguarding region that surrounds the surveillance sensor. No developments shall be agreed to within this area (500 metres).

Zone 2: Detailed Assessment Zone (PSR and SSR).

Following the safeguarded region is an area where surveillance data providers would reject planning applications unless they were supported by a detailed technical assessment provided by the applicant and the results of which are found to be acceptable to the surveillance provider.

Zone 3: Simple Assessment Zone (PSR only).

Beyond the detailed assessment zone is a region within which a simple assessment of PSR performance should be sufficient to enable the surveillance data provider to assess the application.

Zone 4: Accepted Zone (PSR 15km and SSR 16km).

Beyond the simple assessment zone are areas within which no assessments may be required and within which air navigation service providers would be unlikely to raise objections to wind farms on the basis of impact on surveillance services.

Tables 9.4 and 9.5 below show the Assessment Zone arrangement for the two types of aviation radar surveillance systems; Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR).

Table 9.4 PSR Zone Arrangements	
Zone	Description
Zone 1 - Safeguarding	0 - 500m
Zone 2 - Detailed Assessment	500m - 15km and in radar line of sight
Zone 3 - Simple Assessment	Further than 15km and in radar line of sight
Zone 4 - No Assessment	Not in radar line of sight

Table 9.5 SSR Zone Arrangements	
Zone	Description
Zone 1 - Safeguarding	0 - 500m
Zone 2 - Detailed Assessment	500m - 16km and in radar line of sight
Zone 4 - No Assessment	Further than 16km or not in radar line of sight

Figure 9.8 below shows that the distance between the radar surveillance site at Dooncarton and the proposed wind farm at Keerglen is 25 km. At this distance, it is highly unlikely that there will be any impact to the IAA Surveillance Network.



Figure 9.8. Dooncarton MSSR relative to Keerglen.

9.6.1.2 Impacts on Crossmolina Airfield

Field and desktop surveys of Crossmolina Airfield found that the aerodrome has a Code 1 grass-strip runway. There are no PSR or SSR radar systems located at the airfield and the aerodrome operates visual flight rules only. It was not possible to determine details regarding ATS communication facilities located at the airfield; however, ATS communication facilities at small aerodromes generally use VHF radio frequencies. The proposed wind farm is located sufficiently far enough away (> 500m) from any VHF aeriels that may be located at the aerodrome, that the operation of VHF communications links will not be impacted. In addition, the proposed wind farm development is sufficiently far from Crossmolina Airfield that the

aerodrome's Exclusions Zones would not be breached (Obstacle Limitation Surfaces and Parachute Drop Zone).

9.6.1.3 Impacts on Ballina Airstrip

Field and desktop surveys of Crossmolina Airfield found that the aerodrome has a Code 1 grass-strip runway. There are no PSR or SSR radar systems located at the airfield and the aerodrome operates visual flight rules only. It was not possible to determine details regarding ATS communication facilities located at the airfield; however, ATS communication facilities at small aerodromes generally use VHF radio frequencies. The proposed wind farm is located sufficiently far enough away (> 500m) from any VHF aeriels that may be located at the aerodrome, that the operation of VHF communications links will not be impacted. In addition, the proposed wind farm development is sufficiently far from Ballina Airfield that the aerodrome's Exclusions Zones would not be breached (Obstacle Limitation Surfaces and Parachute Drop Zone).

9.6.2 Impacts of the Development on Telecommunications (EMI)

Turbines can interfere with microwave communications link systems, as they can reflect and block microwave link signals. Based on the findings obtained during field surveys and the telecom operator consultation process, an analysis of the telecom networks operating in the vicinity of the proposed Keerglen Wind Farm was carried out. Five telecommunications technologies were considered for analysis:

- Licensed Transmission Networks
- License-Exempt Telecommunications Networks
- GSM Networks
- 3G/4G/5G Networks
- TETRA Network
- Television Network

Sections 9.6.2.1 to 9.6.2.6 below outline the desktop survey analysis findings for each of the technologies listed above.

9.6.2.1 Licensed Transmission Networks

None of the telecom operators contacted during the consultation process have stated that they have any concerns regarding Licensed Telecommunications Networks. Field survey findings also indicate that there will be no Licensed Telecommunications Networks impacted by the proposed development.

9.6.2.2 License-Exempt Telecommunications Networks

None of the telecom operators contacted during the consultation process have stated that they have any concerns regarding License-Exempt Telecommunications Networks. Field survey findings also indicate that there will be no License-Exempt Telecommunications Networks impacted by the proposed development.

9.6.2.3 GSM Access Network

None of the telecom operators contacted during the consultation process have stated any concerns regarding their GSM Access Networks.

9.6.2.4 3G/4G/5G Access Network

None of the telecom operators contacted during the consultation process have stated any concerns regarding their 3G/4G/5G Access Networks.

9.6.2.5 TETRA Network

To-date, Tetra Ireland have not responded to consultations to confirm that there will be no impact to their network. However, field and desktop surveys indicate that there are no Tetra basestations in close proximity to the proposed wind farm and therefore there will be no impacts to the Tetra Ireland communications network.

9.6.2.6 Television Network

In their response to consultations 2RN have stated that they anticipate no impact on their television transmission network from the development at the proposed location. 2RN have highlighted the requirement for a protocol to be signed by the developer to put in place mitigation measures which would resolve any potential TV interference issues for viewers in the area.

9.7 Cumulative Impacts

The cumulative impacts due to the wind farm on Aviation and EMI are outlined in Sections 9.7.1 to 9.7.2 that follow.

9.7.1 Aviation Cumulative Impacts

Any cumulative impacts on aviation communication networks due the Keerglen Wind Farm are expected to be negligible.

9.7.2 EMI Cumulative Impacts

Any cumulative impacts on telecommunication networks due the Keerglen Wind Farm are expected to be negligible.

9.8 Mitigation and Monitoring Measures

Possible mitigation measures proposed to the wind farm owner/developer are described in Sections 9.8.1 to 9.8.2 that follow.

9.8.1 Aviation Mitigation

The following aviation infrastructure was assessed to determine if mitigation measures are required:

- IAA Radar Surveillance System – Dooncarton.
- Crossmolina Airfield
- Ballina Aerodrome

9.8.1.1 IAA Radar Surveillance System – Dooncarton

The proposed wind farm development is located 25km from the Radar Station at Dooncarton and in Assessment Zone 4, which indicates that there will be no impact to the radar surveillance system and mitigation measures will not be required. In addition, the IAA have raised no concerns in relation to the proposed Keerglen Wind Farm and, therefore, no mitigation measures are required for the IAA communications network.

9.8.1.2 Crossmolina Airfield

Findings from field and desktop surveys indicate that there will be no impact to Crossmolina Airfield due to the proposed development and mitigation measures will, therefore, not be required. Although it is envisaged that there will be no impact due to the proposed Keerglen wind turbines, there may be a requirement that the turbines would be fitted with aviation lighting in accordance with standard industry practice.

9.8.1.3 Ballina Aerodrome

Findings from field and desktop surveys indicate that there will be no impact to Ballina Airstrip due to the proposed development and mitigation measures will, therefore, not be required. Although it is envisaged that there will be no impact due to the proposed Keerglen wind turbines, there may be a requirement that the turbines would be fitted with aviation lighting in accordance with standard industry practice.

9.8.2 EMI Mitigation

The following Telecommunications infrastructure was assessed to determine if mitigation measures are required:

- Licensed Transmission Networks
- License-Exempt Telecommunications Networks

- GSM Networks
- 3G/4G Networks
- TETRA Network
- Television Network

9.8.2.1 Licensed Transmission Networks

Findings from field/desktop surveys and the consultation process indicate that no Licensed Transmission Networks will be impacted by the proposed wind farm and mitigation measures will not be required.

9.8.2.2 License-Exempt Telecommunications Networks

Findings from field/desktop surveys and the consultation process indicate that no License-Exempt Telecommunications Networks will be impacted by the proposed wind farm and mitigation measures will not be required.

9.8.2.3 GSM Access Network

Findings from field/desktop surveys and the consultation process indicate that no GSM Access Networks will be impacted by the proposed wind farm and mitigation measures will not be required.

9.8.2.4 3G/4G/5G Access Network

Findings from field/desktop surveys and the consultation process indicate that no 3G/4G/5G Access Networks will be impacted by the proposed wind farm and mitigation measures will not be required.

9.8.2.5 TETRA Network

Findings from field/desktop surveys and the consultation process indicate that the Tetra Ireland Network will not be impacted by the proposed wind farm and mitigation measures will not be required.

9.8.2.6 Television Network

Following the consultations with 2RN there was a requirement for a protocol agreement for mitigation measures to be put in place to remediate any potential TV interference impacts, caused by the proposed wind farm, to viewers in the area. The mitigations measures include;

- TV Antenna re-alignment and increase in height.
- Antenna Re-tuning (getting signal from a different RTE TV transmitter).
- SaorSAT Satellite based TV service.

9.9 Residual Effects

The Residual Effects due to the wind farm on Aviation and EMI are outlined in Sections 9.9.1 to 9.9.2 that follow.

9.9.1 Aviation Residual Effects

Any residual effects on aviation communication networks due the Keerglen Wind Farm are expected to be negligible.

9.9.2 EMI Cumulative Impacts

Any residual effects on telecommunication networks due the Keerglen Wind Farm are expected to be negligible.

9.10 Conclusions

From the findings made in this report the following conclusions have been made regarding existing Aviation and Telecommunication infrastructure.

9.10.1 Aviation Impact Assessment Conclusions

The findings of the aviation study show that the nearest radar navigational equipment (PSR or SSR) is located at Dooncarton, Co Mayo, which is 25 km from Keerglen. As there are no PSR/SSR systems in close proximity to the Keerglen development there should be no impact to the IAA communications networks.

The proposed wind turbine locations do not breach the Exclusion Zones for either Crossmolina Aerodrome or Ballina Aerodrome. As the Exclusion Zones are not breached there should be no impacts to the aviation activities at these aerodromes.

No aviation infrastructure is expected to be impacted by the proposed Keerglen wind farm and therefore mitigation measures are unlikely to be required. However, in the event of a grant of planning consent the IAA are likely to request lighting of the proposed wind turbines in the interest of aviation safe-guarding as the proposed development would be considered as an en-route obstacle. The IAA and ANSP will require wind turbine obstacles to be fitted with an Obstacle Warning Light System.

9.10.2 Telecommunications Impact Assessment Conclusions

The results from field surveys and telecom operator consultations indicate that no Licensed PTP microwave links are likely to be impacted by the proposed wind farm development.

None of the Telecommunications Operators contacted during the consultation process have raised any concerns regarding License-exempt, GSM, 3G/4G/5G or TETRA network infrastructure.

9.10.3 Television Broadcast Impact Assessment Conclusions

With regard to television services, 2RN have not raised any issues in relation television transmission networks that they operate and there will be no impacts on television transmission network services. A standard protocol agreement should be put in place with 2RN to allow for mitigation of any television service issues identified during the operations of the wind farm and this would meet the minimum requirements to satisfy 2RN that there would be no impacts from the proposed wind farm development.

9.11 References

- IWEA - *Best Practice Guidelines for the Irish Wind Energy Industry* (March 2012)
- European Organization for the Safety of Air Navigation EUROCONTROL Guidelines - *How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors*
- UK Civil Aviation Authority (UK CAA) guidelines - *CAP 764: Chapter 2: Impact of wind turbines on aviation*, Appendix A to SUR 13: *Guidance on Wind Farm Mitigation Techniques*.