Report

Garrane Wind Farm
Telecommunications Impact Assessment
Report

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Executive Summary

Ai Bridges was commissioned to evaluate the possible impacts that the proposed wind farm development at Garrane, Co. Limerick could have on existing telecommunications operator networks. The scope of work included field and desktop surveys to determine telecommunications network infrastructure that could be impacted by the proposed development. Consultations with telecom operators were also undertaken to assist in identifying network infrastructure that could be impacted by the proposed wind farm.

Telecommunications mast-sites with network infrastructure that could potentially be impacted by the wind farm development were identified and field surveys of these mast-sites was carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded. The findings of the field surveys are provided in Appendix B of this report.

During the consultation process, sixteen telecom operators were contacted. At the time of writing this report, eleven of these operators have responded to the consultation request. The responses received from each of the telecom operators can be found in Section 3 of this report.

Using the information obtained during the field survey assessments and consultation process a desktop impact analysis was carried out and all of the telecommunication operator networks were analysed using radio planning \ modelling software.

Results from the impact analysis indicate that there are four licensed microwave radio links in the vicinity of the proposed wind farm development. The radio links that cross over the wind farm are listed below in Table 1. 3D analysis indicates that none of the radio links will be impacted by the proposed turbine layout. However, it should be noted that the clearance distance to the Eir link between Kilmallock to Ballyagran is relatively small (i.e. the Clearance Distance between turbine blade-tip and Radio Fresnel Zone is less than 20.0m).

To account for any potential impacts that may be reported during the operational phase of the proposed development, optional mitigation measure solutions should be considered for this radio link. The optional mitigation measures available to the developer for the Eir radio link between Kilmallock to Ballyagran have been provided in Section 6 of this report.

Operator	Link Description	Nearest Turbine	Impact of Wind Farm	Optional Mitigation Measure(s)
Eir	Licenced PTP microwave radio link from Kilmallock to Ballyagran.	T09	No impacts. (Clearance = 17.9m)	**Option 1:** Relay via Alternative Telecoms Mast-site.
Eir	Licenced PTP microwave radio link from Ballyagran to Glenbrohane.	T06	No impacts. (Clearance > 50m)	N.A.
Eir	Licenced PTP microwave radio link from Effin to Kilmacanearla South.	T07	No impacts. (Clearance > 50m)	N.A.
Vodafone	Licenced PTP microwave radio link from Charleville to Howardstown.	T08	No impacts. (Clearance > 50m)	N.A.

Table 1. Microwave radio links radio links in vicinity of proposed wind farm.

Sections

Appendix

Section 1 - Wind Farm Site Information

1. Introduction

In this section a brief summary of the wind farm site is provided. Details regarding the site's geographic location and the proposed wind turbine dimensions are presented.

1.1 Wind Farm Site Information

The wind farm development is located in County Limerick approximately 3 km north of Charleville.

The 9-turbine layout (Turbine Layout 14/06/24) has been considered in this study. The coordinates of the turbines assessed in this report are provided in Appendix A. The dimensions of the turbines assessed in this report are provided in Table 2 below.

Wind Farm ID	Number of Turbines	Turbine Hub Height	Turbine Rotor Diameter
Garrane	9	95 m	150 m

Table 2. Wind Farm Turbine Details

The location of the proposed wind farm development is shown below in Figure 1.

Figure 1. Location of proposed wind farm.

Section 2 - Methodology

2. Introduction

In this section a brief summary of the Telecommunication Impact Study Methodology is provided.

2.1 Methodology

There are four primary stages in preparing and compiling a communication impact study:

- Telecom Operator Consultations
- Field Surveys
- Desktop Survey Network Modelling and Analysis
- Report Generation

A summary of each of these stages is provided below:

Telecom Operator Consultations

Consultations are commenced with telecom operators who are 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.

Field Surveys

Field surveys are undertaken and the co-ordinates of communication masts are recorded. During the field surveys of the communication sites, approximations of antenna size, bearing and height are made for the antennas installed on each of the masts surveyed.

Desktop Survey and Analysis

A desktop survey is carried out to plot the wind turbines in a radio planning tool. The radio planning tool uses GIS and terrain mapping databases to enable accurate modelling. A selection of mast-site coordinates is then obtained and inputs from various operators \ service providers are converted from Irish National Grid (Easting and Northing in meters) to degrees minutes seconds format and then imported into the radio planning tool.

This provides a means of graphically showing telecommunications sites in the vicinity relative to the proposed wind farm at Garrane. Figure 2 below shows the proposed wind farm site boundary plotted in the radio planning tool.

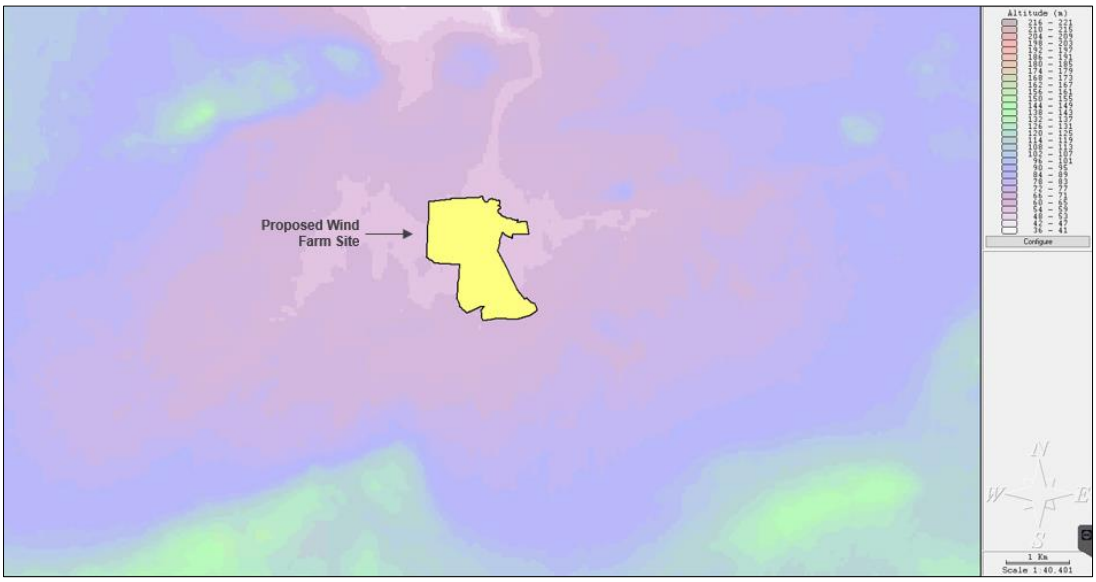

Figure 2. Wind Farm Site Boundary plotted in Radio Planning Software

The findings from the consultations and field surveys are collated and the communications networks requiring further analysis are identified. Network modeling is 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. Figure 3 below shows an example of a microwave radio link that crosses over/near the wind farm site boundary modelled in radio planning software.

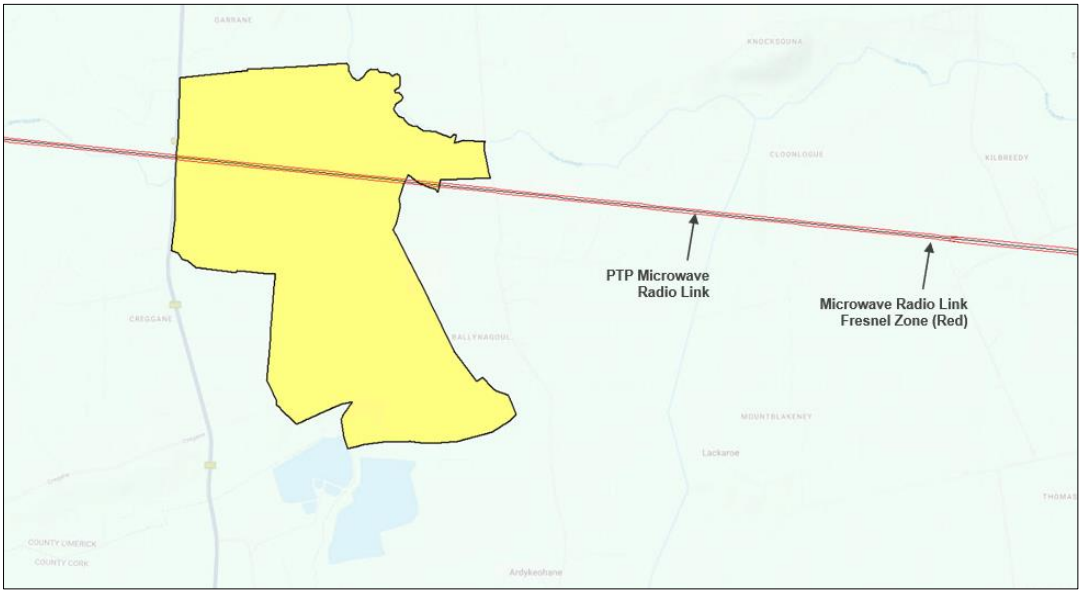

Figure 3. Example of microwave radio link crossing over/near the proposed wind farm site boundary modelled in radio planning software.

Report Generation

The final stage of the communications impact study process is to collate the data and present the findings & analysis into a report for submission.

Section 3 - Telecom Operator Consultations

3. Introduction

In this section the consultation process undertaken with telecom operators is described. The response received from each operator is also provided.

3.1 Telecom Operator Consultations

Consultations beginning in May 2022* were undertaken with telecom network operators to assist in identifying telecommunication infrastructure that could be impacted by proposed wind farm. The operators were requested to raise any concerns they may have regarding impacts to their networks due to the proposed wind farm development.

Table 3 lists the telecom operators contacted and the issues raised by the operators. The responses received from each of the Telecom Operators are provided in Sections 3.1.1 to 3.1.16.

ID	Operator	Response Received (Yes/No)	Issues raised by Operator \ Observations.
1	Enet	Yes	No issues
2	An Garda Síochána	No	No response. (No response expected.)
3	Broadcast Authority of Ireland (BAI)	Yes	No issues
4	BT Ireland	Yes	No issues
5	Eir	Yes	Eir have raised a concern regarding three Licensed PTP microwave radio links
6	ESB Networks	No	No response.
7	Irish Aviation Authority (IAA)	No	No response. (No response expected.)
8	Imagine Broadband	Yes	No issues.
9	Limerick County Council	Yes	No issues.
10	Viatel	No	No response. (No response expected.)
11	2RN	Yes	No issues.
12	Tetra Ireland (TI)	Yes	No issues.
13	Three Ireland	Yes	No issues.
14	Virgin Media	Yes	No issues.
15	Vodafone Ireland	Yes	Vodafone have raised a concern regarding one Licensed PTP microwave radio link
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.)

Table 3. Telecom Operators Consulted

** When the Telecom Operators were first contacted in 2022, the proposed wind farm development was known as "Fort East"*

3.1.1 Enet Response to Consultations

Enet provided the following email response to consultations:

> *"See analysis attached and potential impacts below:"*

Site No.	Wind Farm Site	Potential Impact (Y \ N)
7	Fort East [Garrane], Co Limerick	N

3.1.2 An Garda Síochána

To date no response has been received.

3.1.3 Broadcast Authority of Ireland (BAI)

The BAI provided the following email response to consultations:

> *"The BAI does not perform an in-depth analysis of the effect of wind turbines on FM networks. However, we are not aware of any issues from existing windfarms into existing FM networks. Also, the proposed windfarms are not located close to any existing or planned FM transmission sites."*

3.1.4 BT Ireland

BT provided the following email response to consultations:

> *"We only have a network presence in Louth and Waterford."*

3.1.5 Eir Response to Consultations

Eir provided the following email response to consultations:

> *"We have a transmission link[s] within the proposed areas that would be at risk, the end points of the transmission links are below, if you could design around this and keep a buffer back from the links."*

Site No.	Wind Farm Site	Potential Impact (Y \ N)
7	Fort East [Garrane], Co Limerick	Yes

Fort East, Co Limerick	Link1	11Ghz	LK_2417	52°23'42.37"N	8°33'46.60"W	30m	<--->	LK_2685	52°24'9.13"N	8°46'49.28"W	12m
Fort East, Co Limerick	Link2	13Ghz	BGN	52°24'9.13"N	8°46'49.28"W	12m	<--->	SVH	52°22'41.72"N	8°24'13.28"W	20m
Fort East, Co Limerick	Link3	13Ghz	CK_9244	52°21'6.23"N	8°36'13.92"W	12m	<--->	LK_9015	52°28'33.94"N	8°46'23.91"W	18m

3.1.6 ESB Networks Response to Consultations

To date no response has been received.

3.1.7 IAA Response to Consultations

To date no response has been received.

3.1.8 Imagine Broadband Response to Consultations

Imagine Broadband provided the following email response to consultations:

Site No.	Wind Farm Site	Potential Impact (Y \ N)
7	Fort East [Garrane], Co Limerick	N

3.1.9 Limerick County Council Response to Consultations

Imagine Broadband provided the following email response to consultations.

"The ICT Department do not have infrastructure in area 7 [Fort East]"

3.1.10 Viatel Response to Consultations

To date no response has been received:

3.1.11 2RN Response to Consultations

2RN did not raise any concerns in relation to transmission links; however, 2RN did have a concern regarding their broadcast service in the area and have requested that a protocol document be signed should the wind farm go ahead. The response received from 2RN is provided below.

"With all of the sites there is a risk of interference to broadcast services from our site at Maghera in the areas proposed and we would ask that a protocol be signed between the developer and 2rn."

3.1.12 Tetra Ireland (TI) Response to Consultations

Tetra Ireland provided the following email response to consultations:

"We anticipate no impact from the development as proposed, can you ensure the development is also reviewed by eir."

3.1.13 Three Ireland Response to Consultations

Three Ireland provided the following email response to consultations:

Site No.	Wind Farm Site	Potential Impact (Y \ N)
7	Fort East [Garrane], Co Limerick	N

3.1.14 Virgin Media Response to Consultations

Virgin Media provided the following email response to consultations:

Site No.	Wind Farm Site	Potential Impact (Y \ N)
7	Fort East [Garrane], Co Limerick	N

3.1.15 Vodafone Ireland Response to Consultations

Vodafone provided the following email response to consultations:

Site No.	Wind Farm Site	Potential Impact (Y \ N)
7	Fort East [Garrane], Co Limerick	Y

Link Name / ID	Band MHz\GHz	Link Length	Site A					Site B				
			Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
CKE38-LKC3C	56MHz/18GHz	10.5km	52.3526	-8.6795	153750	122500	15m	52.4466	-8.6937	152881	132965	15m

3.1.16 Department of Defence Response to Consultations

To date no response has been received.

Section 4 - Field Surveys

4. Introduction

To assess the accuracy of the network information (radio link co-ordinates, antenna heights etc.) provided by the telecom operators, field surveys of the telecom-mast sites in the vicinity of the proposed wind farm were carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded.

The telecom mast-sites surveyed for this study (labelled Mast-Sites A, B, C, D, E, F and G) are shown relative to the proposed wind farm site in Figure 4 below. The findings from the field surveys of the mast-sites are presented in Appendix B of this report.

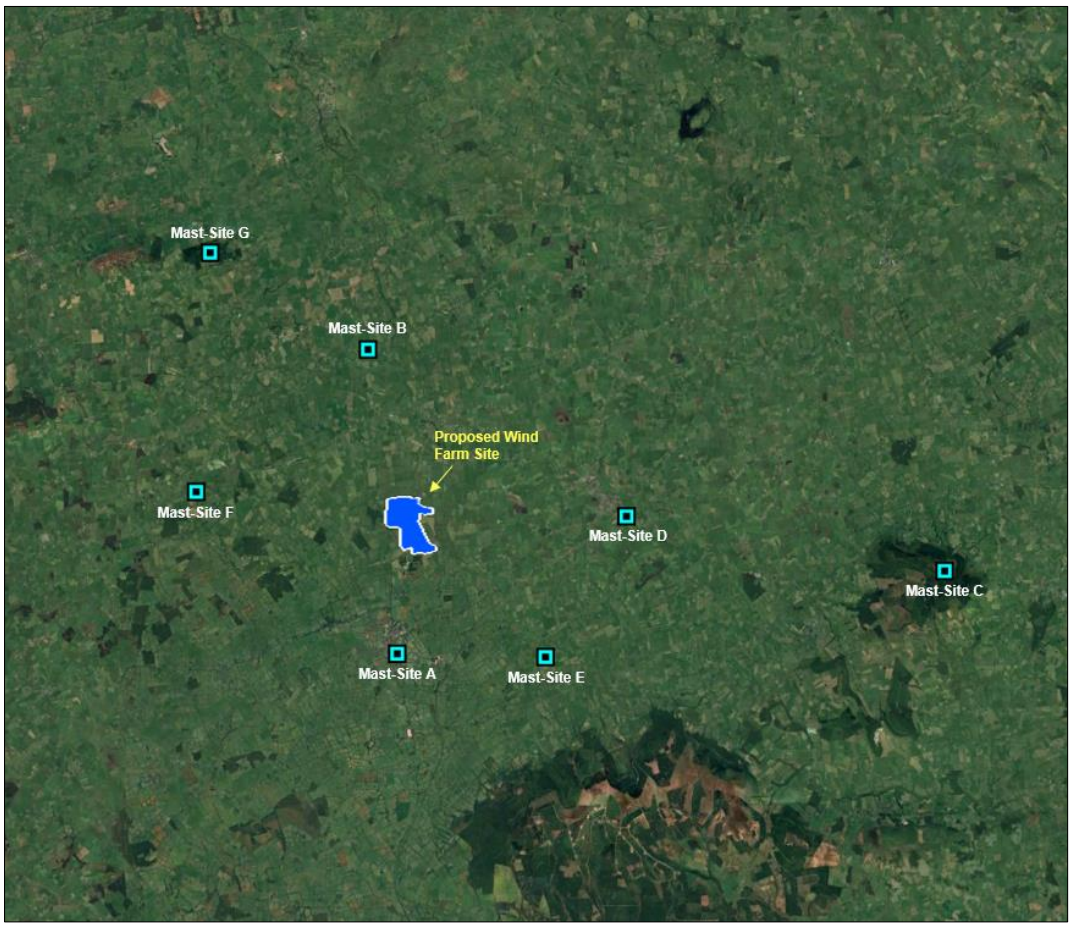

Figure 4. Telecom Mast-Sites Surveyed.

Section 5 - Desktop Survey Analysis

5. Introduction

Based on the findings of the consultation process, there are two Telecom Operators with networks in the vicinity of the proposed wind farm that require a detailed technical analysis:

- Eir Network
- Vodafone Ireland Network

Section 5.1 and Section 5.2 below outline the desktop survey analysis findings* for each of the Telecom Operator networks listed above.

5.1 Eir Network Analysis

The Eir network in the vicinity of the proposed wind farm consists of three Point-to-Point (PTP) microwave radio links. The radio links are listed in Table 4 below and a Plan View of the Eir network is shown in Figure 5.

Link ID	Operator	Link Description
1	Eir	PTP microwave radio link from Kilmallock to Ballyagran
2	Eir	PTP microwave radio link from Ballyagran to Glenbrohane
3	Eir	PTP microwave radio link from Effin to Kilmacanearla South

Table 4. Eir Radio Links requiring Analysis

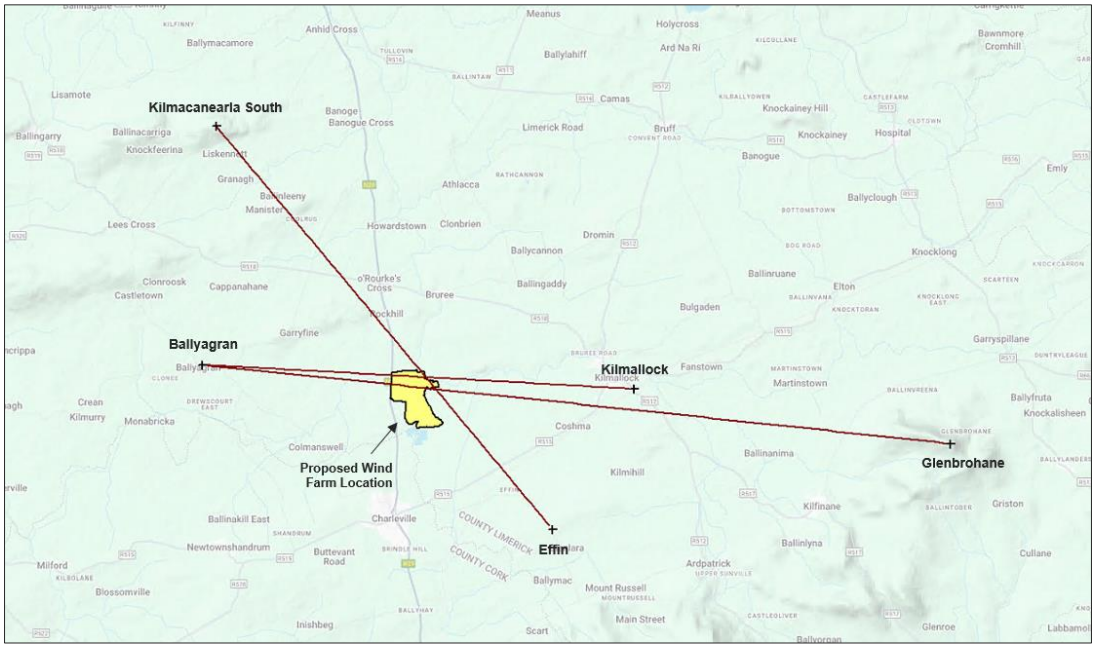

Figure 5. Eir Radio Network – Plan View

A Close-up Plan View (2D) and a 3D View of Eir radio link network relative to the proposed turbines are shown in the figures below. The results indicate that the proposed turbines would not obstruct the Eir radio links.

** The Desktop Survey Analysis findings are subject to accuracy of the information (GPS co-ordinates, turbine dimensions, etc.) provided to Ai Bridges.*

The nearest of the proposed turbines to any of the Eir links is T09. 3D analysis indicates that there would be a Clearance Distance of 17.9 m between the blade-tip of T09 and the Fresnel Zone (F1) of the radio link between Kilmallock and Ballyagran. At this distance there would be no impact on the Eir Link.

Table 5 below provides a brief summary of the network analysis for the Eir network in the vicinity of the proposed wind farm.

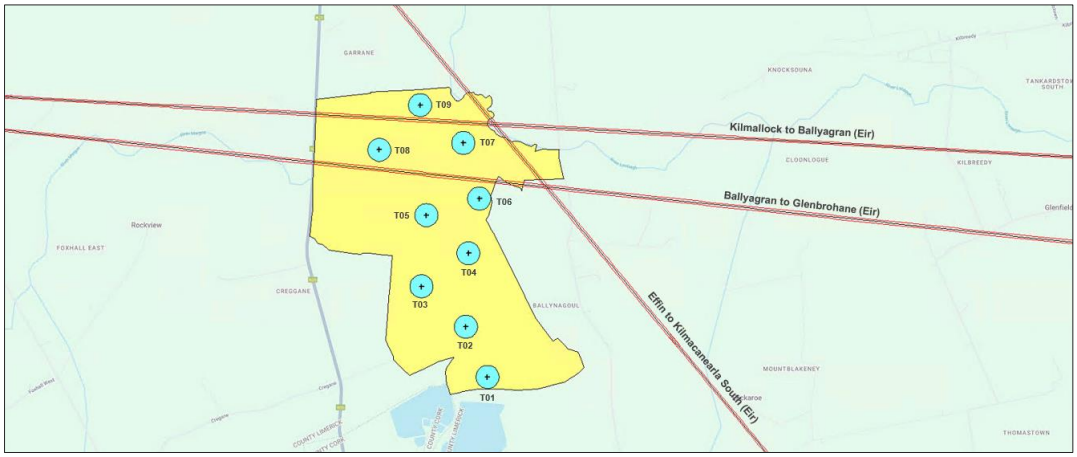

Figure 6. Eir Network - Close-up Plan View

Figure 7. Eir Network – 3D View

Link ID	Link Description	Nearest Turbine	Fresnel Zone (F1) Clearance Distance	Wind Farm Impacts / Observations
Eir_L1	Kilmallock to Ballyagran	T09	17.9 m	No impacts. Should Eir have any concerns regarding the proximity of T09, optional mitigation measures are available (Ref. Section 6).
Eir_L2	Ballyagran to Glenbrohane	T06	> 50 m	No impacts.
Eir_L3	Effin to Kilmacanearla South	T07	> 50 m	No impacts.

Table 5. Analysis Summary – Eir Network

5.2 Vodafone Ireland Network Analysis

The Vodafone network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) microwave radio link. The radio link is listed in Table 6 below and a Plan view of the Vodafone network is shown in Figure 8.

Link ID	Operator	Link Description
1	Vodafone	PTP microwave radio link from Charleville to Howardstown.

Table 6. Vodafone Ireland Radio Links requiring Analysis

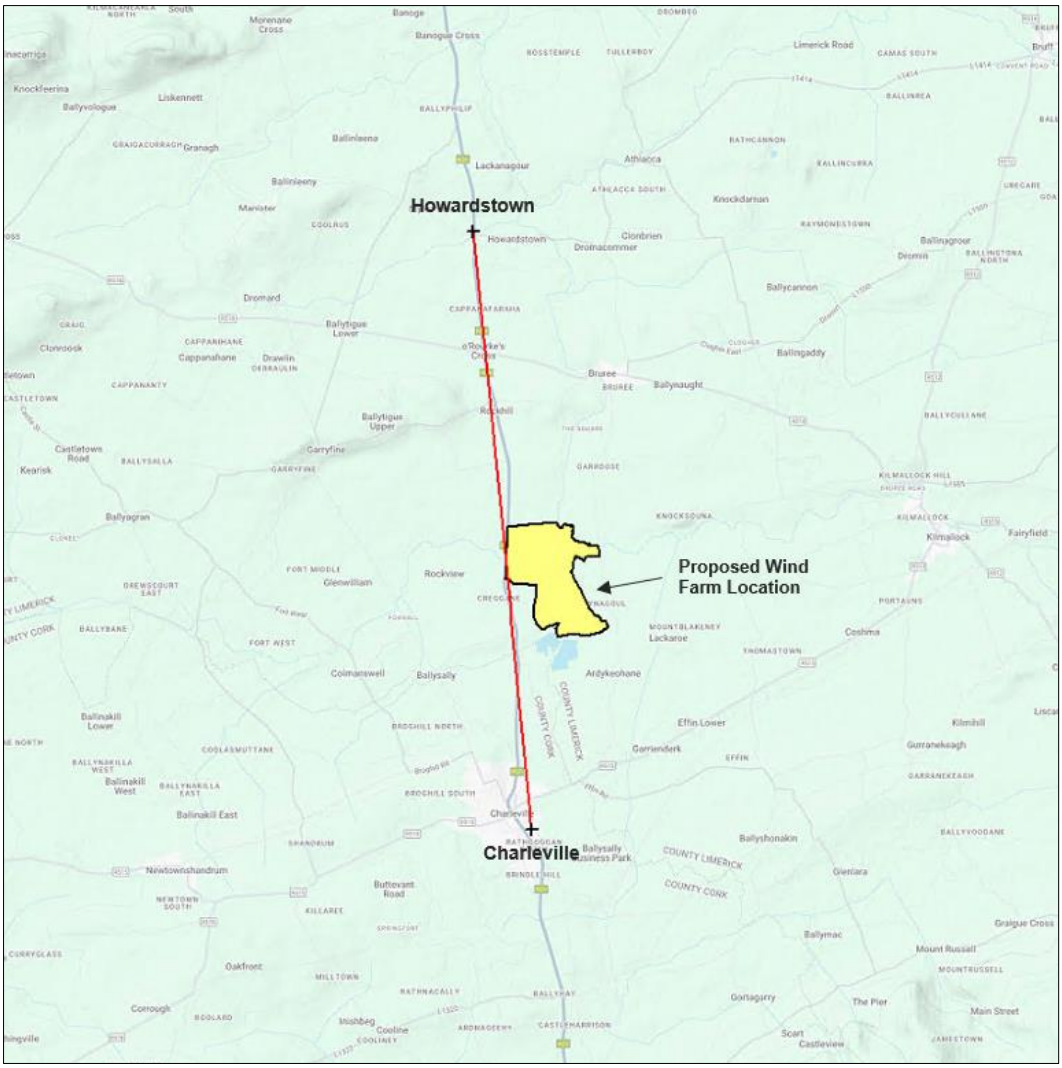

Figure 8. Vodafone Ireland Radio Network – Plan View

Figure 9 below shows a Close-up View of the Vodafone microwave radio link relative to the proposed wind farm turbines. Desktop survey analysis indicates that the PTP radio link is over 350m from the nearest of the proposed turbines (T08). At this distance there will be no impact the Vodafone microwave radio link.

Table 7 below provides a brief summary of the network analysis for the Vodafone Ireland network in the vicinity of the proposed wind farm.

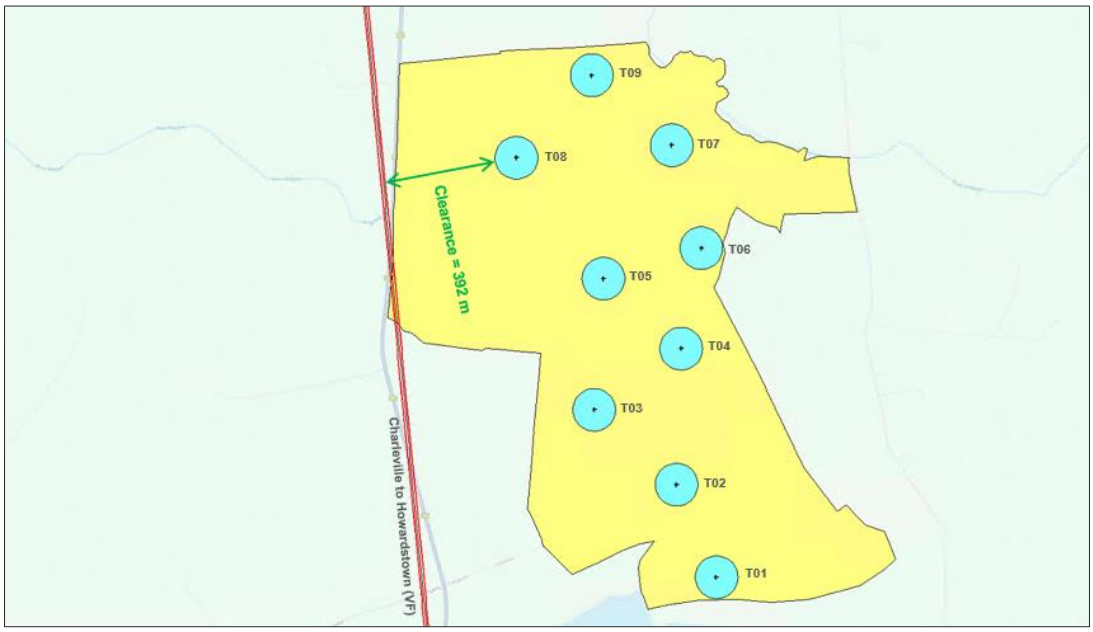

Figure 9. Vodafone Ireland Network – Close-up Plan View.

Link ID	Link Description	Nearest Turbine	Fresnel Zone (F1) Clearance Distance	Wind Farm Impacts / Observations
VF_L1	Charleville to Howardstown	T08	392 m	No impacts.

Table 7. Vodafone Ireland Network – Analysis Summary

Section 6 - Mitigation Measures

6. Mitigation Measures

Although the 3D analysis indicates that none of the microwave radio links would be impacted by the proposed turbines, the clearance distance between T09 and the Eir radio link between Kilmallock and Ballyagran is relatively small (17.9 m).

To account for any potential impacts that may be reported during the operational phase of the proposed wind farm, the optional mitigation measure solutions presented below are available to the developer.

6.1 Mitigation Measure – Eir Network

To offset any potential impacts of T09 on the Eir radio link between Kilmallock and Ballyagran, the following mitigation solutions are available:

Option 1 – Re-routing via Alternative Mast-Site

This mitigation measure is described in Sections 6.1.1 below.

6.1.1 Option 1 – Re-routing via Alternative Mast-Site

The service to/from Ballyagran could be delivered via an alternative mast-site. The existing telecoms mast at Kilmacanearla South has been identified as a mast, which could potentially be used for this purpose.

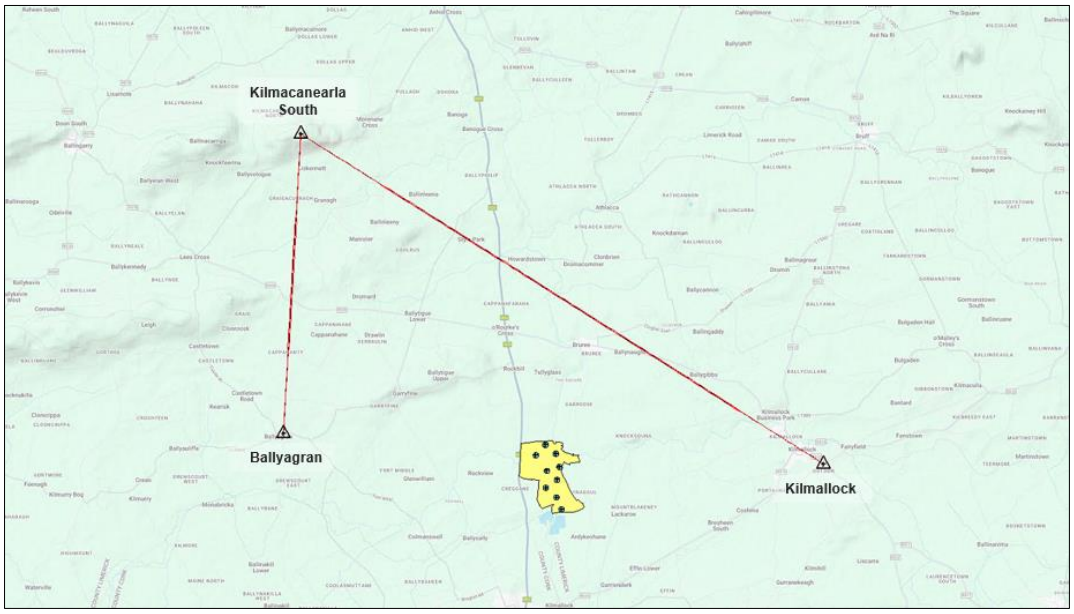

Figure 10. Rerouting via Alternative Mast Site

To determine if the telecoms mast in Kilmacanearla South could be used to facilitate viable connection between Kilmallock and Ballyagran, radio link Path Profiles have been generated.

Radio Link Budgets were also carried out to determine if the proposed radio links would meet the Radio Link Availability Criteria required by ComReg for radio licensing.

6.1.1.1 Path Profile – Kilmallock to Kilmacanearla South

The radio link path profile shows clear Line-of-Sight (LOS) and the link budget results would pass the radio availability criteria. The radio link budget for this link is provided in Appendix C.1.1.

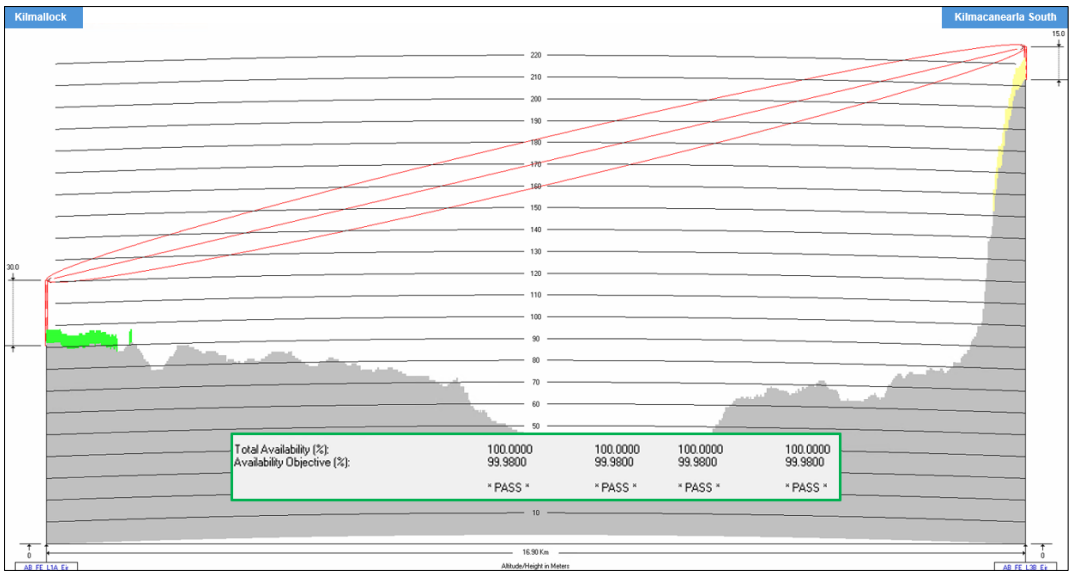

Figure 11. Path Profile - Kilmallock to Kilmacanearla South

6.1.1.2 Path Profile – Kilmacanearla South to Ballyagran

The radio link path profile shows clear Line-of-Sight (LOS) and the link budget results would pass the radio availability criteria. The radio link budget for this link is provided in Appendix C.1.2.

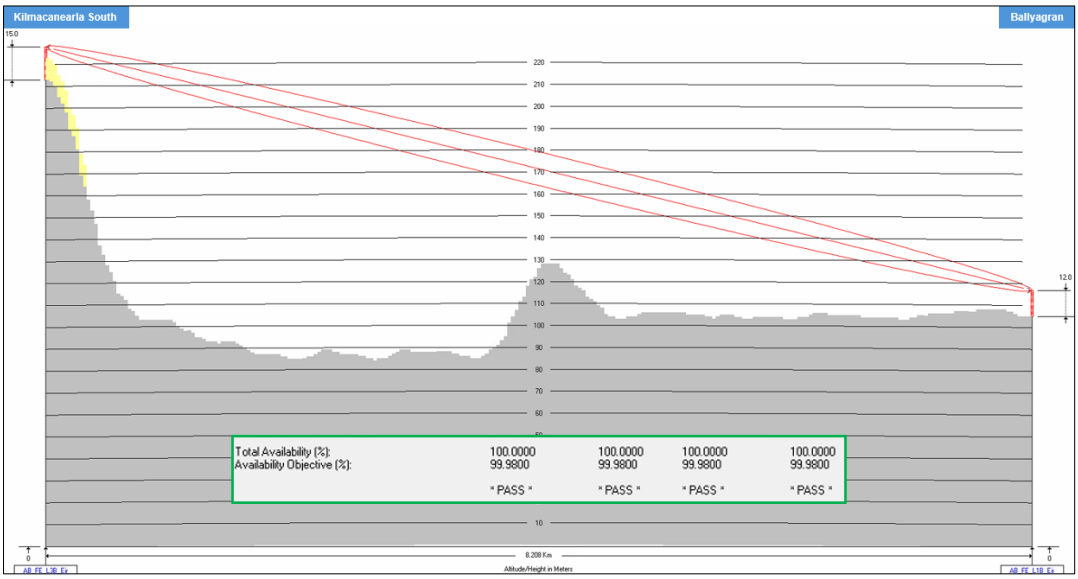

Figure 12. Path Profile - Kilmacanearla South to Ballyagran

Section 7 - Conclusions

7. Conclusions

From the findings made in this report the following conclusions have been made:

- Results from the telecom operator consultations and desktop survey analysis indicate that there are four radio links that cross over the wind farm site boundary.
- The impacts of the proposed turbine layout on the Telecom Operator radio links are listed below in Table 8.

Operator	Radio Link Description	Impacts of Turbine Layout	Optional Mitigation Measure(s)
Eir	PTP microwave radio link from Kilmallock to Ballyagran.	No impacts (Clearance Distance = 17.9 m)	**Option 1:** Relay via Alternative Telecoms Mast-site.
Eir	PTP microwave radio link from Ballyagran to Glenbrohane.	No impacts	N.A.
Eir	PTP microwave radio link from Effin to Kilmacanearla South.	No impacts	N.A.
Vodafone Ireland	PTP microwave radio link from Charleville to Howardstown.	No impacts	N.A.

Table 8. Radio Links in vicinity of proposed development.

- Figure 13 below has been provided to illustrate each of the telecommunication links in the vicinity of the proposed development.

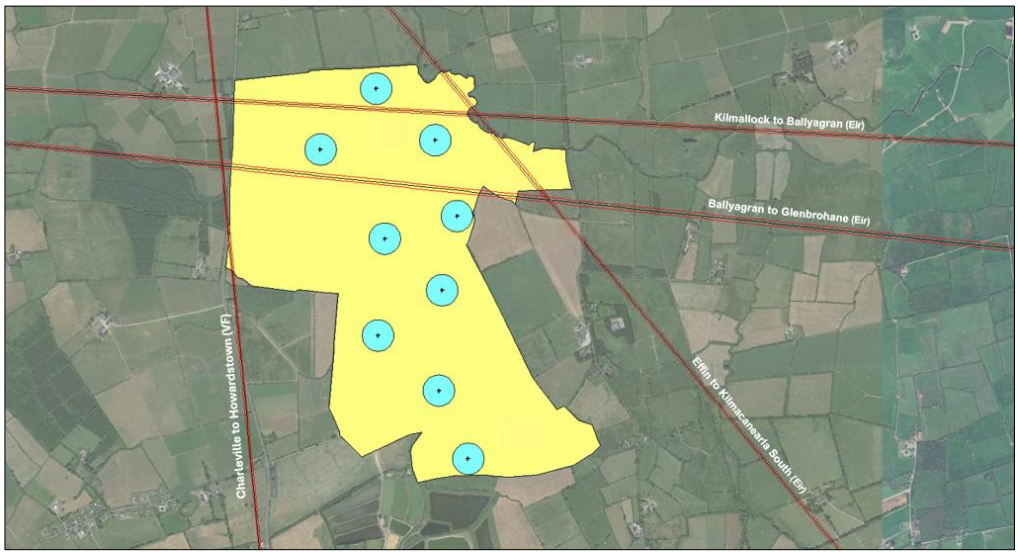

Figure 13. Plan View of radio links in vicinity of proposed development.

APPENDIX A – Wind Farm Turbine Coordinates

Appendix A – Wind Farm Turbine Co-ordinates

The coordinates of the turbine layout considered in this Telecommunications Impact Study are provided below.

Turbine ID	Co-ordinates (ITM)	
	Easting	Northing
T01	554494	626040
T02	554358	626367
T03	554070	626623
T04	554378	626844
T05	554107	627092
T06	554342	626376
T07	554352	627558
T08	553804	627520
T09	554073	627806

Table A1. Turbine Co-ordinates (Turbine Layout 14.06.24)

APPENDIX B – Field Survey Findings

Appendix B – Field Survey Findings

The telecom mast-sites surveyed for this Telecoms Impact Study are shown relative to the proposed wind farm site in Figure 14 below.

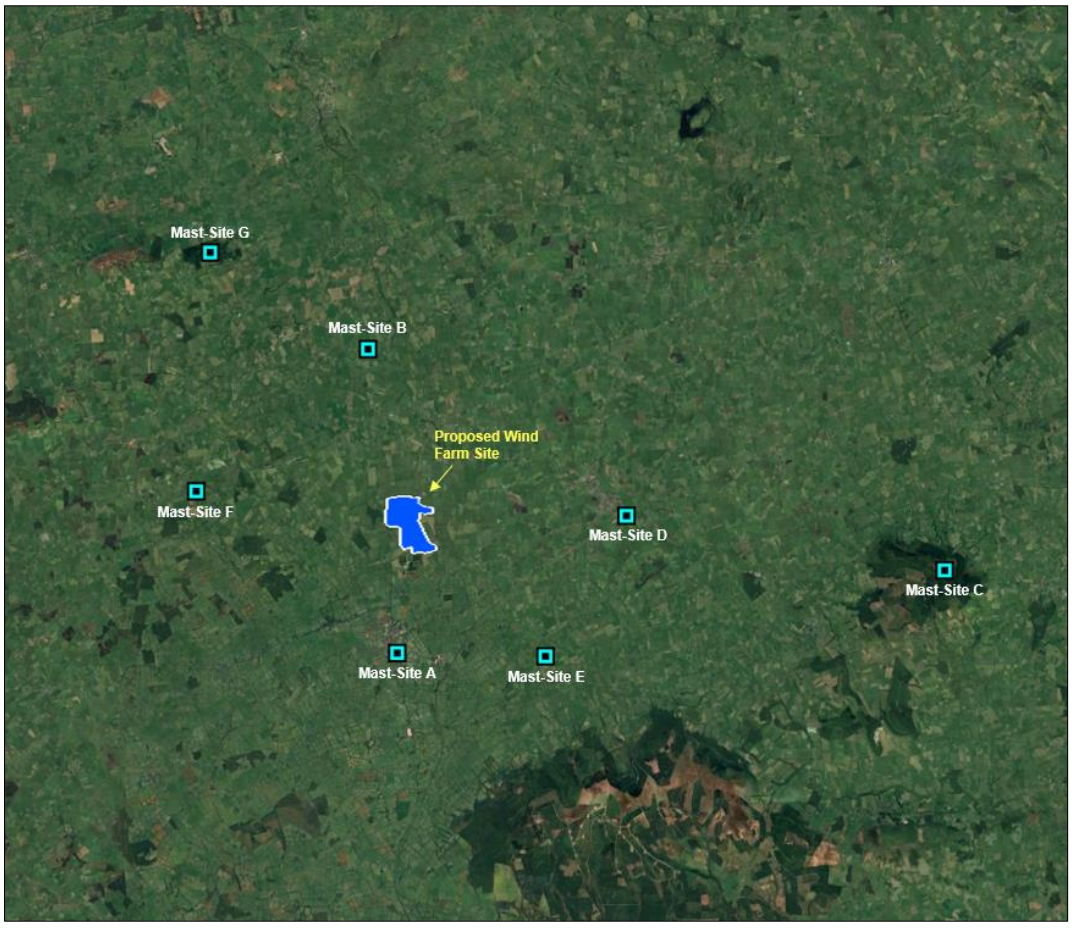

Figure 14. Telecom Mast-Sites shown relative to proposed Wind Farm

The findings from the field surveys of each of the mast-sites are presented below.

Mast-Site A (Charleville)

Telecommunications Mast-Site A is located in Charleville, Co Cork and is approximately 3.4 km south of the proposed wind farm. A photo of the mast at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 9.

Figure 15. Mast A1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast A1	Vodafone

Table 9. Field Survey Summary – Mast A1

Mast-Site B (Howardstown)

Telecommunications Mast-Site B is located in the townland of Howardstown North, Co Limerick and located approximately 5 km north of the proposed wind farm site. A photo of the mast at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 16.

Figure 16. Mast B1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast B1	Vodafone Ireland

Table 10. Field Survey Summary – Mast B1

Mast-Site C (Glenbrohane)

Telecommunications Mast-Site C is located in the townland of Glenbrohane, Co Limerick and is approximately 17 km east of the proposed wind farm. Access into this mast-site was not possible on the day of survey; however, an aerial view of the site is shown below in Figure 17.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 11.

Figure 17. Mast C1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast C1	Eir

Table 11. Field Survey Summary – Mast C1

Mast-Site D (Kilmallock)

Telecommunications Mast-Site D is located in Kilmallock, Co Limercik and is approximately 6.6 km east of the proposed wind farm site. A photo of the mast at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 12.

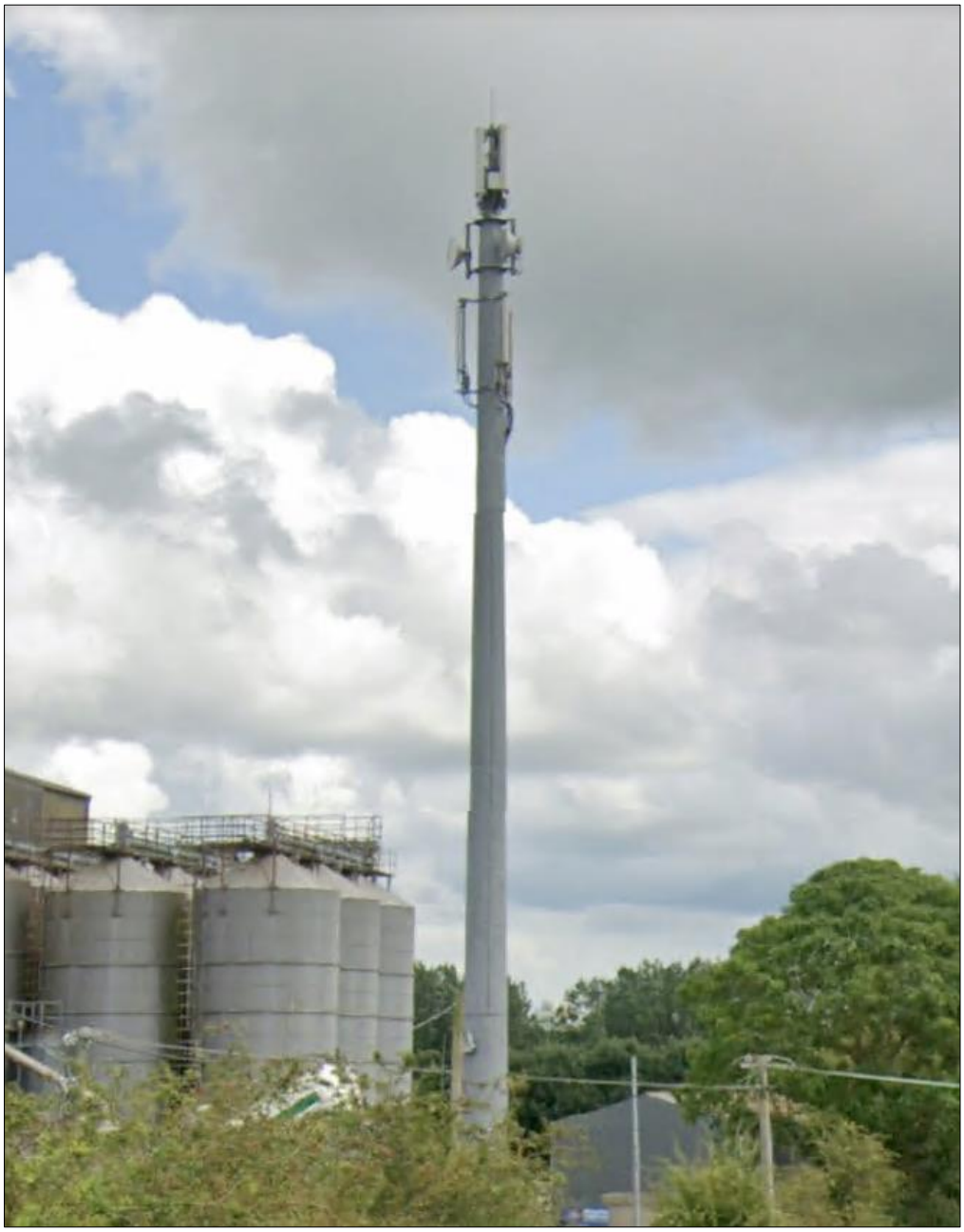

Figure 18. Mast D1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast D1	Vodafone, Three Ireland

Table 12. Field Survey Summary – Mast D1

Mast-Site E (Effin)

Telecommunications Mast-Site E is located in the townland of Effin, Co Limerick and is approximately 5 km southeast of the proposed wind farm. A photo of the mast-structure at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 13.

Figure 19. Mast E1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast E1	Eir

Table 13. Field Survey Summary – Mast E1

Mast-Site F (Ballyagran)

Telecommunications Mast-Site F is located in the townland of Ballyagran, Co Limerick and is approximately 6.5 km west of the proposed wind farm. A photo of the mast-structure at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 14.

Figure 20. Mast F1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast F1	Eir

Table 14. Field Survey Summary – Mast F1

Mast-Site G (Kilmacanearla South)

Telecommunications Mast-Site G is located in the townland of Kilmacanearla South, Co Limerick and is approximately 10 km northwest of the proposed wind farm. Access into this mast-site was not possible on the day of survey; however, an aerial view of the site is shown below in Figure 21.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 15.

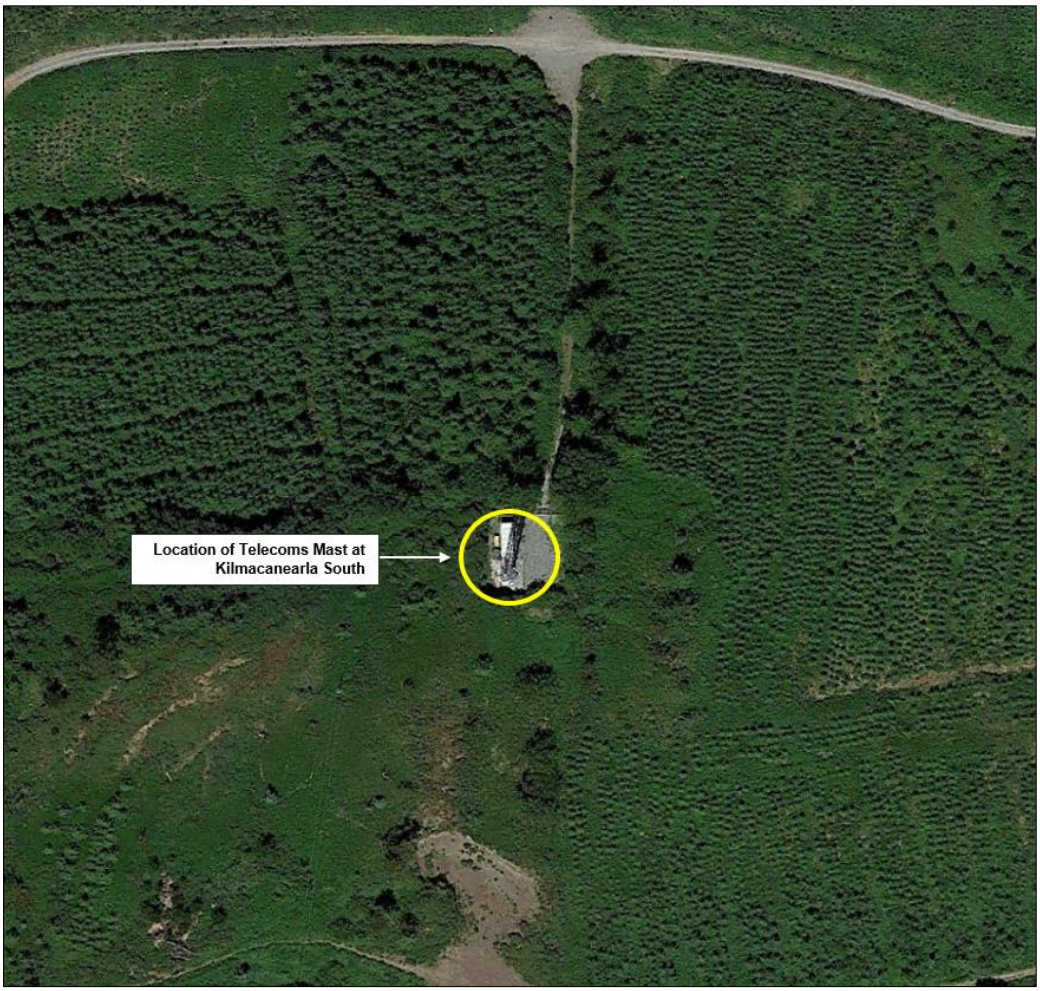

Figure 21. Mast G1

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast G1	Eir

Table 15. Field Survey Summary – Mast G1

APPENDIX C – Radio Link Budgets

APPENDIX C – Radio Link Budgets

C1. Mitigation Measure - Option 1, Radio Link Budgets

C.1.1. Kilmallock – Kilmacanearla South

Site Name:	AB_FE_L1A_Eir (Kilmallock)		AB_FE_L3B_Eir (Kilmacanearla South)	
Type:	Cell	Cell		
Latitude:	52°23'42.3"N		52°28'33.9"N	
Longitude:	8°33'46.6"W		8°46'23.8"W	
Altitude (m):	91.0		213.0	
UserData1:	User Data			
Datum:	World Geodetic System 1984 (WGS 84)			
	Forward Link		Reverse Link	
Transmission Site:	AB_FE_L1A_Eir		AB_FE_L3B_Eir	
Reception Site:	AB_FE_L3B_Eir		AB_FE_L1A_Eir	
Radio Type:	NetRadio0001		NetRadio0001	
Modulation Scheme:	4-QAM		4-QAM	
Bandwidth (MHz):	2	2		
Roll-Off Factor:	0.2	0.2		
Coding Gain (dB):	0	0		
System Gains (dB):	0	0		
Channel Overhead (%):	20		20	
FEC Overhead (%):	0	0		
Reference Temperature (°K):	290		290	
Receiver Noise Figure (dB):	5		5	
Maximum Data Rate (Mbps):	2.667		2.667	
Maximum Bit Rate (Mbps):	3.333		3.333	
Required Bit Error Rate:	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Carrier to Noise Ratio (dB):	14.965	15.965	14.965	15.965
Cross Polarization Improvement Factor (dB):			20	20	20	20
Rx Equalization Sig Norm Parameter (Kn,M):			0.1	0.1	0.1	0.1
Rx Equalization Sig Norm Parameter (Kn,NM):			0.1	0.1	0.1	0.1
UserData1:	User Data		User Data	
Center Frequency (MHz):	11000		11000	
Channel Bandwidth (MHz):	28		28	
Transmission Power (dBm):	30		30	
Transmission Gains (dB):	0		0	
Transmission System Loss (dB):		0		0
Transmission Line Loss (dB/100 m):		4		4
Transmission Line Length (m):		10		10
Transmission Connection Loss (dB):		0.3		0.3
Transmission Number of Connections:		2		2
Transmission Additional Loss (dB):		0		0
Transmission Losses (dB):	1		1	
Transmission Antenna:	HP2-11-NSMA		HP2-11-NSMA	
Transmission Antenna Size (m):		0.6		0.6
Transmission Antenna Height (m):		30		15
Transmission Antenna Gain (dBd):		32.36		32.36
Transmission Antenna Gain (dBi):		34.5		34.5
Transmission Power EIRP (dBm):		63.5		63.5
Reception Gains (dB):	0		0	
Reception System Loss (dB):	0		0	
Reception Line Loss (dB/100 m):		4		4
Reception Line Length (m):	10		10	
Reception Connection Loss (dB):		0.3		0.3
Reception Number of Connections:		2		2
Reception Additional Loss (dB):		0		0

Reception Losses (dB):	1		1	
Reception Antenna:	HP2-11-NSMA		HP2-11-NSMA	
Reception Antenna Size (m):	0.6		0.6	
Reception Antenna Height (m):		15		30
Reception Antenna Gain (dBd):		32.36		32.36
Reception Antenna Gain (dBi):		34.5		34.5
Link Polarization:	Vertical	Vertical		
Cross Polarization Factor (dB):		26.667		26.667
Link Distance (m):	16898.666		16898.666	
Azimuth - True (°):	302.357	122.191		
Azimuth - Magnetic (°):	304.557		124.486	
Transmission Inclination (°):	-0.363		0.363	
Reception Inclination (°):	-0.363		0.363	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	16899.004			16899.004
Center Frequency (MHz):	11000		11000	
Free Space Loss (dB):	137.825		137.825	
Max Fresnel Radius (m):	10.734		10.734	
Max 2nd Fresnel Radius (m):	15.18		15.18	
Earth Radius Factor (K):	4/3			
Effective Radius (m):	8502056.000			
ITU Recommendation:	ITU-R P.526-11			
Diffraction Model:	Cascade Knife Edge			
Diffraction:	No LOS Diffraction		No LOS Diffraction	
Diffraction Loss (dB):	0		0	
Clearance Target (%):	60			
Minimum Clearance (m):	4.587		4.587	
Minimum Clearance Point (m):		16887.504		16887.504
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	256.717		256.717	
Reflection Area 2 (m):	2154.189		2154.189	
Reflection Area 3 (m):	2288.1 - 2422			2288.1 - 2422
Reflection Area 4 (m):	2489 - 2511.4			2489 - 2511.4
Reflection Area 5 (m):	2578.3 - 2600.7			2578.3 - 2600.7
Reflection Area 6 (m):	2712.269		2712.269	
Reflection Area 7 (m):	2779.2 - 2890.9			2779.2 - 2890.9
Reflection Area 8 (m):	3002.5 - 3069.4			3002.5 - 3069.4
Reflection Area 9 (m):	3158.7 - 3203.4			3158.7 - 3203.4
Reflection Area 10 (m):	3292.673		3292.673	
Reflection Area 11 (m):	3381.965		3381.965	
Reflection Area 12 (m):	3493.6 - 3560.6			3493.6 - 3560.6
Reflection Area 13 (m):	3627.5 - 3672.2			3627.5 - 3672.2
Reflection Area 14 (m):	3739.137		3739.137	
Reflection Area 15 (m):	3850.753		3850.753	
Reflection Area 16 (m):	3917.7 - 4074.0			3917.7 - 4074.0
ITU Recommendation:	ITU-R P.676-8			
Atmospheric Pressure (hPa):	1013		1013	
Standard Temperature (°C):	15		15	
Water Vapor Density (g/m³):	7.5		7.5	
Atmospheric Gases Loss (dB):		0.279		0.279
Total Path Loss (dB):	138.104		138.104	
Reception Signal Level (dBm):		-41.104		-41.104

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	49.896	48.896	49.896	48.896

ITU Recommendation:	ITU-R F.1703-0 / ITU-T G.827
Objective ITU Quality Grade:	Short Haul SDH Networks
Unavailability Objective (%):	2.00E-02
Availability Objective (%):	99.9800

ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.826			
Error Performance Objective BBER (%):	1.60E-05		1.60E-05	
Error Performance Objective BBER (s/Month):	0.42		0.42	
	SESR	ESR	SESR	ESR
Error Performance Objective (%):	1.60E-04	3.20E-03	1.60E-04	3.20E-03
Error Performance Objective (s/Month):	4.205	84.096	4.205	84.096

ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.828			
Error Performance Objective BBER (%):	4.00E-06		4.00E-06	
Error Performance Objective BBER (s/Month):	0.105		0.105	
	SESR	ESR	SESR	ESR
Error Performance Objective (%):	1.60E-04	8.00E-04	1.60E-04	8.00E-04
Error Performance Objective (s/Month):	4.205	21.024	4.205	21.024

Multipath Model:	ITU-R P.530-15			
Multipath Planning Type:	Quick Planning			
Multipath Time Frame:	Average annual distribution			
ITU Recommendation:	ITU-R P.453-9			
Point Refractivity Gradient (dN1):	-76.7			
Geoclimatic Factor: 4.05E-05	4.05E-05			
Multipath Occurrence Factor (%):	1.05E-01		1.05E-01	

Precipitation Model: ITU-R P.530-15				
ITU Recommendation:	ITU-R P.837-5 / ITU-R P.841-4			
Precipitation Time Frame:	Average annual distribution			
Precipitation Rate @ 0.01% (mm/h):	22			
ITU Recommendation:	ITU-R P.838-3			
Specific Attenuation (dB/km):	0.627671		0.627671	
Rainfall Attenuation (dB):	7.274		7.274	

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%): 1.22E-07	1.53E-07	1.22E-07	1.53E-07	
Selective Fading Outage (%):	4.08E-09	4.08E-09	4.08E-09	4.08E-09
Composite Fading Outage (%):	1.26E-07	1.57E-07	1.26E-07	1.57E-07

Fading Outage (s/Month):	0.003	0.004	0.003	0.004
Selective Fading Outage (s/Month):	0	0	0	0
Composite Fading Outage (s/Month):	0.003	0.004	0.003	0.004

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Unavailability due to Rain (s/Year):	0	0	0	0

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Fading (%):	1.26E-07	1.57E-07	1.26E-07	1.57E-07
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	1.26E-07	1.57E-07	1.26E-07	1.57E-07
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):	0.04	0.05	0.04	0.05
Unavailability due to Rain (s/Year):	0	0	0	0
Total Unavailability (s/Year): 0.04	0.05	0.04	0.05	
Unavailability Objective (s/Year):	6307.2	6307.2	6307.2	6307.2

Total Availability (%):	100.0000	100.0000	100.0000	100.0000
Availability Objective (%):	99.9800	99.9800	99.9800	99.9800

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C.1.2 Kilmacanearla South – Ballyagran

Site Name:	AB_FE_L3B_Eir (	Kilmacanearla South)	AB_FE_L1B_Eir (Ballyagran)	
Type:	Cell	Cell		
Latitude:	52°28'33.9"N	52°24'09.1"N		
Longitude:	8°46'23.8"W	8°46'49.1"W		
Altitude (m):	213.0	105.0		
UserData1:	User Data			
Datum:	World Geodetic System 1984 (WGS 84)			

	Forward Link		Reverse Link			
Transmission Site:	AB_FE_L3B_Eir		AB_FE_L1B_Eir			
Reception Site:	AB_FE_L1B_Eir		AB_FE_L3B_Eir			
Radio Type:	NetRadio0001		NetRadio0001			
Modulation Scheme:	4-QAM		4-QAM			
Bandwidth (MHz):	2		2			
Roll-Off Factor:	0.2		0.2			
Coding Gain (dB):	0		0			
System Gains (dB):	0		0			
Channel Overhead (%):	20		20			
FEC Overhead (%):	0		0			
Reference Temperature (°K):	290		290			
Receiver Noise Figure (dB):	5		5			
Maximum Data Rate (Mbps):	2.667		2.667			
Maximum Bit Rate (Mbps):	3.333		3.333			
Required Bit Error Rate:	BER 10-3	BER 10-6	BER 10-3	BER 10-6		
Service Threshold (dBm):	-91	-90	-91	-90		
Carrier to Noise Ratio (dB):	14.965	15.965	14.965	15.965		
Cross Polarization Improvement Factor (dB):			20	20	20	20
Rx Equalization Sig Norm Parameter (Kn,M):			0.1	0.1	0.1	0.1
Rx Equalization Sig Norm Parameter (Kn,NM):			0.1	0.1	0.1	0.1
UserData1:	User Data		User Data			
Center Frequency (MHz):	11000		11000			
Channel Bandwidth (MHz):	28		28			
Transmission Power (dBm):	30		30			
Transmission Gains (dB):	0		0			
Transmission System Loss (dB):		0		0		
Transmission Line Loss (dB/100 m):		4		4		
Transmission Line Length (m):		10		10		
Transmission Connection Loss (dB):		0.3		0.3		
Transmission Number of Connections:		2		2		
Transmission Additional Loss (dB):		0		0		
Transmission Losses (dB):	1		1			
Transmission Antenna:	HP2-11-NSMA		HP2-11-NSMA			
Transmission Antenna Size (m):		0.6		0.6		
Transmission Antenna Height (m):		15		12		
Transmission Antenna Gain (dBd):		32.36		32.36		
Transmission Antenna Gain (dBi):		34.5		34.5		
Transmission Power EIRP (dBm):		63.5		63.5		
Reception Gains (dB):	0		0			
Reception System Loss (dB):	0		0			
Reception Line Loss (dB/100 m):		4		4		
Reception Line Length (m):	10		10			
Reception Connection Loss (dB):		0.3		0.3		
Reception Number of Connections:		2		2		
Reception Additional Loss (dB):		0		0		
Reception Losses (dB):	1		1			
Reception Antenna:	HP2-11-NSMA		HP2-11-NSMA			
Reception Antenna Size (m):	0.6		0.6			
Reception Antenna Height (m):		12		15		
Reception Antenna Gain (dBd):		32.36		32.36		
Reception Antenna Gain (dBi):		34.5		34.5		

Link Polarization:	Vertical	Vertical		
Cross Polarization Factor (dB):		26.667		26.667
Link Distance (m):	8208.128	8208.128		
Azimuth - True (°):	183.334	3.328		
Azimuth - Magnetic (°):	185.629		5.614	
Transmission Inclination (°):	0.775		-0.775	
Reception Inclination (°):	0.775		-0.775	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	8208.879		8208.879	
Center Frequency (MHz):	11000		11000	
Free Space Loss (dB):	131.554		131.554	
Max Fresnel Radius (m):	7.481		7.481	
Max 2nd Fresnel Radius (m):	10.58		10.58	
Earth Radius Factor (K):	4/3			
Effective Radius (m):	8502056.000			
ITU Recommendation:	ITU-R P.526-11			
Diffraction Model:	Cascade Knife Edge			
Diffraction:	No LOS Diffraction		No LOS Diffraction	
Diffraction Loss (dB):	0		0	
Clearance Target (%):	60			
Minimum Clearance (m):	4.394		4.394	
Minimum Clearance Point (m):		15.487		15.487
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	696.917		696.917	
Reflection Area 2 (m):	1223.476		1223.476	
Reflection Area 3 (m):	3020.0 - 3050.9			3020.0 - 3050.9
Reflection Area 4 (m):	3360.7 - 3453.6			3360.7 - 3453.6
Reflection Area 5 (m):	3515.6 - 3546.5			3515.6 - 3546.5
Reflection Area 6 (m):	6829.8 - 7046.6			6829.8 - 7046.6
Reflection Area 7 (m):	7139.522		7139.522	
Reflection Area 8 (m):	7294.393		7294.393	
Reflection Area 9 (m):	7387.3 - 7511.2			7387.3 - 7511.2
Reflection Area 10 (m):	7604.1 - 7697			7604.1 - 7697
Reflection Area 11 (m):	7790.0 - 7821.0			7790.0 - 7821.0
ITU Recommendation:	ITU-R P.676-8			
Atmospheric Pressure (hPa):	1013		1013	
Standard Temperature (°C):	15		15	
Water Vapor Density (g/m³):	7.5		7.5	
Atmospheric Gases Loss (dB):		0.136		0.136
Total Path Loss (dB):	131.689		131.689	
Reception Signal Level (dBm):		-34.689		-34.689
	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	56.311	55.311	56.311	55.311
ITU Recommendation:	ITU-R F.1703-0 / ITU-T G.827			
Objective ITU Quality Grade:	Short Haul SDH Networks			
Unavailability Objective (%):	2.00E-02			
Availability Objective (%):	99.9800			
ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.826			
Error Performance Objective BBER (%):	1.60E-05		1.60E-05	
Error Performance Objective BBER (s/Month):		0.42		0.42
	SESR	ESR	SESR	ESR
Error Performance Objective (%):	1.60E-04	3.20E-03	1.60E-04	3.20E-03
Error Performance Objective (s/Month):	4.205	84.096	4.205	84.096
ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.828			
Error Performance Objective BBER (%):	4.00E-06		4.00E-06	
Error Performance Objective BBER (s/Month):		0.105		0.105
	SESR	ESR	SESR	ESR

Error Performance Objective (%):	1.60E-04	8.00E-04	1.60E-04	8.00E-04
Error Performance Objective (s/Month):	4.205	21.024	4.205	21.024

Multipath Model:	ITU-R P.530-15
Multipath Planning Type:	Quick Planning
Multipath Time Frame:	Average annual distribution
ITU Recommendation:	ITU-R P.453-9
Point Refractivity Gradient (dN1):	-76.7
Geoclimatic Factor: 4.05E-05	4.05E-05
Multipath Occurrence Factor (%):	4.69E-03 4.69E-03

Precipitation Model: ITU-R P.530-15				
ITU Recommendation:	ITU-R P.837-5 / ITU-R P.841-4			
Precipitation Time Frame:	Average annual distribution			
Precipitation Rate @ 0.01% (mm/h):	22			
ITU Recommendation:	ITU-R P.838-3			
Specific Attenuation (dB/km):	0.627679	0.627679		
Rainfall Attenuation (dB):	4.074	4.074		

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	9.07E-10	1.14E-09	9.07E-10	1.14E-09
Selective Fading Outage (%):	6.05E-11	6.05E-11	6.05E-11	6.05E-11
Composite Fading Outage (%):		9.67E-10	1.20E-09	9.67E-10 1.20E-09

Fading Outage (s/Month):	0	0	0	0
Selective Fading Outage (s/Month):	0	0	0	0
Composite Fading Outage (s/Month):	0	0	0	0

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Unavailability due to Rain (s/Year):	0	0	0	0

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Fading (%):		9.67E-10	1.20E-09	9.67E-10 1.20E-09
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	9.67E-10	1.20E-09	9.67E-10	1.20E-09
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):	0	0	0	0
Unavailability due to Rain (s/Year):	0	0	0	0
Total Unavailability (s/Year):	0	0	0	
Unavailability Objective (s/Year):	6307.2	6307.2	6307.2	6307.2

Total Availability (%):	100.0000	100.0000	100.0000	100.0000
Availability Objective (%):	99.9800	99.9800	99.9800	99.9800

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