Report

Oatfield Wind Farm
EMI Impact Assessment
Report

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Executive Summary

Ai Bridges was commissioned to evaluate the potential impacts that the proposed development at Oatfield, Co. Clare 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 proposed development were identified and a field survey of each of these 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, nineteen telecom operators were contacted. At the time of writing this report, sixteen 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 responses, a desktop impact analysis was carried out and all of the telecommunication operator networks were analysed using radio planning \ modelling software (2D and 3D). Results from the impact analysis indicate that there is one radio link that crosses over the development would be impacted by the proposed turbine layout.

Operator	Radio Link Description	Impact of Proposed Turbine Layout	Mitigation Measure
Enet	PTP microwave radio link between Kilseily and ESB Killonan.	Radio Link Fresnel Zone obstructed by T08 and T11	Use alternative Telecoms Point of Presence mast-site to provide an alternative Enet service into Kilseily.

Table 1. Licensed microwave radio links impacted by proposed turbine layout.

A mitigation option to offset the impact on the radio link between Kilseily and ESB Killonan would be to use an alternative Enet Point-Of-Presence (POP) Telecoms mast-site to provide a service into Kilseily. This mitigation measure is described in Section 6.1.1 of this report.

Enet have stated that they are open to mitigation proposals (Ref. Section 3.19) and the option of using an alternative POP site has been discussed. Consultations with Enet are ongoing to determine the technical details of the mitigation measure solution. It has been agreed that the Developer would cover the mitigation measure costs.

None of the Telecommunication Operators contacted during the consultation process raised any concerns regarding telecommunications networks operating in the licence-exempt frequency bands. Also there was no impacts reported by any of the telecommunications operators operating GSM Radio Access, Mobile Broadband Data Access, Tetra or Telemetry networks.

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 Clare approximately 4 km northeast of Sixmilebridge. The proposed turbine dimensions considered in this report are shown below in Table 1. The co-ordinates of the proposed turbines are provided in Appendix A.

Wind Farm	Number of Turbines	Turbine Hub Height	Turbine Rotor Diameter
Oatfield	11	105 m	150m

Table 2. Wind Farm Turbine Details

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

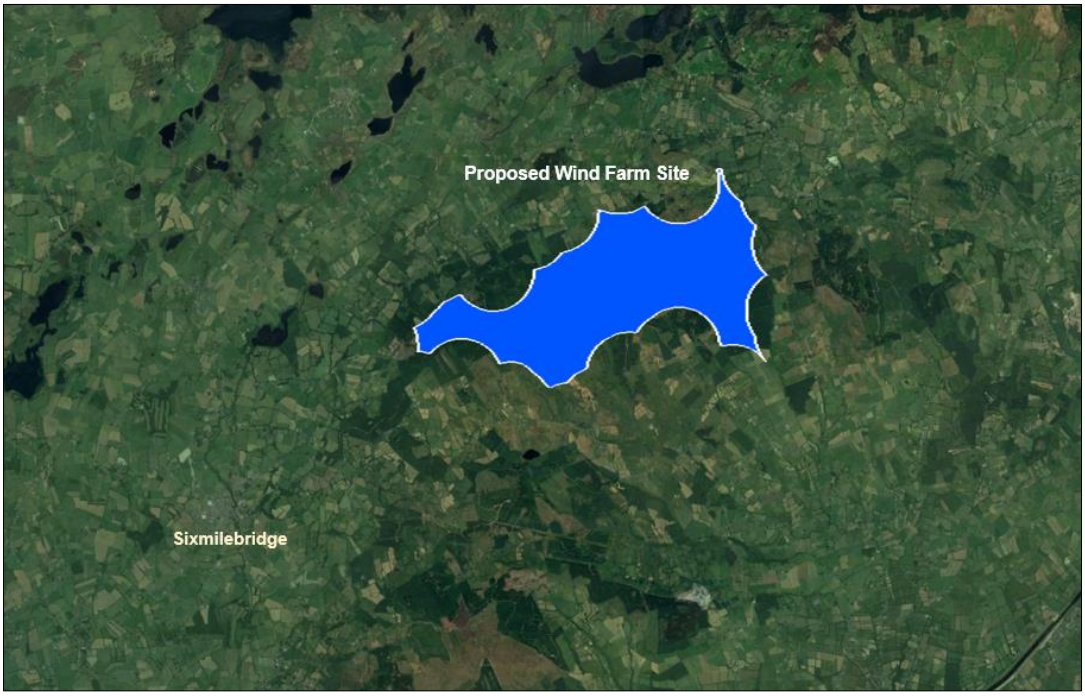


Figure 1. Location of proposed wind farm.

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 development at Oatfield. Figure 2 below shows the proposed wind farm site boundary plotted in the radio planning tool.

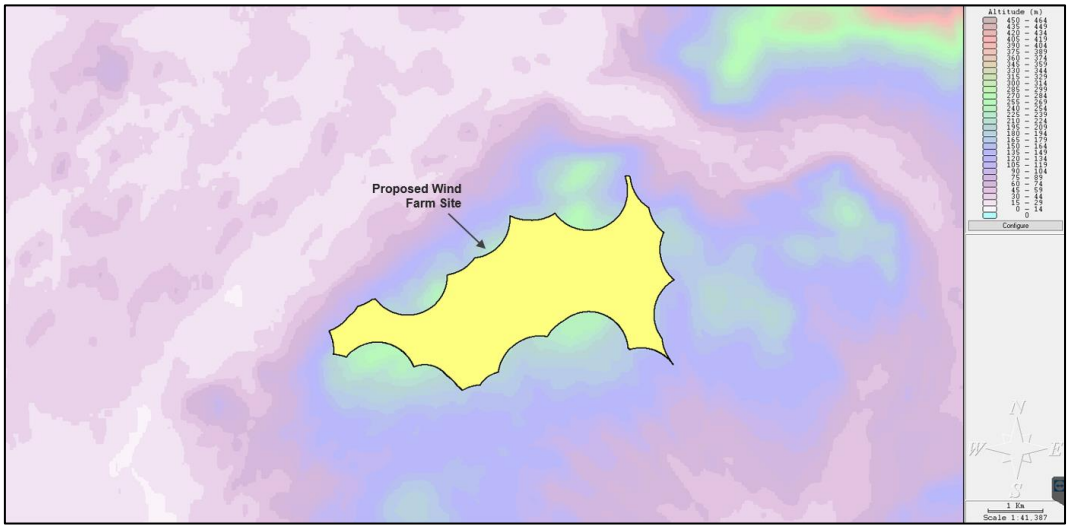


Figure 2. Wind Farm Site Boundary plotted in Radio Planning Software

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.

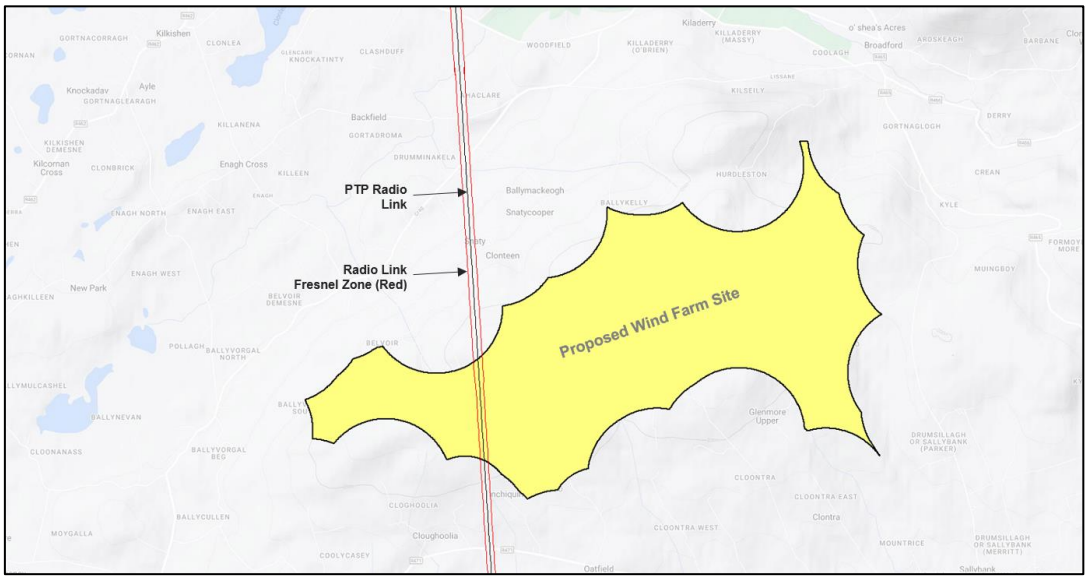


Figure 3. Example of microwave radio link crossing over/near the proposed wind farm site boundary modelled in radio planning software.

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 August 2023 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 3.1.19.

ID	Operator	Response (Yes/No)	Issues raised by Operator \ Observations.
1	2RN	Yes	2RN have raised a concern regarding one Licensed PTP microwave radio link and one DTT off-air (UHF) radio link.
2	Airwave	No	No response. (No response expected.)
3	An Garda Síochána	No	No response. (No response expected.)
4	Coimisiún na Meán (formerly the BAI)	Yes	No issues.
5	BT Ireland	Yes	No issues.
6	CIE/Irish Rail	Yes	No issues.
7	Dept. of Defence	Yes	The Department of Defence have acknowledged receipt of the consultation request and have stated that they will consult with the relevant Military authorities and revert in due course. (No issues expected)
8	Eir	Yes	Eir have raised a concern regarding one Licensed PTP microwave radio link.
9	Enet	Yes	Enet have raised concerns regarding three Licensed PTP microwave radio links.
10	ESB Networks	No	No response.
11	Imagine Broadband	Yes	No issues.
12	AirNav Ireland (formerly of the Irish Aviation Authority)	Yes	No issues regarding transmission links; however, AirNav have requested that their flight calibration contractor; FCSL, be contacted to assess for any adverse effects to Commissioning and Flight Check Profiles.
13	Uisce Éireann	Yes	No issues.
14	Clare County Council	Yes	No issues.
15	Tetra Ireland (TI)	Yes	No issues.
16	Three Ireland	Yes	No issues.
17	Viatel	Yes	No issues.
18	Virgin Media	Yes	No issues.
19	Vodafone Ireland	Yes	Vodafone have raised a concern regarding two Licensed PTP microwave radio links.

Table 3. Telecom Operators Consulted

3.1.1 2RN Response to Consultations

2RN provided the following email response to consultations:

> *"We have a 6GHz Microwave link and a DTT off air link passing through the area that you have highlighted in your email. I have added the details to your table below.*
>
> *There is also a risk of interference to broadcast coverage in the area so we would appreciate it if a protocol could be signed between the developer and 2rn should the site go ahead.*
>
> *Antenna heights are listed as metres Above Mean Sea Level (AMSL), not Above Ground Level (AGL). We would request that the first Fresnel zone remain clear. It looks like our paths pass through the area that you have highlighted at the height of the turbines."*

Link Name / ID	Band MHz\GHz	Link Length	Site A			Site B		
			Lat	Long	Ant Height	Lat	Long	Ant Height
MGH-WCH_6GHz	6GHz	27.8km	52.968795	-8.718379	429 m AMSL	52.719662	-8.692079	260 m AMSL
MGH_WCH_DTT	674MHz	27.8km	52.968795	-8.718379	553 m AMSL	52.719662	-8.692079	297 m AMSL

3.1.2 Airwave Response to Consultations

To date no response has been received.

3.1.3 An Garda Síochána Response to Consultations

To date no response has been received.

3.1.4 Coimisiún na Meán Response to Consultations

Coimisiún na Meán provided the following email response to consultations:

> *"Coimisiún na Meán 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."*

3.1.5 BT Ireland Response to Consultations

BT provided the following email response to consultations:

> *"BT no longer have a radio microwave network."*

3.1.6 CIE/Irish Rail Response to Consultations

CIE provided the following email response to consultations:

> *"Irish Rail have no wireless links within 5km of this proposed development."*

3.1.7 Department of Defence Response to Consultations

The Department of Defence provided the following email response to consultations:

> *"The Department of Defence wished to acknowledge receipt of your e-mail below re: Oatfield Wind Farm Development, Co Clare. The Department will consult with the relevant Military authorities and revert in due course."*

3.1.8 Eir Response to Consultations

Eir provided the following email response to consultations:

"We have 1 transmission link within the proposed area that would be at risk, the end points of the transmission link are below, if you could design around this and keep a buffer back from the link."

#	Band	A-end			Height		B-end			Height
Link1	11Ghz	CE_1954	52°46'19.17"N	8°41'37.38"W	18	<--->	CE_9016	52°43'40.81"N	8°42'20.56"W	26

3.1.9 Enet Response to Consultations

Enet provided the following email response to consultations:

"See our links below passing through this area:"

Link Name / ID	Band MHz\GHz	Link Length	Site A			Site B		
			Lat	Long	Ant Height	Lat	Long	Ant Height
O2 O'Callaghans Mills – ESB Killonan	13GHz	19.1km	52.797167	-8.658075	15m	52.639529	-8.547088	15m
O2 O'Callaghans Mills – Westpark	11GHz	18.7km	52.797167	-8.658075	15m	52.708902	-8.893620	13m
O2 O'Callaghans Mills – KN Shannon	15GHz	16.8km	52.797167	-8.658075	15m	52.718077	-8.870856	8m

29.11.23 – Email from AiBridges Ltd to Enet

Hello Peter

I am following up from our call earlier this week.

As discussed we have modelled your radio network in the vicinity of the proposed wind farm at Oatfield, Co. Clare and the results indicate that your 13 GHz between Kilseily (O'Callaghans Mills) and ESB Killonan would be impacted by two of the proposed turbines. To offset the impact of the two turbines, we have assessed alternative POP sites that may potentially be used to bring a service into Kilseily.

Our engineers' analysis confirms that a radio link from the ESB Telecoms 110kV Substation POP Site at Drumline would be a viable mitigation measure solution. We have generated a radio link path profile which shows clear LOS between Drumline and Kilseily (see screenshots below). Also, the radio link budget indicates that it would meet the Radio Link Availability Criteria required by ComReg for radio licensing.

Following our call this week and our review of the existing Enet nationwide backhaul radio network it has been established that there is already a link from this Drumline POP site to Kilseily Telecoms Mast. As discussed the proposed development is being submitted for planning in the coming weeks and if successful would not going into operation until 2027/2028.

On the basis of the above information would it be possible to agree on the following Mitigation Measure Solution

1. *The alternative radio link (currently existing) from Drumline POP Site to Kilseily (O'Callaghans Mills) Telecoms Mast could be upgraded to a protected\dual link for redundancy*
2. *The developer would agree to cover the costs of the radio link upgrade. The maximum Mitigation Measure Costs are approximated as follows :*

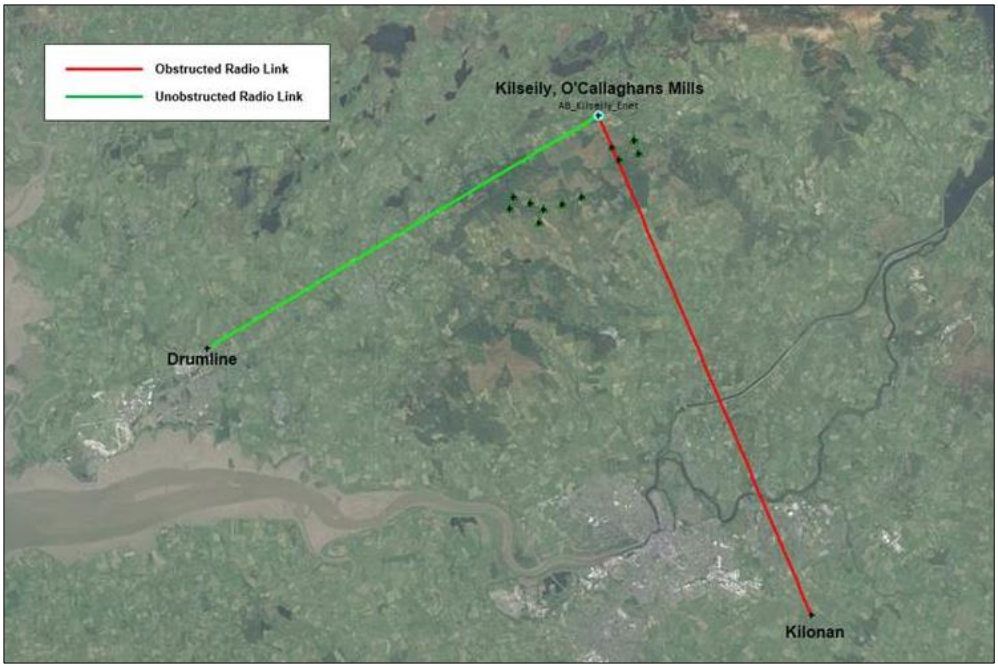
   - *Equipment Costs : €15,000*
   - *PM \ Planning & Design Costs : €5,000*
   - *Installation & Commissioning : €5,000*

3. *Upon successful planning it would be agreed that the Developer would engage with Enet six months in advance of the construction of the impacting turbines and agree commencement \ plan of works of the upgrade based on estimated project commencement date in 2027/2028*

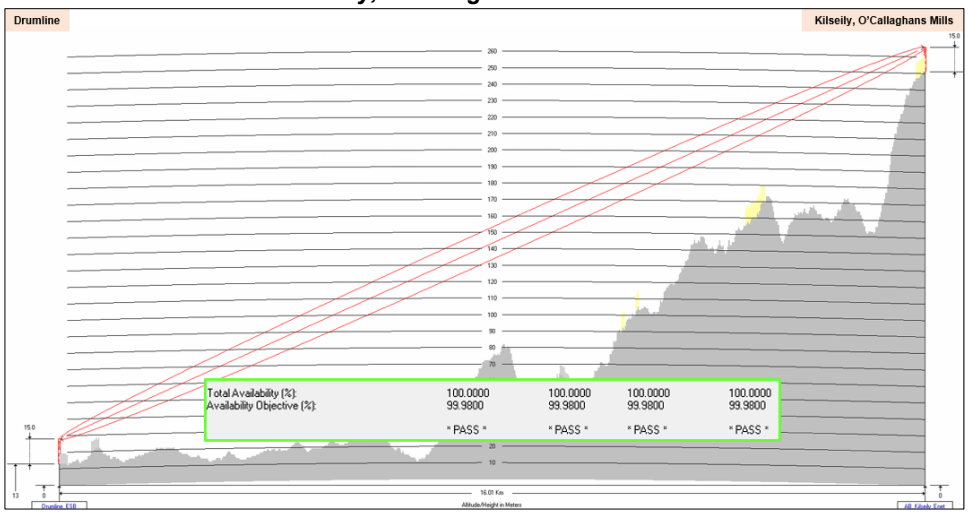
We would be grateful if you could advise if the proposed Mitigation Measure would be acceptable to Enet and if you could confirm same by email. If you require any further information please do not hesitate to contact me

Kilseily (O'Callaghans Mills) - ESB Killonan Radio link obstructed by proposed turbines

Alternative POP Site



Path Profile: Drumline – Kilisiely, O'Callaghans Mills



Note: The Radio Link Path Profile and Radio Link Budget are based on the following ITU-R Recommendations:

- *ITU-R P.525-2*
- *ITU-R P.526-11*
- *ITU-R P.676-8*

Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

29.11.23 – Email response from Enet to AiBridges Ltd

"Hi Kevin,

I was chatting to one of our network engineers and he said the link from O'Callaghans Mills -> ESB Killonan is required to offer diversity to a customer in Shannon,
Our 2nd core link at O'Callaghans Mills is actually to a site called Westpark in Shannon and this won't allow for redundancy for this particular customer,
We may need to onboard at a new high site so that we can continue to offer diversity to this customer,
Can you leave it with me to figure out the best solution and I'll come back to very soon?

Regards,
Peter

Peter O`Brien | Licensed Link planner"

29.11.23 – Email from AiBridges Ltd to Enet

Hello Peter,

Thank you for the prompt response.
In principle are Enet open to a mitigation measure proposal in relation to the proposed wind farm development?

We would be grateful if you could confirm and we will await your further response in relation to the technical details

Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

29.11.23 – Email response from Enet to AiBridges Ltd

"Hi Kevin,

Yes, we are open to a mitigation proposal, but we'll need to figure out what that mitigation will be and the actual cost,

Regards,
Peter
Peter O`Brien | Licensed Link planner"

3.1.10 ESB Networks Response to Consultations

To date no response has been received.

3.1.11 Imagine Broadband Response to Consultations

Imagine Broadband provided the following email response to consultations:

"At present Imagine have no microwave affected by this development.
Your mail has been forwarded to our RF department. They will respond if they have any concerns."

3.1.12 AirNav Response to Consultations

AirNav provided the following email response to consultations:

"The proposed windfarm development falls within the coverage area of AirNav Ireland operated navigational-aids at Shannon Airport and may have an impact on the flight-calibration profiles flown as part of the associated commissioning and periodic routine flight-checks.

AirNav Ireland requests that you contact our flight calibration contractor FCSL, to assess if any adverse effects to Shannon ILS 24 Commissioning and Routine Flight Check Profiles will occur because of this development."

3.1.13 Uisce Éireann Response to Consultations

Uisce Éireann provided the following email response to consultations:

"I can confirm that Uisce Éireann have no communications links traversing the proposed study area."

3.1.14 Clare County Council Response to Consultations

Clare County Council provided the following email response to consultations:

"We are not aware of telecommunications infrastructure owned by Clare County Council at these locations."

3.1.15 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 it is also reviewed by eir."

3.1.16 Three Ireland Response to Consultations

Three Ireland provided the following email response to consultations:

> *"I've reviewed the proposed wind farm development at Oatfield, Co. Clare, and it will have no impact on the Three Ireland Microwave Transmission network."*

3.1.17 Viatel Response to Consultations

Viatel provided the following email response to consultations:

> *"No impact."*

3.1.18 Virgin Media Response to Consultations

Virgin Media provided the following email response to consultations:

> *"Virgin Media Ireland DO NOT have any links in this area."*

3.1.19 Vodafone Ireland Response to Consultations

Vodafone provided the following email response to consultations:

> *"I can confirm that there are two microwave links on the Vodafone network that may be affected by the proposed Oatfield Wind Farm Development in Co. Clare, please see details below.*
>
> *The minimum spacing from any rotor tip in the area to the first Fresnel zone of our link should be a minimum of 30m."*

Link Name / ID	Band MHz\GHz	Link Length	Site A (CE034, Oatfield ESB)					Site B (CE066, Quin)				
			Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
CE066-CE034	23GHz/28MHz	10.89km	52.77202384	-8.693709399	153186	169217	15m	52.78395551	-8.853814589	142397	170661	15m

Link Name / ID	Band MHz\GHz	Link Length	Site A (CEMGA, RTE Maghera)					Site B (CE005, Woodcock Hill)				
			Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
CE005-CEMGA_NL	15GHz/28MHz	27.2km	52.96846084	-8.71772318	151784	191091	20m	52.72408944	-8.70948573	152069	163894	20m

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-Site A to Mast-Site J) 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 four Telecom Operators with networks in the vicinity of the proposed development that require a detailed technical analysis:

- 2RN Network
- Eir Network
- Enet Network
- Vodafone Ireland Network

Sections 5.1 to 5.4 below outline the desktop survey analysis findings* for each of the Telecom Operator networks listed above.

5.1 2RN Network Analysis

The 2RN network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) microwave radio link and one DTT off air (UHF) radio link. The radio links are listed in Table 4 below and a Plan view of the 2RN network is shown in Figure 5.

Link ID	Operator	Link Description
1	2RN	PTP microwave radio link from Maghera to Woodcock Hill
2	2RN	PTP DTT off air (UHF) radio link from Maghera to Woodcock Hill

Table 4. 2RN Radio Links requiring Analysis

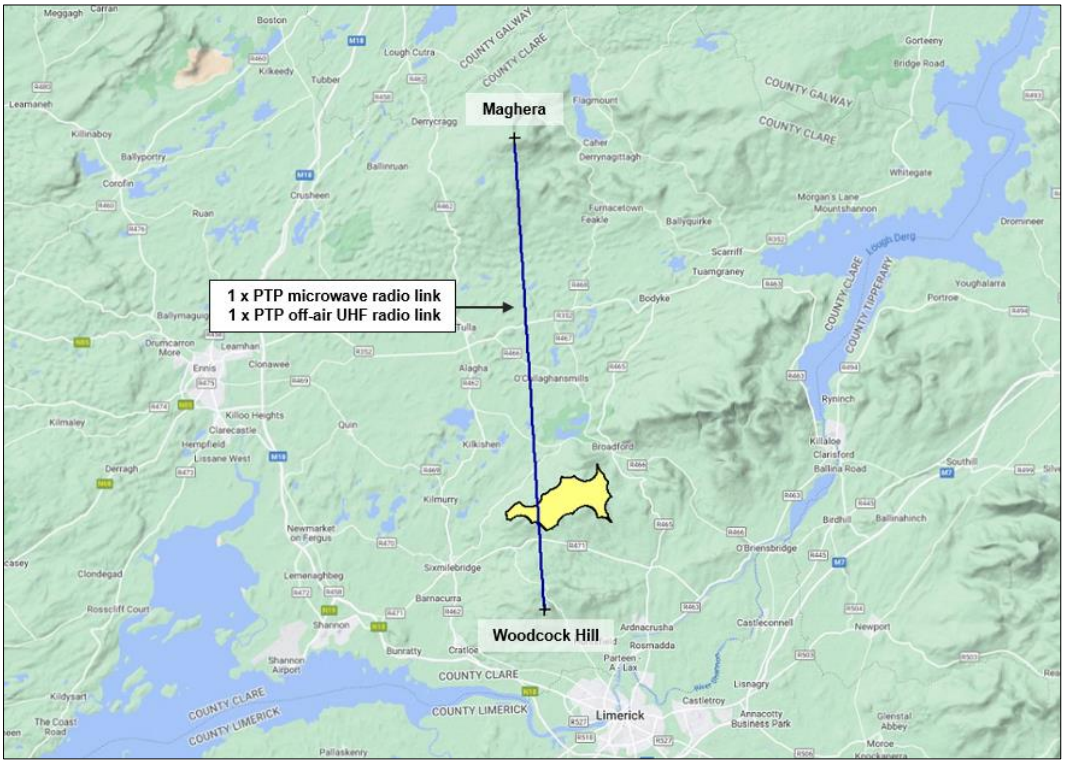


Figure 5. 2RN Network – Plan View

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

Figure 6 below shows a close-up view of the 2RN radio links relative to the proposed wind turbines. Desktop survey analysis indicates that there is a clearance distance of over 100 m between the radio links and the nearest of the proposed turbines. At this distance there will be no impact on the 2RN radio links.

Table 5 below provides a brief summary of the network analysis for the 2RN network in the vicinity of the proposed development.

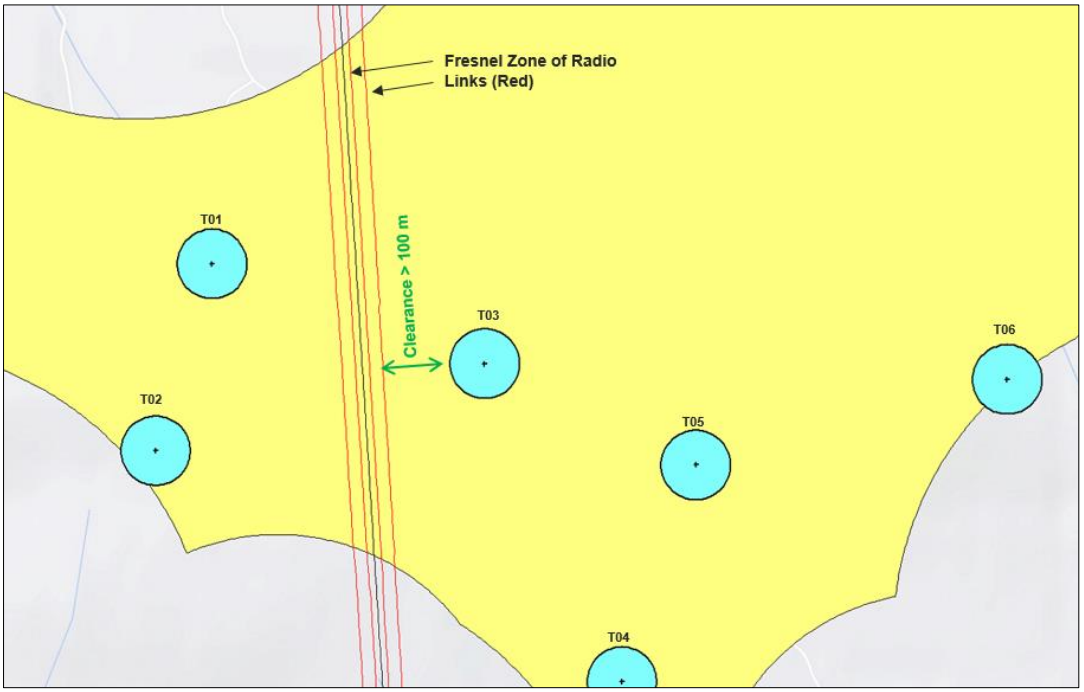


Figure 6. 2RN Network – Close-up Plan View.

Link ID	Link Description	Link Type	Applicable Fresnel Zone	Wind Farm Impacts
2RN Link 1	Maghera to Woodcock Hill	PTP (Microwave)	1st Fresnel	No impacts
2RN Link 2	Maghera to Woodcock Hill	PTP (UHF)	1st Fresnel	No impacts

Table 5. 2RN Network – Analysis Summary

5.2 Eir Network Analysis

The Eir 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 Eir network is shown in Figure 7.

Link ID	Operator	Link Description
1	Eir	PTP microwave radio link from Oatfield to Woodcock Hill

Table 6. Eir Radio Links requiring Analysis

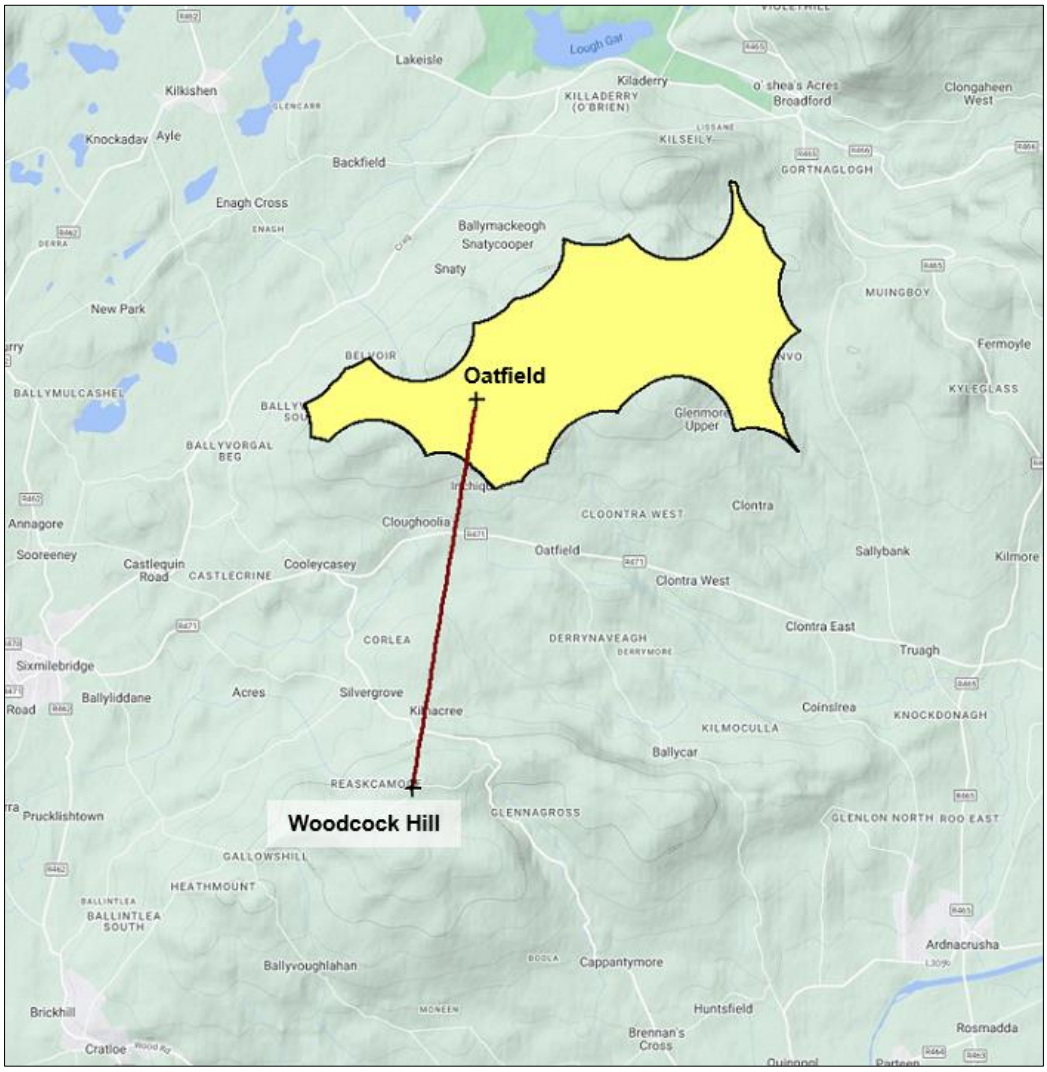


Figure 7. Eir Network – Plan View

To further assess the potential impacts, the radio link has been modelled in 3D and the clearance distance between the Fresnel Zone (F2) and the blade-tip of the nearest of the proposed turbines (T03) has been calculated. The 3D model indicates that there is a clearance distance of 5.63m and the radio link will not be impacted.

It should be noted that the 3D model is based on the following ITU-R Recommendations below

- ITU-R P.530-13/15,
- ITU-R P.526-11

- ITU-R P.676-8

The ITU-R standards recommends clearance from the critical Fresnel Zone of 60% of the first Fresnel (F1). For the purpose of this analysis the second Fresnel Zone (F2) has been used. This is a worst case scenario analysis thus the 60% of F1 clearance range would be more than required for the worst case F2 clearance condition.

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

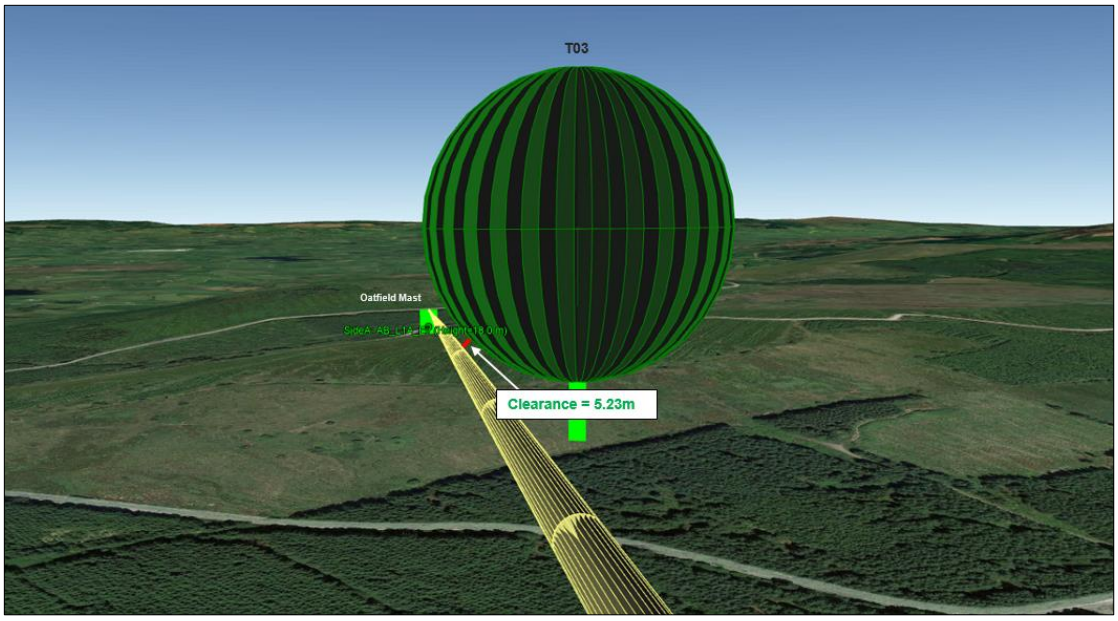


Figure 8. Eir Network – Close-up Plan View.

Link ID	Link Description	Link Type	Applicable Fresnel Zone	Wind Farm Impacts
Eir Link 1	Oatfield to Woodcock Hill	PTP	2nd Fresnel	No impacts

Table 7. Eir Network – Analysis Summary

5.3 Enet Network Analysis

The Enet 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 8 below and a Plan view of the Enet network is shown in Figure 9.

Link ID	Operator	Link Description
1	Enet	PTP microwave radio link from Kilseily to ESB Killonan
2	Enet	PTP microwave radio link from Kilseily to Westpark, Shannon
3	Enet	PTP microwave radio link from Kilseily to KN, Shannon

Table 8. Enet Radio Links requiring Analysis

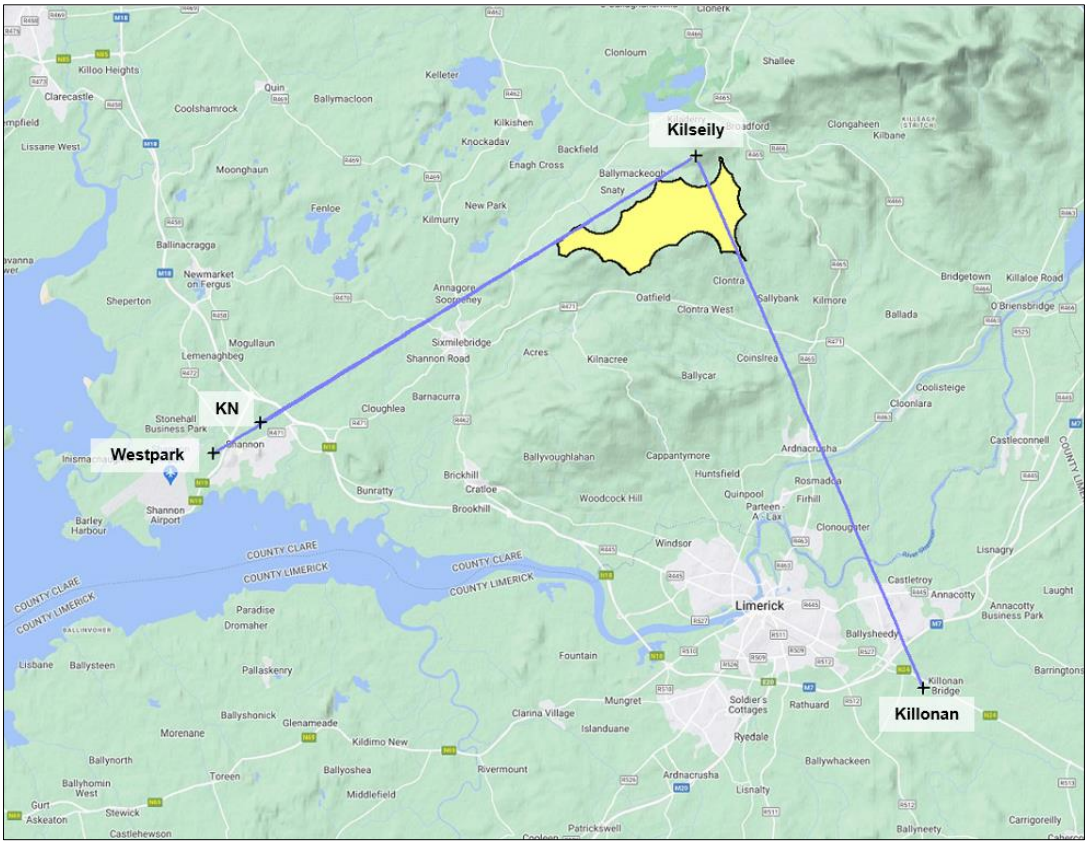


Figure 9. Enet Radio Network – Plan View

Figure 10 below shows a close-up view of the Enet microwave radio links relative to the proposed wind farm site. Desktop survey analysis indicates that Link 2 and Link 3 will not be impacted; however Link 1 would be impacted by turbines T08 and T11.

Table 9 below provides a brief summary of the network analysis for the Enet network in the vicinity of the proposed wind farm.

Figure 10. Enet Network – 3D View.

Link ID	Link Description	Link Type	Applicable Fresnel Zone	Wind Farm Impacts
Enet Link 1	Kilseily to ESB Killonan	PTP	2nd Fresnel	Interference Impact from T08 and T11 which can be mitigated thus no residual impacts. Reference Section 6.1
Enet Link 2	Kilseily to Westpark, Shannon	PTP	2nd Fresnel	No impacts
Enet Link 3	Kilseily to KN, Shannon	PTP	2nd Fresnel	No impacts

Table 9. Enet Network – Analysis Summary

5.4 Vodafone Ireland Network Analysis

The Vodafone network in the vicinity of the proposed wind farm consists of two Point-to-Point (PTP) microwave radio links. The radio links are listed in Table 10 below and a Plan view of the Vodafone Ireland network is shown in Figure 11.

Link ID	Operator	Link Description
1	Vodafone	PTP microwave radio link from Oatfield to Mausnarylaan
2	Vodafone	PTP microwave radio link from Maghera to Woodcock Hill

Table 10. Vodafone Ireland Radio Links requiring Analysis

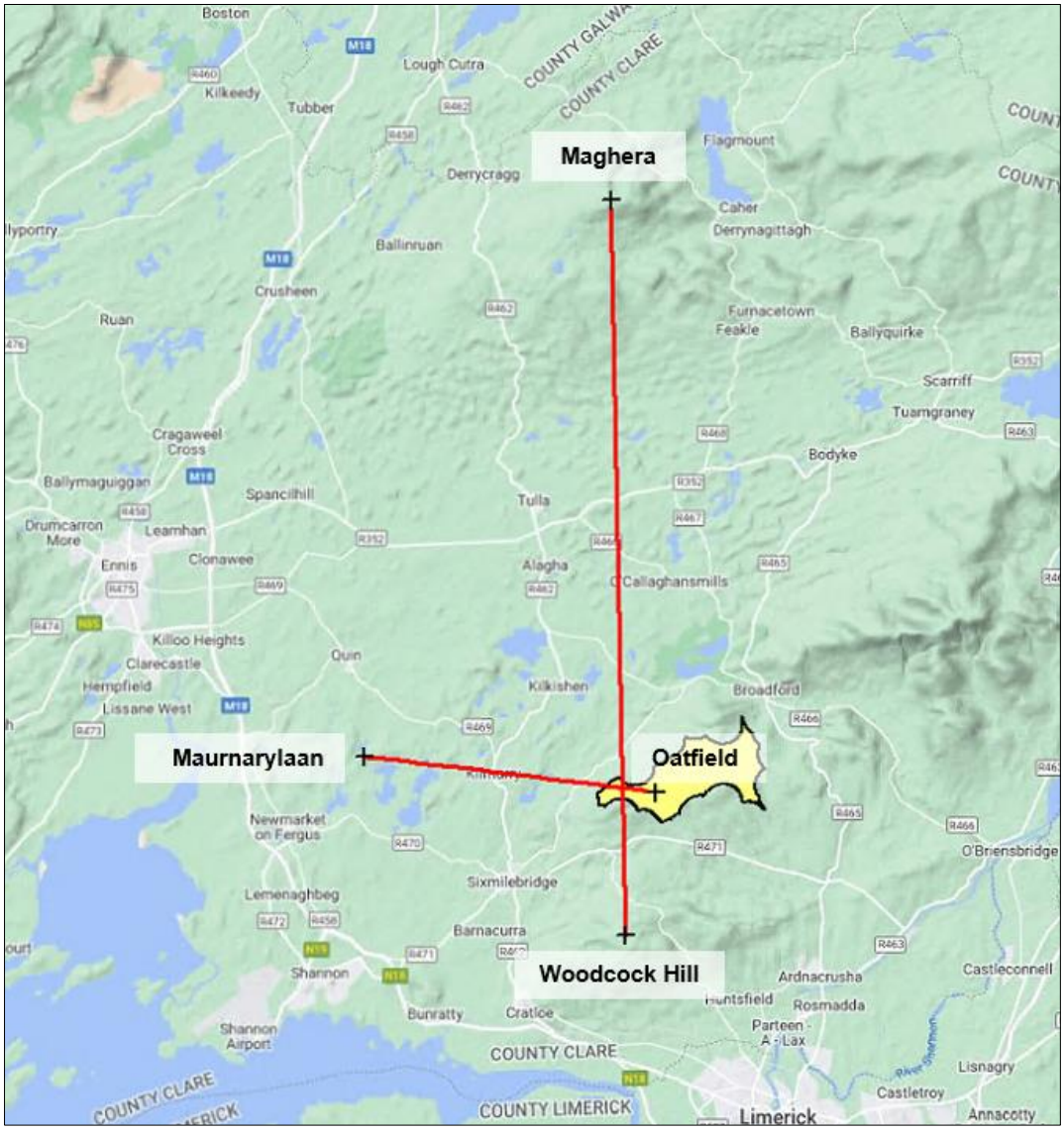


Figure 11. Vodafone Ireland Radio Network – Plan View

Figure 12 below shows a close-up view of the Vodafone microwave radio links relative to the proposed wind farm site. Desktop survey analysis indicates that there is a clearance distance

of over 75 m between the radio links and the nearest of the proposed turbines. At this distance there will be no impact on the Vodafone radio links.

Table 11 below provides a brief summary of the network analysis for the Vodafone network in the vicinity of the proposed wind farm.

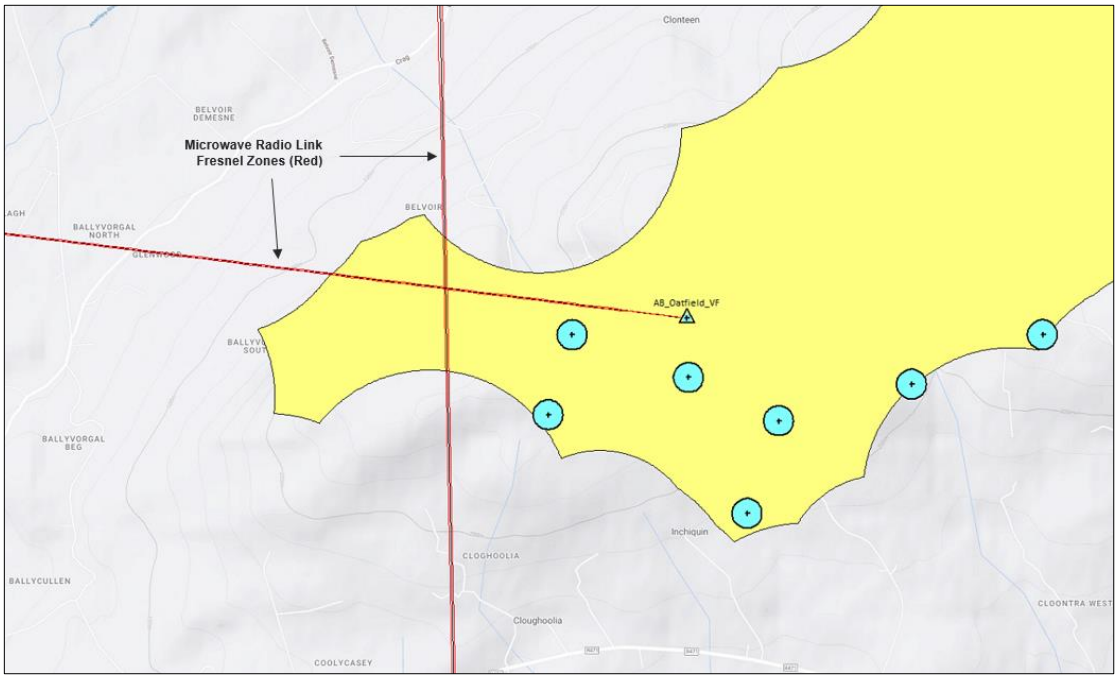


Figure 12. Vodafone Ireland Network – Close-up Plan View.

Link ID	Link Description	Link Type	Applicable Fresnel Zone	Wind Farm Impacts
Vodafone Link 1	Oatfield to Mausnarylaan.	PTP	1st Fresnel	No impacts
Vodafone Link 2	Maghera to Woodcock Hill.	PTP	1st Fresnel	No impacts

Table 11. Vodafone Ireland Network – Analysis Summary

Section 6 - Mitigation Measures

6. Mitigation Measures

Section 6.1 that follows, describes the mitigation measures available to the wind farm developer to offset the impact of the proposed turbine layout on the Enet radio link between Kilseily and ESB Kilonan.

6.1 Mitigation Measure Proposal – Enet Network

To offset the potential impact of T08 and T11 on the Enet radio link from the Kilseily O'Callaghans Mills) Telecommunications Mast to the ESB Killonan the following mitigation measure proposal is available:

i) Re-route the Enet radio link service into the Kilseily Telecommunications Mast from an alternative Telecommunications Point-of-Presence (POP) Mast Site.

This mitigation measure is described in more detail in Section 6.1.1 that follows.

6.1.1 Route the Enet service into Kilseily from an alternative Point-of-Presence Site.

An option to mitigate for the impact on the radio link between ESB Killonan and Kilseily would be to use an alternative Enet Telecoms POP mast site to provide a service into Kilseily. Figure 13 below shows an example of how an alternative feeder-site could be used to mitigate against obstructing turbines.

Enet are in agreement and open to mitigation proposals (Ref. Section 3.19) and the option of using an alternative POP site has been discussed. Consultations with Enet are ongoing to determine an agreeable mitigation measure.

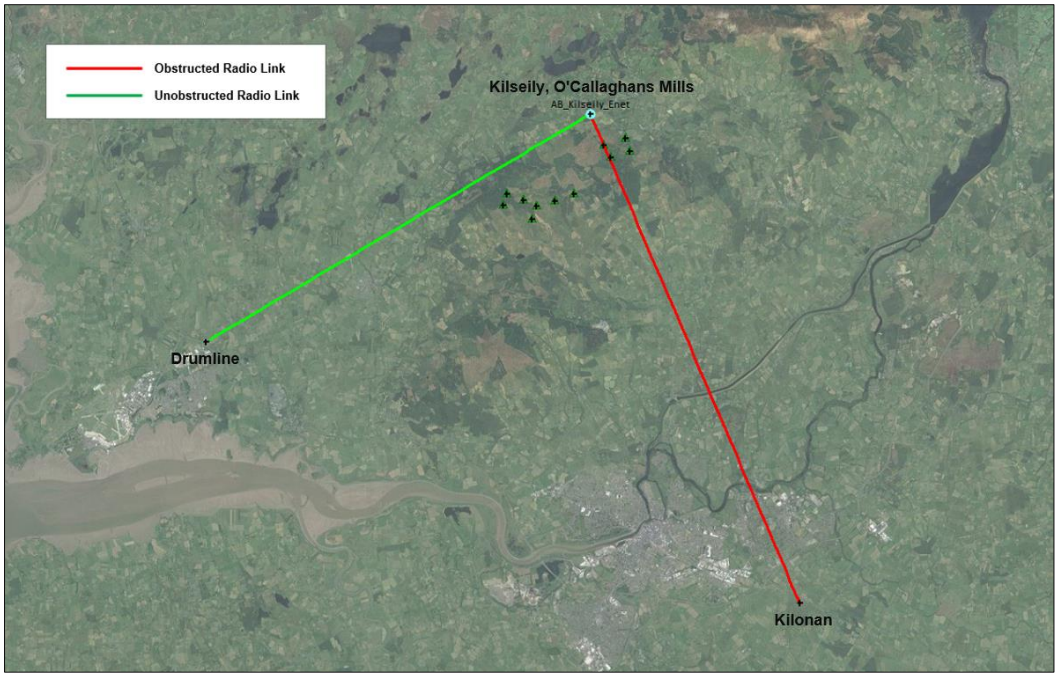


Figure 13. Example of how an alternative feeder-site could be used to mitigate against obstructing turbines.

To determine if an alternative telecommunications mast-site could be used as a viable POP site, a radio link path profile was generated to an established telecommunication POP Mast site within the vicinity of the proposed development This Radio Path Profile is based on the assumed availability of a Telecommunications POP Mast Site at 110kV ESB Sub-station at Drumline, Shannon, Co. Clare.

A radio link budget assessment was also carried out to determine if the proposed link would meet the Radio Link Availability Criteria required by the Communications Regulator for radio licensing purposes.

The Radio Link Path Profile and Radio Link Budget are based on the following ITU-R Recommendations:

- ITU-R P.525-2
- ITU-R P.526-11
- ITU-R P.676-8

The Radio Path Profile is shown below in Section 6.1.2.1. The Radio Link Budget can be found in Appendix C. The final Telecoms Mast Site selection will depend on agreement with Enet

6.1.1.1 Path Profile – Drumline to Kilseily

The radio link path profile shows clear Line-of-Sight (LOS) and the link budget results would pass the radio availability criteria required by the Communications Regulator

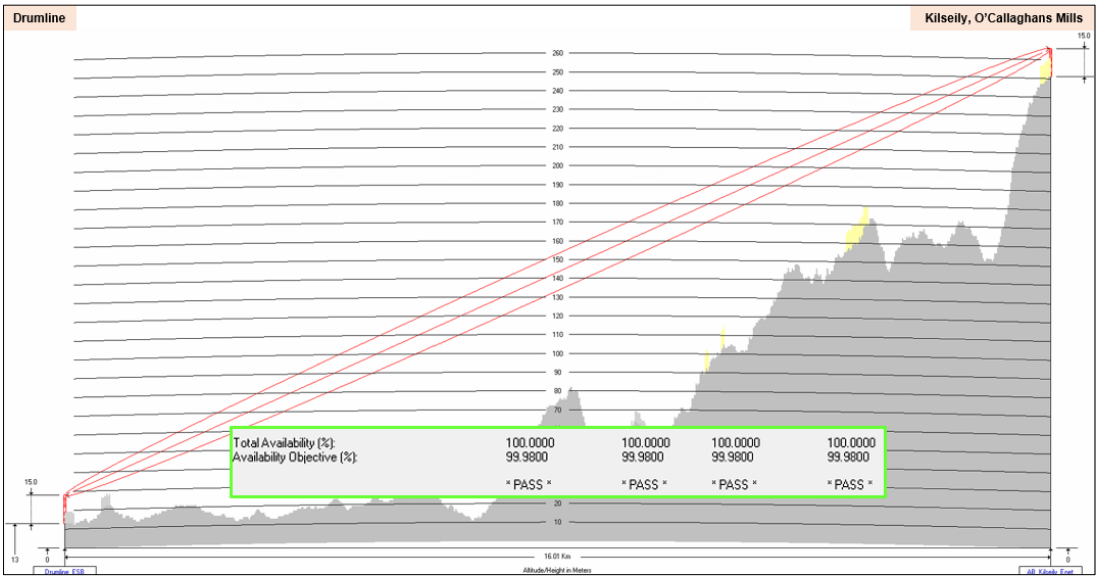


Figure 14. Path Profile – Drumline to Kilseily

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 is one Licensed PTP microwave radio link that crosses over the wind farm which could potentially be impacted by the proposed development.

- The radio links which could potentially be impacted by the wind farm development is listed below in Table 12.

Operator	Radio Link Description	Impact of Proposed Turbine Layout	Mitigation Measure
Enet	PTP radio link between Kilseily and ESB Killonan.	Interference Impact (Radio Link Fresnel Zone obstructed by T08 and T11)	Use alternative telecoms Point-of-Presence (POP) mast-site to provide an alternative service into Kilseily. Enet confirmation and agreement to mitigation measure solution proposals. Consultations ongoing to finalise technical details of mitigation measure solution. Agreement in place that developer would cover the mitigation measure costs.

Table 12. Radio Links in vicinity of proposed Oatfield Wind Farm development.

- Enet have stated that they are open to mitigation proposals and the option of using an alternative POP site has been discussed. Consultations with Enet are ongoing to determine an agreeable mitigation measure to offset the potential impact of T08 and T11 on the radio link between Kilseily and ESB Killonan on the basis that the developer would cover the mitigation measure costs.

- Figure 15 below has been provided to illustrate the Enet radio link that is potentially impacted by the proposed turbine layout.

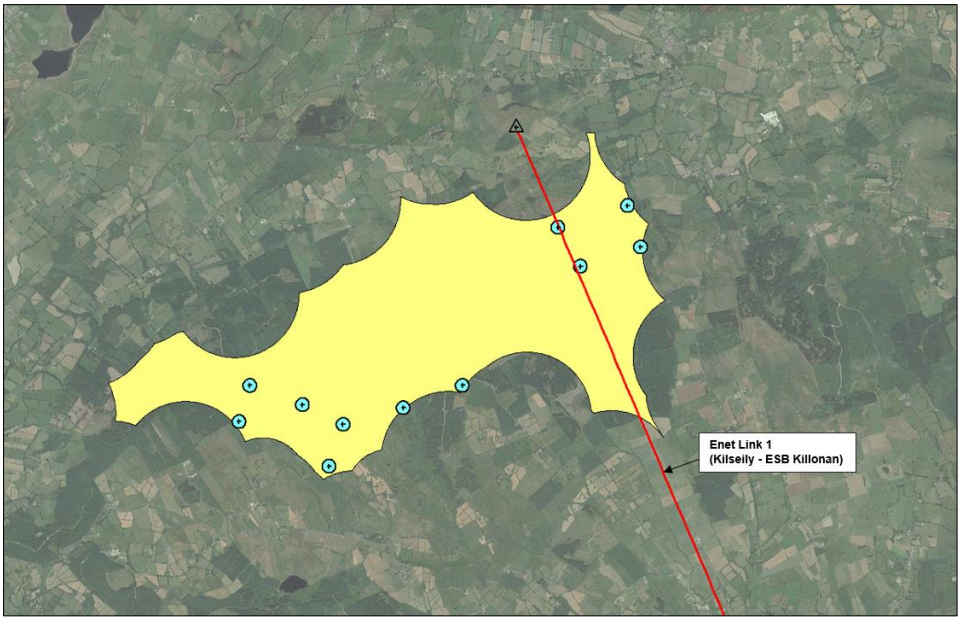


Figure 15. Telecommunication links impacted by proposed wind turbine layout

APPENDIX A – Wind Farm Turbine Coordinates

Appendix A – Wind Farm Turbine Co-ordinates

The co-ordinates of the proposed 11-turbine layout are shown below in Table A1.

Turbine ID	WGS84	
	Latitude	Longitude
T01	52° 46' 16.592"N	8° 42' 8.311"W
T02	52° 46' 3.546"N	8° 42' 14.823"W
T03	52° 46' 9.627"N	8° 41' 36.883"W
T04	52° 45' 47.425"N	8° 41' 21.062"W
T05	52° 46' 2.553"N	8° 41' 12.552"W
T06	52° 46' 8.518"N	8° 40' 36.636"W
T07	52° 46' 16.582"N	8° 40' 1.176"W
T08	52° 46' 59.651"N	8° 38' 50.592"W
T09	52° 47' 6.609"N	8° 38' 14.565"W
T10	52° 47' 21.580"N	8° 38' 22.417"W
T11	52° 47' 13.685"N	8° 39' 3.983"W

Table A1. Turbine Layout

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 16. 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 (Westpark, Shannon)

Telecommunications Mast-Site A is located at Westpark Business Campus, Shannon and is approximately 13 km southwest of the proposed wind farm site.

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 17. Mast-Site A

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast A	Enet

Table 13. Field Survey Summary – Mast-Site A

Mast-Site B (KN, Shannon)

Telecommunications Mast-Site B is located at the Kuehne+Nagel (KN) office in Shannon and is approximately 11 km southwest of the proposed wind farm site.

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 18. Mast-Site B

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast B	Enet

Table 14. Field Survey Summary – Mast-Site B

Mast-Site C (Mausnarylaan)

Telecommunications Mast-Site C is located in the townland of Mausnarylaan, Co Clare and is approximately 9 km west 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 15.

Figure 19. Mast-Site C

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

Table 15. Field Survey Summary – Mast-Site C

Mast-Site D (Maghera)

Telecommunications Mast-Site D is located on Maghera Mountain, Co Clare and is approximately 20 km north 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 20. Mast-Site D

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast D	2RN, Vodafone

Table 16. Field Survey Summary – Mast-Site D

Mast-Site E (Kilseily)

Telecommunications Mast-Site E is located in the townland of Kilseily, Co Clare and is approximately 1 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 17.

Figure 21. Mast-Site E

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast E	Enet

Table 17. Field Survey Summary – Mast-Site E

Mast-Site F (Oatfield)

Telecommunications Mast-Site F is located in the townland of Oatfield, Co Clare and is within the proposed wind farm site boundary. 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 18.

Figure 22. Mast-Site F

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast F	Eir, Vodafone

Table 18. Field Survey Summary – Mast F

Mast-Site G (Woodcock Hill – Vodafone Mast)

Telecommunications Mast-Site G is located at Woodcock Hill (Vodafone Mast), Co Clare and is approximately 5 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 19.

Figure 23. Mast-Site G

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

Table 19. Field Survey Summary – Mast-Site G

Mast-Site H (Woodcock Hill – Eir Mast)

Telecommunications Mast-Site H is located at Woodcock Hill (Eir Mast), Co Clare and is approximately 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 20.

Figure 24. Mast-Site H

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

Table 20. Field Survey Summary – Mast-Site H

Mast-Site I (Woodcock Hill – 2RN Mast)

Telecommunications Mast-Site I is located at Woodcock Hill (2RN Mast), Co Clare and is approximately 5 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 21.

Figure 25. Mast-Site I

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast I	2RN

Table 21. Field Survey Summary – Mast-Site I

Mast-Site J (Killonan)

Telecommunications Mast-Site H is located at the rear of the ESB 110kV Substation at Killonan, Co Limerick and is approximately 16 km southeast 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 22.

Figure 26. Mast-Site J

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast J	Enet

Table 22. Field Survey Summary – Mast-Site J

APPENDIX C – Radio Link Budget Report

Appendix C – Radio Link Budget Reports

C.1 Radio Link Budget Report (Drumline – Kilseily)

Link Budget Report

Site Name:	Drumline_ESB		AB_Kilseily_Enet			
Type:	Cell	Cell				
Latitude:	52°43'25.2"N		52°47'49.8"N			
Longitude:	8°51'43.5"W		8°39'29.0"W			
Altitude (m):	13.0		251.0			
UserData1:	User Data					
Datum:	World Geodetic System 1984 (WGS 84)					
	Forward Link		Reverse Link			
Transmission Site:	Drumline_ESB		AB_Kilseily_Enet			
Reception Site:	AB_Kilseily_Enet		Drumline_ESB			
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):	15000		15000			
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:	HP2-15		HP2-15			
Transmission Antenna Size (m):		0.6		0.6		
Transmission Antenna Height (m):		15		15		
Transmission Antenna Gain (dBd):		34.86		34.86		
Transmission Antenna Gain (dBi):		37		37		
Transmission Power EIRP (dBm):		66		66		
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:	HP2-15		HP2-15	
Reception Antenna Size (m):	0.6		0.6	
Reception Antenna Height (m):		15		15
Reception Antenna Gain (dBd):		34.86		34.86
Reception Antenna Gain (dBi):		37		37
Link Polarization:	Vertical		Vertical	
Cross Polarization Factor (dB):		30		30
Link Distance (m):	16010.117		16010.117	
Azimuth - True (°):	59.157		239.32	
Azimuth - Magnetic (°):	61.71		241.805	
Transmission Inclination (°):	-0.852		0.852	
Reception Inclination (°):	-0.852		0.852	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	16011.886			16011.886
Center Frequency (MHz):	15000		15000	
Free Space Loss (dB):	140.051		140.051	
Max Fresnel Radius (m):	8.947		8.947	
Max 2nd Fresnel Radius (m):	12.653		12.653	
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):	3.999		3.999	
Minimum Clearance Point (m):		15977.443		15977.443
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	838.625		838.625	
Reflection Area 2 (m):	903.973		903.973	
Reflection Area 3 (m):	1012.885		1012.885	
Reflection Area 4 (m):	1078.232		1078.232	
Reflection Area 5 (m):	1187.145		1187.145	
Reflection Area 6 (m):	1252.492		1252.492	
Reflection Area 7 (m):	1317.8 - 1361.4			1317.8 - 1361.4
Reflection Area 8 (m):	1426.752		1426.752	
Reflection Area 9 (m):	1513.882		1513.882	
Reflection Area 10 (m):	10597.173			10597.173
Reflection Area 11 (m):	10749.6 - 10815			10749.6 - 10815
Reflection Area 12 (m):	10967.5 - 10989.3			10967.5 - 10989.3
Reflection Area 13 (m):	11054.604			11054.604
Reflection Area 14 (m):	11250.646			11250.646
Reflection Area 15 (m):	11294.212			11294.212
Reflection Area 16 (m):	11424.906			11424.906
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):		0.489		0.489
Total Path Loss (dB):	140.539		140.539	
Reception Signal Level (dBm):		-38.539		-38.539

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	52.461	51.461	52.461	51.461

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 (%):	5.11E-02	5.11E-02

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):	1.26232	1.26232
Rainfall Attenuation (dB):	13.486	13.486

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	2.80E-08	3.53E-08	2.80E-08	3.53E-08
Selective Fading Outage (%):	2.06E-09	2.06E-09	2.06E-09	2.06E-09
Composite Fading Outage (%):		3.01E-08	3.73E-08	3.01E-08	3.73E-08

Fading Outage (s/Month):	0.001	0.001	0.001	0.001
Selective Fading Outage (s/Month):		0	0	0	0
Composite Fading Outage (s/Month):		0.001	0.001	0.001	0.001

	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 (%):		3.01E-08	3.73E-08	3.01E-08	3.73E-08
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	3.01E-08	3.73E-08	3.01E-08	3.73E-08
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):		0.009	0.012	0.009	0.012
Unavailability due to Rain (s/Year):		0	0	0	0
Total Unavailability (s/Year):	0.009	0.012	0.009	0.012
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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