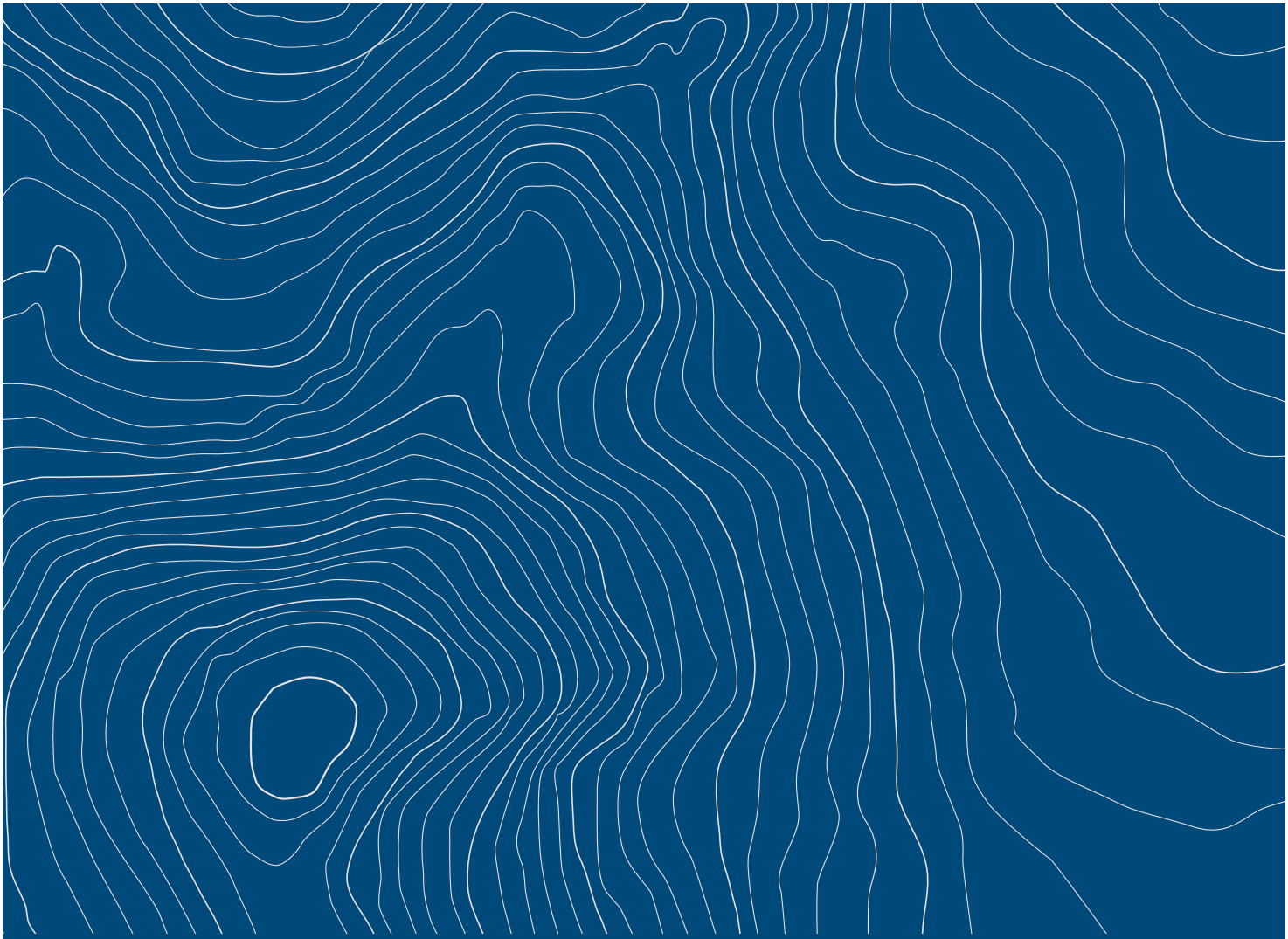

DublinArray
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EIAR Volume 4: Offshore Infrastructure
Technical Appendices
Appendix 4.3.12-3
Radar Assessment Report

Kish Offshore Wind Ltd

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Radar Assessment Report

Dublin Array Wind Farm

Date: 13th December 2024
Author: Linda-Jean Worley
Revision: Issue 1.3
Osprey Ref: 72059 002

Harston Mill, Royston Road Harston, Cambridge CB22 7GG
01172 422533 / enquiries@ospreycsl.co.uk
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Approval Level	Authority	Name
Author	Osprey CSL	Linda-Jean Worley
Technical Governance	Osprey CSL	Foz Binning

Executive Summary

RWE Renewables ("the Applicant") is proposing to construct a large offshore windfarm, the Dublin Array Offshore Wind Farm ("the Development") which will be located in the Irish Sea.

The Ministry of Defence (MOD) and civil Airport's and Air Navigation Service Providers (ANSP's) are responsible for the technical safeguarding of their Communication Navigation and Surveillance (CNS) systems that support the provision of the Air Traffic Services (ATS) that they provide. The MOD, Airports and ANSP's are mandated to assess and determine the level of impact that could be caused to the safe provision of their ATS by wind turbines in the proximity of their operations.

GoBe Consultants Ltd ("the Client") has commissioned Osprey Consulting Services Ltd ("Osprey") on behalf of the Applicant to conduct two types of technical assessments: Radar Line of Site, and Intervisibility Coverage assessments ("the Assessments").

Osprey identified a number of MOD, civil Airport's and ANSP's radars (the "In-Scope radars") that could be affected by the Development and that should be considered in the Assessments to determine the likelihood of whether the In-Scope radars have electronic visibility of the Development's Wind Turbine Generator (WTG)s.

It is worth noting, that whilst the Development falls under Irish aviation jurisdiction, UK based radars that might be affected have also been included within the scope of the Assessments for completeness.

This report details the approach and presents the results of the Assessments commissioned and identifies any potential visibility of the Development on the In-Scope radars under consideration.

Scope

In-Scope CNS

To establish the scope of radars to be included in the Assessment, Osprey considered the relative likely detection range, altitude of the radar site, mode of operation (Termina/ Area) and Declared Operational Coverage (DOC) of radars in a region. This concluded that for the purposes of this report and the scope of work undertaken in the assessment contained within, the In-Scope CNS systems being considered are defined as:

- Dublin Airport - Tooman Radar
- Dublin Airport - Dublin 3 Radar
- NATS - St Annes Radar
- NATS - Great Dun Fell Radar
- NATS - Lowther Hill Radar
- NATS - Clee Hill Radar
- Isle of Man Airport Primary Surveillance Radar (PSR)

- MOD RAF Valley PSR
- BAE Warton Aerodrome PSR

The Development

For the purposes of this report and the scope of work undertaken in the Assessments contained within, the Development is defined as the proposed Dublin Array Offshore Wind Farm located in the Irish Sea. The Development consists of thirty-nine (39) WTGs, with a maximum tip height of 307.5 meters (m) Above Mean Sea Level (AMSL).

Three layout options corresponding to each of the proposed turbine classes A, B and C are being considered for the Development, full details are provided in Volume 2, Chapter 6 Project Description of the Dublin Array EIAR. The Assessments have been conducted against Layout Option C that includes the tallest turbines and therefore is the worst-case scenario (Maximum Design Scenario (MDS)) in terms of the tallest WTG being assessed and potential detection by radar at greater distances.

Requirement

The Client has commissioned two specific technical safeguarding Assessments to be conducted. The Assessments are fully detailed in respective sections of this document, with summary conclusions also being provided as follows:

- **Radar Line of Site Assessment**

  Radar Line of Sight (LOS) assessment using industry standard Radio Frequency (RF) Planning tools, of each WTG of the Development MDS (Layout Option C) against the respective In-Scope CNS.

- **Intervisibility Assessment**

  Intervisibility assessment using industry standard RF Planning tools, of the Development as a single obstruction (with an obstruction height equal to the tallest WTG from the MDS (Layout Option C) against the respective In-Scope CNS.

Conclusions

Radar Line of Site Assessment

- **Conclusions**

  The Radar LOS assessment conducted concludes that all WTGs within the Development are expected to have direct optical visibility to the Dublin Tooman Radar and Dublin 3 Radar.

Intervisibility Assessment

- **Conclusions**

  The Intervisibility assessment including the Optical Path assessment (see Section 3 for details) conducted concludes that Development will not be visible to the NATS - St Annes Radar, NATS - Great Dun Fell Radar, NATS - Lowther Hill Radar, NATS - Clee Hill Radar, Isle of Man Airport PSR, MOD RAF Valley PSR or the BAE Warton Aerodrome PSR.

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1 Introduction

1.1 Background

Dublin Array is a proposed offshore wind farm located on the Kish and Bray Banks approximately 10 km off the coast of counties Dublin and Wicklow. The proposed wind farm array is located within an area of approximately 59 square kilometres (km2).

Dublin Array Offshore Wind Farm ("the Development") is being developed by Kish Offshore Wind Limited and Bray Offshore Wind Limited, ("the Applicant"). The shareholders in both companies are RWE (RWE Renewables Ireland Limited) and Saorgus Energy Limited.

GoBe Consultants Ltd ("the Client") provides planning and environmental services consultancy including strategic and project-specific planning & environmental advice to the offshore energy, dredging, subsea cables, ports, coastal infrastructure and public sectors. The Client is supporting the Developer with environmental services for the Development project.

1.2 Purpose

The Ministry of Defence (MOD) and civil Airport's and Air Navigation Service Providers (ANSP's) are responsible for the technical safeguarding of their Communication Navigation and Surveillance (CNS) systems that support the provision of the Air Traffic Services (ATS) that they provide. The MOD, Airports and ANSP's are mandated to assess and determine the level of impact that could be caused to the safe provision of their ATS by wind turbines in the proximity of their operations.

An electronic visibility assessment is a recognised safeguarding assessment that is widely used to help the MOD, Airports and ANSP's establish whether radars they operate may detect Radio Frequency (RF) echoes being returned from the physical structures of a wind farm.

On behalf of the Applicant, the Client approached Osprey Consulting Services Ltd ("Osprey") to identify MOD, civil Airport's and ANSP's radars that could be affected by the Development, and to propose suitable electronic visibility assessments to be conducted.

Osprey identified a number of MOD, civil Airport's and ANSP's radars (the "In-Scope radars") that could be affected by the Development and proposed two types of electronic visibility assessments: Radar Line of Site, and Intervisibility Coverage assessments ("the Assessments") as being suitable to establish the likelihood of the Development being visible to the systems being considered; the two assessments recommended and subsequently commissioned and detailed in this report were:

- Radar Line of Site assessments are detailed appraisals that consider RF Propagation modelling against each wind turbine individually, this type of assessment has been conducted against the closest radar systems to the Development where the likelihood of visibility was considered to be high.
- Intervisibility Coverage assessments are course optical line of site appraisals that consider the Development as a single large object. This type of assessment has been conducted against radar systems where the likelihood of visibility was considered to be marginal.

It is worth noting, that whilst the Development falls under Irish aviation jurisdiction, UK based radars that might be affected have also been included within the scope of the Assessments for completeness.

This report details the approach and presents the results of the Assessments commissioned and identifies any potential visibility of the Development on the In-Scope radars under consideration.

1.3 Scope

1.3.1 In-Scope CNS

To establish the scope of radars to be included in the Assessment and the type of visibility Assessment to be conducted, Osprey considered the relative likely detection range, altitude of the radar site, mode of operation (Termina/ Area radar) and Declared Operational Coverage (DOC) of radars in a region. This concluded that for the purposes of this report and the scope of work undertaken in the Assessments contained within, the In-Scope CNS systems and the respective assessments being conducted are defined as detailed in Table 1 below:

Airport/ Operator	In-Scope CNS	Approx. Distance to Development (NM)	Assessment Required	
			Radar Line of Site	Intervisibility
Dublin Airport	Tooman	7.8	✓	
	Dublin 3	14.5	✓	
NATS	St Annes	108		✓
	Great Dun Fell	148		✓
	Lowther Hill	145		✓
	Clee Hill	129		✓
Isle of Man Airport	Primary Surveillance Radar (PSR)	68		✓
MOD	RAF Valley PSR	68		✓
BAE	Warton Aerodrome PSR	110		✓

Table 1 - In-Scope Radar Systems Assessments

1.3.1.1 Dublin Airport - Tooman Radar

Dublin Airport is an international airport serving Dublin, Ireland. It is operated by DAA plc (previously Dublin Airport Authority). The airport is in Collinstown, 3.77 Nautical Miles (NM) north of Dublin, and 1.6NM south of the town of Swords. The Tooman Radar is a new system due in service soon and is located approximately 7.8NM north of the

airport. Tooman Radar is approximately 19.5NM from the Development. Figure 1 below depicts its location:

Figure 1 - Dublin Airport - Tooman Radar

Specific parameters used in the assessments for the Tooman Radar are detailed in Table 2 below.

Parameter	Value	Notes
Coordinates	Latitude: 53.555758° Longitude: -6.250681°	Airport Provided
Antenna Electrical Centre Height (m AGL)	28	Airport Provided
TX Peak Power (kW)	15	Airport Provided
TX/RX Frequency (MHz)	2800	Airport Provided
TX/RX Antenna Gain (dBi)	34.3	Airport Provided
Declared Operational Coverage (NM)	64	Airport Provided

Table 2 - Dublin Airport - Tooman Radar Parameters

1.3.1.2 Dublin Airport - Dublin 3 Radar

The Dublin 3 Radar is in the north of the main Dublin Airport site and is approximately 14.5NM from the Development. Figure 2 below depicts its location:

Figure 2 - Dublin Airport - Dublin 3 Radar

Specific parameters used in the assessments for the Dublin 3 Radar are detailed in Table 3 below.

Parameter	Value	Notes
Coordinates	Latitude: 53.438662° Longitude: -6.257494°	Airport Provided
Antenna Electrical Centre Height (m AGL)	14	Airport Provided
TX Peak Power (kW)	15	Airport Provided
TX/RX Frequency (MHz)	2800	Airport Provided
TX/RX Antenna Gain (dBi)	34.3	Airport Provided
Declared Operational Coverage (NM)	64	Airport Provided

Table 3 - Dublin Airport - Dublin 3 Radar Parameters

1.3.1.3 NATS St Annes Radar

NATS St Annes Radar station is located approximately 3.4NM southeast of the town of Blackpool. St Annes Radar is approximately 108NM from the Development. Figure 3 below depicts its location:

Figure 3 - NATS St Annes Radar

The parameters used in the assessments for the NATS St Annes Radar are detailed in Table 4 below.

Parameter	Value	Notes
Coordinates	Latitude: 53.768361° Longitude: -2.990778°	Osprey Radar Database
Antenna Electrical Centre Height (m AGL)	25	Osprey Radar Database
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	N/A	
TX/RX Antenna Gain (dBi)	N/A	
Declared Operational Coverage (NM)	60	Osprey Radar Database

Table 4 - NATS St Annes Radar Parameters

1.3.1.4 NATS Great Dun Fell Radar

The NATS radar station is located at the summit of Great Dun Fell which is the second-highest mountain in England's Pennines. Great Dun Fell Radar is approximately 148NM from the Development. Figure 4 below depicts its location:

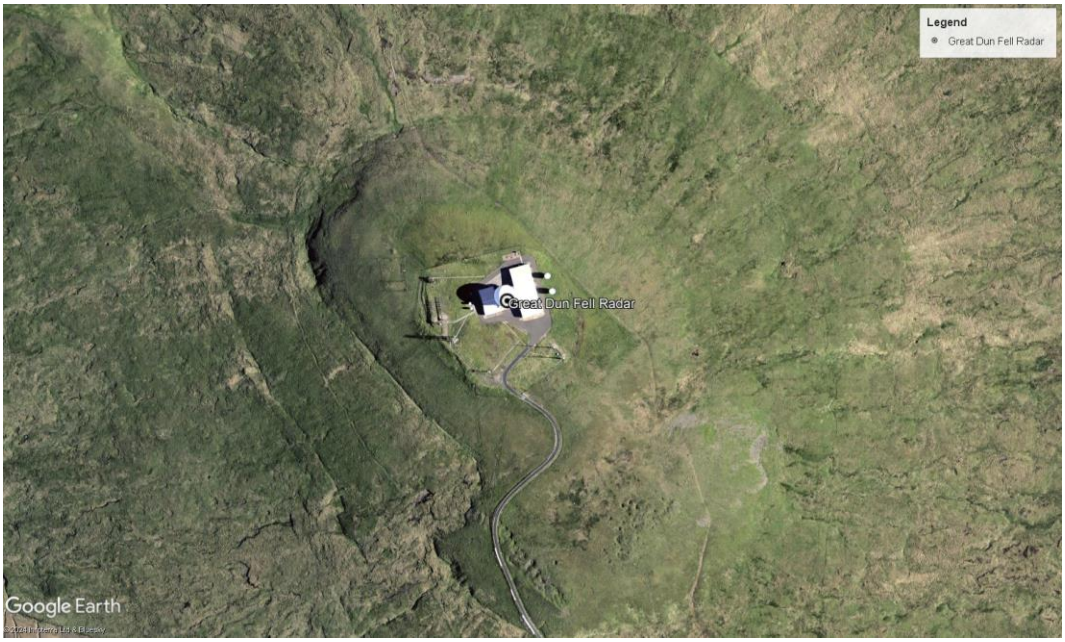


Figure 4 - NATS Great Dun Fell Radar

The parameters used in the assessments for the NATS Great Dun Fell Radar are detailed in Table 5 below.

Parameter	Value	Notes
Coordinates	Latitude: 54.684111° Longitude: -2.450861°	Osprey Radar Database
Antenna Electrical Centre Height (m AGL)	16.1	Osprey Radar Database
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	1300	Osprey Radar Database
TX/RX Antenna Gain (dBi)	N/A	
Declared Operational Coverage (NM)	120	Osprey Radar Database

Table 5 - NATS Great Dun Fell Radar Parameters

1.3.1.5 NATS Lowther Hill Radar

The NATS radar station is located at Lowther Hill in the Southern Uplands of Scotland within Lanarkshire. Lowther Hill Radar is approximately 145NM from the Development. Figure 5 below depicts its location:

Figure 5 - NATS Lowther Hill Radar

The parameters used in the Assessments for the NATS Lowther Hill Radar are detailed in Table 6 below.

Parameter	Value	Notes
Coordinates	Latitude: 55.377778° Longitude: -3.753000°	Osprey Radar Database
Antenna Electrical Centre Height (m AGL)	15	Osprey Radar Database
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	1300	Osprey Radar Database
TX/RX Antenna Gain (dBi)	N/A	
Declared Operational Coverage (NM)	120	Osprey Radar Database

Table 6 - NATS Lowther Hill Radar Parameters

1.3.1.6 NATS Clee Hill Radar

The NATS radar station is located at the summit of Titterstone Clee Hill in the English county of Shropshire. Clee Hill Radar is approximately 129NM from the Development. Figure 6 below depicts its location:

Figure 6 - NATS Clee Hill Radar

The parameters used in the Assessments for the NATS Clee Hill Radar are detailed in Table 7 below.

Parameter	Value	Notes
Coordinates	Latitude: 52.398316° Longitude: -2.597416°	Osprey Radar Database
Antenna Electrical Centre Height (m AGL)	16.8	Osprey Radar Database
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	1300	Osprey Radar Database
TX/RX Antenna Gain (dBi)	N/A	
Declared Operational Coverage (NM)	120	Osprey Radar Database

Table 7 - NATS Clee Hill Radar Parameters

1.3.1.7 Isle of Man Airport PSR

Isle of Man Airport is the main civilian airport on the Isle of Man. It is located in the south of the island at Ronaldsway near Castletown, 6NM southwest of Douglas. The Isle of Man PSR is northeast of the main airport site and is approximately 68NM from the Development. Figure 7 below depicts its location:

Figure 7 - Isle of Man Airport PSR

Specific parameters used in the assessments for the Isle of Man Airport PSR are detailed in Table 8 below.

Parameter	Value	Notes
Coordinates	Latitude: 54.090278° Longitude: -4.613889°	Airport Provided
Antenna Electrical Centre Height (m AGL)	13	Airport Provided
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	N/A	
TX/RX Antenna Gain (dBi)	N/A	
Declared Operational Coverage (NM)	50	UK AIP

Table 8 - Isle of Man Airport PSR Parameters

1.3.1.8 MOD RAF Valley PSR

RAF Valley is a Royal Air Force station on the island of Anglesey, Wales, and which is also used as Anglesey Airport. RAF Valley is home to No 4 Flying Training School, responsible for training the UK's next generation of fighter pilots. The RAF Valley PSR is

in the northwest of the airbase and is approximately 68NM from the Development.

Figure 8 below depicts its location:

Figure 8 - MOD RAF Valley PSR

Specific parameters used in the assessments for the MOD RAF Valley PSR are detailed in Table 9 below.

Parameter	Value	Notes
Coordinates	Latitude: 53.257389° Longitude: -4.544111°	Osprey Radar Database
Antenna Electrical Centre Height (m AGL)	12.68	Osprey Radar Database
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	N/A	

TX/RX Antenna Gain (dBi)	N/A	
Declared Operational Coverage (NM)	60	Osprey Radar Database

Table 9 - MOD RAF Valley PSR Parameters

1.3.1.9 BAE Warton Aerodrome PSR

BAE Warton Aerodrome is located near Warton village on the Fylde in Lancashire, England, 6NM west of Preston. The aerodrome is a major assembly and testing facility of BAE Systems Military Air & Information.

The PSR is in the southwest of the aerodrome and is approximately 110NM from the Development. Figure 9 below depicts its location:

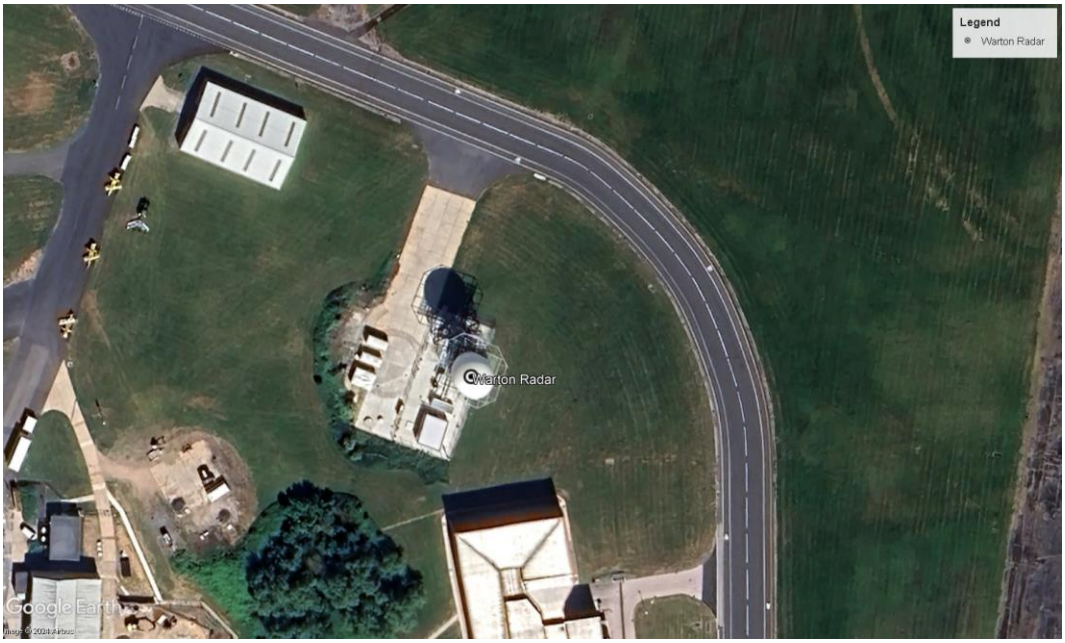


Figure 9 - BAE Warton Aerodrome PSR

BAE Warton were approached to provide specific radar parameters, but no response was received. As such Osprey has derived the data based on assumptions. The parameters used in the assessments for the BAE Warton Aerodrome PSR are detailed in Table 10 below.

Parameter	Value	Notes
Coordinates	Latitude: 53.738862° Longitude: -2.893654°	Google Earth Assessment of site
Antenna Electrical Centre Height (m AGL)	23	4 x 5m tower sections plus 3m for S-Band radar antenna.
TX Peak Power (kW)	N/A	
TX/RX Frequency (MHz)	N/A	
TX/RX Antenna Gain (dBi)	N/A	

Parameter	Value	Notes
Declared Operational Coverage (NM)	40[1]	UK AIP

Table 10 - BAE Warton Aerodrome PSR Parameters

1.3.2 The Development

For the purposes of this report and the scope of work undertaken in the Assessments contained within, the Development is defined as the proposed Dublin Array Offshore Wind Farm located in the Irish Sea.

The Development consists of thirty-nine (39) WTGs, with a maximum tip height of 307.5 meters (m) Above Mean Sea Level (AMSL). The model used takes a conservative approach based on the worst-case scenario (Maximum Design Scenario (MDS) Option C) in terms of the tallest WTG being considered .

Figure 10 below depicts the Red Line Boundary (RLB) of the Development relevant to the In-Scope Radars defined in Section 1.3.1.

Figure 10 - Development Location

Figure 11 below respectively depicts the layout of the Development as used in the Assessments.

[1] BAE Warton's declared Radar ATS according to the UK AIP is 40NM, however it is understood that BAE Warton conduct special ATS for their own aircraft at ranges exceeding this.

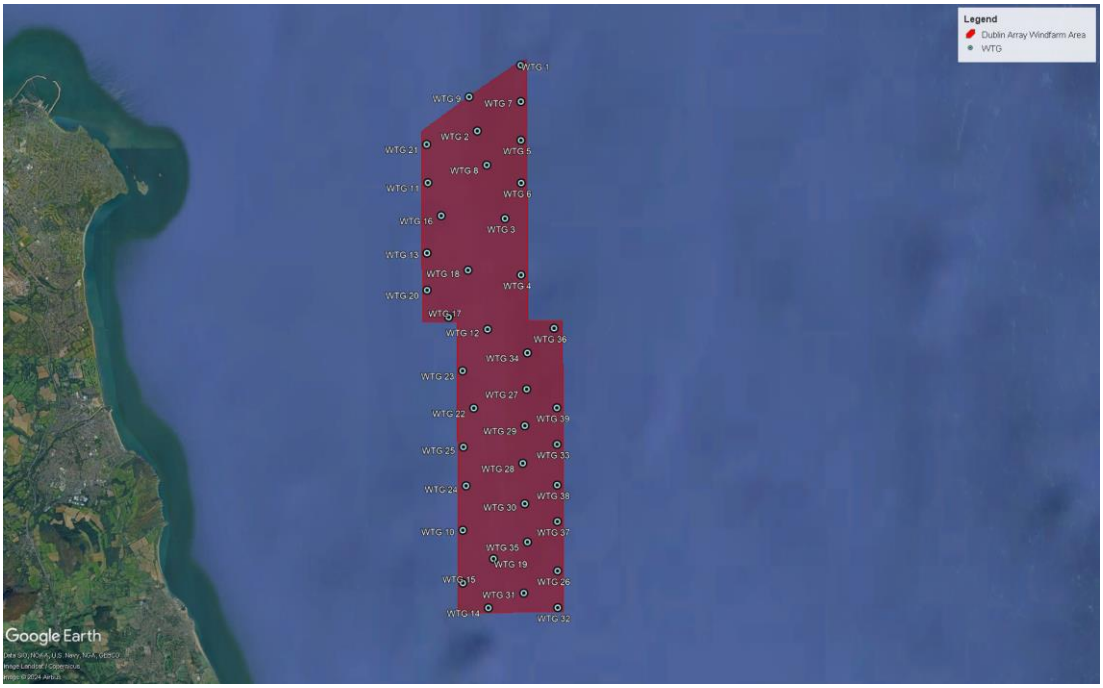


Figure 11 - Development Layout

Specific parameters and geolocations of WTGs modelled for the Assessments are detailed in Table 11 below.

ID	Latitude	Longitude	Max Tip Height (m) AMSL
WTG 1	53.30690729	-5.90238912	307.5
WTG 2	53.28807986	-5.92333656	307.5
WTG 3	53.26297438	-5.91021719	307.5
WTG 4	53.24677339	-5.90259981	307.5
WTG 5	53.28537186	-5.90241765	307.5
WTG 6	53.27313663	-5.9023729	307.5
WTG 7	53.29646012	-5.90238023	307.5
WTG 8	53.27832006	-5.9188469	307.5
WTG 9	53.29785966	-5.9271813	307.5
WTG 10	53.17371429	-5.93091841	307.5
WTG 11	53.27330452	-5.94711125	307.5
WTG 12	53.231254	-5.9187532	307.5
WTG 13	53.25315976	-5.94761726	307.5
WTG 14	53.15142888	-5.91883645	307.5
WTG 15	53.15856457	-5.93096771	307.5
WTG 16	53.26384914	-5.94075106	307.5
WTG 17	53.23476846	-5.93732594	307.5
WTG 18	53.24820545	-5.92801452	307.5
WTG 19	53.16550624	-5.91633092	307.5

ID	Latitude	Longitude	Max Tip Height (m) AMSL
WTG 20	53.24252661	-5.94762505	307.5
WTG 21	53.28429568	-5.94761769	307.5
WTG 22	53.20867766	-5.92548245	307.5
WTG 23	53.21937364	-5.93075398	307.5
WTG 24	53.18643679	-5.9292757	307.5
WTG 25	53.19755497	-5.93050214	307.5
WTG 26	53.1619559	-5.88571695	307.5
WTG 27	53.2140449	-5.90013926	307.5
WTG 28	53.19283235	-5.90210521	307.5
WTG 29	53.20358993	-5.90107416	307.5
WTG 30	53.18123163	-5.90125036	307.5
WTG 31	53.15562776	-5.90188422	307.5
WTG 32	53.15142424	-5.88570187	307.5
WTG 33	53.19821492	-5.8856928	307.5
WTG 34	53.22445682	-5.89971639	307.5
WTG 35	53.17025768	-5.90005131	307.5
WTG 36	53.23148584	-5.88690355	307.5
WTG 37	53.17609931	-5.88569464	307.5
WTG 38	53.18653239	-5.8857316	307.5
WTG 39	53.20868833	-5.88572663	307.5

Table 11 - Development Parameters

1.3.3 Requirement

The Client has commissioned two specific technical safeguarding Assessments to be conducted. The Assessments are fully detailed in respective sections of this document, with summary conclusions also being provided as follows:

- **Section 2 - Radar Line of Site Assessment**
  Radar Line of Sight (LOS) assessment using industry standard Radio Frequency (RF) Planning tools of every WTG of the Development against the In-Scope CNS listed below:
  - Dublin Airport - Tooman Radar
  - Dublin Airport - Dublin 3 Radar
- **Section 3 - Intervisibility Assessment**
  Intervisibility assessment using industry standard RF Planning tools of the Development as a single obstruction against the In-Scope CNS listed below:
  - NATS - St Annes Radar
  - NATS - Great Dun Fell[2]

[2] Because the altitude of the radar site was greater than the target assessment altitude, standard Intervisibility Coverage modelling was not possible. As such these sites were assessed using the optical path of a standard Line of Site

- NATS - Lowther Hill[2]
- NATS - Clee Hill[2]
- Isle of Man Airport PSR
- MOD RAF Valley PSR
- BAE Warton Aerodrome PSR

1.4 Abbreviations

The following abbreviations are used within this document:

Abbreviation	Meaning
AGL	Above Ground Level
AMSL	Above Mean Sea level
ANSP	Air Navigation Service Provider
ARP	Airfield Reference Point
ASL	Above Sea level
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CAP	CAA Publication
CNS	Communications Navigation and Surveillance
dB	decibels
dBi	DB relative to isotropic
DOC	Declared Operational Coverage
DTM	Digital Terrain Model
HTZ Comms	ATDI HTZ Communications
kW	kilowatt
m	meters
MHz	megahertz
MOD	Ministry of Defence
NM	Nautical Miles
Osprey	Osprey Consulting Services Limited
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RF	Radio Frequency
RLB	Red Line Boundary
the Development	Dublin Array Wind Farm
VHF	Very High Frequency
W	Watts
WF	Wind Farm

[2] Assessment against three positions placed on the closest boundary of the Development. See Section 3.5 for further details.

Abbreviation	Meaning
WTG	Wind Turbine Generator

Table 12 - Abbreviations

2 Radar Line of Site (LOS) Assessment

2.1 Introduction

This section presents the Radar LOS Assessment. Using composite optical line of site functions, coupled with RF propagation and Fresnel zone calculations in ATDI HTZ Communications (HTZ Comms) which is an industry standard RF network planning toolset with extensive RF Propagation analysis and modelling capabilities. Analysis has been conducted of point-to-point visibility between the In-Scope CNS and the individual WTGs of the Development being considered.

2.2 Overview

LOS in its most simplistic form is a calculation to determine whether one object can see another in a direct path. A WTG presents reflecting surfaces on which a radar transmitting energy can be returned and processed from. If a radar can see a WTG, then it will most likely be processed and cause an impact to the radar's ability to determine valid targets.

Radars operate by transmitting pulses of RF energy. RF does not just propagate in straight 'optical' lines, but rather it spreads after it leaves the antenna. This spread is known as the Fresnel zones[3]. Objects which appear in a Fresnel zone can cause in phase or out of phase reflections of the RF wave.

Additionally, to better understand whether a reflecting object will be seen by a radar, consideration must also be made of interlaying terrain and the curvature of the earth.

Osprey has extensive experience of modelling Radar LOS using HTZ Comms. Our assessment considers optical line of site, the upper Fresnel zone, the Earth's curvature and terrain.

2.3 Scope

As described in Section 1.3.1, Osprey conducted an initial course appraisal of the likelihood of the development being visible to the radars in consideration. Detailed RF LOS assessments were only conducted against the closest radars. As per Table 1, the scope of the LOS assessment undertaken, is against:

- Dublin Airport - Tooman Radar
- Dublin Airport - Dublin 3 Radar

2.4 Methodology

2.4.1 CNS Modelling

The In-Scope CNS listed in Table 1 for LOS Assessment were modelled as RF emitters with specific parameters as detailed in Table 2 and Table 3.

[3] Fresnell zones are confocal prolate ellipsoidal regions of space between and around a radio frequency transmitter and receiver. Each ellipsoid has an 'upper' and 'lower' zone which surrounds the direct 'straight line' optic path.

2.4.2 Development Model

Individual models of each WTG in the Development were created in HTZ Comms using the data detailed in Table 11; specifically:

- Each WTG was created as a target point in space by using x, y, z as location and the max tip height parameters.

2.4.3 LOS Assessment

Each WTG is assessed for visibility against the In-Scope CNS. An example of a resultant profile path is depicted in Figure 12 below:

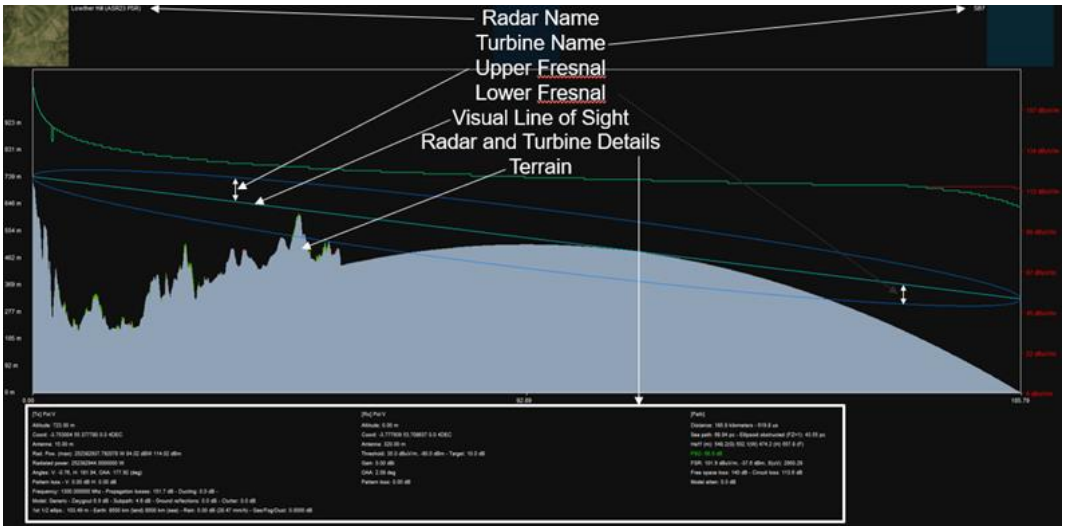


Figure 12 - Example LOS Profile Path

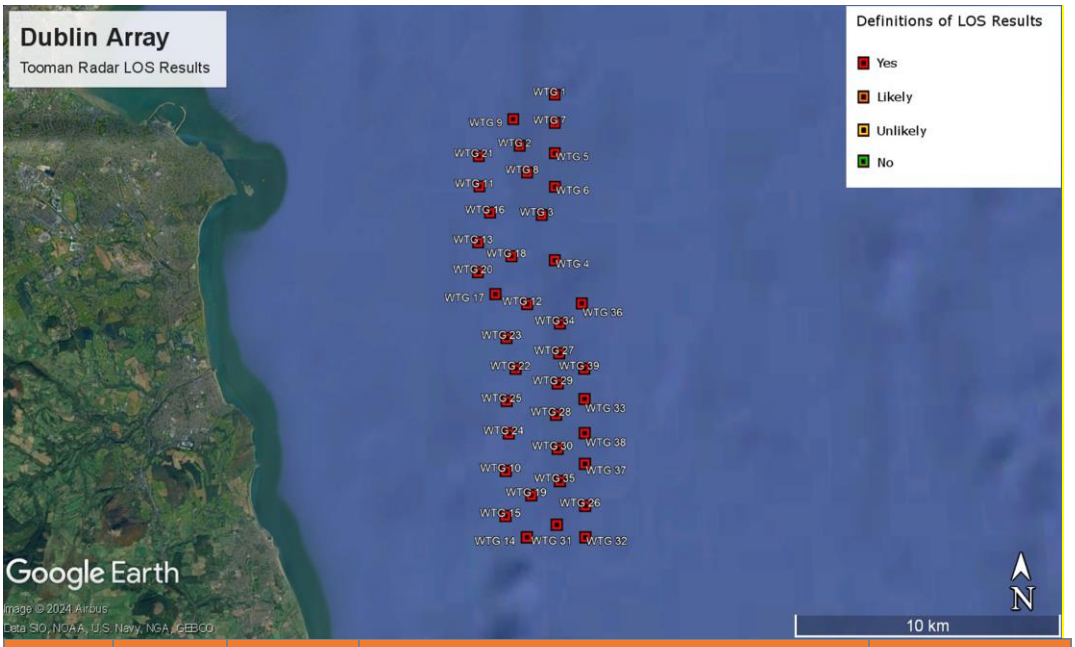
Profile paths were individually evaluated by a Subject Matter Expert (SME) who determined the results as presented in Section 2.5.

2.5 Results

Summary results of the LOS assessments conducted against the Development is presented in the following sections, visibility results of each WTG are determined to be one of the following:

- **Yes** (Red) - Visible to the In-Scope CNS System (the WTG has direct optical LOS)
- **Likely** (Amber) - Likely to be visible to the In-Scope CNS System (the WTG does not have direct optical LOS, but the interlaying terrain intersects less than or equal to 60% of the upper Fresnel zone)
- **Unlikely** (Yellow) - Unlikely to be visible to the In-Scope CNS System (the wind turbine does not have direct optical LOS, but the interlaying terrain intersects more than 60% but less 100% of the upper Fresnel zone)
- **No** (Green) - Not visible to the In-Scope CNS System (the wind turbine generator does not have direct optical LOS as the interlaying terrain intersects more than 100% of the upper Fresnel zone).

2.5.1 Dublin Airport - Tooman Radar LOS Results



WTG	Tip Height (m)	Visibility Result	Description	Appendix 1 Reference
WTG 1	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 19
WTG 2	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 20
WTG 3	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 21
WTG 4	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 22
WTG 5	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 23
WTG 6	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 24
WTG 7	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 25
WTG 8	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 26
WTG 9	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 27
WTG 10	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 28
WTG 11	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 29
WTG 12	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 30
WTG 13	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 31

WTG	Tip Height (m)	Visibility Result	Description	Appendix 1 Reference
WTG 14	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 32
WTG 15	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 33
WTG 16	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 34
WTG 17	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 35
WTG 18	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 36
WTG 19	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 37
WTG 20	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 38
WTG 21	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 39
WTG 22	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 40
WTG 23	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 41
WTG 24	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 42
WTG 25	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 43
WTG 26	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 44
WTG 27	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 45
WTG 28	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 46
WTG 29	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 47
WTG 30	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 48
WTG 31	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 49
WTG 32	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 50
WTG 33	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 51
WTG 34	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 52
WTG 35	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 53

WTG	Tip Height (m)	Visibility Result	Description	Appendix 1 Reference
WTG 36	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 54
WTG 37	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 55
WTG 38	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 56
WTG 39	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 57

Table 13 - Dublin Airport - Tooman Radar LOS Results

2.5.2 Dublin Airport - Dublin 3 Radar LOS Results

WTG	Tip Height (m)	Visibility Result	Description	Artifact Reference
WTG 1	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 58
WTG 2	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 59
WTG 3	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 60
WTG 4	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 61
WTG 5	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 62
WTG 6	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 63
WTG 7	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 64

WTG	Tip Height (m)	Visibility Result	Description	Artifact Reference
WTG 8	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 65
WTG 9	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 66
WTG 10	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 67
WTG 11	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 68
WTG 12	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 69
WTG 13	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 70
WTG 14	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 71
WTG 15	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 72
WTG 16	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 73
WTG 17	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 74
WTG 18	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 75
WTG 19	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 76
WTG 20	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 77
WTG 21	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 78
WTG 22	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 79
WTG 23	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 80
WTG 24	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 81
WTG 25	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 82
WTG 26	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 83
WTG 27	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 84
WTG 28	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 85

WTG	Tip Height (m)	Visibility Result	Description	Artifact Reference
WTG 29	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 86
WTG 30	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 87
WTG 31	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 88
WTG 32	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 89
WTG 33	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 90
WTG 34	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 91
WTG 35	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 92
WTG 36	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 93
WTG 37	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 94
WTG 38	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 95
WTG 39	307.5	YES	Visible to the In-Scope CNS System (the WTG has direct optical LOS)	Figure 96

Table 14 - Dublin Airport - Dublin 3 Radar LOS Results

2.6 Conclusions

The LOS assessments conducted conclude that all WTGs within the Development are expected to have a direct optical visibility to the In-Scope CNS.

3 Intervisibility / Optical Path Assessments

3.1 Introduction

This section presents the Intervisibility Assessment, using composite optical line of site functions in HTZ Comms to create coverage maps highlighting potential issues on the In-Scope CNS systems coverage caused by physical obstruction from the Development.

HTZ Comms is an industry standard RF network planning toolset with extensive RF Propagation analysis and modelling capabilities.

3.2 Overview

An Intervisibility calculation fundamentally ascertains whether a point in space can be directly seen from a source point, or whether the path to the point in space is blocked by an obstruction.

HTZ Comms incorporates extensive Digital Terrain Models (DTM) which feature not only terrain elevation at high resolution, but also includes clutter layers (building and vegetation height).

Where the results of a Intervisibility Assessment display loss of coverage to an In-Scope CNS system, we can determine that there is direct optical line of site, and that the Development will be visible to the system in question.

Unlike a Radar LOS assessment, Intervisibility only considers direct path and not RF propagation characteristics.

3.3 Scope

As described in Section 1.3.1, Osprey conducted an initial course appraisal of the likelihood of the development being visible to the radars in consideration. Intervisibility Assessments were conducted against radars where it was considered that visibility was unlikely.

It was later found that due to a technical limitation with HTZ Comms that Intervisibility Assessments cannot be conducted when the source point (the radar) is at a higher altitude than the test point (307.5M AMSL). To overcome this limitation Osprey have conducted an Optical Path Assessment of these higher radars using standard LOS functionality (without consideration of RF Fresnel zones).

As such the scope of the assessments is as follows:

- Intervisibility Assessments conducted against:
  - NATS St Annes Radar
  - Isle of Man Airport PSR
  - MOD RAF Valley PSR
  - BAE Warton Aerodrome PSR

- Optical Path Assessment
  - NATS St Great Dun Fell Radar
  - NATS Lowther Hill Radar
  - NATS Clee Hill Radar

The methodology and results of each type of assessment is detailed in the following Sections.

- 3.4 Intervisibility Assessment
- 3.5 Optical Path Assessment

3.4 Intervisibility Assessment

3.4.1 Methodology

3.4.1.1 Development Model

The Development was modelled as a single building with a height of 307.5 AMSL Figure 13 below depicts the Development modelled as a building visually:

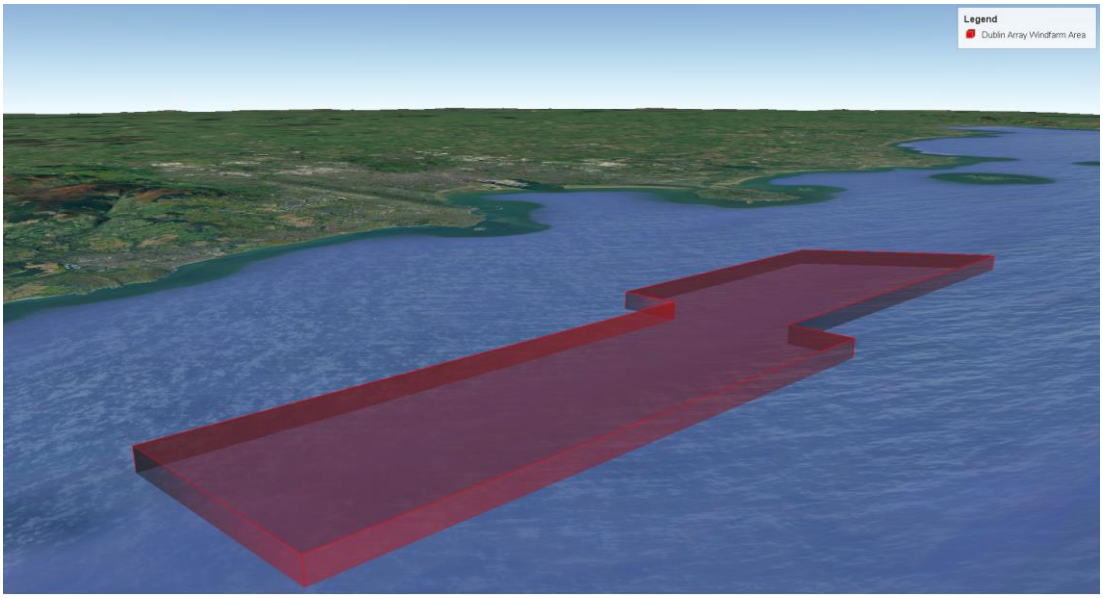


Figure 13 - Development Modelled as a Building

3.4.1.2 CNS Modelling

In the case of the intervisibility coverage assessments conducted, each In-Scope CNS listed in Section 3.3 was modelled as a source point by using x, y, z as location and height (of the antenna) parameters.

3.4.1.3 Assessment Process

Test points along an azimuth are tested at the same altitude path, either until the direct visibility is blocked by terrain, clutter, or the Development or until the maximum test range as been reached. This process is repeated for every azimuth step from the Source Point with a full 360° intervisibility coverage chart being produced.

Readers of this report should note: All assessments have been conducted to a range of 240NM, however as the altitude tested (307.5M AMSL) is relatively low, the Intervisibility coverage ranges attained are relative to the system location and the curvature of the earth.

Figure 14 below depicts this process for a single azimuth step on a defined azimuth/ altitude path.

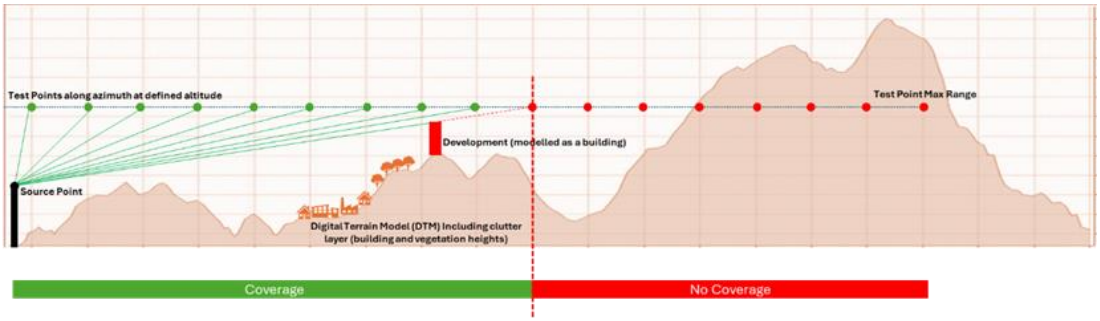


Figure 14 - Intervisibility Assessment along Azimuth/ Altitude Path

Important Note: Modelling the Development as a single building presents the 'worst case' profile to the In-Scope CNS; in real-world operation the profile will be variable dependent on number, position, size and orientation of the actual WTG with respect to the CNS being considered. Additionally, RF waves do not propagate only in direct 'straight lines', as such the actual impact upon coverage is likely to be less than depicted by the Intervisibility assessment maps in this report.

Intervisibility coverage maps were produced for the In-Scope CNS for the following three use cases:

3.4.1.1 Baseline Intervisibility Map

Baseline intervisibility map without the Development. This displays the potential coverage of the In-Scope CNS without any impact from the Development. Figure 15 below depicts an example of a Baseline Intervisibility map.

Figure 15 - Example Baseline Intervisibility Map

3.4.1.2 Development Intervisibility Map:

An Intervisibility map with the Development modelled as a building. This displays the potential coverage of the In-Sope CNS with identified impacts. Figure 16 below depicts an example of a Development Intervisibility Map.

Figure 16 - Example Development Intervisibility Map

3.4.1.3 Composite Intervisibility Map

Composite intervisibility coverage map where the Development Intervisibility Map (Blue) is overlaid on a Baseline Intervisibility Map (Red). Red areas of this type of map illustrate the extent of potential CNS coverage loss, and hence that the Development will be visible to the CNS under consideration. Figure 17 below depicts an example of a Composite Intervisibility Map.

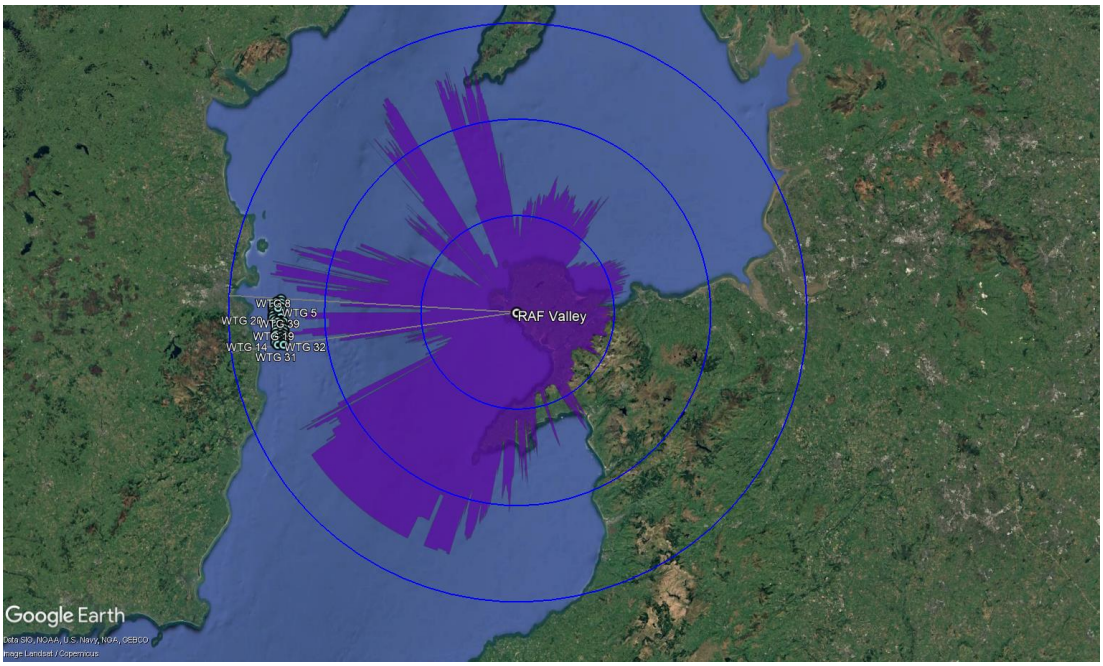


Figure 17 - Example Composite Intervisibility Map

Azimuth bearings from the respective CNS under consideration to the Development site are included in the Composite Coverage Map to show the areas where coverage impacts are possible.

To assess whether the Development is likely to be visible to the In-Scope CNS the Intervisibility Assessments were conducted at 307.5M AMSL, the same height as the Development model.

3.4.2 Results

Composite Intervisibility Coverage maps (Appendix 2) have been produced and assessed for the following In-Scope CNS:

CNS System	Visible (Y/N)	Appendix 2 Reference
NATS St Annes Radar	N	Figure 97
Isle of Man Airport PSR	N	Figure 98
MOD RAF Valley PSR	N	Figure 99
BAE Warton Aerodrome PSR	N	Figure 100

Table 15 - Intervisibility Assessment Summary

3.4.3 Conclusions

The interlaying terrain, distance and curvature of the earth between the In-Scope CNS and all of the WTGs assessed, blocks the direct optical path, and hence the assessment concludes that the Development will not be visible to any of the In-Scope CNS assessed for Intervisibility.

3.5 Optical Path Assessment

3.5.1 Methodology

3.5.1.4 Development Model

For each of the In-Scope CNS, three (3) points (WTGs) were selected that represented the closest boundary of the Development to the CNS System being considered. Each WTG was created as a target point in space by using x, y, z as location and the max tip height parameters.

Specific details of the WTGs assessed for each In-Scope CNS are provided in the respective sections of Appendix 3.

3.5.1.5 CNS Modelling

As per the Intervisibility Assessment, Individual models of each In-Scope CNS were created in HTZ Comms using the data detailed in Table 5, Table 6 and Table 7; specifically:

- Each CNS were created as a source point in space by using x, y, z as location and the antenna electrical height parameters.

3.5.1.6 Assessment Process

Each WTG is assessed for visibility against the In-Scope CNS using the same LOS functionality of HTZ Comms as described in Section 2. It should be noted though, that when conducting a pure optical path assessment, RF parameters and RF propagation characteristics are not considered. An example of a resultant profile is depicted in Figure 12 below, the yellow line depicts the direct optical path from the In-Scope CNS to the WTG being considered:

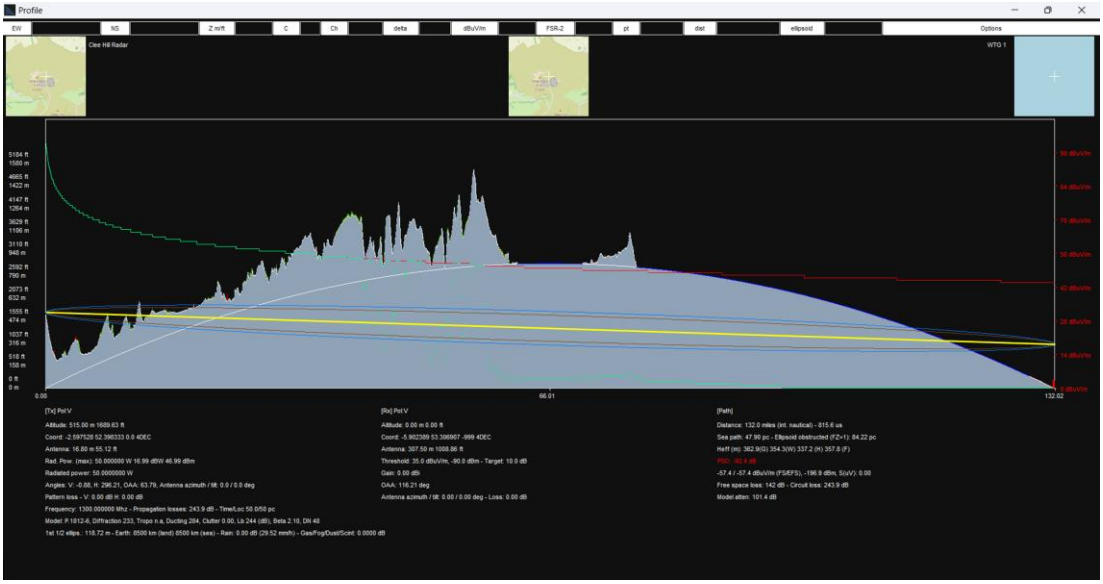


Figure 18 - Example Optical Path Profile

3.5.2 Results

Optical Path Profiles (Appendix 3) have been produced and assessed for the In-Scope CNS; the results are:

CNS System	WTG	Visible (direct optical LOS)	Appendix 3 Reference
NATS Great Dun Fell Radar	WTG 1	N	Figure 102
NATS Great Dun Fell Radar	WTG 32	N	Figure 103
NATS Great Dun Fell Radar	WTG 36	N	Figure 104
NATS Lowther Hill Radar	WTG 1	N	Figure 106
NATS Lowther Hill Radar	WTG 21	N	Figure 107
NATS Lowther Hill Radar	WTG 32	N	Figure 108
NATS Clee Hill Radar	WTG 1	N	Figure 110
NATS Clee Hill Radar	WTG 14	N	Figure 111
NATS Clee Hill Radar	WTG 32	N	Figure 112

Table 16 - Optical Path Assessment Summary

3.5.3 Conclusions

The interlaying terrain, distance and curvature of the earth between the In-Scope CNS and the respective WTGs assessed blocks the direct optical path, and hence the assessment concludes that the Development will not be visible to any of the In-Scope CNS assessed for Optical Path.

Appendix 1 Radar LOS Profiles

A1.1 Introduction

In conducting the Radar LOS Assessments, many technical artifacts are generated. Profile Path images are produced for the point-to-point visibility between the In-Scope CNS and the individual WTGs of the Developments being considered.

For ease of readability of the main report, these images are contained within this Appendix.

A1.2 Contents

The contents of this Appendix are as follows:

A1.3 Dublin Airport - Tooman Radar LOS Profile Paths

A1.3.1 WTG 1

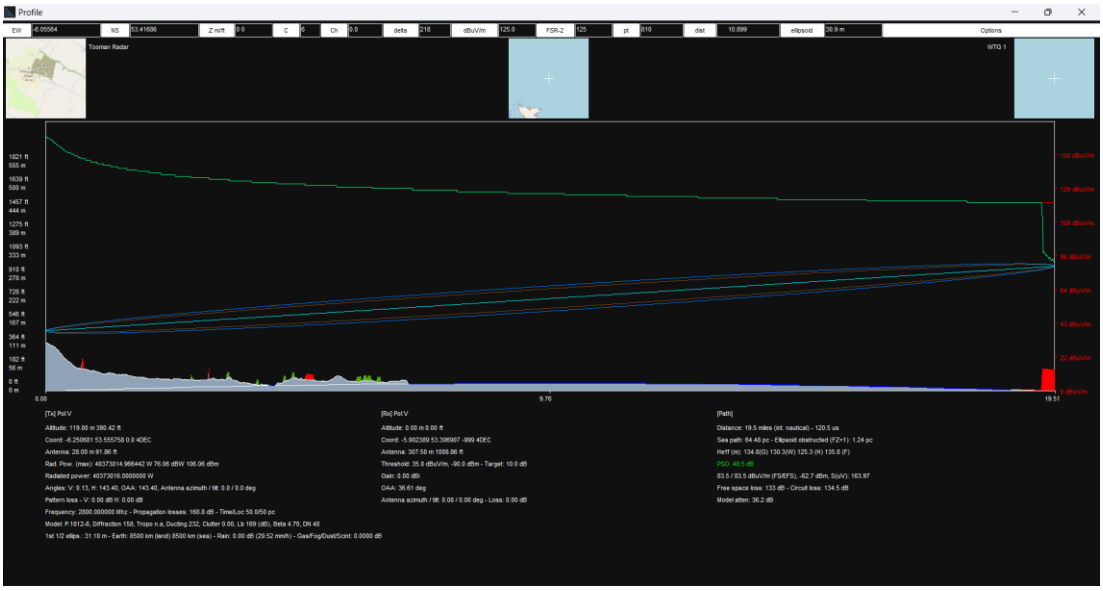


Figure 19 - Dublin Airport - Tooman Radar WTG 1 LOS Profile

A1.3.2 WTG 2

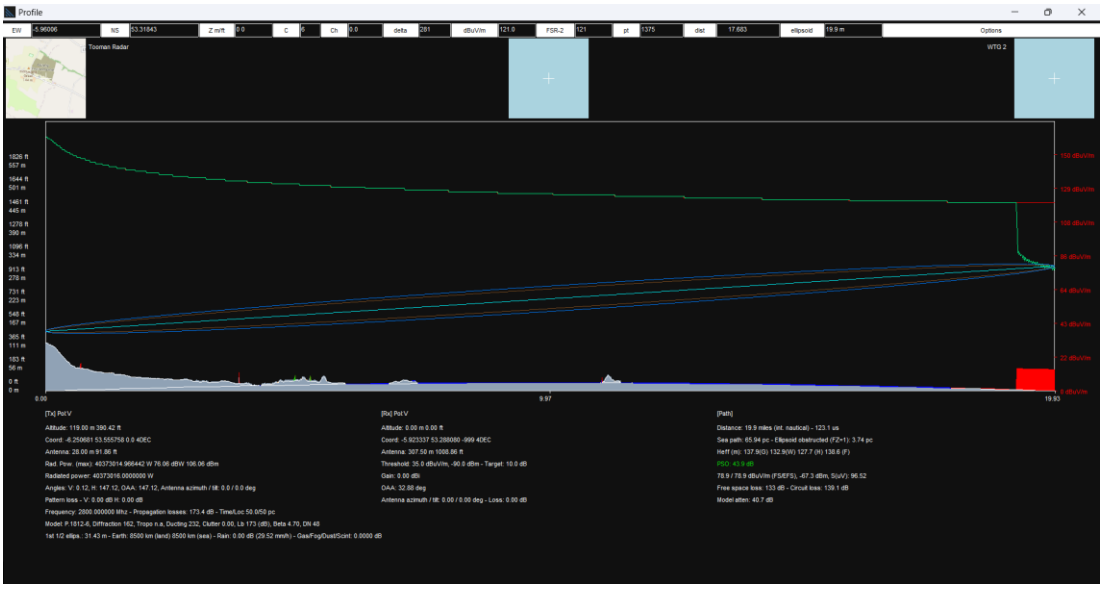


Figure 20 - Dublin Airport - Tooman Radar WTG 2 LOS Profile

A1.3.3 WTG 3

Figure 21 - Dublin Airport - Tooman Radar WTG 3 LOS Profile

A1.3.4 WTG 4

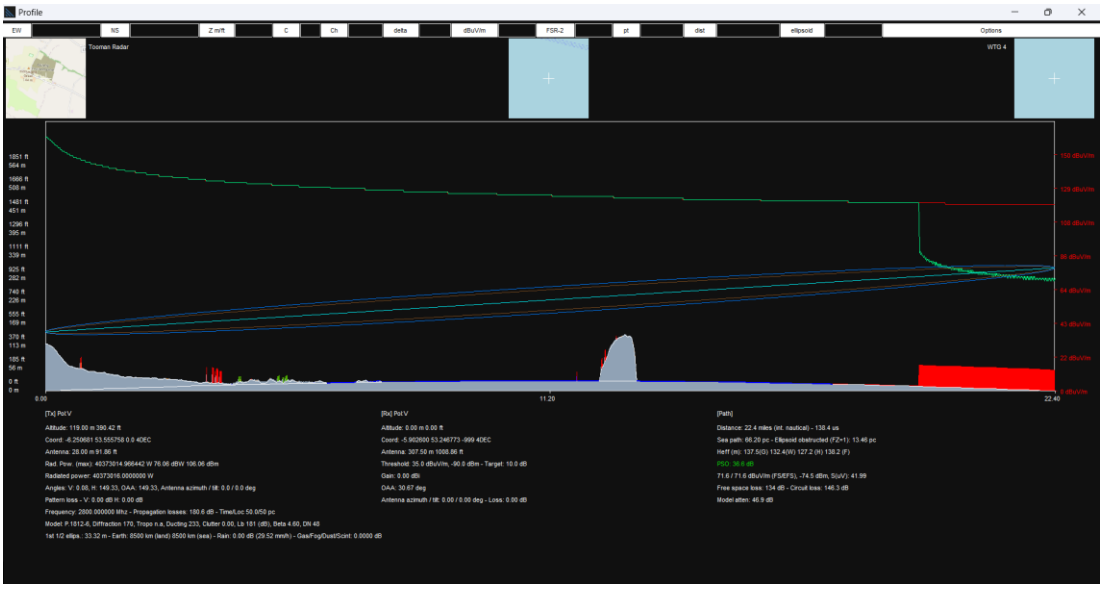


Figure 22 - Dublin Airport - Tooman Radar WTG 4 LOS Profile

A1.3.5 WTG 5

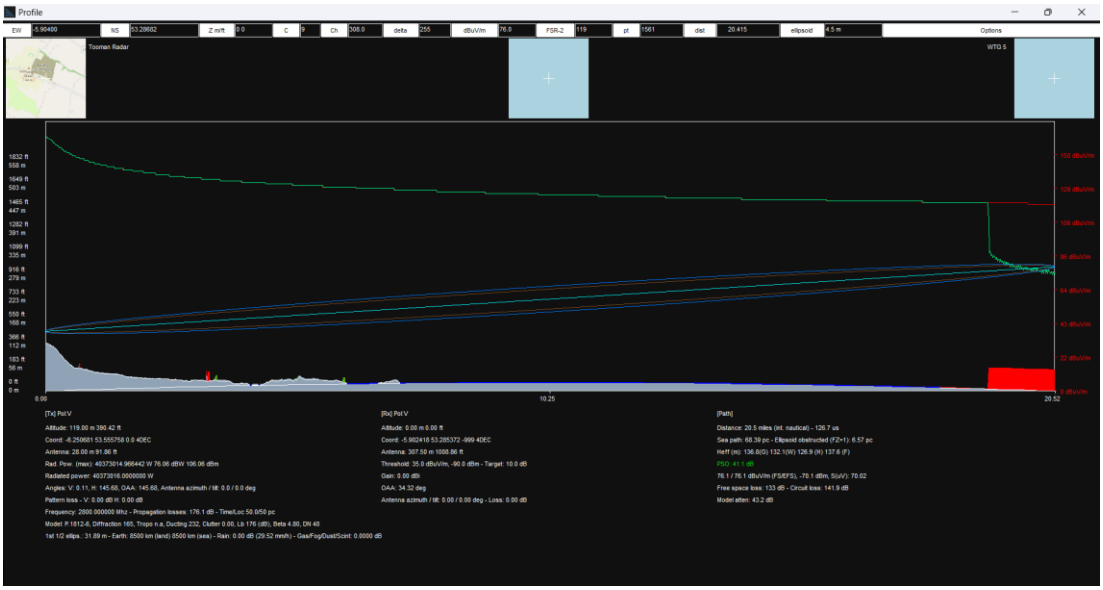


Figure 23 - Dublin Airport - Tooman Radar WTG 5 LOS Profile

A1.3.6 WTG 6

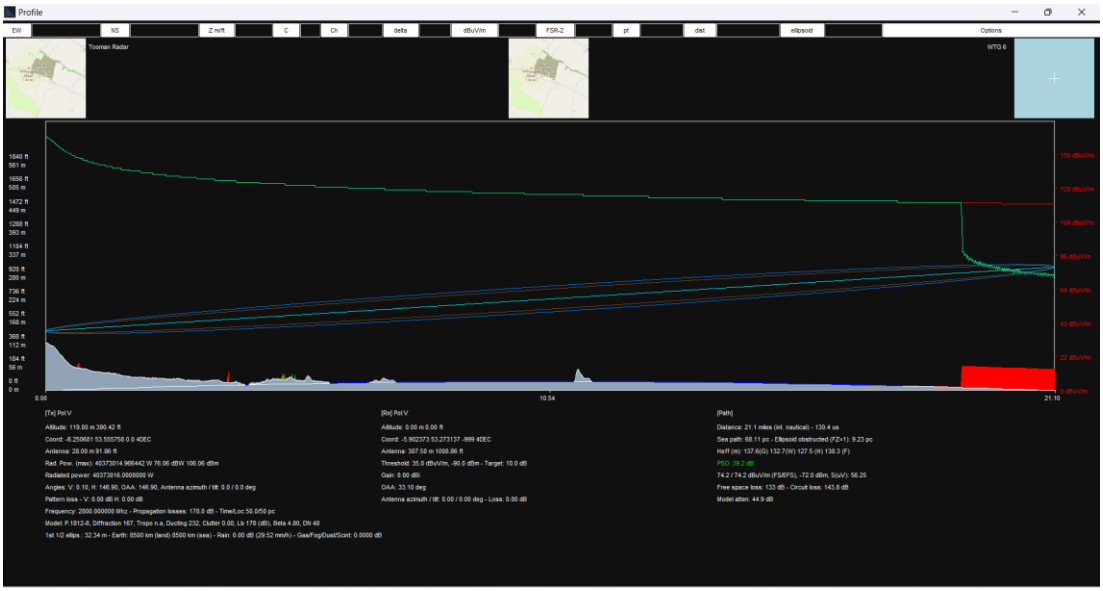


Figure 24 - Dublin Airport - Tooman Radar WTG 6 LOS Profile

A1.3.7 WTG 7

Figure 25 - Dublin Airport - Tooman Radar WTG 7 LOS Profile

A1.3.8 WTG 8

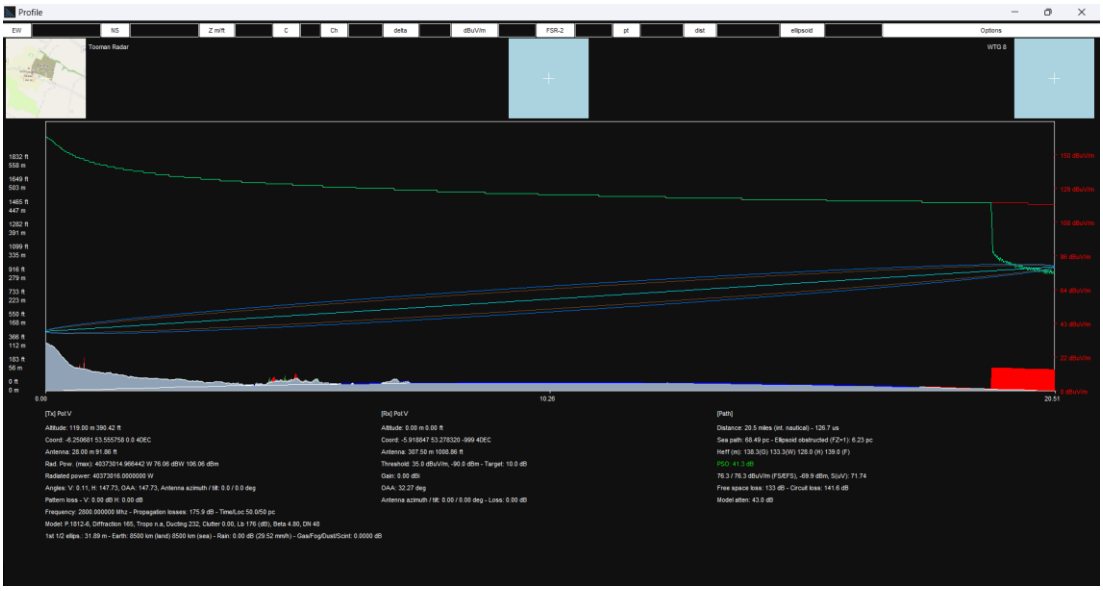


Figure 26 - Dublin Airport - Tooman Radar WTG 8 LOS Profile

A1.3.9 WTG 9

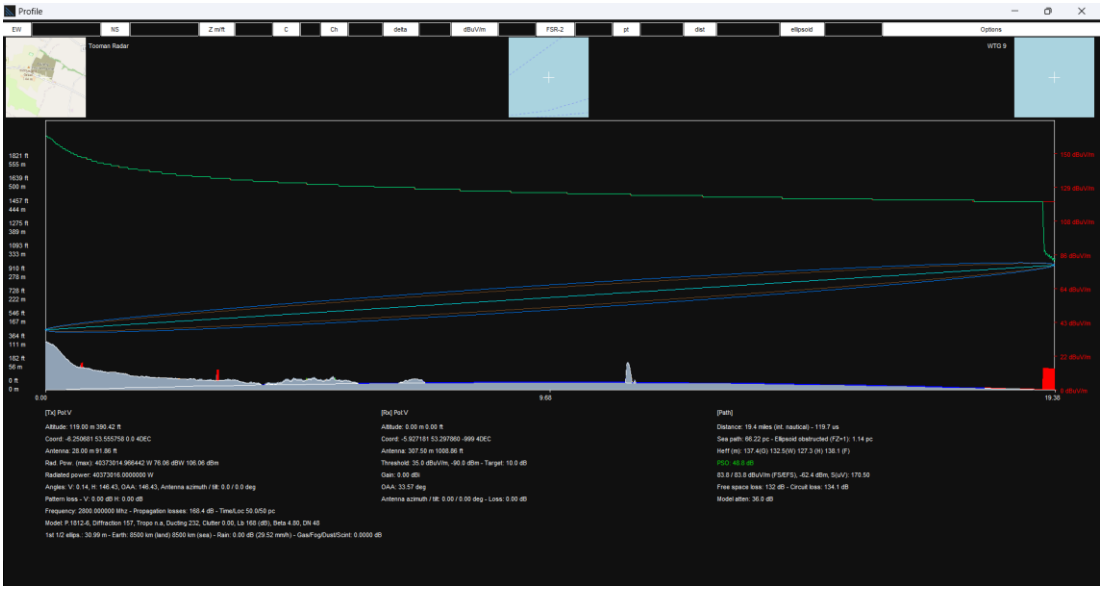


Figure 27 - Dublin Airport - Tooman Radar WTG 9 LOS Profile

A1.3.10 WTG 10

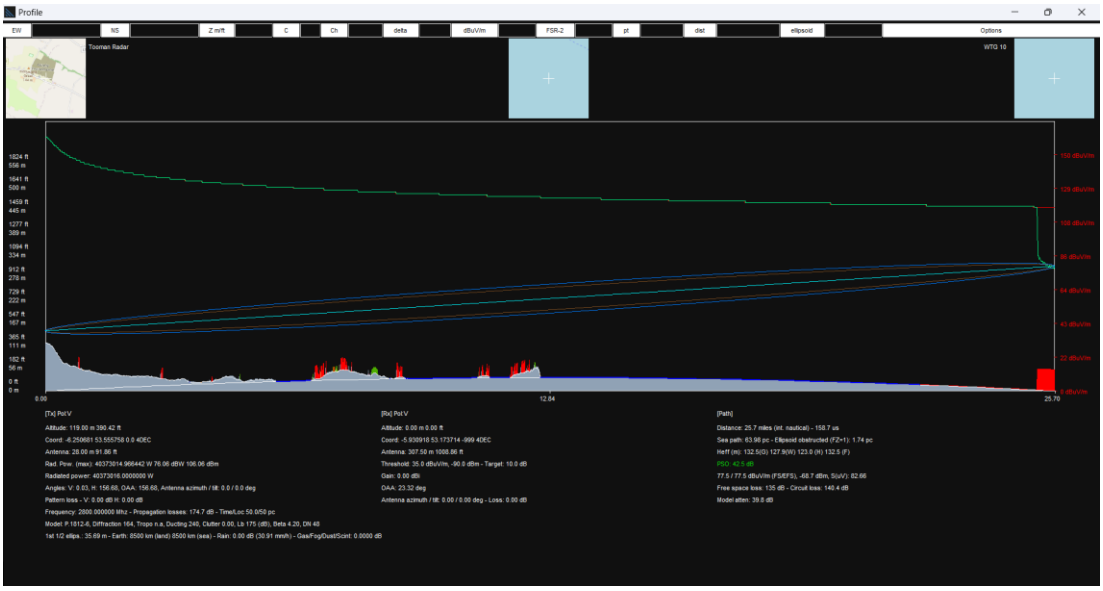


Figure 28 - Dublin Airport - Tooman Radar WTG 10 LOS Profile

A1.3.11 WTG 11

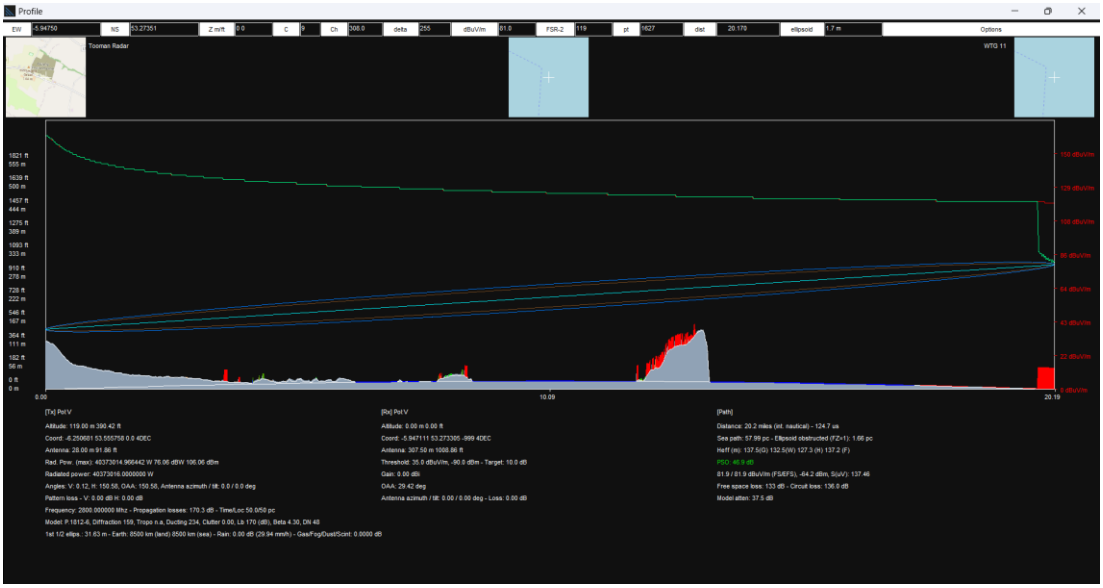


Figure 29 - Dublin Airport - Tooman Radar WTG 11 LOS Profile

A1.3.12 WTG 12

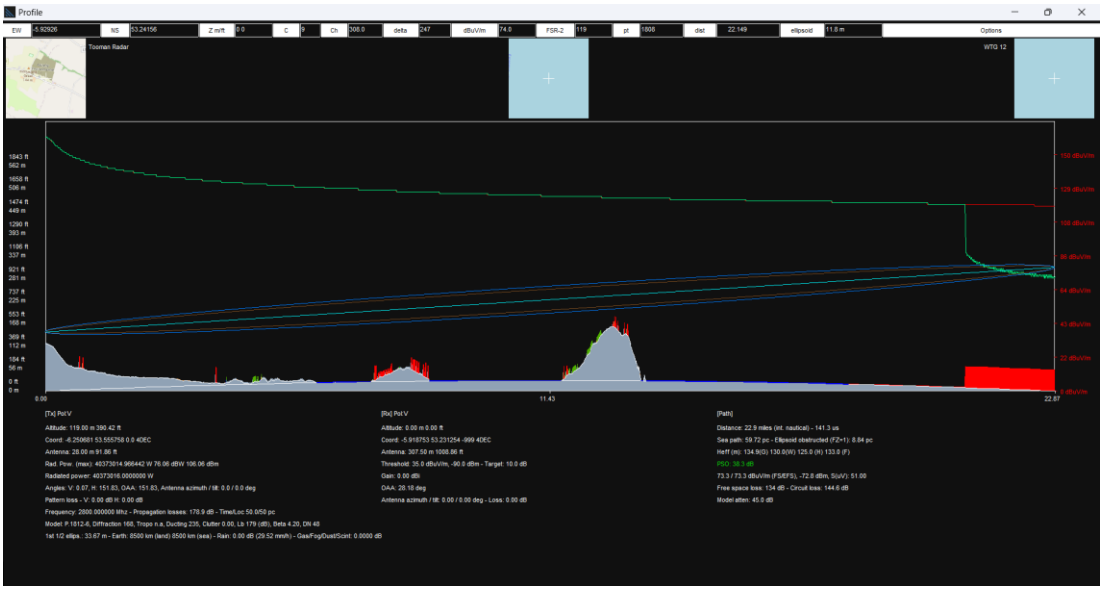


Figure 30 - Dublin Airport - Tooman Radar WTG 12 LOS Profile

A1.3.13 WTG 13

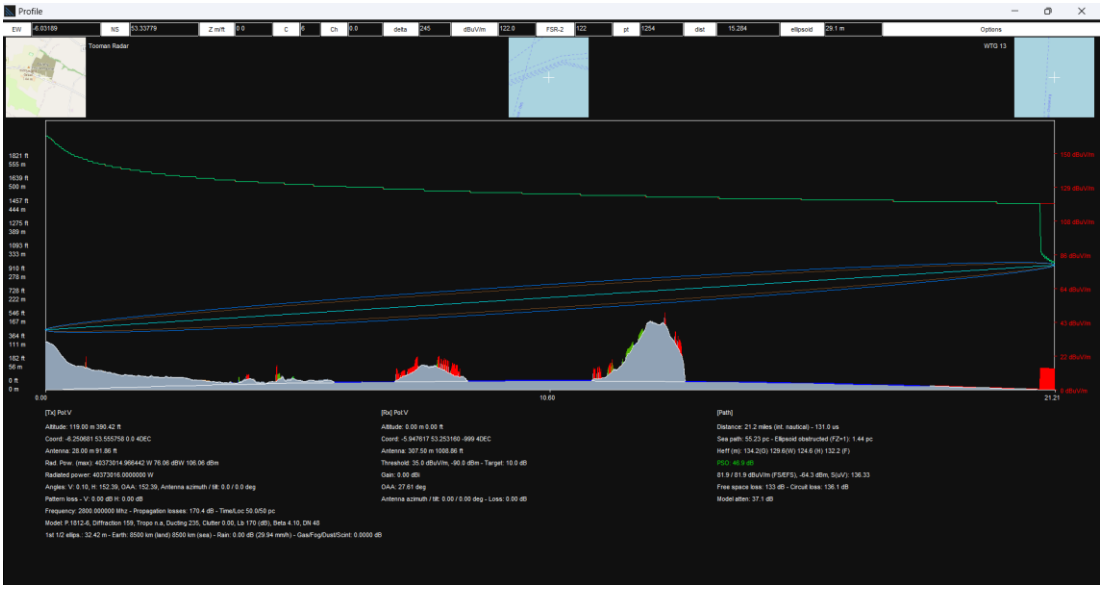


Figure 31 - Dublin Airport - Tooman Radar WTG 13 LOS Profile

A1.3.14 WTG 14

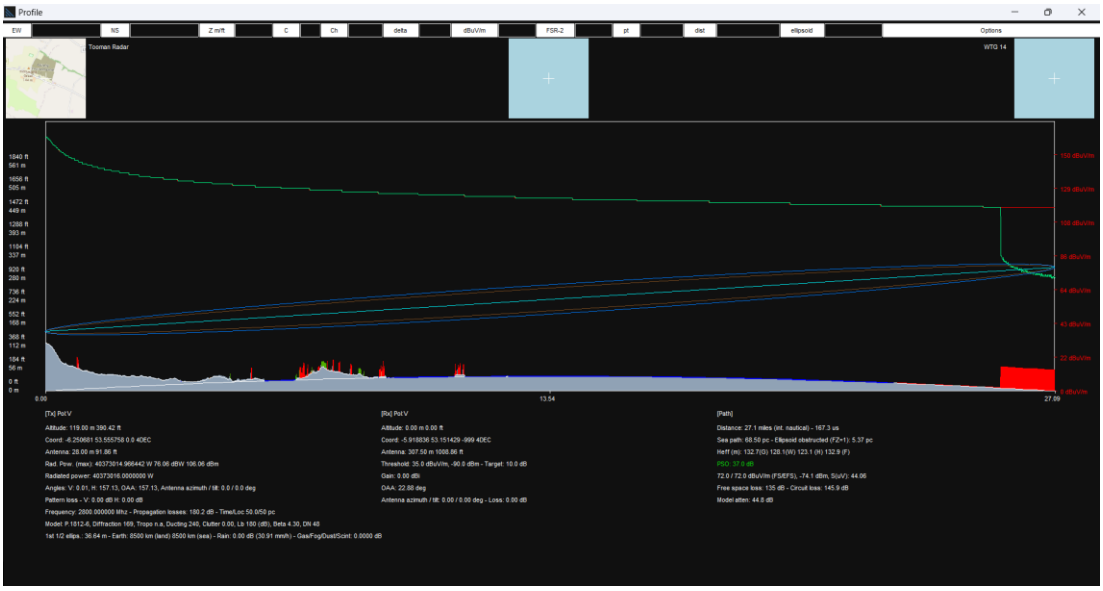


Figure 32 - Dublin Airport - Tooman Radar WTG 14 LOS Profile

A1.3.15 WTG 15

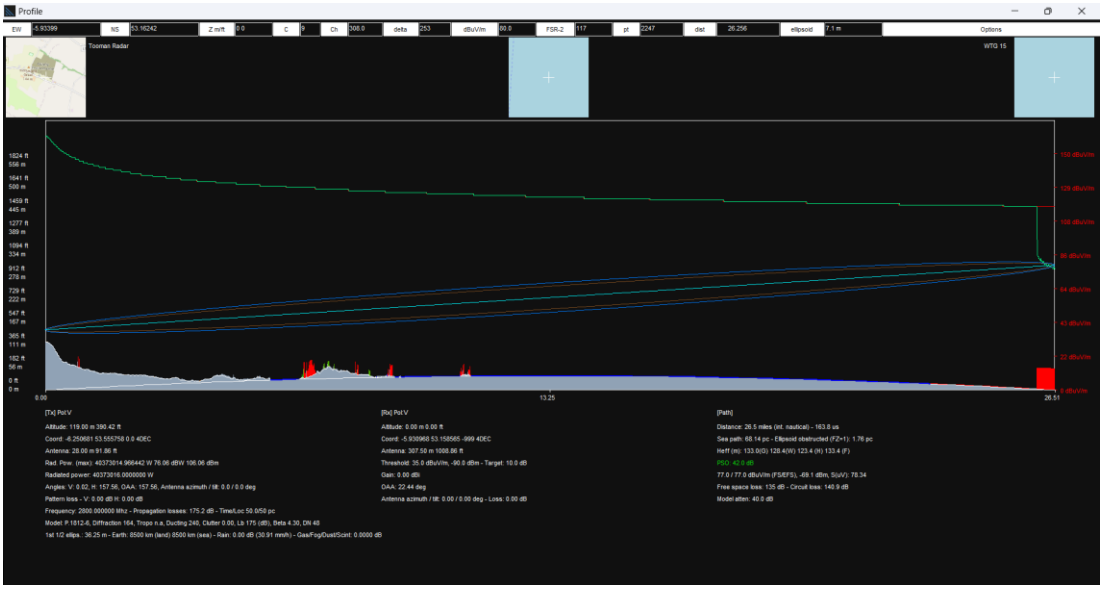


Figure 33 - Dublin Airport - Tooman Radar WTG 15 LOS Profile

A1.3.16 WTG 16

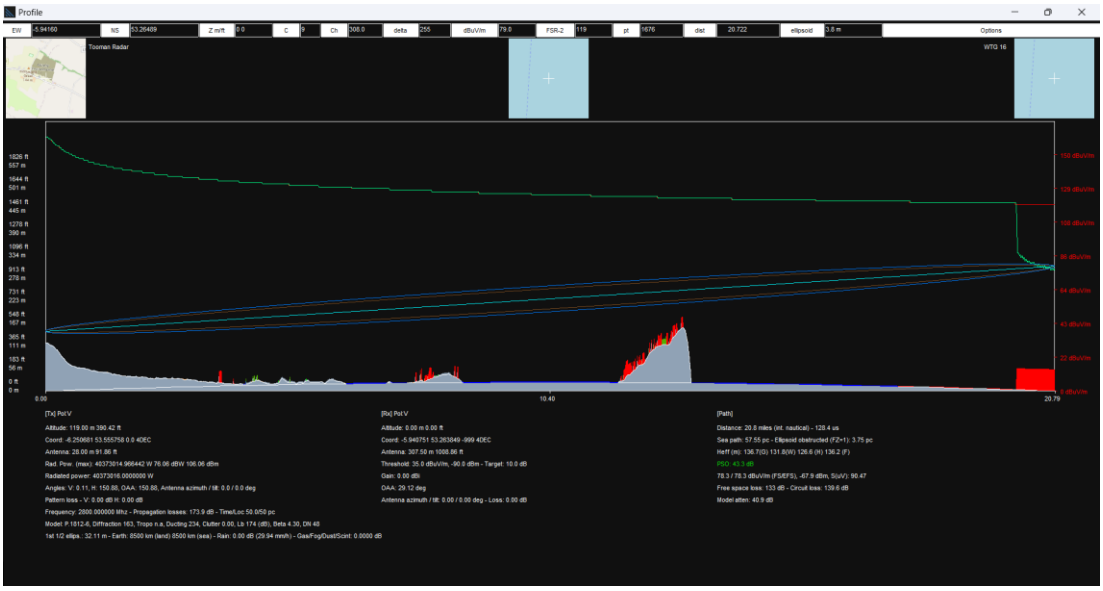


Figure 34 - Dublin Airport - Tooman Radar WTG 16 LOS Profile

A1.3.17 WTG 17

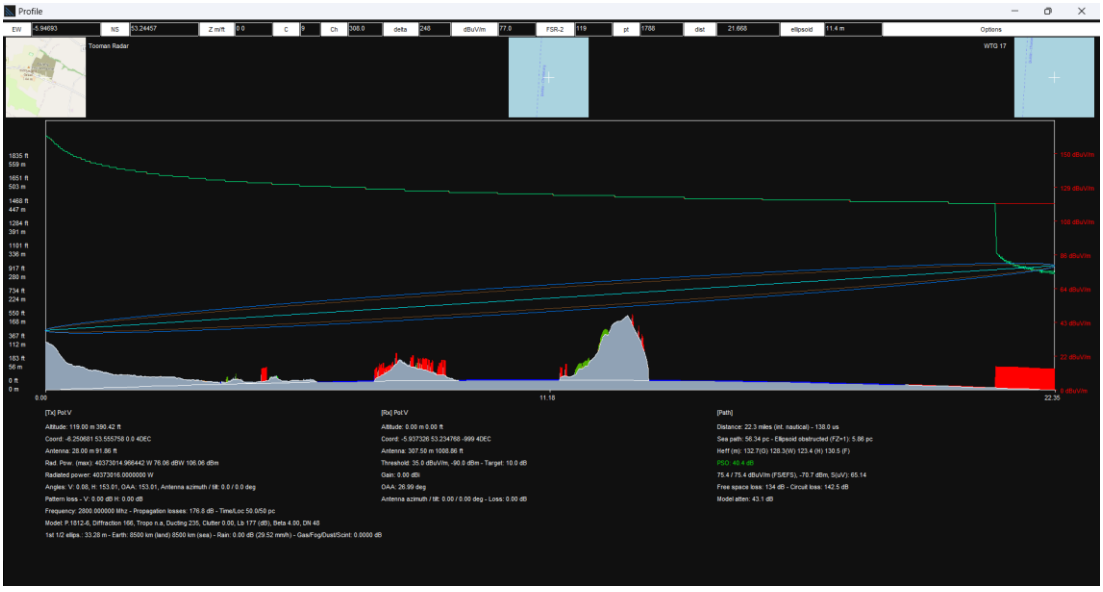


Figure 35 - Dublin Airport - Tooman Radar WTG 17 LOS Profile

A1.3.18 WTG 18

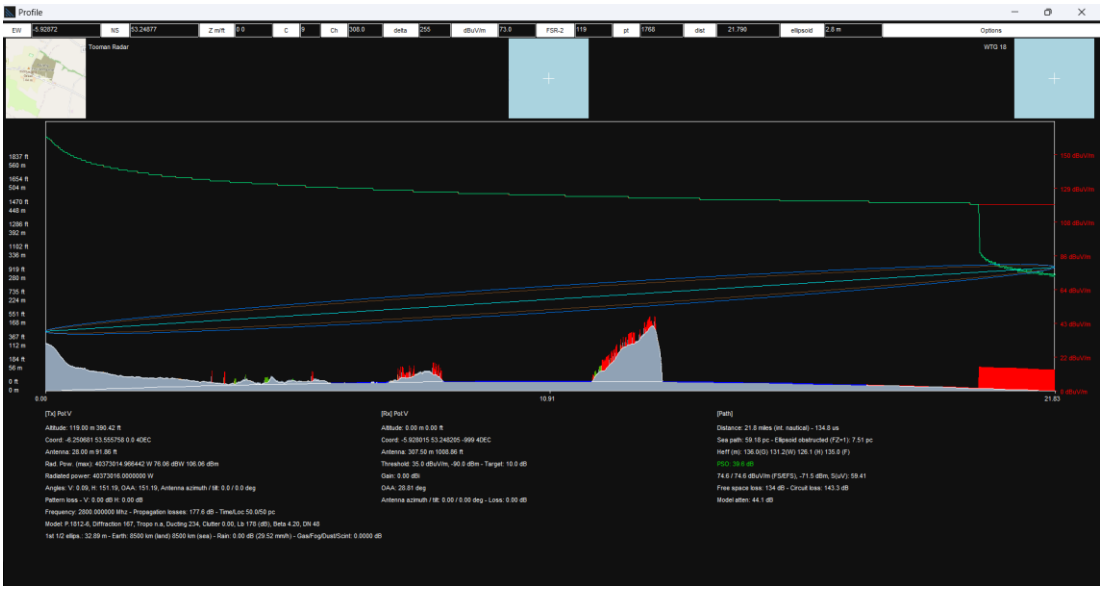


Figure 36 - Dublin Airport - Tooman Radar WTG 18 LOS Profile

A1.3.19 WTG 19

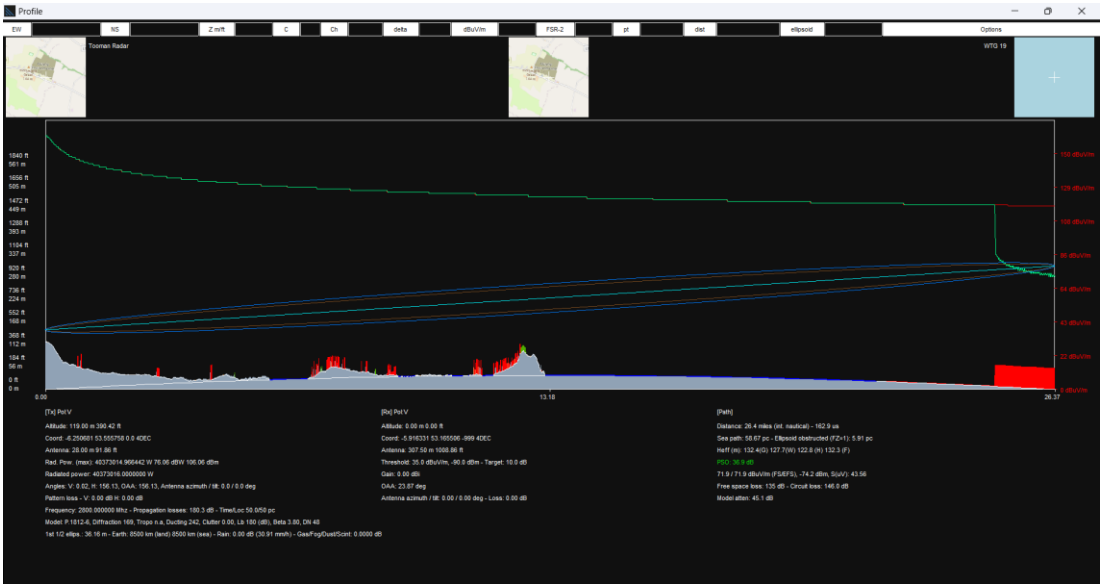


Figure 37 - Dublin Airport - Tooman Radar WTG 19 LOS Profile

A1.3.20 WTG 20

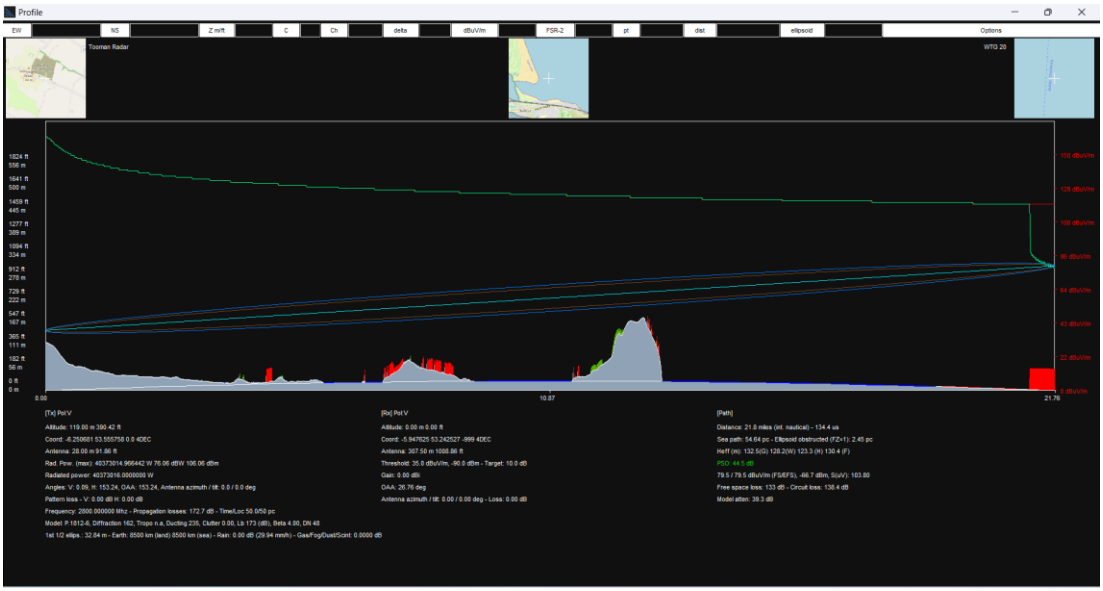


Figure 38 - Dublin Airport - Tooman Radar WTG 20 LOS Profile

A1.3.21 WTG 21

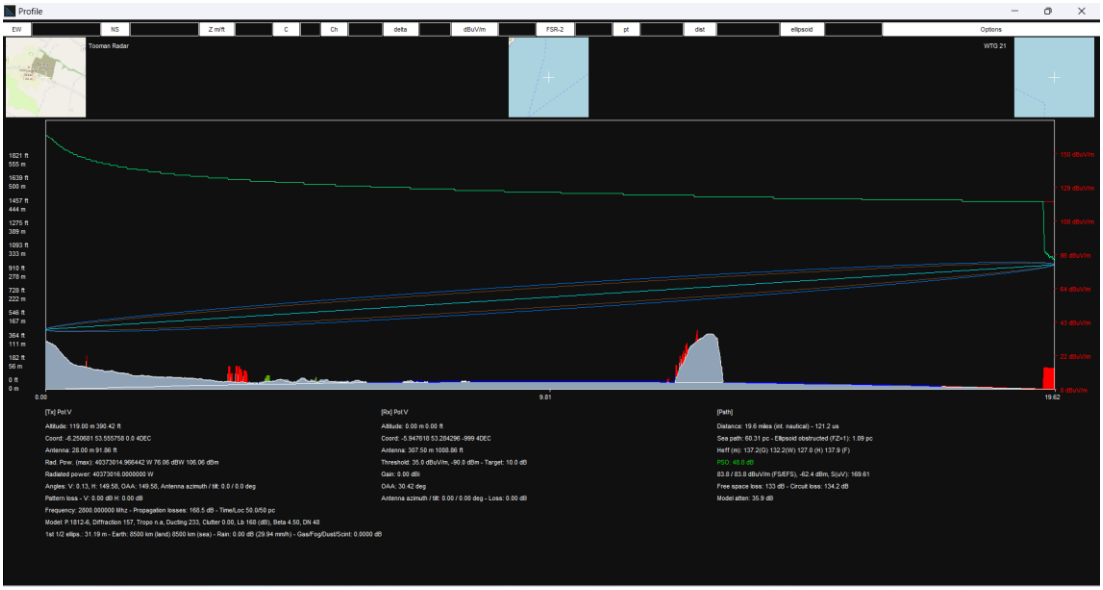


Figure 39 - Dublin Airport - Tooman Radar WTG 21 LOS Profile

A1.3.22 WTG 22

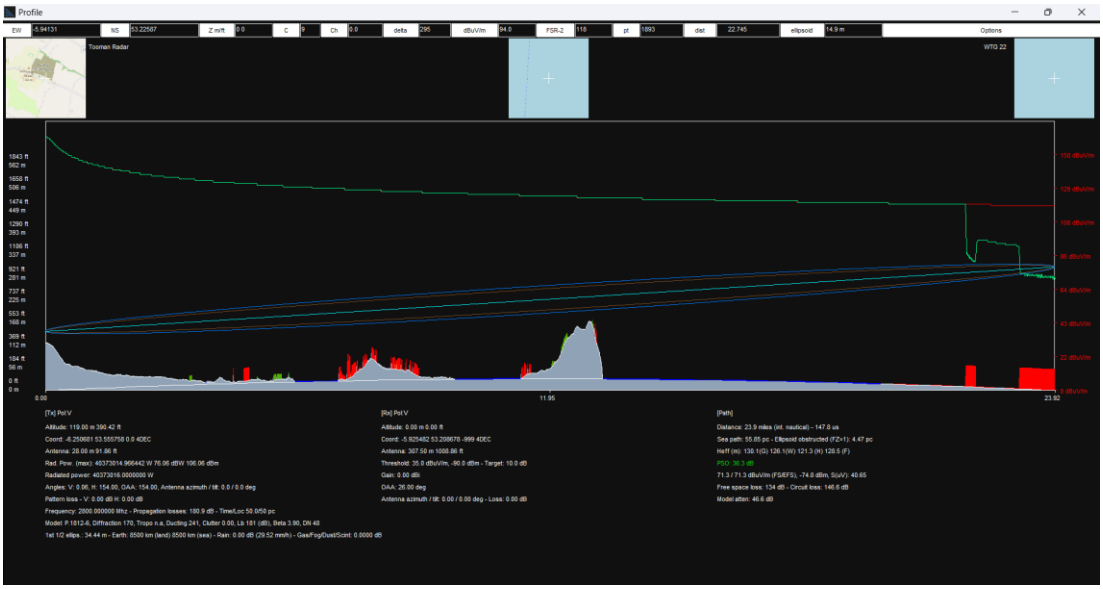


Figure 40 - Dublin Airport - Tooman Radar WTG 22 LOS Profile

A1.3.23 WTG 23

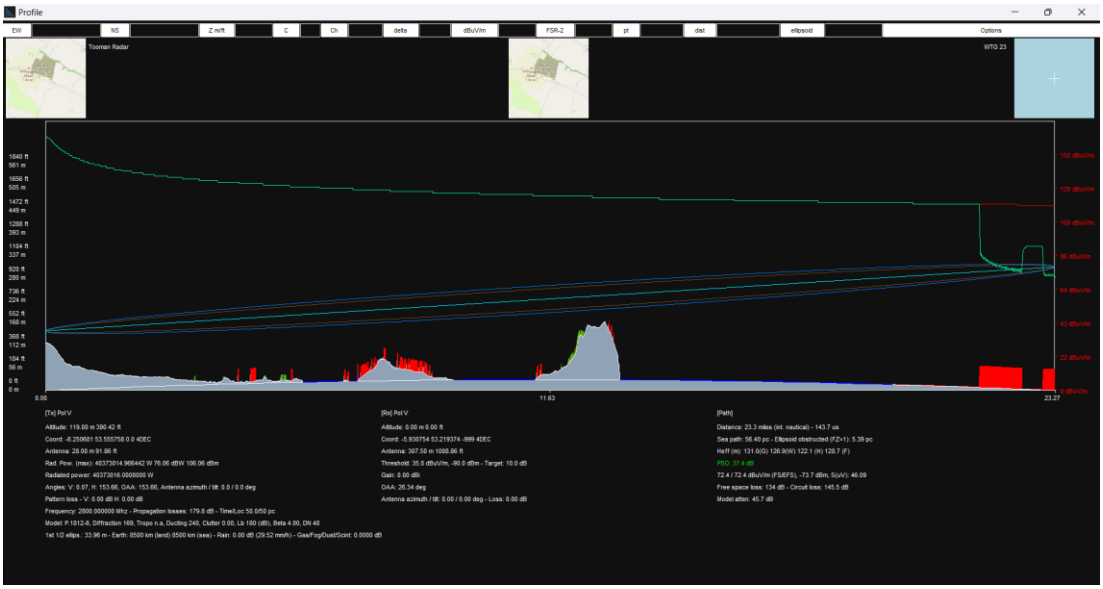


Figure 41 - Dublin Airport - Tooman Radar WTG 23 LOS Profile

A1.3.24 WTG 24

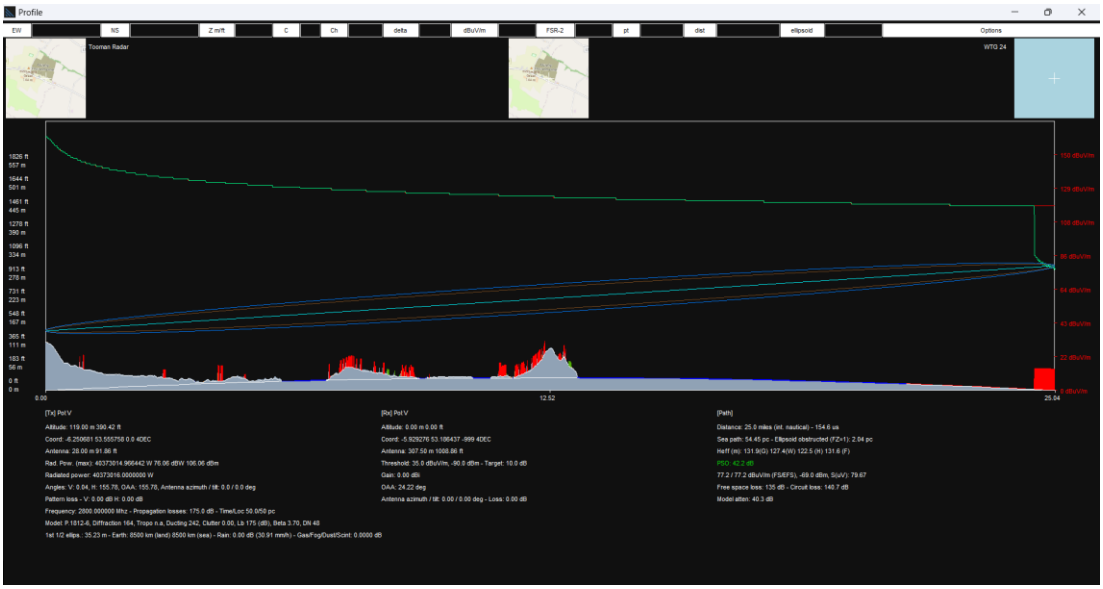


Figure 42 - Dublin Airport - Tooman Radar WTG 24 LOS Profile

A1.3.25 WTG 25

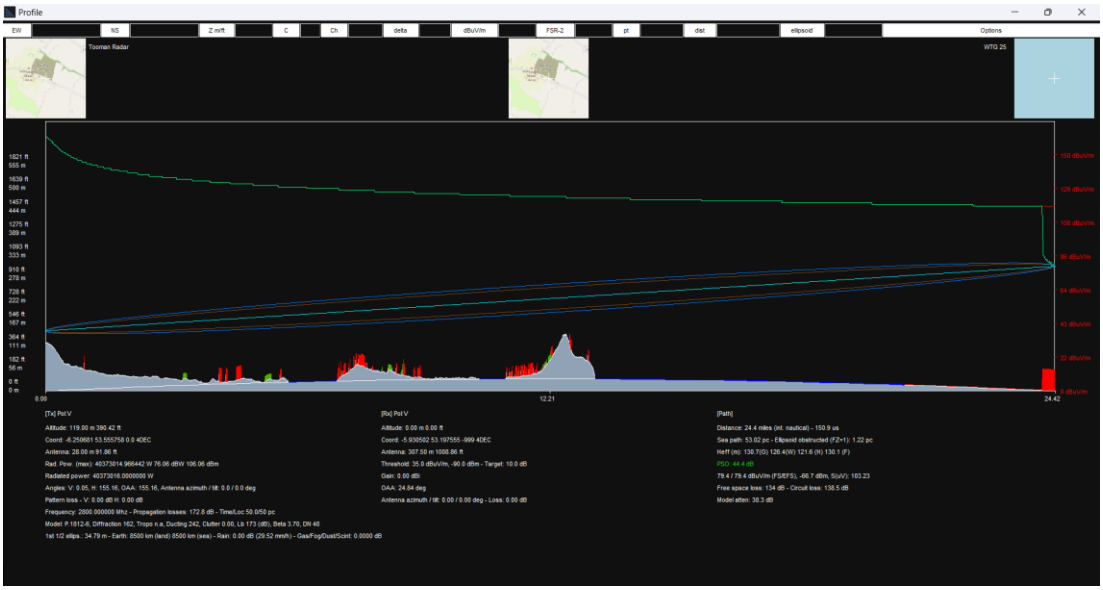


Figure 43 - Dublin Airport - Tooman Radar WTG 25 LOS Profile

A1.3.26 WTG 26

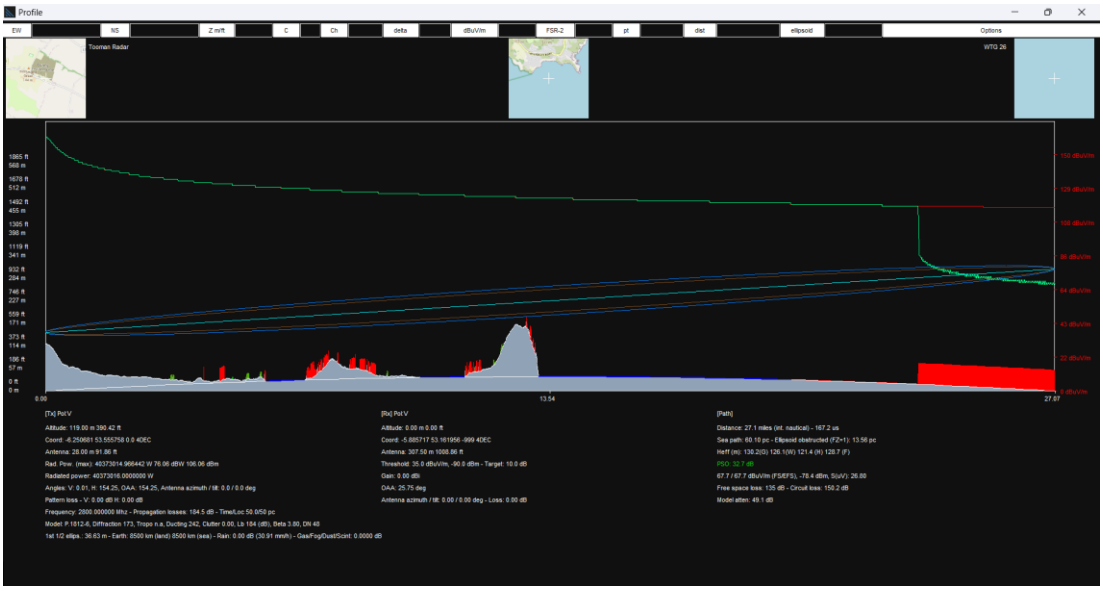


Figure 44 - Dublin Airport - Tooman Radar WTG 26 LOS Profile

A1.3.27 WTG 27

Figure 45 - Dublin Airport - Tooman Radar WTG 27 LOS Profile

A1.3.28 WTG 28

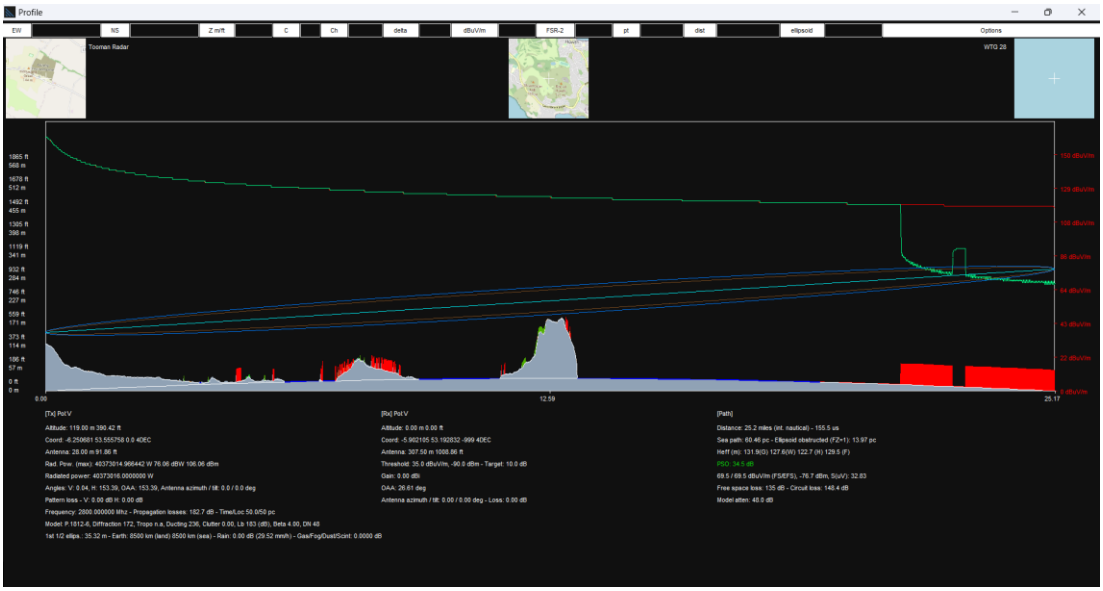


Figure 46 - Dublin Airport - Tooman Radar WTG 28 LOS Profile

A1.3.29 WTG 29

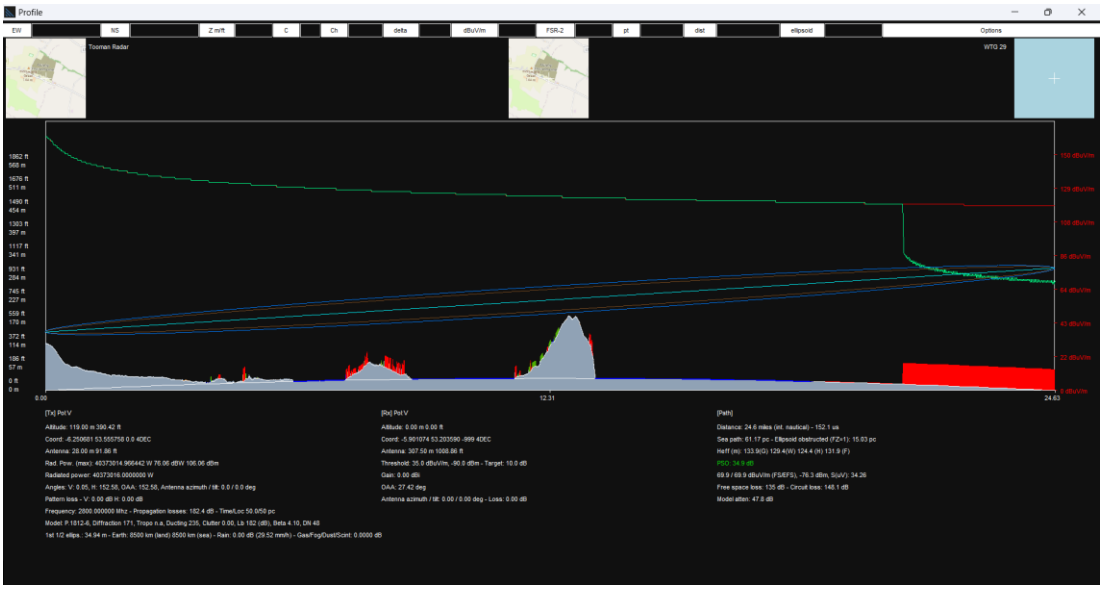


Figure 47 - Dublin Airport - Tooman Radar WTG 29 LOS Profile

A1.3.30 WTG 30

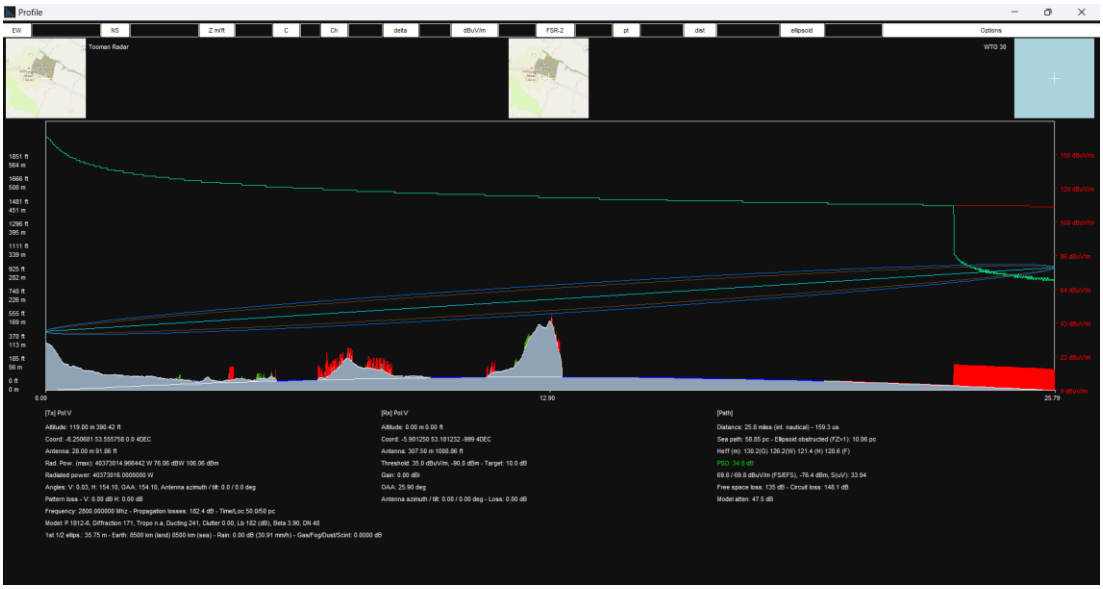


Figure 48 - Dublin Airport - Tooman Radar WTG 30 LOS Profile

A1.3.31 WTG 31

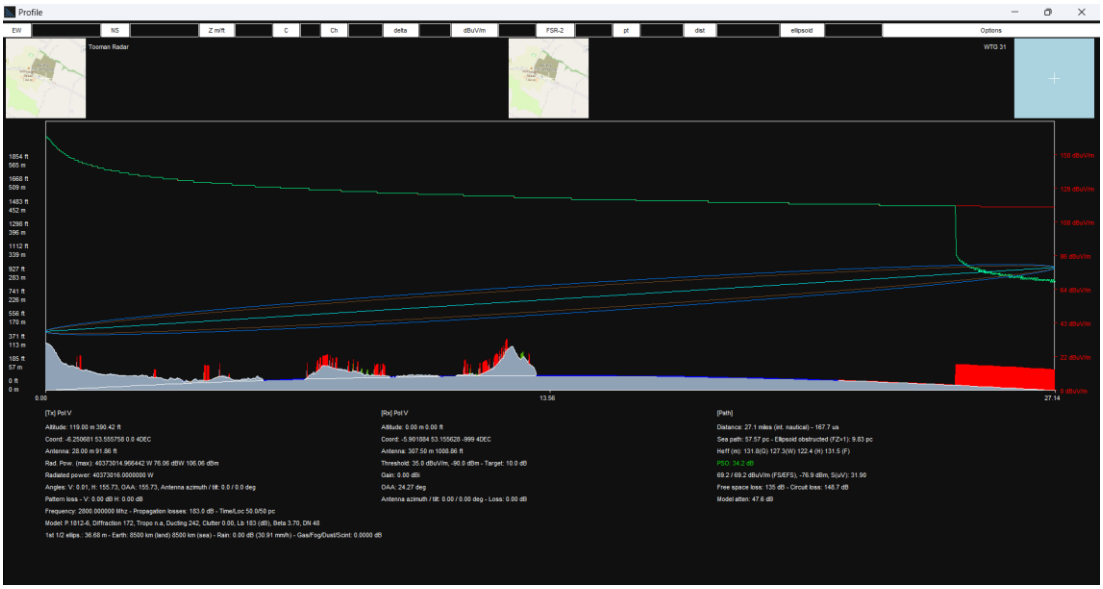


Figure 49 - Dublin Airport - Tooman Radar WTG 31 LOS Profile

A1.3.32 WTG 32

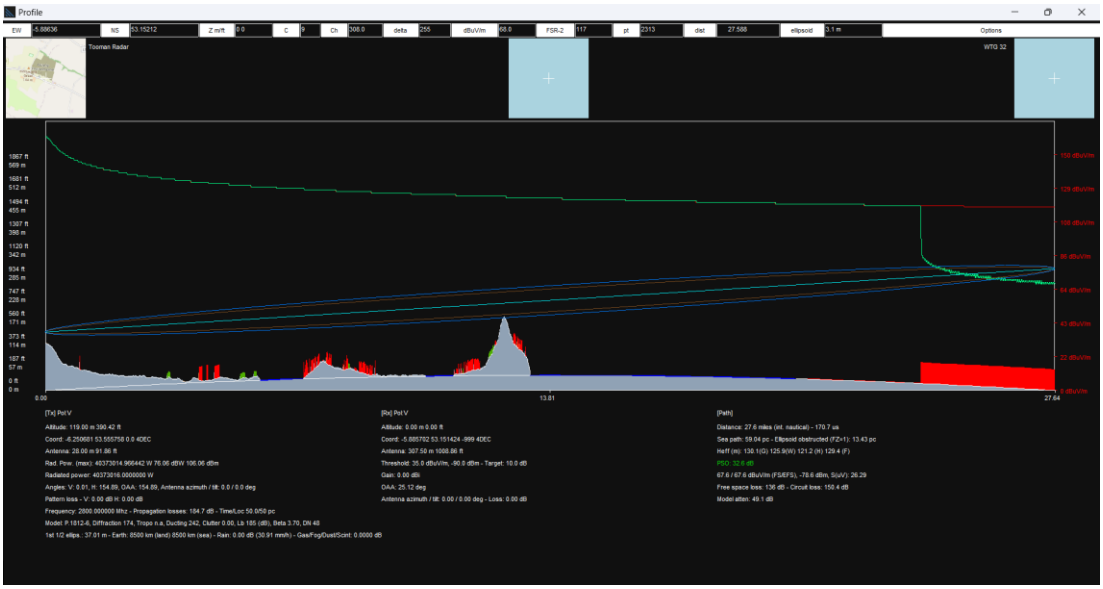


Figure 50 - Dublin Airport - Tooman Radar WTG 32 LOS Profile

A1.3.33 WTG 33

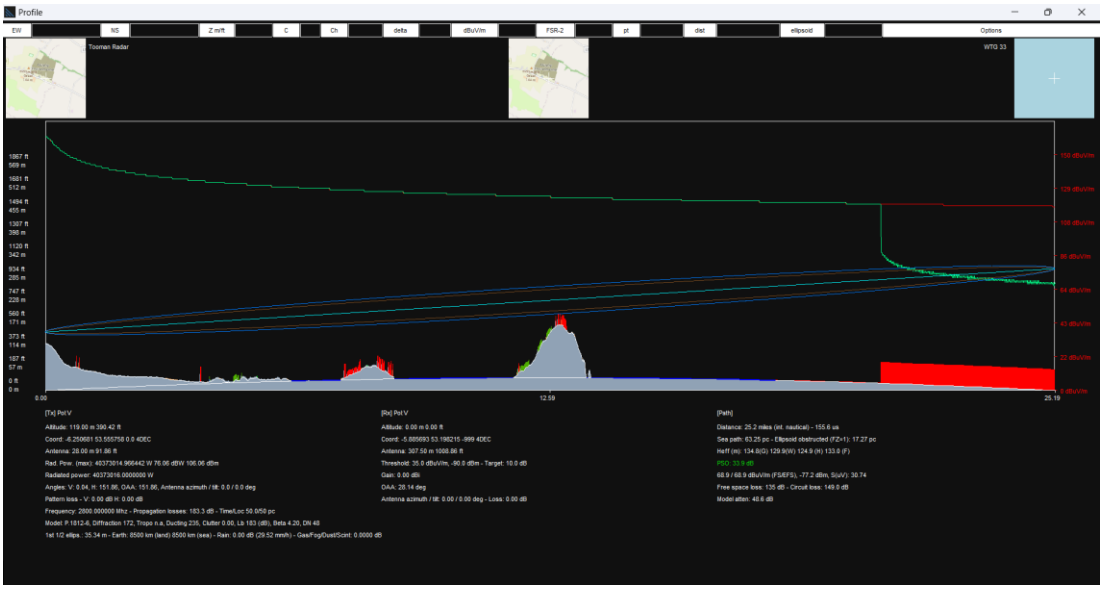


Figure 51 - Dublin Airport - Tooman Radar WTG 33 LOS Profile

A1.3.34 WTG 34

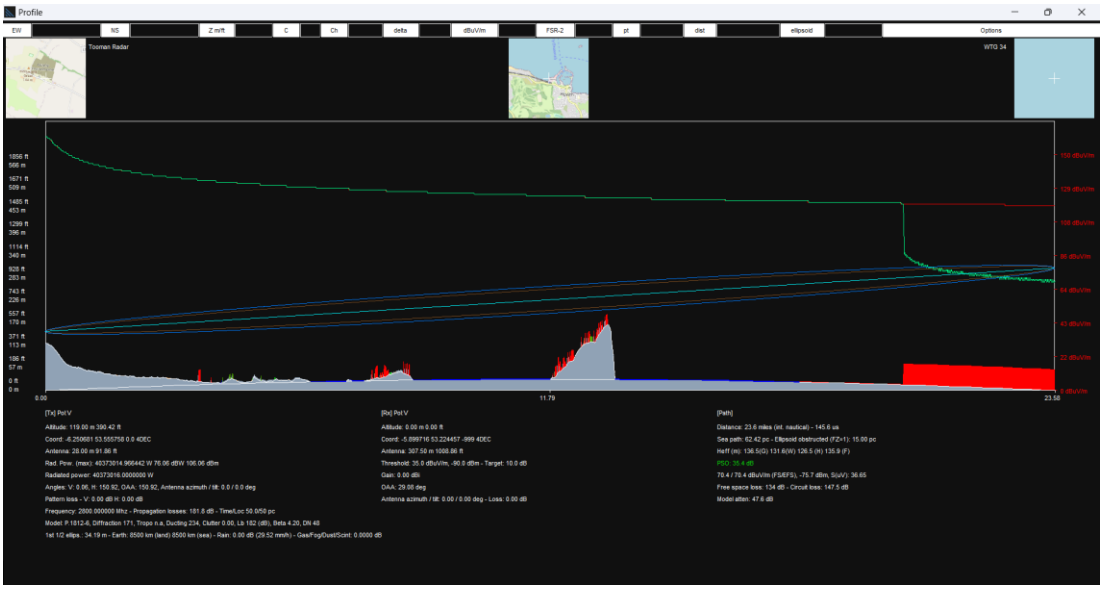


Figure 52 - Dublin Airport - Tooman Radar WTG 34 LOS Profile

A1.3.35 WTG 35

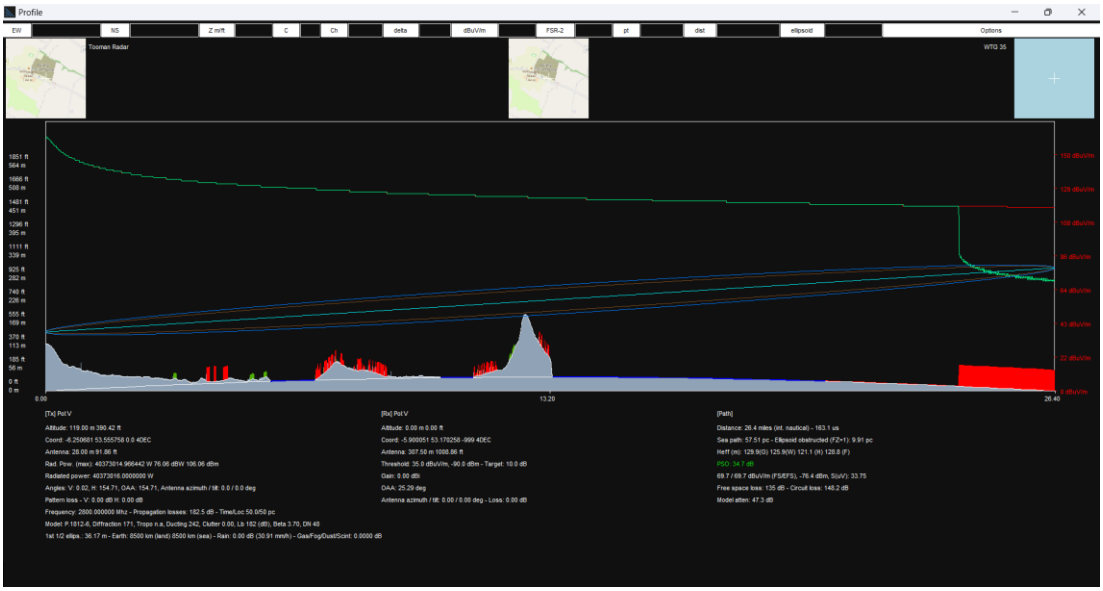


Figure 53 - Dublin Airport - Tooman Radar WTG 35 LOS Profile

A1.3.36 WTG 36

Figure 54 - Dublin Airport - Tooman Radar WTG 36 LOS Profile

A1.3.37 WTG 37

Figure 55 - Dublin Airport - Tooman Radar WTG 37 LOS Profile

A1.3.38 WTG 38

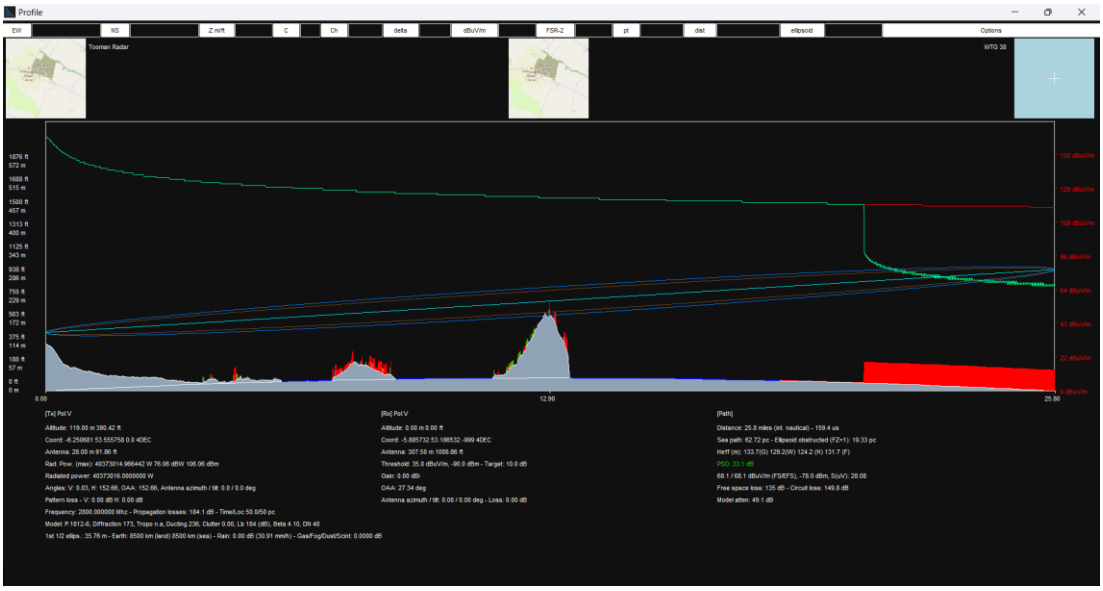


Figure 56 - Dublin Airport - Tooman Radar WTG 38 LOS Profile

A1.3.39 WTG 39

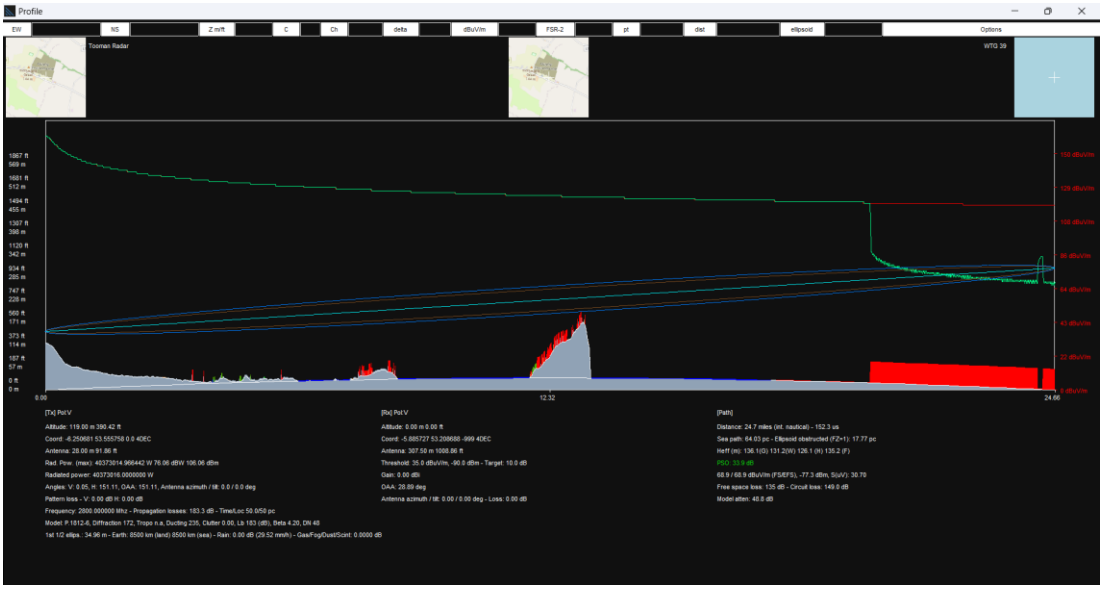


Figure 57 - Dublin Airport - Tooman Radar WTG 39 LOS Profile

A1.4 Dublin Airport - Dublin Radar 3 LOS Profile Paths

A1.4.1 WTG 1

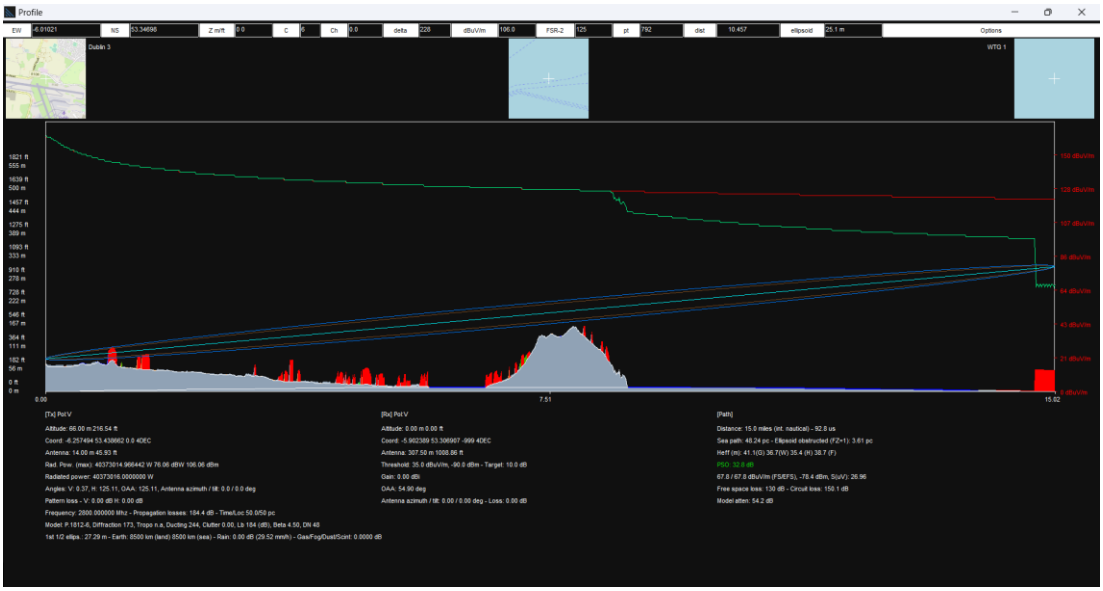


Figure 58 - Dublin Airport - Dublin Radar 3 WTG 1 LOS Profile

A1.4.2 WTG 2

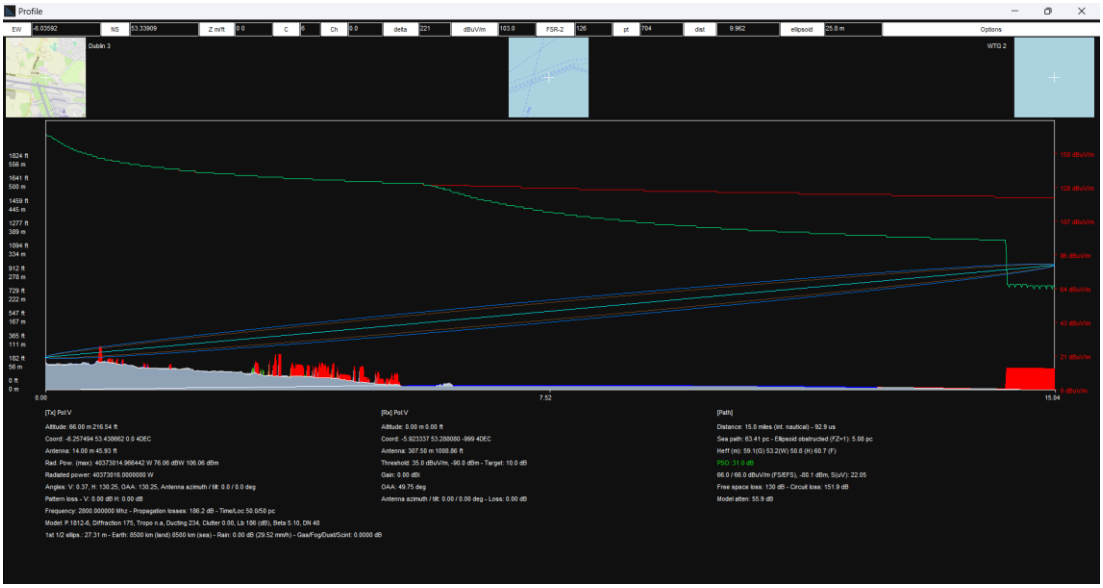


Figure 59 - Dublin Airport - Dublin Radar 3 WTG 2 LOS Profile

A1.4.3 WTG 3

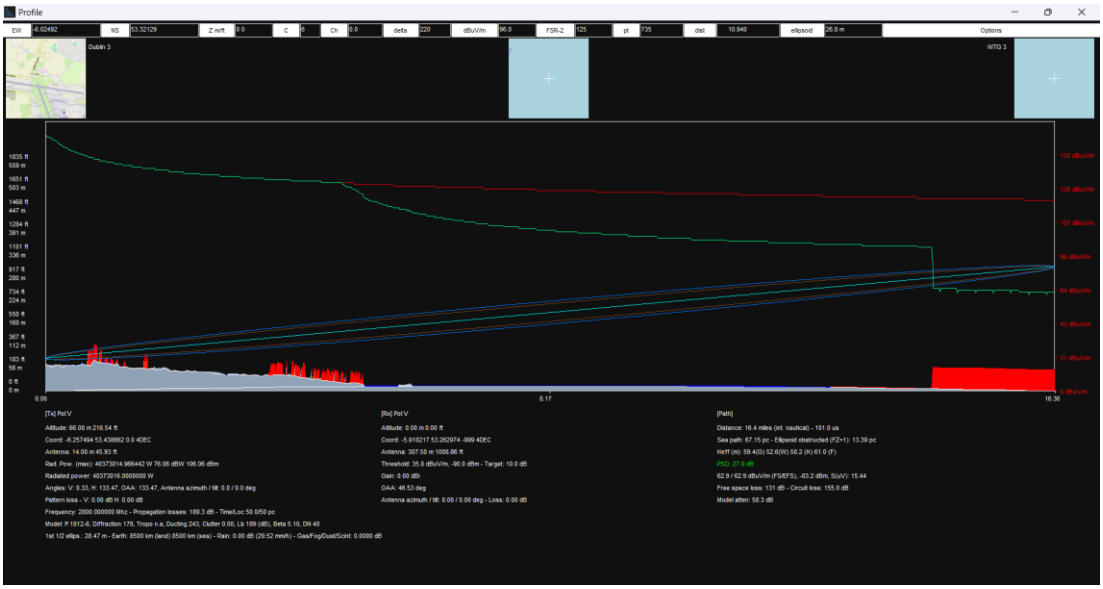


Figure 60 - Dublin Airport - Dublin Radar 3 WTG 3 LOS Profile

A1.4.4 WTG 4

Figure 61 - Dublin Airport - Dublin Radar 3 WTG 4 LOS Profile

A1.4.5 WTG 5

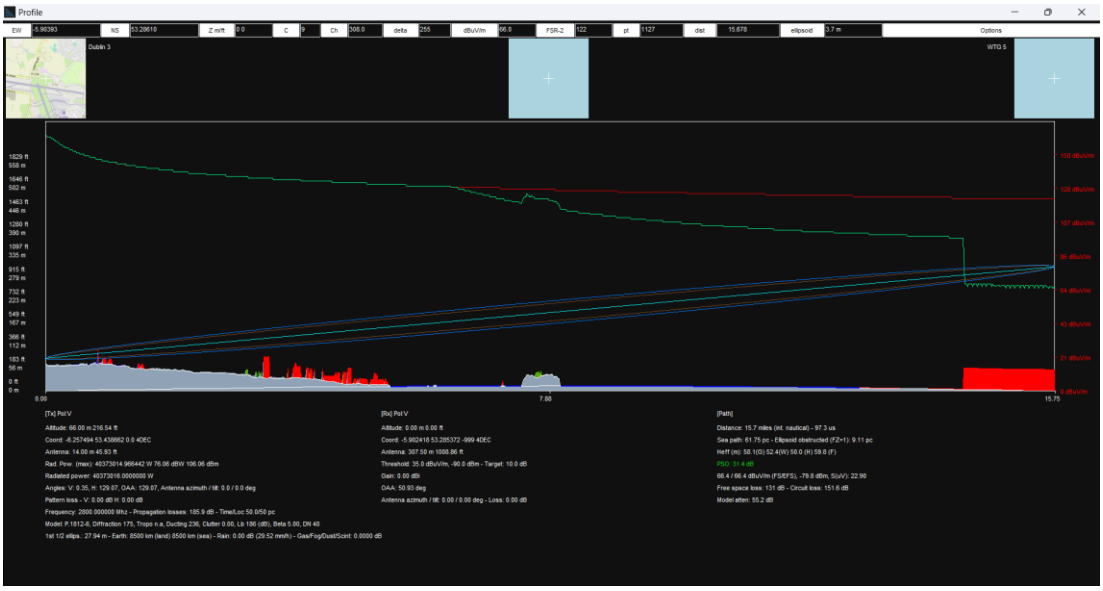


Figure 62 - Dublin Airport - Dublin Radar 3 WTG 5 LOS Profile

A1.4.6 WTG 6

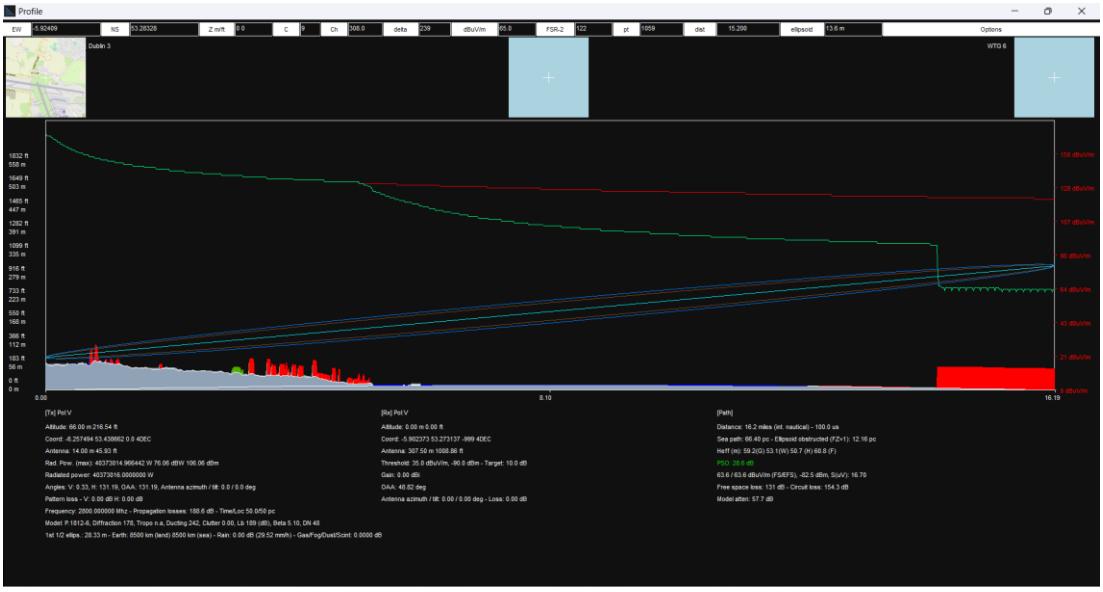


Figure 63 - Dublin Airport - Dublin Radar 3 WTG 6 LOS Profile

A1.4.7 WTG 7

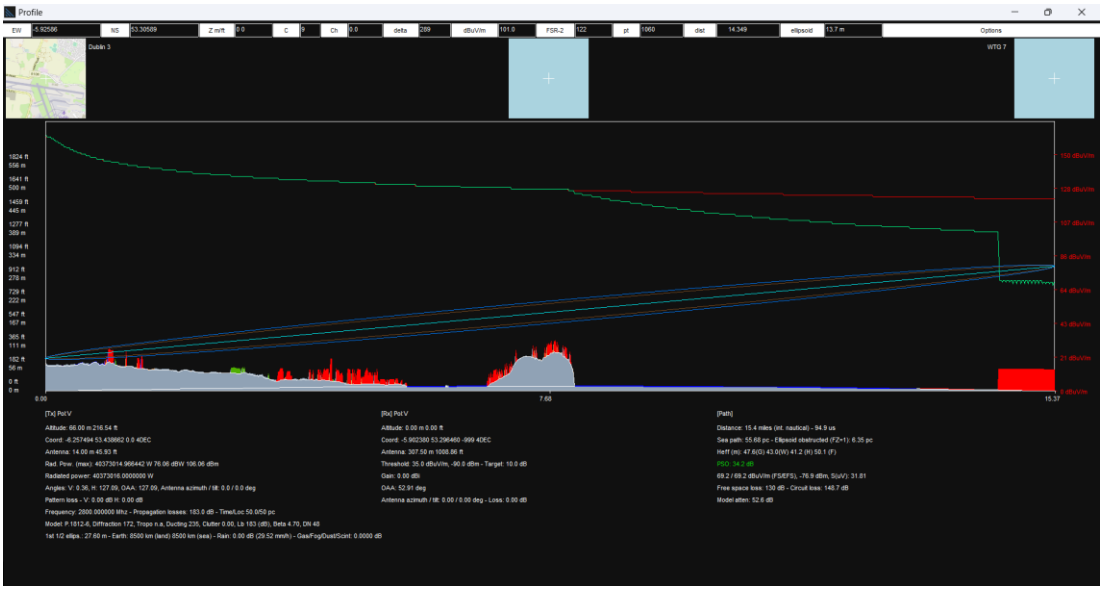


Figure 64 - Dublin Airport - Dublin Radar 3 WTG 7 LOS Profile

A1.4.8 WTG 8

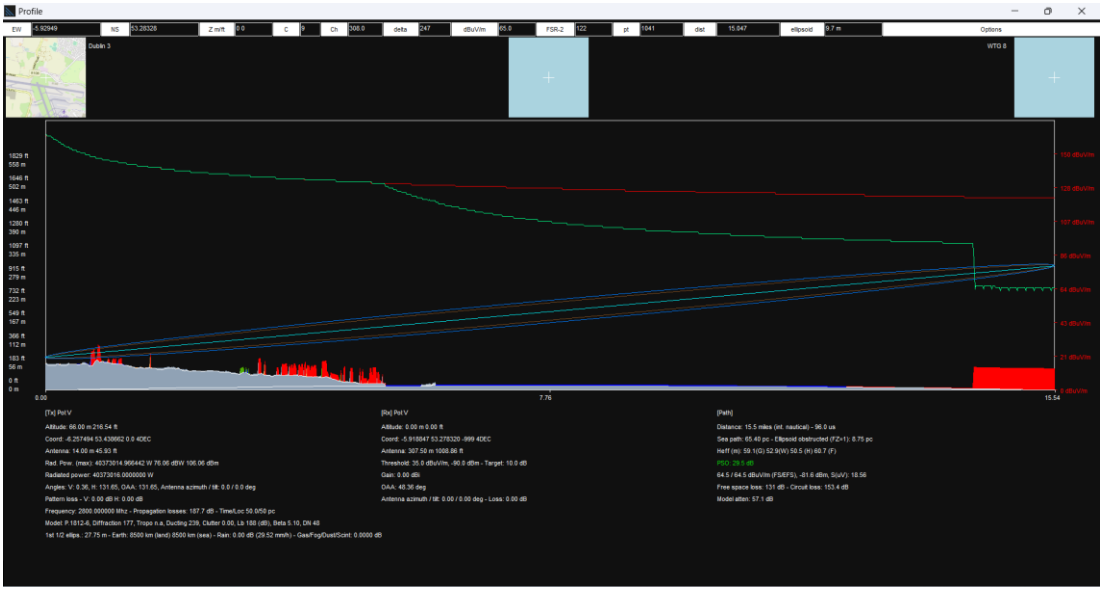


Figure 65 - Dublin Airport - Dublin Radar 3 WTG 8 LOS Profile

A1.4.9 WTG 9

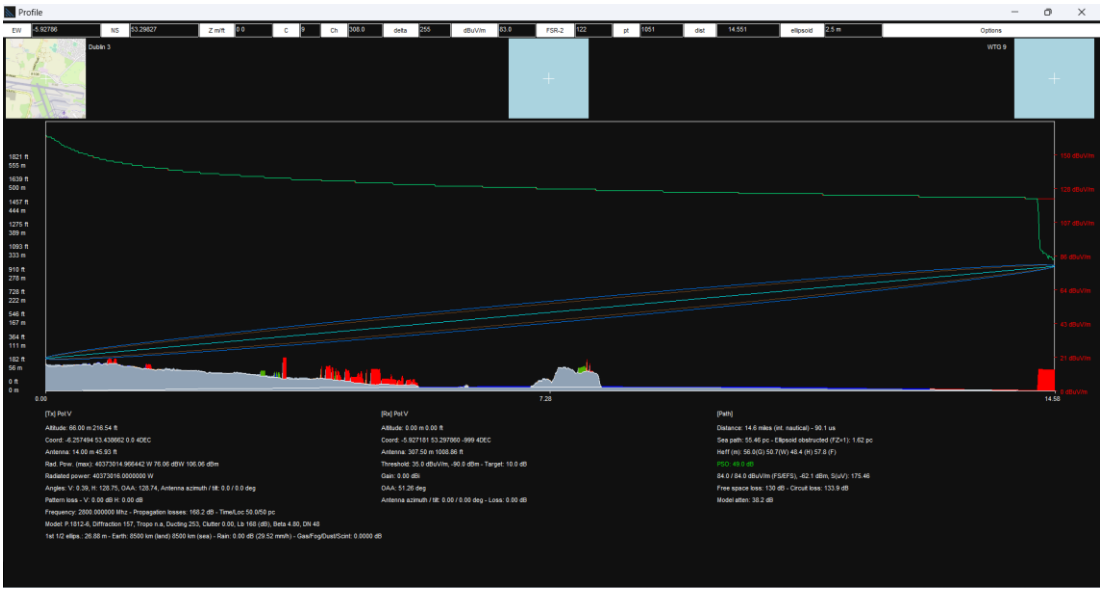


Figure 66 - Dublin Airport - Dublin Radar 3 WTG 9 LOS Profile

A1.4.10 WTG 10

Figure 67 - Dublin Airport - Dublin Radar 3 WTG 10 LOS Profile

A1.4.11 WTG 11

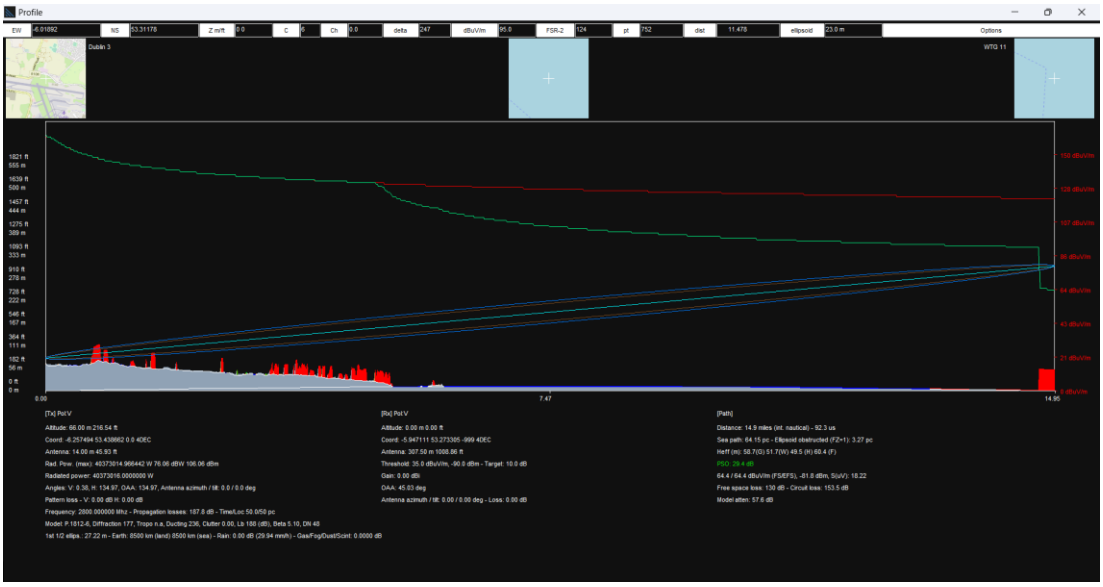


Figure 68 - Dublin Airport - Dublin Radar 11 WTG 1 LOS Profile

A1.4.12 WTG 12

Figure 69 - Dublin Airport - Dublin Radar 3 WTG 12 LOS Profile

A1.4.13 WTG 13

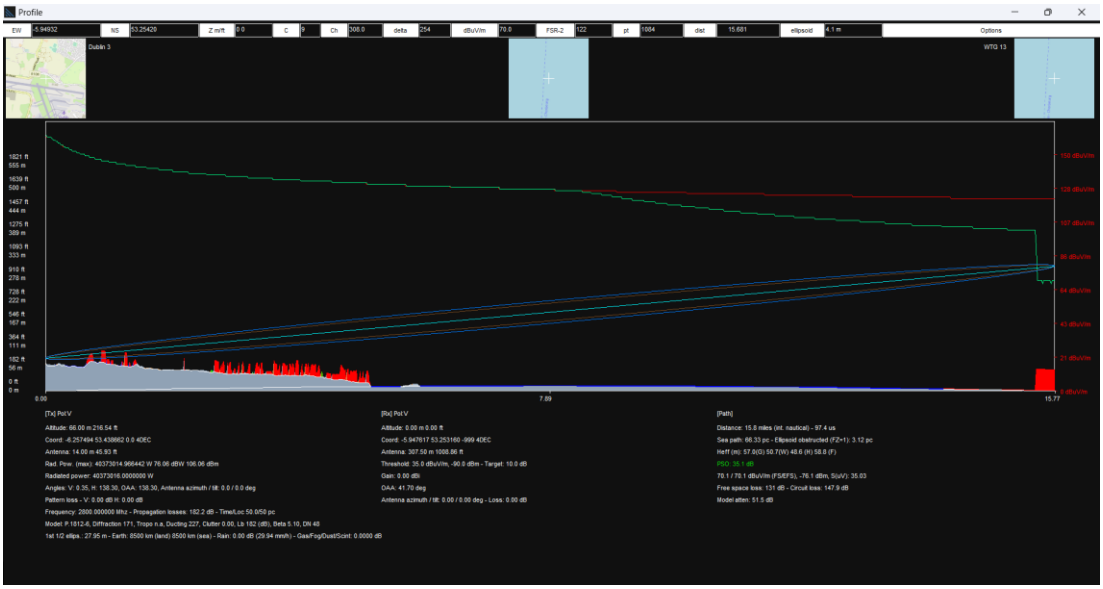


Figure 70 - Dublin Airport - Dublin Radar 3 WTG 13 LOS Profile

A1.4.14 WTG 14

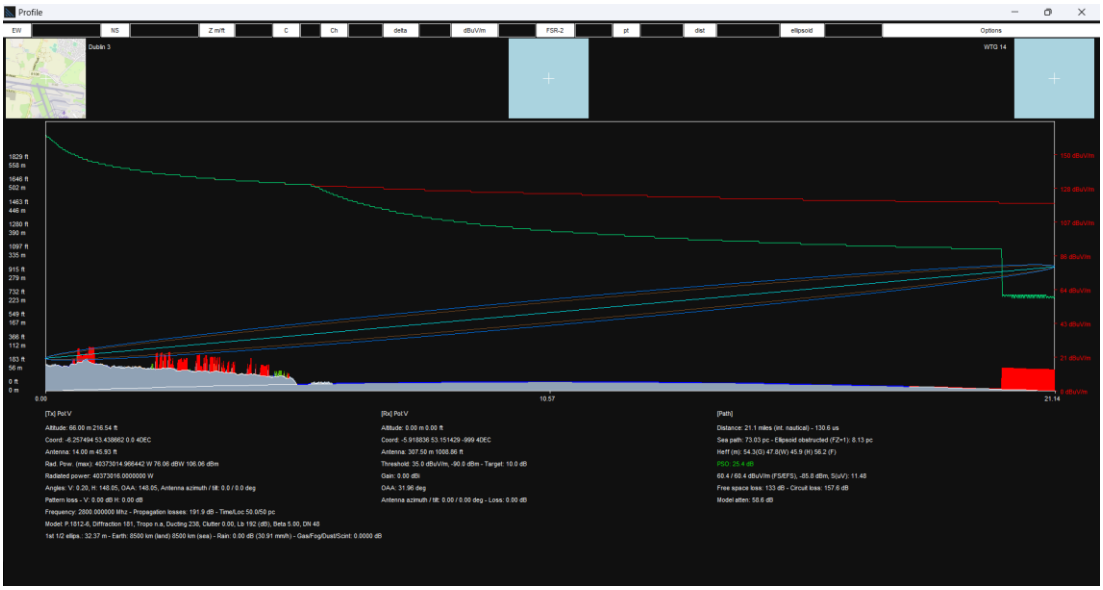


Figure 71 - Dublin Airport - Dublin Radar 3 WTG 14 LOS Profile

A1.4.15 WTG 15

Figure 72 - Dublin Airport - Dublin Radar 3 WTG 15 LOS Profile

A1.4.16 WTG 16

Figure 73 - Dublin Airport - Dublin Radar 3 WTG 16 LOS Profile

A1.4.17 WTG 17

Figure 74 - Dublin Airport - Dublin Radar 3 WTG 17 LOS Profile

A1.4.18 WTG 18

Figure 75 - Dublin Airport - Dublin Radar 3 WTG 18 LOS Profile

A1.4.19 WTG 19

Figure 76 - Dublin Airport - Dublin Radar 3 WTG 19 LOS Profile

A1.4.20 WTG 20

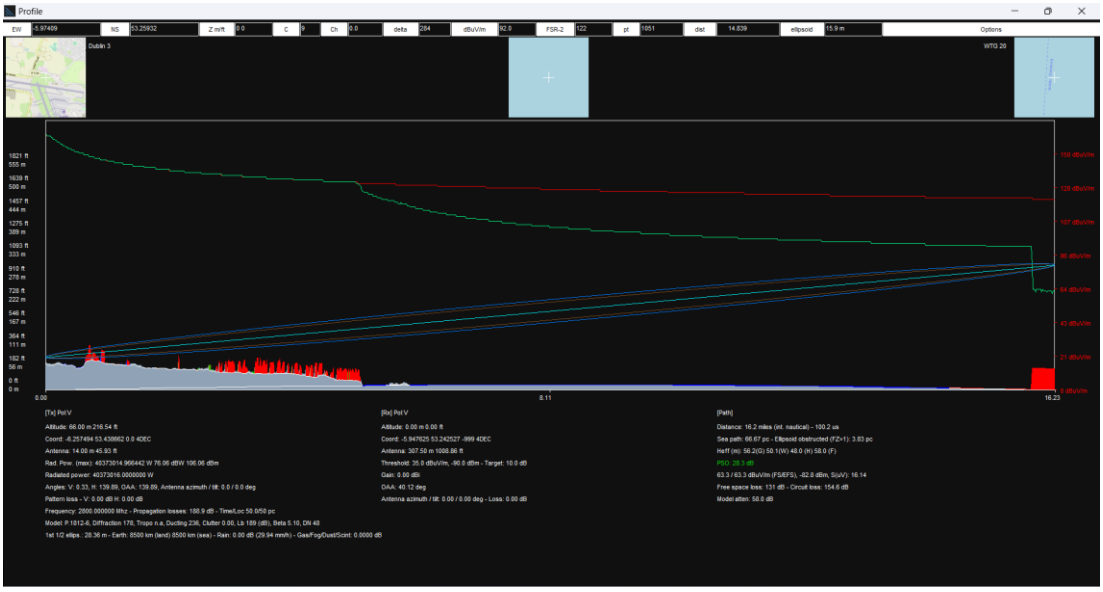


Figure 77 - Dublin Airport - Dublin Radar 3 WTG 20 LOS Profile

A1.4.21 WTG 21

Figure 78 - Dublin Airport - Dublin Radar 3 WTG 21 LOS Profile

A1.4.22 WTG 22

Figure 79 - Dublin Airport - Dublin Radar 3 WTG 22 LOS Profile

A1.4.23 WTG 23

Figure 80 - Dublin Airport - Dublin Radar 3 WTG 23 LOS Profile

A1.4.24 WTG 24

Figure 81 - Dublin Airport - Dublin Radar 3 WTG 24 LOS Profile

A1.4.25 WTG 25

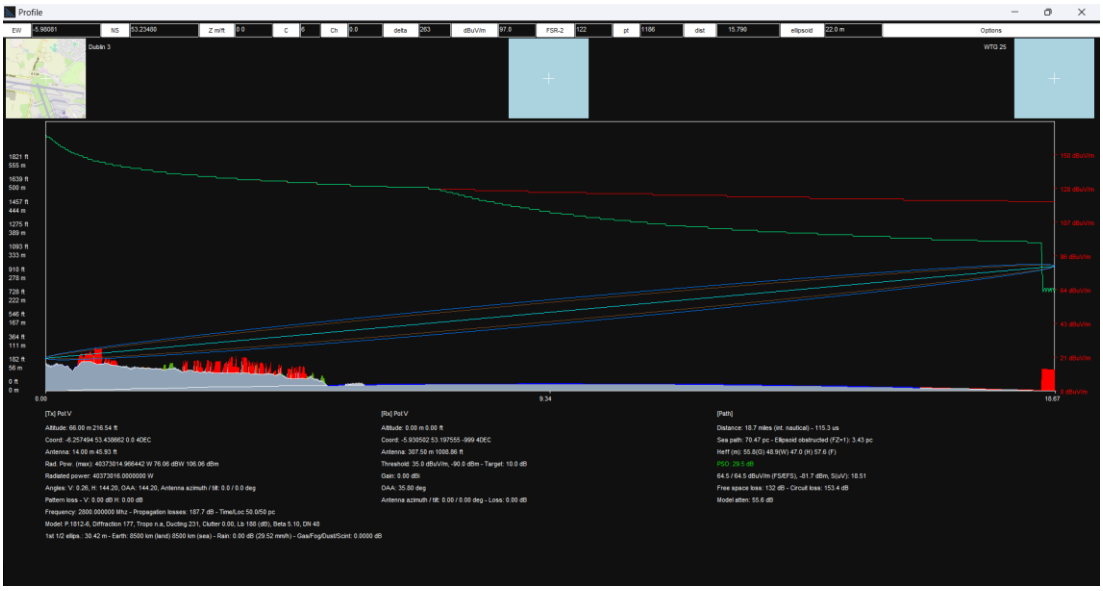


Figure 82 - Dublin Airport - Dublin Radar 3 WTG 25 LOS Profile

A1.4.26 WTG 26

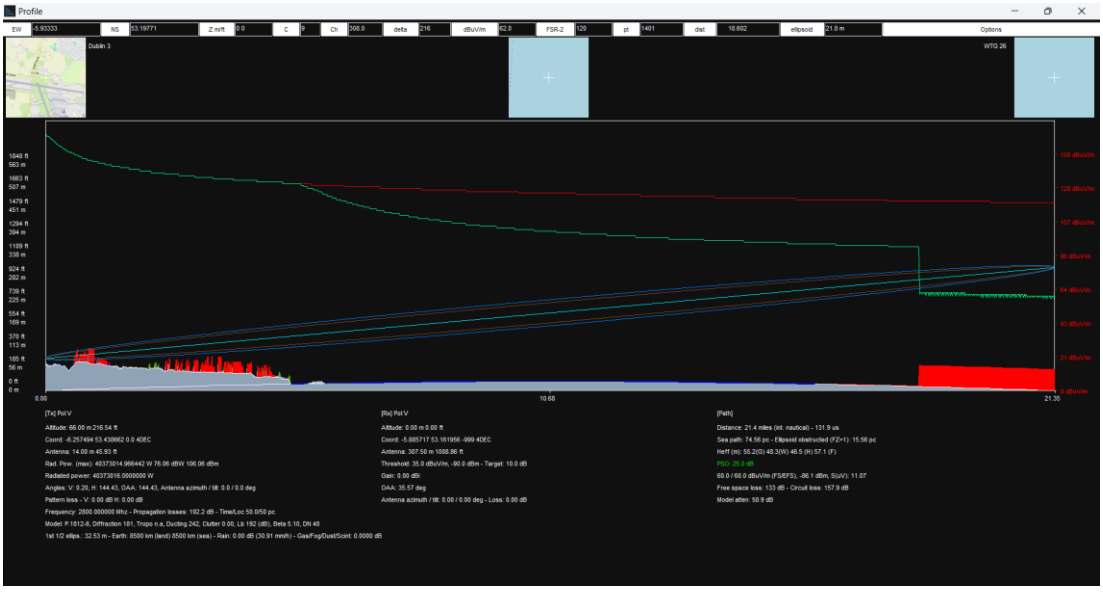


Figure 83 - Dublin Airport - Dublin Radar 3 WTG 26 LOS Profile

A1.4.27 WTG 27

Figure 84 - Dublin Airport - Dublin Radar 3 WTG 27 LOS Profile

A1.4.28 WTG 28

Figure 85 - Dublin Airport - Dublin Radar 3 WTG 28 LOS Profile

A1.4.29 WTG 29

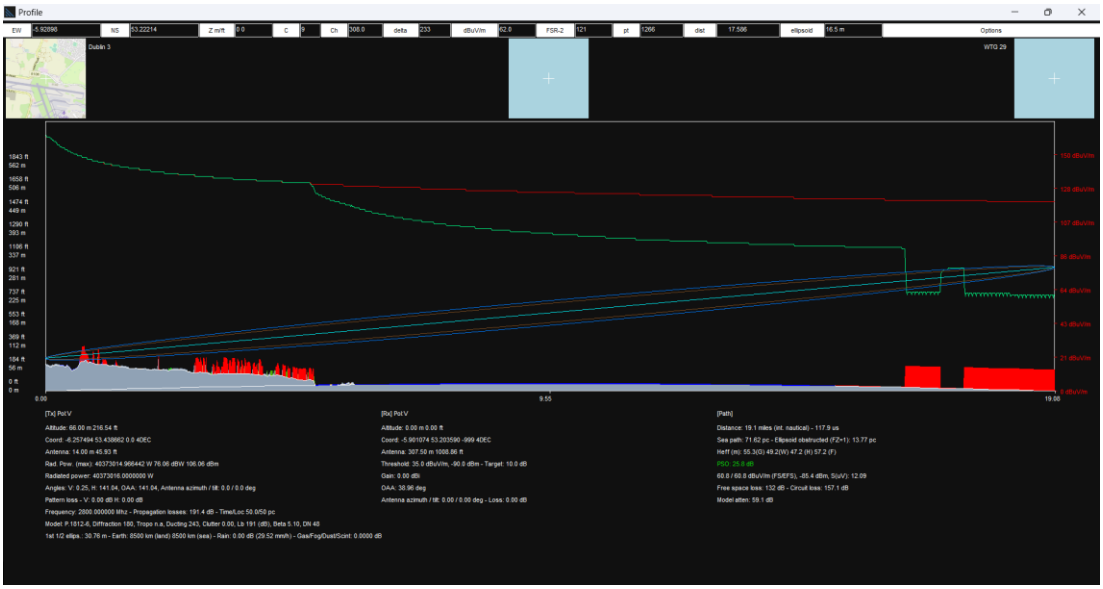


Figure 86 - Dublin Airport - Dublin Radar 3 WTG 29 LOS Profile

A1.4.30 WTG 30

Figure 87 - Dublin Airport - Dublin Radar 3 WTG 30 LOS Profile

A1.4.31 WTG 31

Figure 88 - Dublin Airport - Dublin Radar 3 WTG 31 LOS Profile

A1.4.32 WTG 32

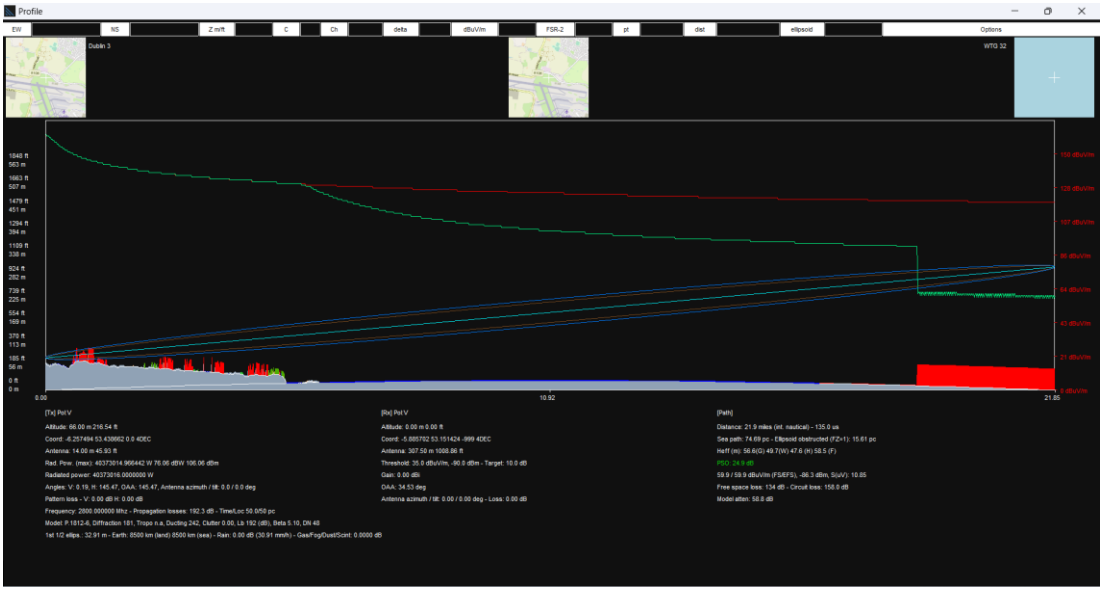


Figure 89 - Dublin Airport - Dublin Radar 3 WTG 32 LOS Profile

A1.4.33 WTG 33

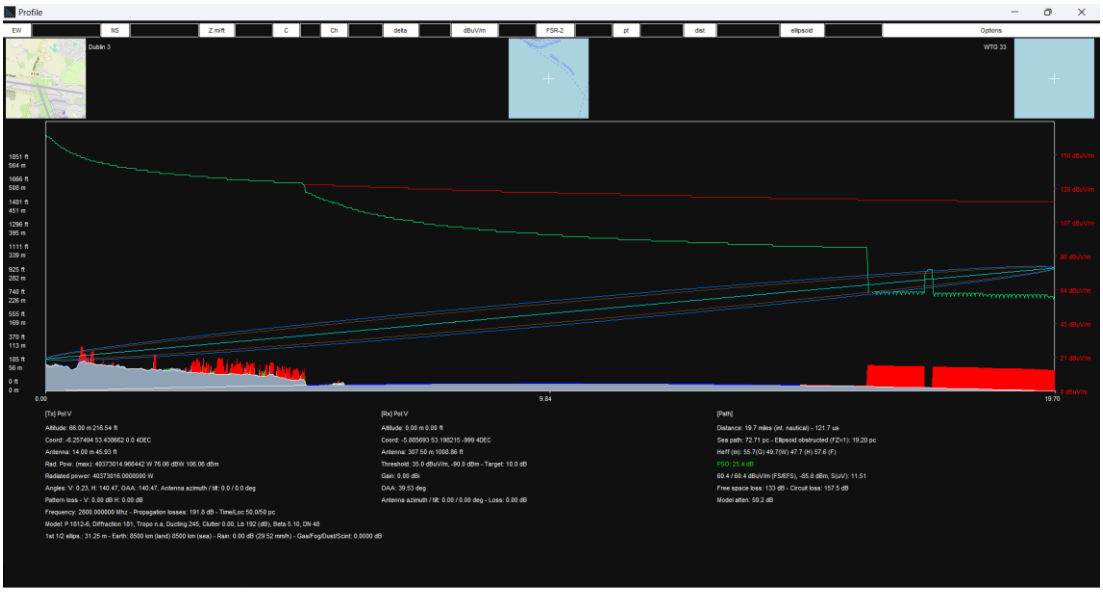


Figure 90 - Dublin Airport - Dublin Radar 3 WTG 33 LOS Profile

A1.4.34 WTG 34

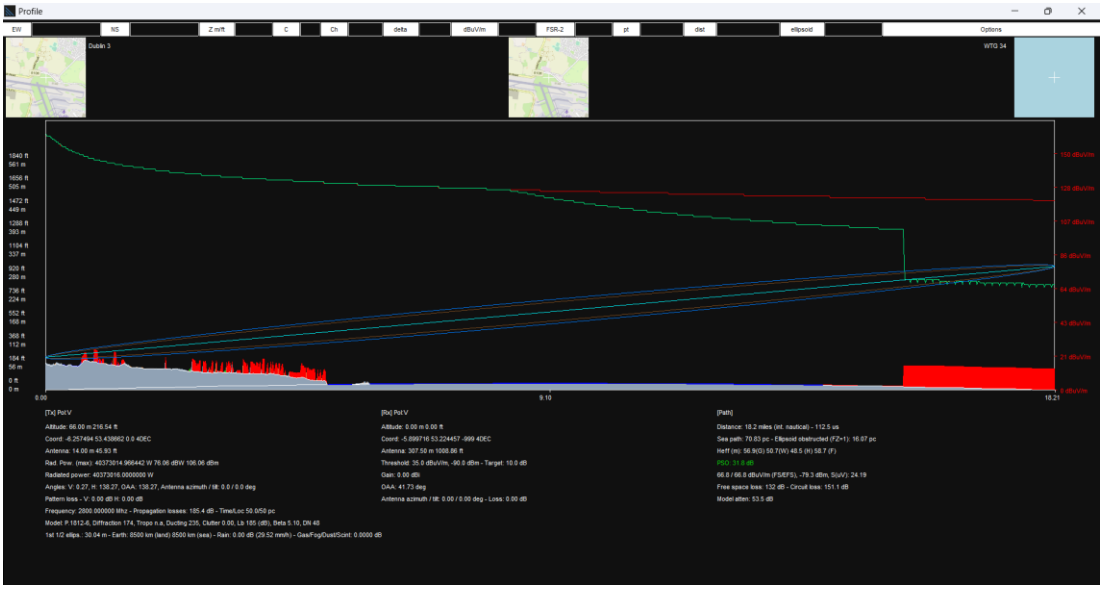


Figure 91 - Dublin Airport - Dublin Radar 3 WTG 34 LOS Profile

A1.4.35 WTG 35

Figure 92 - Dublin Airport - Dublin Radar 3 WTG 35 LOS Profile

A1.4.36 WTG 36

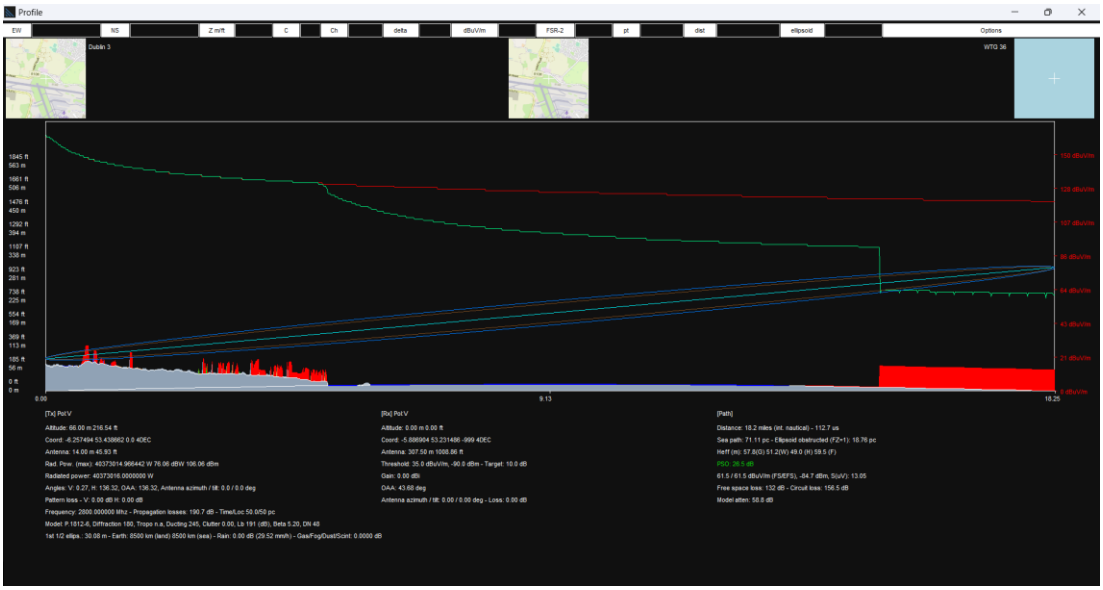


Figure 93 - Dublin Airport - Dublin Radar 3 WTG 36 LOS Profile

A1.4.37 WTG 37

Figure 94 - Dublin Airport - Dublin Radar 3 WTG 37 LOS Profile

A1.4.38 WTG 38

Figure 95 - Dublin Airport - Dublin Radar 3 WTG 38 LOS Profile

A1.4.39 WTG 39

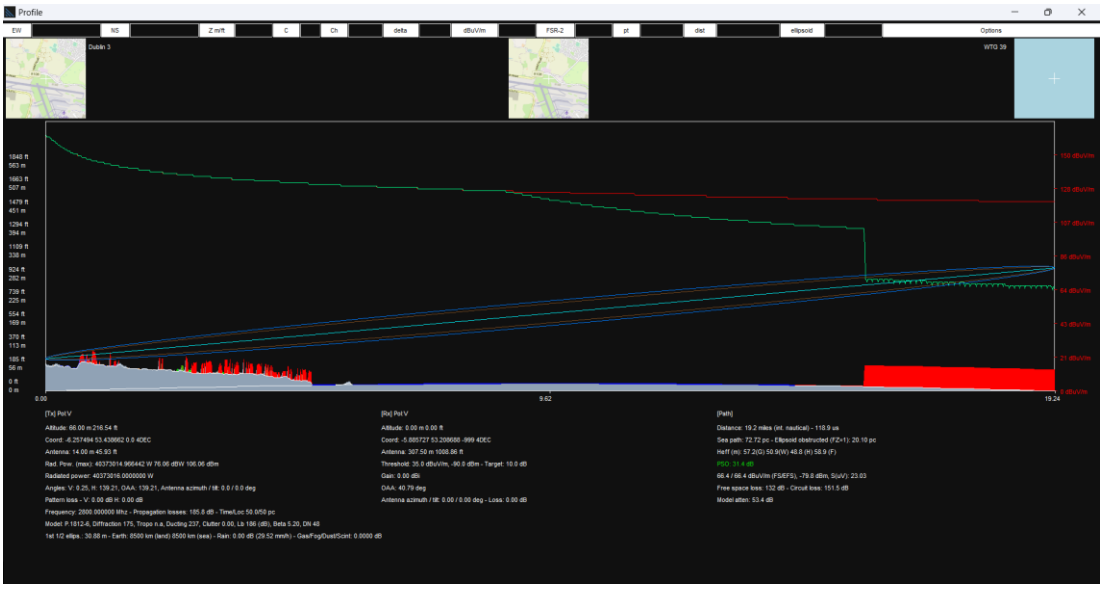


Figure 96 - Dublin Airport - Dublin Radar 3 WTG 39 LOS Profile

Appendix 2 Composite Intervisibility Maps

A2.1 Introduction

In conducting the Intervisibility Assessment, Map images are produced for three different use cases, at the altitude being assessed for each CNS being considered.

To improve readability of this document, only the key Composite Intervisibility Maps have been included for reference in this Appendix.

The Baseline Invisibility Coverage Maps and Development Invisibility Coverage Maps are available for audit/ inspection by the client.

A2.2 Contents

The contents of this Appendix are as follows:

Note: [Images are displayed from the next page onwards]

A2.3 NATS St Annes Radar

A2.3.1 307.5M AMSL

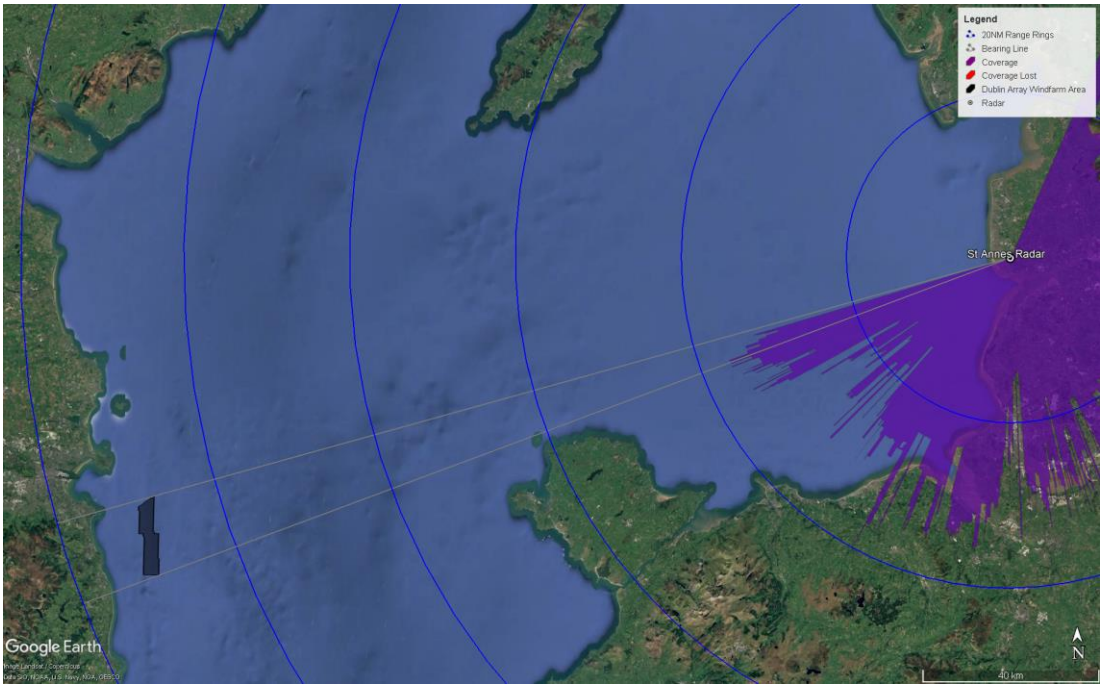


Figure 97 - NATS St Annes Radar 307.5M AMSL Composite Intervisibility Map

A2.4 Isle of Man Airport PSR

A2.4.1 307.5M AMSL

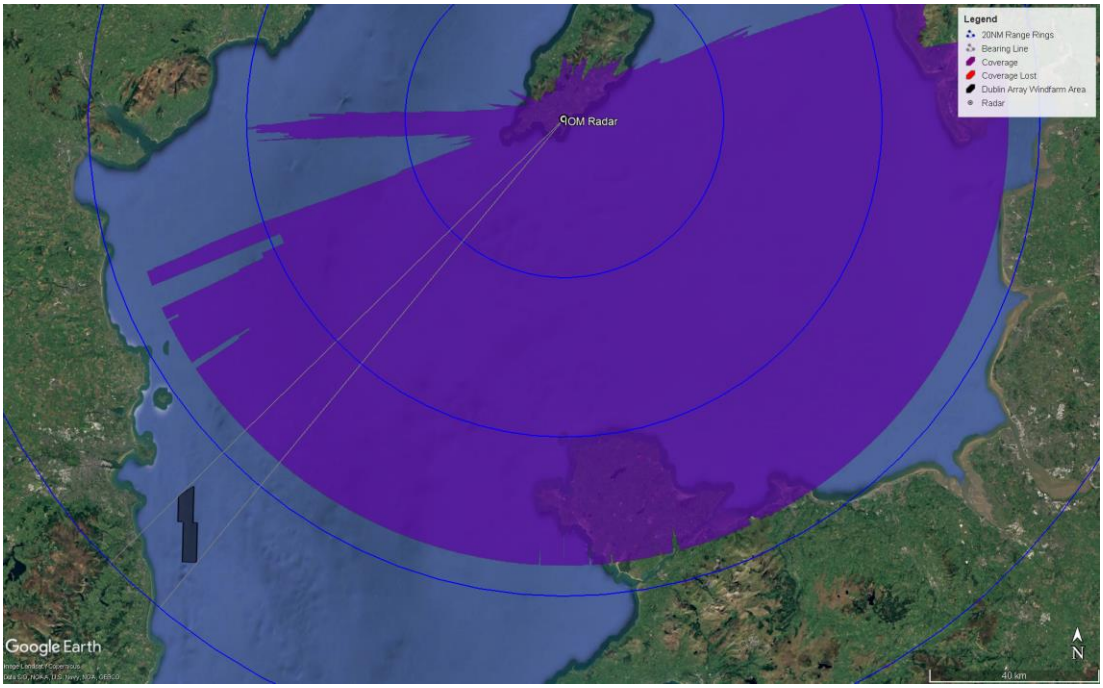


Figure 98 - Isle of Man Airport PSR 307.5M AMSL Composite Intervisibility Map

A2.5 MOD RAF Valley PSR

A2.5.1 307.5M AMSL

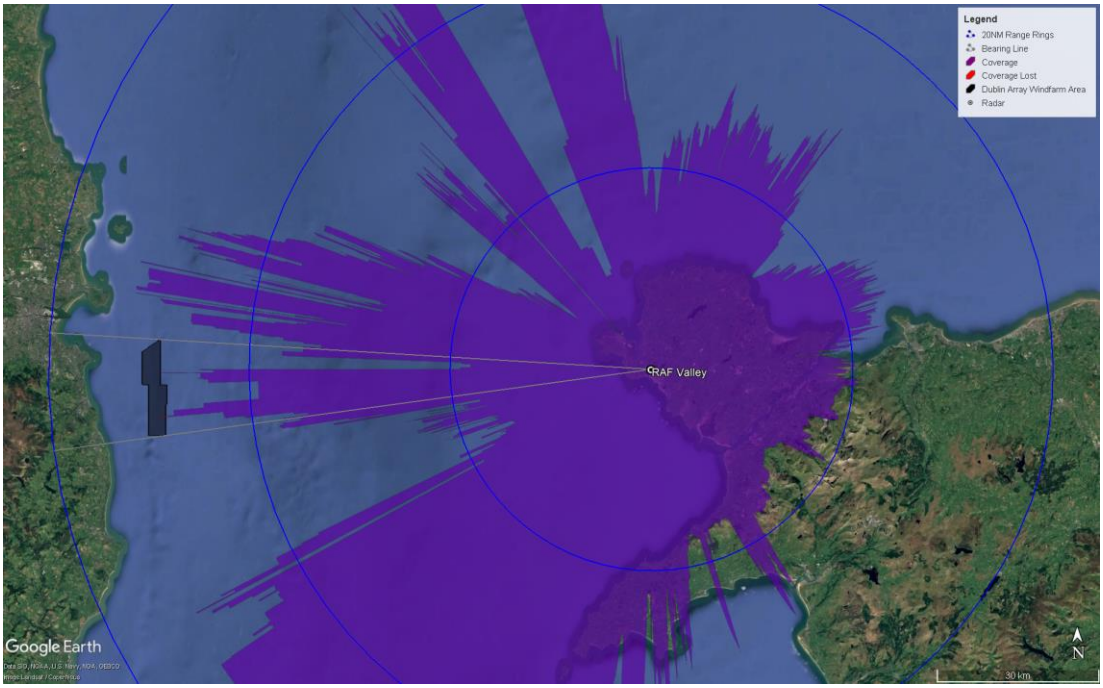


Figure 99 - MOD RAF Valley PSR 307.5M AMSL Composite Intervisibility Map

A2.6 BAE Warton Aerodrome PSR

A2.6.1 307.5M AMSL

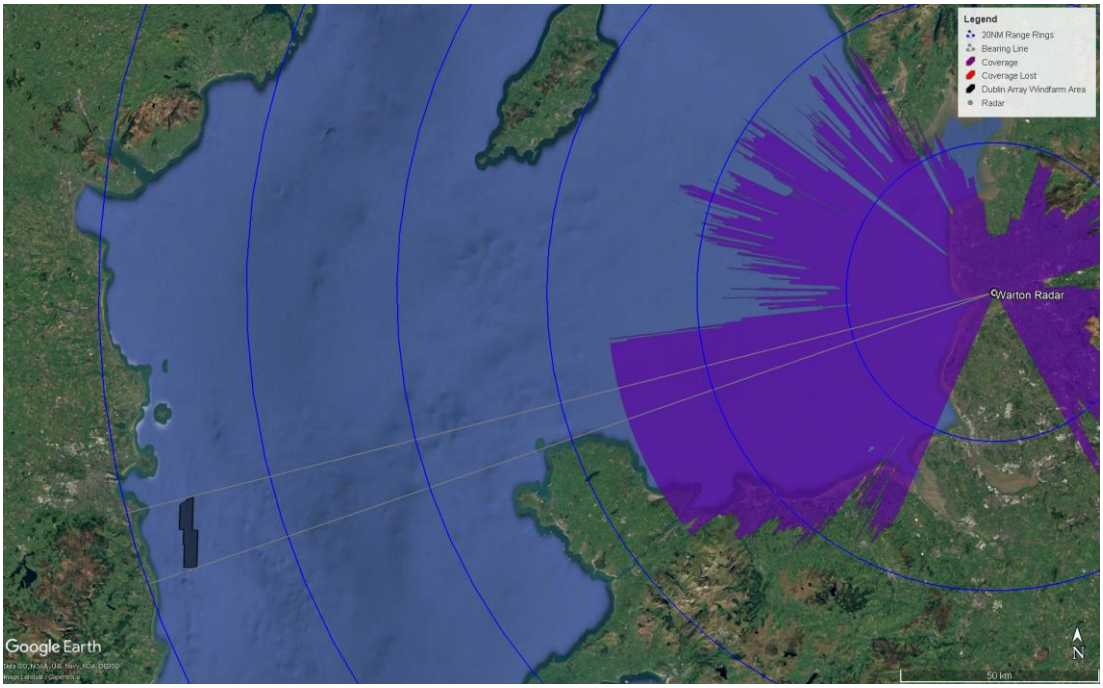


Figure 100 - BAE Warton Aerodrome PSR 307.5M AMSL Composite Intervisibility Map

Appendix 3 Optical Path Profiles

A3.1 Introduction

In conducting the Optical Path Assessments, technical artifacts are generated. Profile Path images are produced for the point-to-point visibility between the In-Scope CNS and the individual WTGs of the Developments being considered.

For ease of readability of the main report, these images are contained within this Appendix.

A3.2 Contents

The contents of this Appendix are as follows:

Note: [Images are displayed from the next page onwards]

A3.3 NATS Great Dun Fell Radar

Three WTG's (WTG 1, 32 and 36) that represented the closest boundary of the Development to the NATS Great Dun Fell Radar were selected for an optical assessment. Figure 101 depicts these paths.

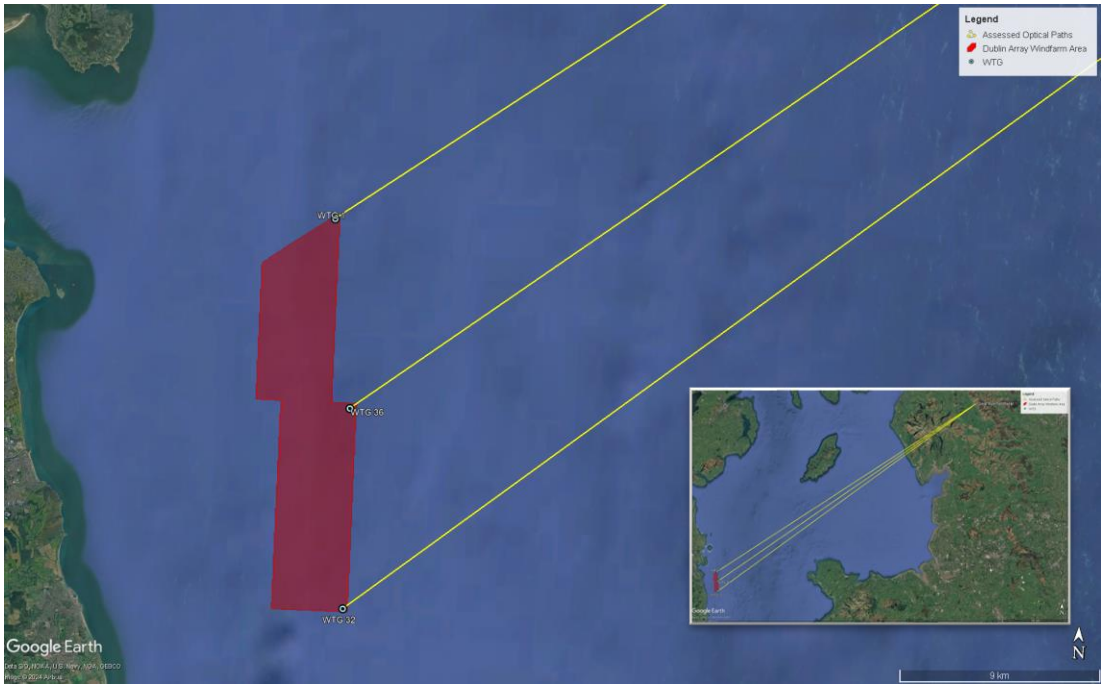


Figure 101 - NATS Great Dun Fell Radar Optical Paths Assessed

The Optical Path profiles for each WTG is presented in the following paragraphs.

A3.3.1 WTG 1

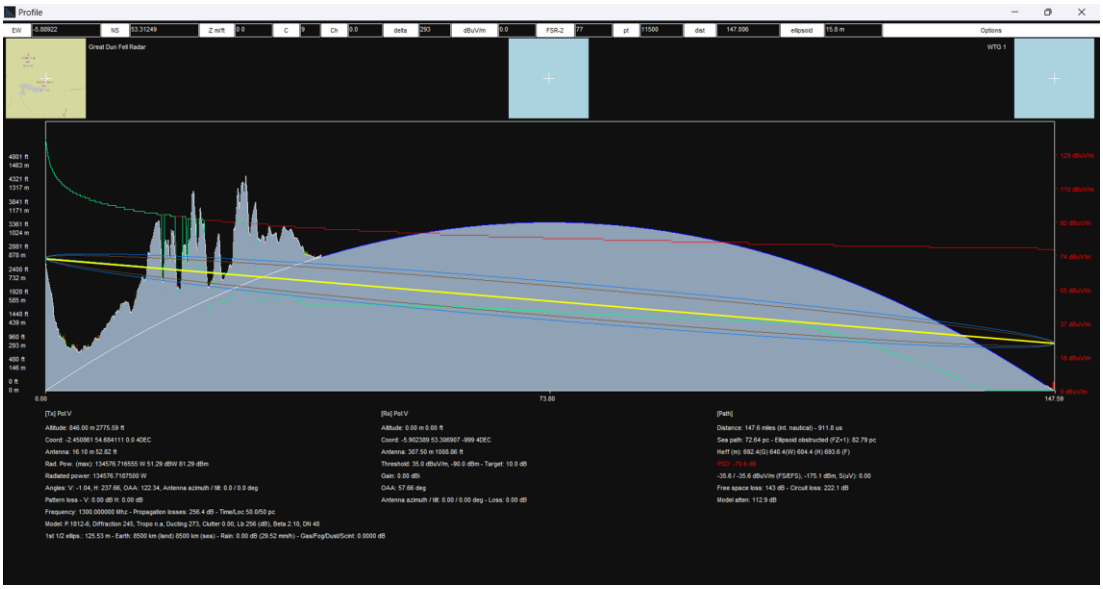


Figure 102 - NATS Great Dun Fell Radar 307.5M AMSL WTG 1 Optical Path Profile

A3.3.2 WTG 32

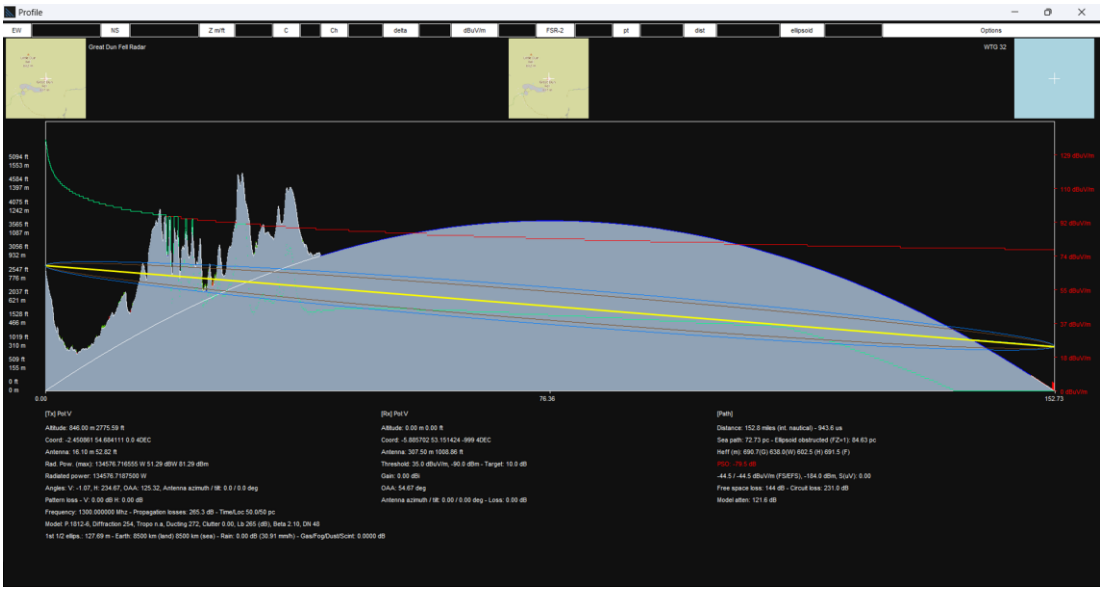


Figure 103 - NATS Great Dun Fell Radar 307.5M AMSL WTG 32 Optical Path Profile

A3.3.3 WTG 36

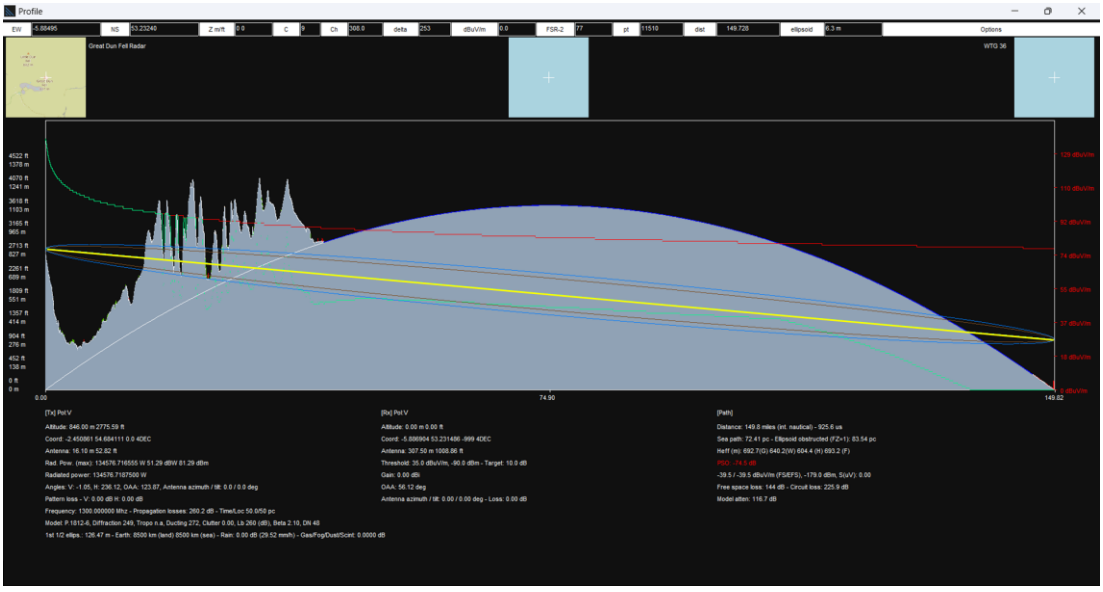


Figure 104 - NATS Great Dun Fell Radar 307.5M AMSL WTG 36 Optical Path Profile

A3.4 NATS Lowther Hill Radar

Three WTG's (WTG 1, 21 and 32) that represented the closest boundary of the Development to the NATS Lowther Hill Radar were selected for an optical assessment. Figure 105 depicts these paths.

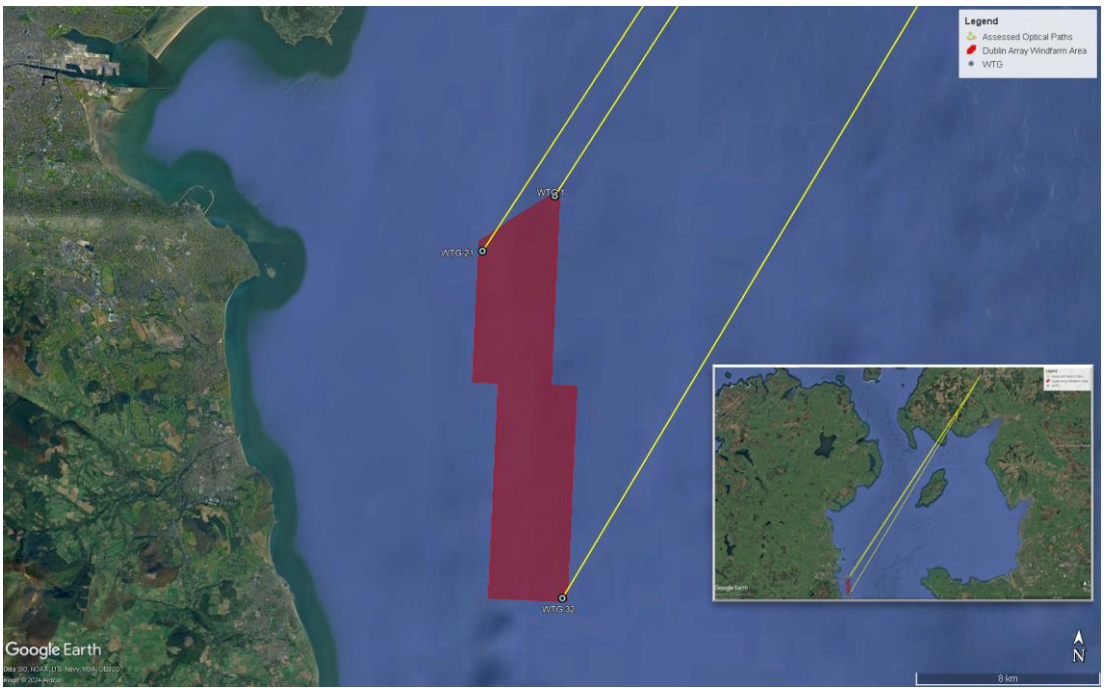


Figure 105 - NATS Lowther Hill Radar Optical Paths Assessed

The Optical Path profiles for each WTG is presented in the following paragraphs.

A3.4.1 WTG 1

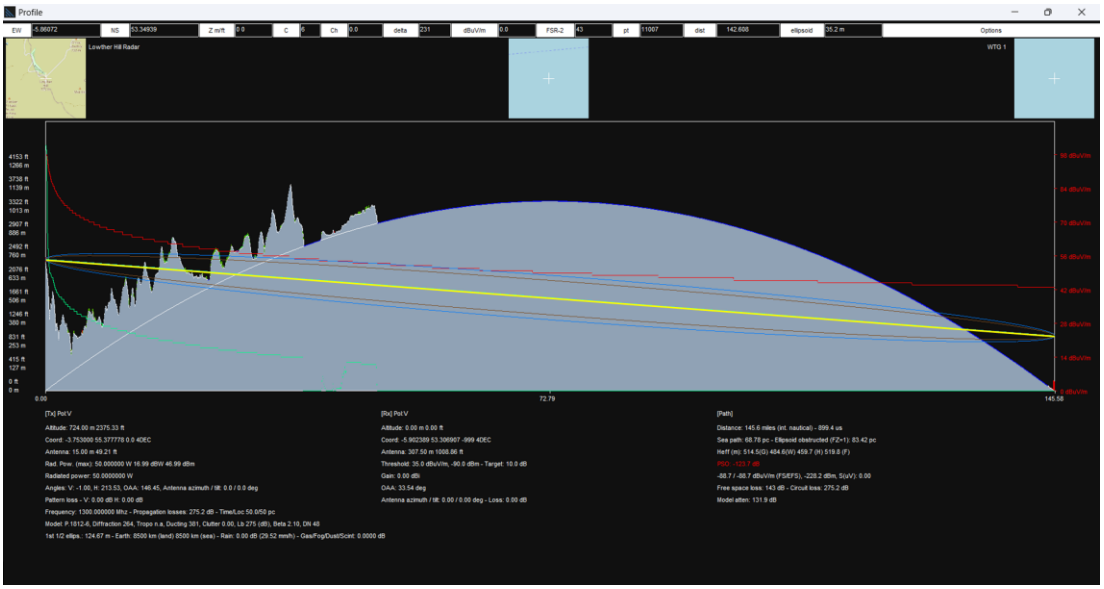


Figure 106 - NATS Lowther Hill Radar 307.5M AMSL WTG 1 Optical Path Profile

A3.4.2 WTG 21

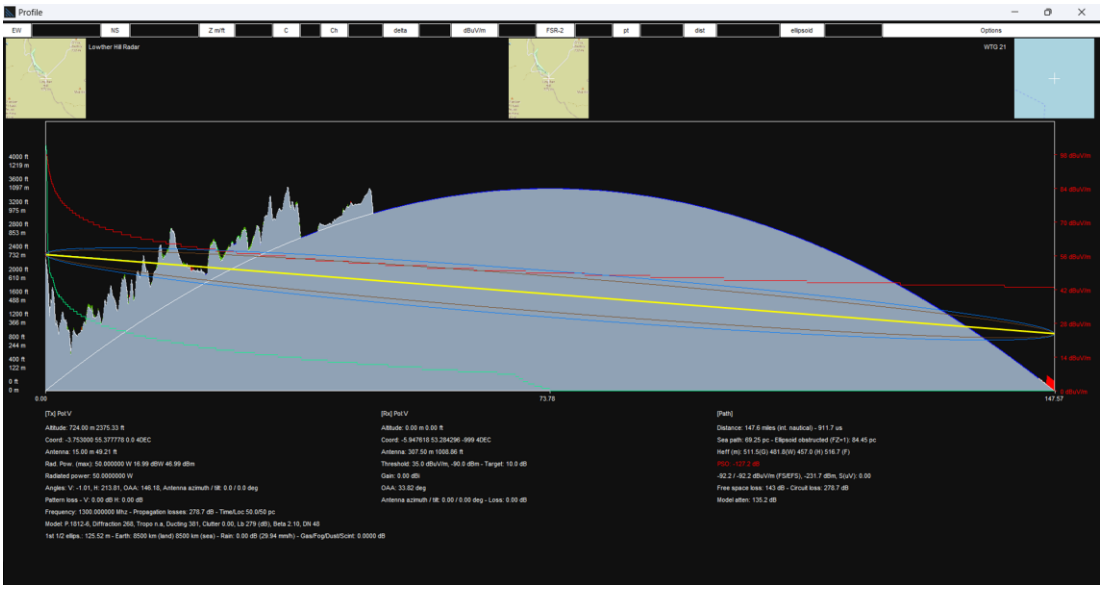


Figure 107 - NATS Lowther Hill Radar 307.5M AMSL WTG 21 Optical Path Profile

A3.4.3 WTG 32

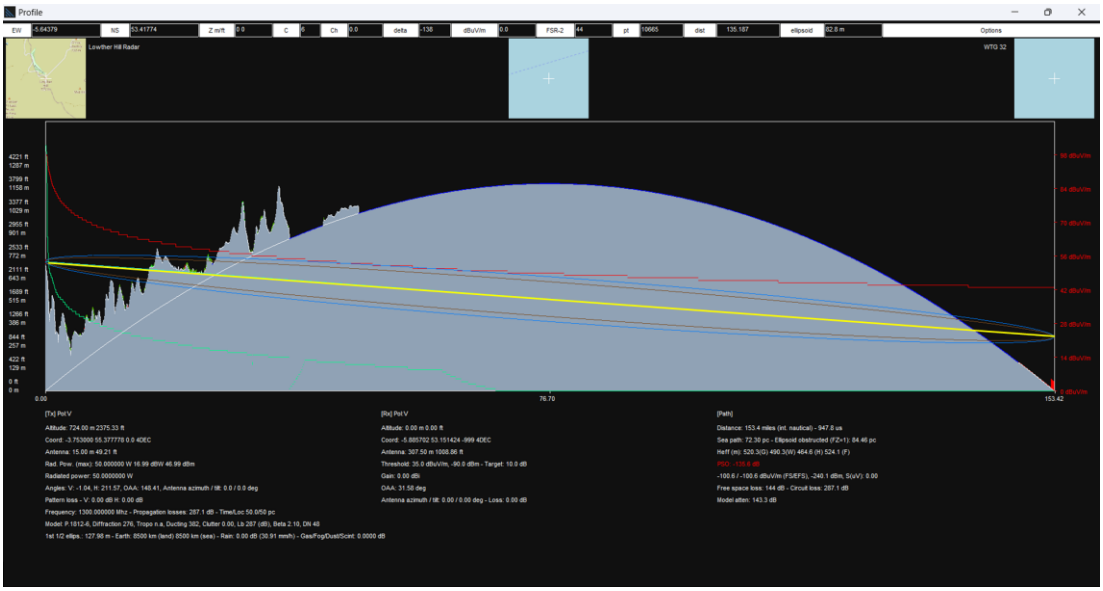


Figure 108 - NATS Lowther Hill Radar 307.5M AMSL WTG 32 Optical Path Profile

A3.5 NATS Clee Hill Radar

Three WTGs (WTG 1, 14 and 32) that represented the closest boundary of the Development to the NATS Clee Hill Radar were selected for an optical assessment. Figure 109 depicts these paths.

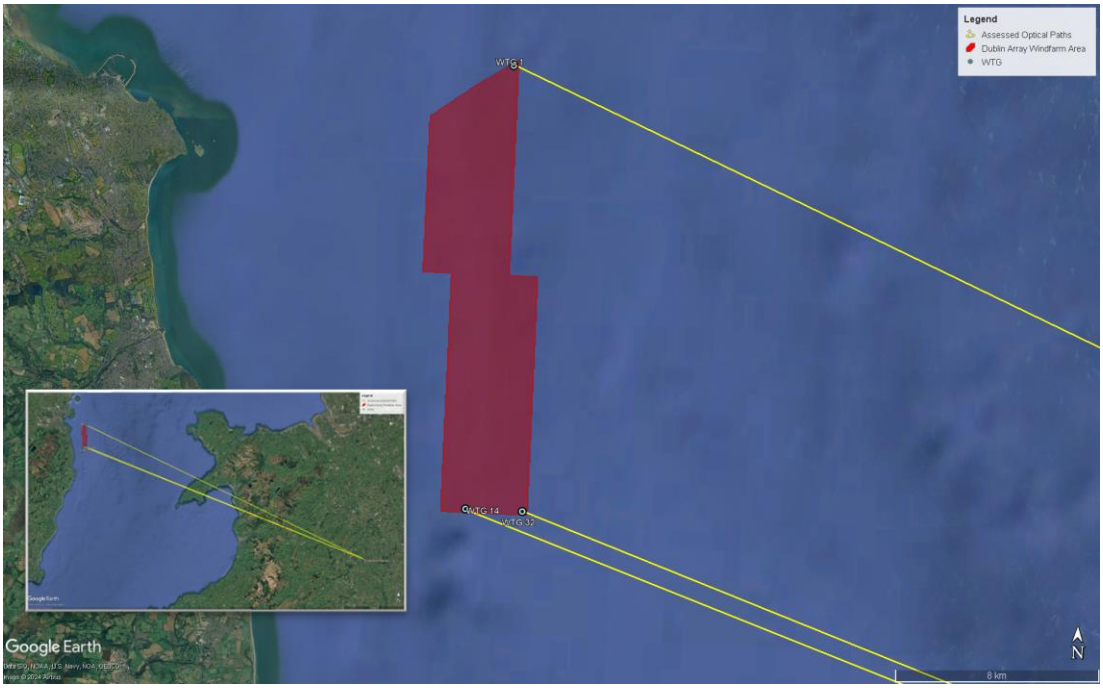


Figure 109 - NATS Clee Hill Radar Optical Paths Assessed

The Optical Path profiles for each WTG is presented in the following paragraphs.

A3.5.1 WTG 1

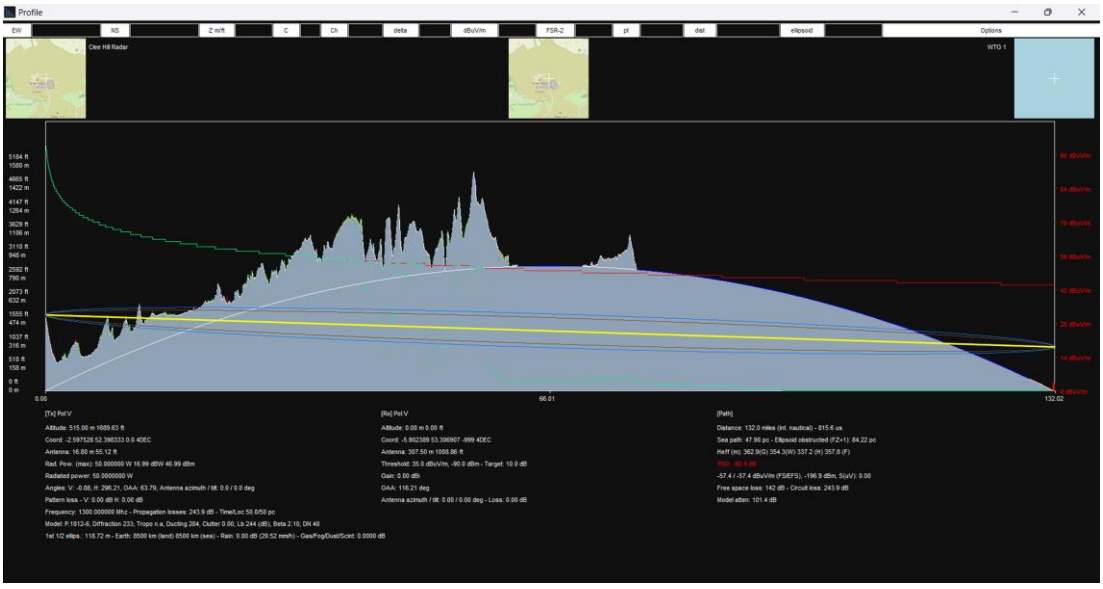


Figure 110 - NATS Clee Hill Radar 307.5M AMSL WTG 1 Optical Path Profile

A3.5.2 WTG 14

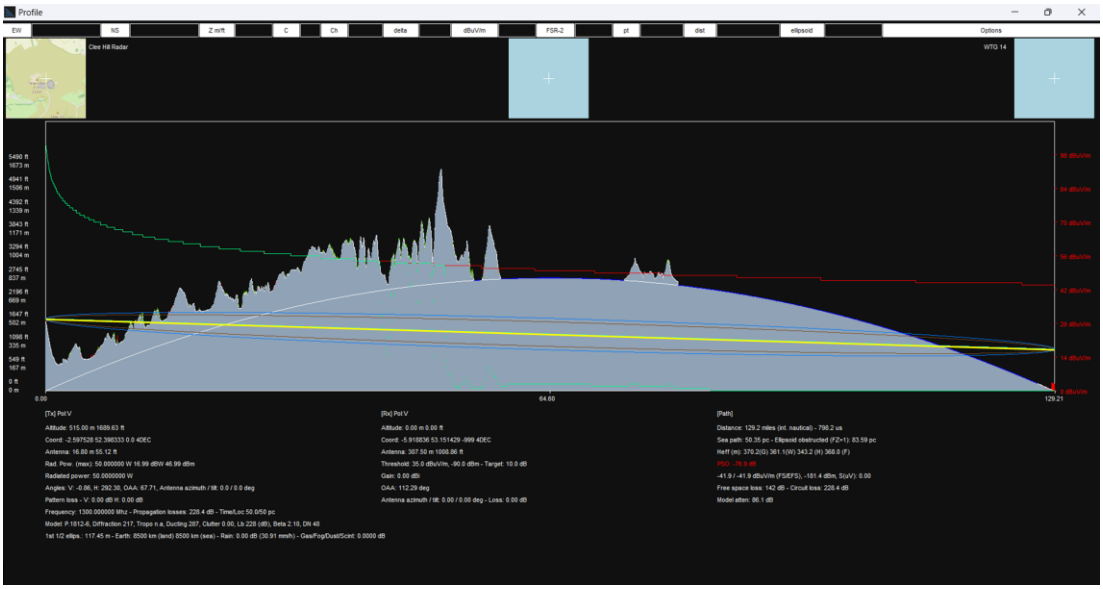


Figure 111 - NATS Clee Hill Radar 307.5M AMSL WTG 14 Optical Path Profile

A3.5.3 WTG 32

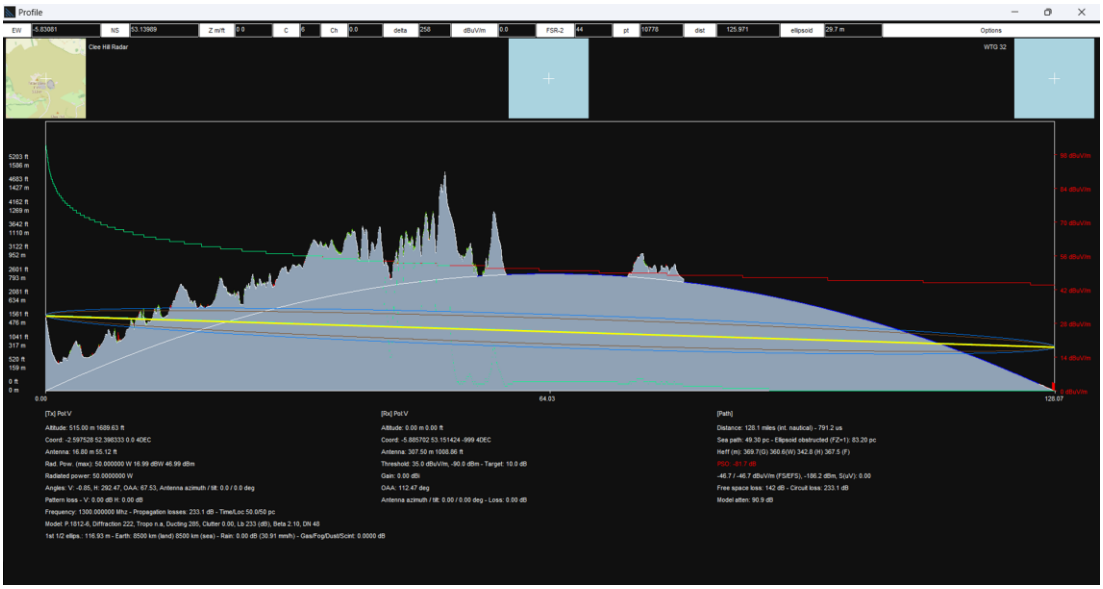


Figure 112 - NATS Clee Hill Radar 307.5M AMSL WTG 32 Optical Path Profile