Salamander Offshore Wind Farm Offshore EIA Report

Volume ER.A.4, Annex 15.1: Radar Line of Sight Assessment

SALAMANDER

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Salamander Offshore Wind Farm ("Salamander Project")

Radar Line of Sight Assessment

Date: 15th February 2024
Author: Linda-Jean Worley
Revision: Issue 1.3
Osprey Ref: 71800 001

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Approval Level	Authority	Name
Author	Osprey CSL	Linda-Jean Worley
Reviewer	Osprey CSL	Bob Burke Richie Hinchcliffe

Executive Summary

Project Requirement

Osprey Consulting Services Limited (Osprey) was commissioned by ERM on behalf of Salamander Wind Project Company Ltd (SWPC) to undertake a Line of Sight (LoS) assessment to understand the potential impact of a proposed Salamander Offshore Wind Farm ("Salamander Project") consisting of seven Wind Turbine Generators (WTG) located in the North Sea off the coast of Scotland, approximately 35 kilometres (km) east of Peterhead. This report presents the results of the assessment of eleven representative WTG positions within the Salamander Project Offshore Array Area.

This is a limited and theoretical desk-based study; in reality there are unpredictable levels of signal diffraction and attenuation within a given radar environment that can influence the probability of a wind turbine being detected. The analysis is designed to give a conservative indication of the likelihood of the wind turbine being detected such that the operational significance of the Salamander Project relative to the radar systems can be assessed.

The seven WTG positions for Salamander Project have not been confirmed at this stage. Osprey have therefore used a representative array consisting in eleven WTGs to take into account radar coverage of the Salamander Project Offshore Array Area rather than unique, as yet undefined positions.

This report presents the results of the radar LoS assessment undertaken by Osprey, together with conclusions and recommendations.

Safeguarding Assessment Undertaken

Osprey carried out the following Safeguarding Assessment on positionally representative WTGs within the Salamander Project Offshore Array Area:

LoS Assessment on the following eleven representative WTG positions within the Offshore Array Area:

- Eleven (11) WTGs T1 to T11 at a blade tip height of 300 metres (m) Above Mean Sea Level (AMSL) and 325m AMSL.

Conclusions and Recommendations

Osprey concluded that the eleven WTG locations within the Salamander Project Offshore Array Area, at a blade tip height of 300m AMSL and 325m AMSL, will be detected by the following radar systems due to no intervening terrain on the visual LoS:

- NATS Allanshill
- NATS Perwinnes
- MOD Buchan
- Met Office Hill of Dudwick

The Met office state that the base of the Hill of Dudwick radar beam will be 310 m (at its lowest elevation) in the vicinity of the Salamander Project.

During project development, and with a view to addressing Met Office responses regarding turbine heights in excess of 310 m AMSL, the maximum tip height proposed for the Salamander Project has been reduced to 310 m AMSL.

The WTGs will not be detected by the following radar systems as there is no direct LoS:

- MOD Brizlee Wood

As seen above, the results of the assessment show that there is direct LoS between all projected WTGs within the Salamander Project Offshore Array Area and the NATS Allanshill, Perwinnes, MOD Buchan and Met Office Hill of Dudwick radars.

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Acronyms

Term	Definition
AMSL	Above Mean Sea Level **Note 1**
km	Kilometre
LoS	Line of Sight
m	Metre
NM	Nautical Mile
ODN	Ordnance Datum Newlyn
PSR	Primary Surveillance Radar
RF	Radio Frequency
WGS84	The World Geodetic System 1984 **Note 2**
WTG	Wind Turbine Generator

Note 1: In this report Mean Sea Level based on the Newlyn Ordnance Datum (ODN)
Note 2: WGS84 is a datum featuring coordinates that change with time. WGS84 is defined and maintained by the United States National Geospatial-Intelligence Agency (NGA). It is consistent, to about 1 centimetre (cm), with the International Terrestrial Reference Frame (ITRF).

1 Introduction

1.1 Overview

Osprey Consulting Services Limited (Osprey) was commissioned by ERM on behalf of Salamander Wind Project Company Ltd (SWPC) to undertake a Line of Sight (LoS) assessment to understand the potential impact of the Salamander Offshore Wind Farm Project (Salamander Project) consisting of seven (7) Wind Turbine Generators (WTG) located in the North Sea off the coast of Scotland, approximately 35 kilometres (km) east of Peterhead. This report presents the results of the assessment completed of eleven (11) representative WTG positions within the Salamander Project Offshore Array Area.

1.2 Purpose and Requirement

The aim of this study was to determine the potential impact of Salamander Project Offshore Array Area on the performance of the following Primary Surveillance Radars (PSR):

- NATS Allanshill (ASR10 PSR)
- NATS Perwinnes (ASR23 PSR)
- Ministry of Defence (MOD) Buchan (TPS 77)
- MOD Brizlee Wood (TPS77 ADR)
- Met Office Hill of Dudwick

The proposed WF lies approximately 22 Nautical Miles (NM) from the closest Primary Surveillance Radar (PSR), Buchan.

The seven WTG positions for Salamander Project have not been confirmed at this stage. Osprey have therefore used a representative array consisting in eleven WTGs to take into account radar coverage of the Salamander Project Offshore Array Area rather than unique, as yet undefined positions.

Osprey conducted a Line of Sight (LoS) assessment to identify whether the WTGs in the Salamander Project Offshore Array Area will be seen by the above radar systems.

1.3 Scope

This report provides:

- A list of assumptions used as the plausible criteria by which to perform the LoS assessment in the Advanced Topographic Development, and Imaging (ATDI) HTZ Communications[1] software tool.
- LoS results for the Salamander Project in relation to the PSRs in question.
- Assessment conclusions and recommendations.

[1] ATDI HTZ Communications Version 2023.1 dated 25th Jan 2023 release 1487.

1.4 Assumptions

Osprey has made the following assumptions in the conduct of this assessment:

- The Salamander Project is situated approximately 22 NM from the closest PSR (Buchan).

Figure 1 below shows representative WTGs within the Salamander Project Offshore Array Area as the seven WTG positions for Salamander Project have not been confirmed at this stage. Specifically:

  - One on each corner of the Offshore Array Area boundary (four WTGs) of the .kml.
  - Seven other WTGs in random positions within the Offshore Array Area boundary (greater than 2 km from the edge).

Figure 1 - Salamander Project Offshore Array Area (representative WTG positioning)

- Based on the parameters provided by the Client, WTG tip heights of 325 metres (m) Above Mean Sea Level (AMSL)[2] and 300m AMSL have been used in the assessment, with the coordinates shown in Table 1.

WTG Reference	Representative Coordinates World Geodetic System 1984 (WGS84)[3]	
T1	57°38'47.76"N	1°11'46.45"W

[2] Newlyn Ordnance Datum (OD)
[3] WGS84 is a datum featuring coordinates that change with time. WGS84 is defined and maintained by the United States National Geospatial-Intelligence Agency (NGA). It is consistent, to about 1 cm, with the International Terrestrial Reference Frame (ITRF).

WTG Reference	Representative Coordinates World Geodetic System 1984 (WGS84)[3]	
T2	57°36'56.04"N	1° 07'29.72"W
T3	57°34'39.81"N	1°12'19.19"W
T4	57°37'54.65"N	1°16'04.17"W
T5	57°37'21.88"N	1°13'07.75"W
T6	57°37'33.17"N	1°12'08.32"W
T7	57°36'52.80"N	1°10'35.92"W
T8	57°36'16.01"N	1°11'51.47"W
T9	57°37'8.71"N	1°12'19.17"W
T10	57°37'6.80"N	1°11'29.73"W
T11	57°36'52.76"N	1°11'54.86"W

Table 1 – Representative WTG coordinates

- The coordinates of the PSRs and radar parameters considered for this assessment are given in Table 4 in Annex A3.

2 Methodology

2.1 Overview

Osprey used the following methodology to conduct this assessment:

- Google Earth Pro: Set up WTG array and PSR locations (WGS84) to be assessed.
- ATDI modelling tool: Undertook LoS using ATDI software, to determine if the proposed WTGs indicate Radio Frequency (RF) signal degradation that may affect the assessed PSR coverage.

2.2 Model

This is a limited and theoretical desk-based study; in reality there are unpredictable levels of signal diffraction and attenuation, due to atmospheric temperature, pressure, humidity and radar location topography, within a given radar environment that can influence the probability of a wind turbine being detected. The analysis is designed to give a conservative indication of the likelihood of the wind turbine being detected such that the operational significance of the Salamander Project relative to the radar systems can be assessed.

3 LoS Assessment Results

3.1 Introduction

This section presents the results of the LoS assessment for the proposed Salamander Project on the performance of the radar systems specified in Section 1.2 of this report. Osprey conducted a series of LoS assessments from each PSR location to each of the eleven WTG locations, at WTG tip heights of 300m AMSL and 325m AMSL.

3.2 LoS Result Definitions

The qualitative definitions utilised in the LoS assessment are defined in Table 2.

Result	Definition
Yes	The WTG is clearly detected by the radar; direct LoS exists between the radar and the WTG
Likely	The WTG is likely to be detected by the radar, at least intermittently
Unlikely	The WTG is unlikely to be detected by the radar, but cannot rule out occasional detection
No	The WTG will NOT be detected by the radar as significant intervening terrain or shielding exists

Table 2 – Qualitative definition of LoS results

3.3 LoS Assessment

3.3.1 Theoretical LoS

A graphical representation of theoretical radar detectability of the Salamander Project representative WTGs is shown in Figure 2 to Figure 11.

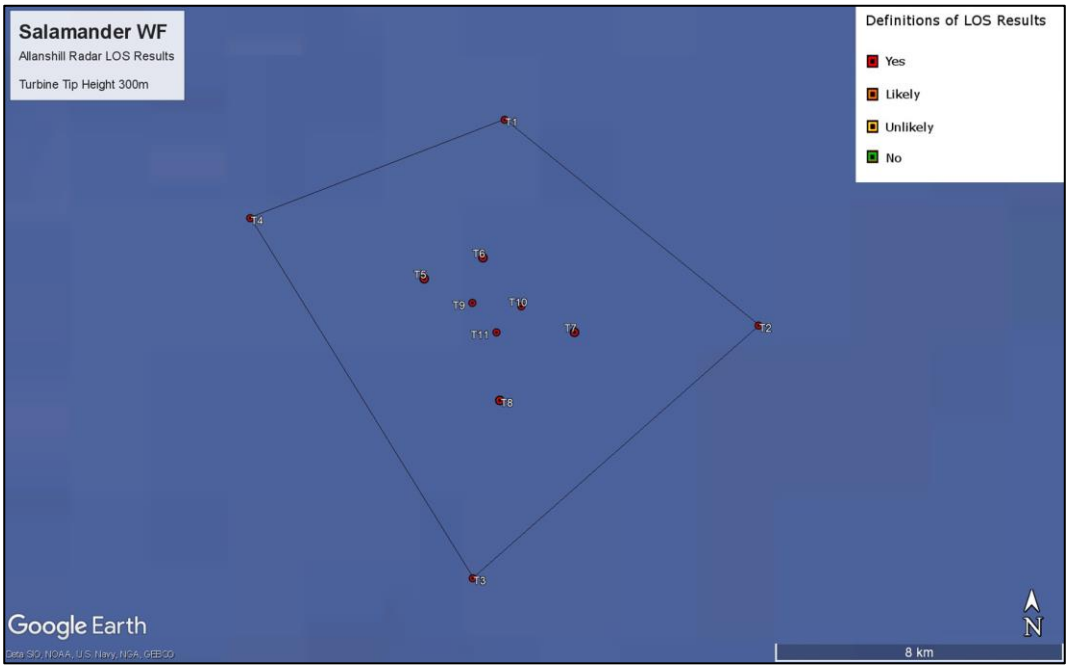


Figure 2 – Salamander Project Offshore Array Area (representative WTGs) – Allanshill Radar LoS results (tip height 300m)

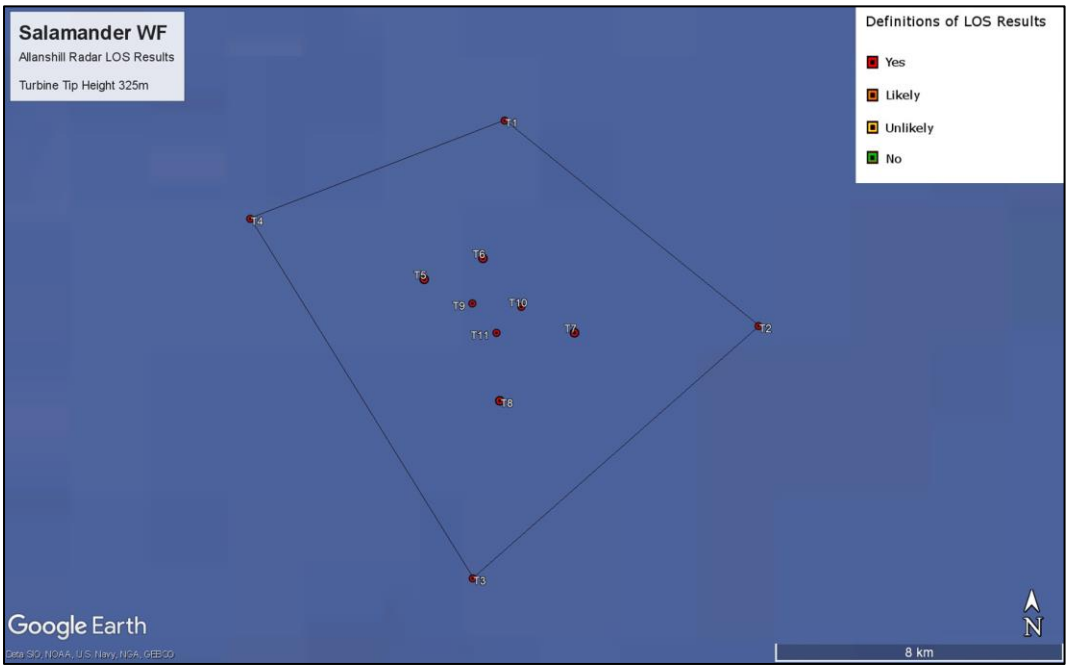


Figure 3 - Salamander Project Offshore Array Area (representative WTGs) – Allanshill Radar LoS results (tip height 325m)

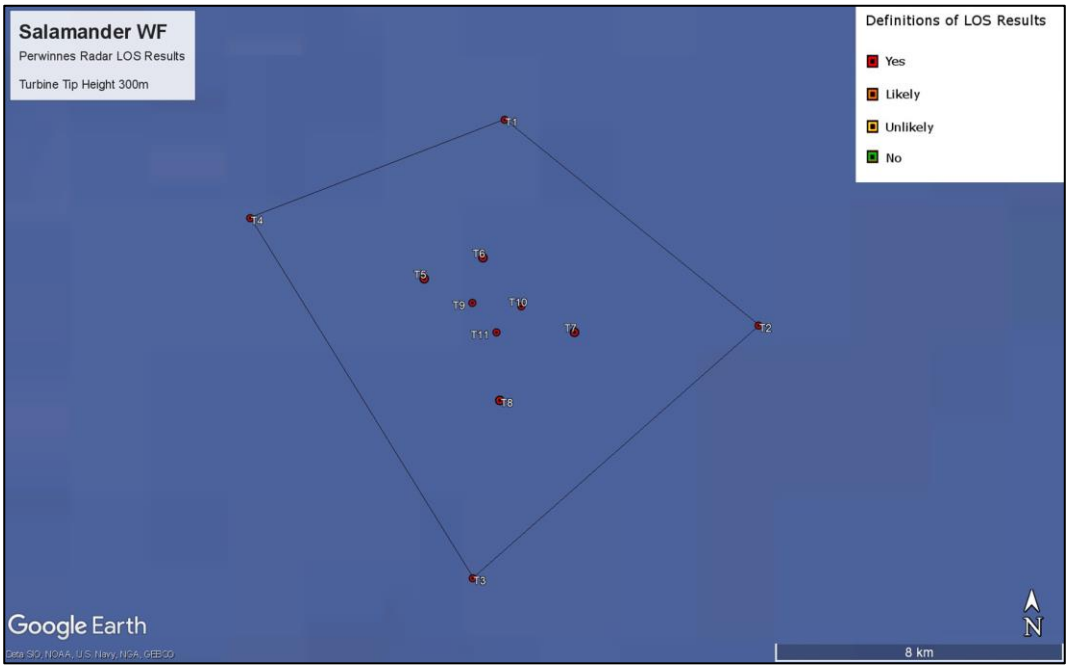


Figure 4 - Salamander Project Offshore Array Area (representative WTGs) – Perwinnes Radar LoS results (tip height 300m)

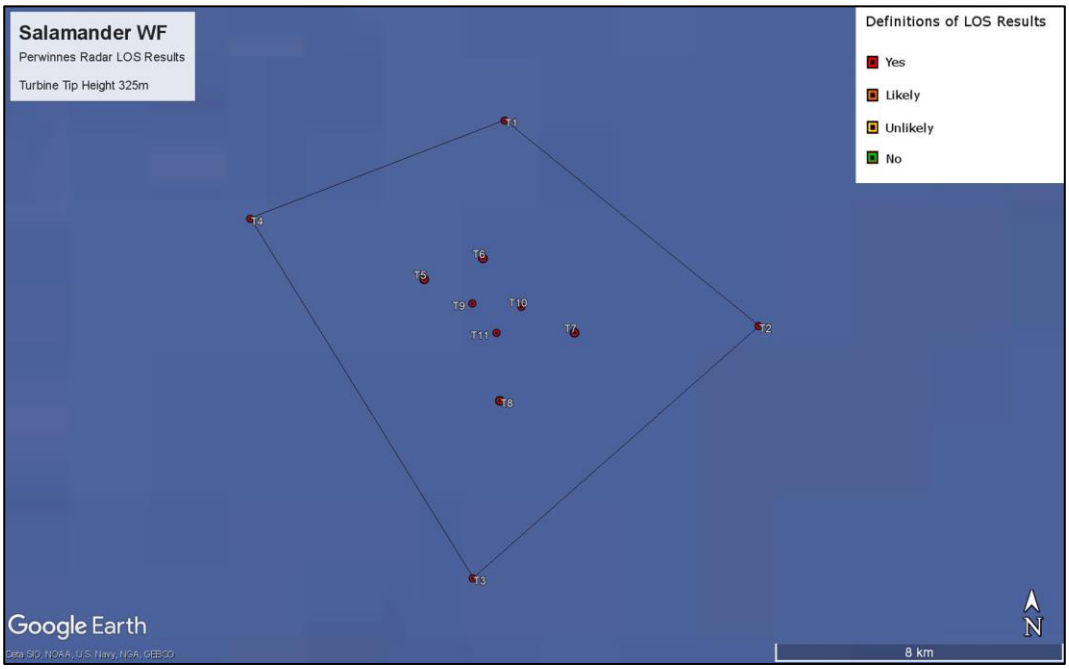


Figure 5 - Salamander Project Offshore Array Area (representative WTGs) – Perwinnes Radar LoS results (tip height 325m)

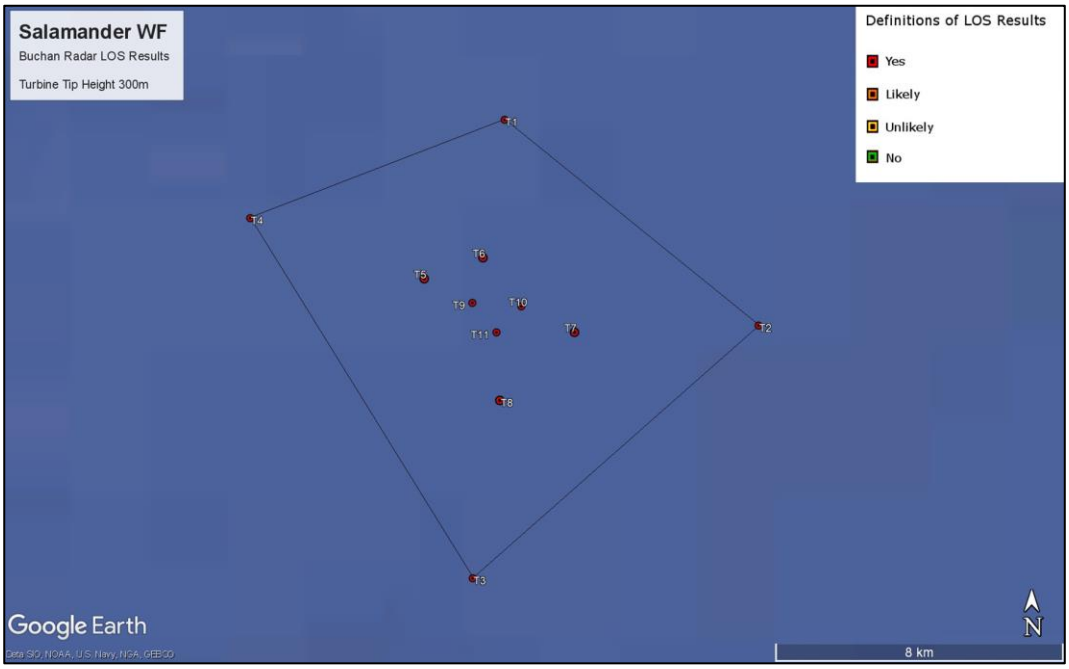


Figure 6 - Salamander Project Offshore Array Area (representative WTGs) – Buchan Radar LoS results (tip height 300m)

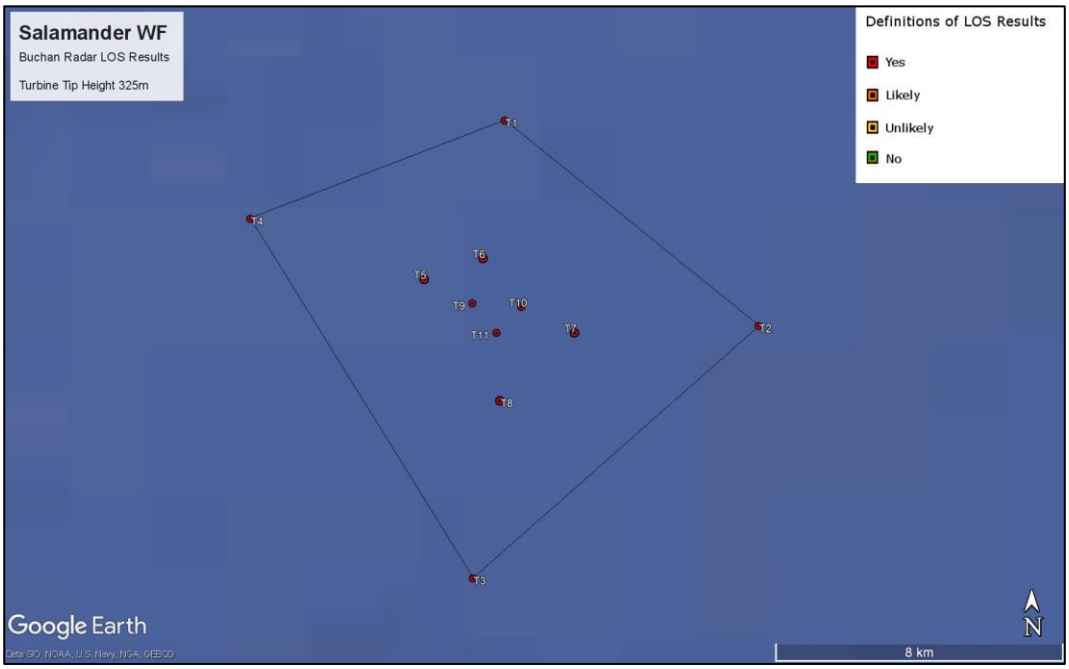


Figure 7 - Salamander Project Offshore Array Area (representative WTGs) – Buchan Radar LoS results (tip height 325m)

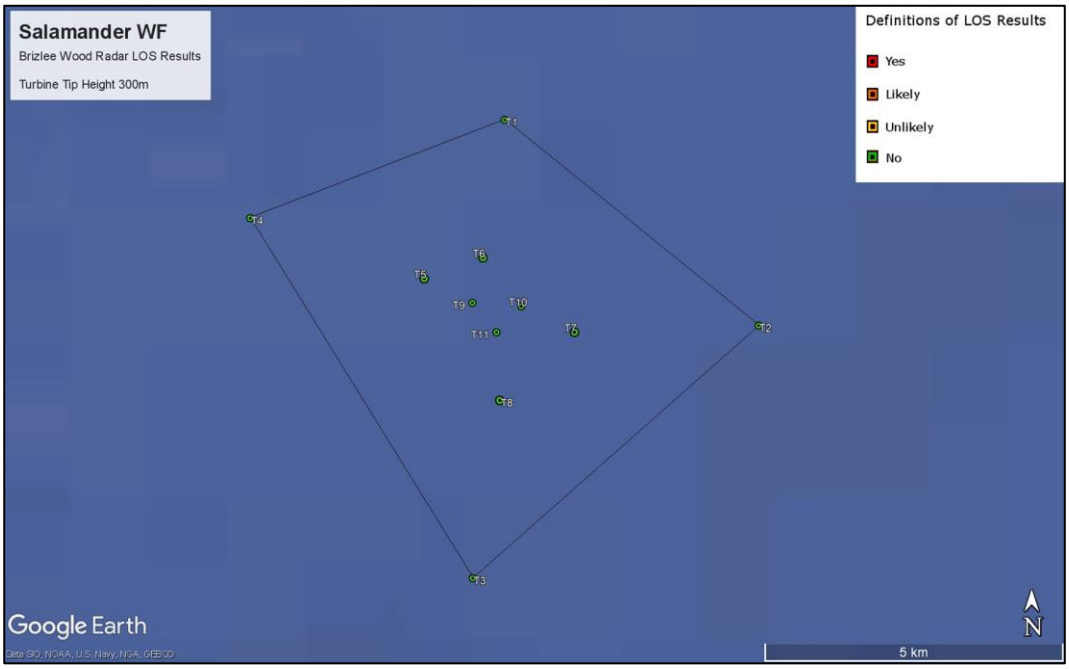


Figure 8 - Salamander Project Offshore Array Area (representative WTGs) – Brizlee Wood Radar LoS results (tip height 300m)

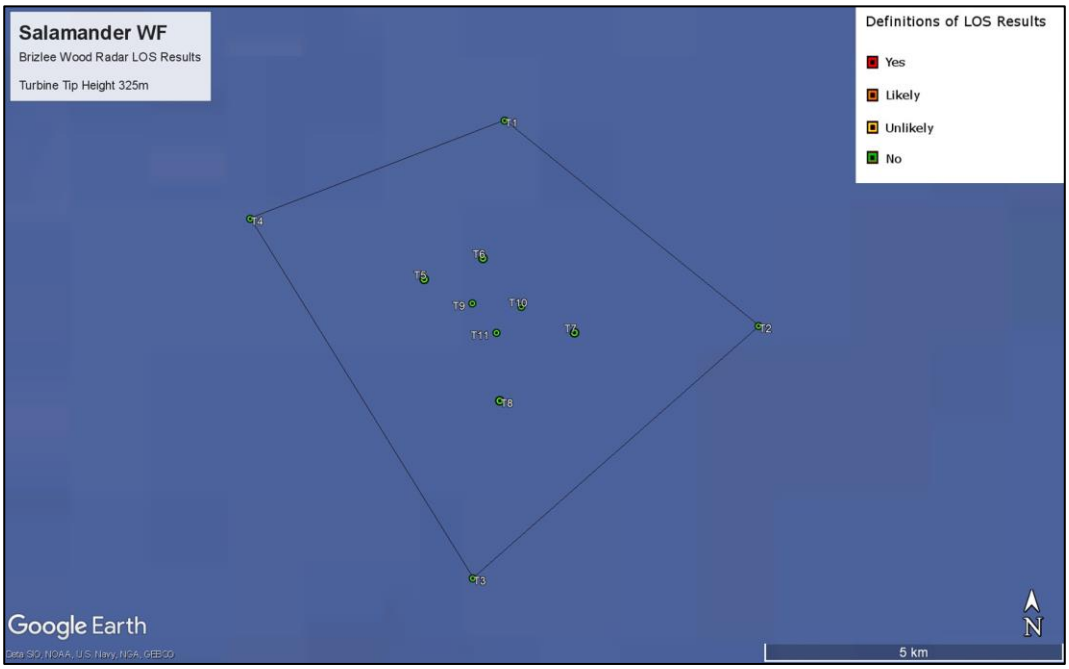


Figure 9 - Salamander Project Offshore Array Area (representative WTGs) – Brizlee Wood Radar LoS results (tip height 325m)

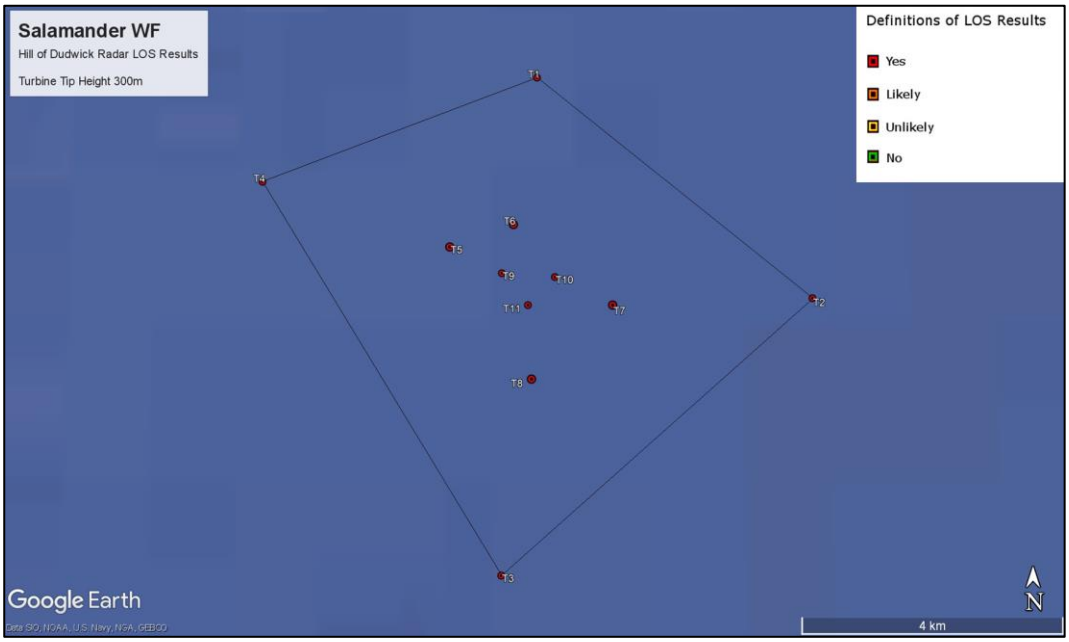


Figure 10 - Salamander Project Offshore Array Area (representative WTGs) – Hill of Dudwick Radar LoS results (tip height 300m)

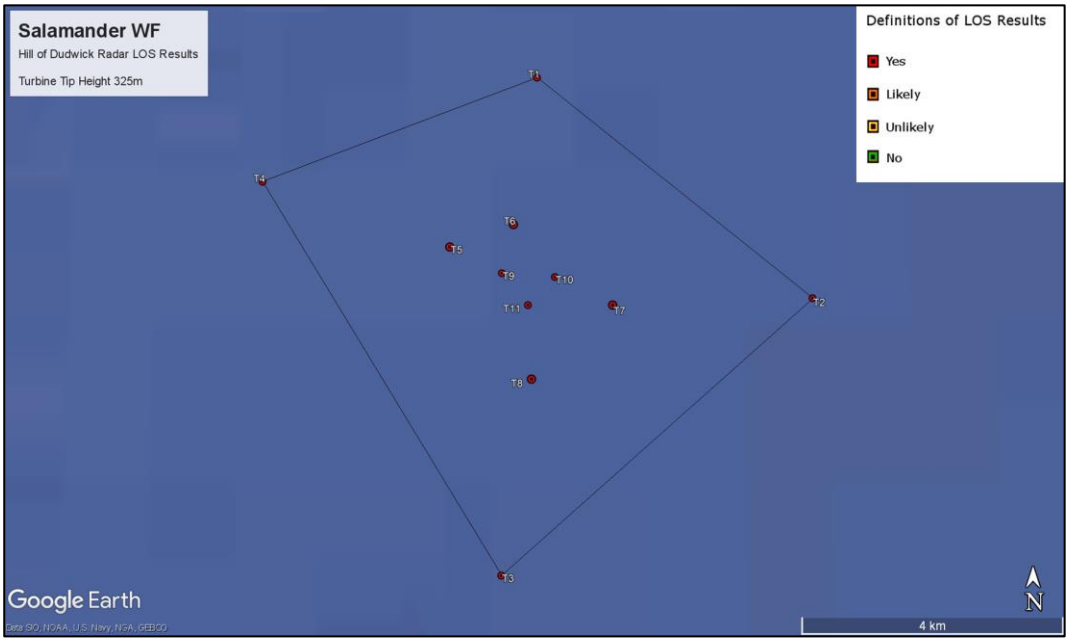


Figure 11 - Salamander Project Offshore Array Area (representative WTGs) – Hill of Dudwick Radar LoS results (tip height 325m)

3.3.2 LoS Terrain Elevation Profile

Figure 12 shows the elevation profile terms used in the LoS assessment as the baseline for the analysis.

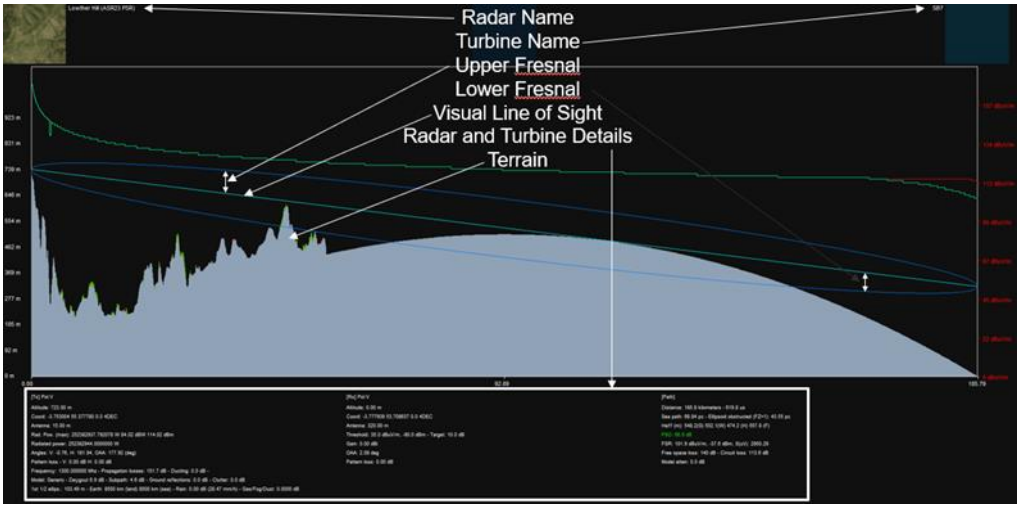


Figure 12 – Elevation profile terms

3.3.3 LoS Assessment Results

The LoS assessment results for each radar system are given in Table 3 in Annex A1. LoS terrain elevation profiles for each assessed radar, at WTG tip heights of 300m AMSL and 325m AMSL, are also provided in Annex A1.

It is seen from Table 3 that at a blade tip height of 300m AMSL and 325m AMSL, the WTGs will be detected by the following radar systems due to no intervening terrain on the visual LoS:

- Allanshill
- Perwinnes
- Buchan
- Hill of Dudwick

The Met office state (email 21 Aug 2023) that the base of the Hill of Dudwick radar beam will be 310 m, at its lowest elevation, in the vicinity of the Salamander Project and "*To avoid any impact on our radar, we would like to request that the maximum tip height is no more than 310 m*".

During project development, and with a view to addressing Met Office responses regarding turbine heights in excess of 310 m AMSL, Ordnance Datum Newlyn (ODN), the maximum tip height proposed for the Salamander Project has been reduced to 310 m AMSL (ODN).

The WTGs will not be detected by the following radar systems as there is no direct LoS:

- Brizlee Wood

4 Conclusions

4.1 Conclusions

Having conducted the LoS assessment, Osprey conclude that the eleven representative WTG locations within the Salamander Project Offshore Array Area, at a blade tip height of 300m AMSL and 325m AMSL, will be detected by the following radar systems due to no intervening terrain on the LoS:

- Allanshill
- Perwinnes
- Buchan
- Hill of Dudwick

The Met office state (email 21 Aug 2023) that the base of the Hill of Dudwick radar beam will be 310 m, at its lowest elevation, in the vicinity of the Salamander Project and "*To avoid any impact on our radar, we would like to request that the maximum tip height is no more than 310 m*".

During project development, and with a view to addressing Met Office responses regarding turbine heights in excess of 310 m AMSL (ODN), the maximum tip height proposed for the Salamander Project has been reduced to 310 m AMSL (ODN).

The WTGs will not be detected by the following radar systems as there is no direct LoS:

- Brizlee Wood

A1 LoS Assessment Results Overview

WTG	Allanshill (300m)	Allanshill (325m)	Perwinnes (300m)	Perwinnes (325m)	Buchan (300m)	Buchan (325m)	Brizlee Wood (300m)	Brizlee Wood (325m)	Hill of Dudwick[4] (300m)	Hill of Dudwick[4] (325m)
T1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T3	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T4	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T5	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T6	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T7	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T8	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T9	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
T10	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

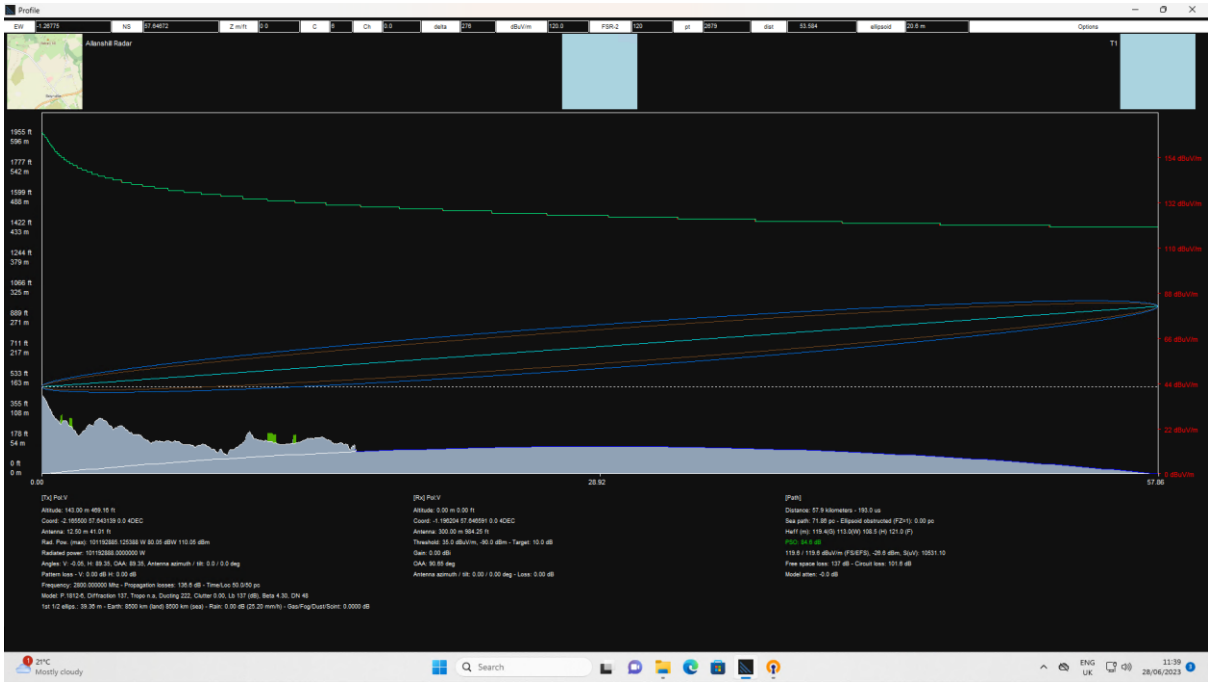
[4] The Met office state that the base of the Hill of Dudwick radar beam will be 310 m, at its lowest elevation, in the vicinity of the Salamander Project

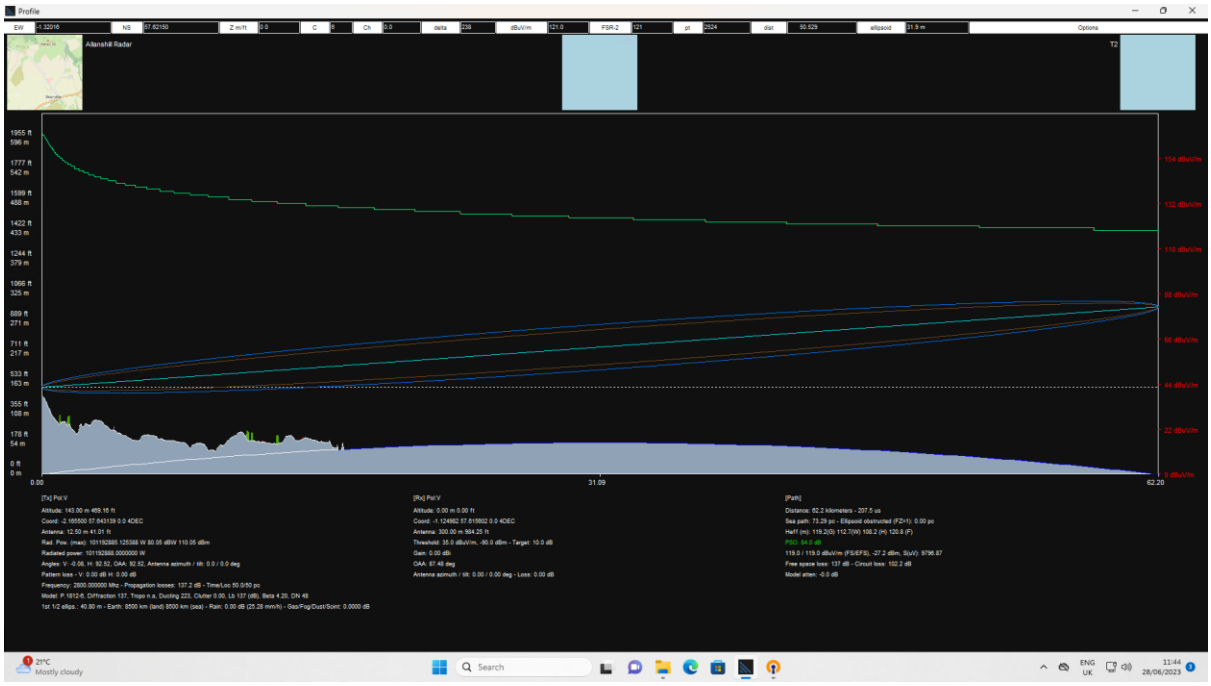
WTG	Allanshill (300m)	Allanshill (325m)	Perwinnes (300m)	Perwinnes (325m)	Buchan (300m)	Buchan (325m)	Brizlee Wood (300m)	Brizlee Wood (325m)	Hill of Dudwick[4] (300m)	Hill of Dudwick[4] (325m)
T11	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

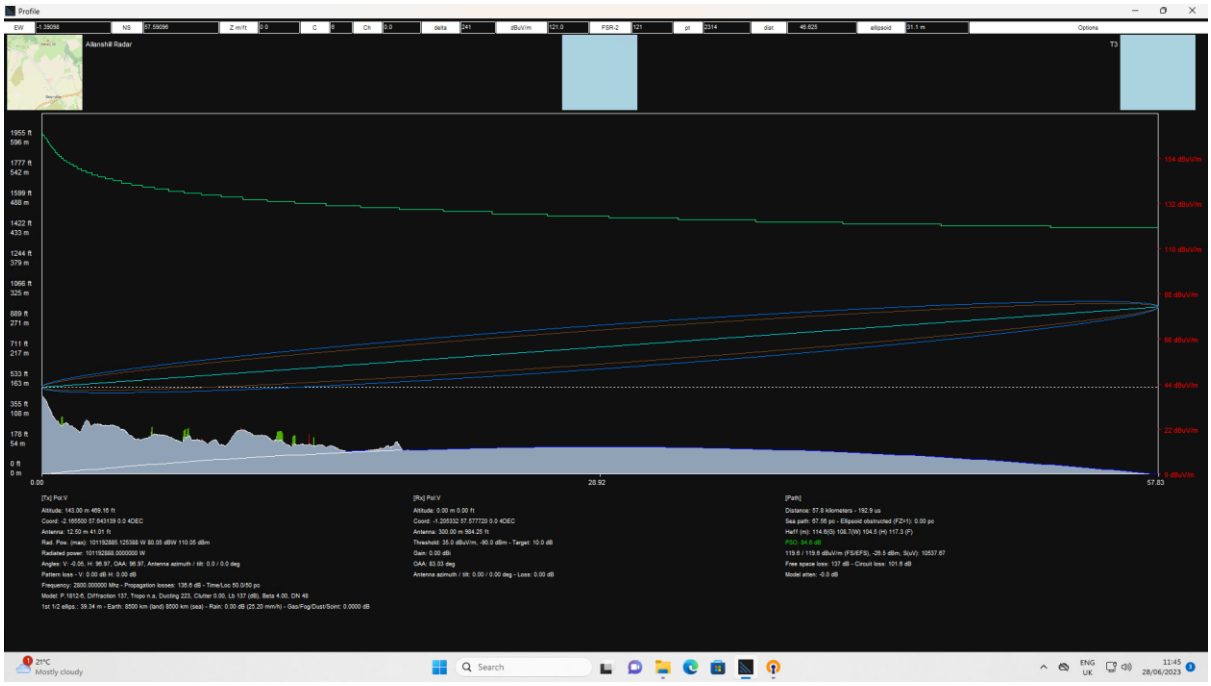
Table 3 – LoS assessment results

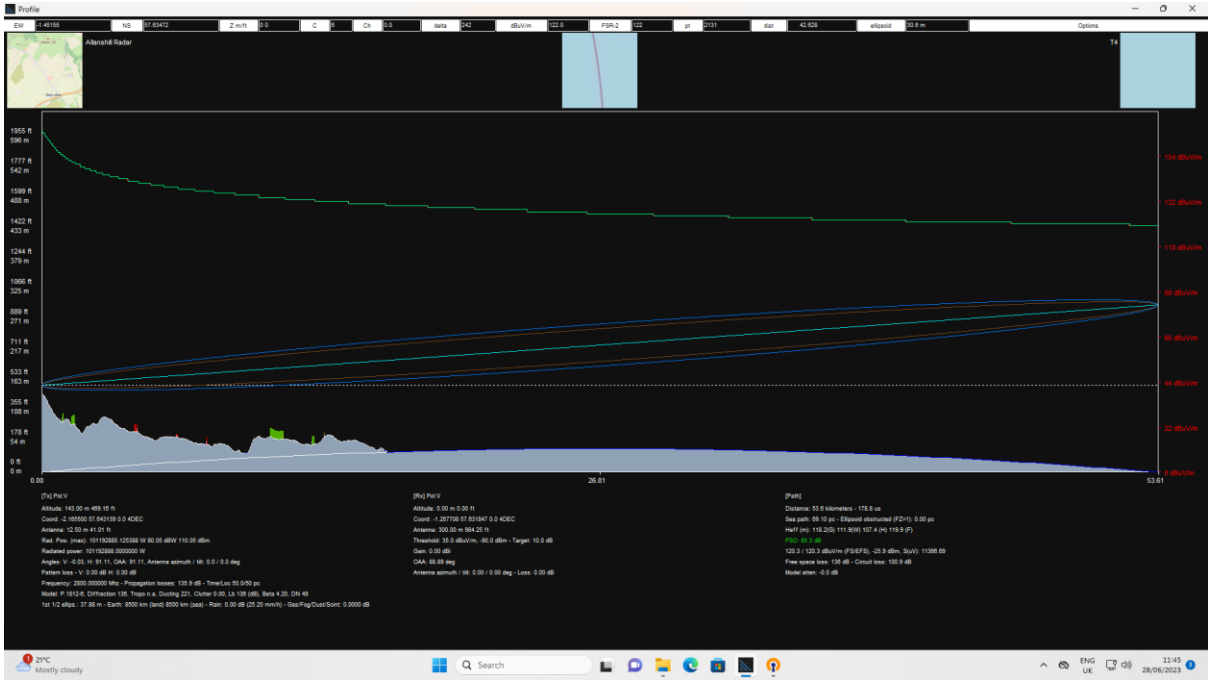
A2 LoS Terrain Elevation Profiles

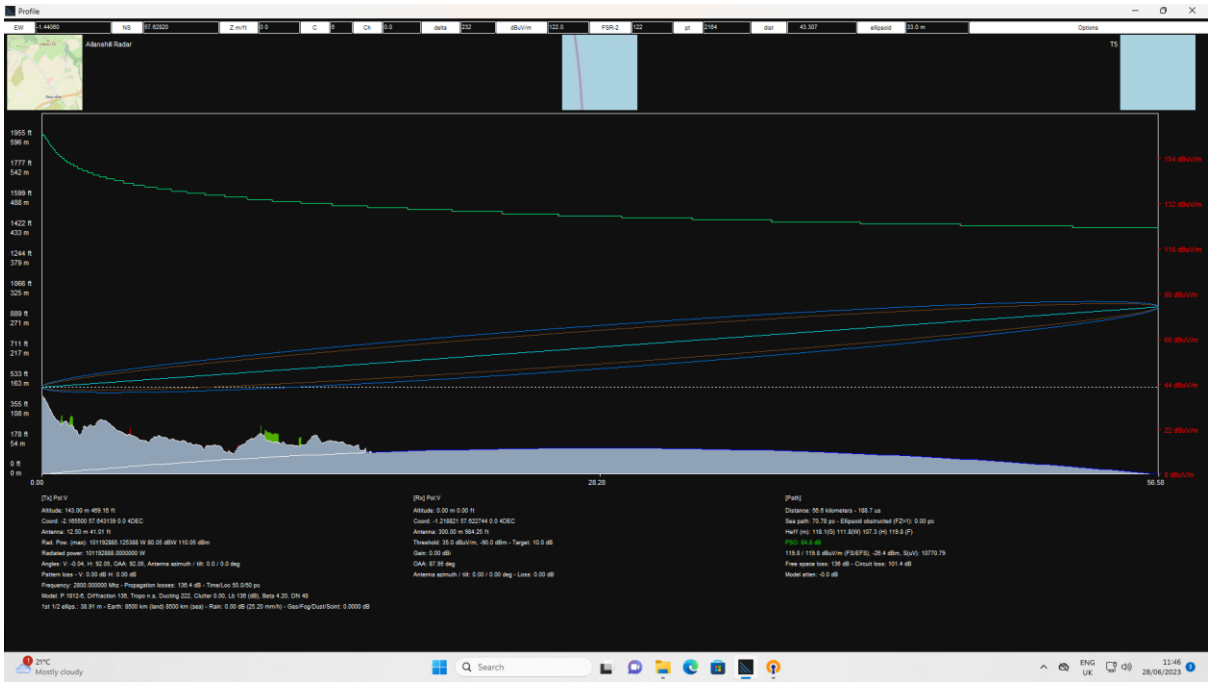
A2.1 Allanshill Radar (WTG Tip Height 300m)

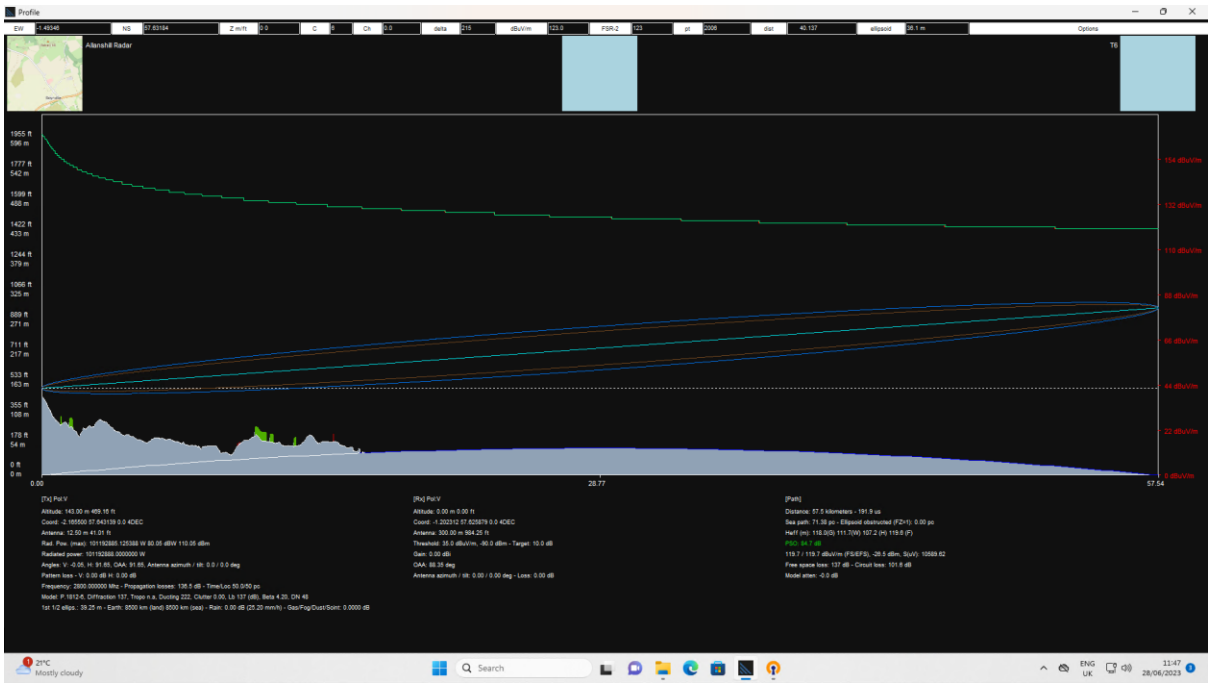





Profile
Allanshill Radar
T3
0.00
28.92
57.83


Profile
Allanshill Radar
T4
0.00
26.81
53.61


Profile
Allanshill Radar
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
28.28
56.58


Profile
Allanshill Radar
1955 ft
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1777 ft
542 m
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433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
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217 m
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108 m
178 ft
54 m
0 ft
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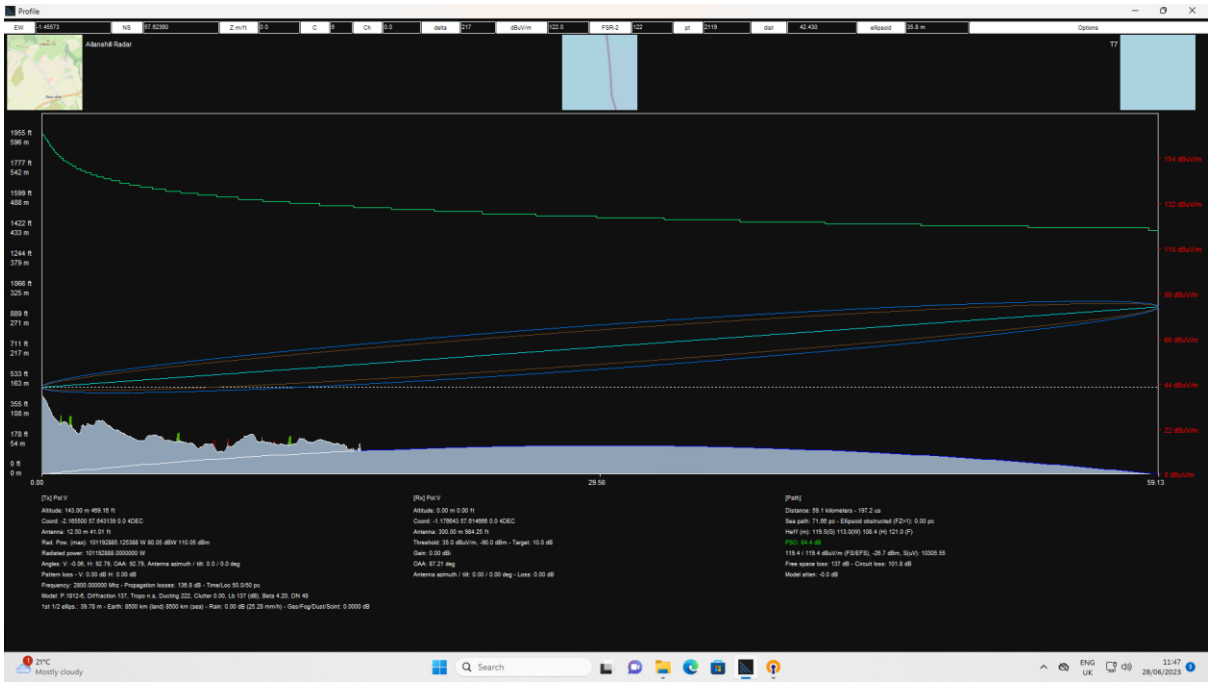
28.77
57.54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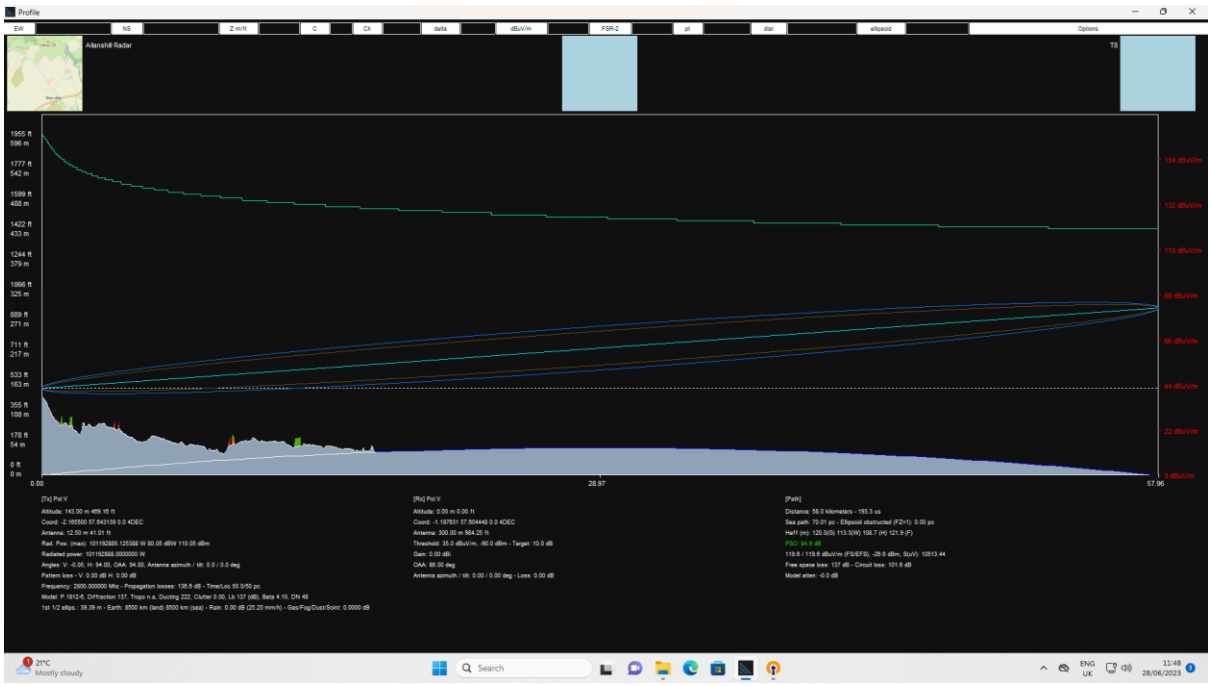
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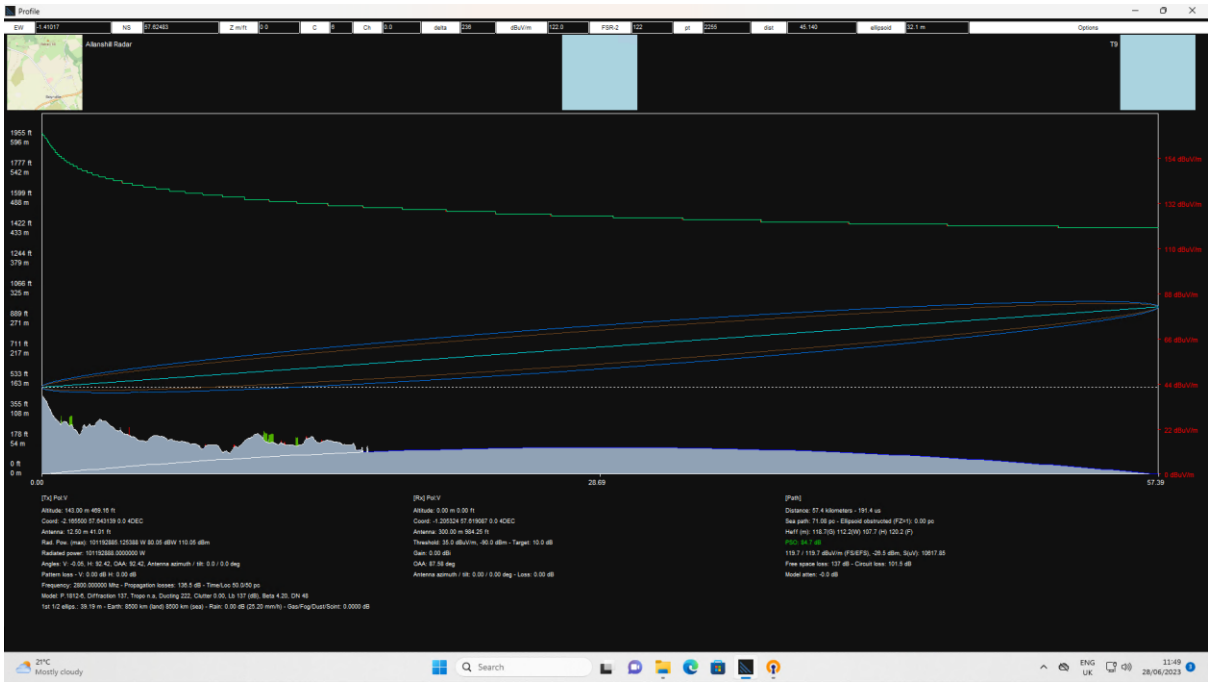
Allanshill Radar
0.00
28.97
57.96


Profile
Allanshill Radar
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
28.69
57.39
154 dBuV/m
132 dBuV/m
110 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
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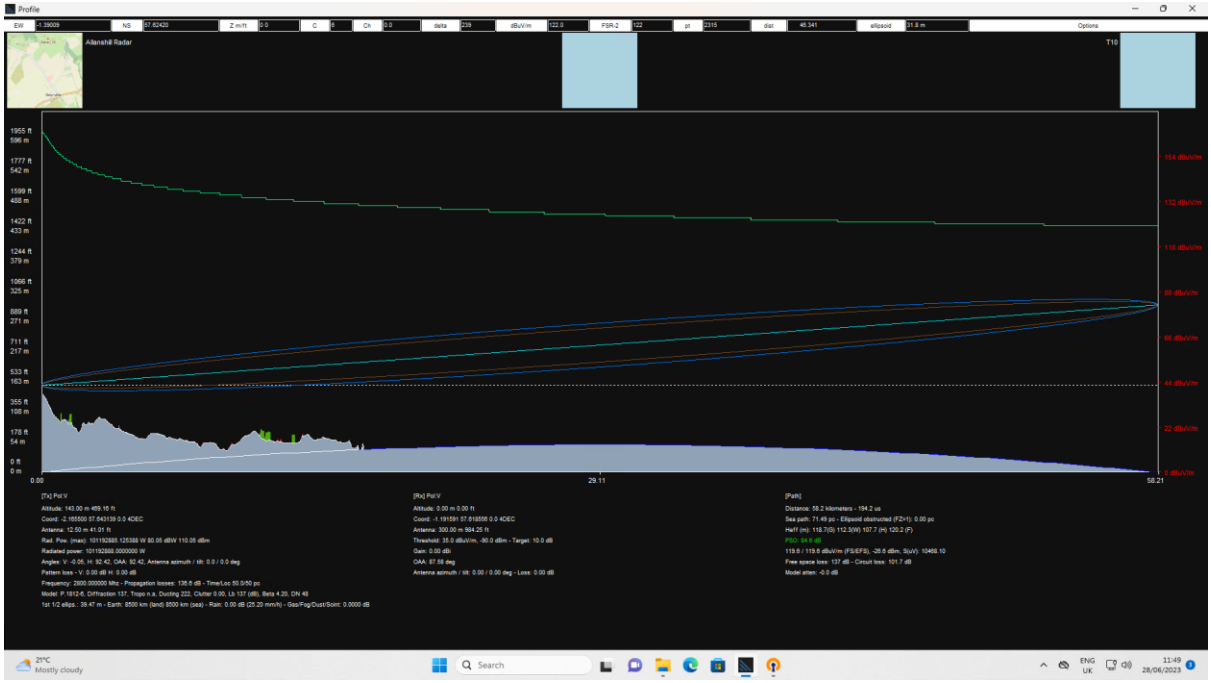
28/06/2023


Profile
Allanshill Radar
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
29.11
58.21
154 dBuV/m
132 dBuV/m
110 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
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[Rx] Pol:V
[Path]
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UK
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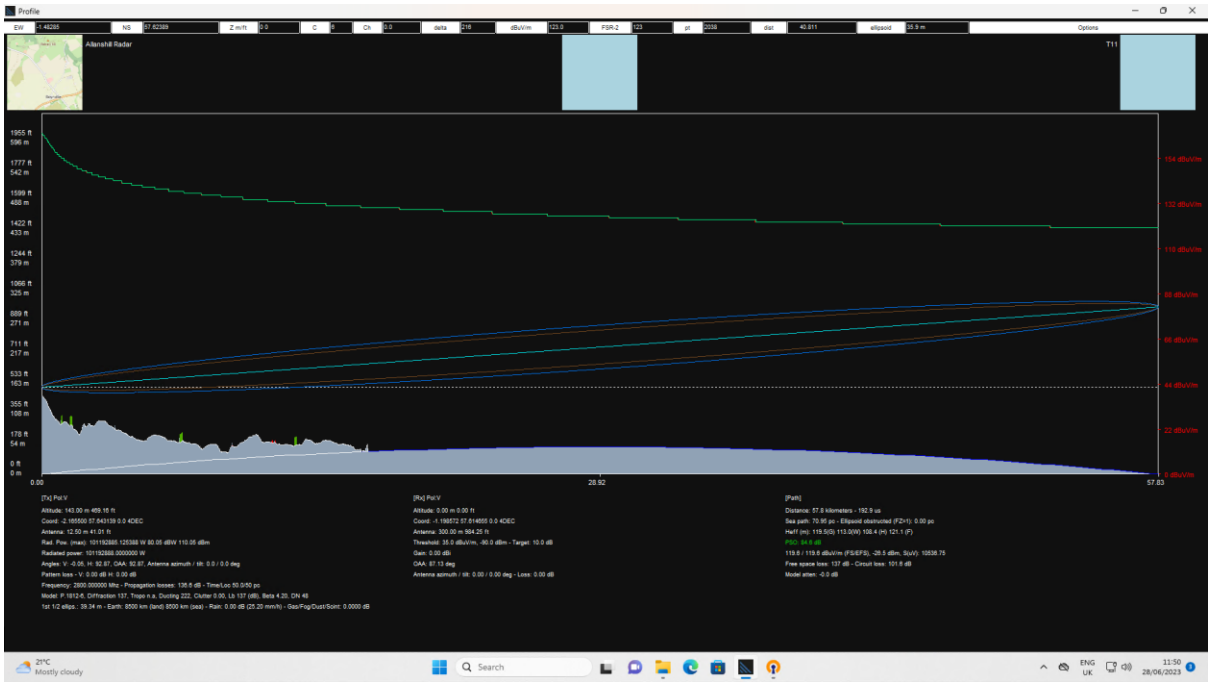
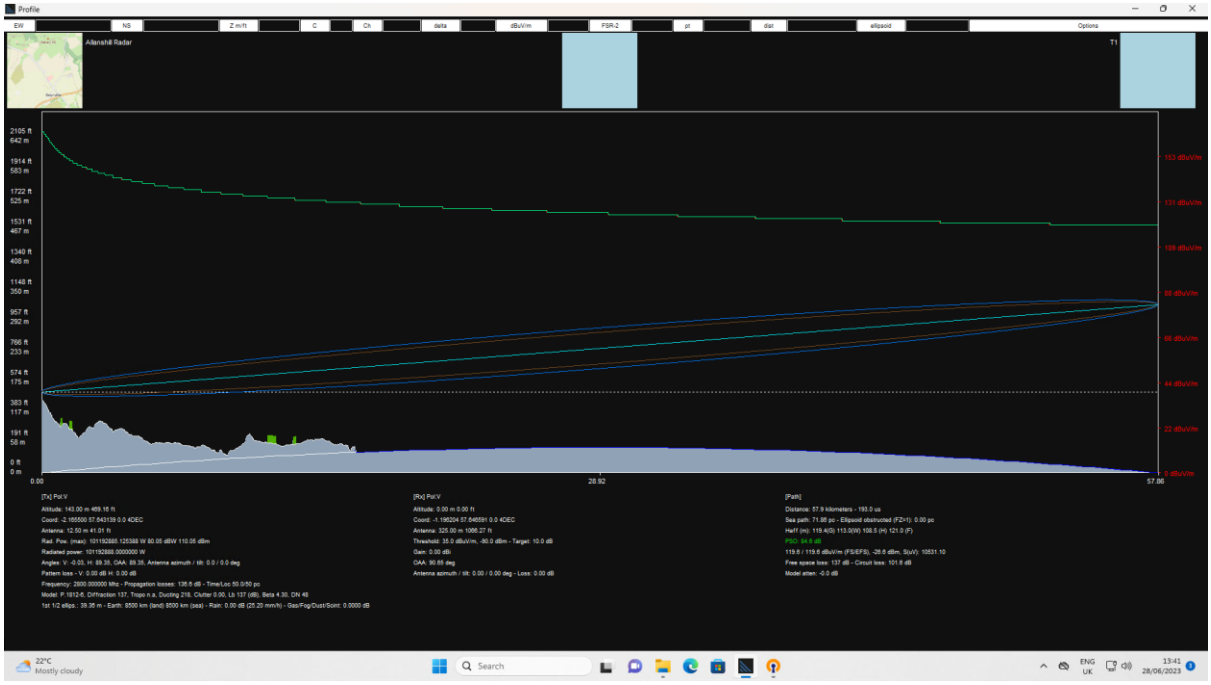
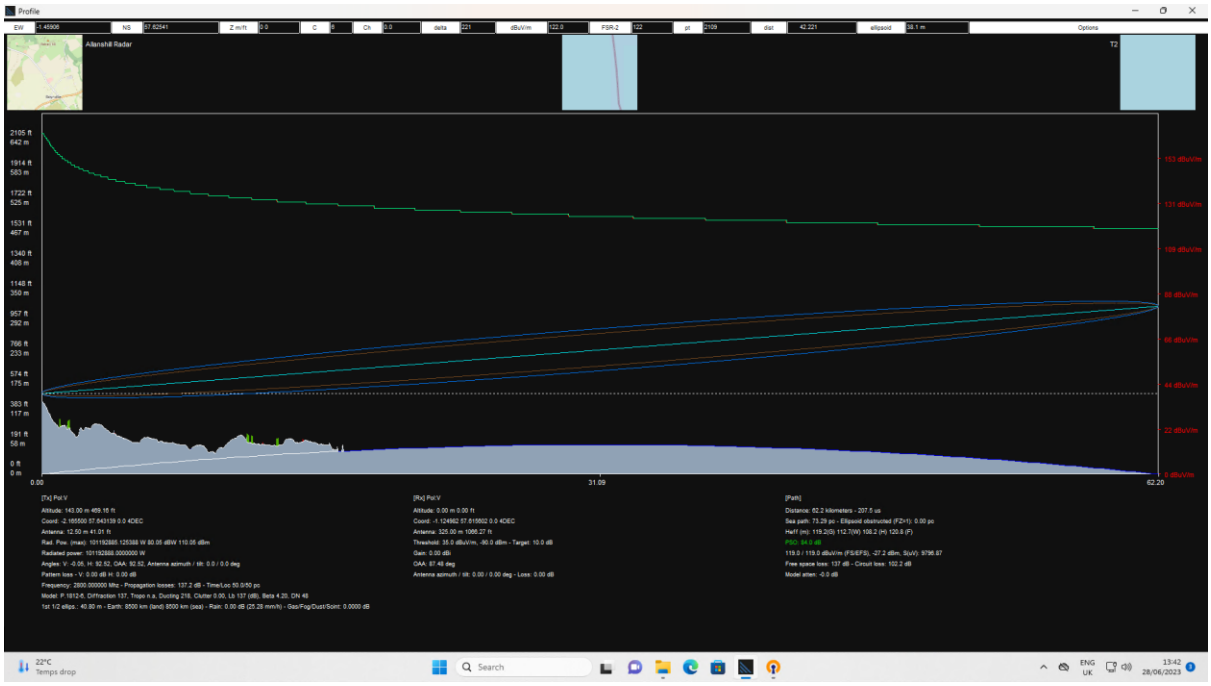
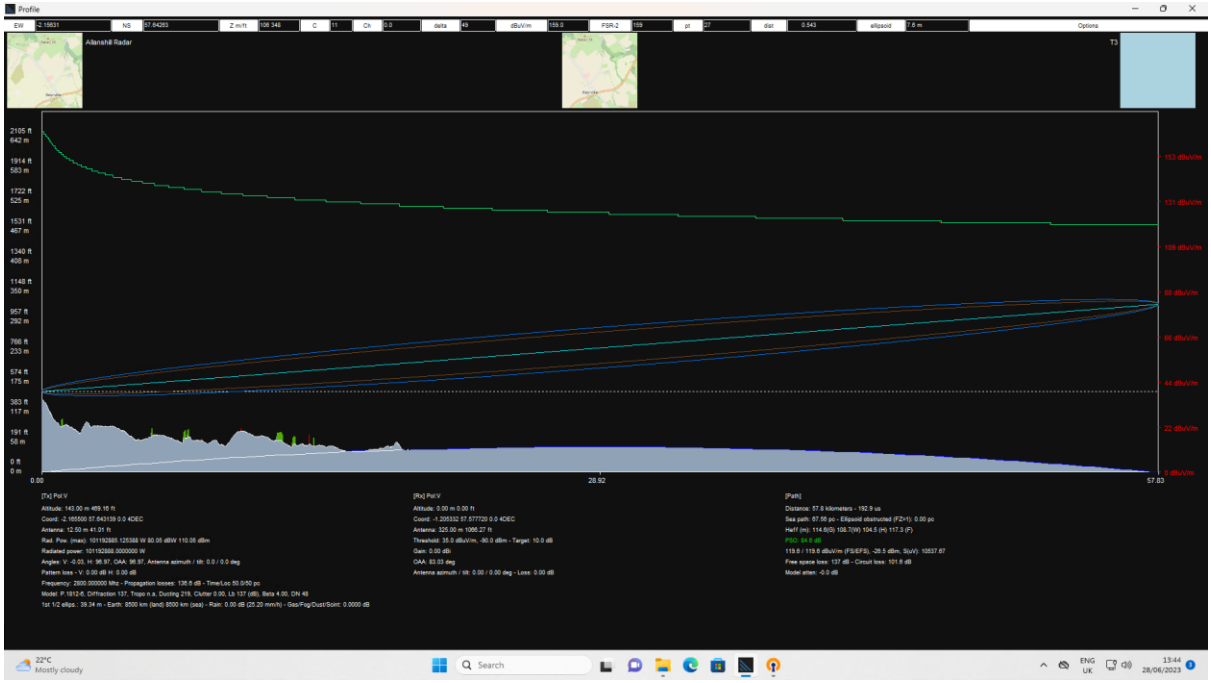
28/06/2023

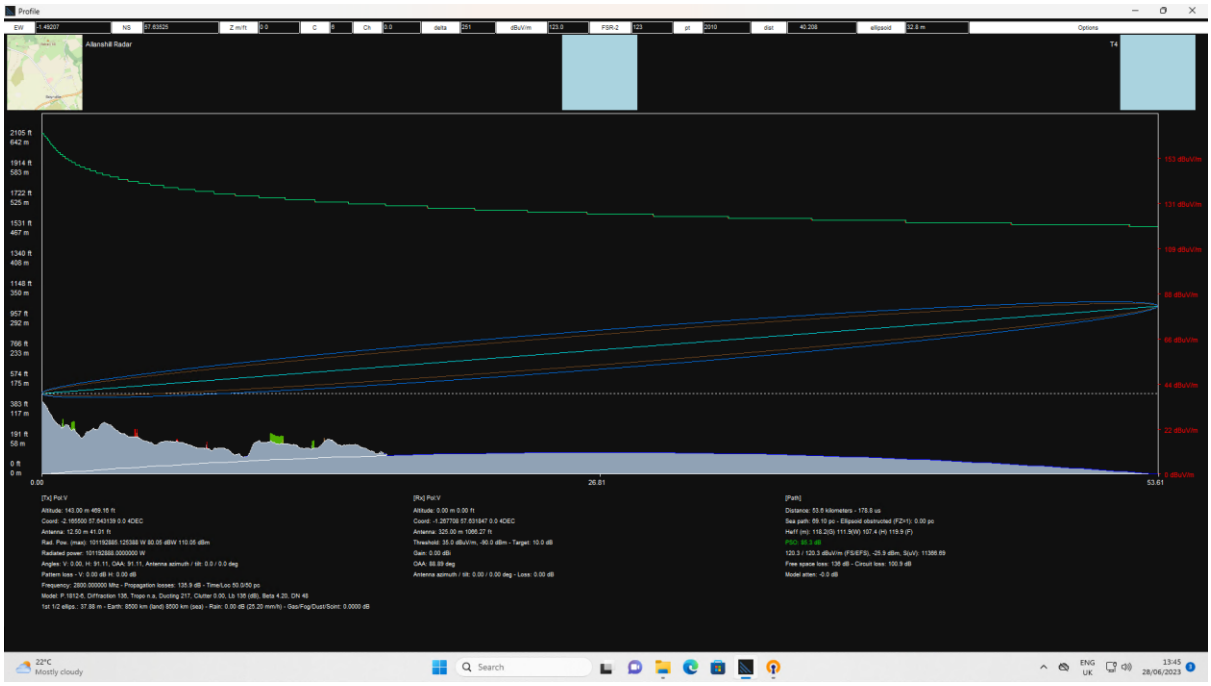


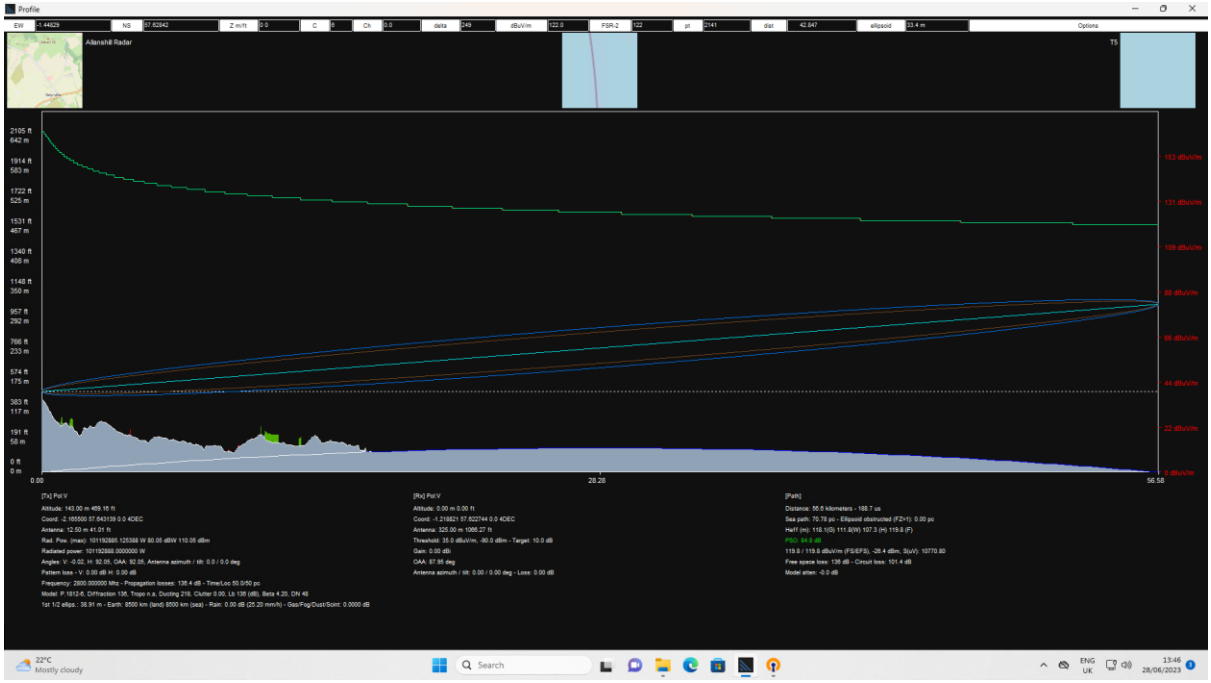
A2.2 Allanshill Radar (WTG Tip Height 325m)

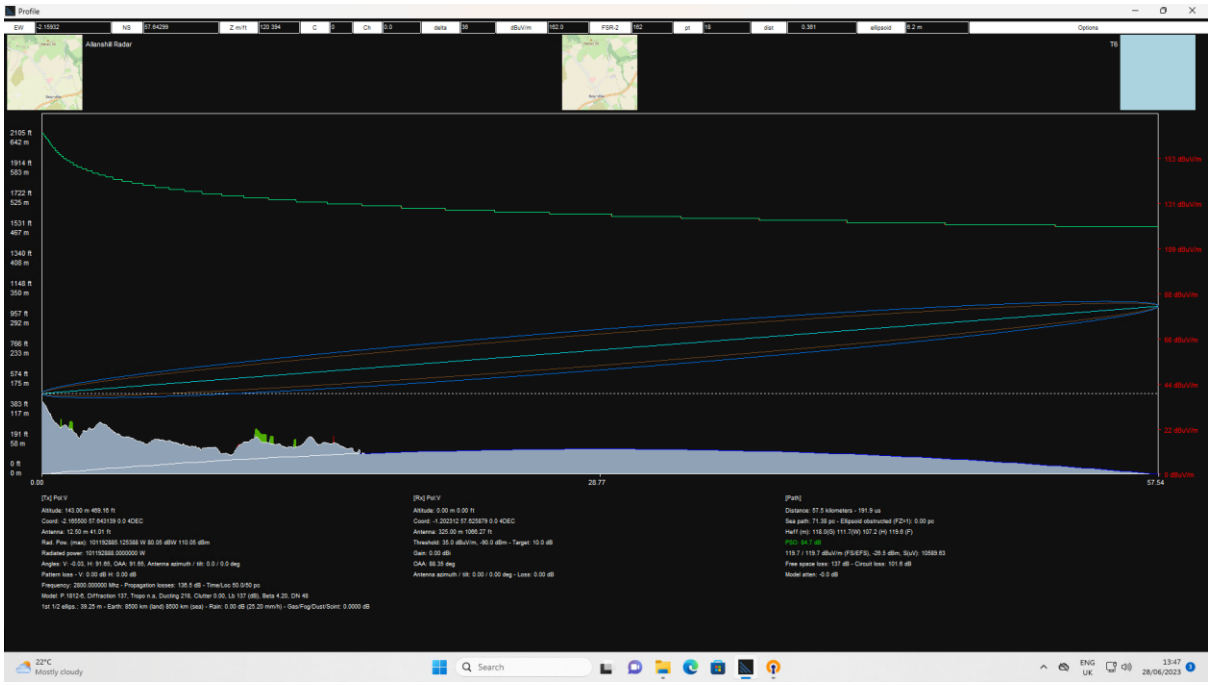


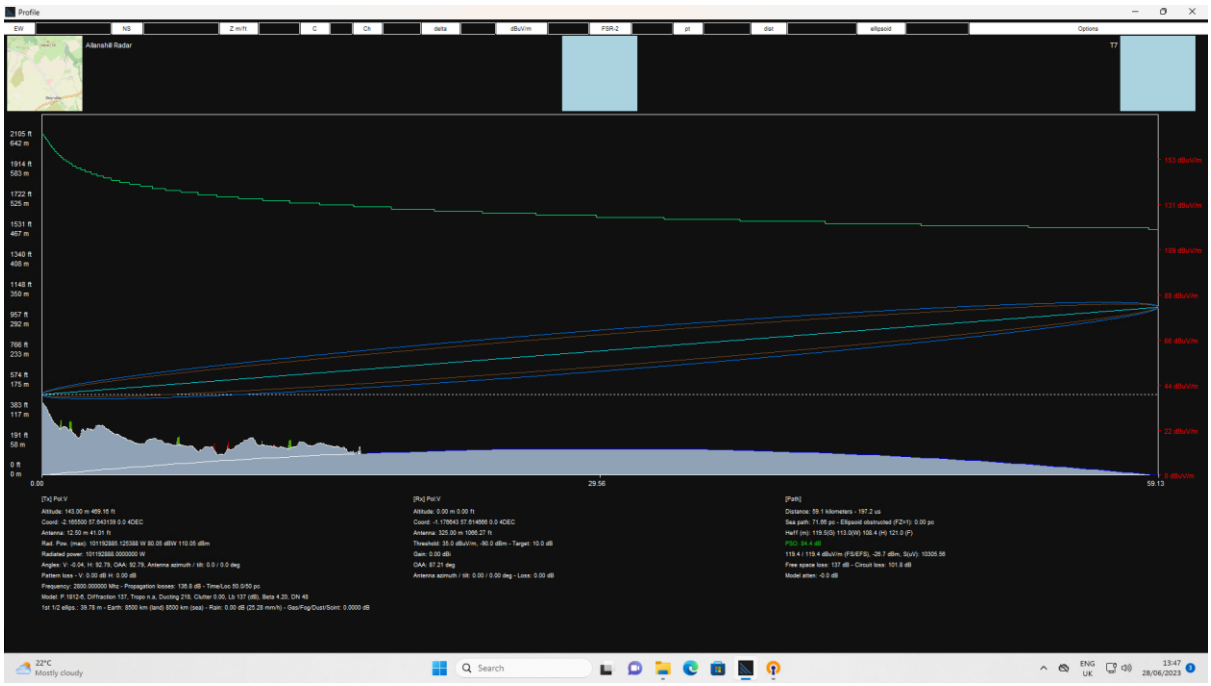

Profile
Allanshill Radar
T2
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
31.09
62.20
153 dBuV/m
131 dBuV/m
109 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Temps drop
Search
ENG
UK
13:42
28/06/2023

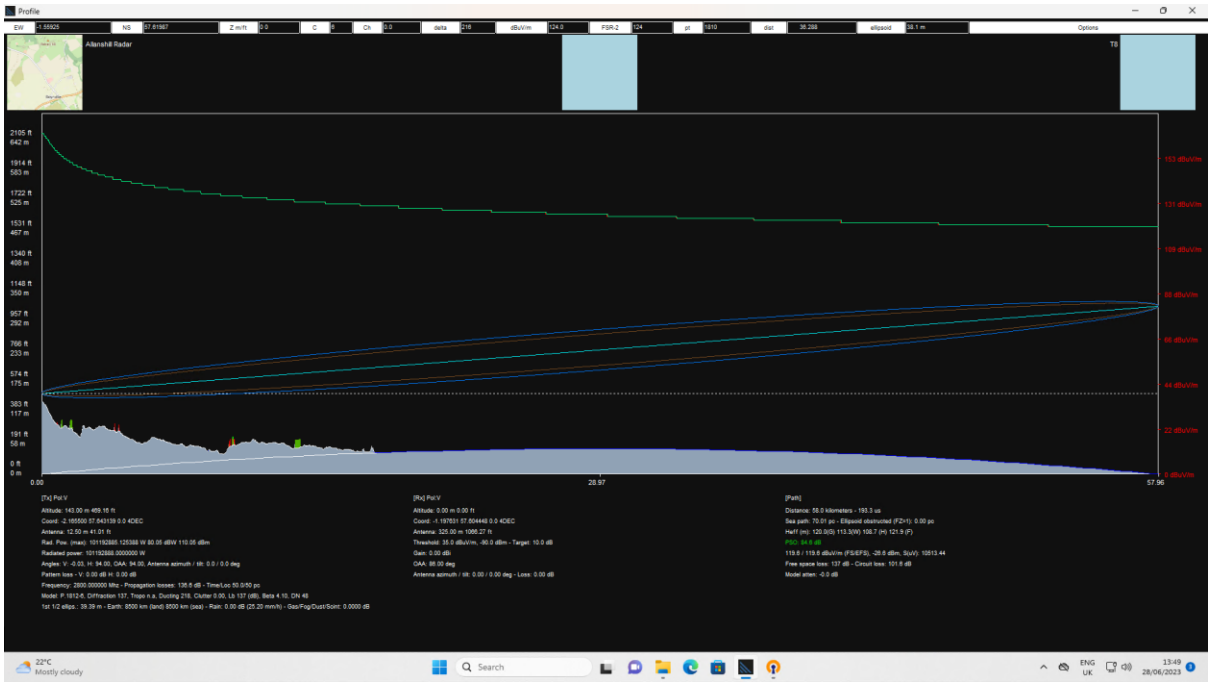

Profile
Allanshill Radar
T3
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
28.92
57.83
153 dBuV/m
131 dBuV/m
109 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
13:44
28/06/2023

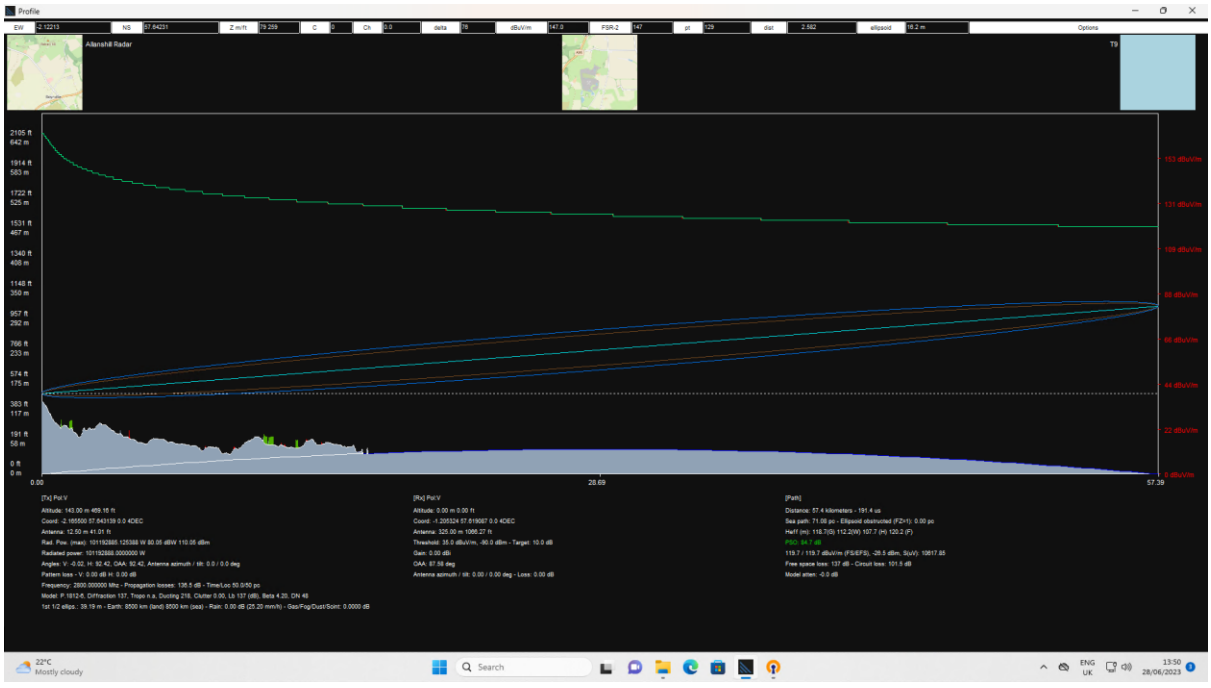

Profile
Allanshill Radar
T4
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
26.81
53.61
153 dBuV/m
131 dBuV/m
109 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
13:45
28/06/2023

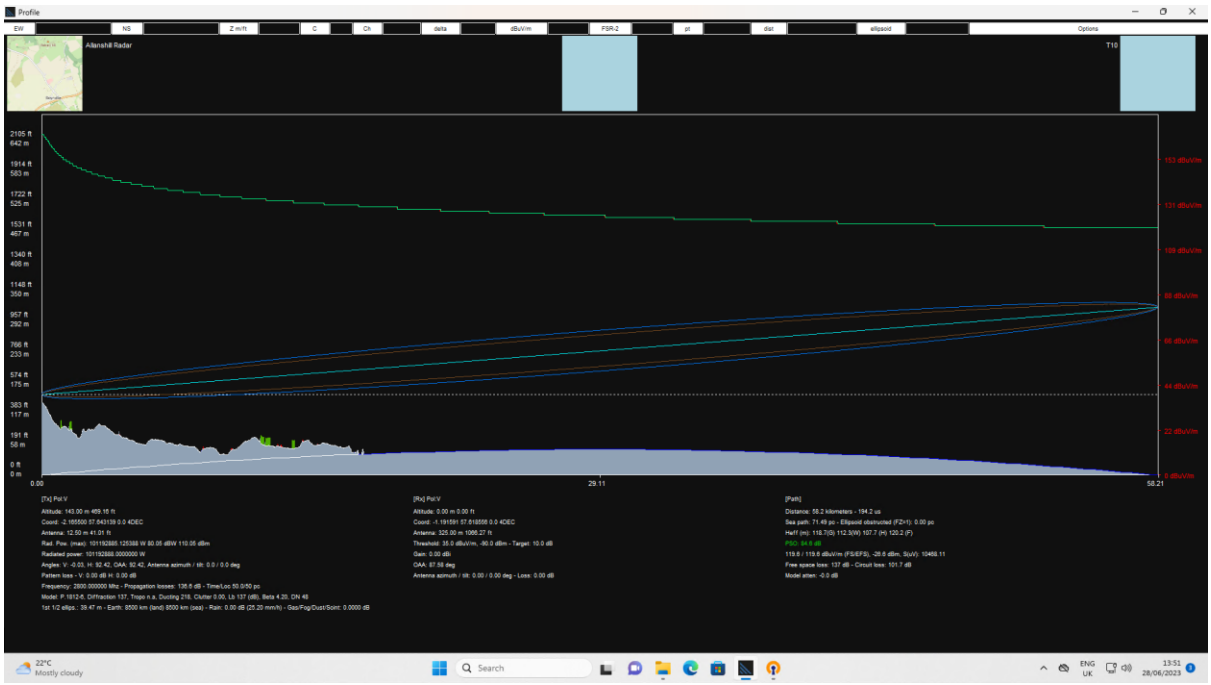

Profile
Allanshill Radar
T5
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
28.28
56.58
153 dBuV/m
131 dBuV/m
109 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
13:46
28/06/2023

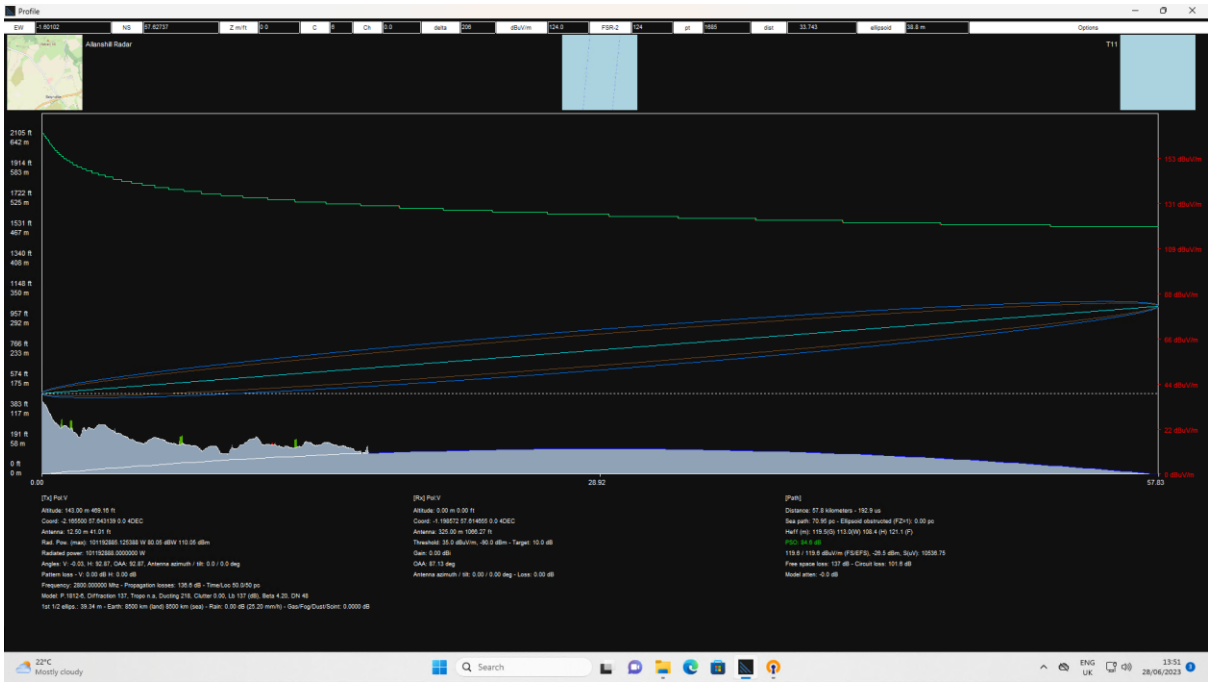

Profile
Allanshill Radar
T6
0.00
28.77
57.54


Profile
Allanshill Radar
T7
0.00
29.56
59.13

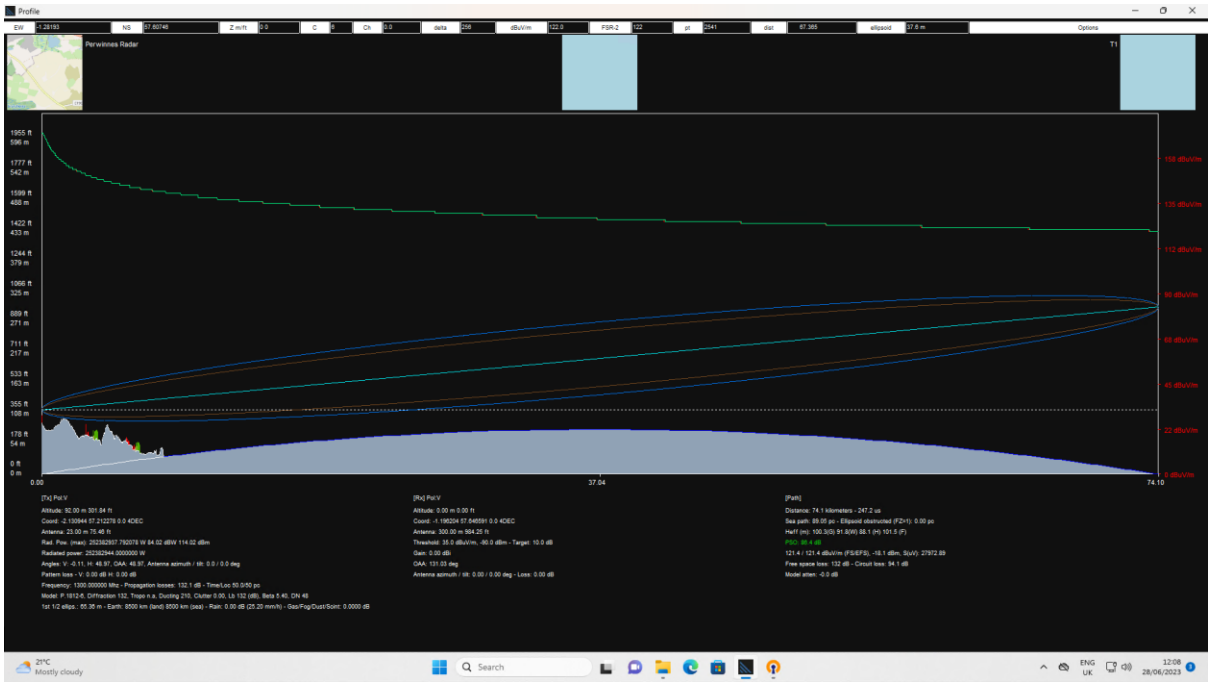

Profile
Allanshill Radar
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
28.97
57.96
153 dBuV/m
131 dBuV/m
109 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
22°C
Mostly cloudy
Search
ENG
UK
13:49
28/06/2023

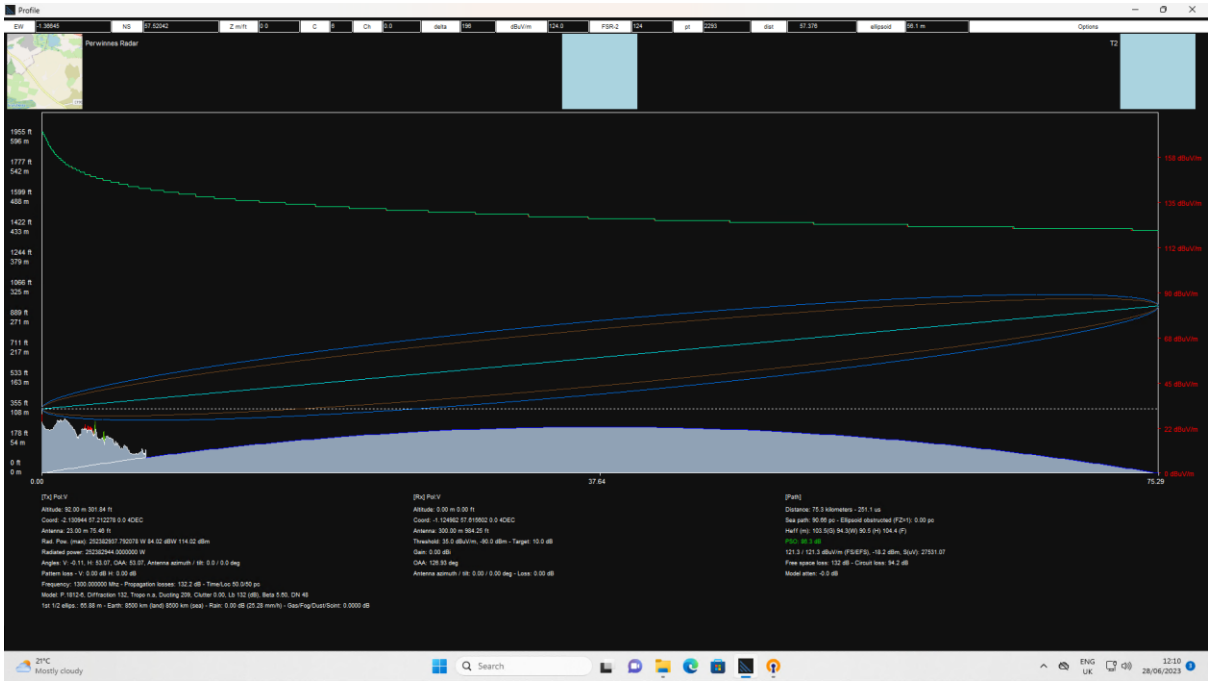

Profile
Allanshill Radar
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
28.69
57.39
153 dBuV/m
131 dBuV/m
109 dBuV/m
88 dBuV/m
66 dBuV/m
44 dBuV/m
22 dBuV/m
0 dBuV/m
22°C
Mostly cloudy
Search
ENG
UK
13:50
28/06/2023

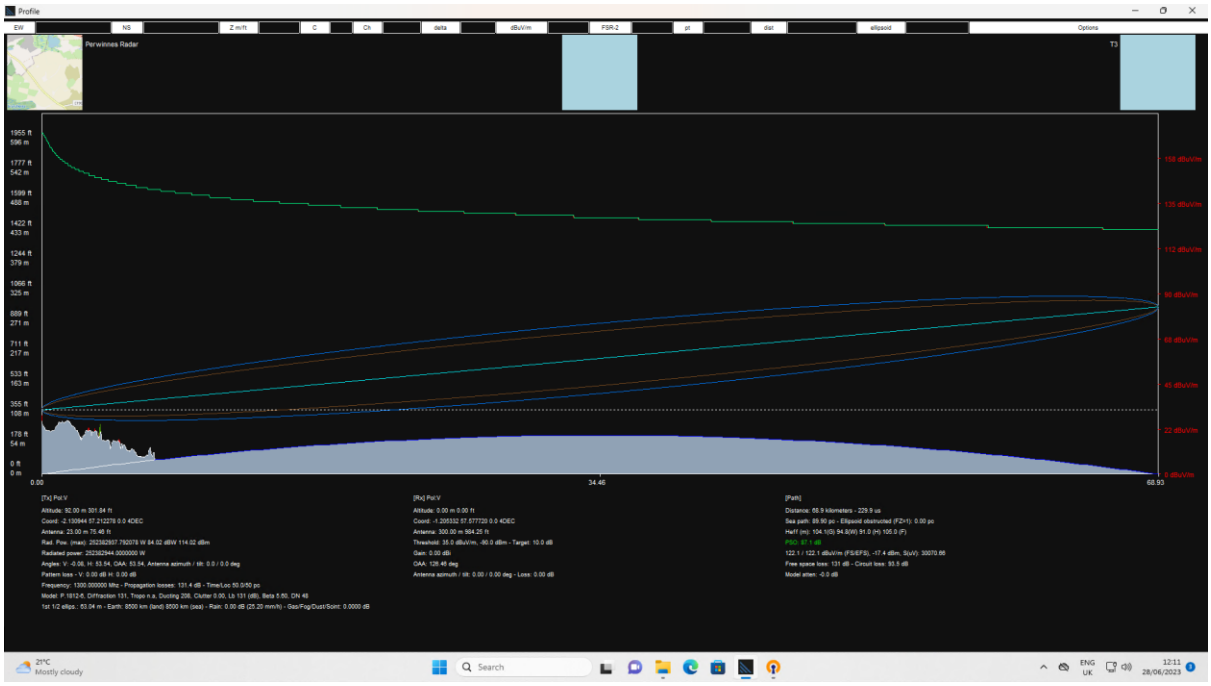

Profile
Allanshill Radar
T10
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
29.11
58.21

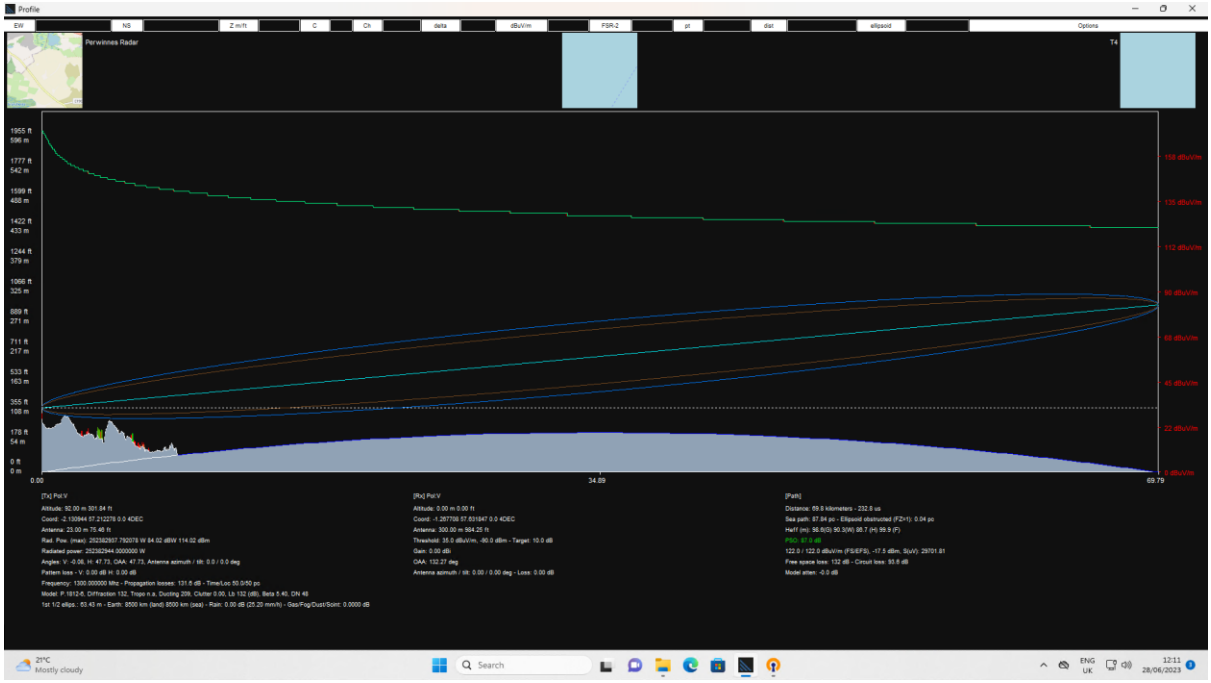

Profile
Allanshill Radar
T11
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
28.92
57.83

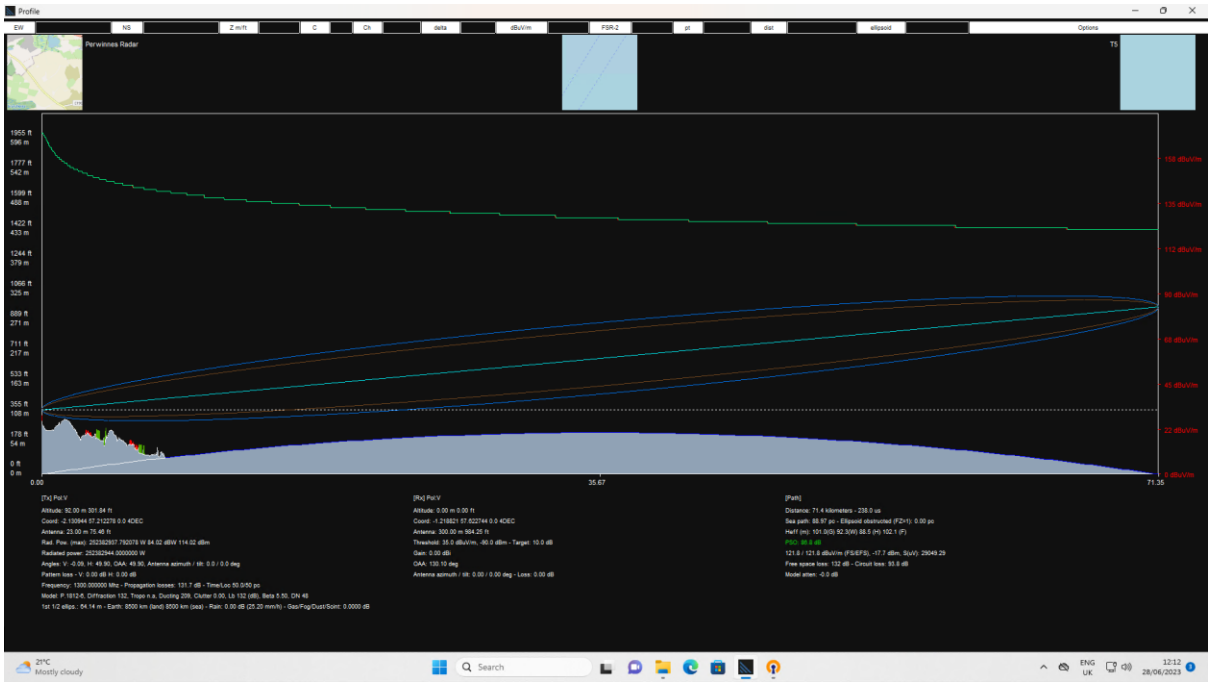
A2.3 Perwinnes Radar (WTG Tip Height 300m)

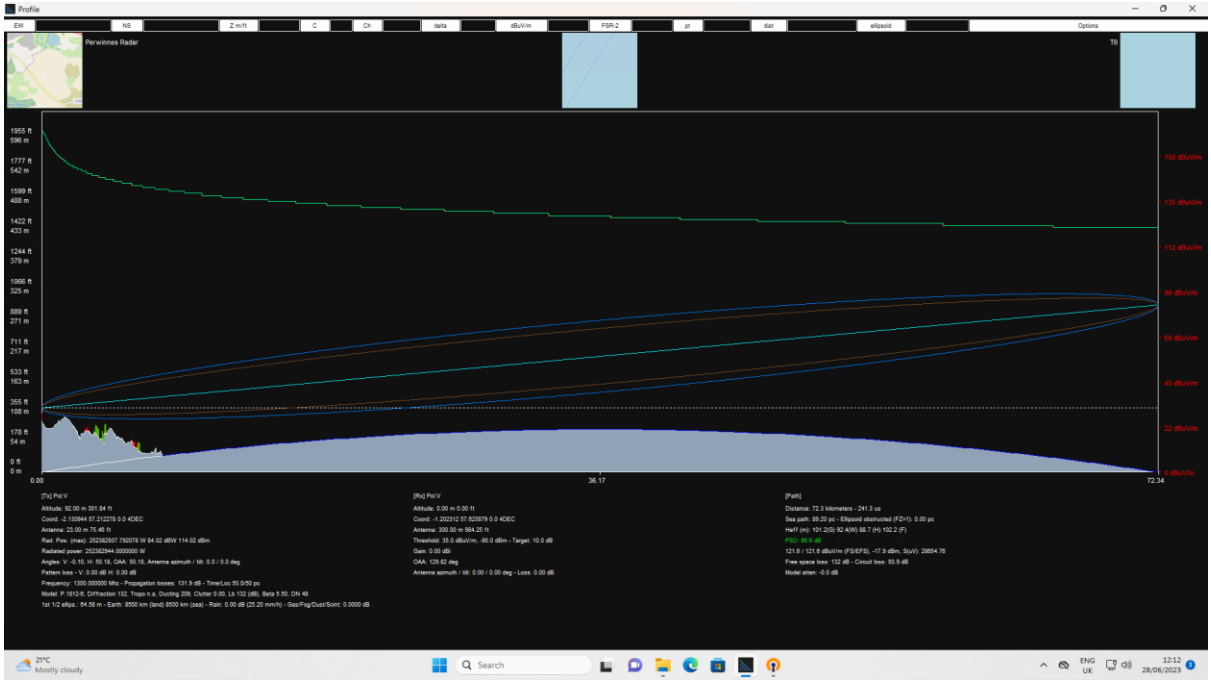


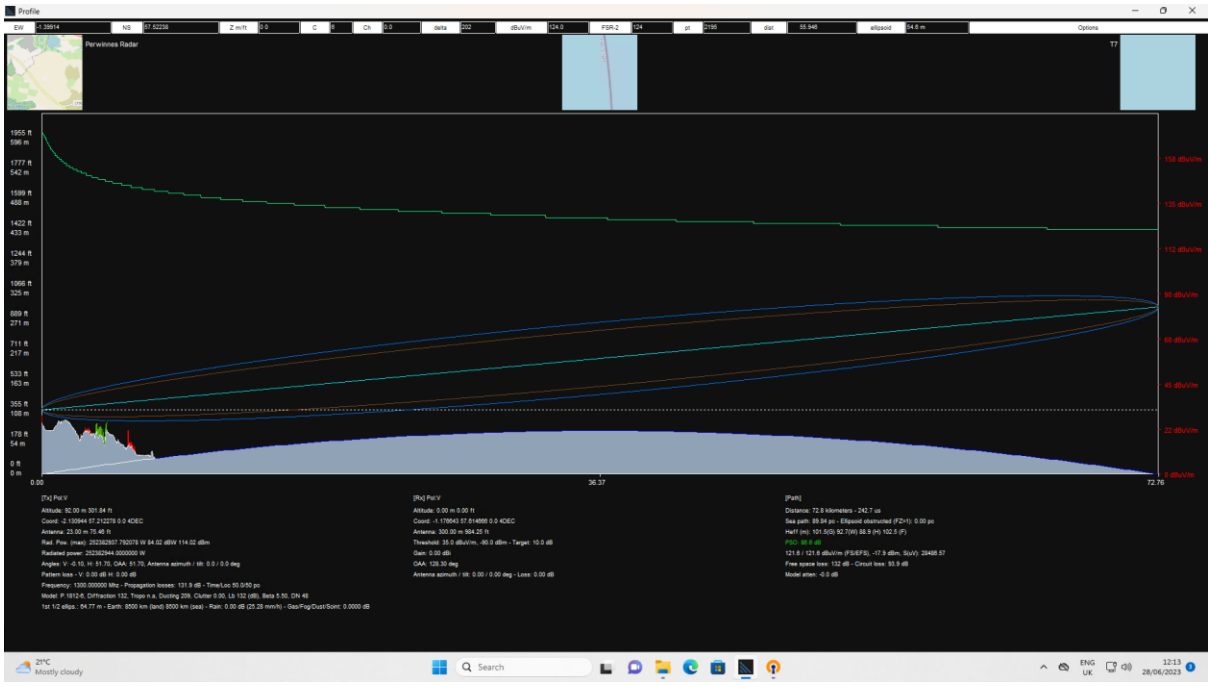


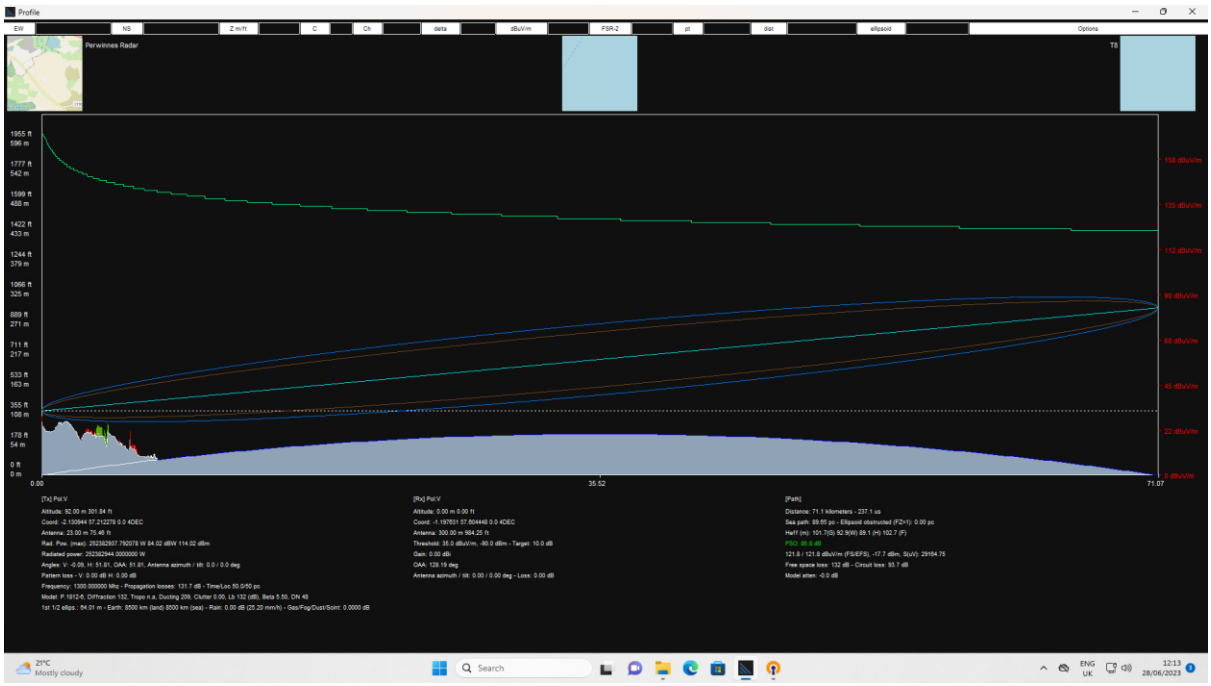

Profile
Perwinnes Radar
T3
0.00
34.46
68.93

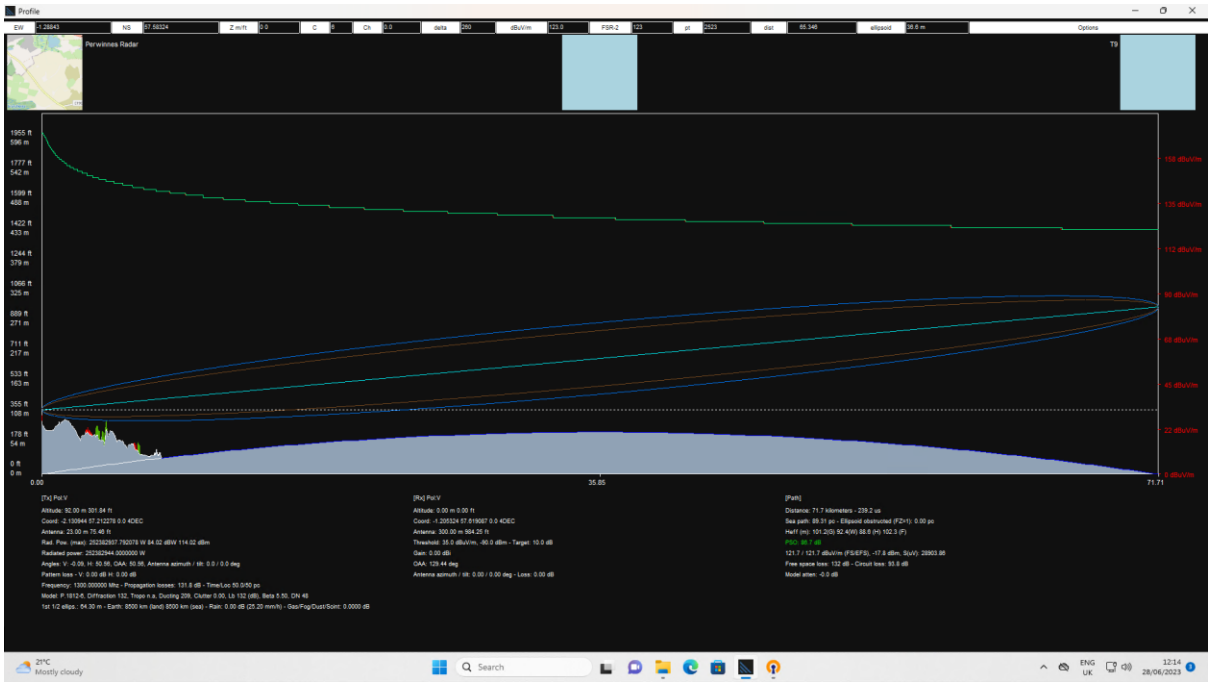

Profile
Perwinnes Radar
T4
0.00
34.89
69.79

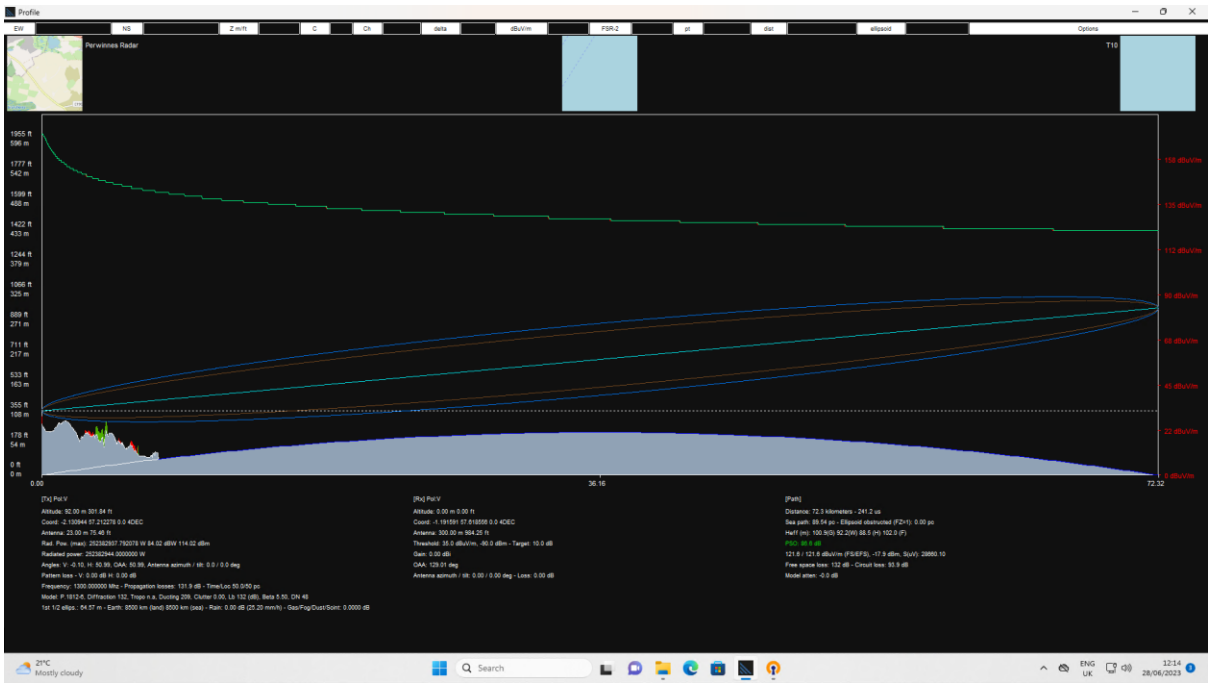

Profile
Perwinnes Radar
0.00
35.67
71.35

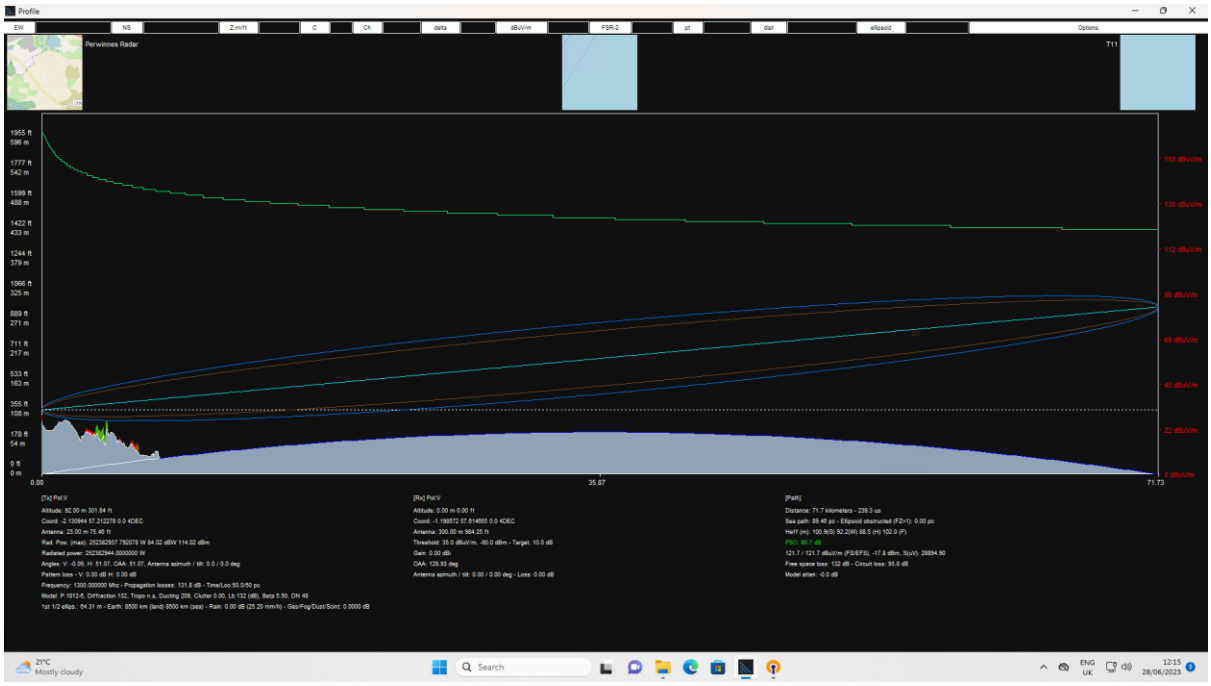

Profile
Perwinnes Radar
0.00
36.17
72.34


Profile
Perwinnes Radar
T7
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
36.37
72.76

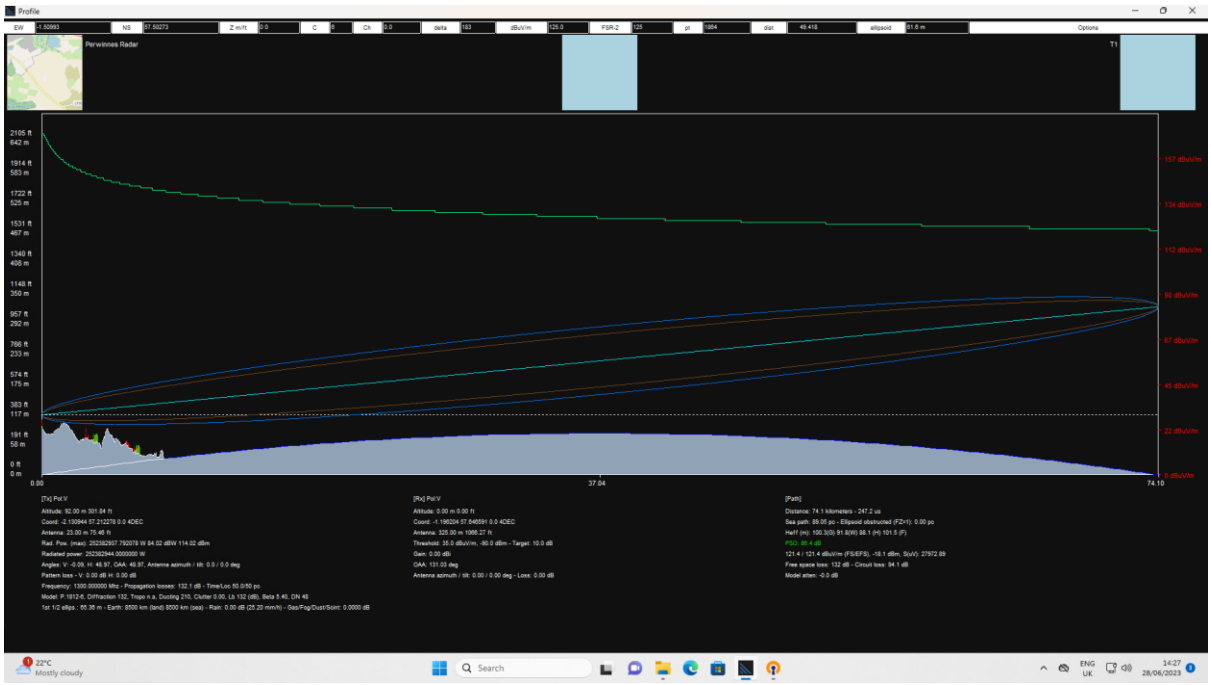

Profile
Perwinnes Radar
T8
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
35.52
71.07

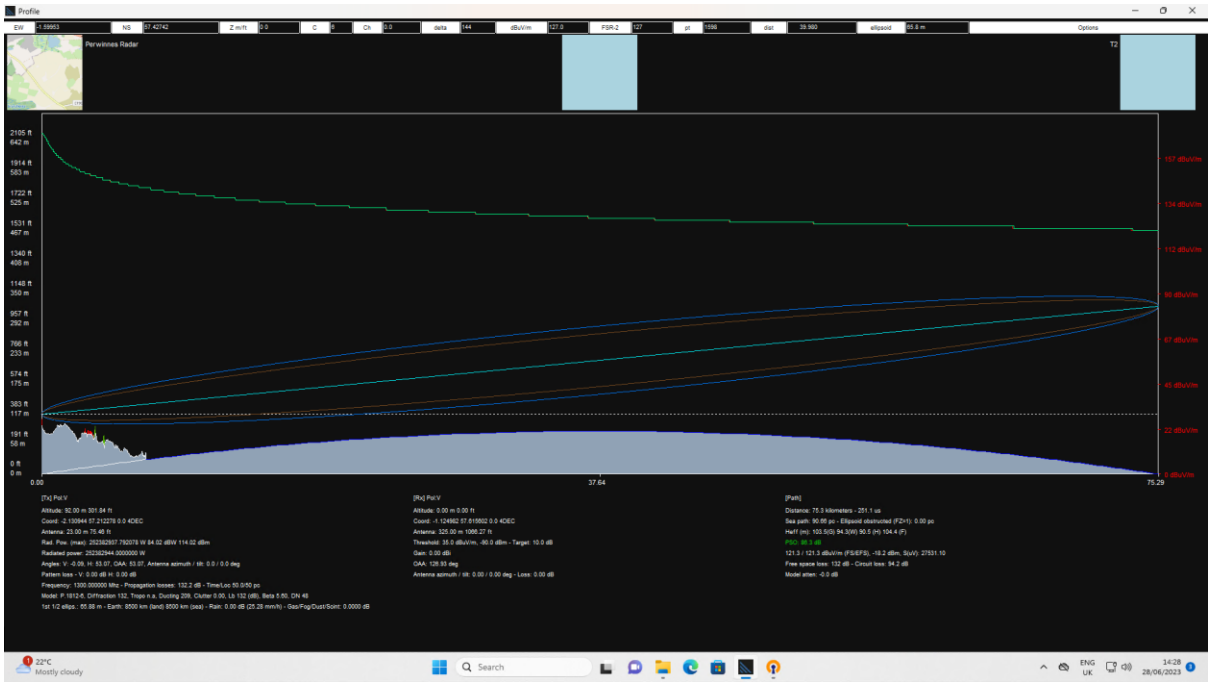

Profile
Perwinnes Radar
T9
0.00
35.85
71.71

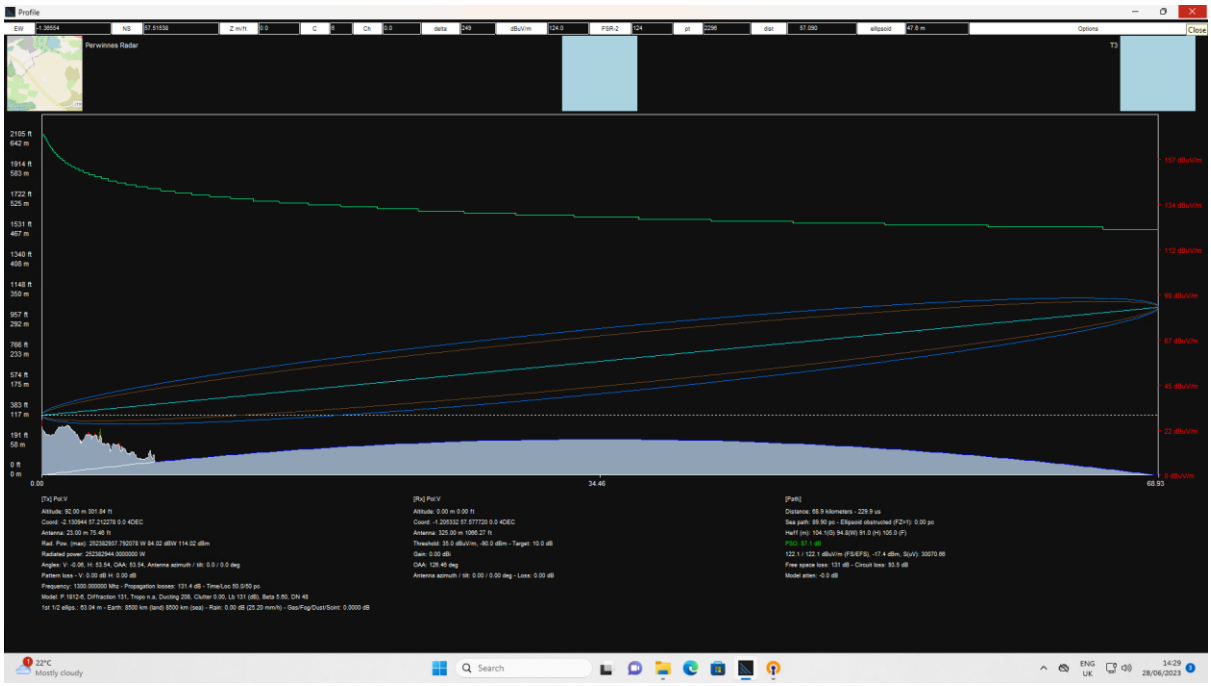

Profile
Perwinnes Radar
T10
0.00
36.16
72.32

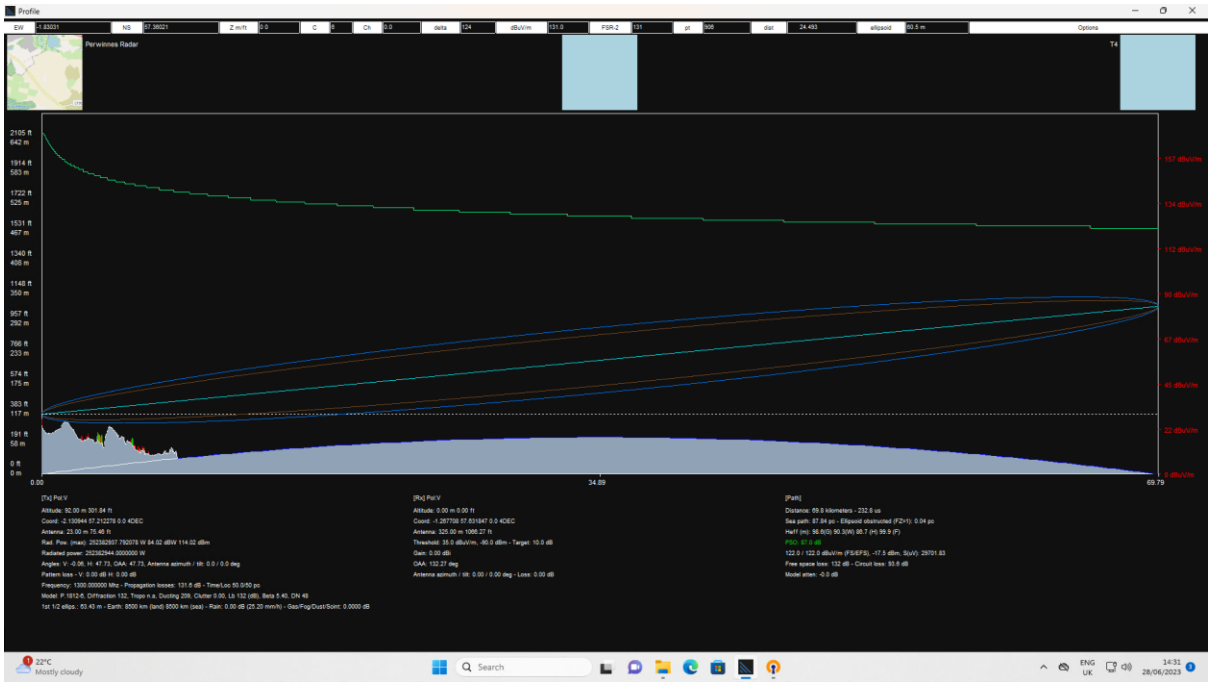


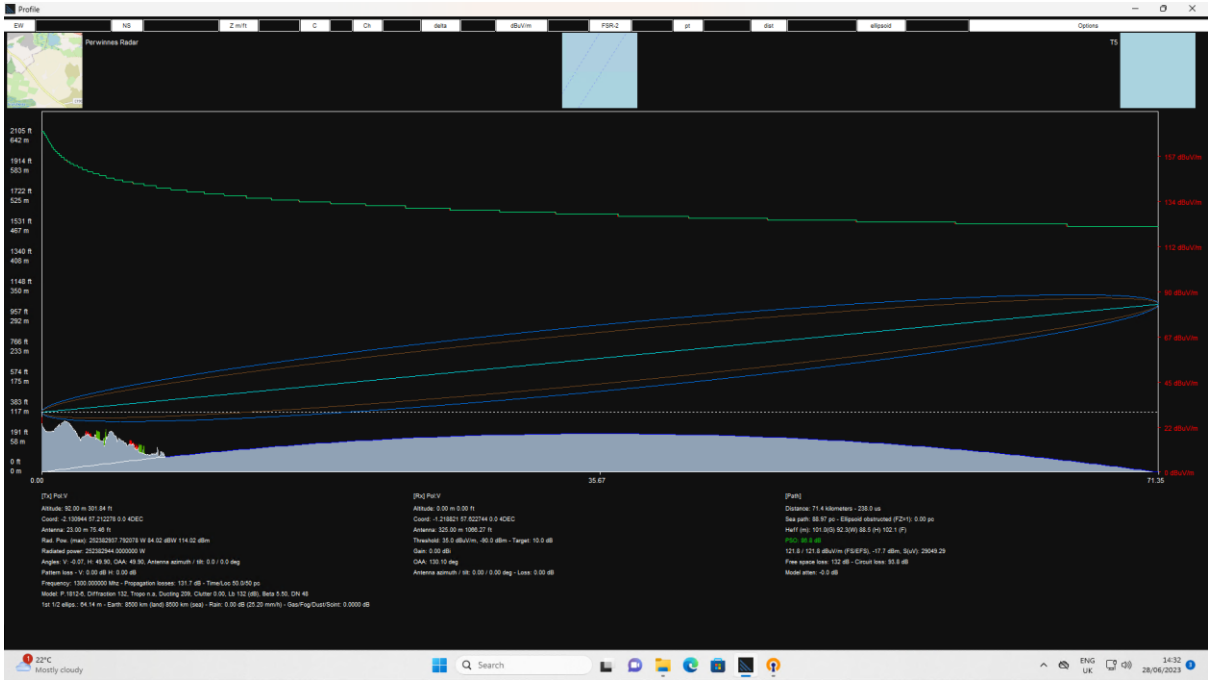
A2.4 Perwinnes Radar (WTG Tip Height 325m)

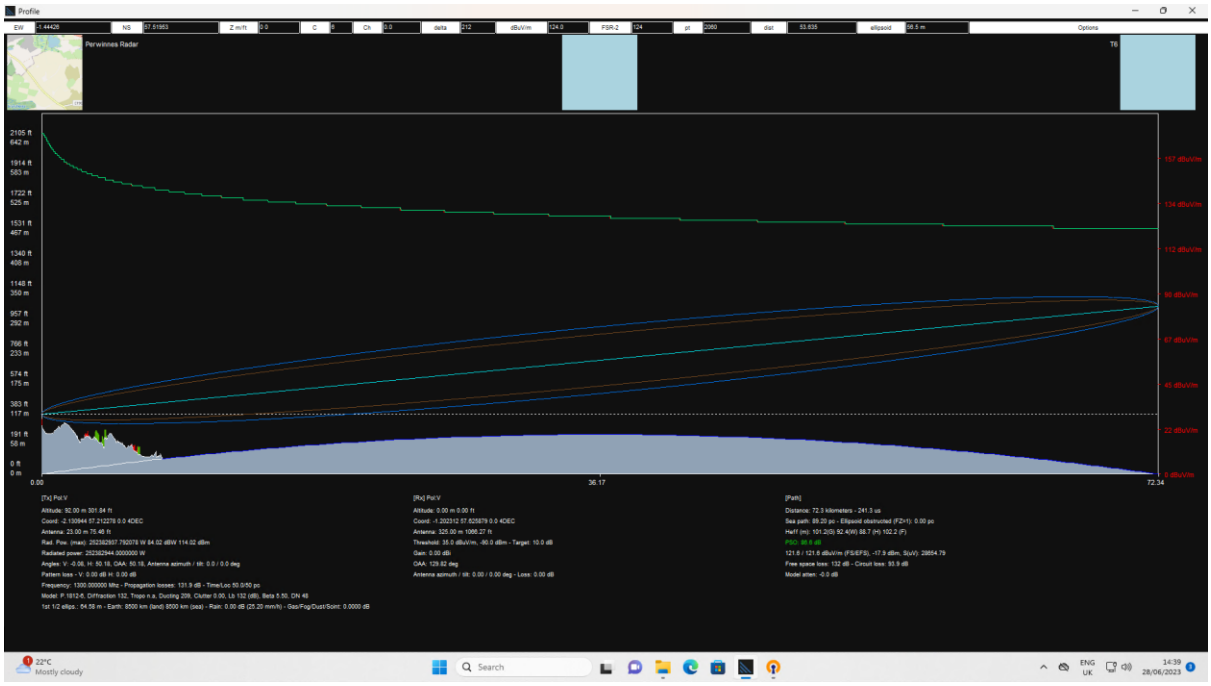


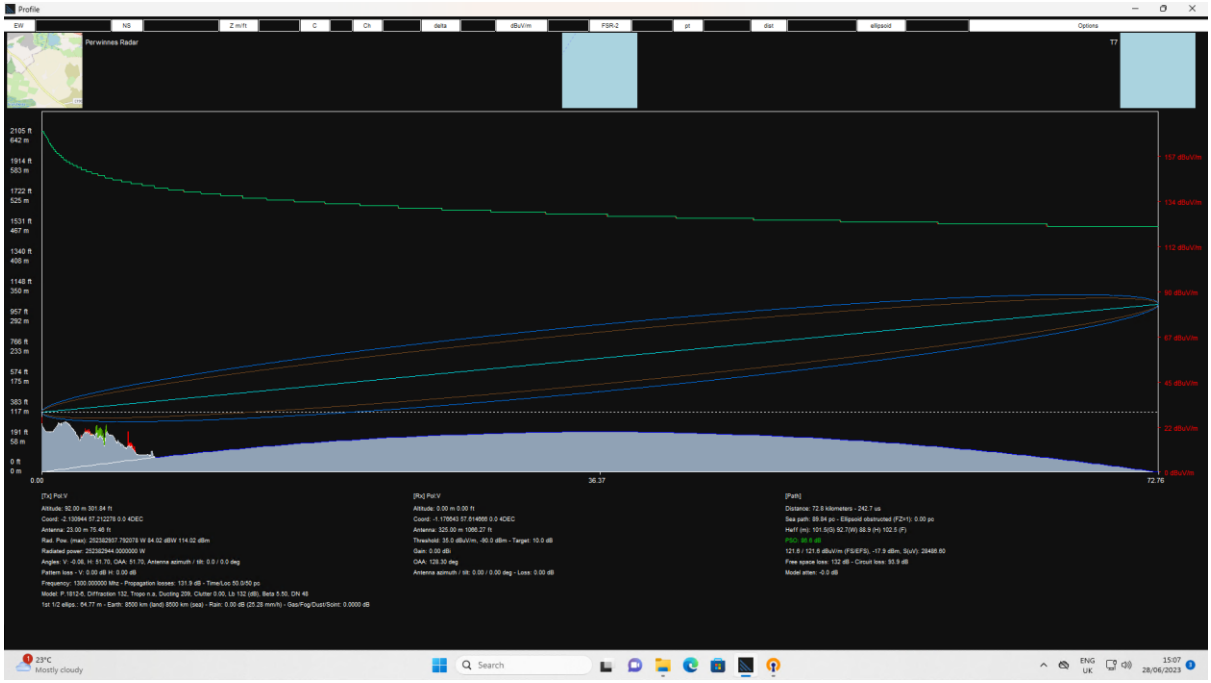

Profile
Perwinnes Radar
T2
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
37.64
75.29
157 dBuV/m
134 dBuV/m
112 dBuV/m
90 dBuV/m
67 dBuV/m
45 dBuV/m
22 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
14:28
28/06/2023

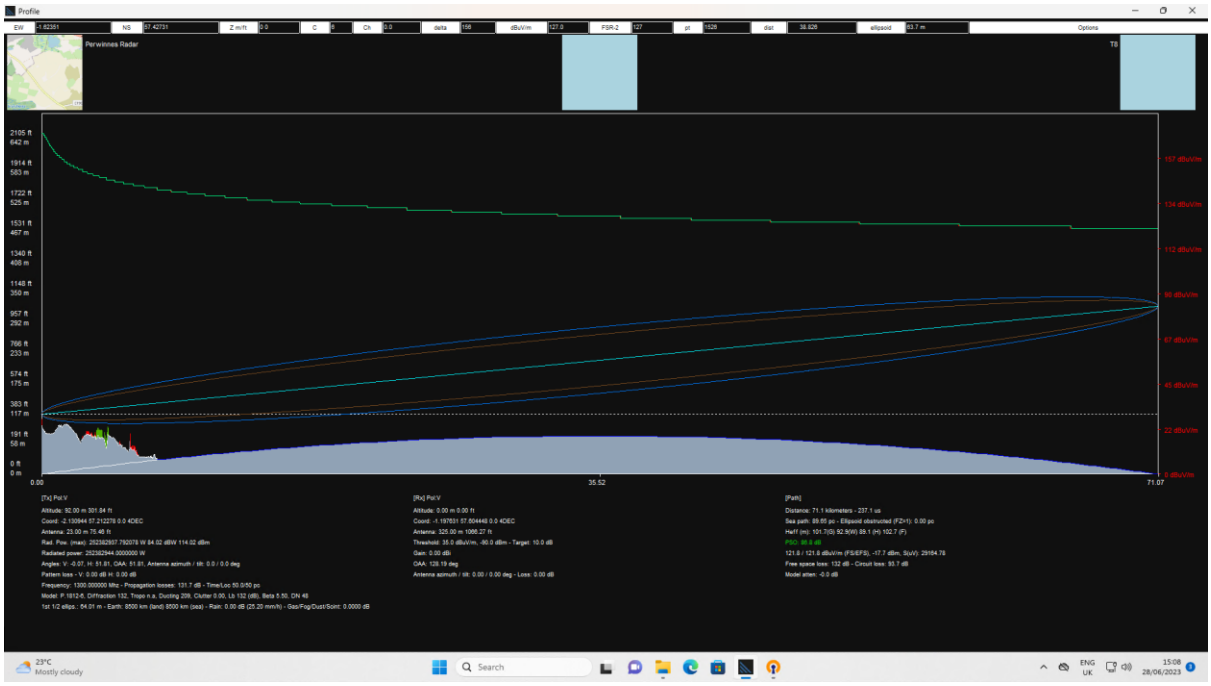

Profile
Perwinnes Radar
T3
Close
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
34.46
68.93
157 dBuV/m
134 dBuV/m
112 dBuV/m
90 dBuV/m
67 dBuV/m
45 dBuV/m
22 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
14:29
28/06/2023

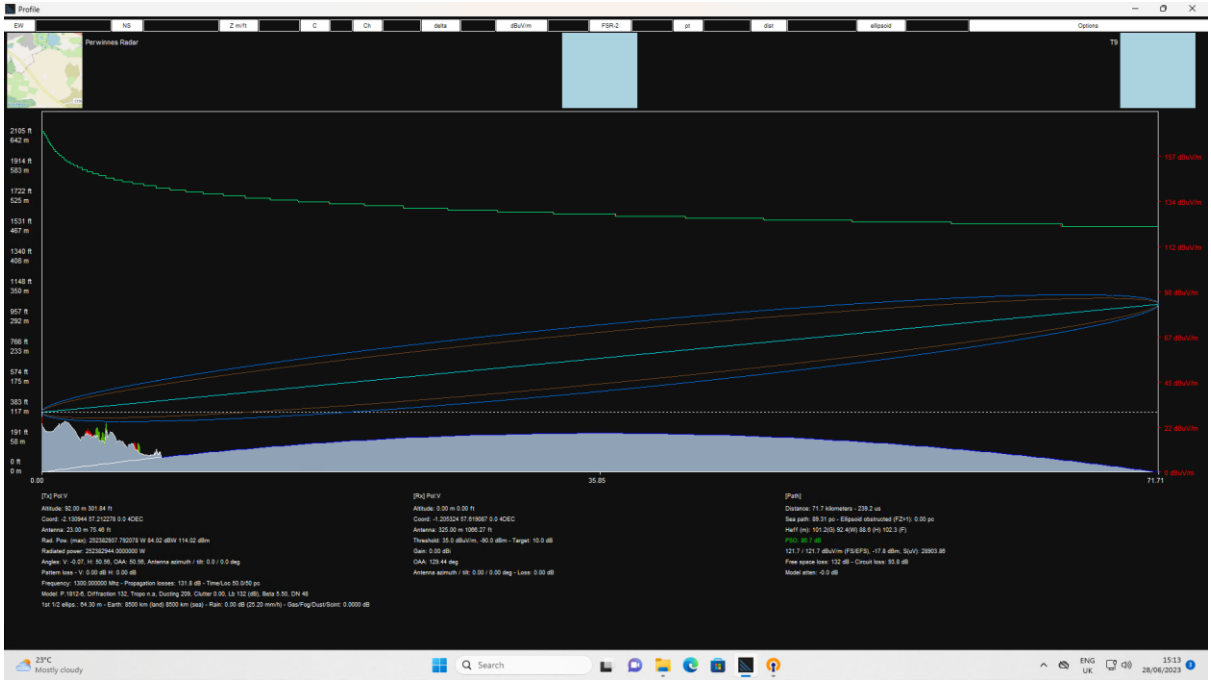

Profile
Perwinnes Radar
T4
0.00
34.89
69.79

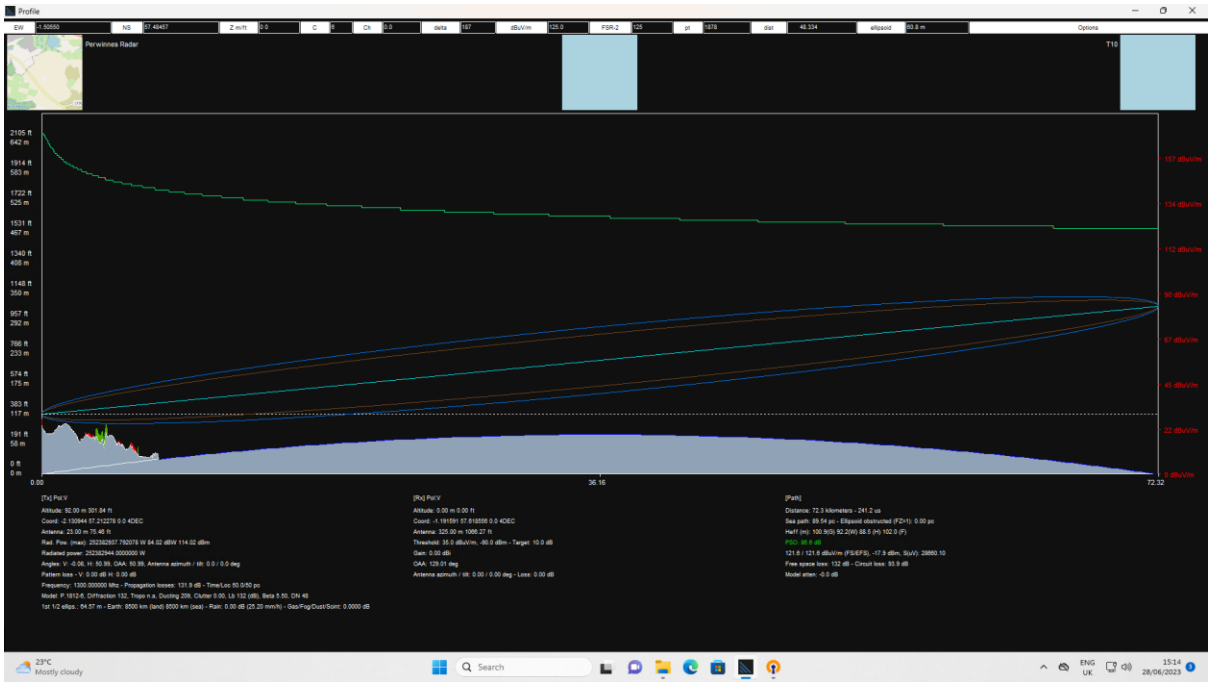

Profile
Perwinnes Radar
T5
0.00
35.67
71.35

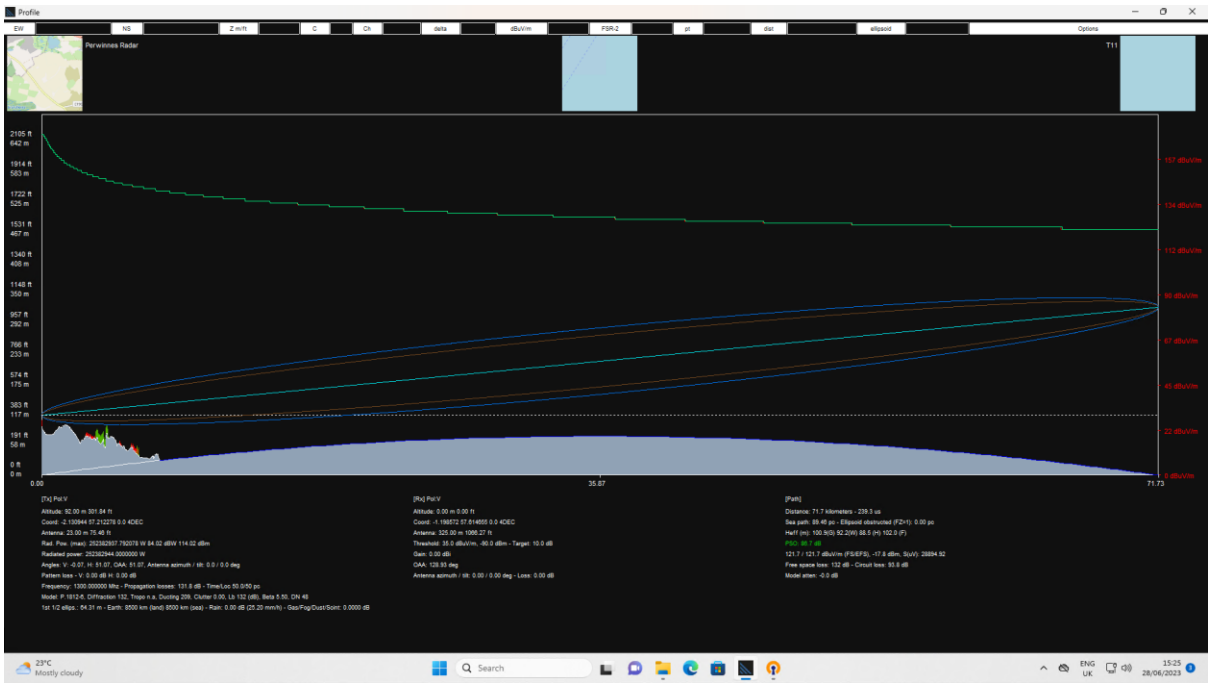

Profile
Perwinnes Radar
T6
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
36.17
72.34
157 dBuV/m
134 dBuV/m
112 dBuV/m
90 dBuV/m
67 dBuV/m
45 dBuV/m
22 dBuV/m
0 dBuV/m


Profile
Perwinnes Radar
T7
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
36.37
72.76
157 dBuV/m
134 dBuV/m
112 dBuV/m
90 dBuV/m
67 dBuV/m
45 dBuV/m
22 dBuV/m
0 dBuV/m

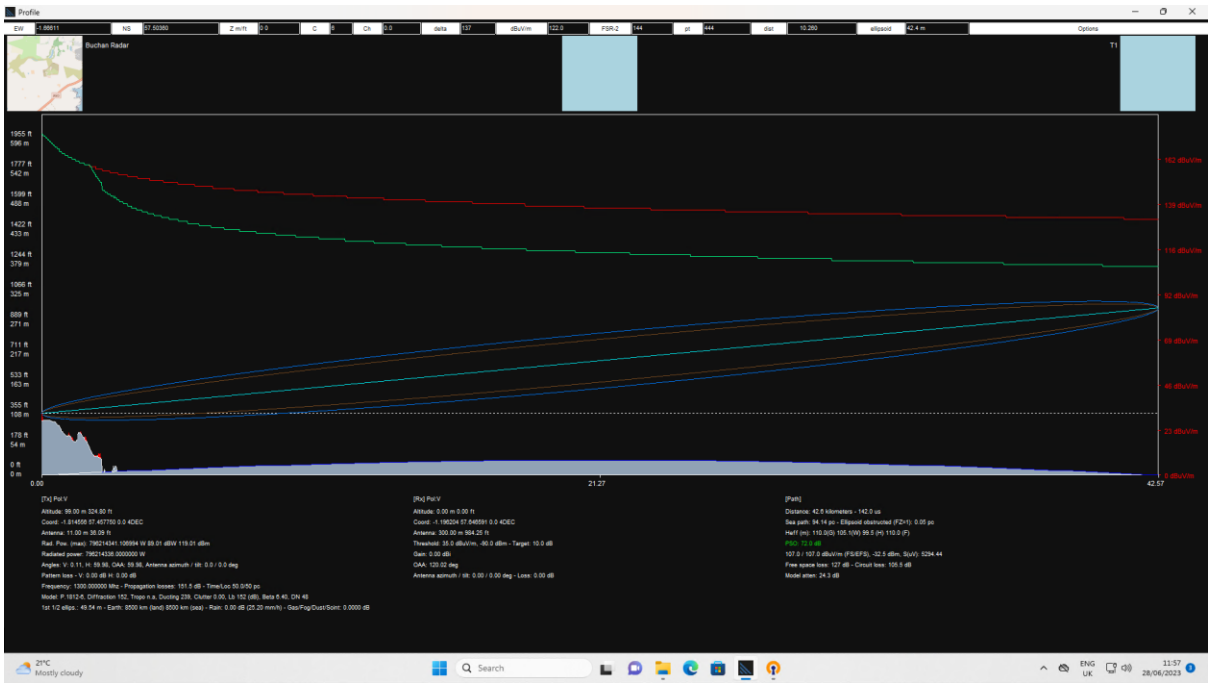

Profile
Perwinnes Radar
0.00
35.52
71.07

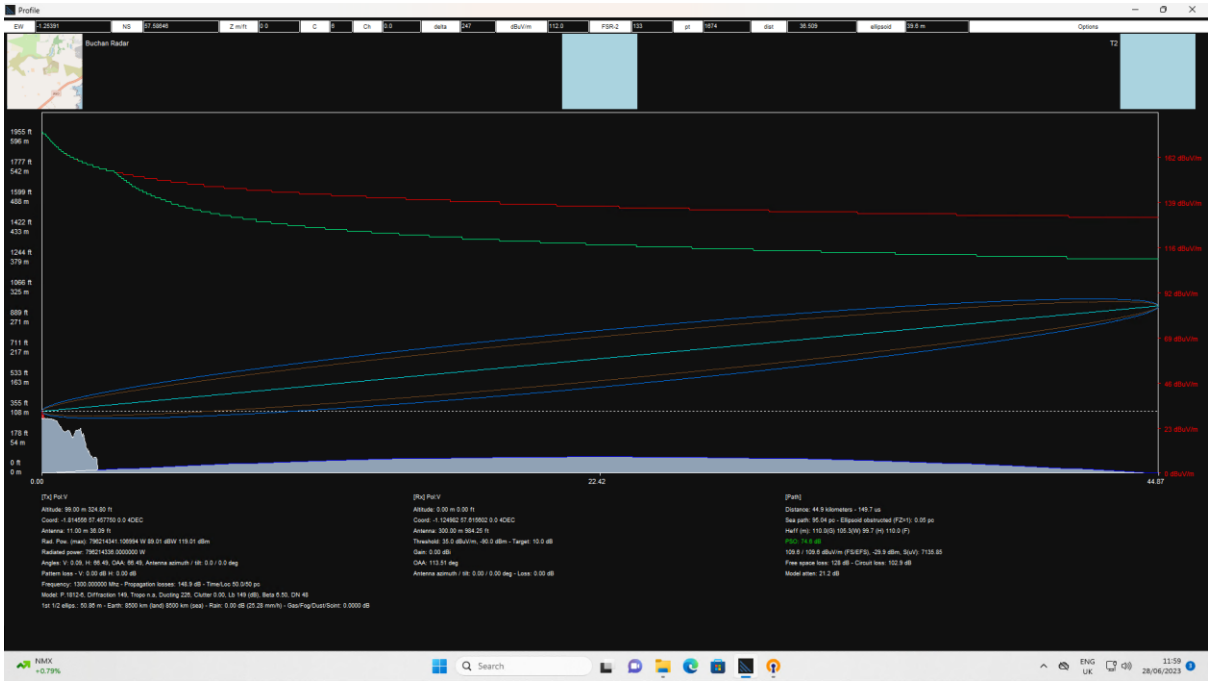

Profile
Perwinnes Radar
0.00
35.85
71.71

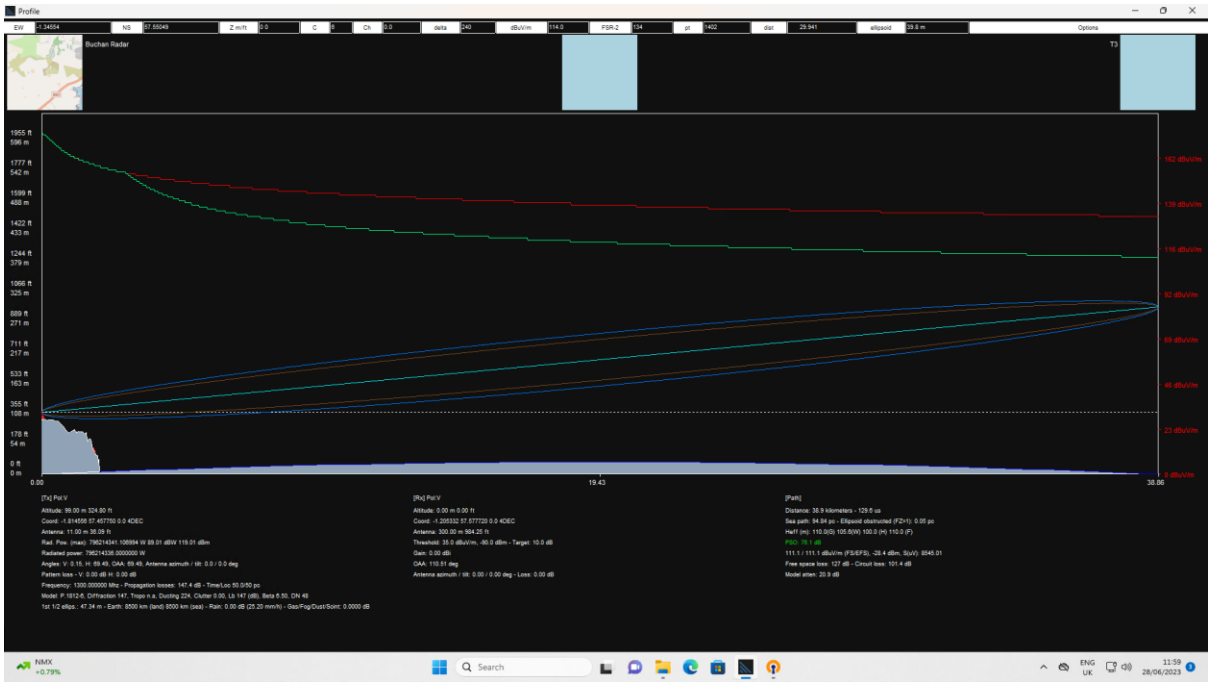

Profile
Perwinnes Radar
T10
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
36.16
72.32
157 dBuV/m
134 dBuV/m
112 dBuV/m
90 dBuV/m
67 dBuV/m
45 dBuV/m
22 dBuV/m
0 dBuV/m

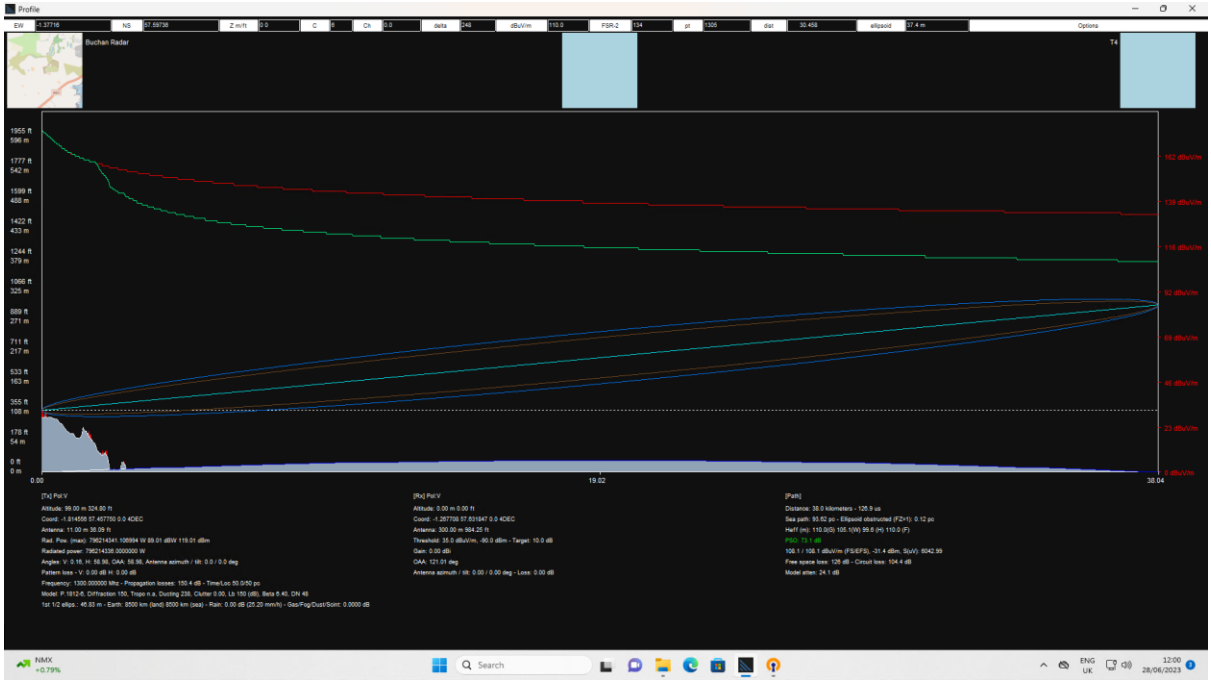

Profile
Perwinnes Radar
T11
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
35.87
71.73
157 dBuV/m
134 dBuV/m
112 dBuV/m
90 dBuV/m
67 dBuV/m
45 dBuV/m
22 dBuV/m
0 dBuV/m

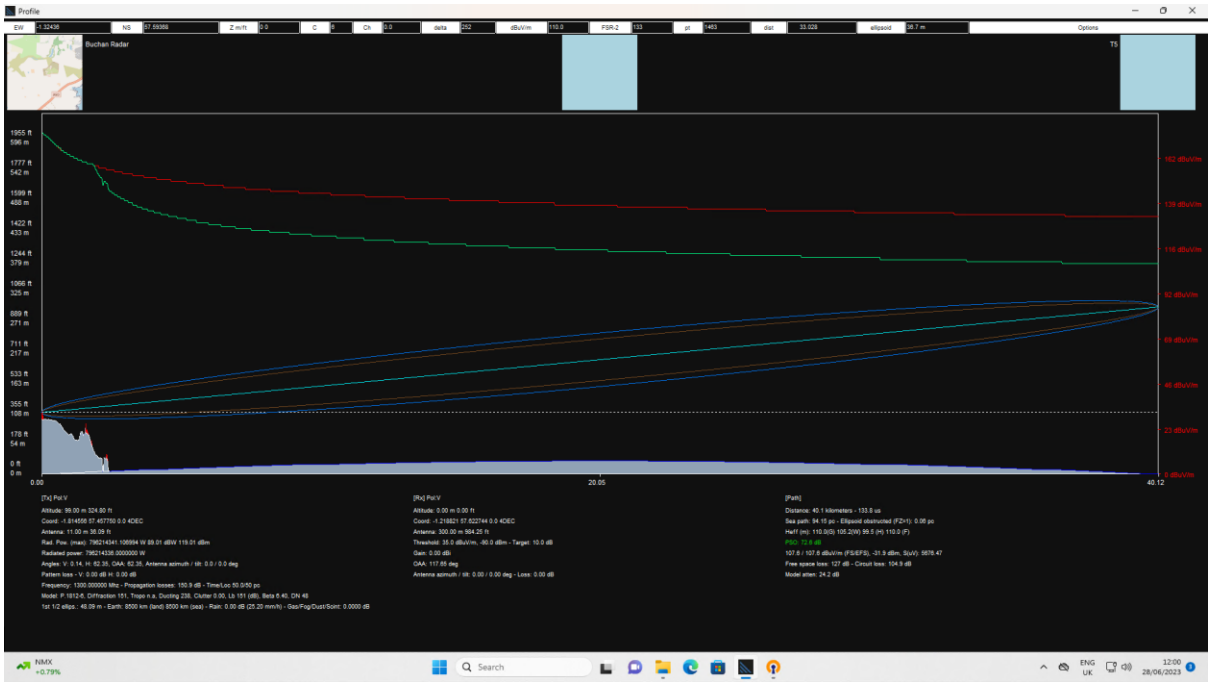
A2.5 Buchan Radar (WTG Tip Height 300m)

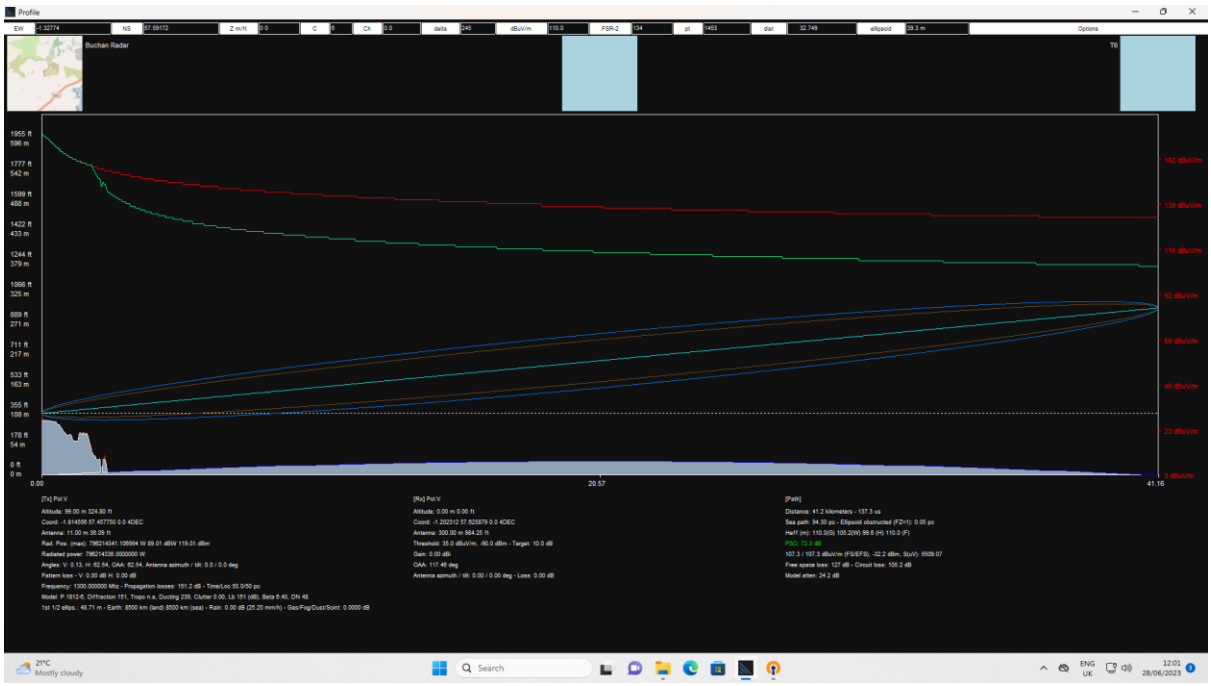


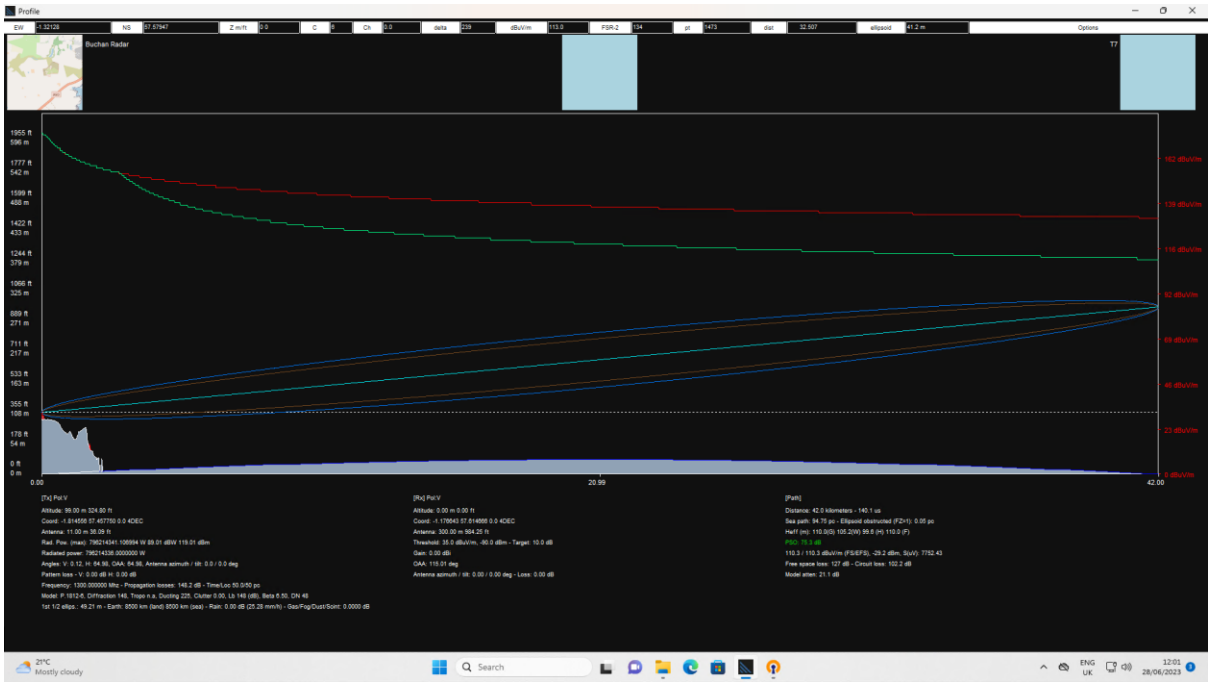


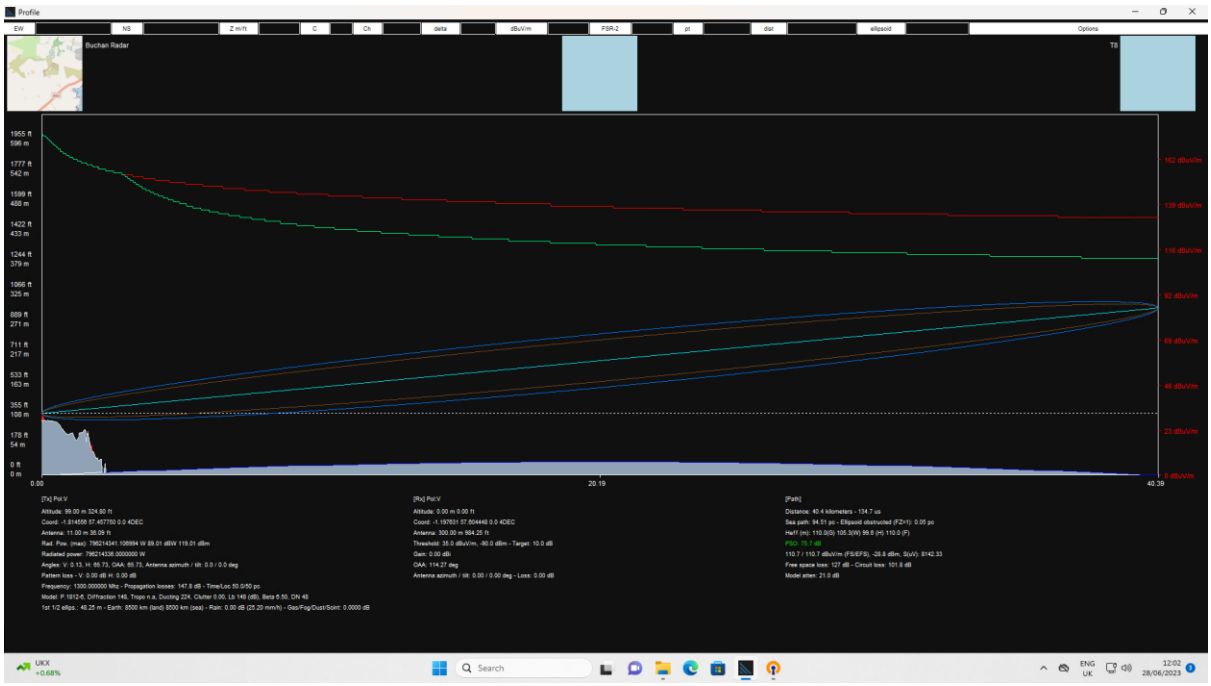

Profile
Buchan Radar
T3
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
19.43
38.86

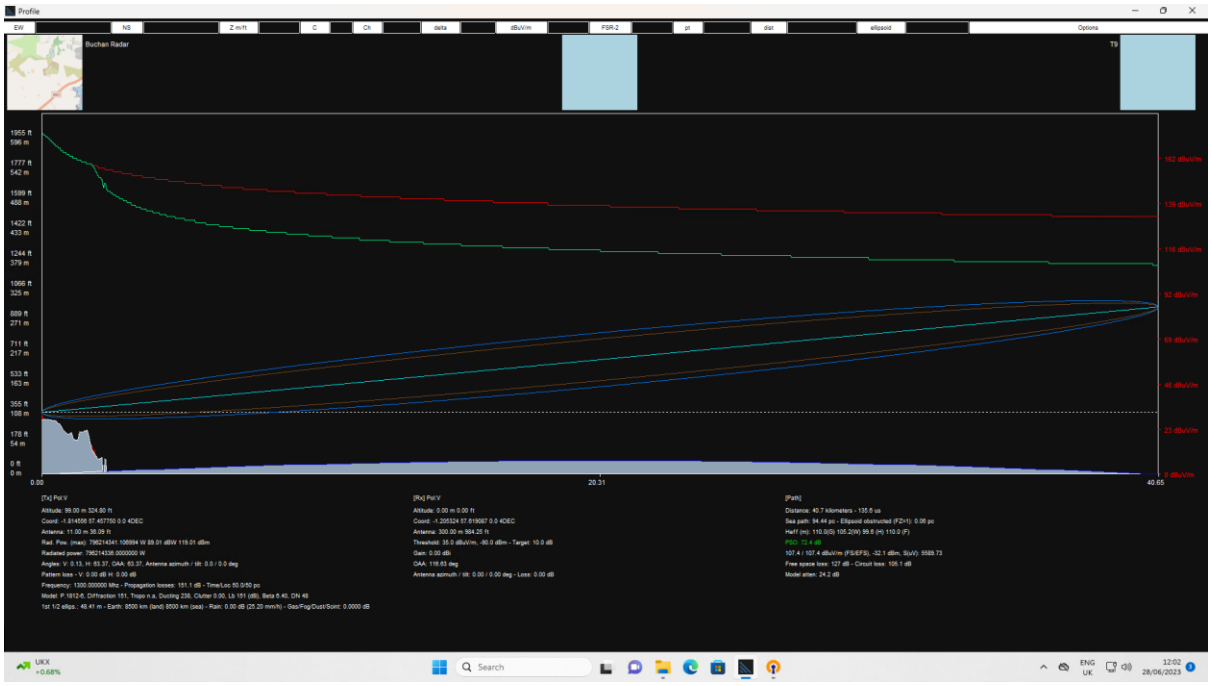

Profile
Buchan Radar
T4
1955 ft
596 m
1777 ft
542 m
1599 ft
488 m
1422 ft
433 m
1244 ft
379 m
1066 ft
325 m
889 ft
271 m
711 ft
217 m
533 ft
163 m
355 ft
108 m
178 ft
54 m
0 ft
0 m
0.00
19.02
38.04

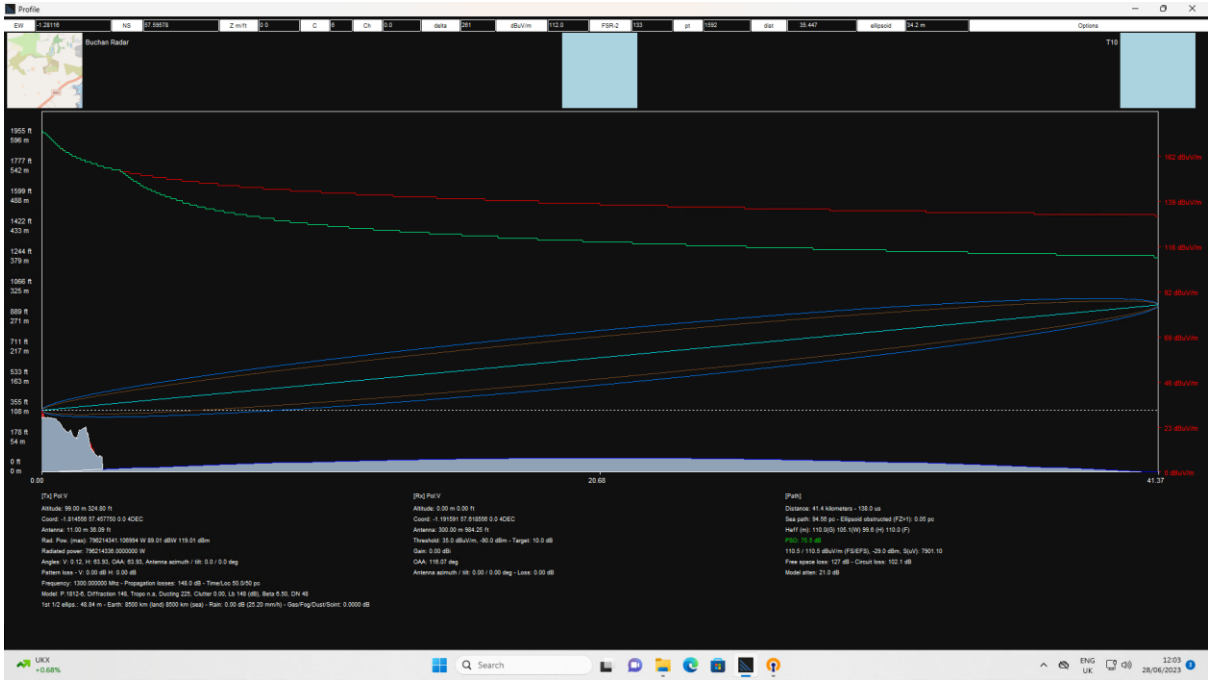

Profile
Buchan Radar
0.00
20.05
40.12

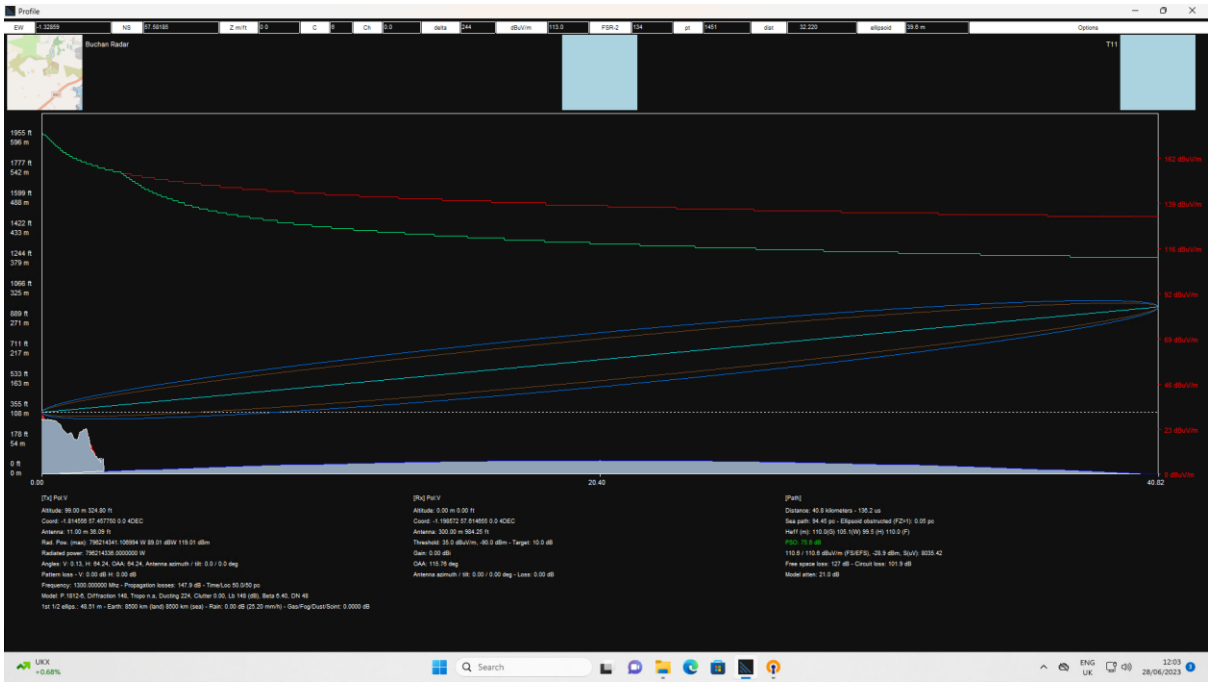

Profile
Buchan Radar
0.00
20.57
41.16


Profile
Buchan Radar
T7
0.00
20.99
42.00

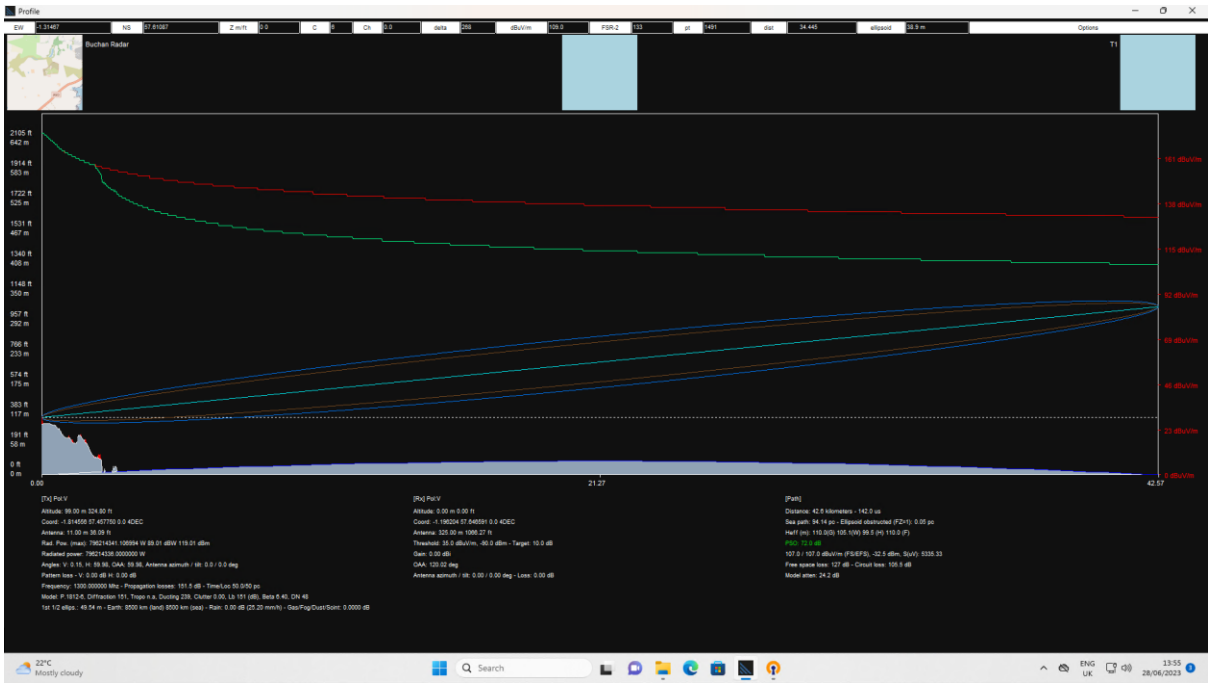

Profile
Buchan Radar
T8
0.00
20.19
40.39

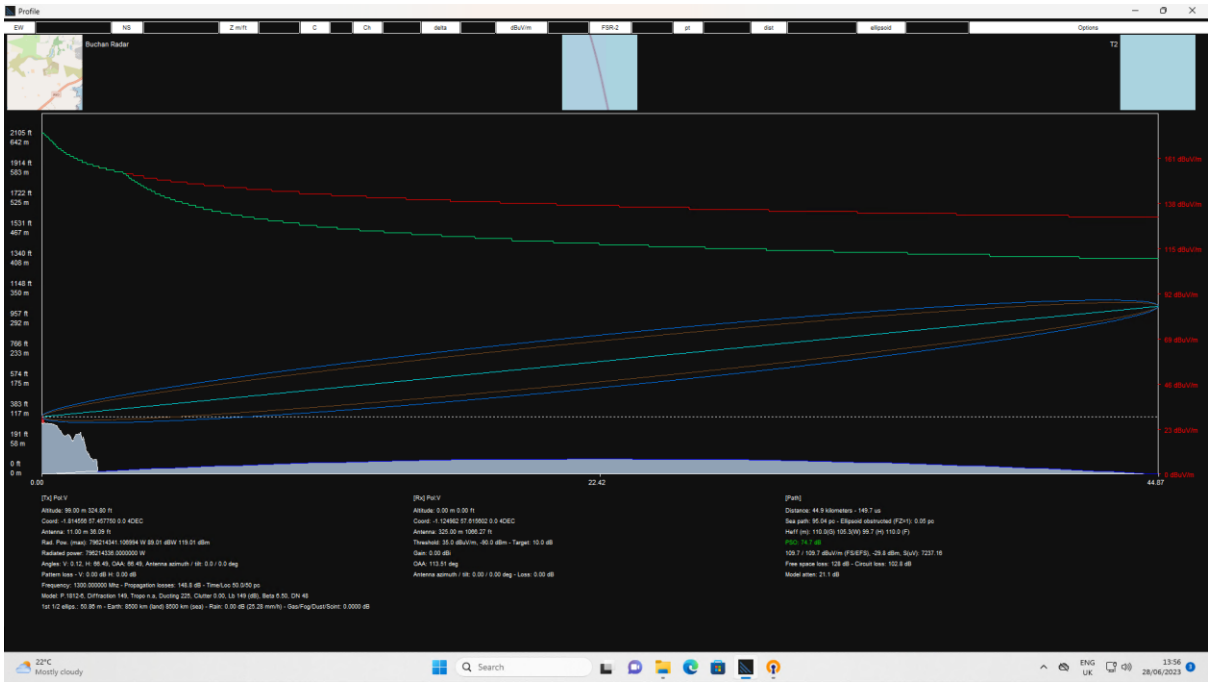

Profile
Buchan Radar
T9
0.00
20.31
40.65

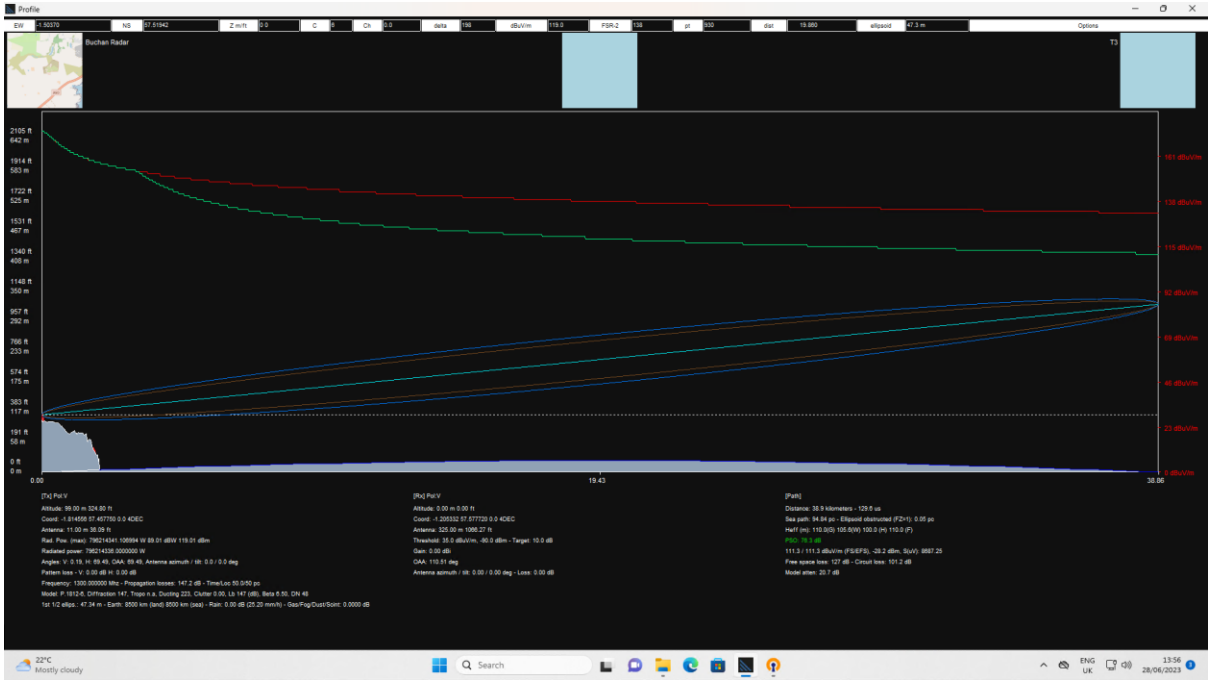

Profile
Buchan Radar
T10
0.00
20.68
41.37



A2.6 Buchan Radar (WTG Tip Height 325m)







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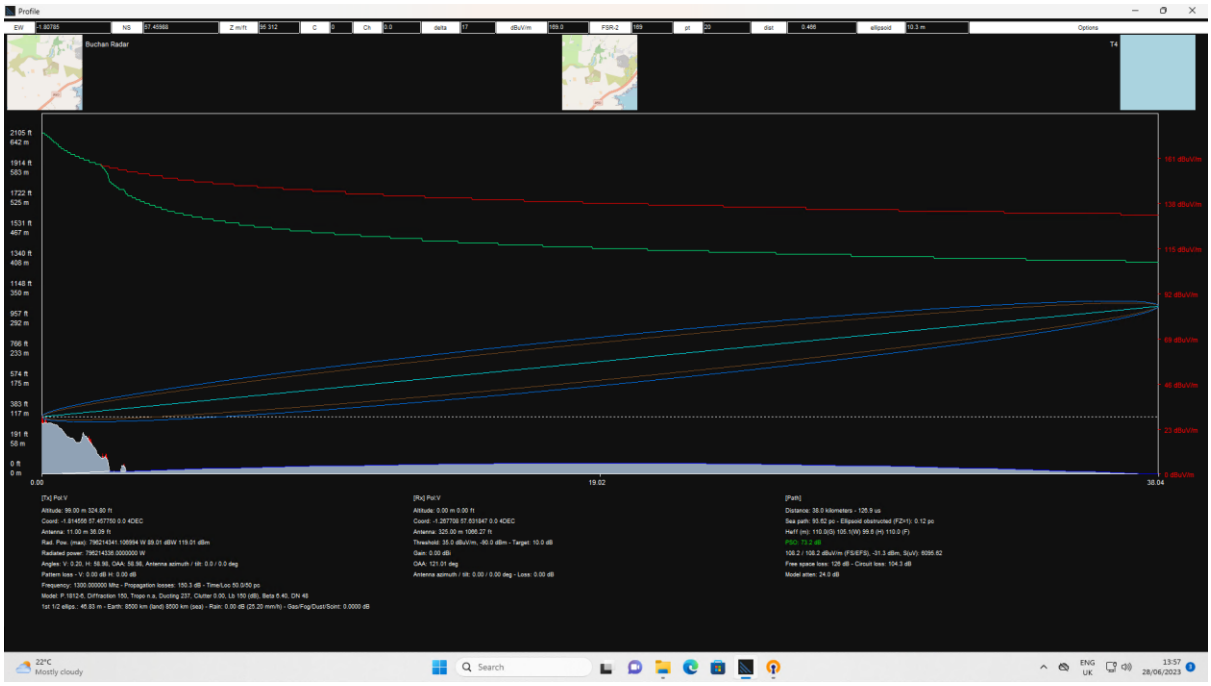
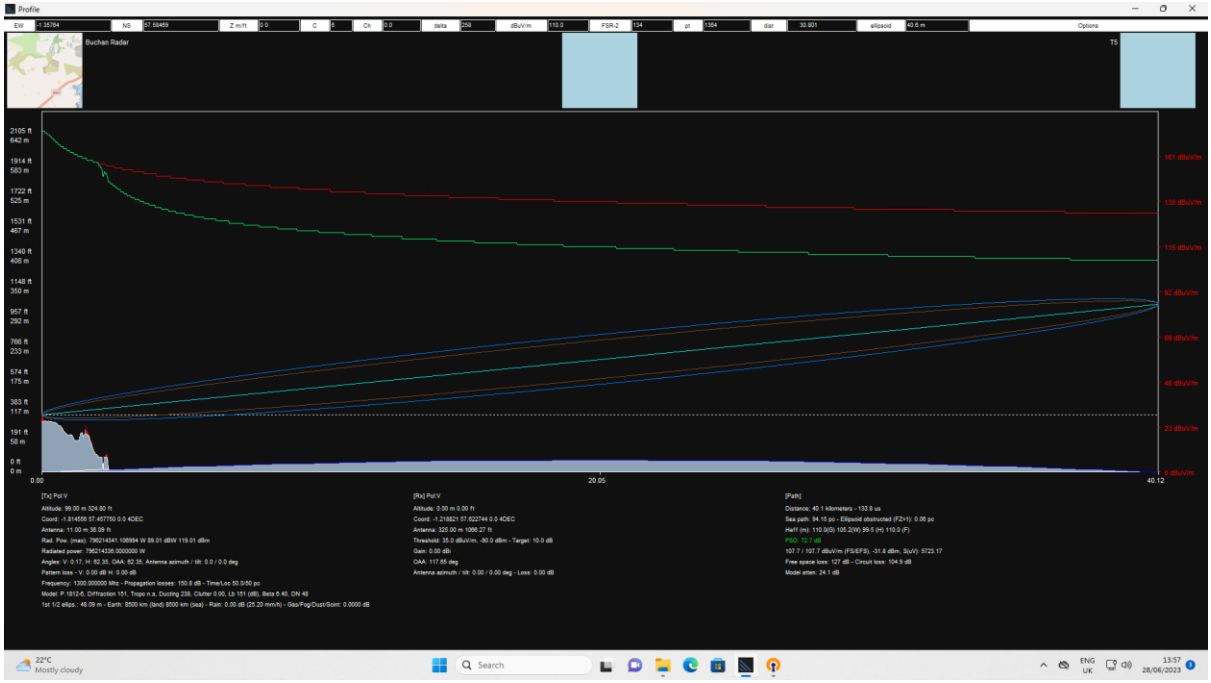
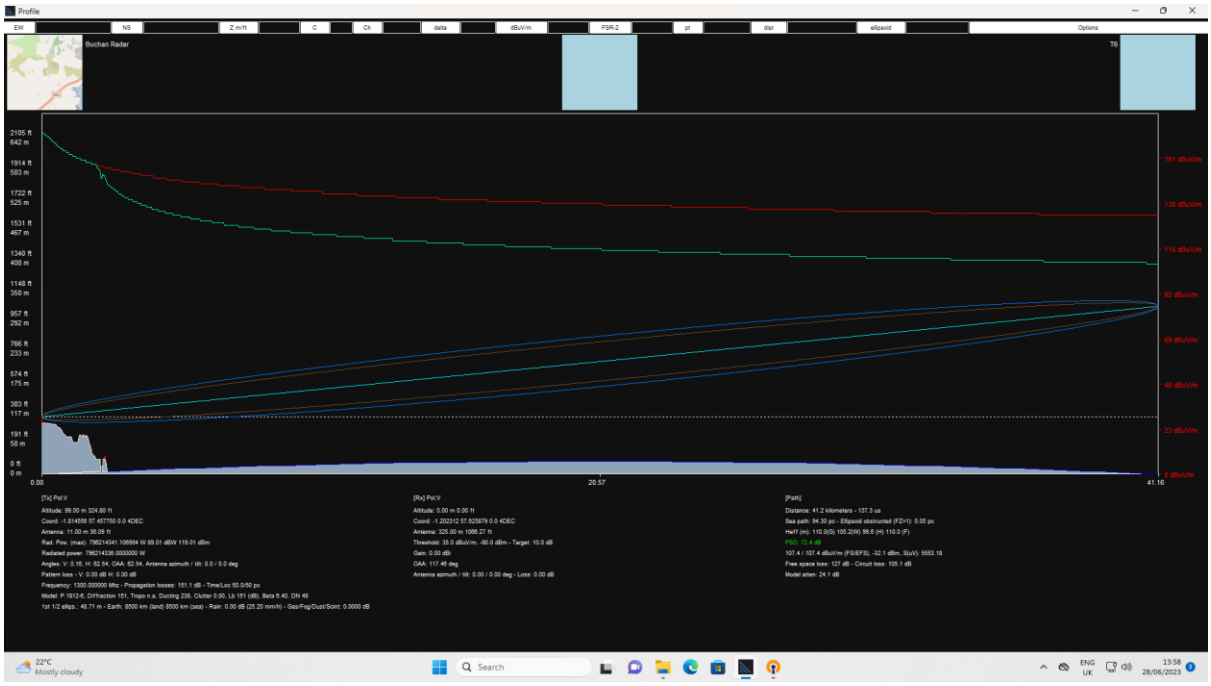
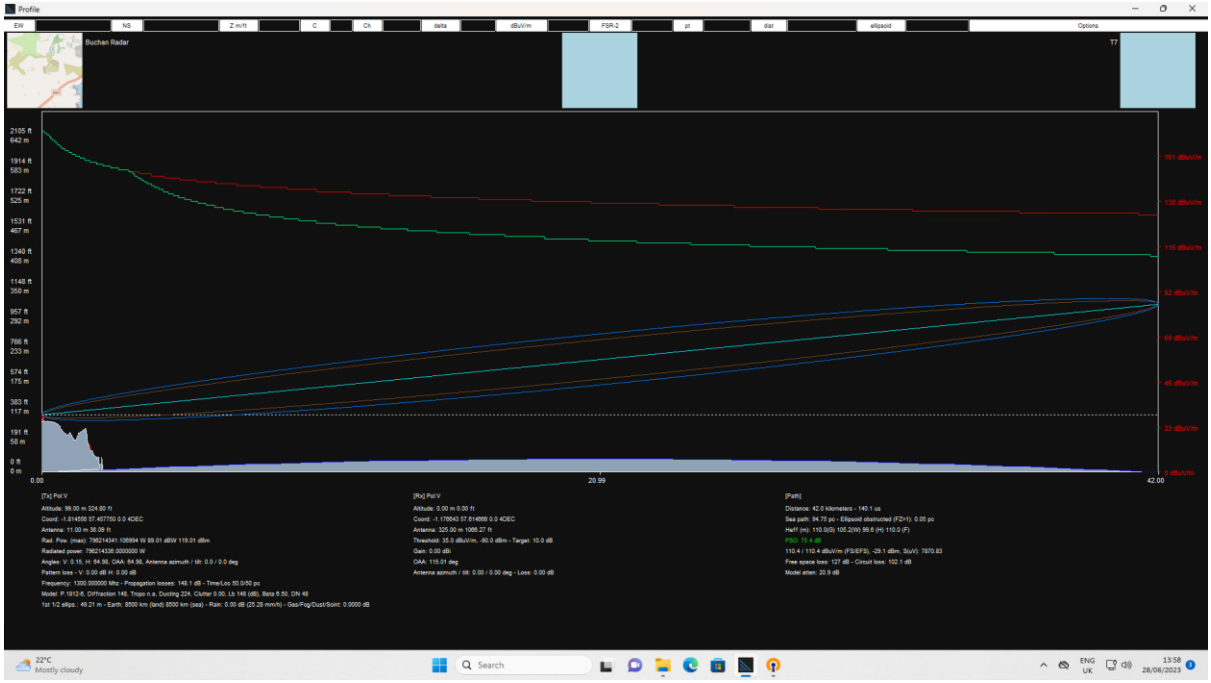
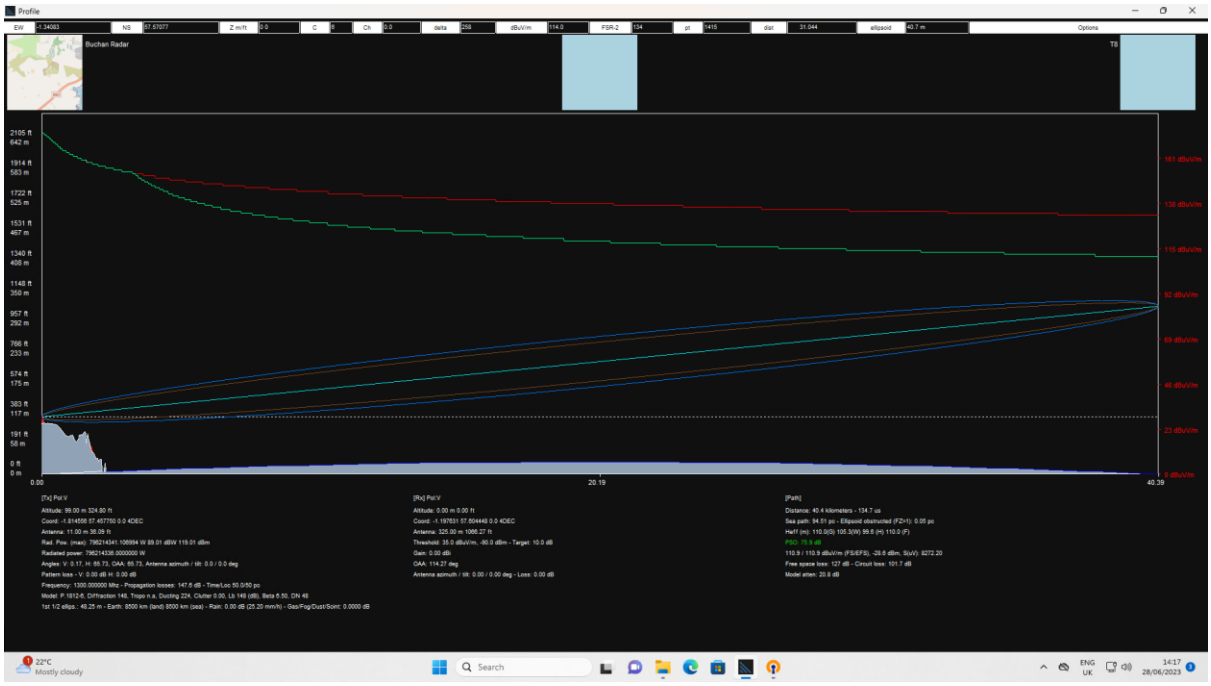
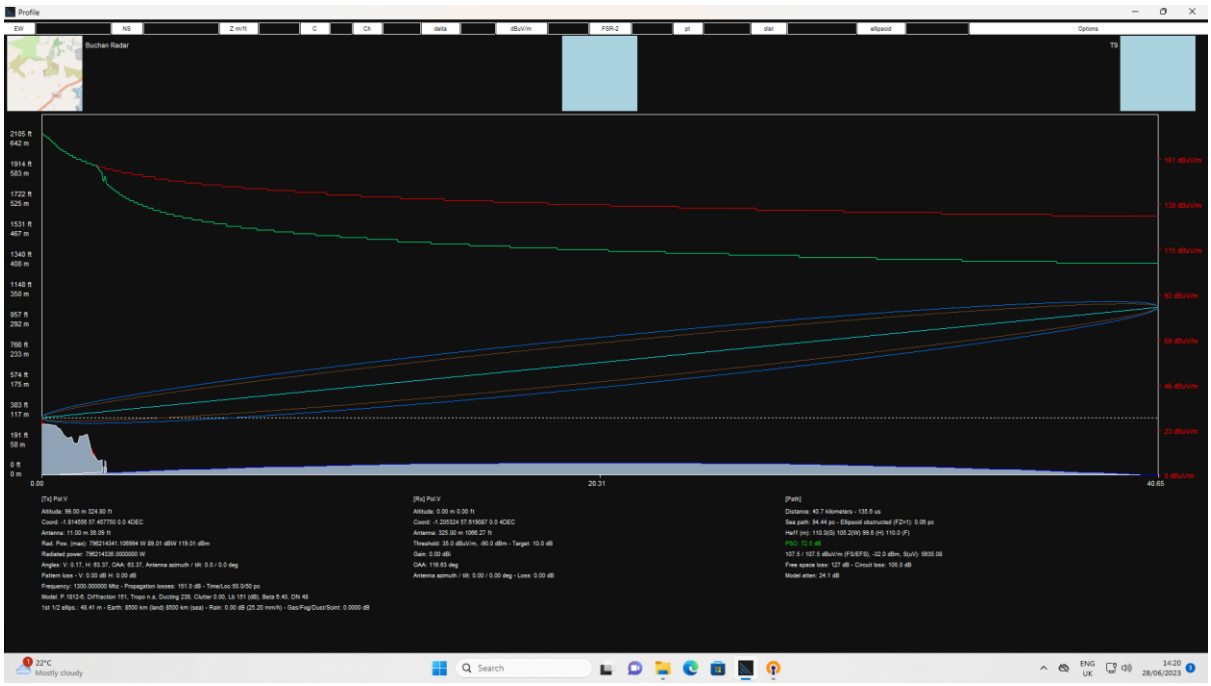

Profile
Buchan Radar
T4
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
19.02
38.04
161 dBuV/m
138 dBuV/m
115 dBuV/m
92 dBuV/m
69 dBuV/m
46 dBuV/m
23 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
13:57
28/06/2023

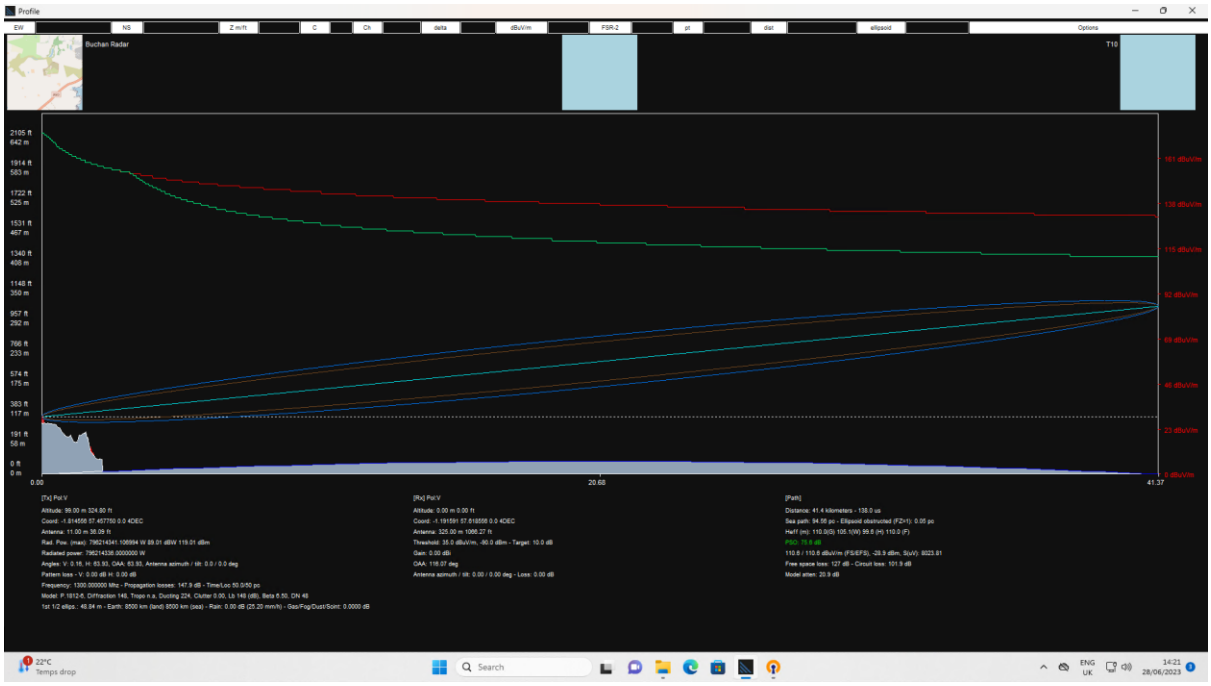

Profile
Buchan Radar
T5
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
20.05
40.12
161 dBuV/m
138 dBuV/m
115 dBuV/m
92 dBuV/m
69 dBuV/m
46 dBuV/m
23 dBuV/m
0 dBuV/m
[Tx] Pol:V
[Rx] Pol:V
[Path]
22°C
Mostly cloudy
Search
ENG
UK
13:57
28/06/2023

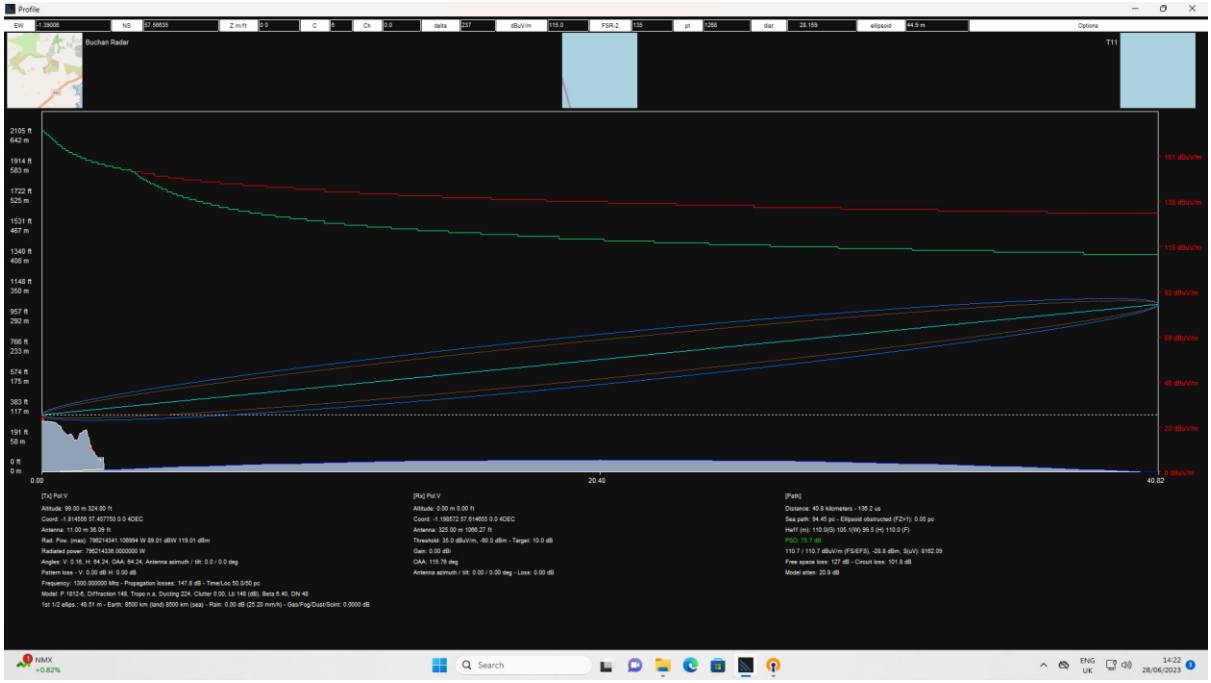

Profile
Buchan Radar
T6
0.00
20.57
41.16


Profile
Buchan Radar
T7
0.00
20.99
42.00

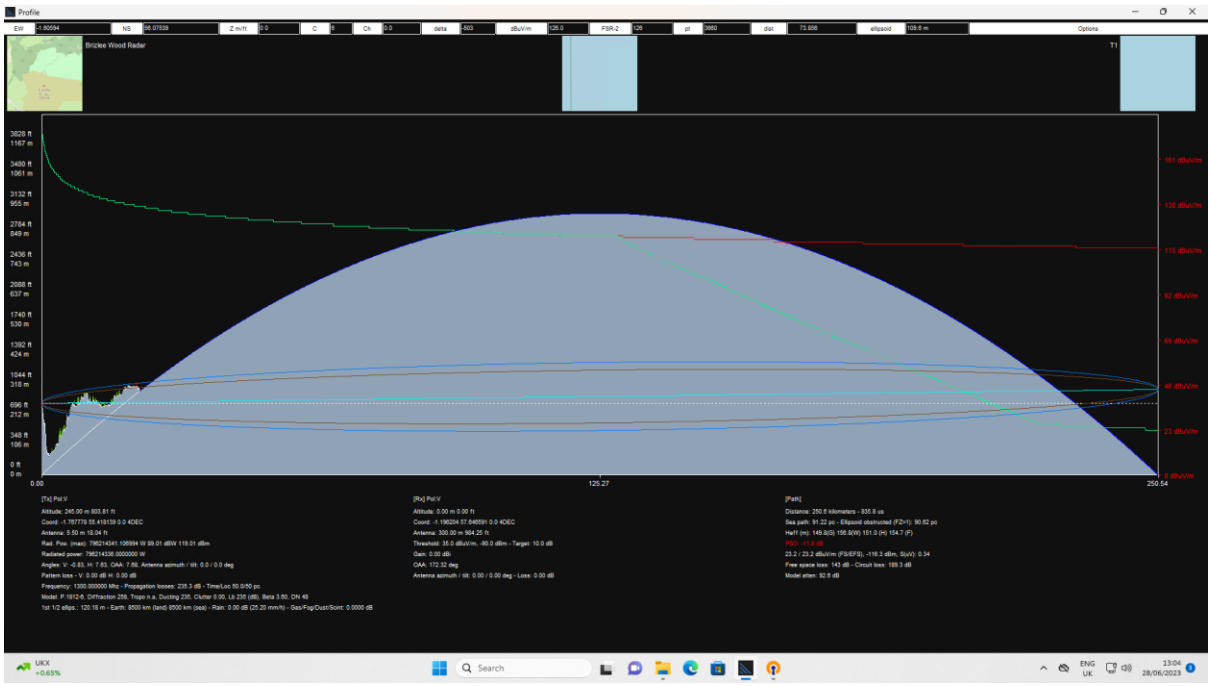

Profile
Buchan Radar
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
20.19
40.39

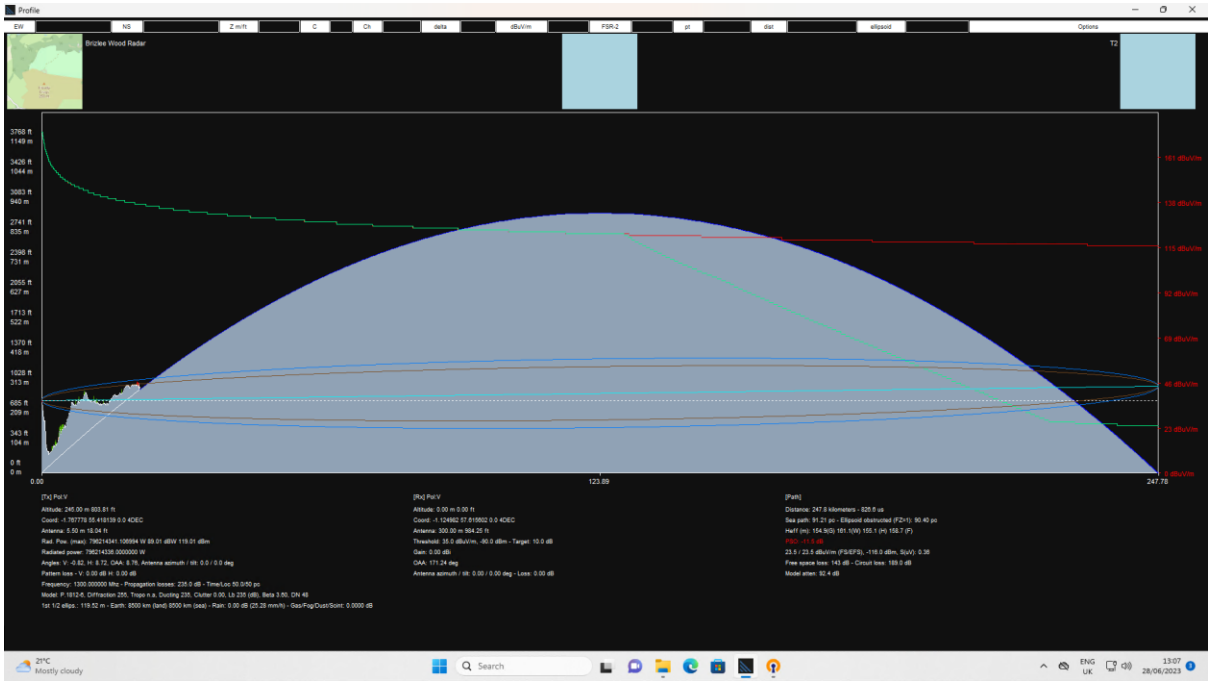

Profile
Buchan Radar
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
20.31
40.65

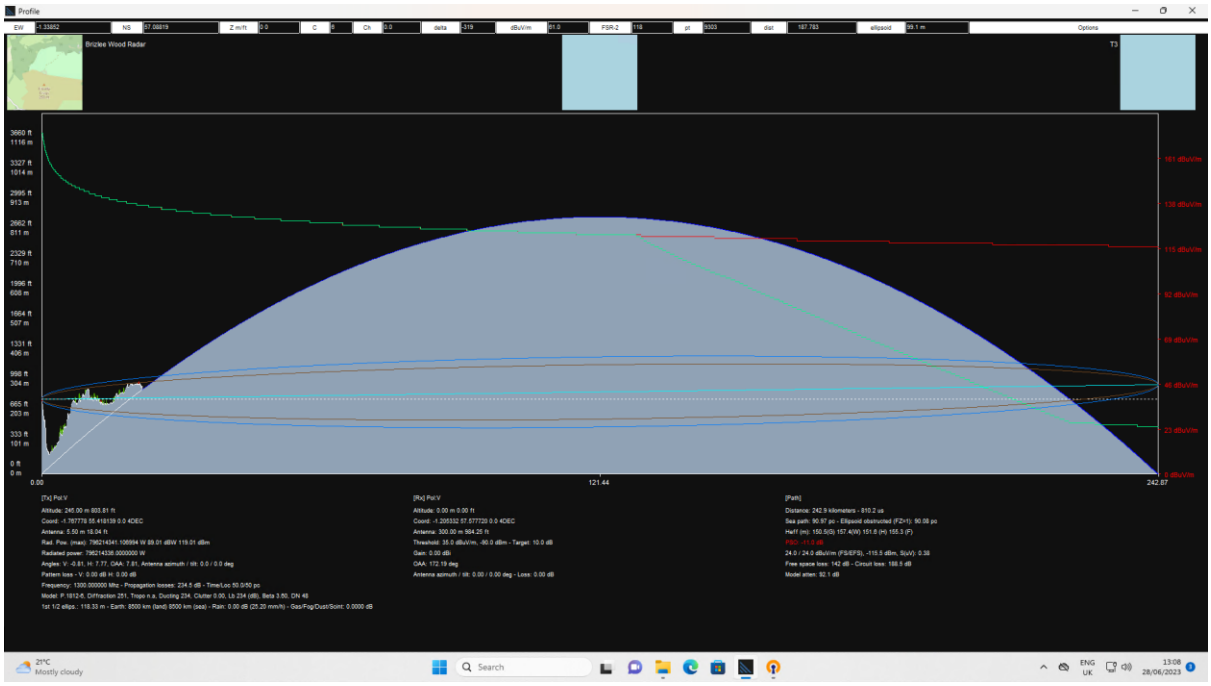

Profile
Buchan Radar
T10
0.00
20.68
41.37

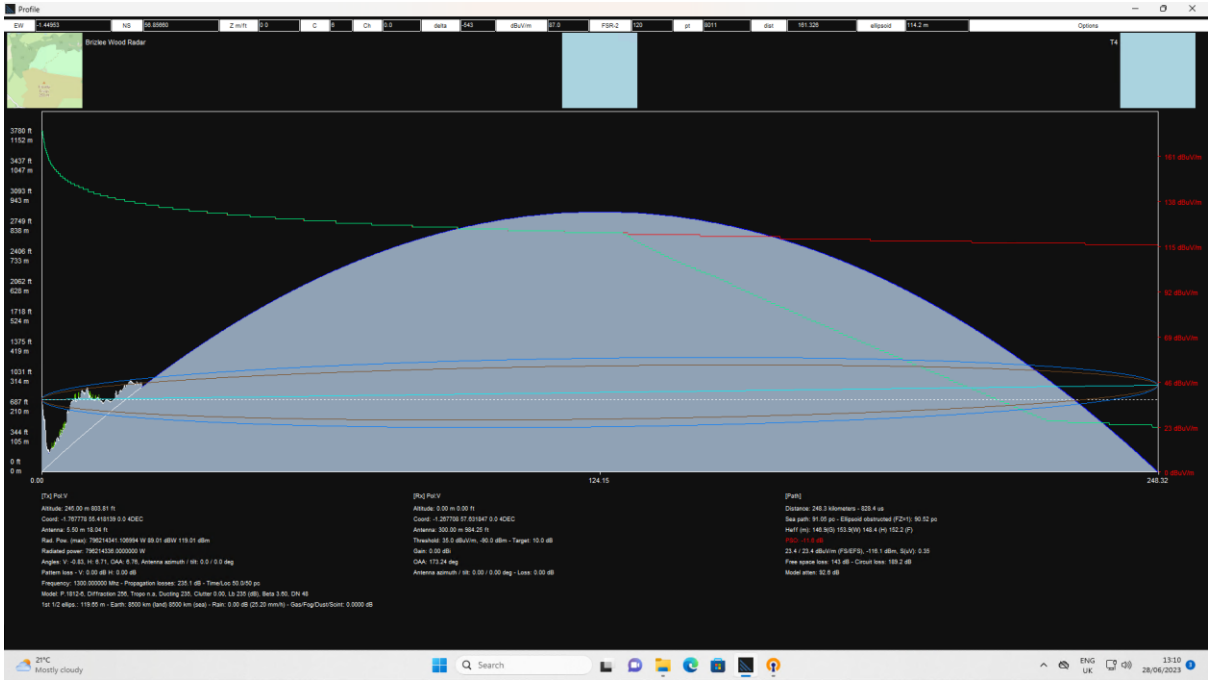

Profile
Buchan Radar
T11
0.00
20.40
40.82

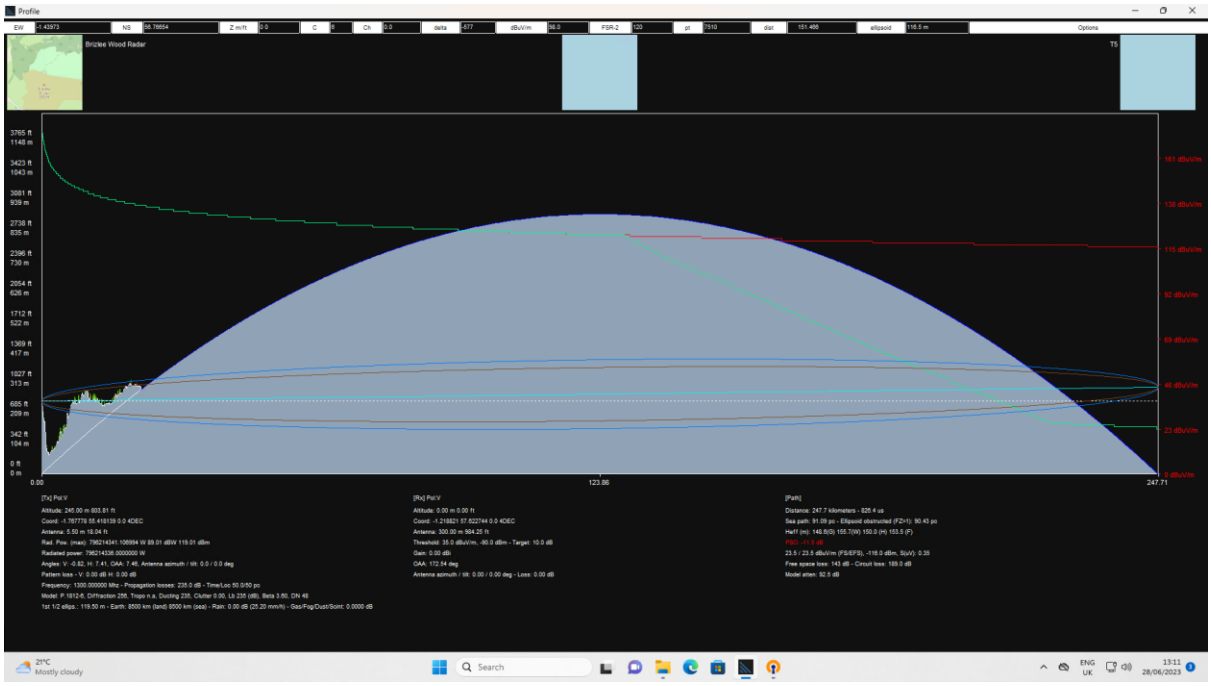
A2.7 Brizlee Wood Radar (WTG Tip Height 300m)

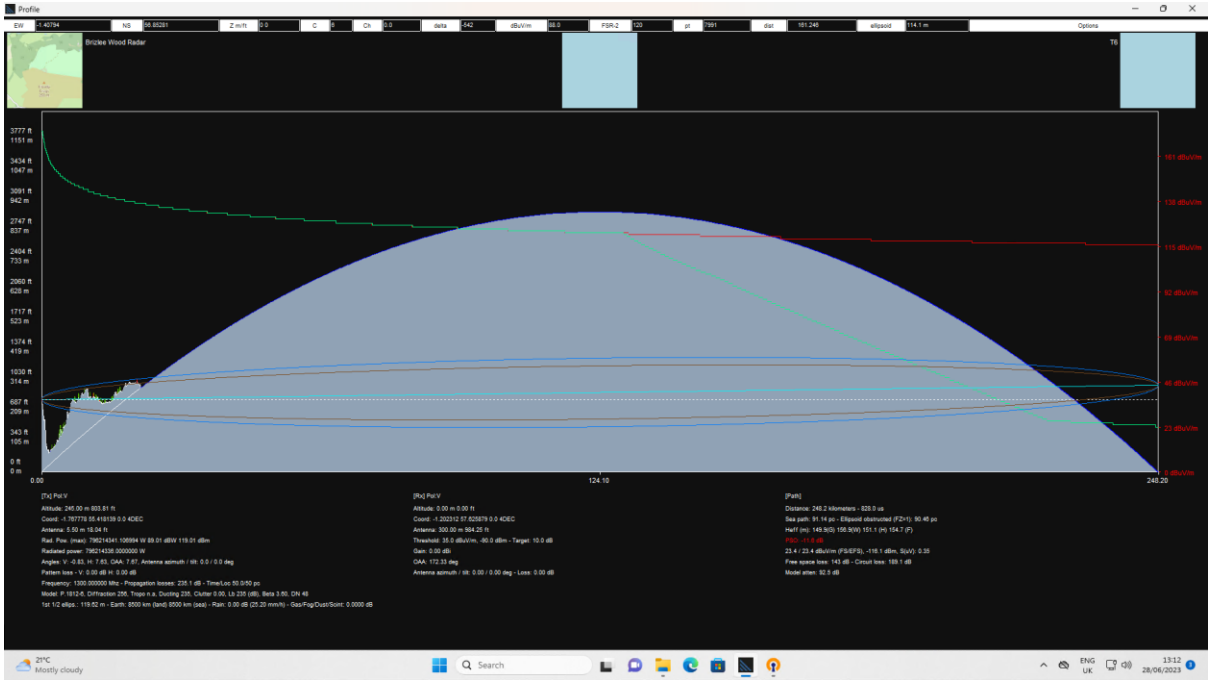


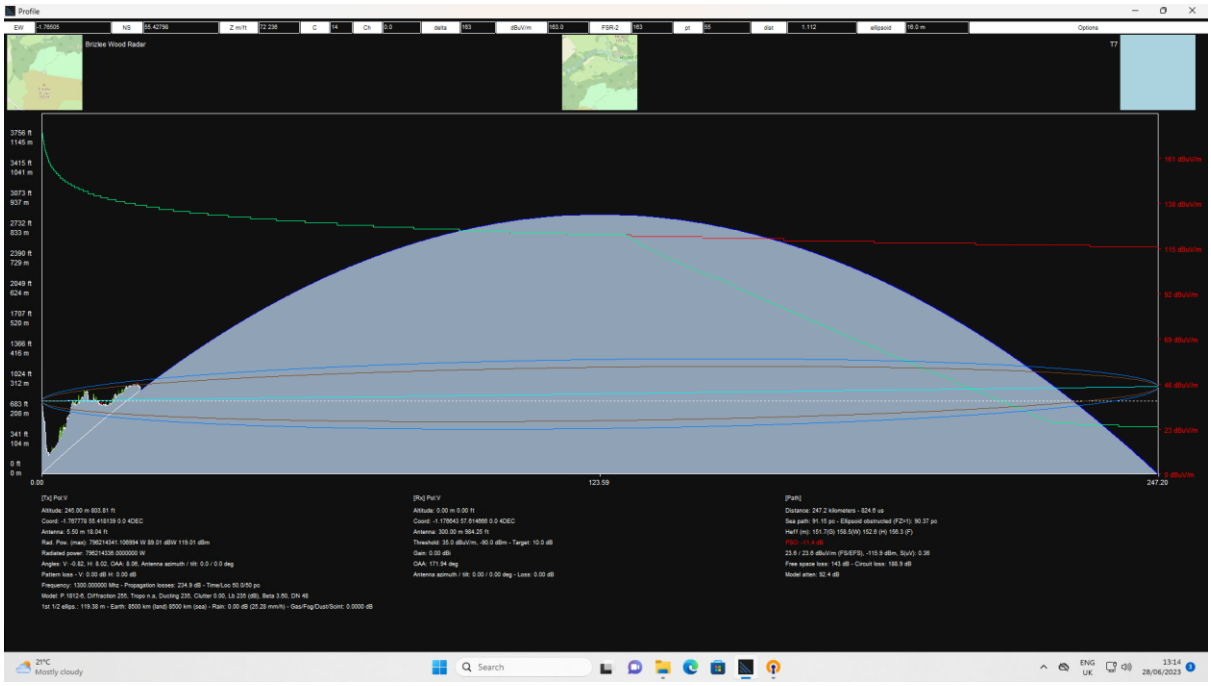


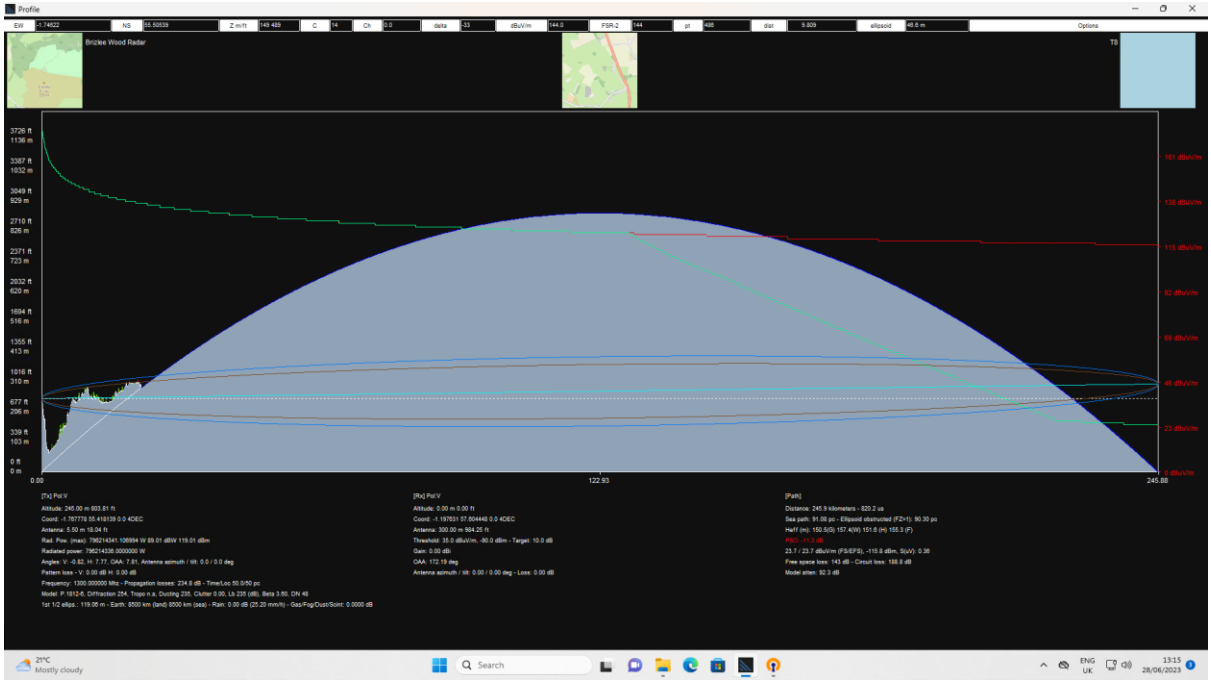

Profile
Brickie Wood Radar
T3
121.44
242.87

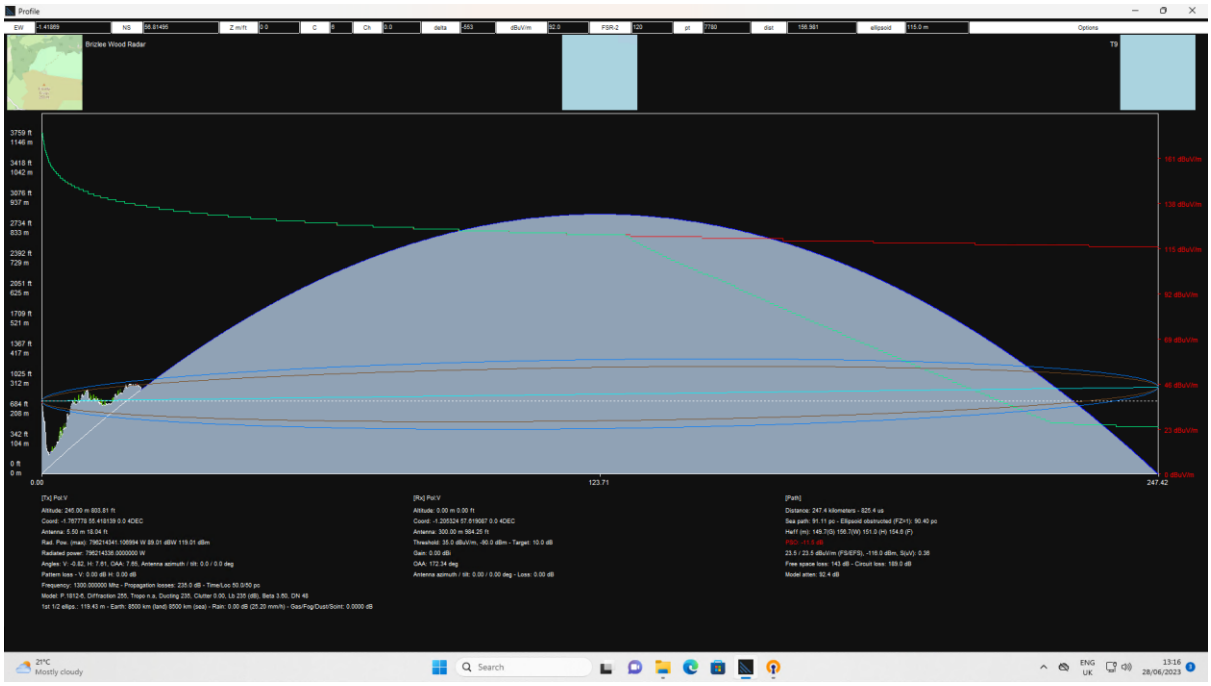

Profile
Brickie Wood Radar
T4
124.15
248.32

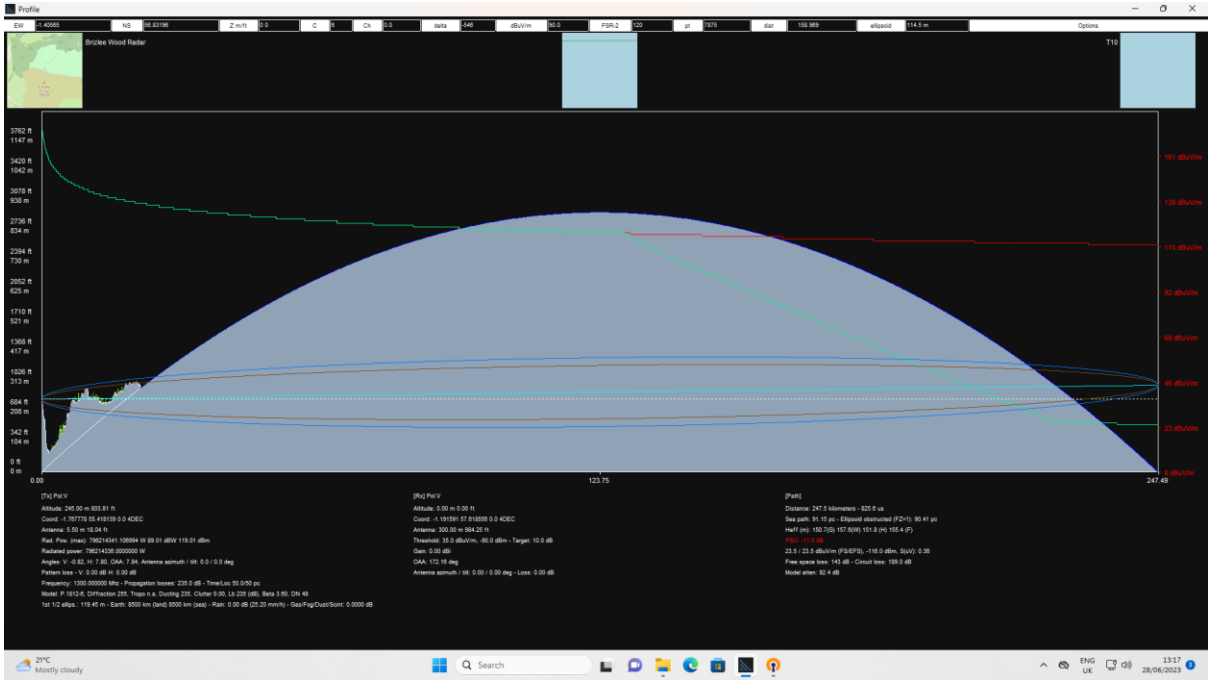

Profile
Bricke Wood Radar
0.00
123.86
247.71

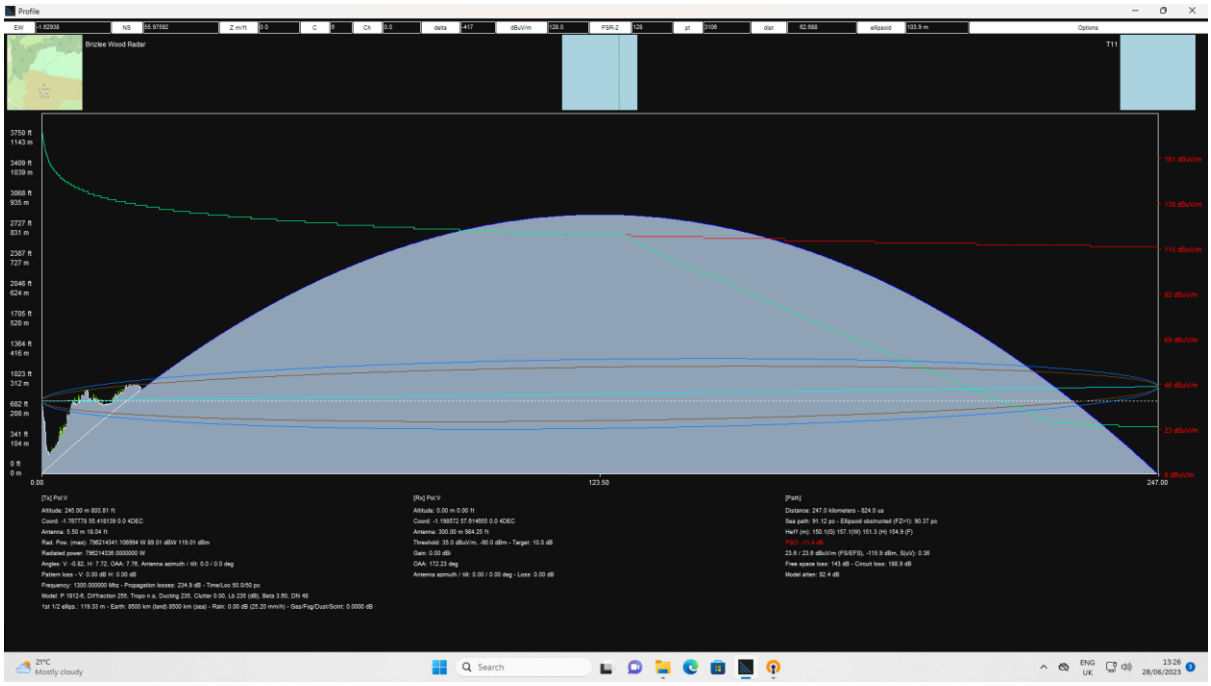

Profile
Bricke Wood Radar
0.00
124.10
248.20


Profile
Brickie Wood Radar
0.00
123.59
247.26

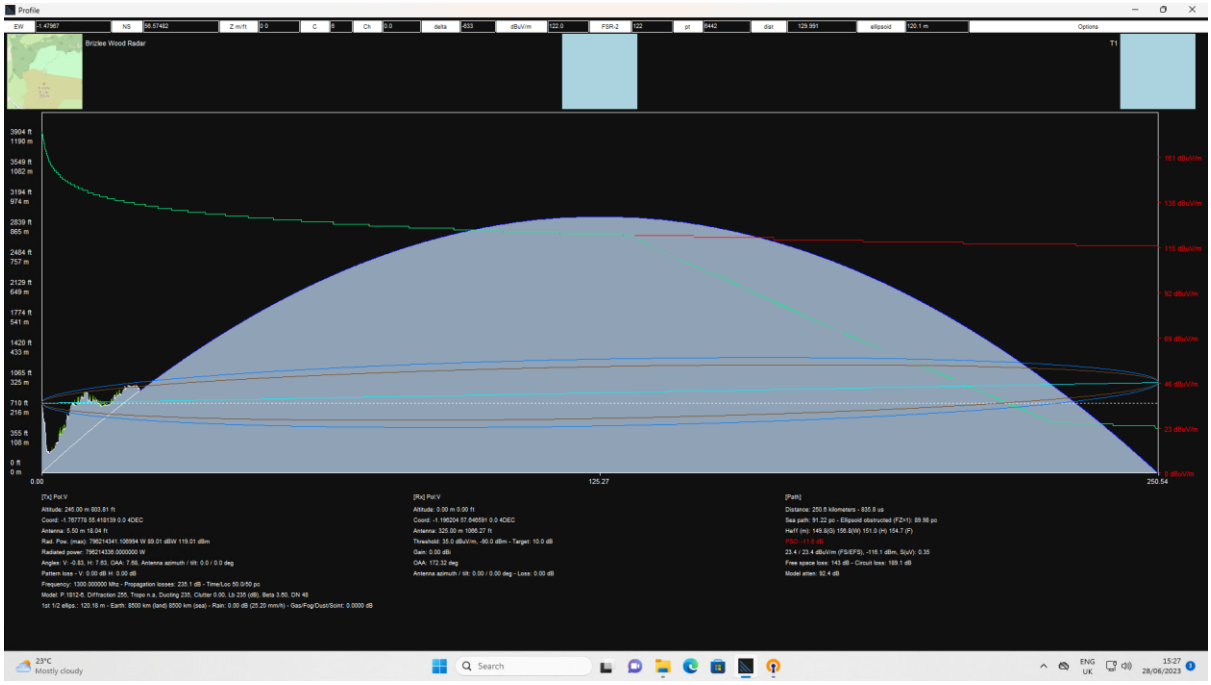

Profile
Brickie Wood Radar
0.00
122.93
245.88


Profile
Brickie Wood Radar
T9
123.71
247.42


Profile
Brickie Wood Radar
T10
123.75
247.49



A2.8 Brizlee Wood Radar (WTG Tip Height 325m)



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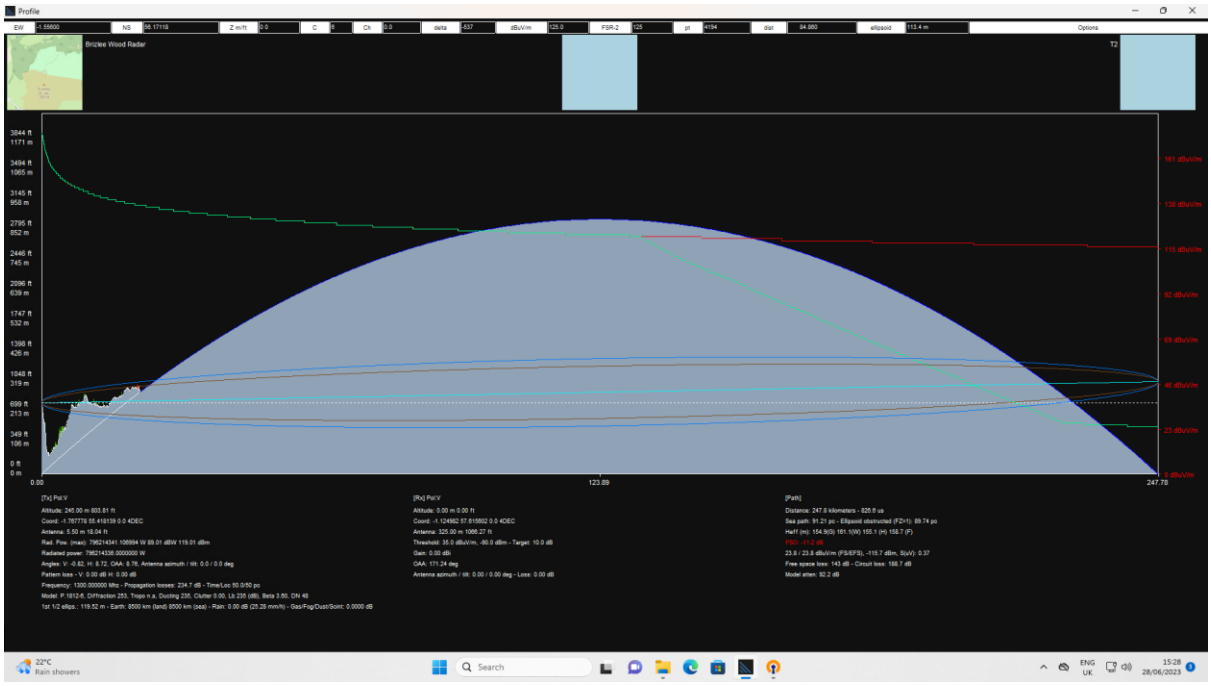
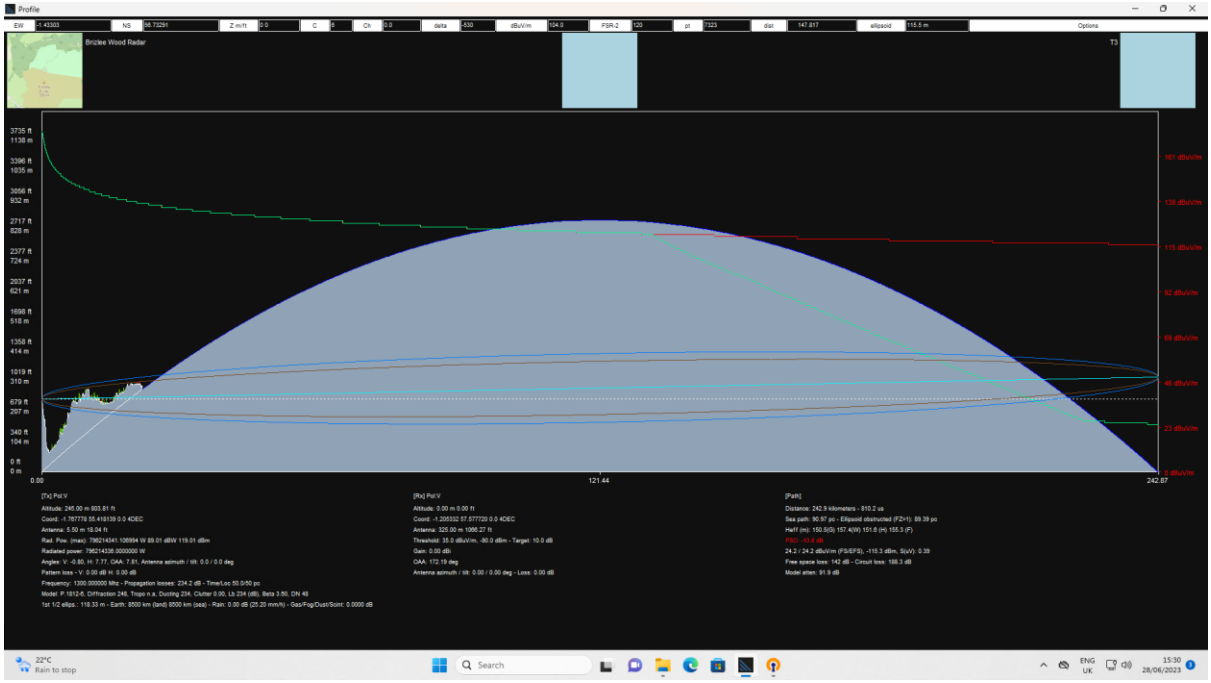
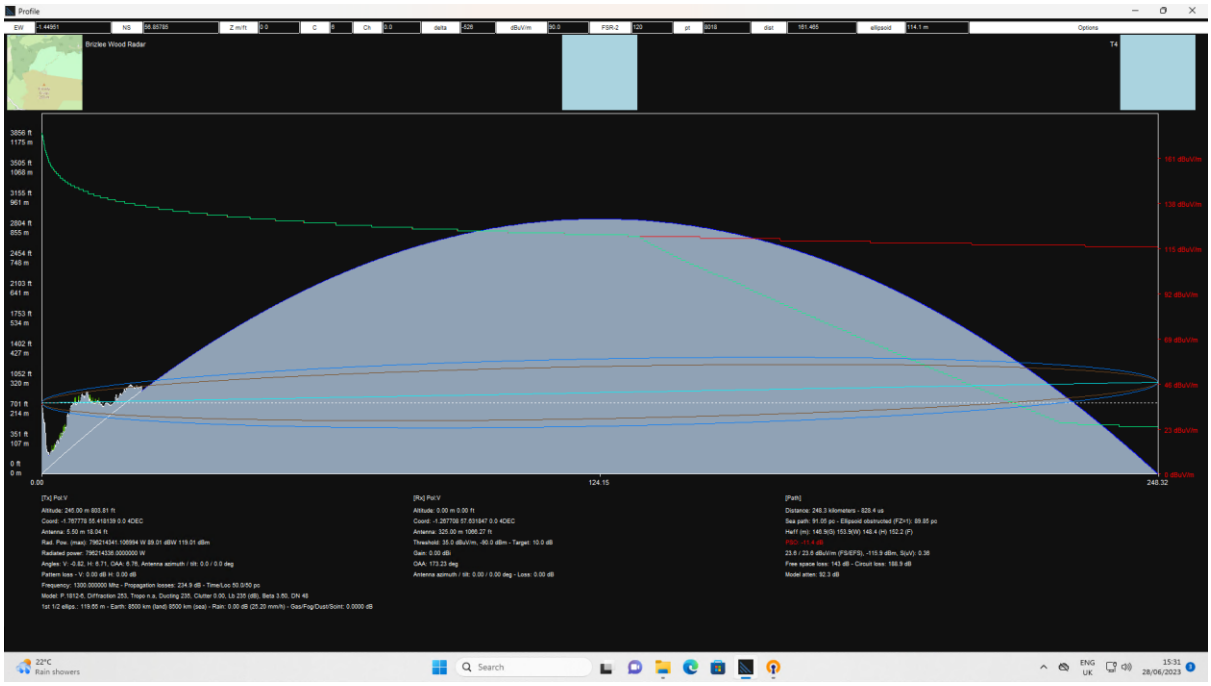
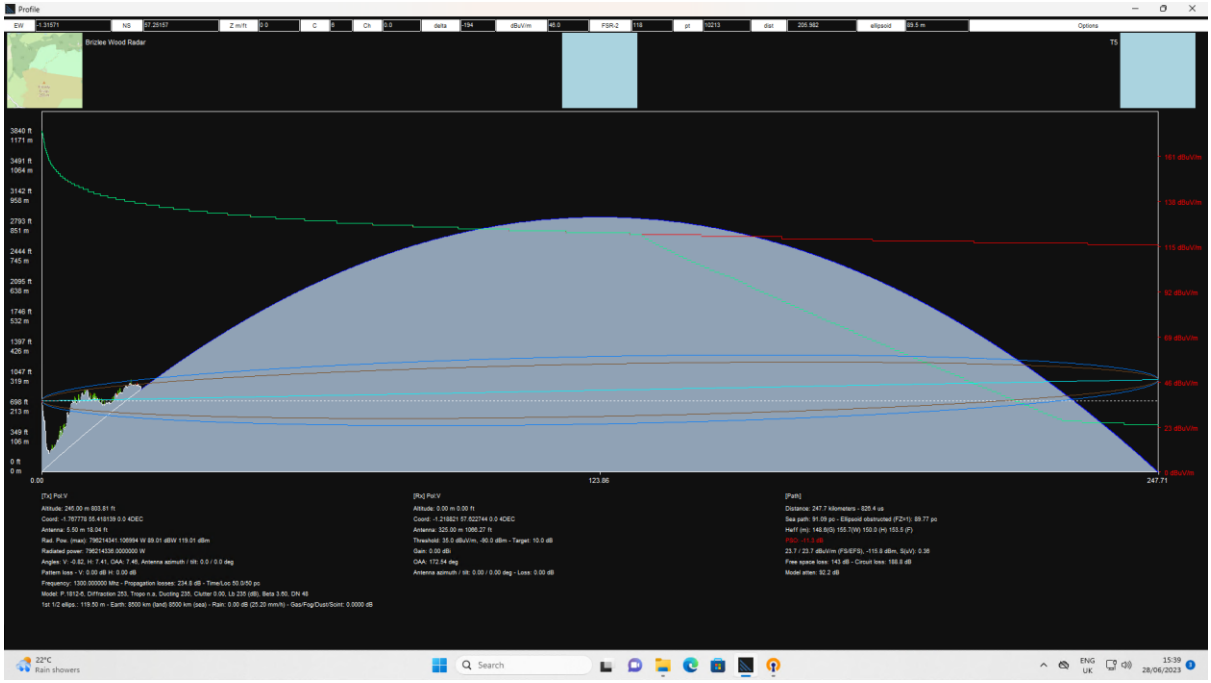
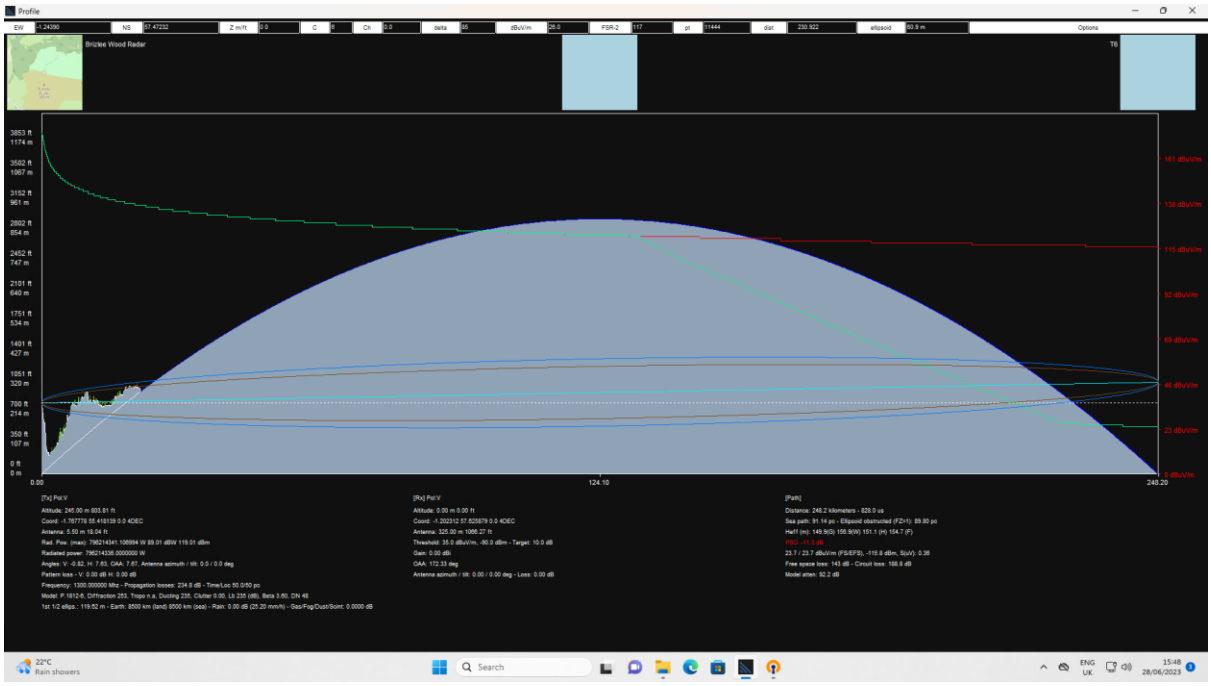
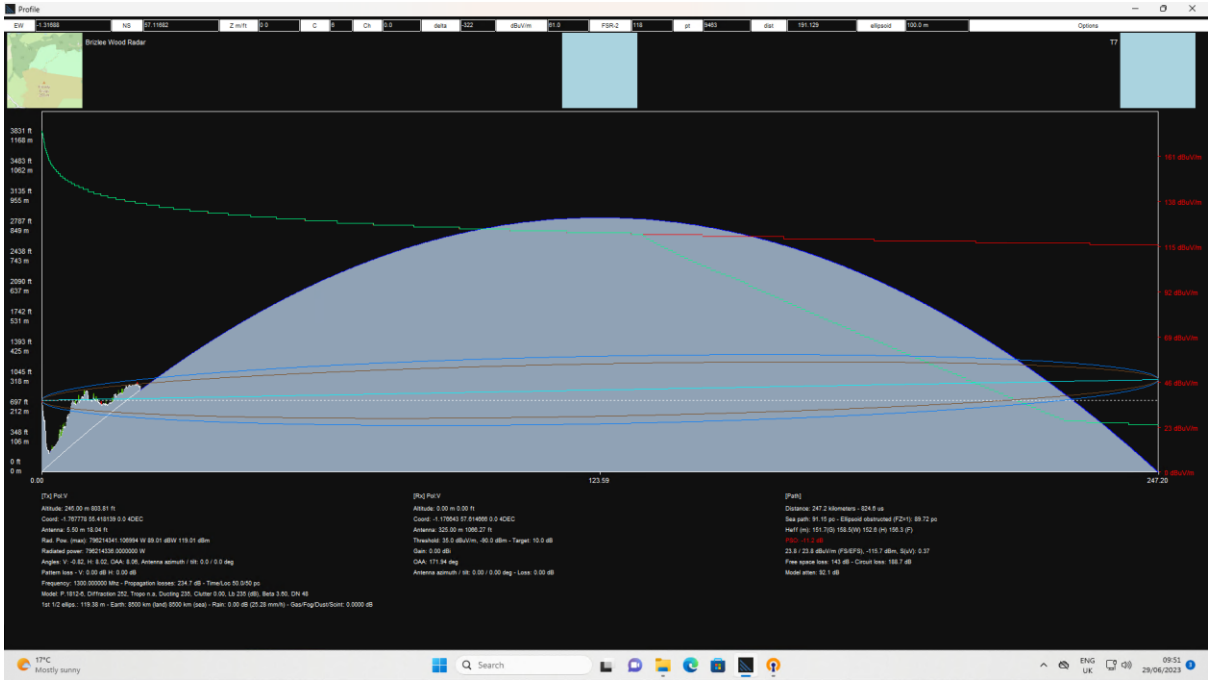

Profile
Brickie Wood Radar
T2
0.00
123.89
247.78

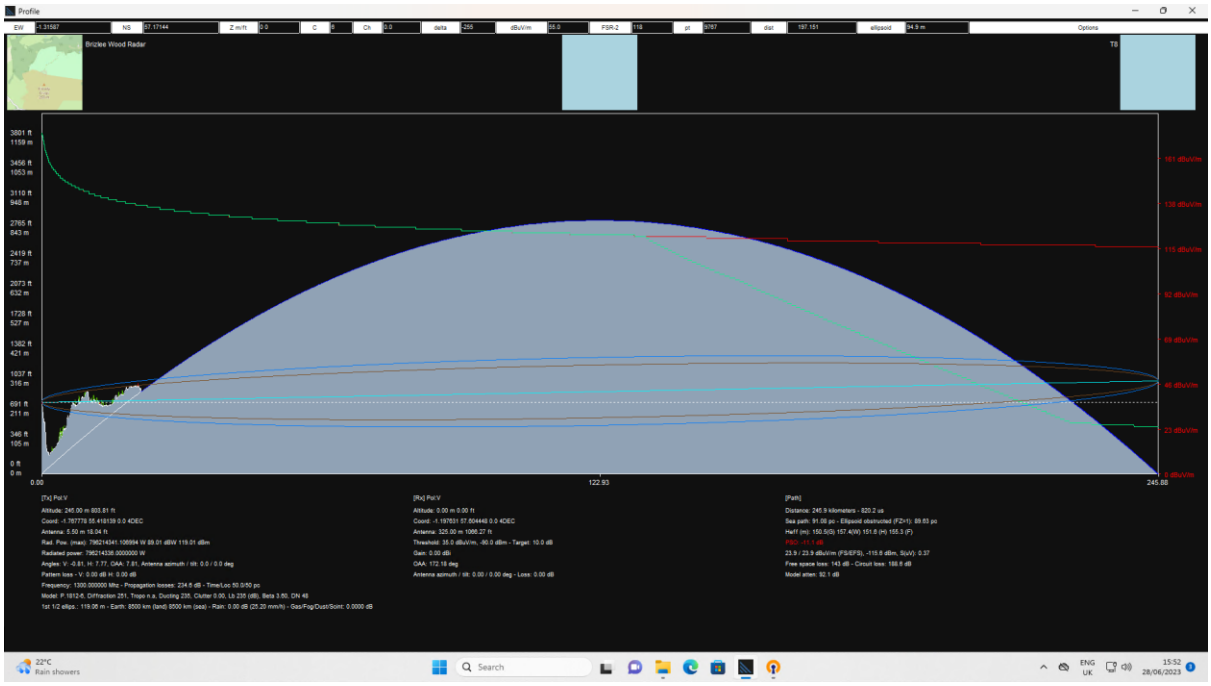

Profile
Brickie Wood Radar
T3
0.00
121.44
242.87

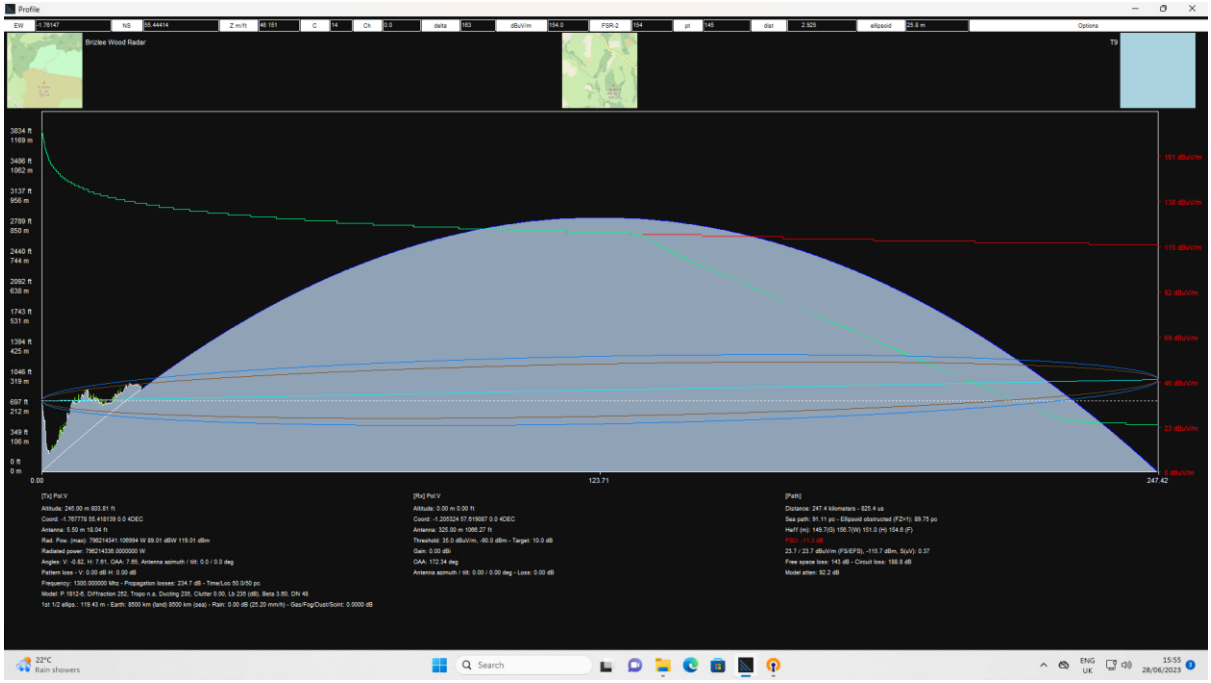

Profile
Brickie Wood Radar
124.15
248.32

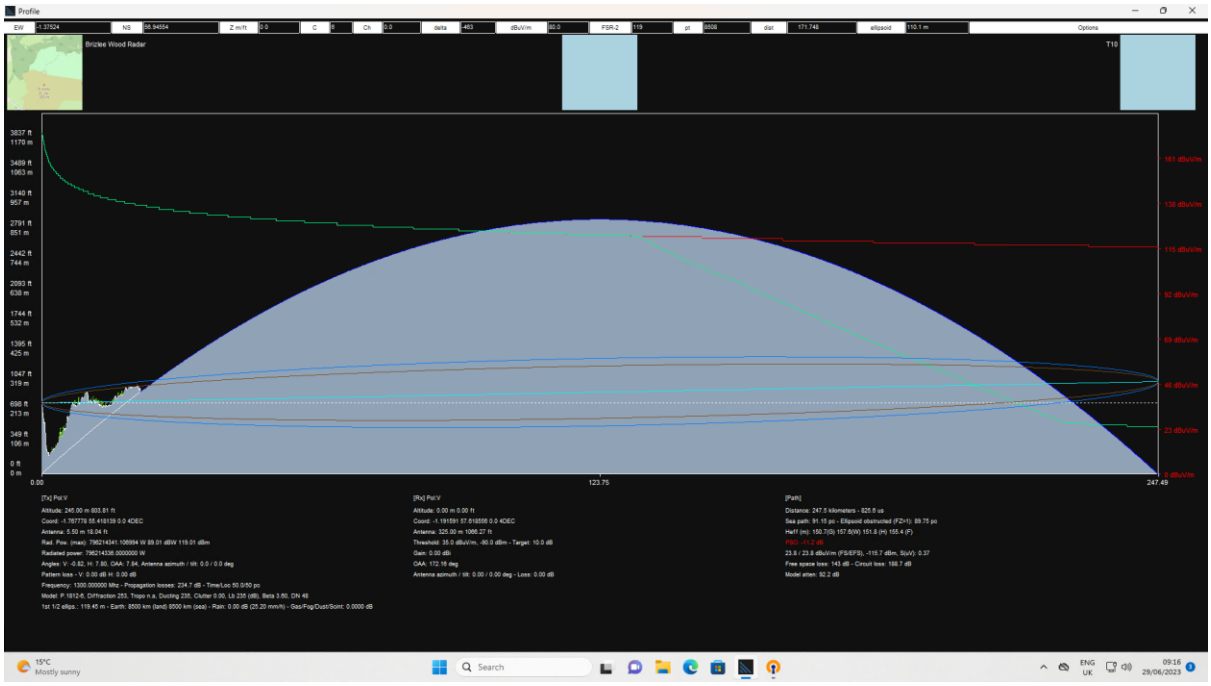

Profile
Brickie Wood Radar
123.86
247.71

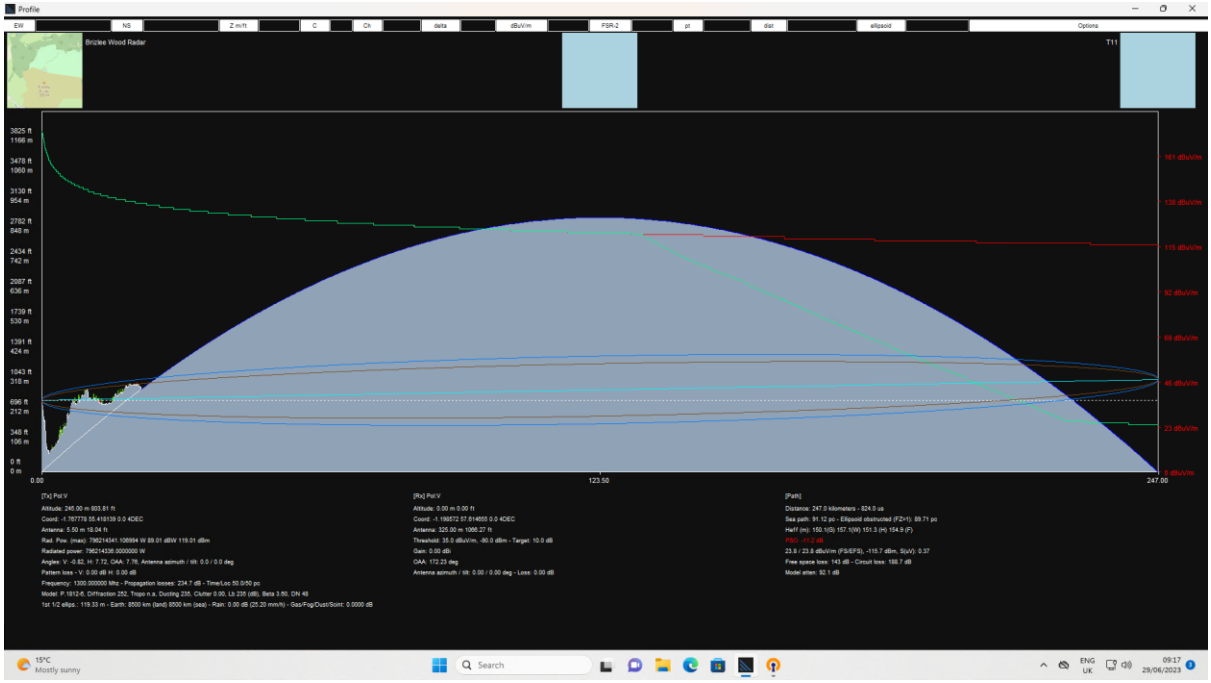

Profile
Brickie Wood Radar
T6
124.10
248.20


Profile
Brickie Wood Radar
T7
123.59
247.20

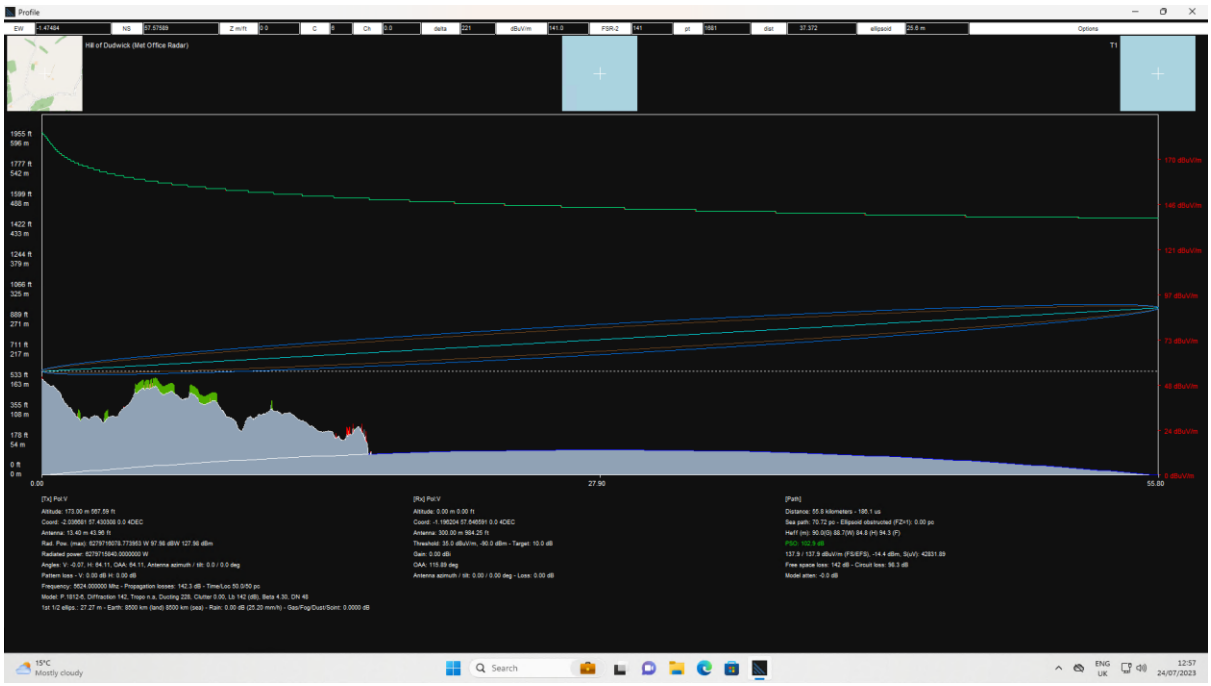

Profile
Bricke Wood Radar
122.93
245.88

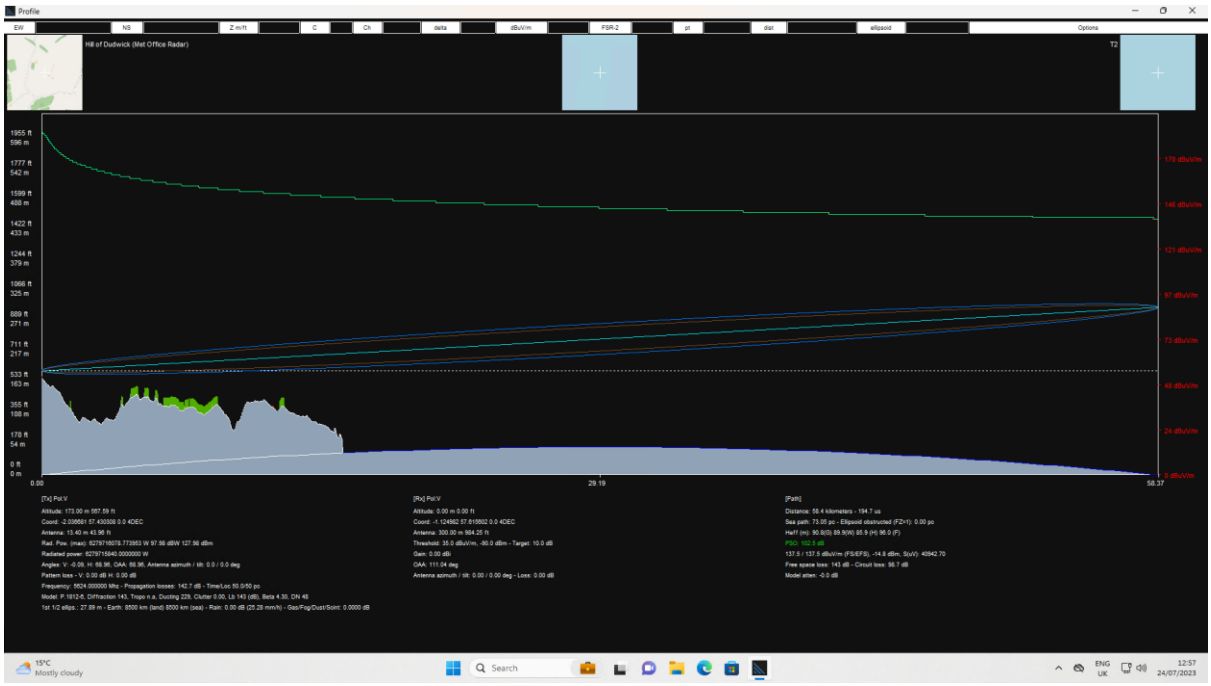

Profile
Bricke Wood Radar
123.71
247.42

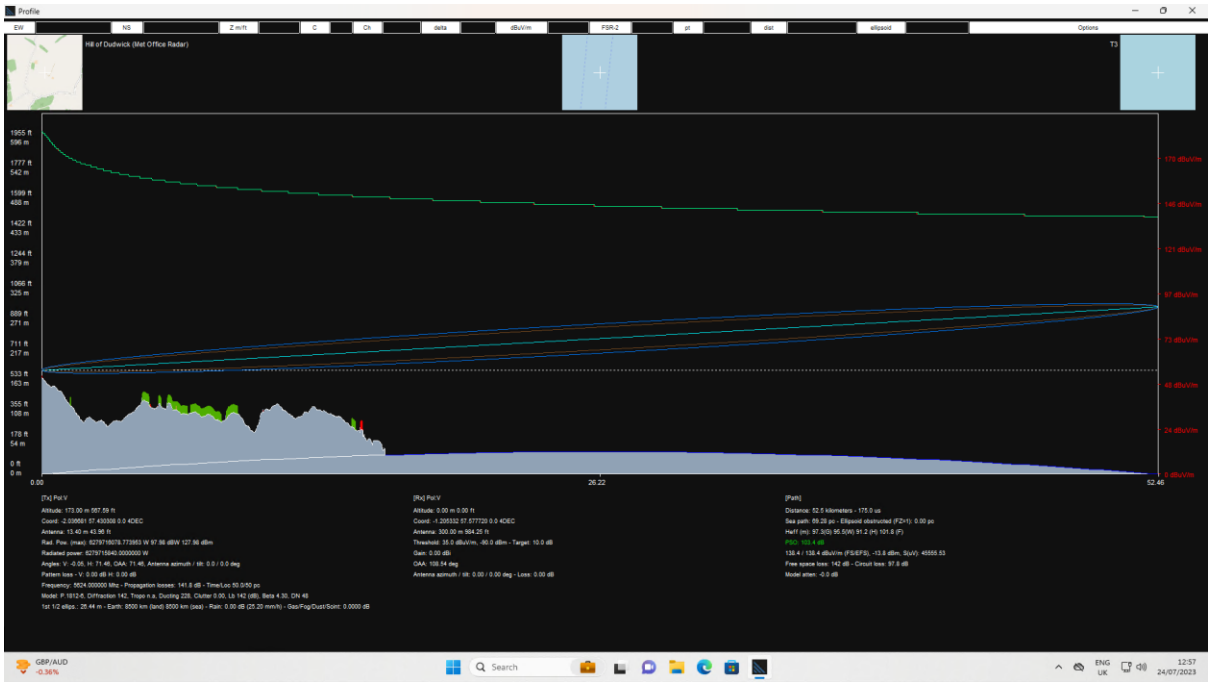

Profile
Brickie Wood Radar
T10
123.75
247.49

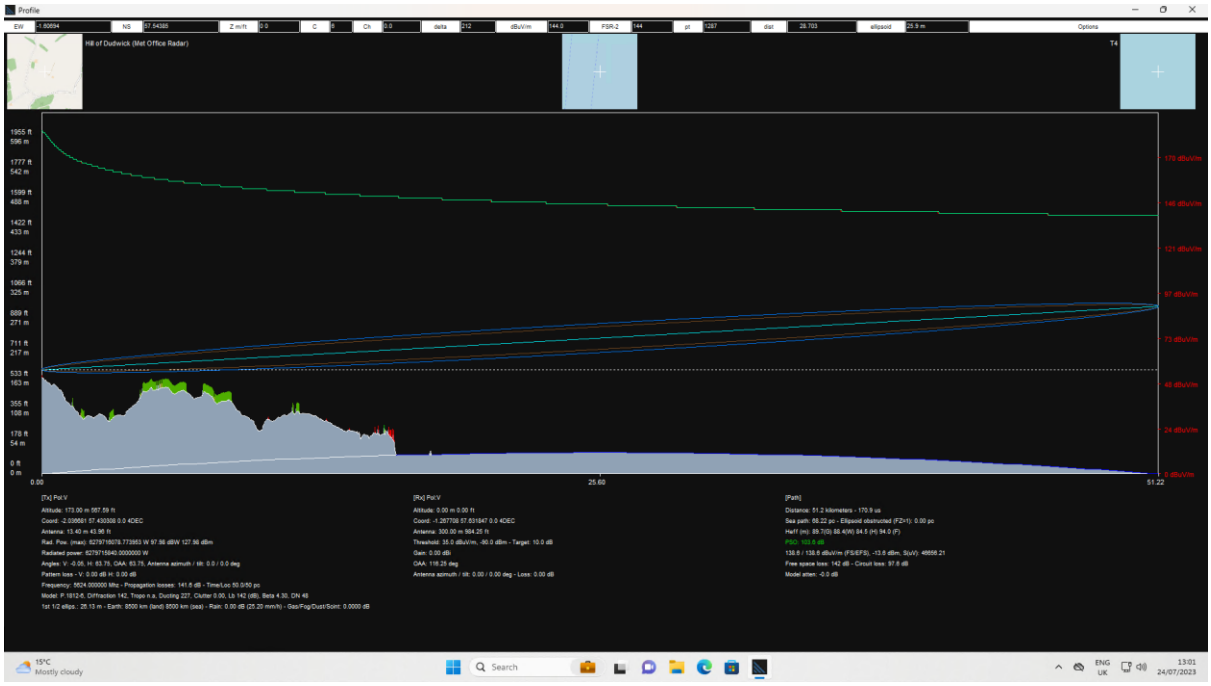

Profile
Brickie Wood Radar
T11
123.50
247.00

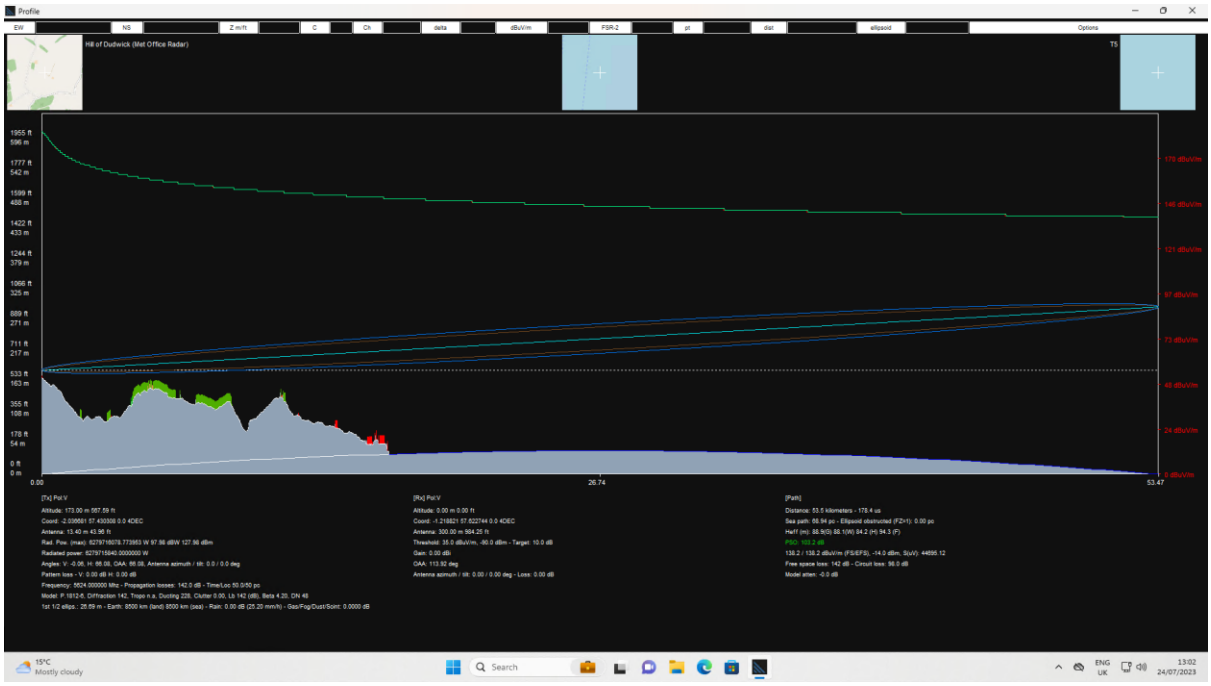
A2.9 Hill of Dudwick Radar (WTG Tip Height 300m)

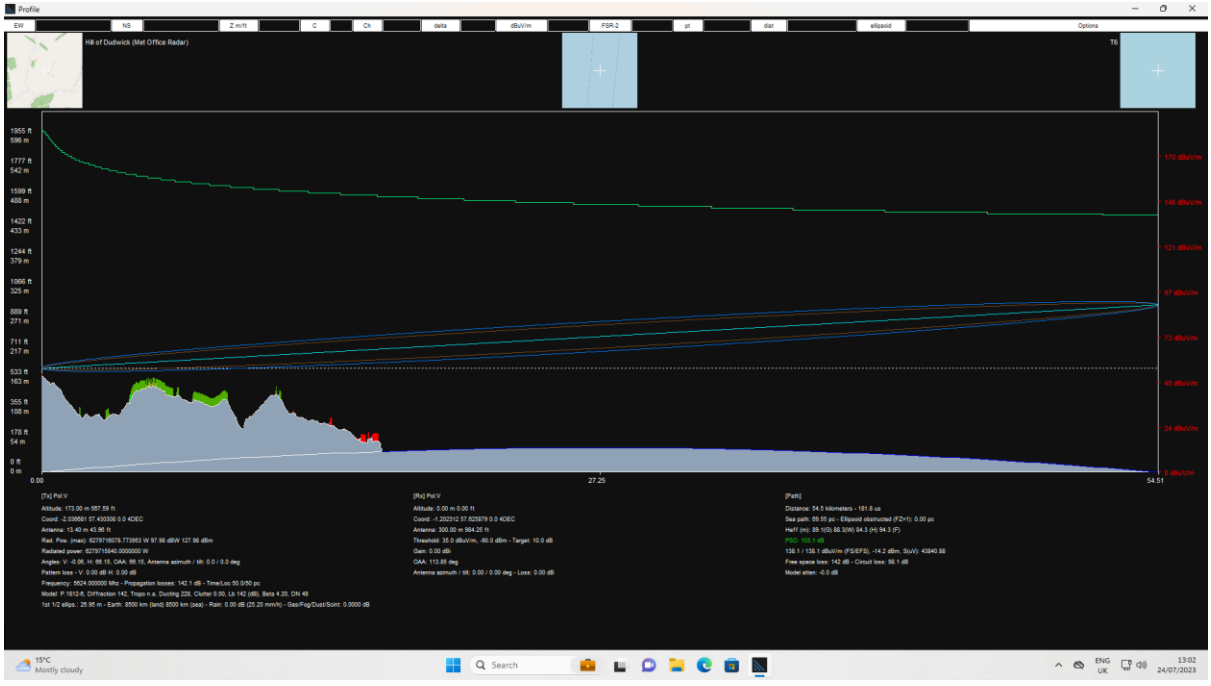


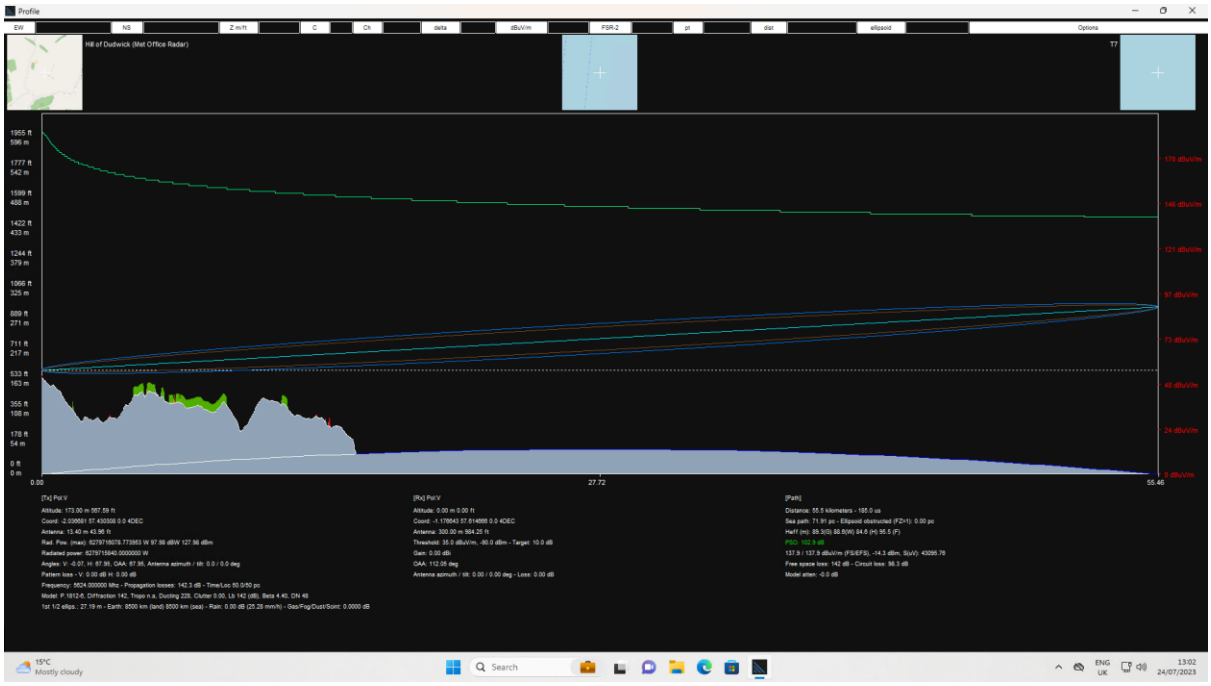


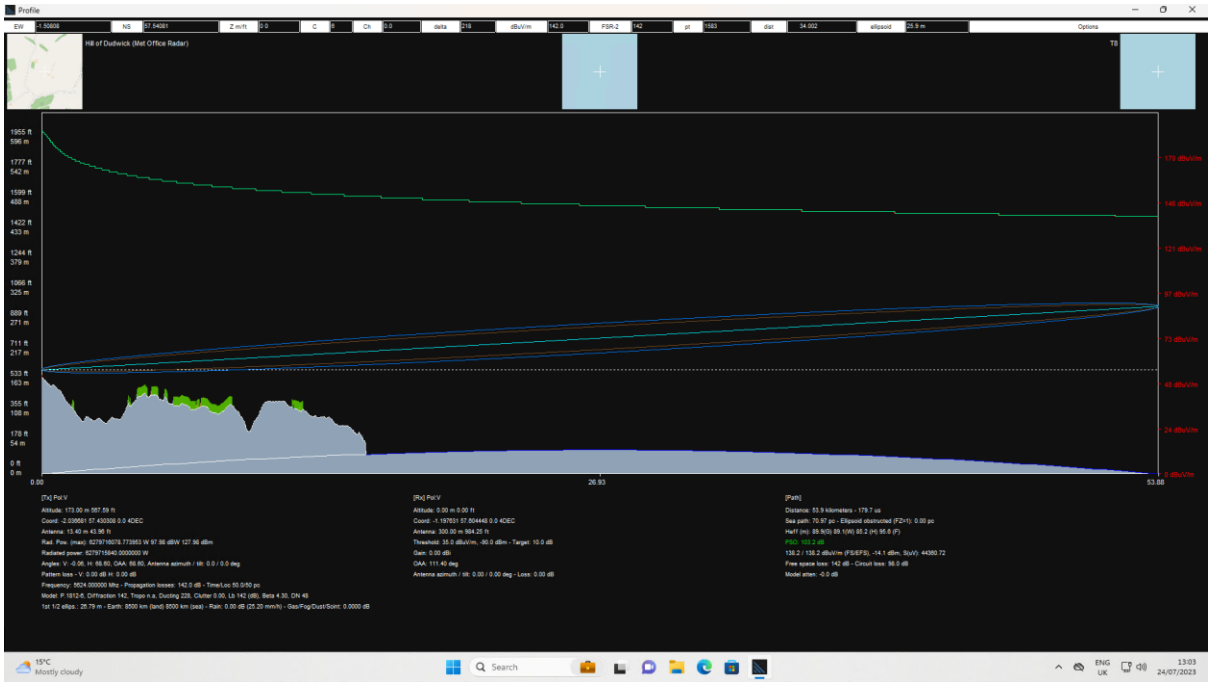

Profile
Hill of Dudwick (Met Office Radar)
T3
0.00
26.22
52.46

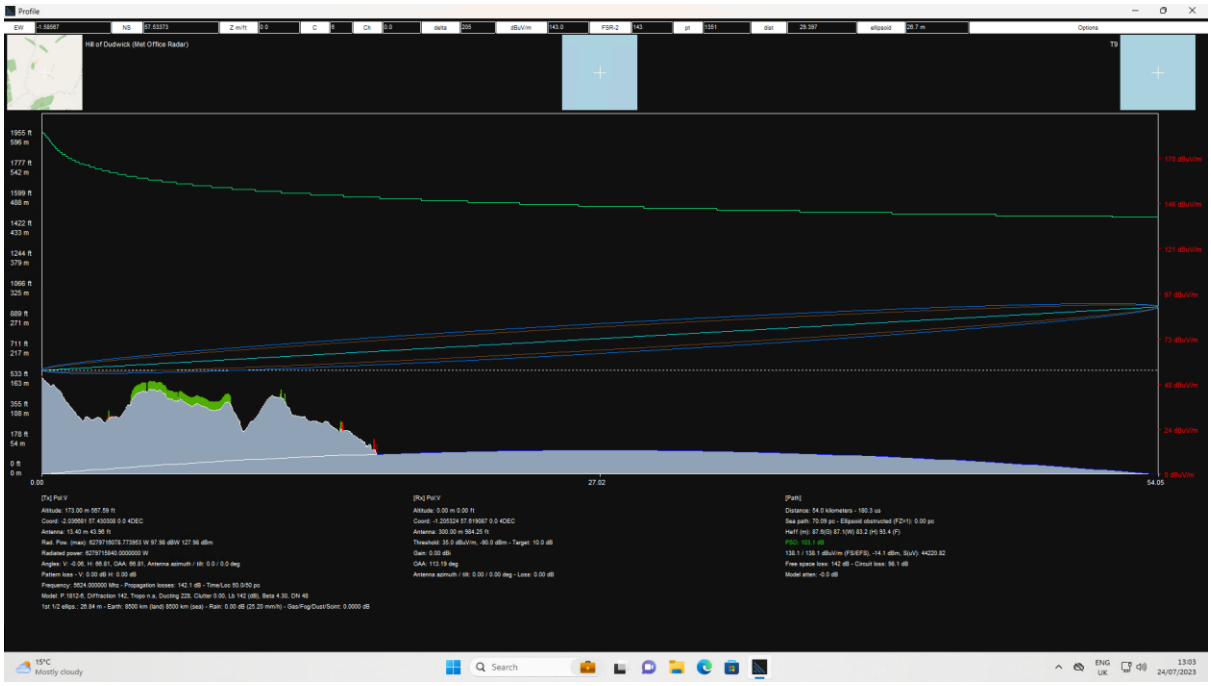

Profile
Hill of Dudwick (Met Office Radar)
T4
0.00
25.60
51.22

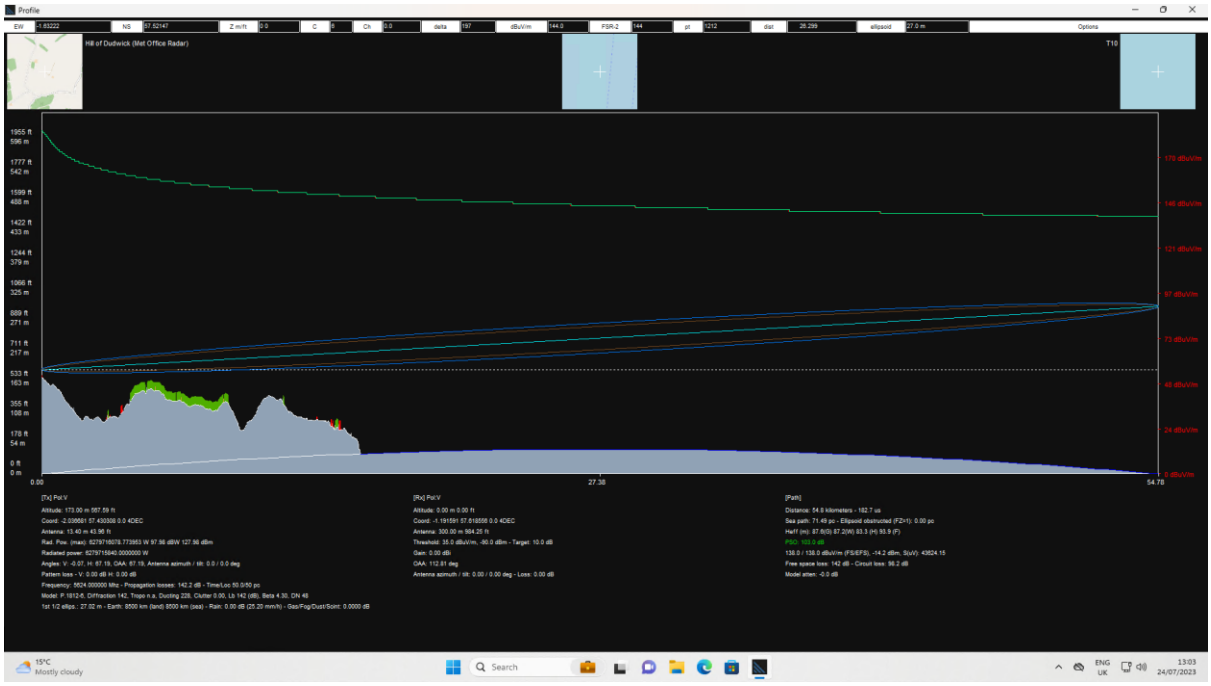

Profile
Hill of Dudwick (Met Office Radar)
T5
0.00
26.74
53.47

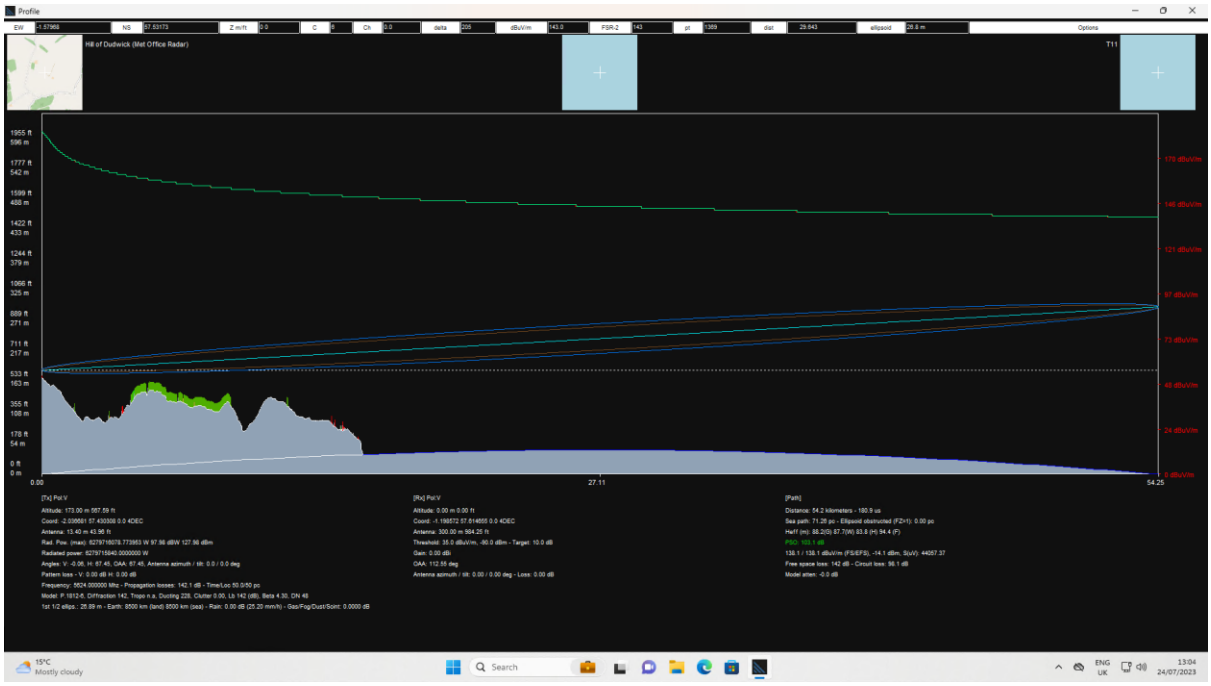

Profile
Hill of Dudwick (Met Office Radar)
T6
0.00
27.25
54.51


Profile
Hill of Dudwick (Met Office Radar)
0.00
27.72
55.46

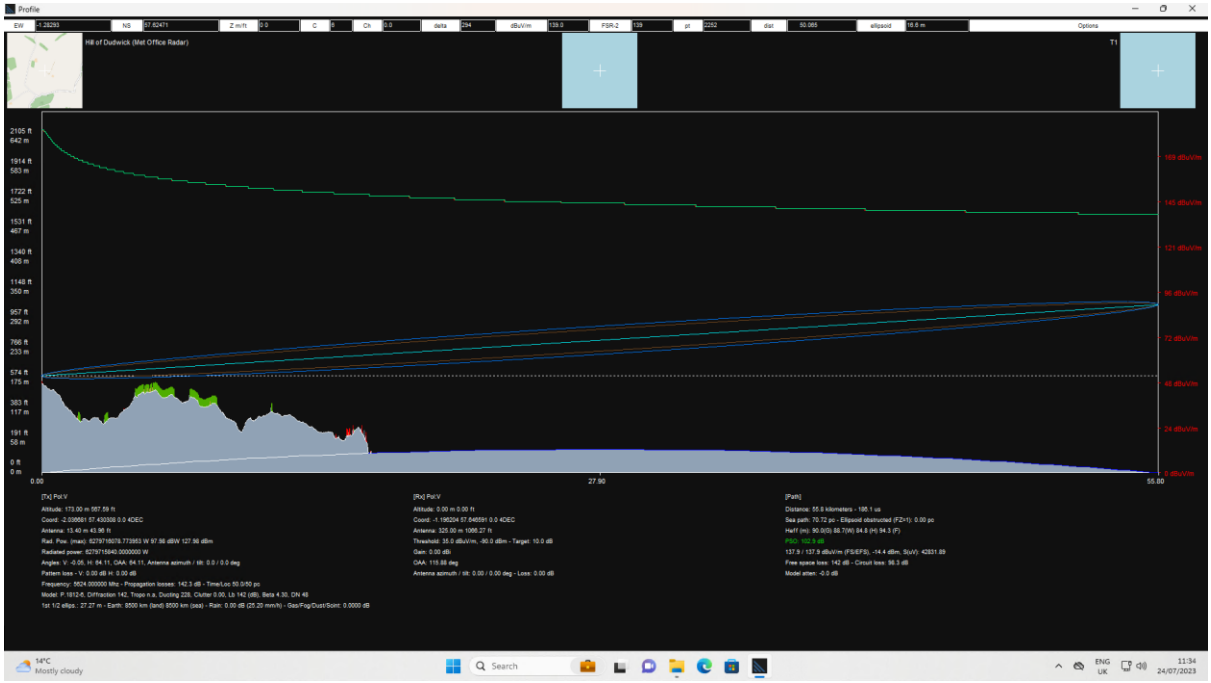

Profile
Hill of Dudwick (Met Office Radar)
0.00
26.93
53.88

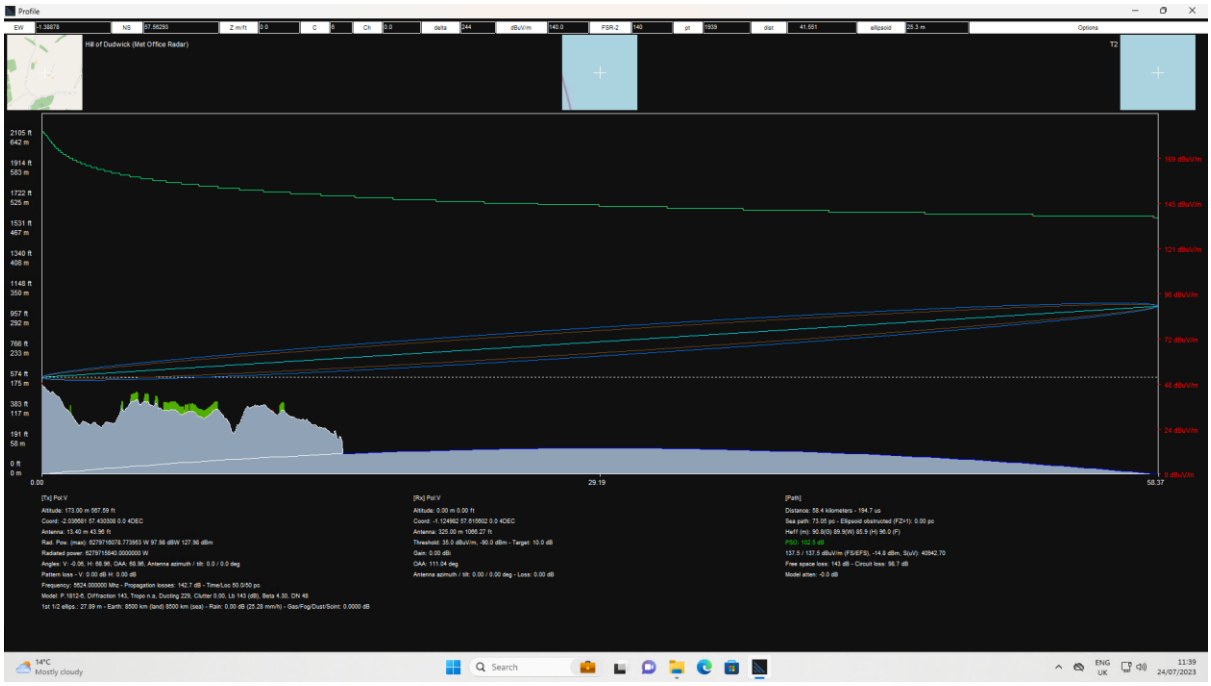

Profile
Hill of Dudwick (Met Office Radar)
T9
0.00
27.02
54.05

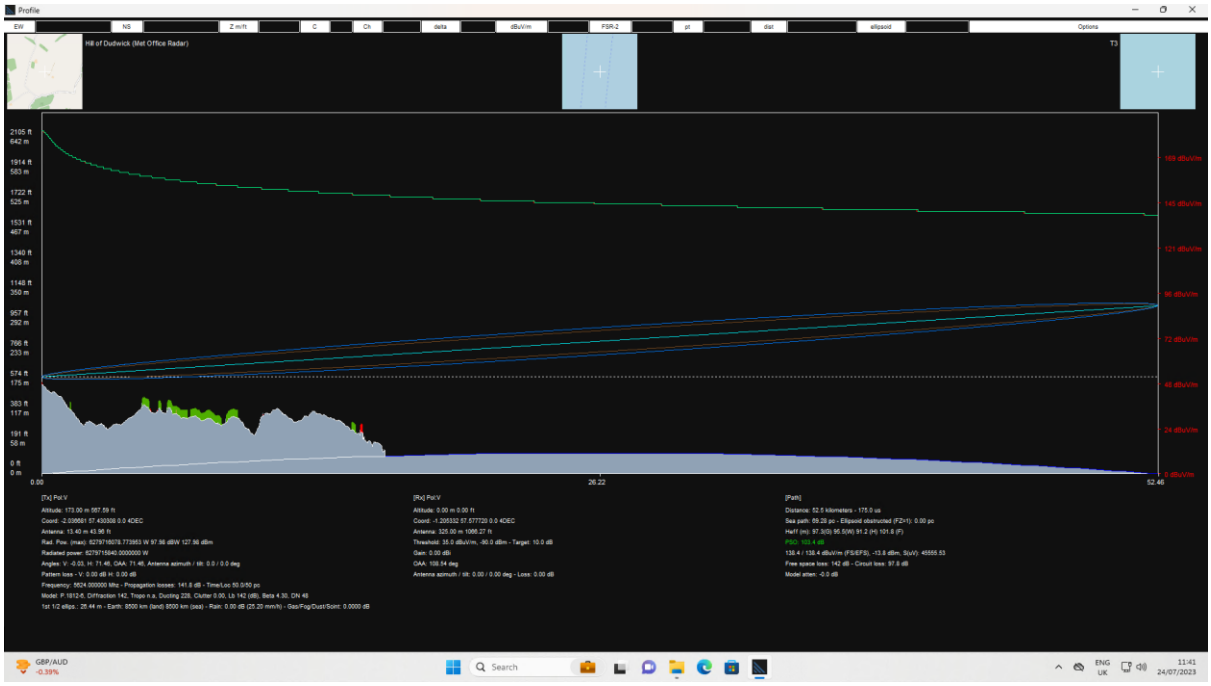

Profile
Hill of Dudwick (Met Office Radar)
T10
0.00
27.38
54.78

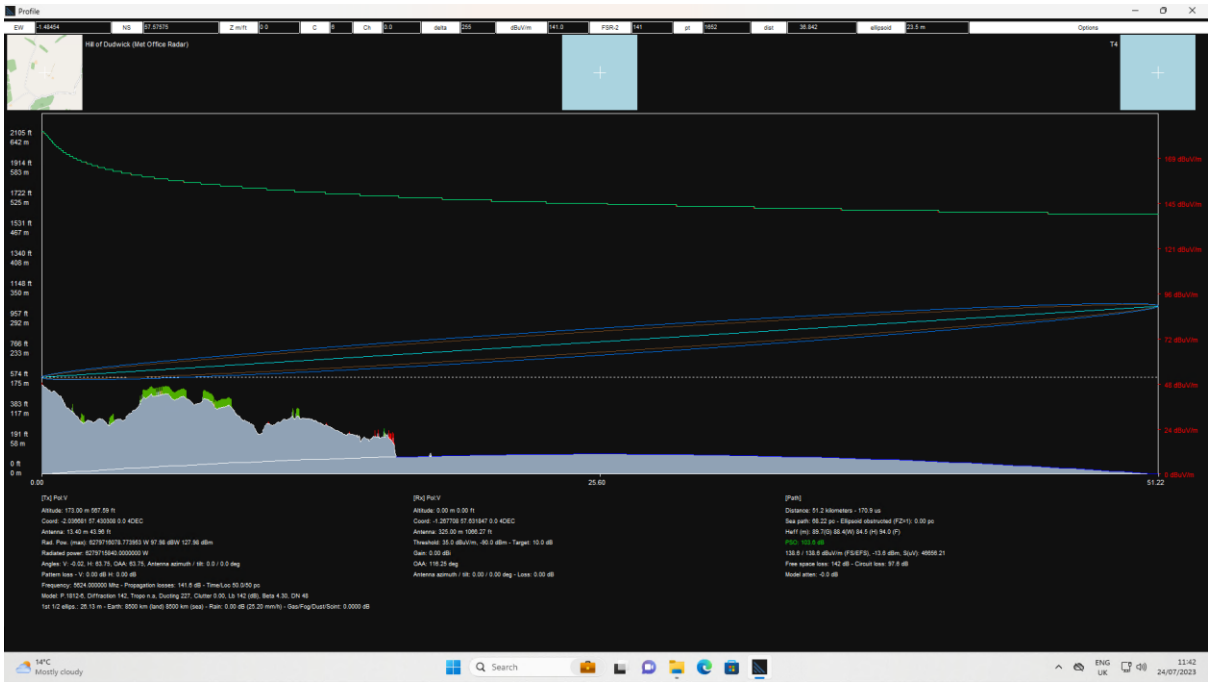


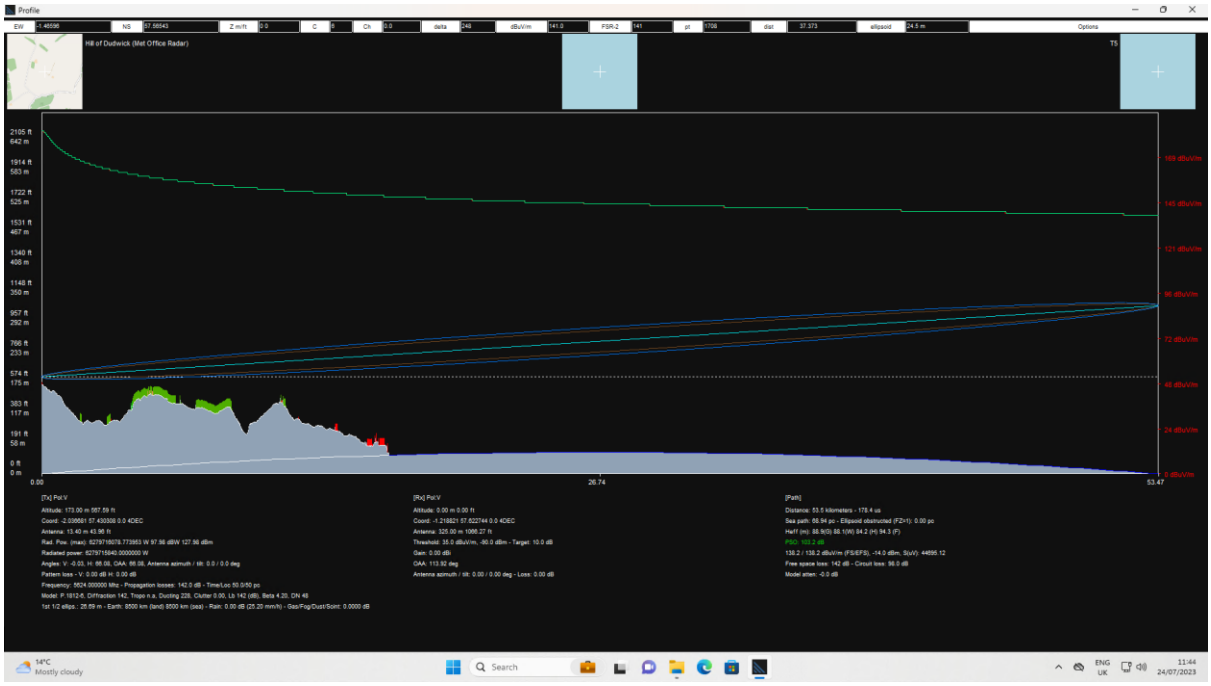
A2.10 Hill of Dudwick Radar (WTG Tip Height 325m)

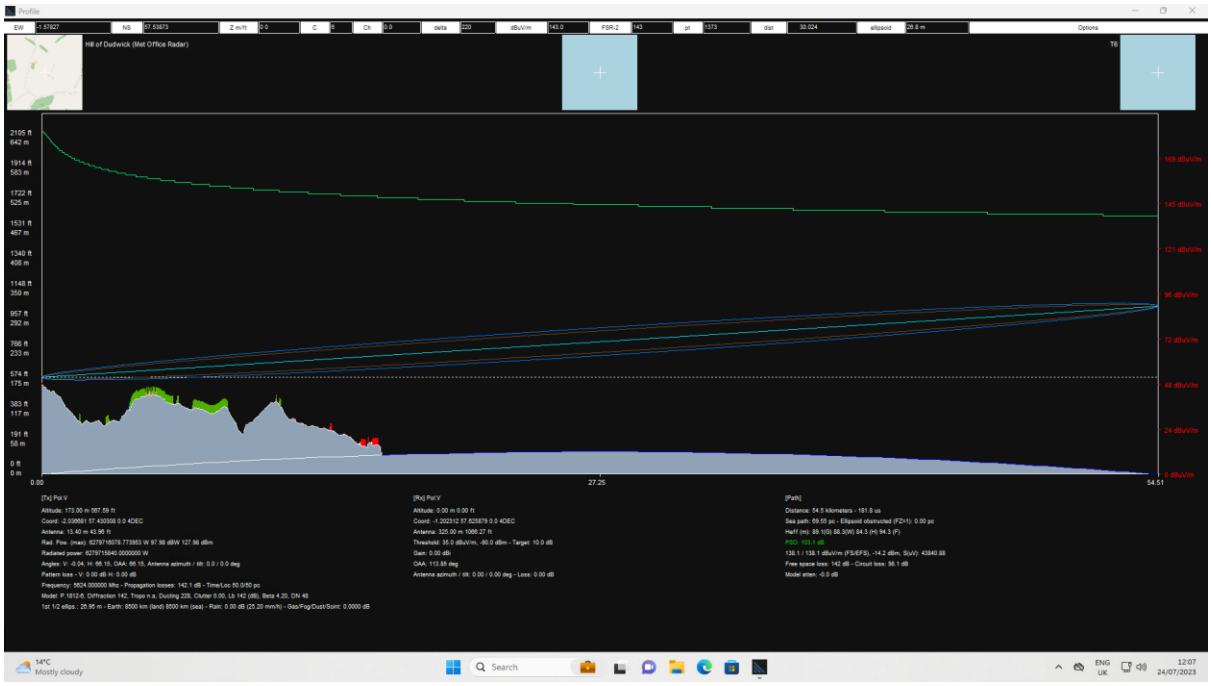


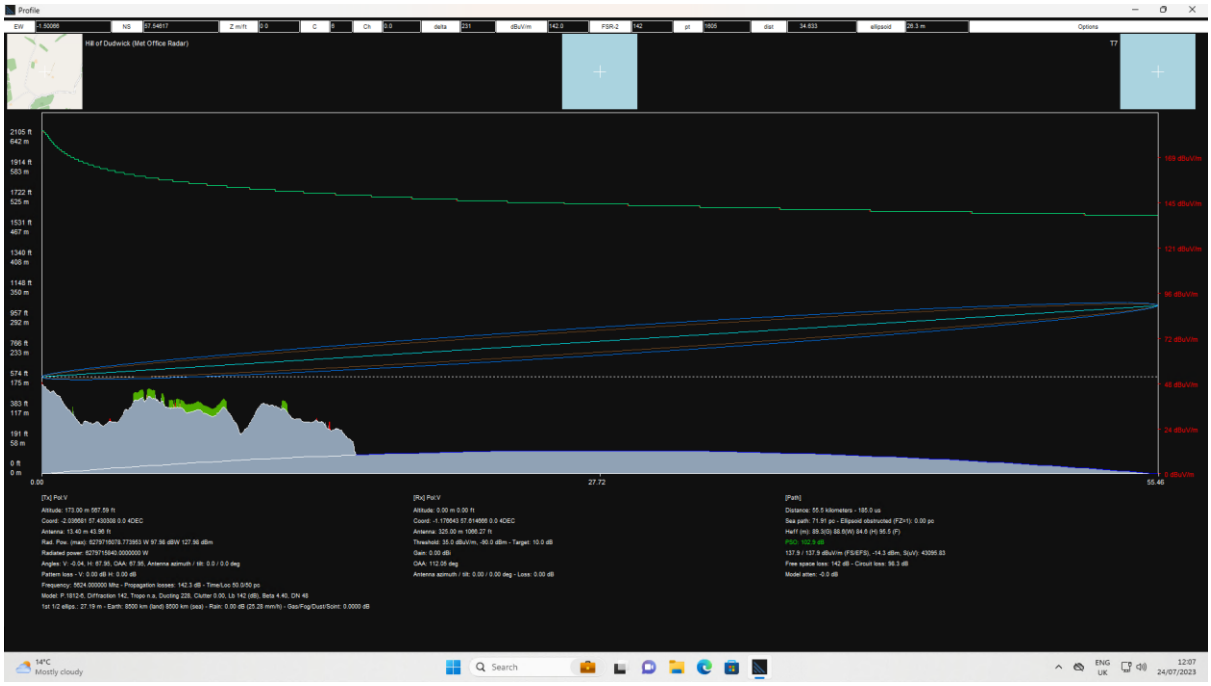

Profile
Hill of Dudwick (Met Office Radar)
T2
0.00
29.19
58.37

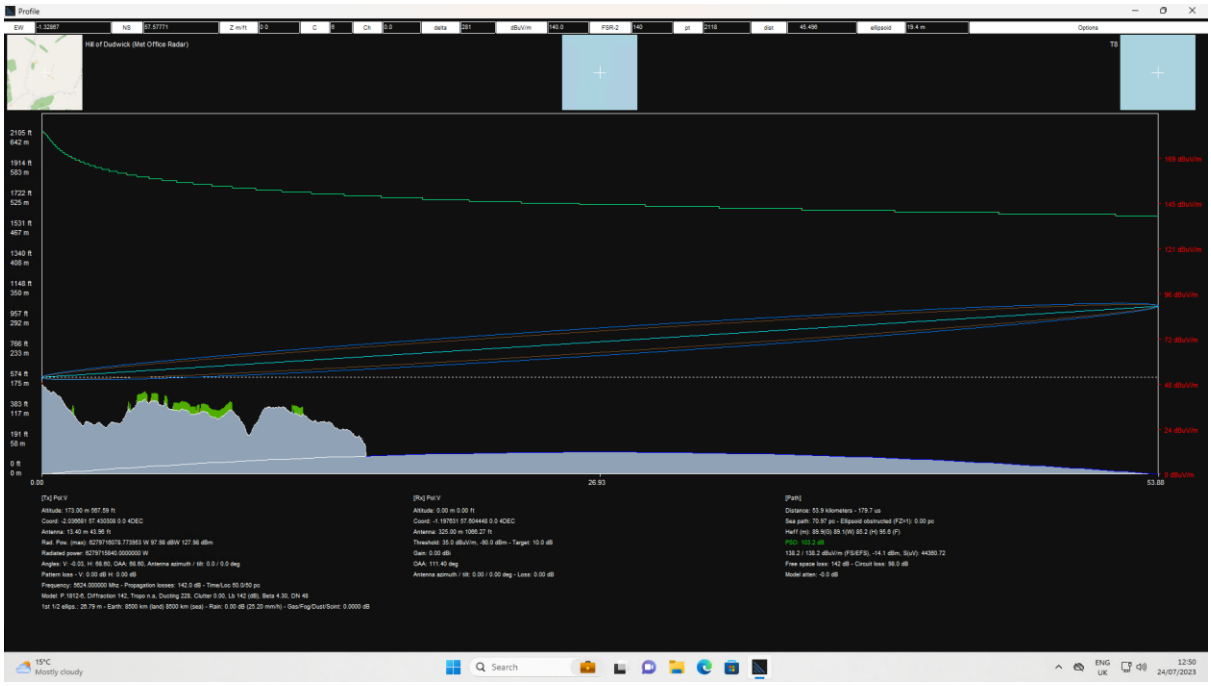

Profile
Hill of Dudwick (Met Office Radar)
T3
0.00
26.22
52.46

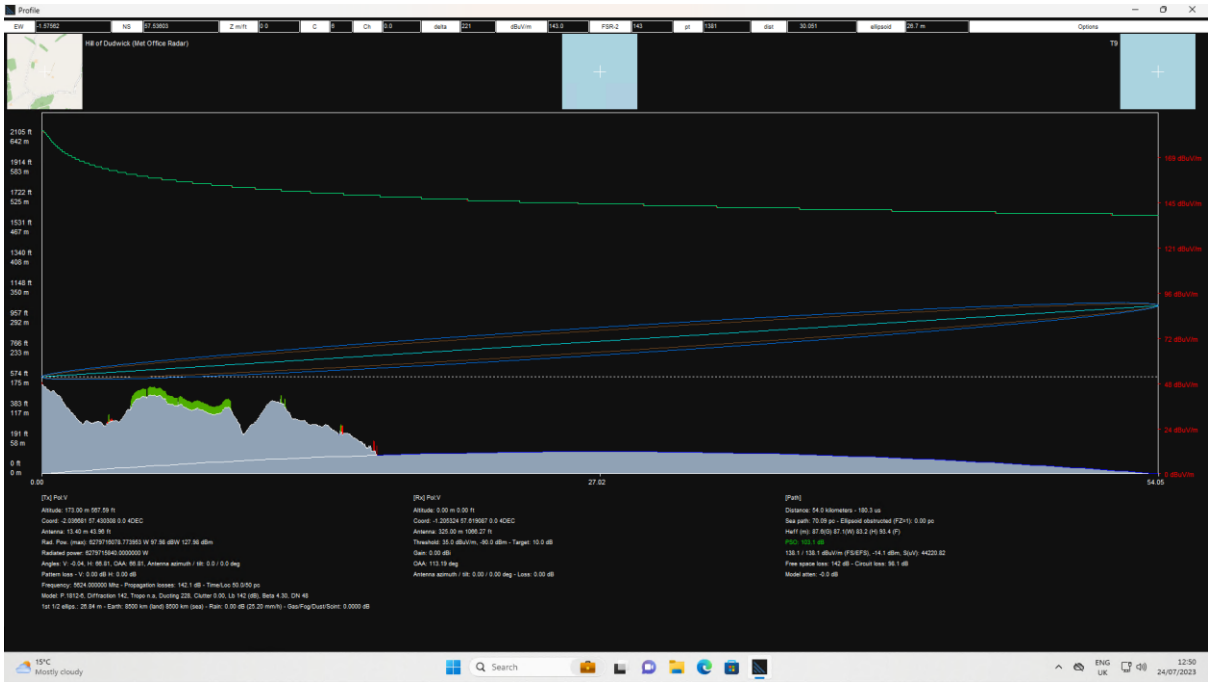

Profile
Hill of Dudwick (Met Office Radar)
0.00
25.60
51.22

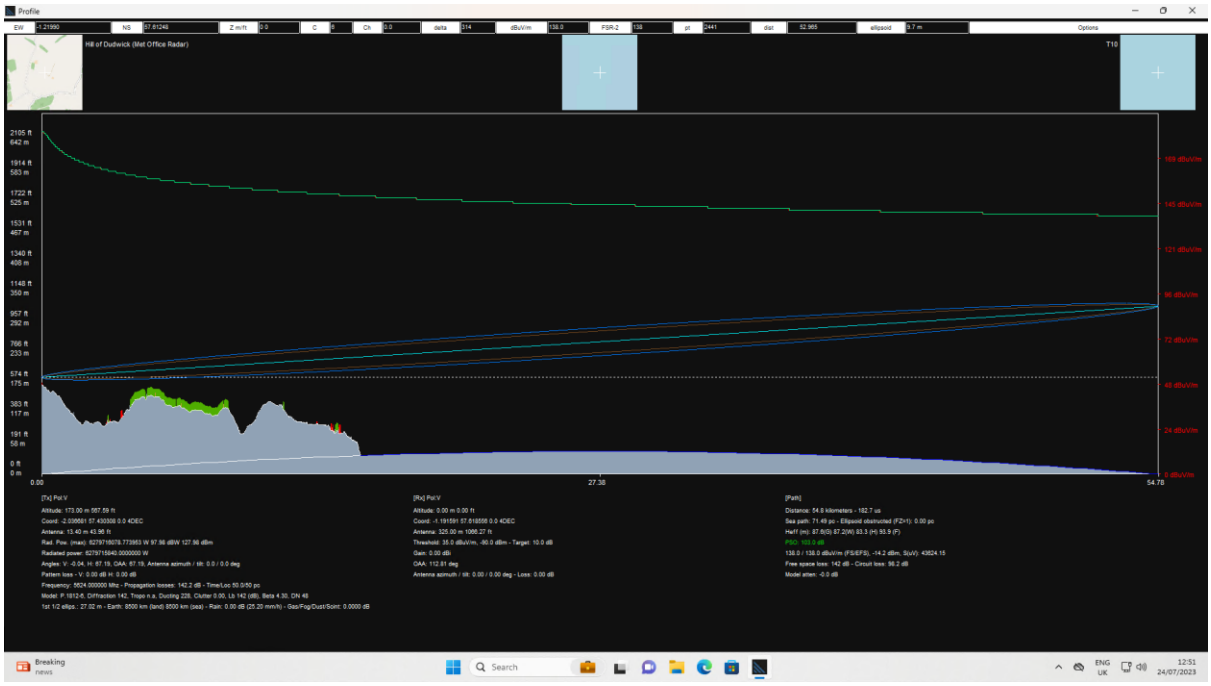

Profile
Hill of Dudwick (Met Office Radar)
0.00
26.74
53.47

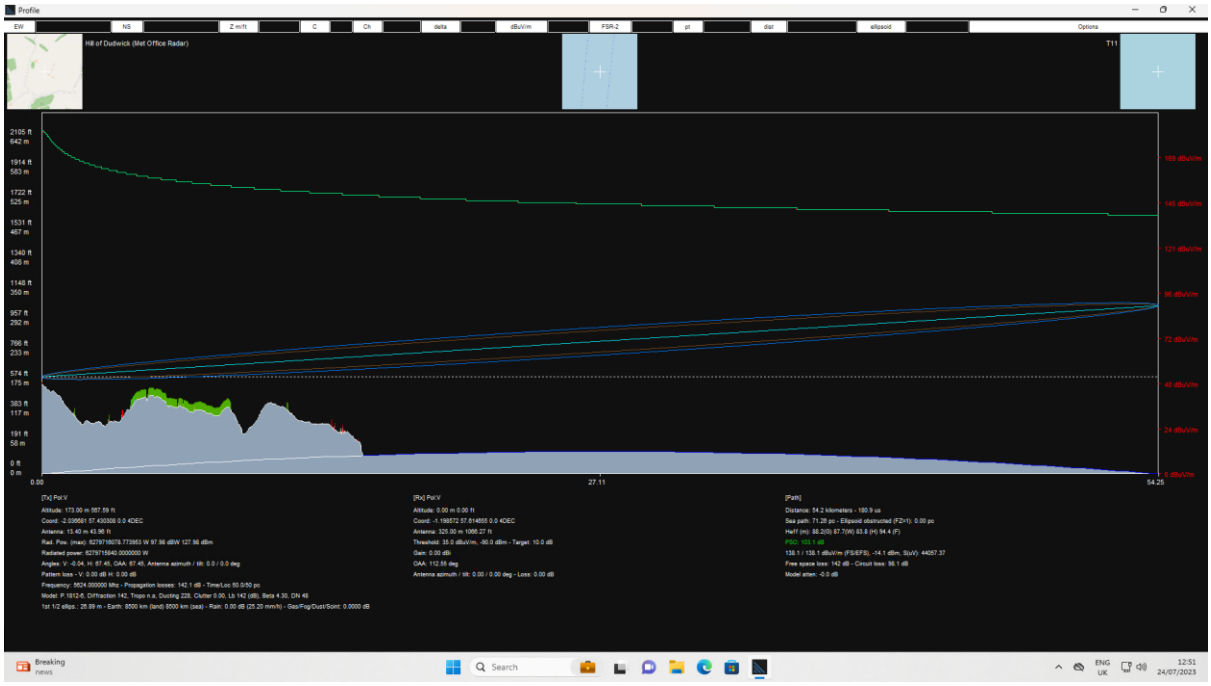

Profile
Hill of Dudwick (Met Office Radar)
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
27.25
54.51
[Tx] Pol:V
[Rx] Pol:V
[Path]


Profile
Hill of Dudwick (Met Office Radar)
2105 ft
642 m
1914 ft
583 m
1722 ft
525 m
1531 ft
467 m
1340 ft
408 m
1148 ft
350 m
957 ft
292 m
766 ft
233 m
574 ft
175 m
383 ft
117 m
191 ft
58 m
0 ft
0 m
0.00
27.72
55.46
[Tx] Pol:V
[Rx] Pol:V
[Path]


Profile
Hill of Dudwick (Met Office Radar)
0.00
26.93
53.88


Profile
Hill of Dudwick (Met Office Radar)
0.00
27.02
54.05





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A3 Radar Sites

Radar Site	Coordinates		Parameters	Data Source
Allanshill	57°38'35.30"N	2° 9'55.80"W	Antenna height: 12.5m, Tx Power: 32kW, Tx Freq: 2800MHz, Antenna gain: 35dBi	Ofcom (Antenna height); LoSCOV database for other radar parameters
Perwinnes	57°12'44.2"N	2°07'51.4"W	Antenna height: 23m, Tx Power: 40kW, Tx Freq: 1300MHz, Antenna gain: 38dBi	LoSCOV database
Buchan	57°27'32.48"N	1°48'42.94"W	Antenna height: 5m, Tx Power: 20kW, Tx Freq: 1300MHz, Antenna gain: 46dBi	LoSCOV database
Brizlee Wood	55°25'5.30"N	1°46'4.00"W	Antenna height: 5.5m, Tx Power: 20kW, Tx Freq: 1300MHz, Antenna gain: 46dBi	Ofcom (Antenna height); LoSCOV database for other radar parameters
Hill of Dudwick	57.430319 N	2.036672W	Antenna height: 13.4m, Tx Power: 250kW, Tx Freq: 5624MHz, Antenna gain: 44dBi	Met Office (Email response dated 14/07/23)

Table 4 – Radar site parameters used for the LoS assessment