Inverness Airport – IFP Safeguarding Report – Tom Na Clach Wind Farm Extension

Assessment of Instrument Flight Procedures and Obstacle Limitation Surfaces

Date: 6th December 2021
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Author	Osprey CSL	Sam Shuttlewood (APD)
Technical Reviewer	Osprey CSL	Liam Clarke (IAPD)
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Executive Summary

Osprey CSL has been commissioned by Infinergy Ltd to assess the impact of a 7 Turbine Extension at the Tom Na Clach Wind Farm with Turbine tip heights of 149.9m Above Ground Level (AGL) on the Obstacle Limitation Surfaces (OLS) and Instrument Flight Procedures (IFPs) at Inverness Airport.

Impact on the OLS

The Wind Turbines are outside the OLS and have no effects.

Impact on the IFPs

Published Procedures in the Aeronautical Information Publication (AIP)

There are no effects on the published IFPs at Inverness Airport.

Draft Procedures not currently published in the AIP

The Draft Procedure RNP RWY 23 (CL-5484-DOC-005 Runway 23 CHART V2.0 31072020) would be affected by the Wind Turbines. The 'NIBKU' Terminal Arrival Altitude (TAA) 10NM Minimum Obstacle Clearance Altitude (MOCA) of 3200ft is affected. Turbine 5 produces a MOCA of 3297ft, which is greater than the charted MOCA of 3200ft. The presence of the Turbine would require the TAA 10NM for 'NIBKU' to be raised to 3300ft. See Section 3.3.7 for further details.

Note: The Draft Procedures not currently published in the AIP are the latest versions of the procedures that we are aware of. There is no guarantee that the procedures shall be published in the future. Additionally, it is possible that the procedures could change as they have not yet been approved by the Civil Aviation Authority (CAA).

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1 Introduction

1.1 Background

Osprey CSL has been commissioned by Infinergy Ltd to assess the impact of a 7 Turbine Extension at the Tom Na Clach Wind Farm with Turbine tip heights of 149.9m Above Ground Level (AGL) on the Obstacle Limitation Surfaces (OLS) and Instrument Flight Procedures (IFPs) at Inverness Airport.

The Wind Farm is located approximately 10.3NM South East of Inverness Airport.

1.2 Scope of the Assessment

This report assesses the Turbines in relation to the Obstacle Limitation Surfaces (OLS) and Instrument Flight Procedures (IFPs) and has been completed with the use of the Airport's 2020 CAP 1732 aerodrome survey data (EGPE-2020).

1.3 Data Provided by Client

Email dated 09/11/2021 provided the Easting, Northing, Hub Height and Tip Height (AGL) based on Vesta V136 4.2MW Turbines.

Turbine No.	X(East) – OSGB36	Y(North) – OSGB36	Hub Height (m)	Tip Height (m)
1	287046	835418	82	149.9
2	287546	835407	82	149.9
3	287203	834826	82	149.9
4	286951	834149	82	149.9
5	286341	833716	82	149.9
6	287624	834318	82	149.9
7	287070	833723	82	149.9

Table 1 – Turbine Data Provided

These positions were converted, using Grid Inquest II, into ETRS89 Lat Long for use in the AutoCAD model.

Turbine No.	ETRS89-Lat	ETRS89-Long
1	+57 23 42.30	-3 52 51.91
2	+57 23 42.39	-3 52 21.96
3	+57 23 23.31	-3 52 41.53
4	+57 23 1.20	-3 52 55.49
5	+57 22 46.66	-3 53 31.28
6	+57 23 7.27	-3 52 15.49
7	+57 22 47.54	-3 52 47.67

Table 2 – ETRS89 Latitude and Longitude Output from Conversion

Ordnance Survey 'Terrain 50' data was used to define the Ground Elevation. The elevations were rounded up to the nearest metre to provide a level of conservativeness.

The Turbine Tip Elevations Above Mean Sea Level (AMSL) used are as follows:

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)
1	149.9	449	598.9
2	149.9	441	590.9
3	149.9	486	635.9
4	149.9	493	642.9
5	149.9	555	704.9
6	149.9	474	623.9
7	149.9	522	671.9

Table 3 – Turbine Tip Elevations

A radius of 100m shall be used which will cover the rotor diameter and also allow for a small difference in lateral position.

1.4 Orientation

The Wind Turbines were added to the AutoCAD Model:

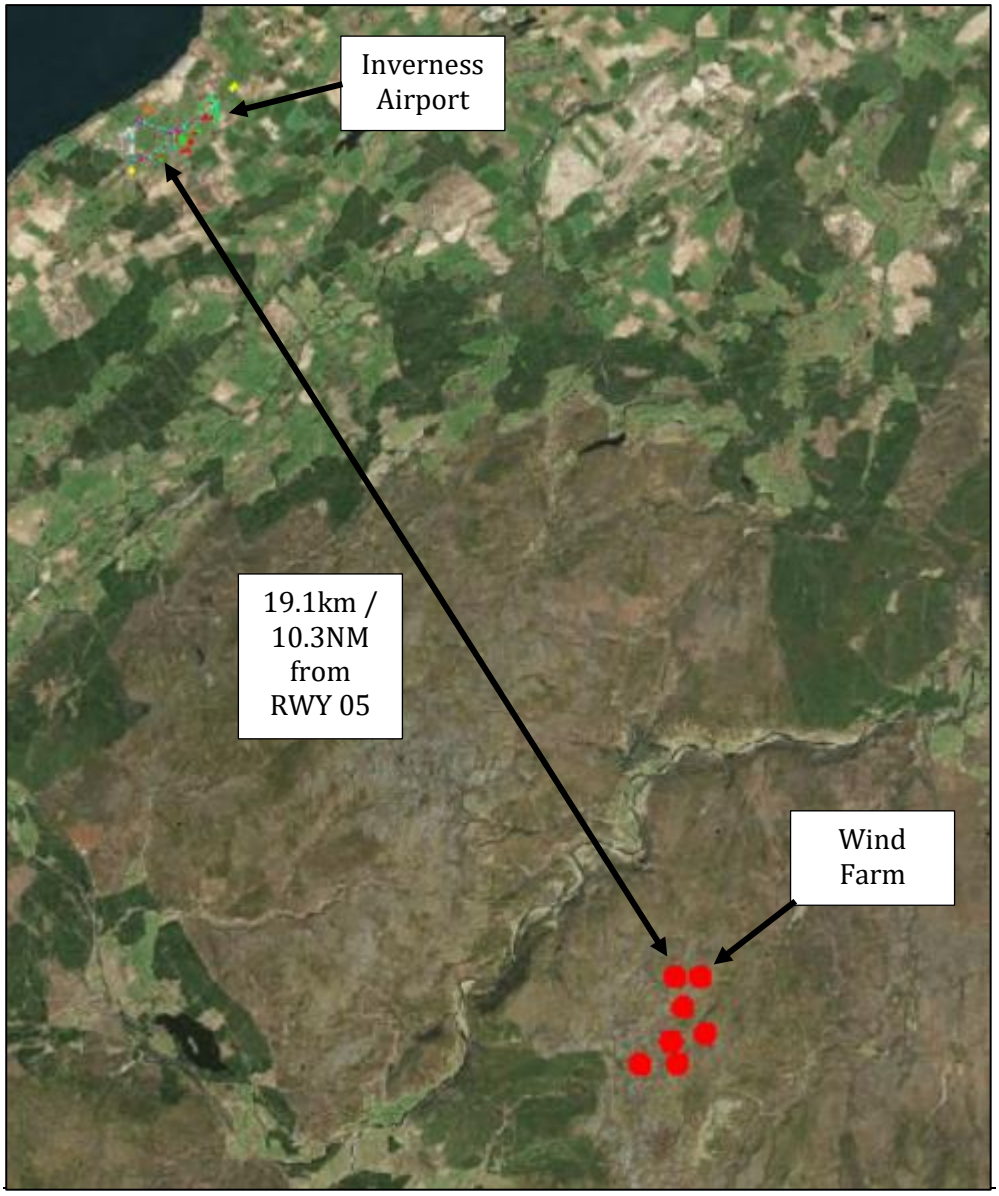

Figure 1 – Location of Wind Farm in Relation to Airport

2 OLS Analysis

2.1 Runway 05/23

The Wind Turbines are outside all Obstacle Limitation Surfaces (OLS).

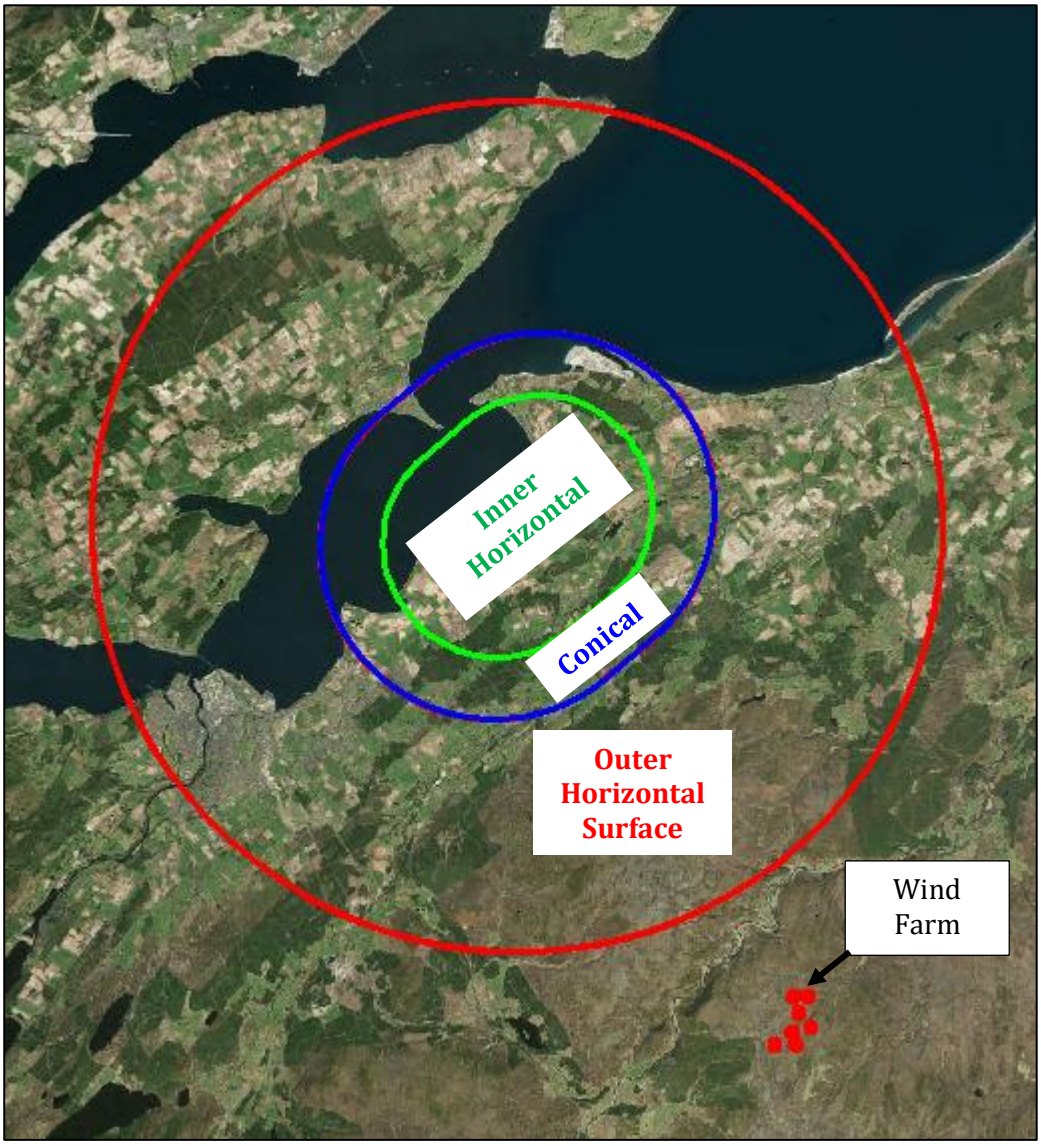

Figure 2 – Wind Farm with OLS Surfaces

The Wind Farm has no effect on the OLS.

3 IFP Safeguarding

3.1 General

The IFPs assessed are as follows:

3.1.1 Published Procedures

AIRAC Effective 2nd December 2021

- ATCSMAC AD 2-EGPE-5-1 (06/12/2018);
- ILS/DME/VOR RWY 05 CAT AB AD 2-EGPE-8-1 (12/08/2021);
- ILS/DME/VOR RWY 05 CAT C AD 2-EGPE-8-2 (12/08/2021);
- LOC/DME/VOR RWY 05 CAT AB AD 2-EGPE-8-3 (12/08/2021);
- LOC/DME/VOR RWY 05 CAT C AD 2-EGPE-8-4 (12/08/2021);
- VOR/DME RWY 05 CAT AB AD 2-EGPE-8-5 (12/08/2021);
- VOR/DME RWY 05 CAT C AD 2-EGPE-8-6 (12/08/2021);
- Direct Arrivals ILS/LOC/DME RWY 05 CAT AB AD 2-EGPE-8-7 (12/08/2021);
- Direct Arrivals ILS/LOC/DME RWY 05 CAT C AD 2-EGPE-8-8 (12/08/2021);
- Direct Arrivals VOR/DME RWY 05 CAT AB AD 2-EGPE-8-9 (12/08/2021);
- Direct Arrivals VOR/DME RWY 05 CAT C AD 2-EGPE-8-10 (12/08/2021);
- ILS/DME/VOR RWY 23 CAT ABC AD 2-EGPE-8-11 (12/08/2021);
- LOC/DME/VOR RWY 23 CAT ABC AD 2-EGPE-8-12 (12/08/2021);
- VOR/DME RWY 23 CAT ABC AD 2-EGPE-8-13 (12/08/2021);
- VOR RWY 23 CAT ABC AD 2-EGPE-8-14 (12/08/2021);
- Direct Arrivals ILS/LOC/DME RWY 23 CAT AB AD 2-EGPE-8-15 (12/08/2021);
- Direct Arrivals VOR/DME RWY 23 CAT AB AD 2-EGPE-8-16 (12/08/2021).

Additionally, the following were checked:

- Visual Circling
- Holding
- Visual Segment Surface
- Minimum Sector Altitudes

3.1.2 Procedures Awaiting Approval / Draft Procedures

- 71144 002 Inverness Airport - Direct Arrivals ILS LOC DME RWY 05 CAT CD Chart V1;
- 71144 003 Inverness Airport - ILS DME VOR RWY 05 CAT CD Chart V1;
- 71144 004 Inverness Airport - ILS DME VOR RWY 23 CAT ABCD Chart V1;
- 71144 005 Inverness Airport - LOC DME VOR RWY 05 CAT CD Chart V1;
- 71144 006 Inverness Airport - LOC DME VOR RWY 23 CAT ABCD Chart V1;
- CL-5484-DOC-005 Runway 23 CHART V2.0 31072020 – Inverness RNP RWY 23;
- CL-5484-DOC-010 Runway 05 CHART V2.0 31072020 – Inverness RNP RWY 05;

- 70550-IFP-007-EGPE_GUSSI RWY 05 SID-Chart_V1;
- 70550-IFP-008-EGPE_GARVA RWY 05 SID-Chart_V1;
- 70550-IFP-009-EGPE_BONBY RWY 05 SID-Chart_V1;
- 70550-IFP-010-EGPE_GUSSI RWY 23 SID-Chart_V1;
- 70550-IFP-011-EGPE_GARVA RWY 23 SID-Chart_V1;

- 70550-IFP-012-EGPE_BONBY RWY 23 SID-Chart_V1;
- 70550-IFP-013-EGPE_GUSSI RWY 05 STAR-Chart_V1;
- 70550-IFP-014-EGPE_GARVA RWY 05 STAR-Chart_V1;
- 70550-IFP-015-EGPE_BONBY RWY 05 STAR-Chart_V1;
- 70550-IFP-016-EGPE_GUSSI RWY 23 STAR-Chart_V1;
- 70550-IFP-017-EGPE_GARVA RWY 23 STAR-Chart_V1;
- 70550-IFP-018-EGPE_BONBY RWY 23 STAR-Chart_V1.

3.2 Assessment

3.2.1 ATCSMAC AD 2-EGPE-5-1 (06/12/2018);

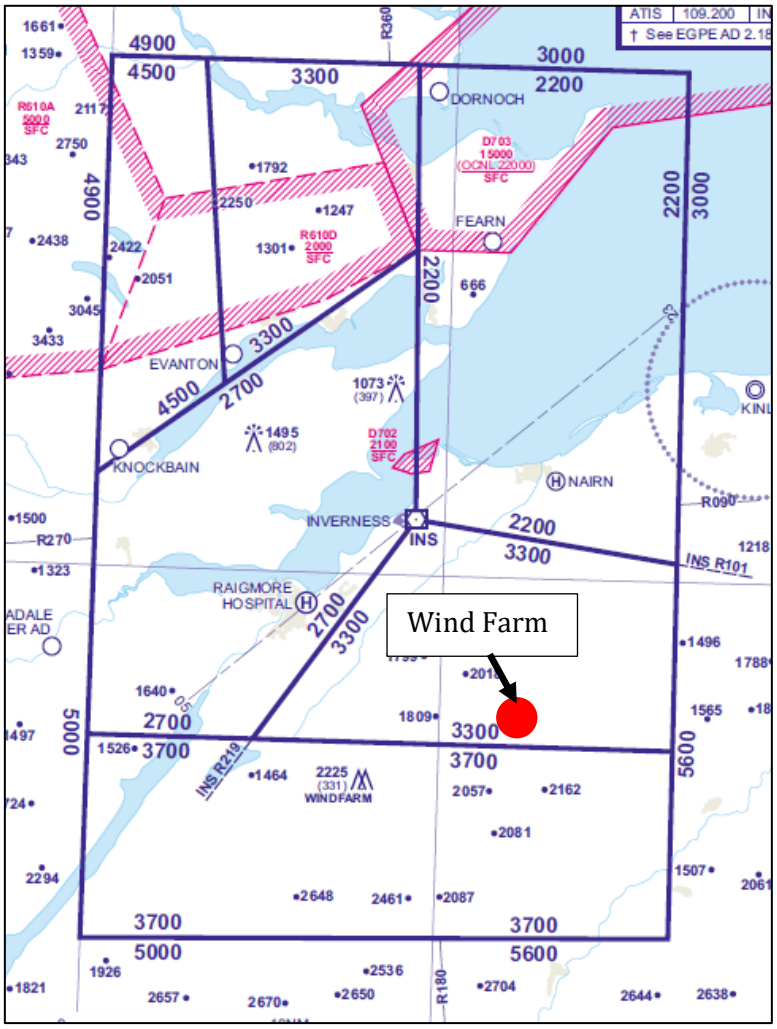

Figure 3 – ATCSMAC

According to CAP 777, all significant obstacles or terrain located within the Surveillance Minimum Altitude Area (SMAA) are to be assessed considering a 3NM or 5NM buffer (dependent on Radar Approval) and then apply the MOC, which is 300 m.

Inverness Airport are approved to use a 5NM Air Traffic separation within their area of activity. The SMAA assessment will therefore be assessed with reference to a 5 NM lateral buffer.

The Wind Farm is inside the lateral confines of the Surveillance Minimum Altitude Area (SMAA) with a Minimum Obstacle Clearance Altitude (MOCA) of 3300ft and also 3700ft when considering the required 5NM buffer.

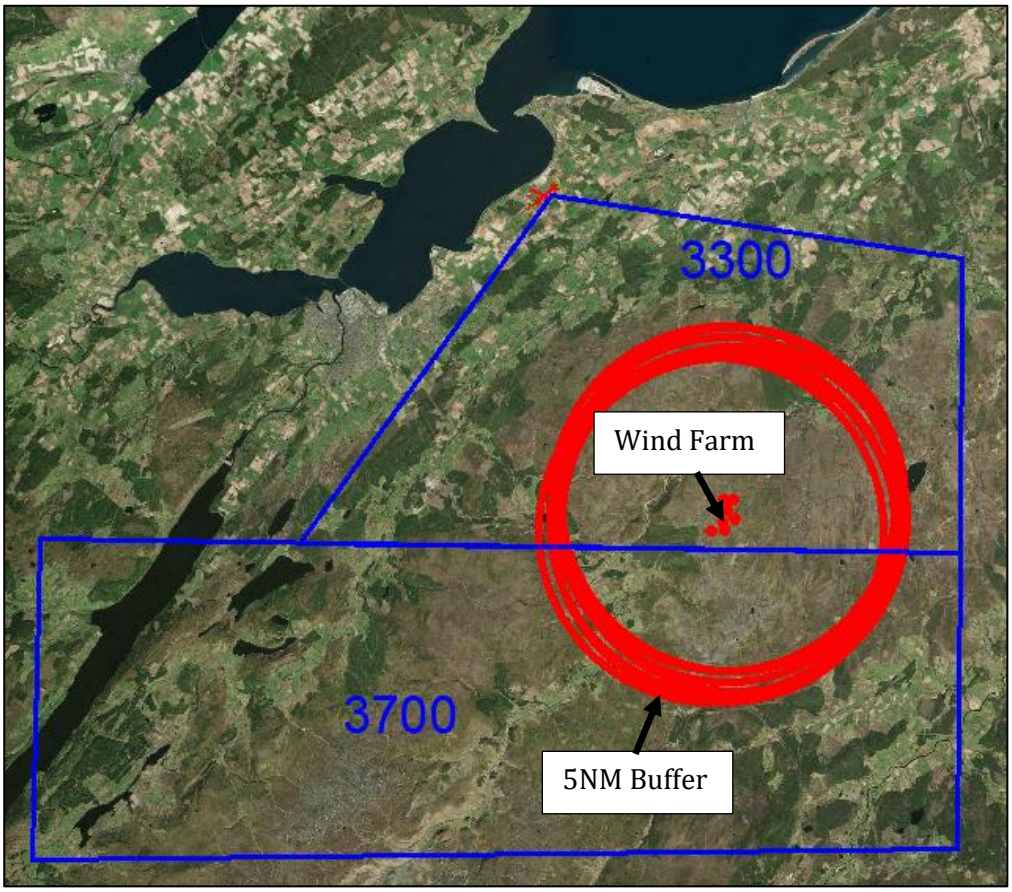

Figure 4 – ATCSMAC with Wind Farm and 5NM Buffer

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)	Minimum Obstacle Clearance (m)	Calculated MOCA (ft)	Max. Acceptable Tip Height (m)
1	149.9	449	598.9	300	2950	256
2	149.9	441	590.9	300	2923	264
3	149.9	486	635.9	300	3071	219
4	149.9	493	642.9	300	3094	212
5	149.9	555	704.9	300	3297	150
6	149.9	474	623.9	300	3032	231
7	149.9	522	671.9	300	3189	183

Table 4 – ATCSMAC Obstacle Assessment

All Turbines produce a MOCA below the published value of 3300ft.

The Wind Farm has no effect on the ATCSMAC.

Note: - Wind Turbine 5 calculations indicate that the maximum Turbine height permitted at the site, to NOT affect the ATCSMAC, is 150m. It is suggested that this site is surveyed to make sure that the ground level elevation is no greater than 555m. (Our Terrain model (OS Terrain 50) is based on elevation values which are taken every 50m).

3.2.2 ILS/DME/VOR RWY 05 CAT AB AD 2-EGPE-8-1 (12/08/2021); ILS/DME/VOR RWY 05 CAT C AD 2-EGPE-8-2 (12/08/2021);

Note: This Base Turn has been drawn for CAT D Aircraft due to a revised procedure having been designed but not yet published.

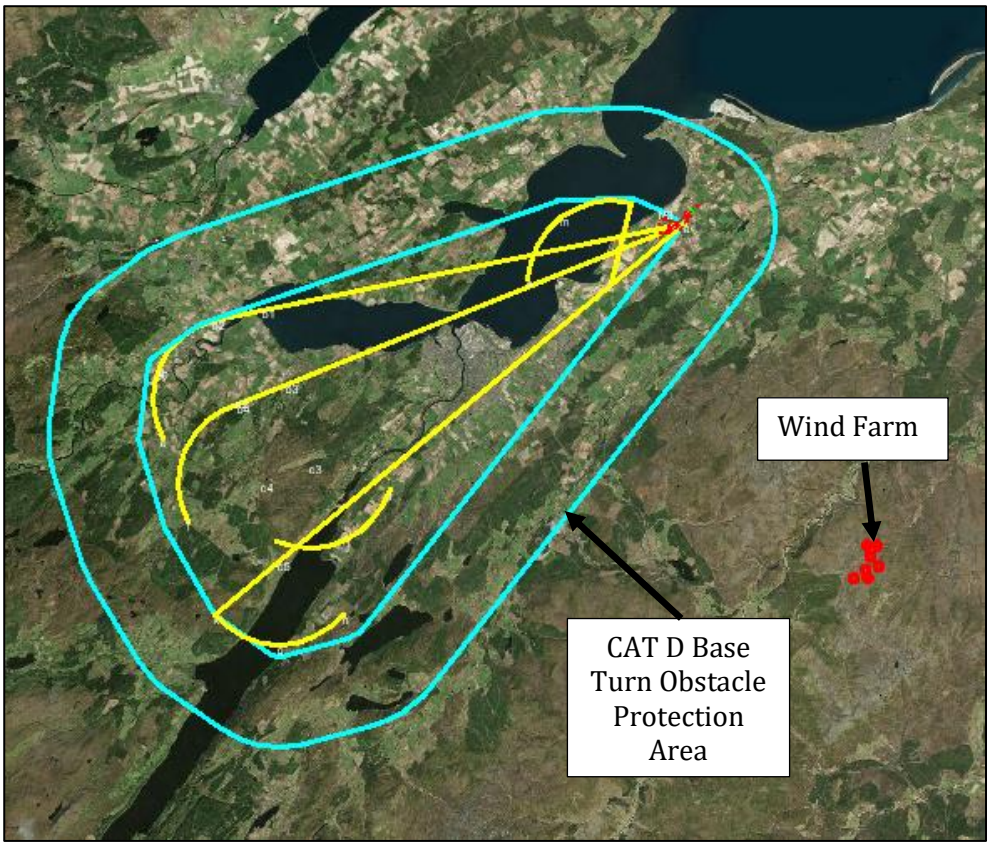

Figure 5 – Wind Farm in relation to ILS/DME/VOR RWY 05 CAT D Base Turn

The Wind Farm is outside the Obstacle Protection Areas associated with the ILS/DME/VOR RWY 05 CAT A, B, C and proposed CAT D Base Turn.

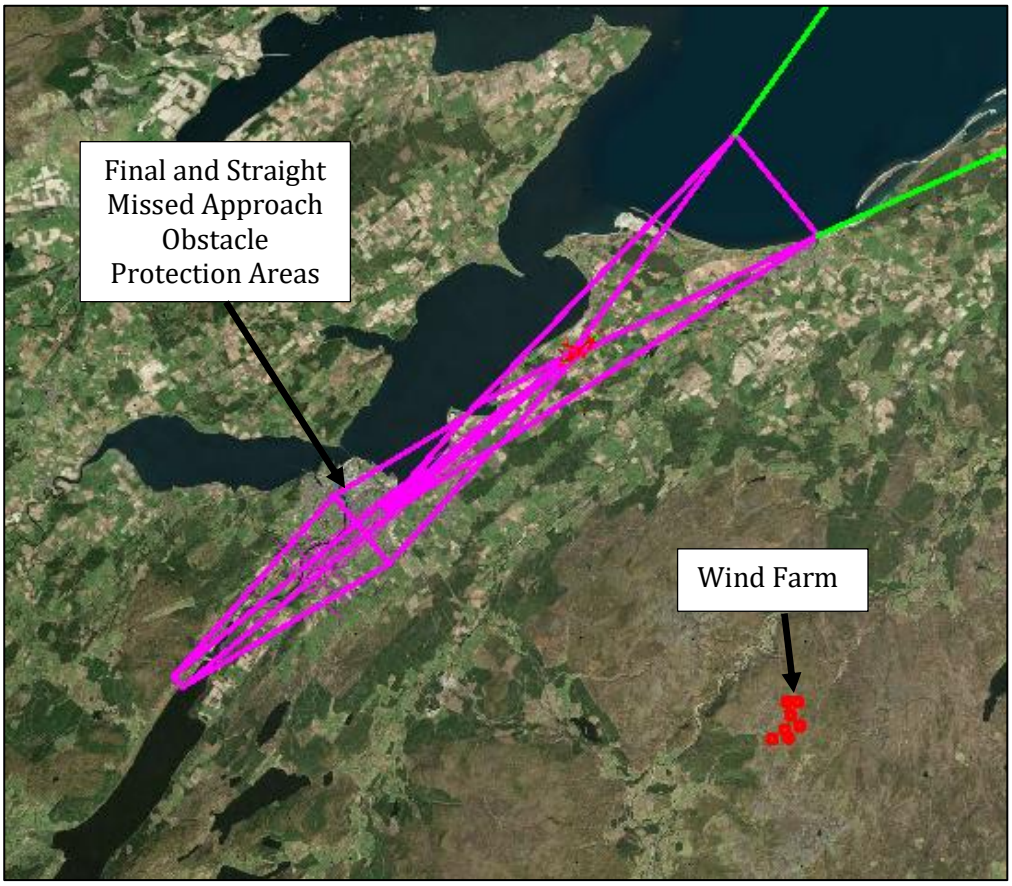

Figure 6 – Wind Farm in relation to ILS/DME/VOR RWY 05 Final and Straight Missed Approach Protection Areas

The proposed Wind Farm is outside of the Final and Straight Missed Approach Obstacle Protection Areas associated with the ILS/DME/VOR RWY 05 CAT A, B, C and proposed CAT D procedure.

Aircraft executing a turn in the Missed Approach would not do so unless at an altitude of 2000 ft. The following Figure shows that the Wind Farm is outside the Obstacle Protection Areas for the Final Missed Approach.

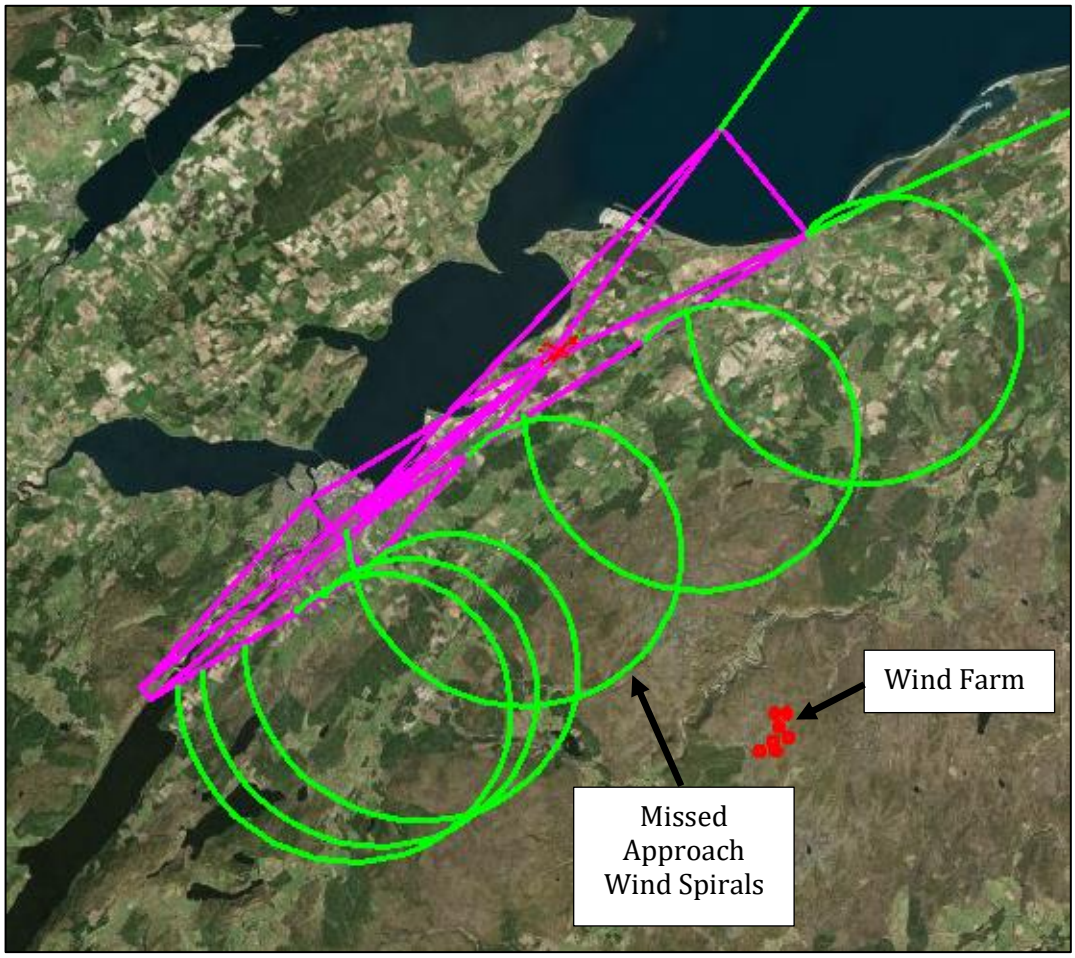

Figure 7 – Wind Farm in relation to ILS/DME/VOR RWY 05 Final Missed Approach Protection Areas

The Wind Farm will have no effect on the ILS/DME/VOR RWY 05 CAT AB AD 2-EGPE-8-1 (12/08/2021) and ILS/DME/VOR RWY 05 CAT C AD 2-EGPE-8-2 (12/08/2021), as well as the proposed CAT D procedures.

3.2.3 LOC/DME/VOR RWY 05 CAT AB AD 2-EGPE-8-3 (12/08/2021); LOC/DME/VOR RWY 05 CAT C AD 2-EGPE-8-4 (12/08/2021);

See Section 3.2.2.

The Wind Farm will have no effect on the LOC/DME/VOR RWY 05 CAT AB AD 2-EGPE-8-3 (12/08/2021) and LOC/DME/VOR RWY 05 CAT C AD 2-EGPE-8-4 (12/08/2021), as well as the proposed CAT D procedures.

3.2.4 VOR/DME RWY 05 CAT AB AD 2-EGPE-8-5 (12/08/2021); VOR/DME RWY 05 CAT C AD 2-EGPE-8-6 (12/08/2021);

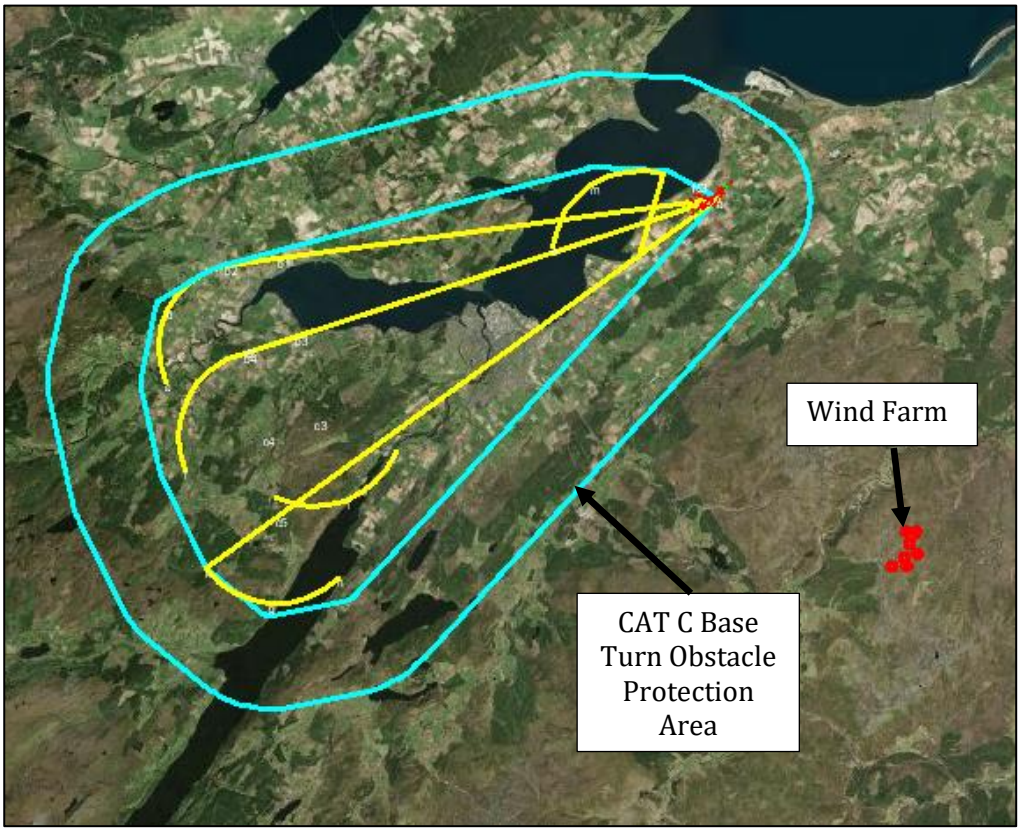

Figure 8 – Wind Farm in relation to VOR/DME RWY 05 CAT C Base Turn

The Wind Farm is outside the Obstacle Protection Areas associated with the VOR/DME RWY 05 CAT AB and C. The Areas shown are for CAT C Aircraft; CAT A/B Areas are smaller than this.

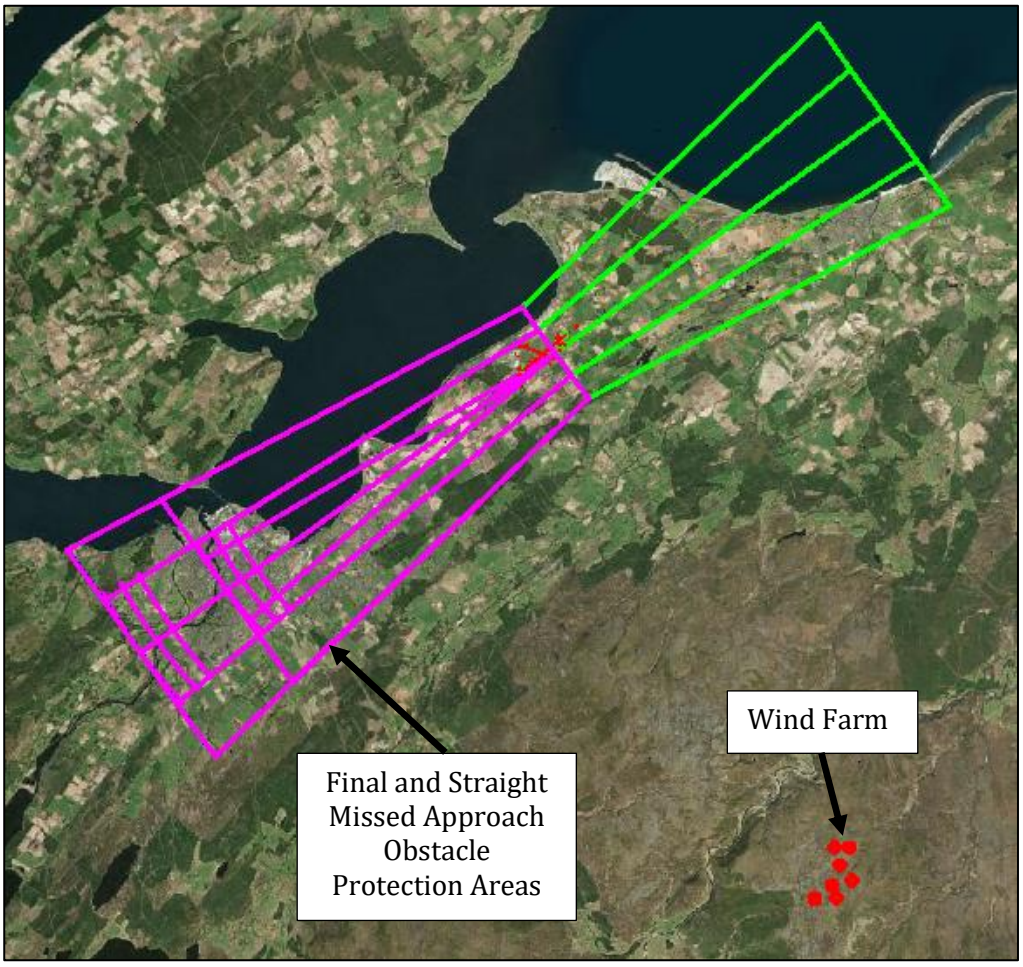

Figure 9 – Wind Farm in relation to VOR/DME RWY 05 Final and Straight Missed Approach Protection Areas

The proposed Wind Farm is outside of the Final and Straight Missed Approach Obstacle Protection Areas associated with the VOR/DME RWY 05 CAT AB and C procedures.

Aircraft executing a turn in the Missed Approach would not do so unless at an altitude of 2000 ft. Using a worse case possible scenario where an Aircraft could execute the Missed Approach at the Final Approach Fix (FAF), the following Figure shows that the Wind Farm is outside the Obstacle Protection Areas for the Final Missed Approach.

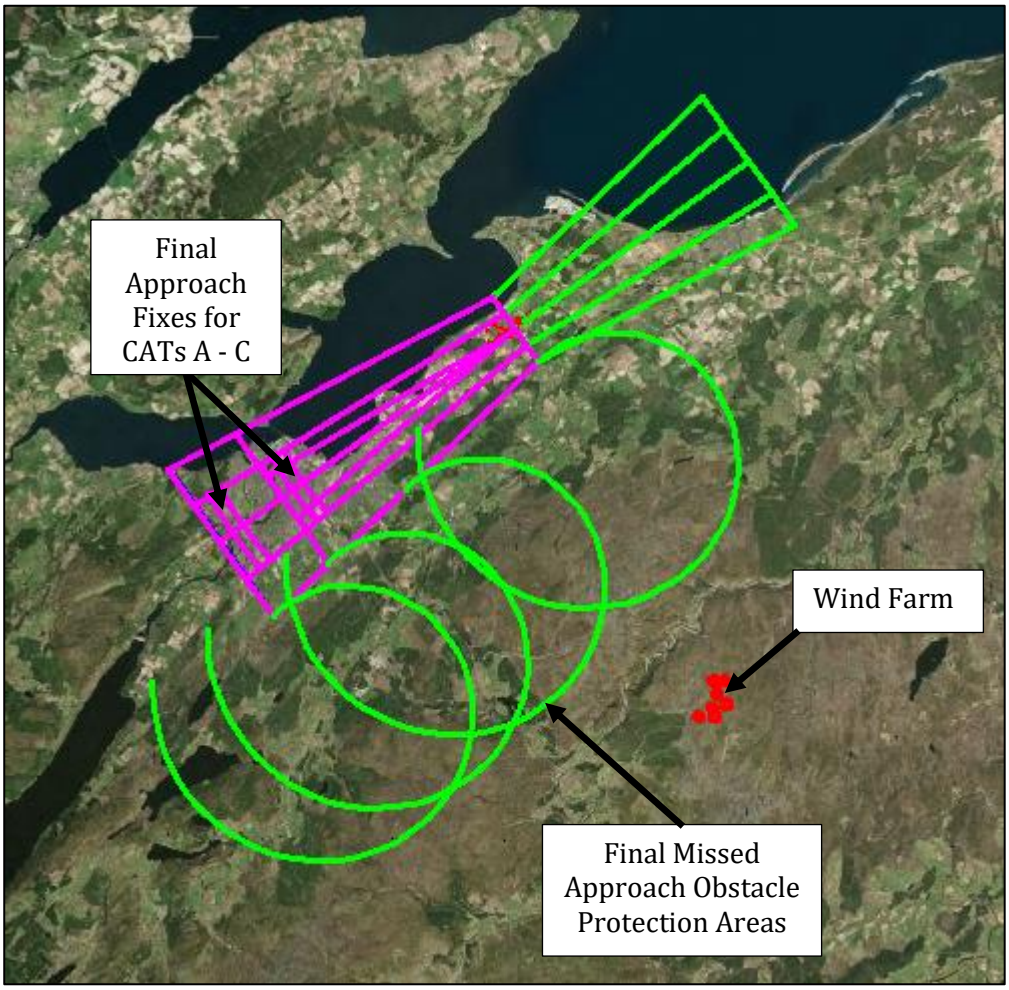

Figure 10 – Wind Farm in relation to VOR/DME RWY 05 Final Missed Approach Protection Areas

The proposed Wind Farm is outside of the Final Missed Approach Obstacle Protection Areas associated with the VOR/DME RWY 05 CAT AB and C procedures.

The Wind Farm will have no effect on the VOR/DME RWY 05 CAT AB AD 2-EGPE-8-5 (12/08/2021) and VOR/DME RWY 05 CAT C AD 2-EGPE-8-6 (12/08/2021) procedures.

3.2.5 Direct Arrivals ILS/LOC/DME RWY 05 CAT AB AD 2-EGPE-8-7 (12/08/2021);

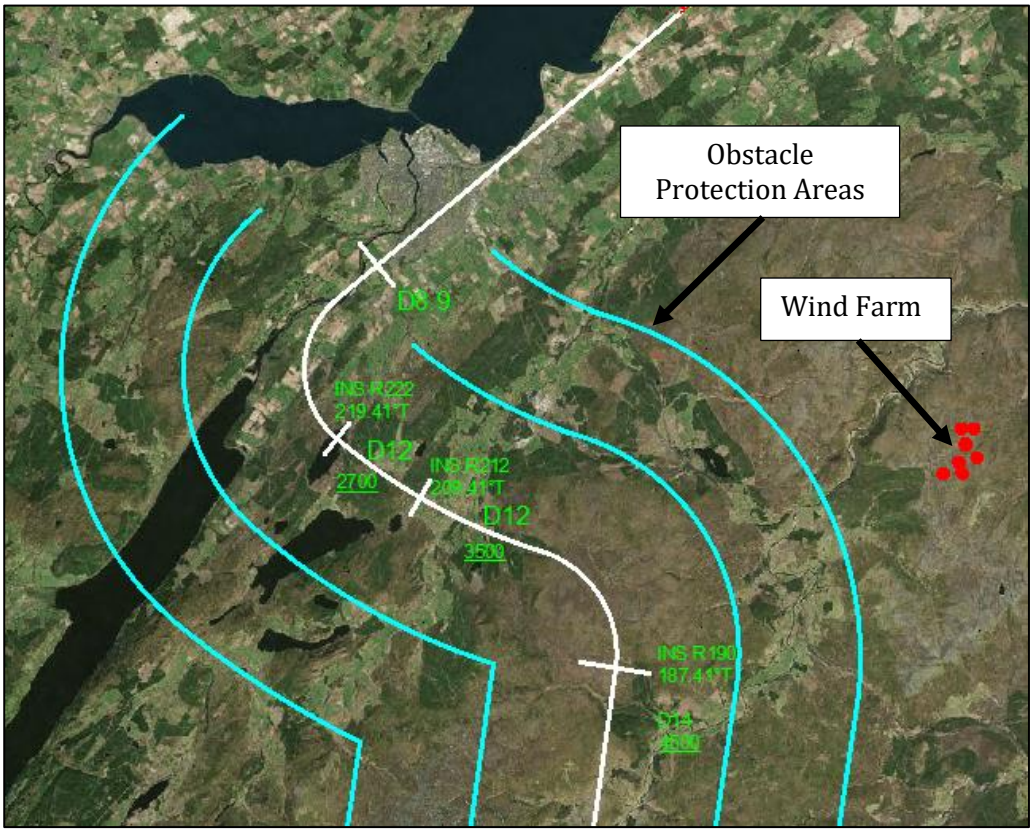

Figure 11 – Wind Farm in relation to Direct Arrivals ILS/LOC/DME RWY 05 CAT AB

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Direct Arrivals ILS/LOC/DME RWY 05 CAT AB procedure.

The Wind Farm will have no effect on the Direct Arrivals ILS/LOC/DME RWY 05 CAT AB AD 2-EGPE-8-7 (12/08/2021) procedure.

3.2.6 Direct Arrivals ILS/LOC/DME RWY 05 CAT C AD 2-EGPE-8-8 (12/08/2021);

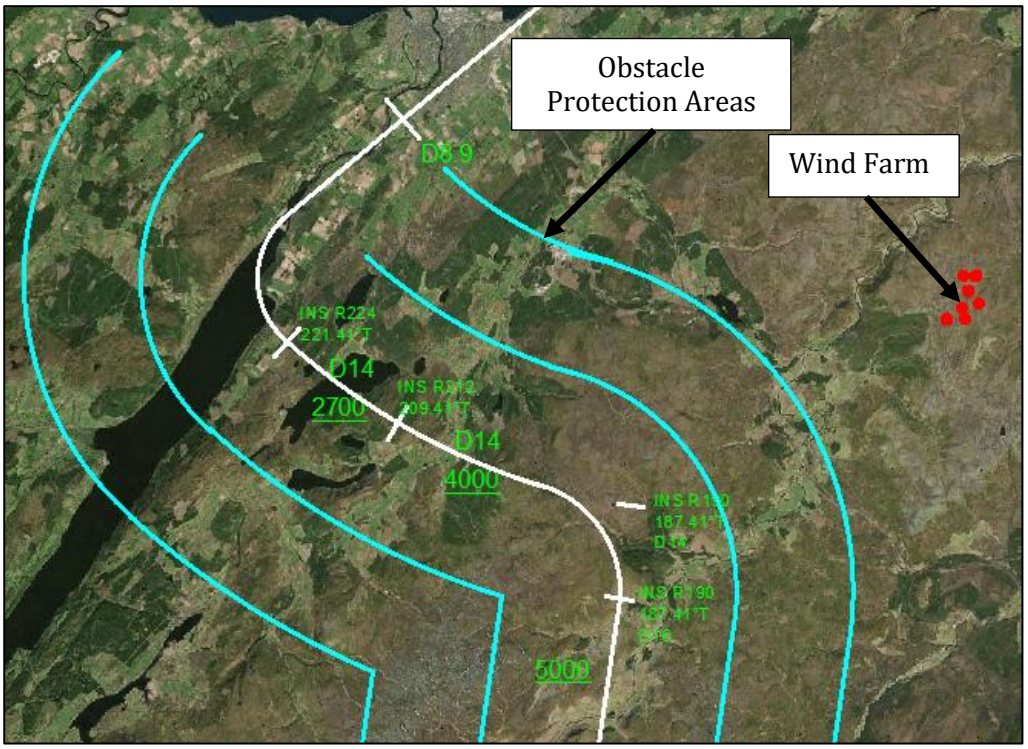

Figure 12 – Wind Farm in relation to Direct Arrivals ILS/LOC/DME RWY 05 CAT C

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Direct Arrivals ILS/LOC/DME RWY 05 CAT C procedure.

The Wind Farm will have no effect on the Direct Arrivals ILS/LOC/DME RWY 05 CAT C AD 2-EGPE-8-8 (12/08/2021) procedure.

3.2.7 Direct Arrivals VOR/DME RWY 05 CAT AB AD 2-EGPE-8-9 (12/08/2021);

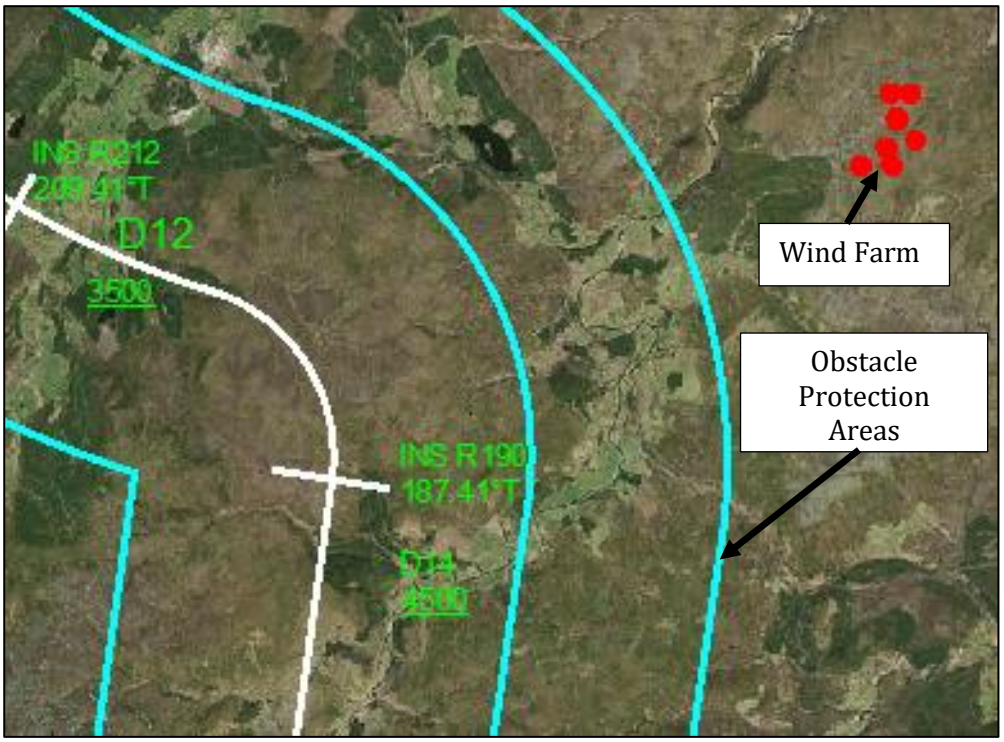

Figure 13 – Wind Farm in relation to Direct Arrivals VOR/DME RWY 05 CAT AB

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Direct Arrivals VOR/DME RWY 05 CAT AB procedure.

The Wind Farm will have no effect on the Direct Arrivals VOR/DME RWY 05 CAT AB AD 2-EGPE-8-9 (12/08/2021) procedure.

3.2.8 Direct Arrivals VOR/DME RWY 05 CAT C AD 2-EGPE-8-10 (12/08/2021);

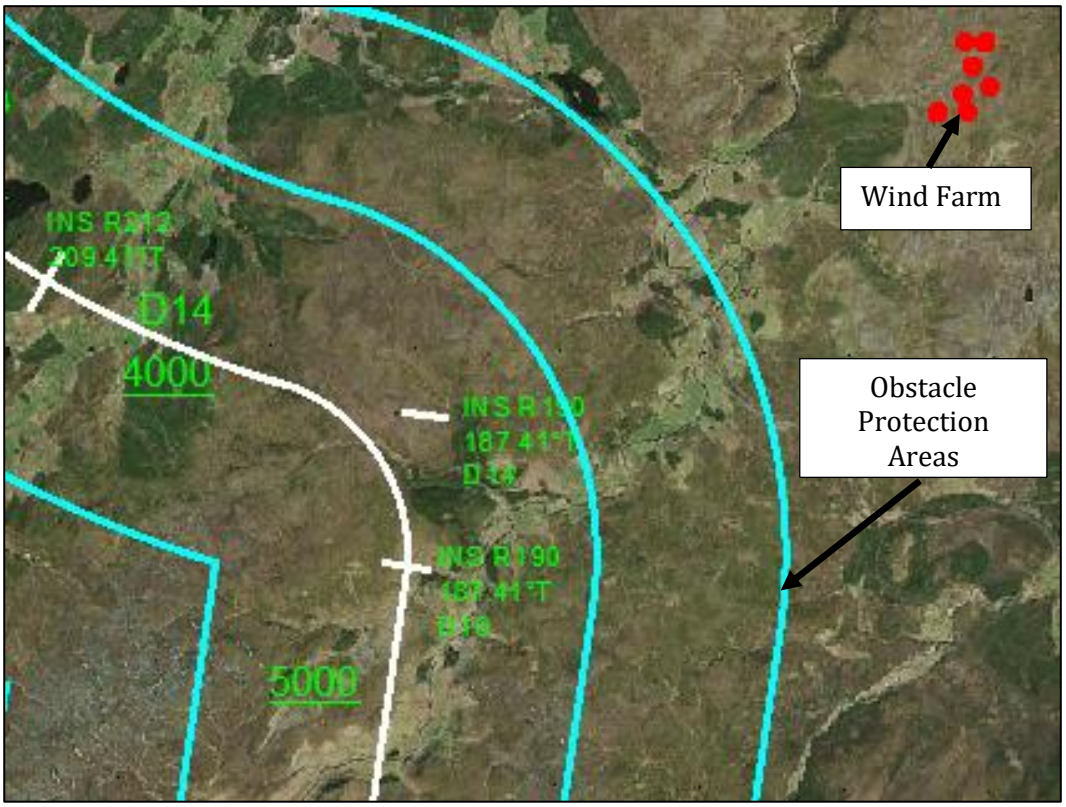

Figure 14 – Wind Farm in relation to Direct Arrivals VOR/DME RWY 05 CAT C

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Direct Arrivals VOR/DME RWY 05 CAT C procedure.

The Wind Farm will have no effect on the Direct Arrivals VOR/DME RWY 05 CAT C AD 2-EGPE-8-10 (12/08/2021) procedure.

3.2.9 ILS/DME/VOR RWY 23 CAT ABC AD 2-EGPE-8-11 (12/08/2021);

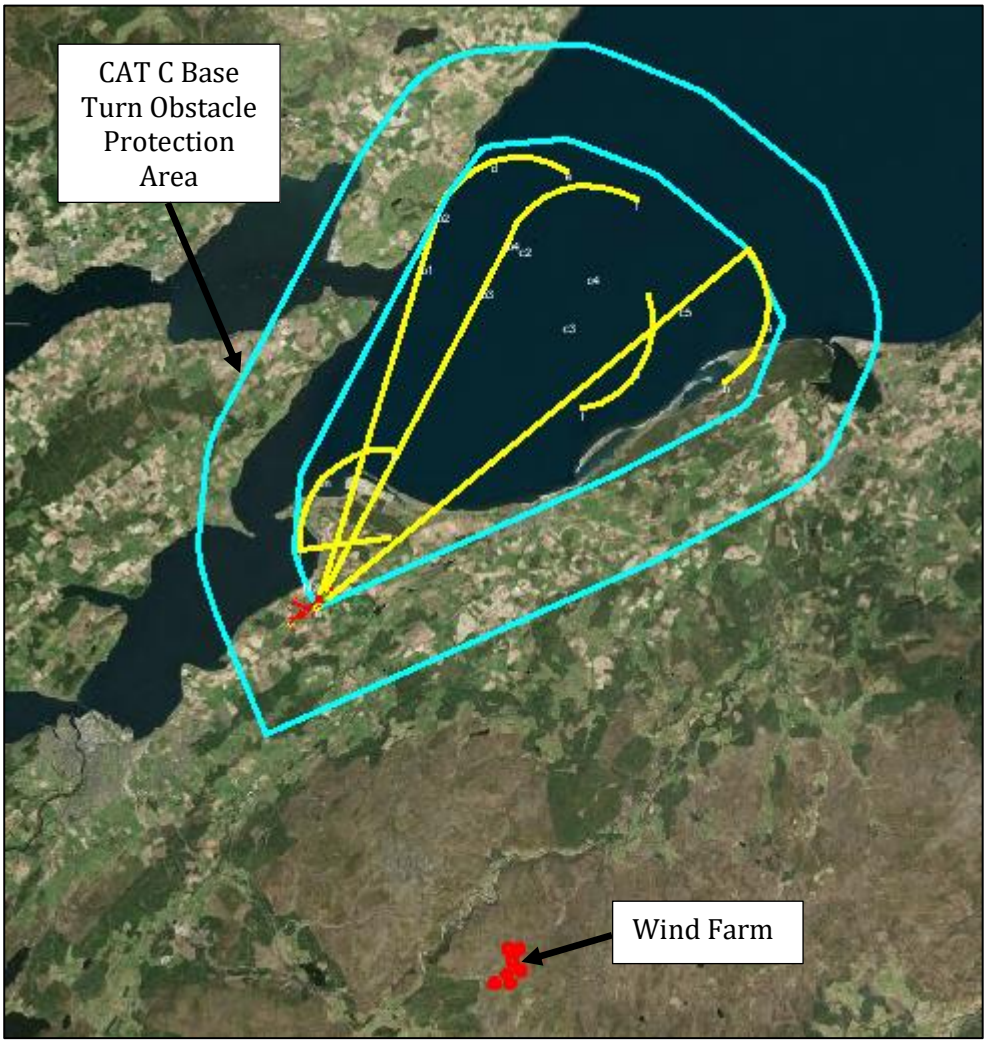

Figure 15 – Wind Farm in relation to ILS/DME/VOR RWY 23 CAT ABC Base Turn

The Wind Farm is outside the Obstacle Protection Areas associated with the ILS/DME/VOR RWY 23 CAT ABC procedure. The Areas shown are for CAT C Aircraft; CAT A/B Areas are smaller than this.

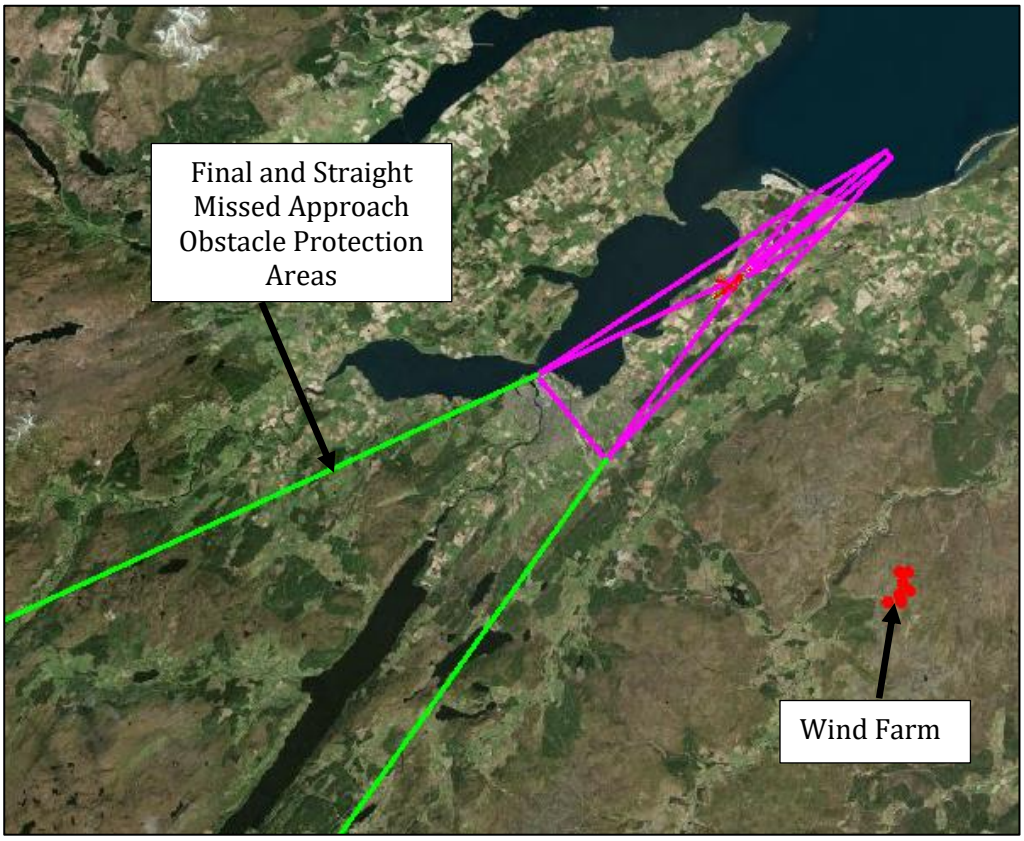

Figure 16 – Wind Farm in relation to ILS/DME/VOR RWY 23 CAT ABC Final and Straight Missed Approach

The proposed Wind Farm is outside of the Final and Straight Missed Approach Obstacle Protection Areas associated with the ILS/DME/VOR RWY 23 CAT ABC procedure.

Aircraft executing a turn in the Final Missed Approach would not do so unless at an altitude of 2000 ft. Aircraft would be turning AWAY from the area of the Wind Farm (to the West) and therefore there would be no effects on the procedure.

The Wind Farm will have no effect on the ILS/DME/VOR RWY 23 CAT ABC AD 2-EGPE-8-11 (12/08/2021).

3.2.10 LOC/DME/VOR RWY 23 CAT ABC AD 2-EGPE-8-12 (12/08/2021);

See Section 3.2.9.

The Wind Farm will have no effect on the LOC/DME/VOR RWY 23 CAT ABC AD 2-EGPE-8-12 (12/08/2021) procedure.

3.2.11 VOR/DME RWY 23 CAT ABC AD 2-EGPE-8-13 (12/08/2021);

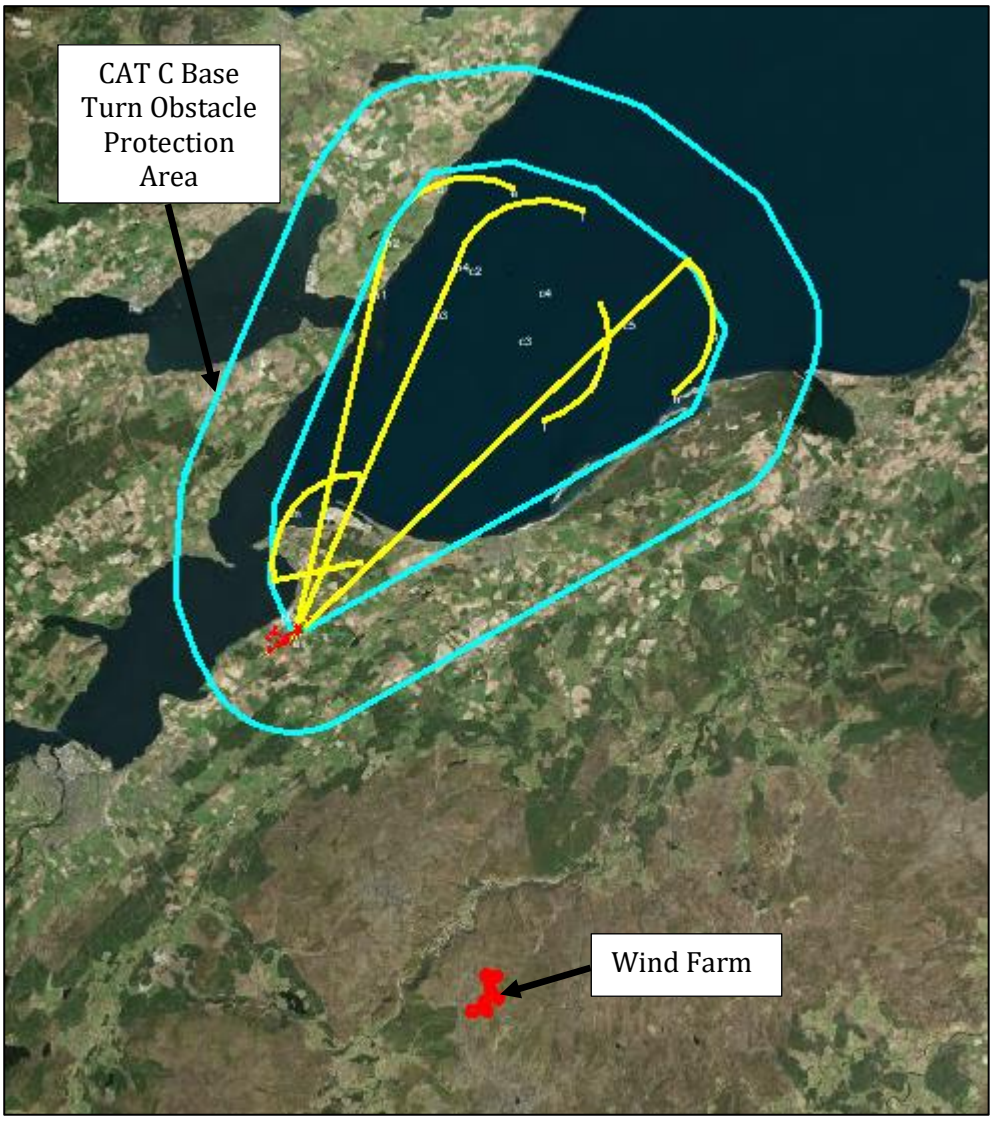

Figure 17 – Wind Farm in relation to VOR/DME RWY 23 CAT C Base Turn

The Wind Farm is outside the Obstacle Protection Areas associated with the VOR/DME RWY 23 CAT ABC. The Areas shown are for CAT C Aircraft; CAT A/B Areas are smaller than this.

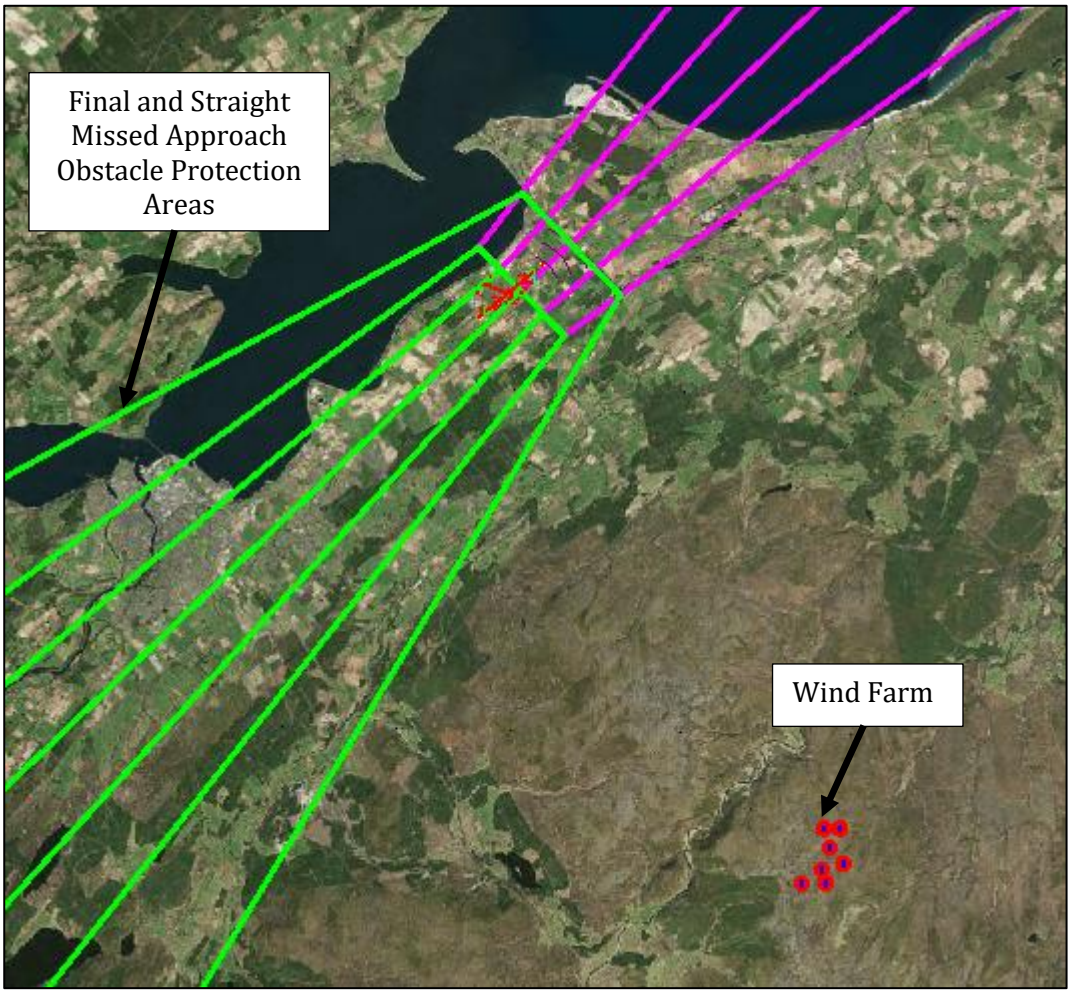

Figure 18 – Wind Farm in relation to VOR/DME RWY 23 Final and Straight Missed Approach Protection Areas

The proposed Wind Farm is outside of the Final and Straight Missed Approach Obstacle Protection Areas associated with the VOR/DME RWY 23 CAT ABC procedure.

Aircraft executing a turn in the Final Missed Approach would not do so unless at an altitude of 2000 ft. Aircraft would be turning AWAY from the area of the Wind Farm (to the West) and therefore there would be no effects on the procedure.

The Wind Farm will have no effect on the VOR/DME RWY 23 CAT ABC AD 2-EGPE-8-13 (12/08/2021) procedure.

3.2.12 VOR RWY 23 CAT ABC AD 2-EGPE-8-14 (12/08/2021);

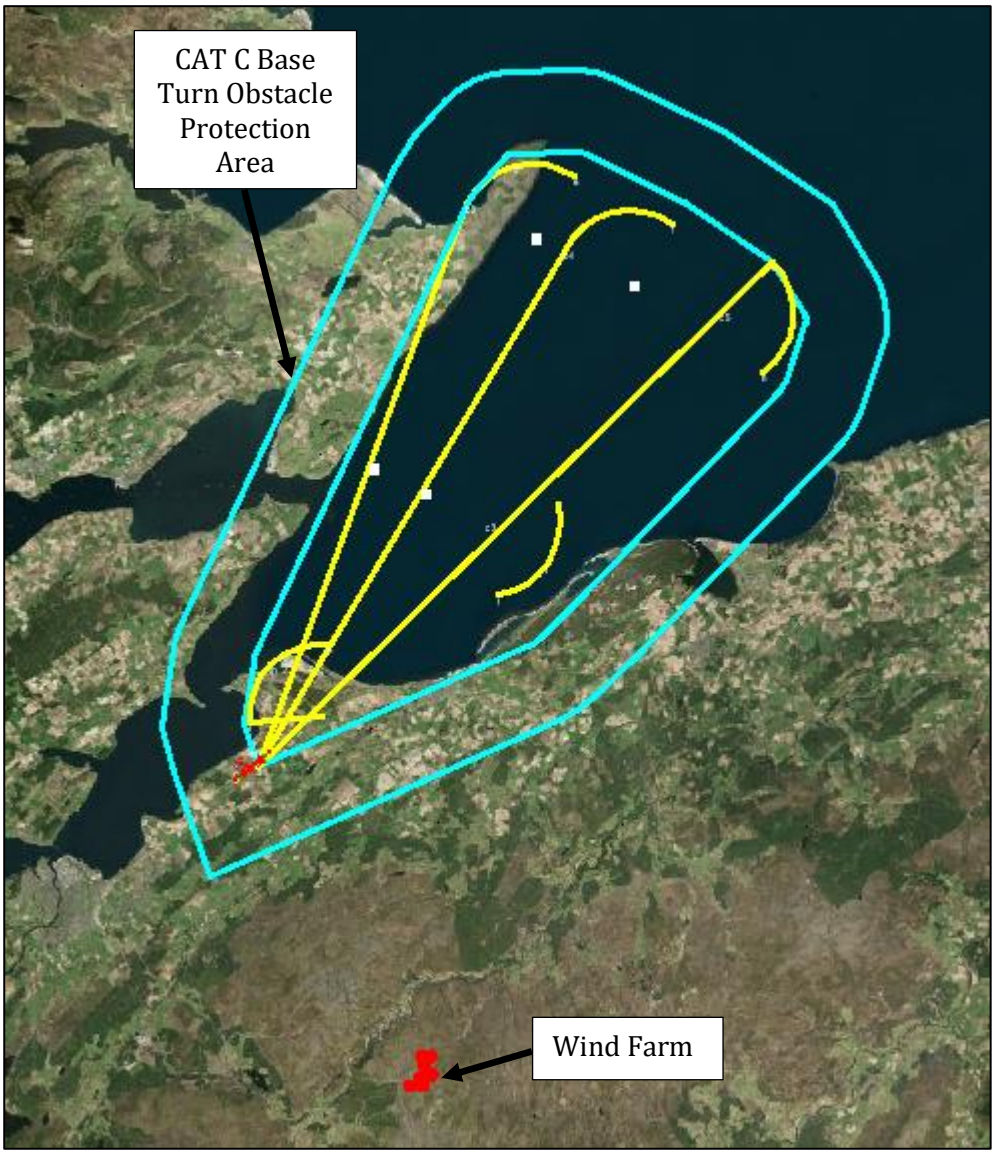

Figure 19 – Wind Farm in relation to VOR RWY 23 CAT C Base Turn

The Wind Farm is outside the Obstacle Protection Areas associated with the VOR RWY 23 CAT ABC. The Areas shown are for CAT C Aircraft; CAT A/B Areas are smaller than this.

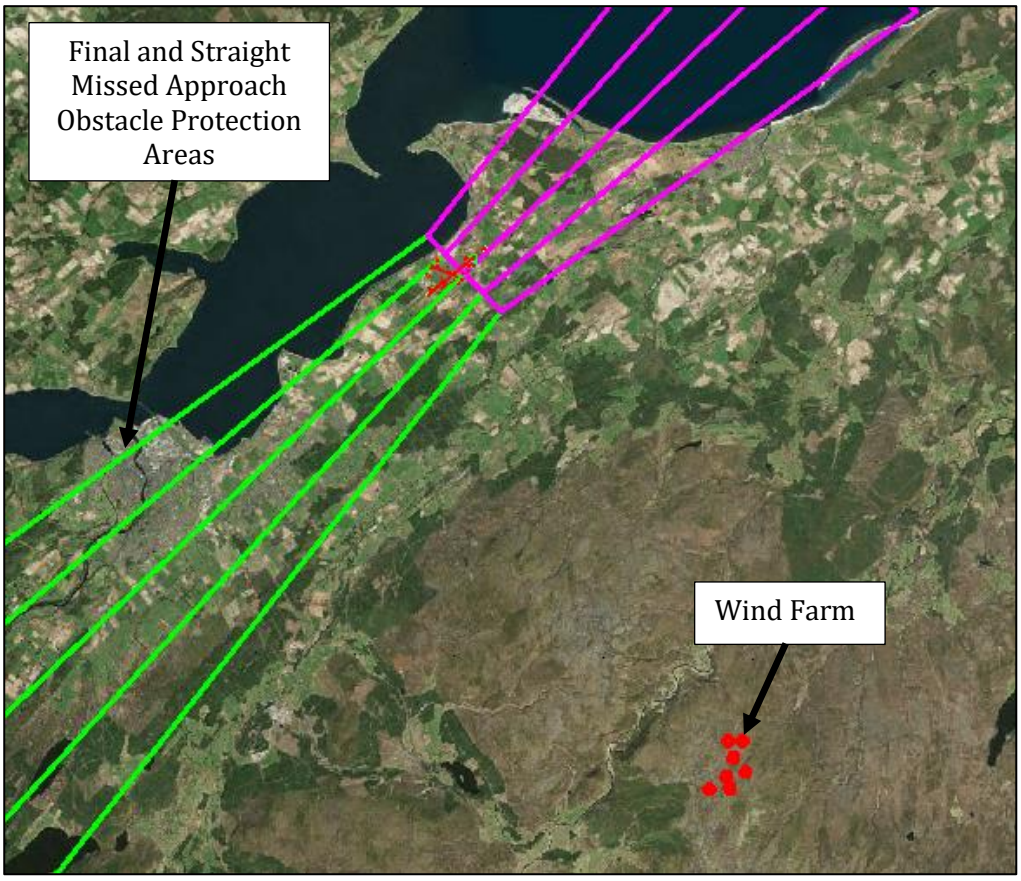

Figure 20 – Wind Farm in relation to VOR RWY 23 Final and Straight Missed Approach Protection Areas

The proposed Wind Farm is outside of the Final and Straight Missed Approach Obstacle Protection Areas associated with the VOR RWY 23 CAT ABC procedure.

Aircraft executing a turn in the Final Missed Approach would not do so unless at an altitude of 2000 ft. Aircraft would be turning AWAY from the area of the Wind Farm (to the West) and therefore there would be no effects on the procedure.

The Wind Farm will have no effect on the VOR RWY 23 CAT ABC AD 2-EGPE-8-14 (12/08/2021) procedure.

3.2.13 Direct Arrivals ILS/LOC/DME RWY 23 CAT AB AD 2-EGPE-8-15 (12/08/2021);

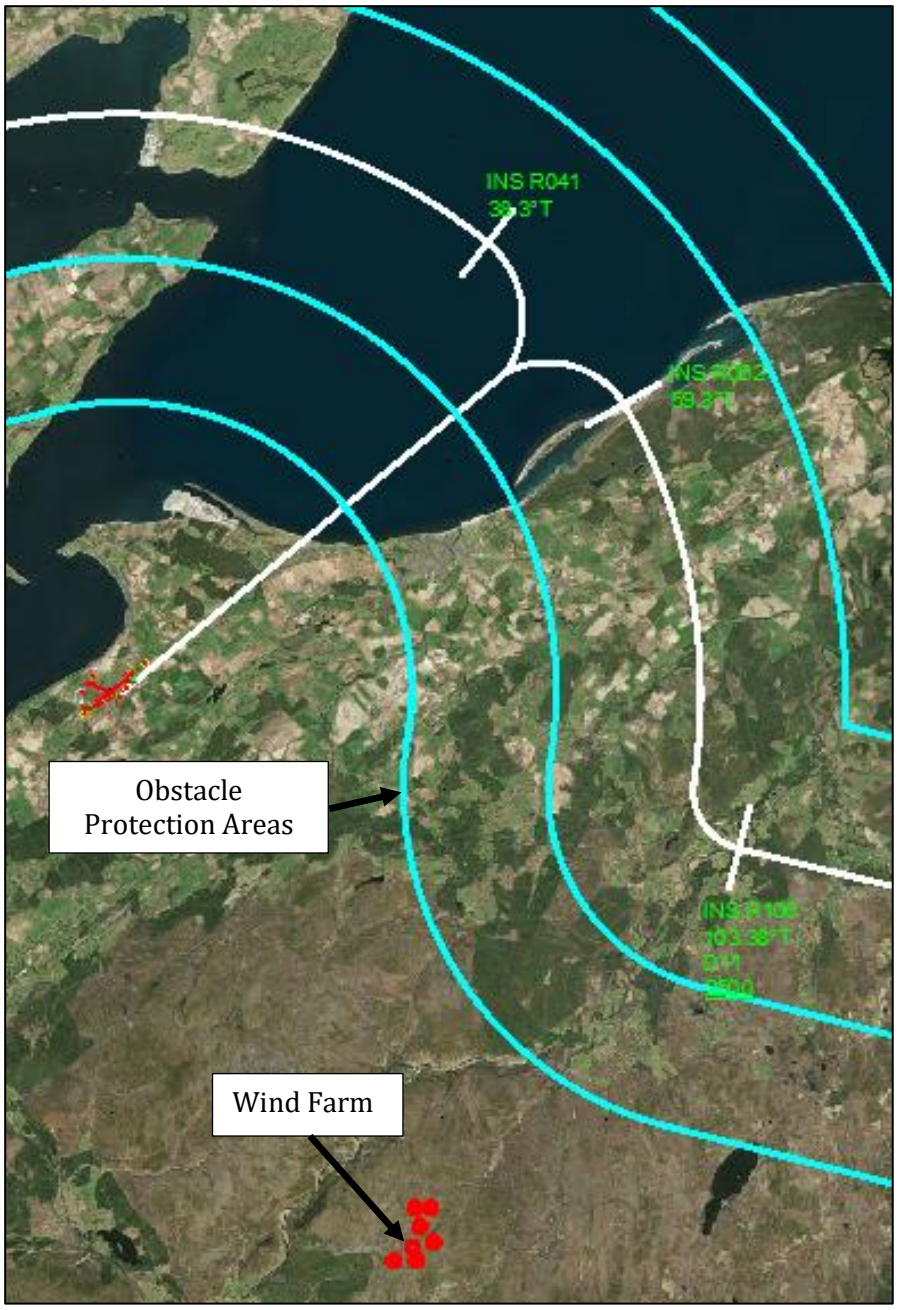

Figure 21 – Wind Farm in relation to Direct Arrivals ILS/LOC/DME RWY 23 CAT AB

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Direct Arrivals ILS/LOC/DME RWY 23 CAT AB procedure.

The Wind Farm will have no effect on the Direct Arrivals ILS/LOC/DME RWY 23 CAT AB AD 2-EGPE-8-15 (12/08/2021) procedure.

3.2.14 Direct Arrivals VOR/DME RWY 23 CAT AB AD 2-EGPE-8-16 (12/08/2021);

Figure 22 – Wind Farm in relation to Direct Arrivals VOR/DME RWY 23 CAT AB

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Direct Arrivals VOR/DME RWY 23 CAT AB procedure.

The Wind Farm will have no effect on the Direct Arrivals VOR/DME RWY 23 CAT AB AD 2-EGPE-8-16 (12/08/2021) procedure.

3.2.15 Visual Circling

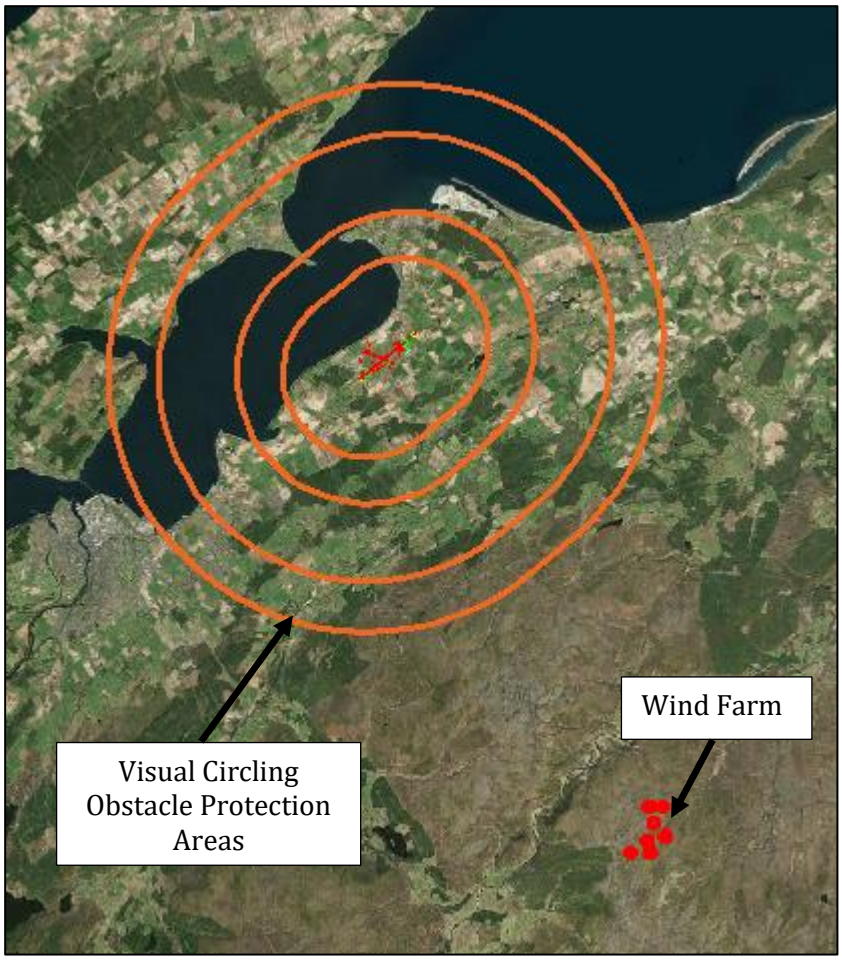

Figure 23 – Wind Farm in relation to Visual Circling Areas

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Visual Circling Obstacle Protection Areas.

The Wind Farm will have no effect on the Visual Circling at Inverness Airport.

3.2.16 Runway 05 Holding (VOR INS)

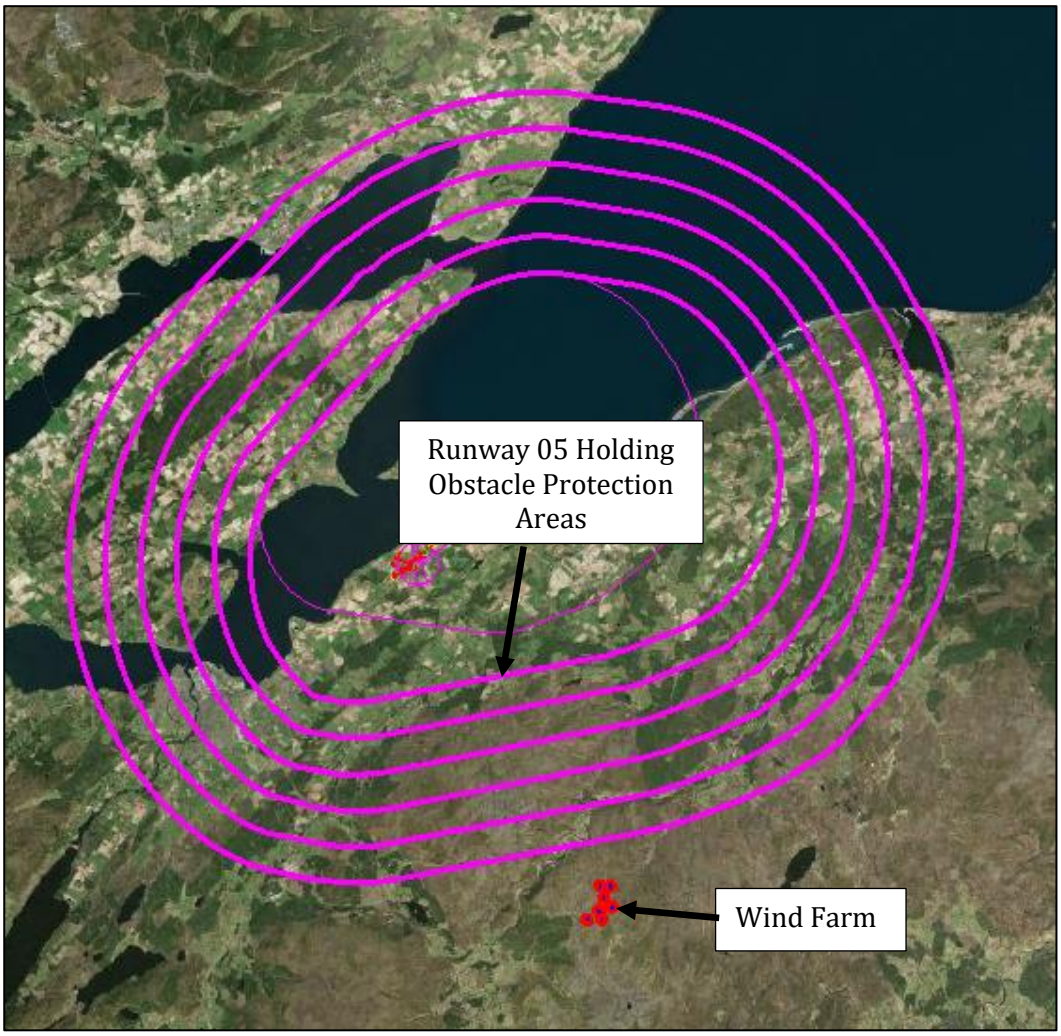

Figure 24 – Wind Farm in relation to Runway 05 Hold (VOR INS)

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Runway 05 Hold.

The Wind Farm will have no effect on the Runway 05 Hold (VOR INS) at Inverness Airport.

3.2.17 Runway 23 Holding (VOR INS)

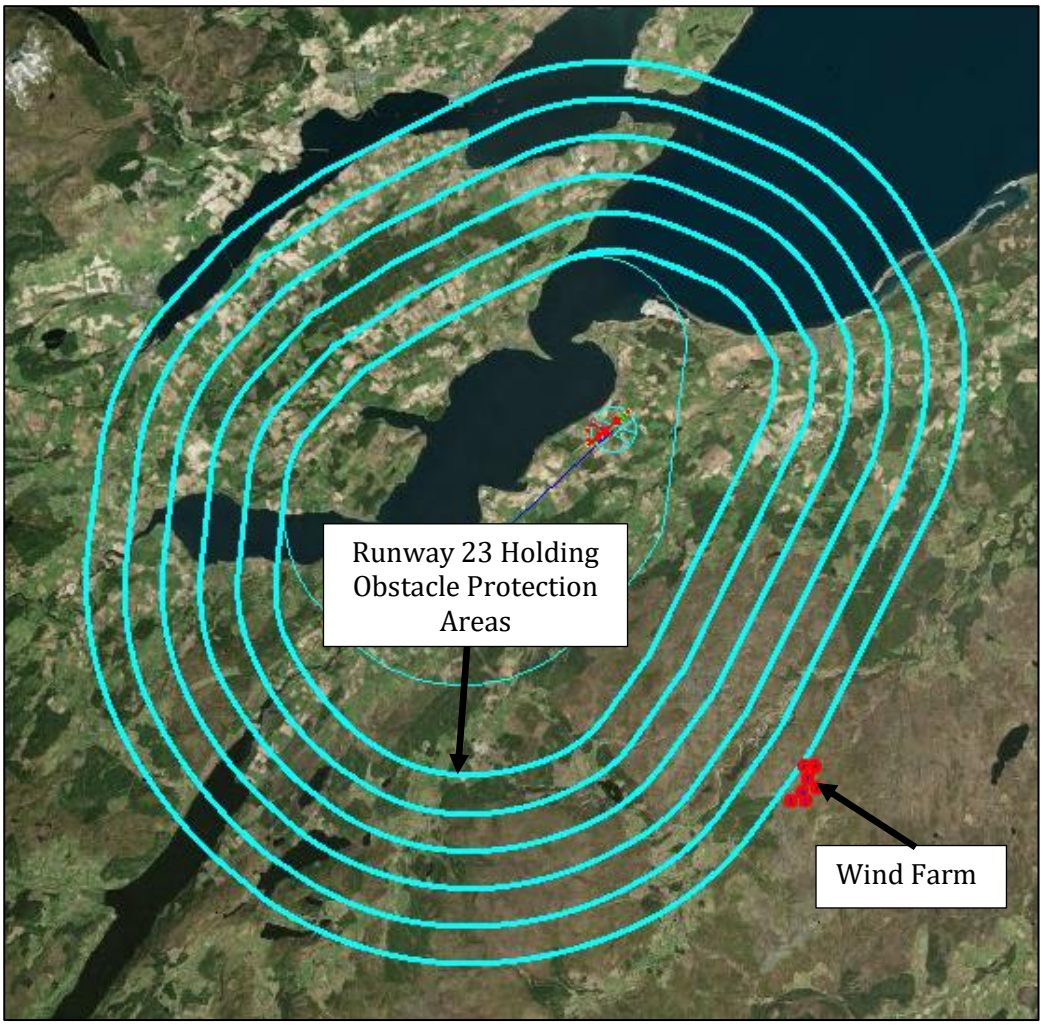

Figure 25 – Wind Farm in relation to Runway 23 Hold (VOR INS)

The proposed Wind Farm is outside of the Obstacle Protection Areas associated with the Runway 23 Hold.

The Wind Farm will have no effect on the Runway 23 Hold (VOR INS) at Inverness Airport.

3.2.18 Minimum Sector Altitudes

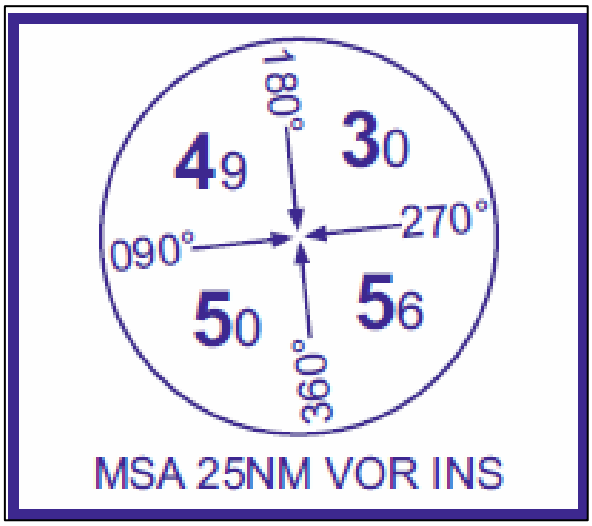

Figure 26 – Wind Farm in relation to MSA VOR INS

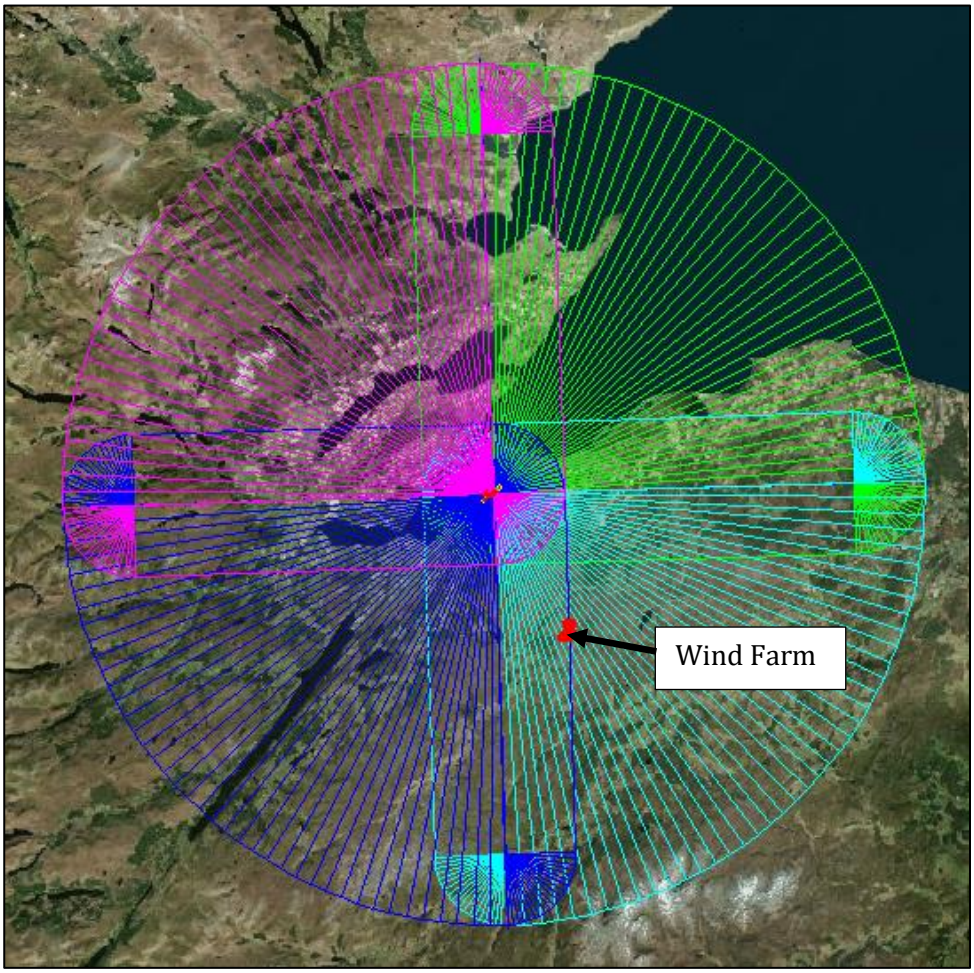

Figure 27 – Wind Farm in relation to MSA VOR INS

The Wind Farm is located within the lateral confines of the South East and South West Minimum Sector Altitude (MSA) areas.

Using the T5 turbine which has the highest elevation of any Turbine at 704.9m AMSL, this produces a MOCA of 704.9m + 300m MOC = 1004.9m / 3297ft. This is below the published MSAs of 5600ft (South East) and 5000ft (South West).

The Wind Farm will have no effect on the Minimum Sector Altitudes.

3.3 Draft Procedures

3.3.1 Direct Arrivals ILS/LOC/DME RWY 05 CAT CD

The following procedure is covered in this assessment:

- 71144 002 Inverness Airport - Direct Arrivals ILS LOC DME RWY 05 CAT CD Chart V1.

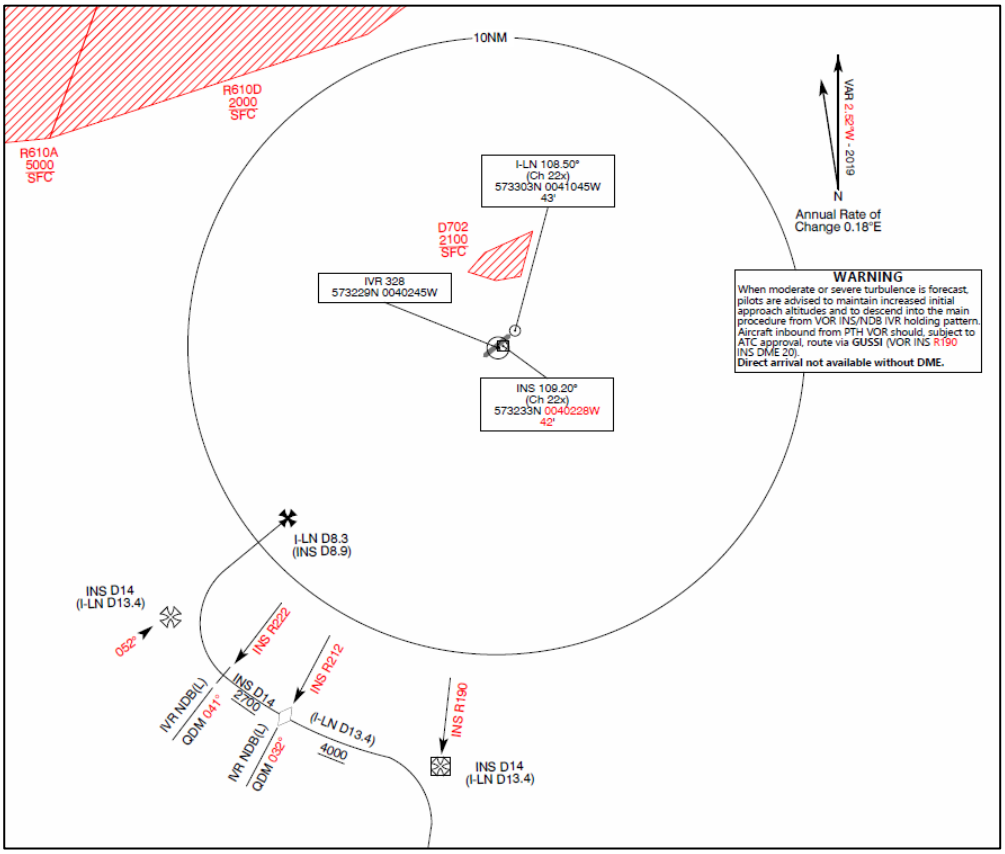

Figure 28 – Direct Arrivals ILS/LOC/DME 05 CAT C,D

See Section 3.2.6.

The Wind Farm will have no effect on the Direct Arrivals ILS/LOC/DME RWY 05 CAT CD procedure

3.3.2 ILS/DME/VOR RWY 05 CAT CD

The following procedure is covered in this assessment:

- 71144 003 Inverness Airport - ILS DME VOR RWY 05 CAT CD Chart V1.

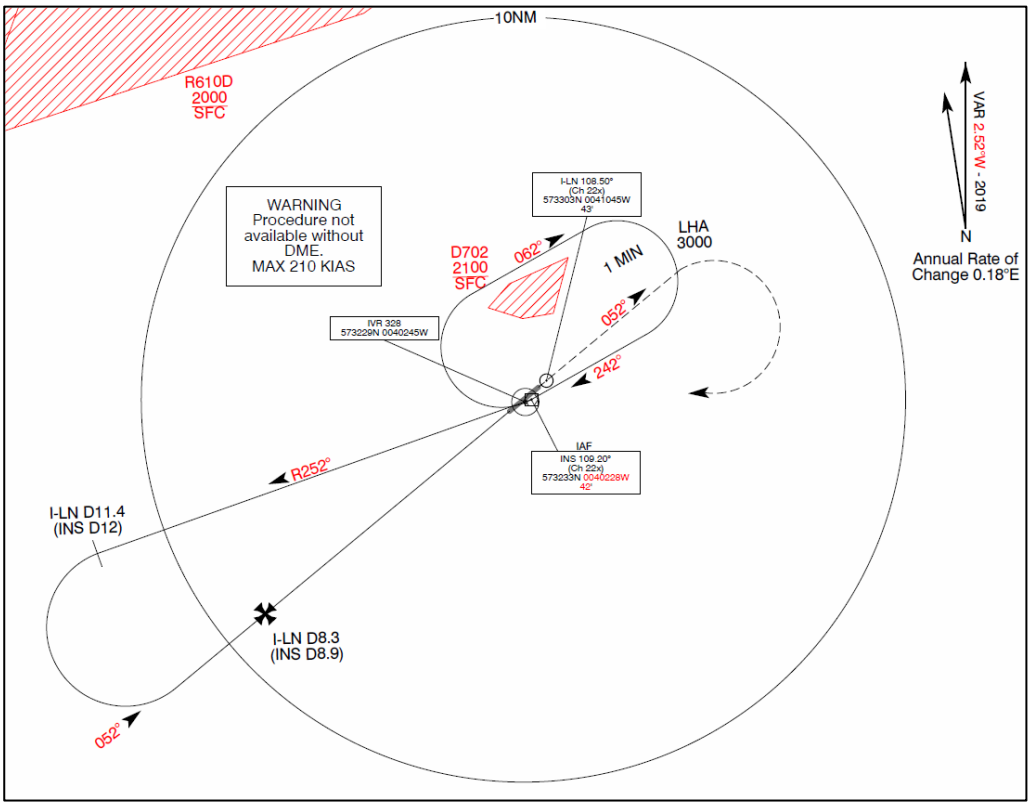

Figure 29 – Direct Arrivals ILS/DME/VOR 05 CAT C,D

See Section 3.2.2.

The Wind Farm will have no effect on the ILS/DME/VOR RWY 05 CAT CD procedure.

3.3.3 LOC/DME/VOR RWY 05 CAT CD

The following procedure is covered in this assessment:

- 71144 005 Inverness Airport - LOC DME VOR RWY 05 CAT CD Chart V1.

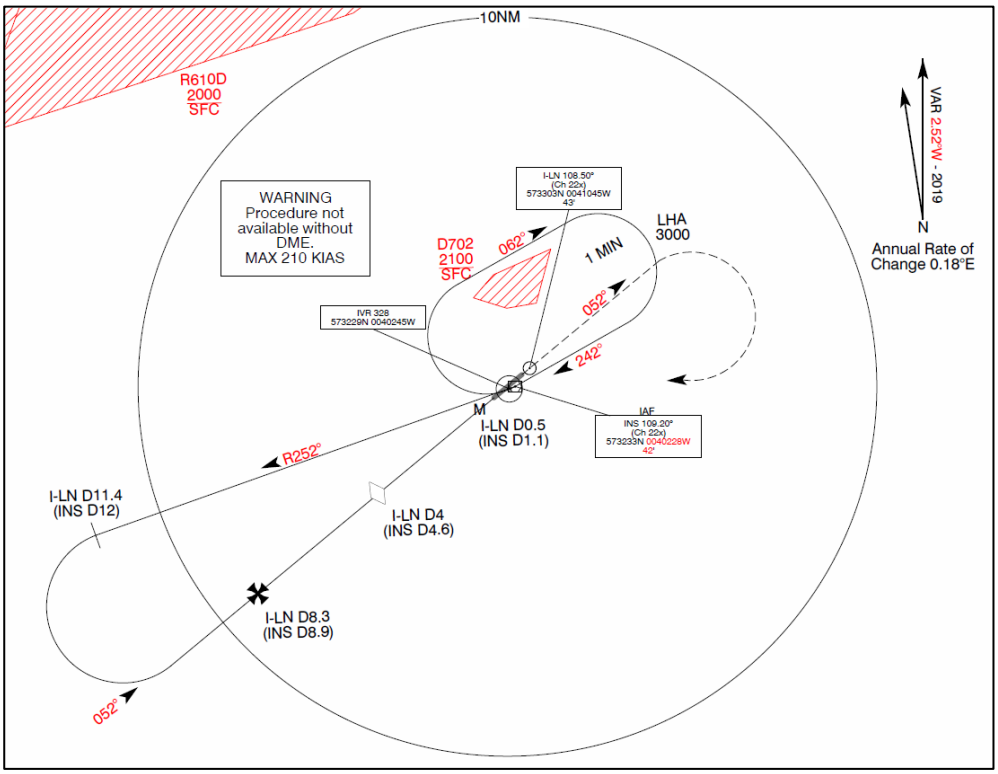

Figure 30 – Direct Arrivals LOC/DME/VOR 05 CAT C,D

See Section 3.2.3.

The Wind Farm will have no effect on the LOC/DME/VOR RWY 05 CAT CD procedure.

3.3.4 ILS/DME/VOR RWY 23 CAT ABCD

The following procedure is covered in this assessment:

- 71144 004 Inverness Airport - ILS DME VOR RWY 23 CAT ABCD Chart V1.

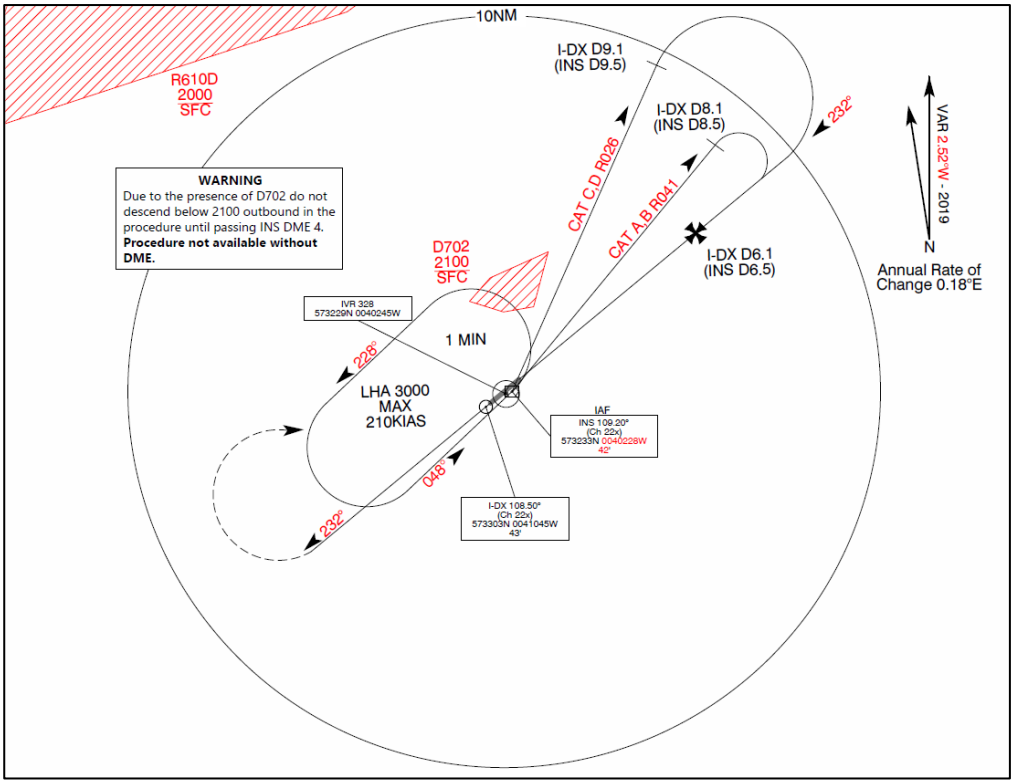

Figure 31 – Direct Arrivals ILS/DME/VOR 23 CAT A,B,C,D

See Section 3.2.9.

The Wind Farm will have no effect on the ILS/DME/VOR RWY 23 CAT ABCD procedure.

3.3.5 LOC/DME/VOR RWY 23 CAT ABCD

The following procedure is covered in this assessment:

- 71144 006 Inverness Airport - LOC DME VOR RWY 23 CAT ABCD Chart V1.

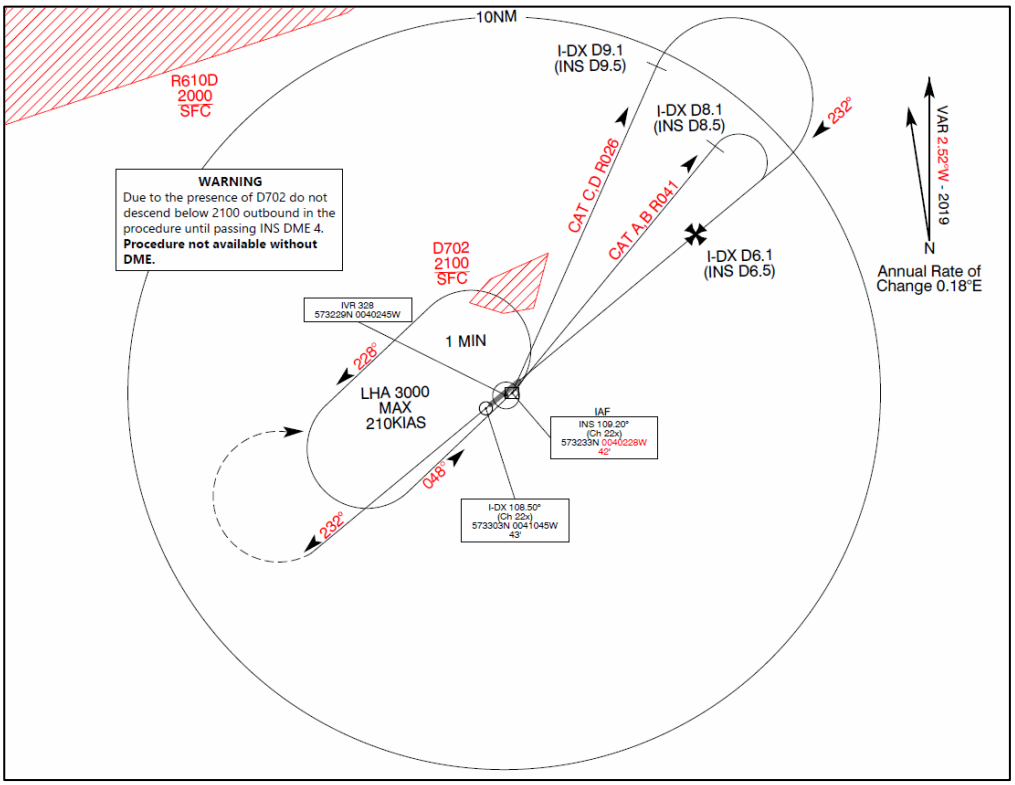

Figure 32 – Direct Arrivals LOC/DME/VOR 23 CAT A,B,C,D

See Section 3.2.10.

The Wind Farm will have no effect on the LOC/DME/VOR RWY 23 CAT ABCD procedure.

3.3.6 RNP RWY 05

The following procedure is covered in this assessment:

- CL-5484-DOC-010 Runway 05 CHART V2.0 31072020.

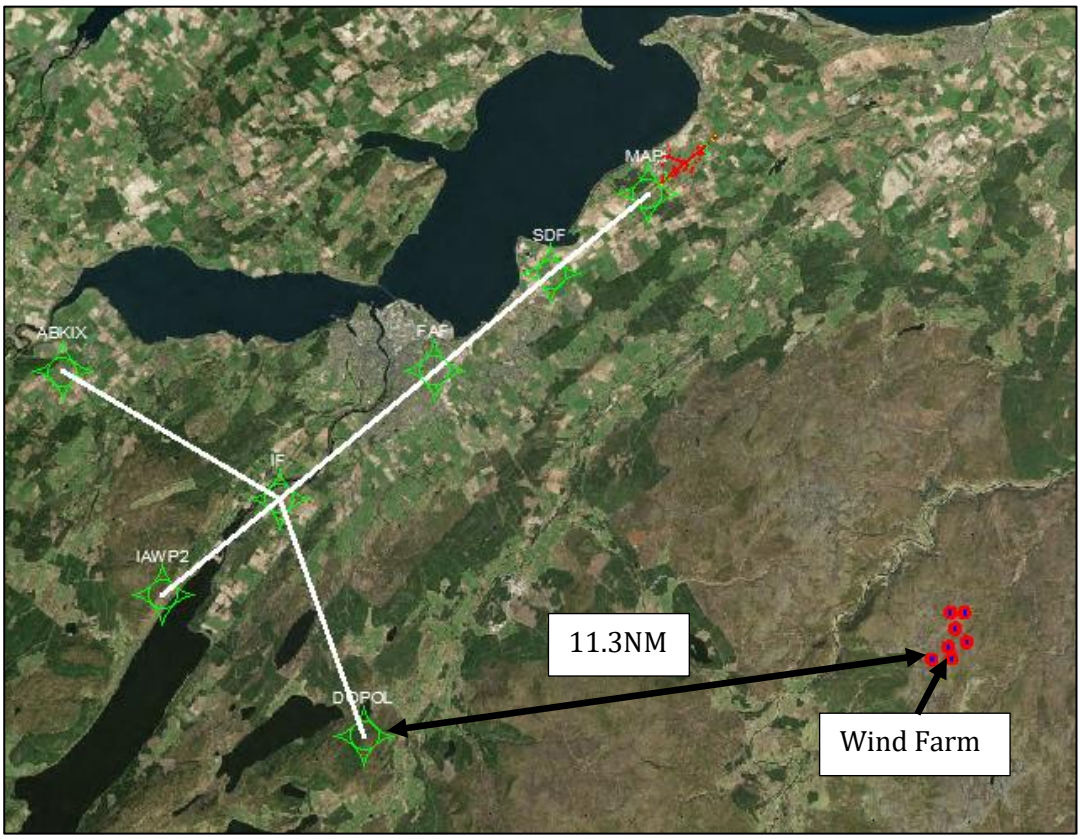

Figure 33 – RNP RWY 05 Procedure

The Wind Farm is 11.3NM from the IAWP 'DOPOL'. Therefore, it is within the 10NM Terminal Arrival Altitude (TAA) area (a 5NM lateral buffer is applied) which has a MOCA of 4100ft.

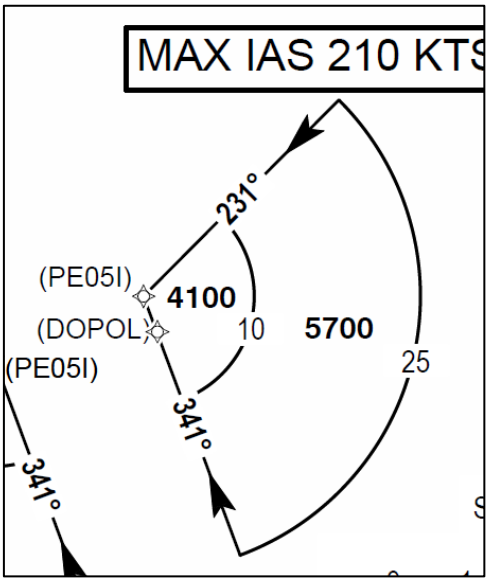

Figure 34 – RNP RWY 05 TAA for IAWP 'DOPOL'

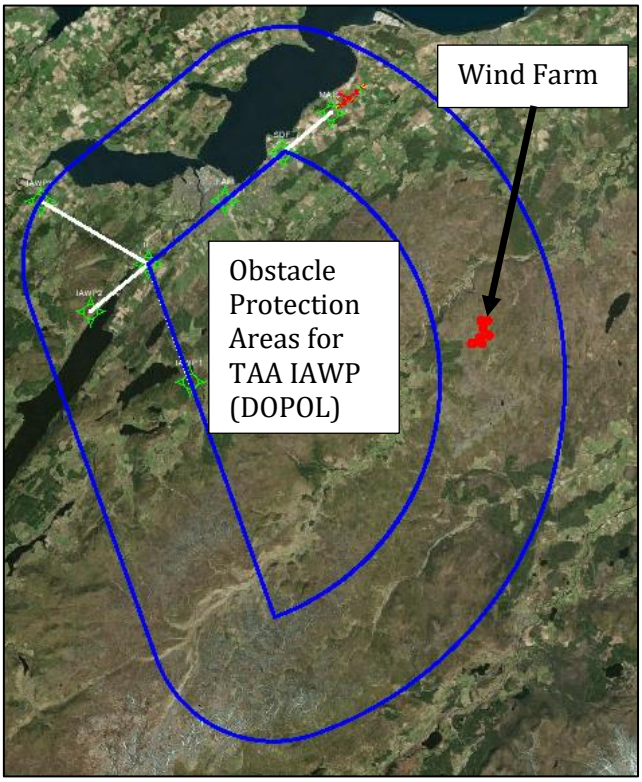

Figure 35 – RNP RWY 05 TAA 10NM + 5NM buffer for IAWP 'DOPOL' Obstacle Protection Areas

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)	Minimum Obstacle Clearance (m)	Calculated MOCA (ft)
1	149.9	449	598.9	300	2950
2	149.9	441	590.9	300	2923
3	149.9	486	635.9	300	3071
4	149.9	493	642.9	300	3094
5	149.9	555	704.9	300	3297
6	149.9	474	623.9	300	3032
7	149.9	522	671.9	300	3189

Table 5 – RNP RWY 05 TAA 10NM IAWP 'DOPOL' Obstacle Assessment

All Turbines produce a MOCA below the published value of 4100ft.

Aircraft flying the Missed Approach would fly over waypoint PEM02 before being permitted to Turn Right at 2000ft. The distance between PEM02 and the Wind Farm is over 10NM.

Figure 36 – RNP RWY 05 Wind Farm in relation to PEM02 Waypoint

Aircraft would be at an altitude of at least 3000ft if flying directly from PEM02 towards the Wind Farm. The required MOCA at the Wind Farm is 704.9m (T5 being the tip elevation of the highest Turbine) + 50m (Final Missed Approach MOC) = 754.9m / 2477ft.

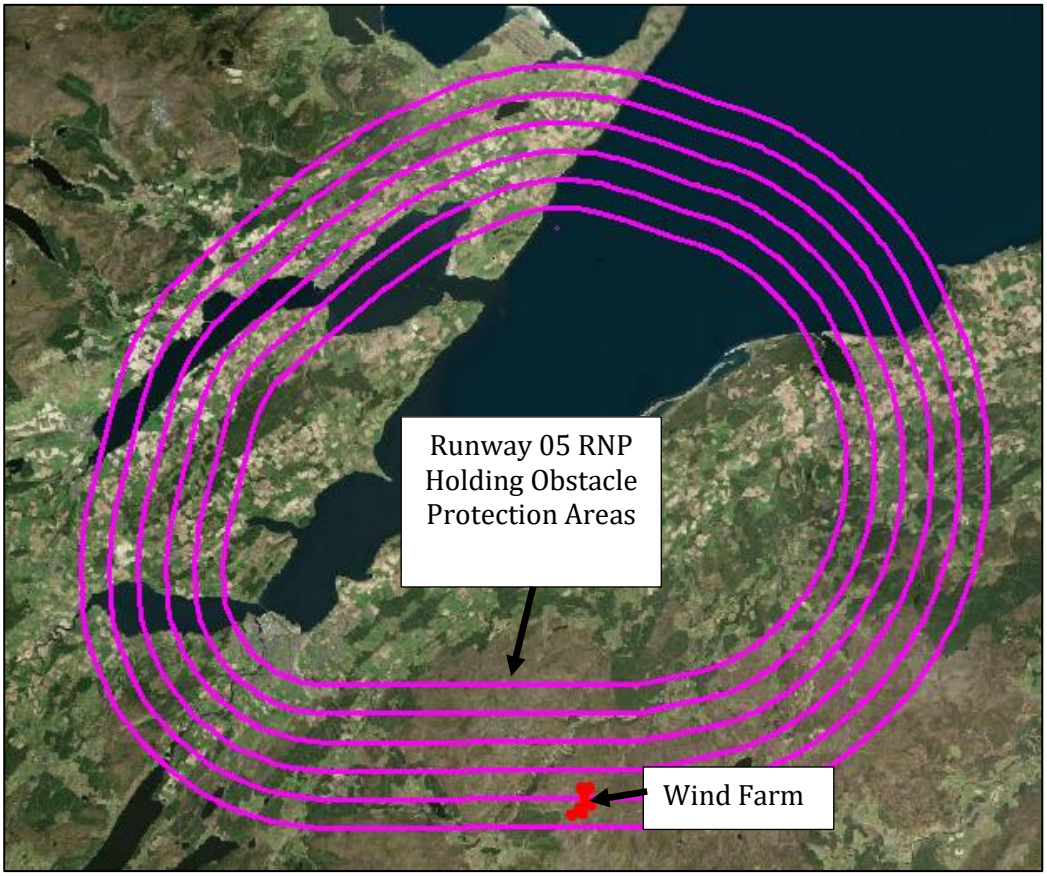

Figure 37 – Wind Farm in relation to Runway 05 RNP Hold

The Wind Farm is within the Hold Buffer Areas which have a varying MOC from 300m for the inside buffer and decreasing to 150m, 120m, 90m, and 60m at the outside.

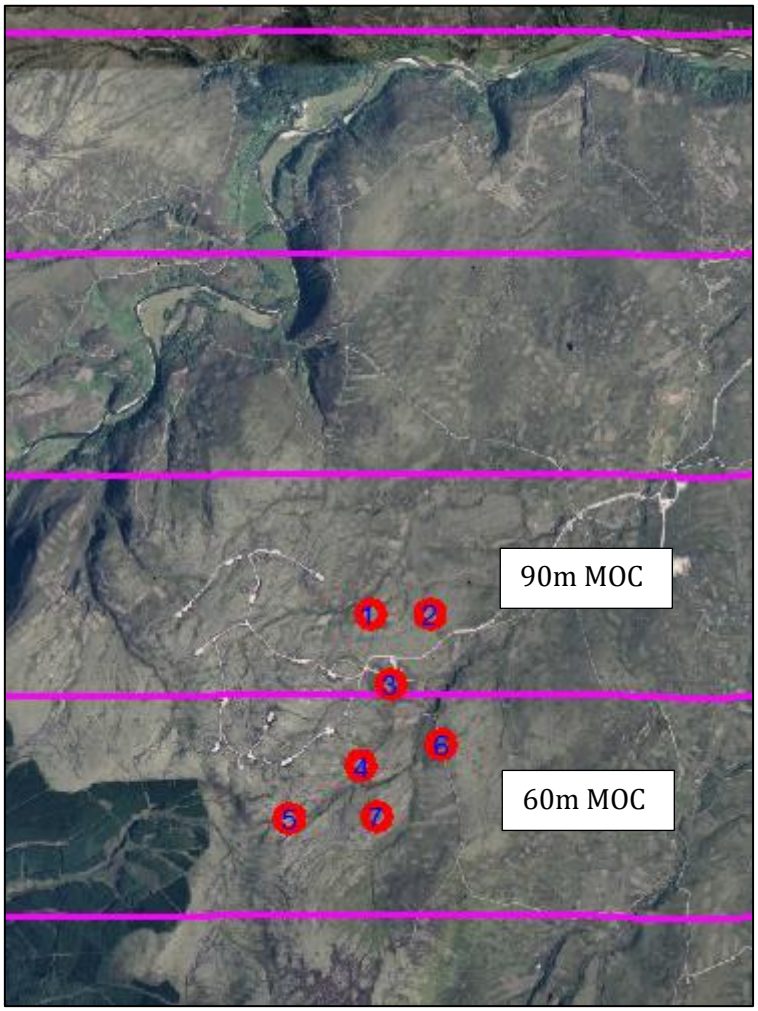

Figure 38 – Wind Farm in relation to Runway 05 RNP Hold Buffer Areas

The following table details the obstacle assessment.

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)	Minimum Obstacle Clearance (m)	Calculated MOCA (ft)
1	149.9	449	598.9	90	2261
2	149.9	441	590.9	90	2234
3	149.9	486	635.9	90	2382
4	149.9	493	642.9	60	2307
5	149.9	555	704.9	60	2510
6	149.9	474	623.9	60	2244
7	149.9	522	671.9	60	2402

Table 6 – Runway 05 RNP Hold Obstacle Assessment

All Turbines produce a MOCA below the Minimum Hold Altitude of 3000ft.

The Minimum Sector Altitudes, with a single 25NM circle based on the ARP, with a MOCA of 5400ft, are unaffected.

The Wind Farm will have no effect on the RNP RWY 05 procedure.

3.3.7 RNP RWY 23

The following procedure is covered in this assessment:

- CL-5484-DOC-005 Runway 23 CHART V2.0 31072020.

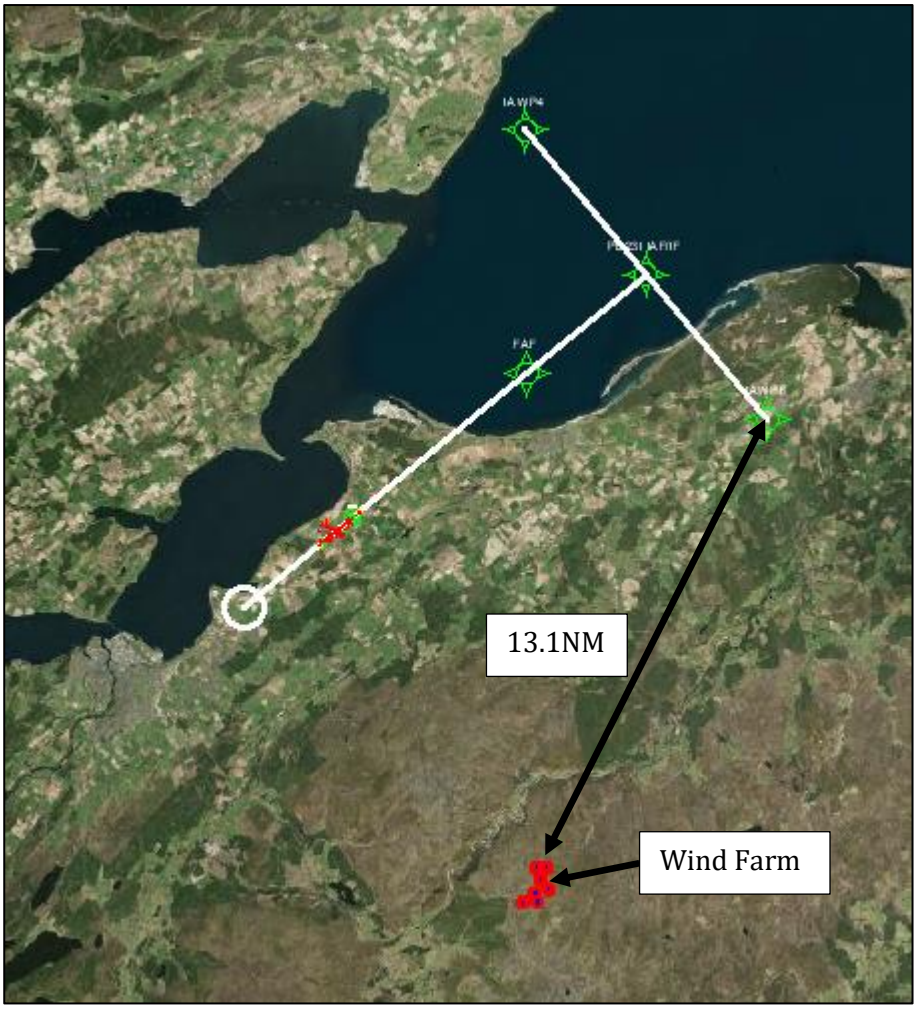

Figure 39 – RNP RWY 23 Procedure

The Wind Farm is 13.1NM from the IAWP 'NIBKU'. Therefore, it is within the 10NM Terminal Arrival Altitude (TAA) area (a 5NM lateral buffer is applied) which has a MOCA of 3200ft.

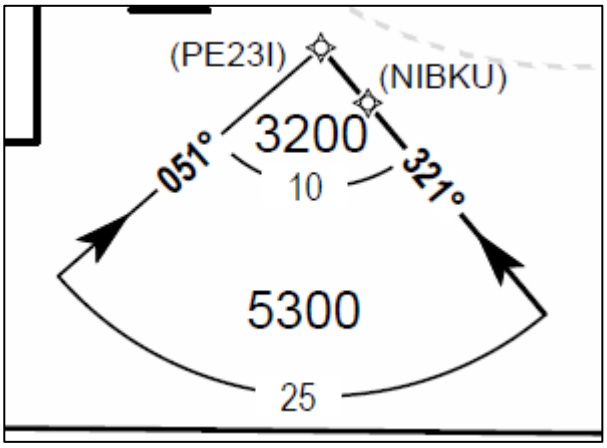

Figure 40 – RNP RWY 23 TAA for IAWP 'NIBKU'

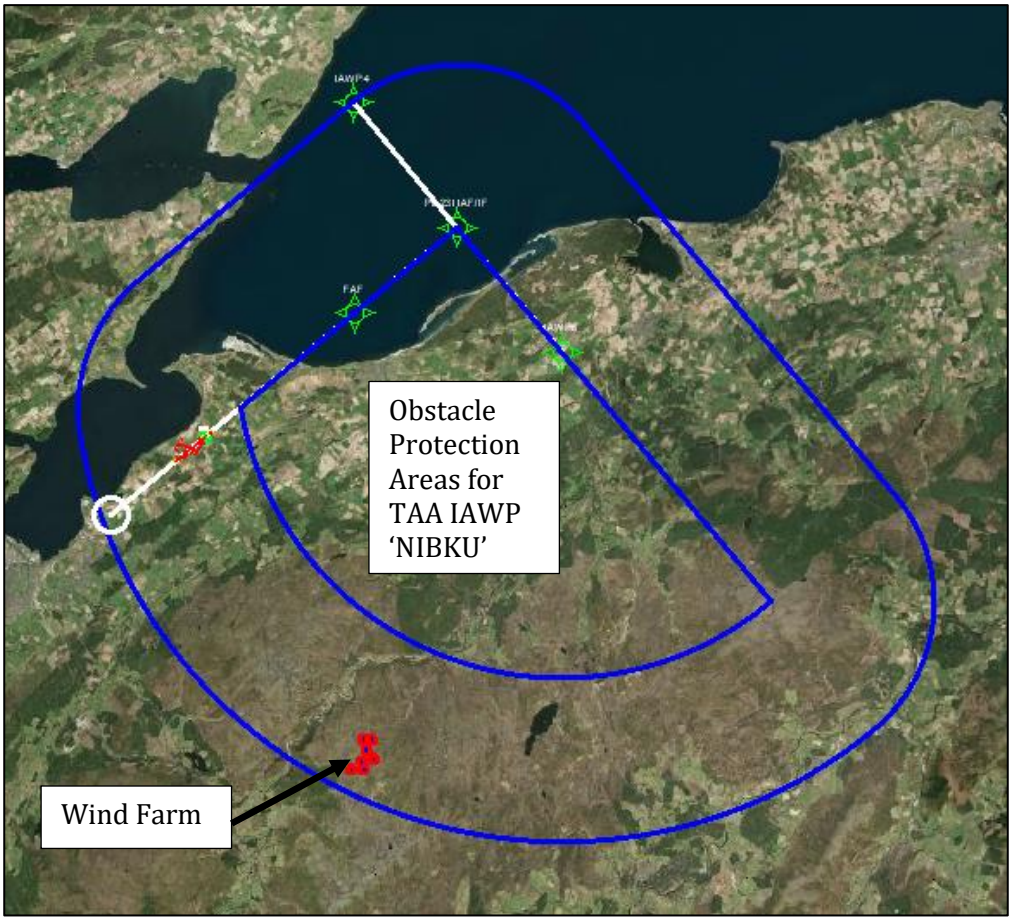

Figure 41 – RNP RWY 23 TAA 10NM + 5NM buffer for IAWP 'NIBKU' Obstacle Protection Areas

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)	Minimum Obstacle Clearance (m)	Calculated MOCA (ft)	Max. Acceptable Tip Height (m)
1	149.9	449	598.9	300	2950	226
2	149.9	441	590.9	300	2923	234
3	149.9	486	635.9	300	3071	189
4	149.9	493	642.9	300	3094	182
5	149.9	555	704.9	300	3297	120
6	149.9	474	623.9	300	3032	201
7	149.9	522	671.9	300	3189	153

Table 7 – RNP RWY 23 TAA 10NM IAWP 'NIBKU' Obstacle Assessment

Turbine 5 produces a MOCA of 3297ft, which is greater than the charted MOCA of 3200ft. The presence of the Turbine would require the TAA 10NM for IAWP6(NIBKU) to be raised to 3300ft.

Note: - It is suggested that if this increase in MOCA is acceptable to the Airport, this site is surveyed to make sure that the ground level elevation is no greater than 555m. (Our Terrain model (OS Terrain 50) is based on elevation values which are taken every 50m). An increase in ground elevation of just 1m from 555m to 556m would mean that the MOCA would then be calculated as 3301ft which would require the TAA 10NM for IAWP6(NIBKU) to be 3400ft.

All other Turbines produce a MOCA below the published value of 3200ft.

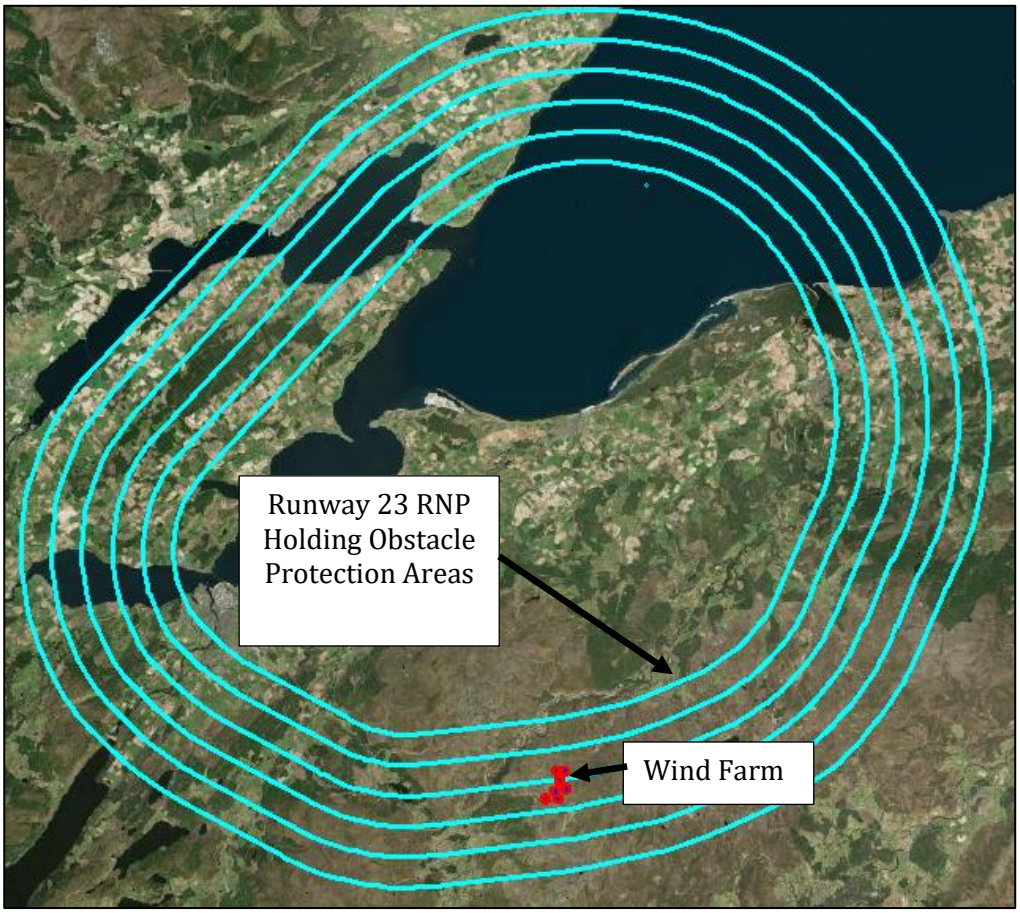

Figure 42 – Wind Farm in relation to Runway 23 RNP Hold

The Wind Farm is within the Hold Buffer Areas which have a varying MOC from 300m for the inside buffer and decreasing to 150m, 120m, 90m, and 60m at the outside.

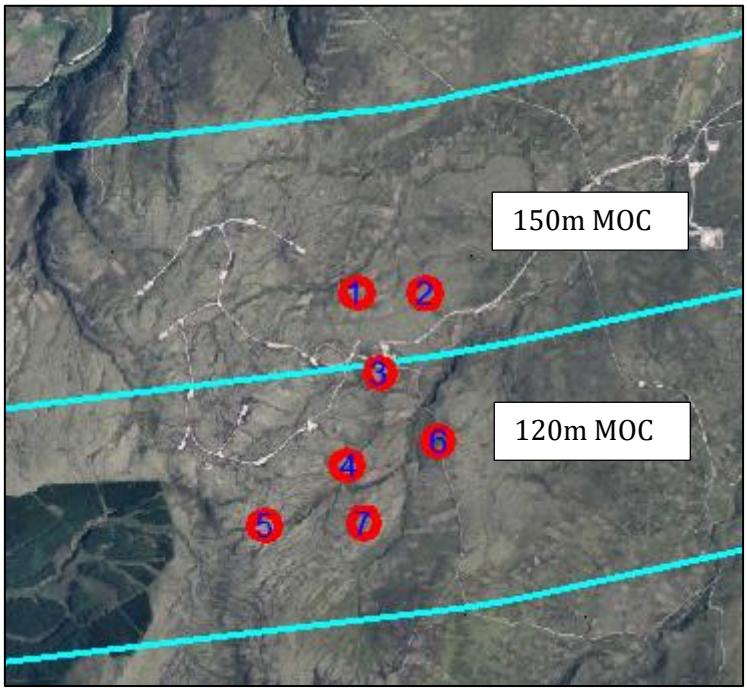

Figure 43 – Wind Farm in relation to Runway 23 RNP Hold Buffer Areas

The following table details the obstacle assessment.

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)	Minimum Obstacle Clearance (m)	Calculated MOCA (ft)
1	149.9	449	598.9	150	2457
2	149.9	441	590.9	150	2431
3	149.9	486	635.9	150	2579
4	149.9	493	642.9	120	2503
5	149.9	555	704.9	120	2707
6	149.9	474	623.9	120	2441
7	149.9	522	671.9	120	2599

Table 8 – Runway 23 RNP Hold Obstacle Assessment

All Turbines produce a MOCA below the Minimum Hold Altitude of 3000ft.

The Minimum Sector Altitudes, with a single 25NM circle based on the ARP, with a MOCA of 5400ft, are unaffected.

The Wind Farm will impact on the RNP RWY 23 procedure.

3.3.8 RWY 05 SIDS GUSSI / GARVA / BONBY

The following procedures are covered in this assessment:

- 70550-IFP-007-EGPE_GUSSI RWY 05 SID-Chart_V1;
- 70550-IFP-008-EGPE_GARVA RWY 05 SID-Chart_V1;
- 70550-IFP-009-EGPE_BONBY RWY 05 SID-Chart_V1.

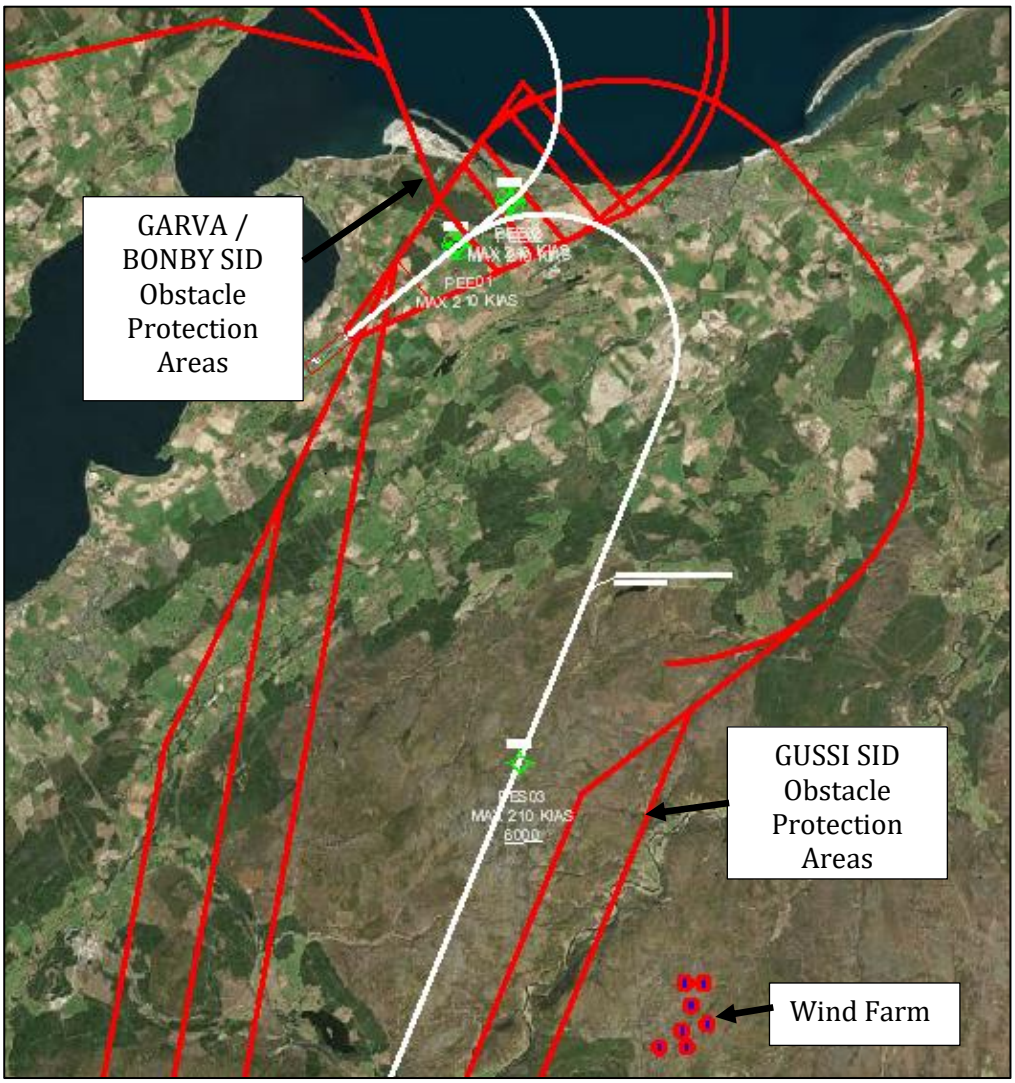

Figure 44 – Wind Farm in relation to RWY 05 SIDs GUSSI / GARVA / BONBY

The Wind Farm is outside the Obstacle Protection Areas associated with the proposed RWY 05 SIDs GUSSI, GARVA and BONBY.

The Wind Farm will have no effect on the RWY 05 SIDS GUSSI / GARVA / BONBY.

3.3.9 RWY 23 SIDS GUSSI / GARVA / BONBY

The following procedures are covered in this assessment:

- 70550-IFP-010-EGPE_GUSSI RWY 23 SID-Chart_V1;
- 70550-IFP-011-EGPE_GARVA RWY 23 SID-Chart_V1;
- 70550-IFP-012-EGPE_BONBY RWY 23 SID-Chart_V1.

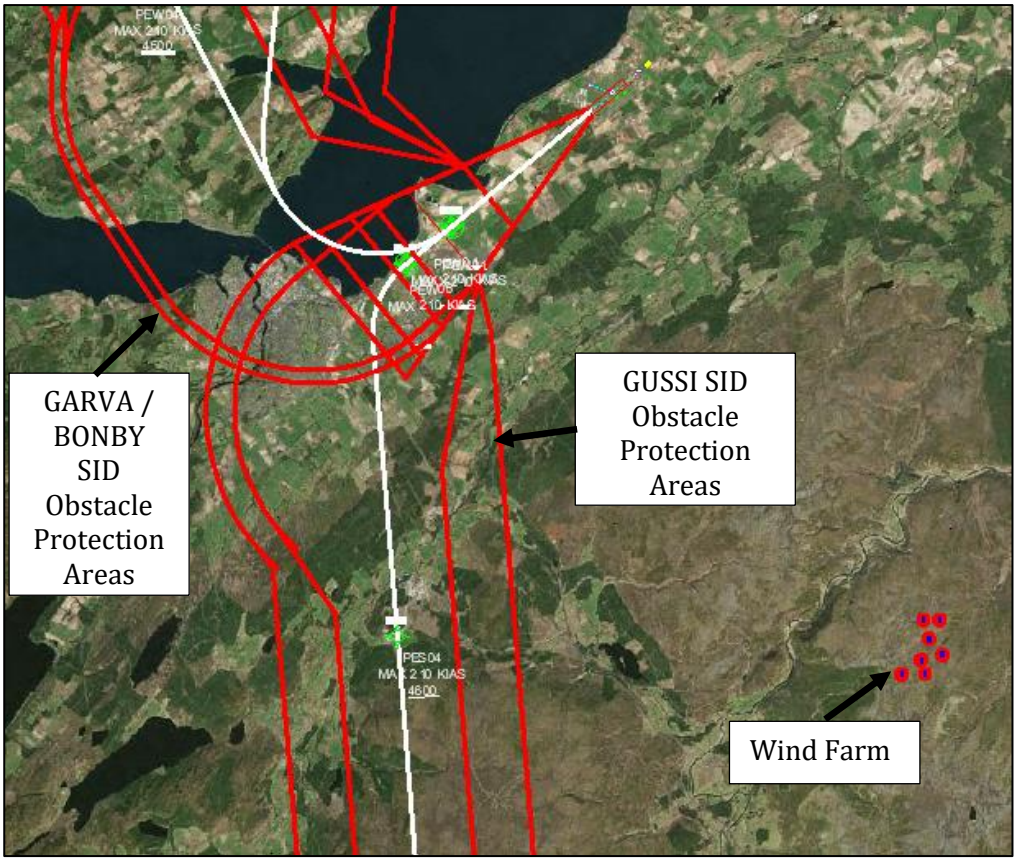

Figure 45 – Wind Farm in relation to RWY 23 SIDs GUSSI / GARVA / BONBY

The Wind Farm is outside the Obstacle Protection Areas associated with the proposed RWY 23 SIDs GUSSI, GARVA and BONBY.

The Wind Farm will have no effect on the RWY 23 SIDS GUSSI / GARVA / BONBY.

3.3.10 RWY 05 /23 STARS GUSSI / GARVA / BONBY

The following procedures are covered in this assessment:

- 70550-IFP-013-EGPE_GUSSI RWY 05 STAR-Chart_V1;
- 70550-IFP-014-EGPE_GARVA RWY 05 STAR-Chart_V1;
- 70550-IFP-015-EGPE_BONBY RWY 05 STAR-Chart_V1;
- 70550-IFP-016-EGPE_GUSSI RWY 23 STAR-Chart_V1;
- 70550-IFP-017-EGPE_GARVA RWY 23 STAR-Chart_V1;
- 70550-IFP-018-EGPE_BONBY RWY 23 STAR-Chart_V1.

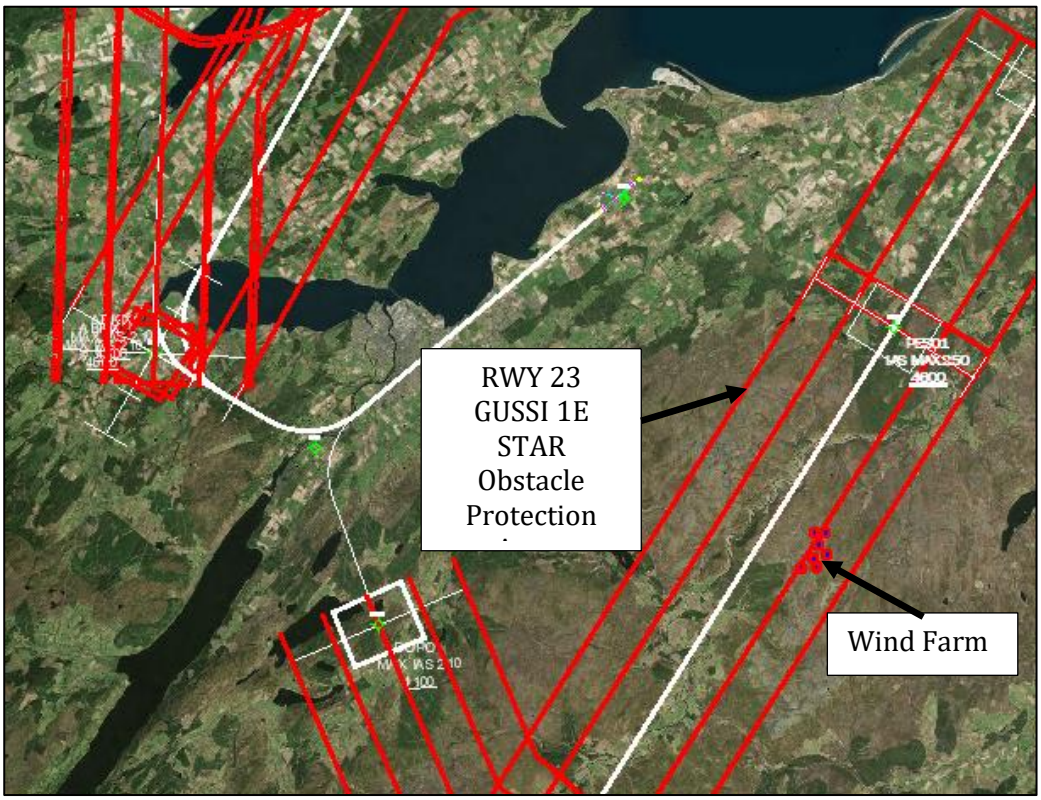

Figure 46 – Wind Farm in relation to RWY 05 / 23 STARs GUSSI / GARVA / BONBY

The Wind Farm is within the Obstacle Protection Areas for the GUSSI 1E STAR.

The following table details the obstacle assessment.

Turbine No.	Tip Height (m)	Ground Elevation AMSL (m)	Tip Elevation AMSL (m)	Minimum Obstacle Clearance (m)	Calculated MOCA (ft)
1	149.9	449	598.9	300	2950
2	149.9	441	590.9	300	2923
3	149.9	486	635.9	300	3071
4	149.9	493	642.9	300	3094
5	149.9	555	704.9	300	3297
6	149.9	474	623.9	300	3032
7	149.9	522	671.9	300	3189

Table 9 – Runway 23 STAR GUSSI 1E Obstacle Assessment

All Turbines produce a MOCA below the MOCA for the GUSSI 1E STAR prior to waypoint which is 4600ft.

The Wind Farm will have no effect on the RWY 05 /23 STARS GUSSI / GARVA / BONBY.

Conclusions

Impact on the OLS

The Wind Turbines are outside the OLS and have no effects.

Impact on the IFPs

Published Procedures in the Aeronautical Information Publication (AIP)

There are no effects on the published IFPs at Inverness Airport.

Draft Procedures not currently published in the AIP

The Draft Procedure RNP RWY 23 (CL-5484-DOC-005 Runway 23 CHART V2.0 31072020) would be affected by the Wind Turbines. The 'NIBKU' Terminal Arrival Altitude (TAA) 10NM Minimum Obstacle Clearance Altitude (MOCA) of 3200ft is affected. Turbine 5 produces a MOCA of 3297ft, which is greater than the charted MOCA of 3200ft. The presence of the Turbine would require the TAA 10NM for 'NIBKU' to be raised to 3300ft. See Section 3.3.7 for further details.

Note: The Draft Procedures not currently published in the AIP are the latest versions of the procedures that we are aware of. There is no guarantee that the procedures shall be published in the future. Additionally, it is possible that the procedures could change as they have not yet been approved by the Civil Aviation Authority (CAA).