Dublin Array

Generation for generations

EIAR Volume 4: Offshore Infrastructure
Technical Appendices
Appendix 4.3.12-1
Instrument Flight Procedures Assessment

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Dublin Array Offshore Windfarm EIAR

Instrument Flight Procedures Assessment

Date: 30th January 2024

Author: Chris Latus

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Osprey Ref: 71266 003

Harston Mill, Royston Road, Harston, Cambridge, CB22 7GG

01172 422 533/ enquiries@ospreycsl.co.uk

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Approval Level	Authority	Name
APD	Osprey CSL	Chris Latus

IAPD	Osprey CSL	Sam Shuttlewood
Design Authority	Osprey CSL	Mark Wakeman

Executive Summary

GoBe Consultants Ltd (GoBe), with technical input from Osprey Consulting Services Limited (Osprey), is supporting their client RWE Renewables Ireland Ltd (previously innogy Renewables Ireland Ltd) in the development of the Dublin Array Wind Farm (Dublin Array), located approximately 4.7 nautical miles (NM) from the East Irish coast. The Dublin Array is a joint venture between Saorgus Energy Ltd and RWE with RWE taking the lead role. Due to the positioning of the proposed development, it has the potential to impact the published Instrument Flight Procedures (IFPs) at three aerodromes, all listed below:

- Dublin Airport.
- Weston Airport.
- Casement Aerodrome.

The purpose of the Instrument Flight Procedures (IFP) assessment is to inform the project design, to provide basis of consultation with the Irish Aviation Authority and to determine the maximum tip height that can be accommodated without affecting any published IFPs. The assessment methodology and conclusions are set out in this report.

Initially in 2020, Osprey were provided with a maximum blade tip elevation of 321.44 metres (m) above mean sea level (amsl) and assessments conducted concluded that at this elevation, multiple procedures would be impacted. Consequently, a maximum blade tip elevation of 309.6 m amsl was applied to the entire project envelope.

2023 Results

Assessments indicate that a maximum blade tip elevation of 309.6 m amsl would not affect safe flights operations for the published IFPs at Dublin Airport or Casement Aerodrome.

Weston Airport do not currently have any IFPs published in the AIP. Historically, Weston had a ‘VOR B’, ‘VOR C’ and ‘VOR D’ published, which were assessed within the Issue 3 version of this report including a Circling and MSA assessment.

WTG Installation

While the exact construction process is unknown at this stage, WTG installation for the Dublin Array is likely to be conducted with the use of a jack-up vessel and components would be lifted into place by crane.

The use of cranage and any other tall equipment would have to conform to the safeguarding restrictions imposed by the aerodrome and ICAO document PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures. Given the scale of the project, it would be expected that cranage in place would have a similar elevation to the WTGs being constructed and RWE have confirmed that no crane boom height will exceed the upper blade tip elevation of 309.6m amsl, which will be applied to the entire project envelope.

Glossary

Term	Definition
AMSL	Above Mean Sea Level. The datum used to determine the vertical height of an object relative to the mean sea level datum.
ATCSMAC	The chart used by Civil Air Traffic Controllers to determine the minimum safe altitude for radar vectoring aircraft within the aerodrome environs.
ATS	Air Traffic Service. A service offered in real time to assist in the safe operations of aircraft.
CAT	Category. The type of aircraft category used in an Instrument Flight Procedure, either A, B, C or D. Generally, aircraft size increases from A-D and on an Instrument Approach Procedure the approach speed increases from A-D.
Circling	A type of approach procedure where the pilot intends to land on a runway where no straight-in approach procedure exists. Pilots will fly on an instrument approach to the opposite runway end to a specified altitude and then manoeuvre, by means of visual references, to the desired runway.
CNS	Communication, Navigation and Surveillance Systems. Functions of aviation infrastructure that aid Air Traffic Management.
DME	Distance Measuring Equipment. A radio navigation aid that measures a distance between the ground station and the aircraft.
Hold	An IFR procedure that is flown within a specified portion of airspace until further ATC clearance is given.
ICAO	International Civil Aviation Organization. The specialised aviation agency of the United Nations that mandates standards and provides recommended practices.
Irish Aviation Authority	The commercial semi-state company responsible for the safety regulation in Ireland.
IAP	Instrument Approach Procedure. A series of predetermined maneuvers undertaken by an aircraft with reference to flight instruments down to a position from which a landing may be completed.
Instrument Flight Rules	The regulation which dictates the operation of an aircraft when navigation by means of visual references is not possible.
Instrument Flight Procedure	A series of published predetermined manoeuvres by an aircraft flying in accordance with Instrument Flight Rules.

ILS	Instrument Landing System. A type of approach procedure navigation aid which uses radio beams to provide the pilot of an aircraft vertical and horizontal guidance during landing.
Latitude	The geographic coordinate on the earth's surface that specifies a position either north or south of the equator.
LOC	Localizer. Part of an ILS installation which provides horizontal guidance to a pilot during an approach.
Longitude	The geographic coordinate on the earth's surface that specifies a position either east or west of the meridian.
Missed Approach	A part of an Instrument Approach Procedure initiated when it is not possible for a pilot to complete the landing, often due to meteorological reasons.
MOC	Minimum Obstacle Clearance. The buffer used in Instrument Flight Procedure design to ensure safe clearance from terrain / obstacles.
MSA	Minimum Sector Altitude. The minimum safe altitude which provides 300 m (1000 ft) of clearance from obstacles. Often calculated as a 25 NM radius centered on an aerodromes radio aid or aerodrome reference point.
NDB	Non-Directional Beacon. A type of ground-based radio transmitter that emits signals to provide pilots of aircraft with a means of navigation.
NM	Nautical Mile. A unit of measurement used in both the aviation and maritime industry. Equal to 1852 m.
NOTAM	A NOTAM is a form of notice issued at licensed aerodromes to highlight any potential hazards to flight safety.
NPA	Non-Precision Approach. A two-dimensional (2D) instrument approach operation.
OCA	Obstacle Clearance Altitude. The lowest altitude with reference to Mean Sea Level that is used in establishing compliance with appropriate obstacle clearance criteria.
PA	Precision Approach. A three-dimensional (3D) instrument approach operation.
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations. The rules for the construction and operation of Visual and Instrument Flight Procedures.
Radar Vector	When an Air Traffic Controller tells a pilot of an aircraft, which is visible on a radar screen, to fly a specified heading.
Radar Vectoring Chart	The military equivalent to an ATCSMAC.
RNAV	Area Navigation. A type of navigation performance which utilizes the earths satellite constellations to provide accurate positioning of an aircraft.

RNP	Required Navigation Performance. A type of navigation performance which utilizes the earths satellite constellations to provide accurate positioning of an aircraft.
SID	Standard Instrument Departure. A published departure procedure used in Instrument Flight Rules.
SRA	Surveillance Radar Approach. A type of radar approach procedure that requires active assistance from an Air Traffic Controller to aid pilots with the correct descent profile and azimuth.
STAR	Standard Arrival. A designated IFR arrival route linking a specified point, normally on an ATS route, with a point from which a published IAP can be commenced.
Start of Climb	The calculated point on a Missed Approach procedure where it is assumed the pilot will initiate a climb.
Visual Flight Rules	The rules governing the operation of aircraft in Visual Meteorological Conditions.
VMC	Visual Meteorological Conditions. The meteorological conditions, such as visibility and distance from cloud which determines if VFR operations are permitted.
VOR	VHF Omnidirectional Range. A type of navigation aid beacon that emits radio signals to provide pilots of aircraft with a means of navigation.
Waypoint	A waypoint is the term used for a geographic position, expressed as World Geodetic System 1984 (WGS84) Latitude and Longitude and created for the purpose of satellite-based navigation.
WGS84	World Geodetic System. A type of reference coordinate system and geodetic datum used within aviation amongst other industries.
WTG	Wind Turbine Generator. A device that converts kinetic energy from wind into a useable source of electrical energy.

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1 Introduction

1.1 Overview

GoBe Consultants Ltd (GoBe) is supporting their client RWE Renewables Ireland Ltd (previously innogy Ireland Renewables Ltd) in the development of the Dublin Array Wind Farm (Dublin Array), located approximately 4.7 nautical miles (NM) from the East Irish coast. The Dublin Array is a joint venture between Saorgus Energy Ltd and RWE with RWE taking the lead role.

As part of the due diligence process for the project design, Osprey Consulting Services Limited (Osprey) have been commissioned to undertake the aviation impact assessment for the project.

An initial assessment was conducted in 2020, subsequently, due to the passing of time there is a requirement to update the assessment to form the 2023 baseline. Initially, Osprey were provided with a maximum blade tip elevation of 321.44 metres (m) above mean sea level (amsl) and assessments concluded that at this elevation, multiple procedures would be impacted. Consequently, a maximum blade tip elevation of 309.6 m amsl was applied to the entire project envelope.

The project envelope as assessed in 2021 and proposed maximum blade tip elevation of 309.6 m amsl will be used for this report.

1.2 About Osprey

Osprey are an approved Instrument Flight Procedure (IFP) Design organisation. Osprey has experience in providing support to many offshore and onshore Wind Farm developers in the form of both physical & technical safeguarding and Environmental Impact Assessments (EIA).

1.3 Background

Initial consultation took place in July 2019 with the IAA Safety Regulation Division (SRD) in which the IAA have confirmed that an analysis of the IFPs that serve the aerodromes in the vicinity would need to be conducted.

1.4 Aerodromes Considered for Assessment

An analysis of the development location and surrounding areas was undertaken to identify the aerodromes which potentially could be affected by the development.

Three aerodromes have been included in the IFP assessment; these are listed below:

- Dublin Airport.
- Weston Airport.
- Casement Aerodrome.

Newcastle Aerodrome, approximately 11 kilometres (km) to the south west of the proposed development, does not have published IFPs and is therefore not within the scope of this assessment.

1.5 Purpose

Due to the likelihood of future changes in the design and availability of wind farm components and uncertainty regarding future costs, it is not feasible to determine the optimum design solution for Dublin Array at this stage of the development process; however, RWE are currently considering a range of wind turbine options to take forward for assessment in the EIA for the project.

The assessment presented in this report has been undertaken to determine the maximum tip height that can be accommodated without affecting any published IFPs. The assessment has been undertaken on a blade tip elevation of 309.6 m amsl. Where potential effects of this blade tip elevation are identified the assessment has then established the maximum blade tip elevation that can be accommodated without affecting any published IFPs. The results of the assessment are provided in this report and will provide a basis of consultation with the IAA and also to inform the EIA.

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2 Site Details

2.1 Location

The Dublin Array is located approximately 4.7 nautical miles (NM) from the East Irish coast.

While the detailed design of the layout is not yet decided, the wind farm could potentially be in three to four rows. The outline of the site which is shown in Figure 1 has been used to consider the possible WTG locations against the IFPs for the three aerodromes.

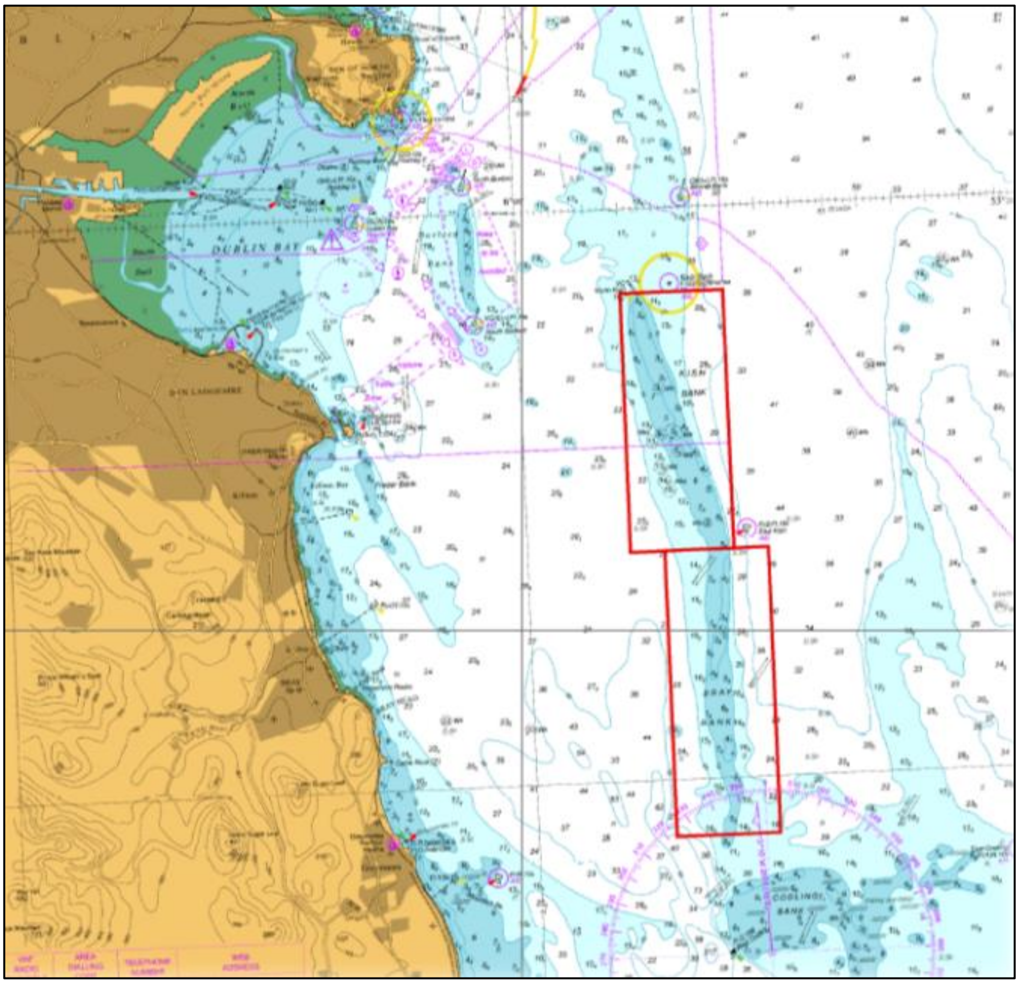

Figure 1 - Dublin Array Site Outline

2.2 Assessed WTG Elevation

	Blade tip elevation (m) Above Mean Sea Level	Maximum Rotor Diameter (m)
WTG	309.6	278

Table 1 – WTG Information

The WTGs have been assessed against the IFP's considering a blade tip elevation of 309.6 m amsl. This is a maximum elevation that will be used to test what would be acceptable as part of the design iteration process.

3 Guidance, Legislation and Policy

3.1 Background

Due to the nature of the aviation industry, there is a wide range of guidance, legislation and policy in place. This information, which includes publications at an International, European and National level, sets out the criteria for aviation stakeholders to follow in order to ensure safety standards are maintained. In the Republic of Ireland, the competent authority responsible for the regulatory activities is the IAA.

It is imperative that new developments which are in the vicinity of an aerodrome are considered against the potential affects that they may have on aviation operations. The safeguarding of such obstacles is an essential step in a process that enables all stakeholders to consult on potential issues and to ensure that all parties are content before any construction takes place.

3.2 IAA Publications

In the context of this assessment, the IAA applies the following documentation which stipulates the regulatory requirements for obstacles that have the potential to affect aviation.

- Irish Aviation Authority (IAA) Statutory Instruments, S.I 215 of 2005; Obstacles to Aircraft in Flight Order.
- Irish Aviation Authority (IAA) Statutory Instruments, S.I 423 of 1999; En-route Obstacles to Air Navigation.
- Irish Aviation Authority (IAA) Statutory Instruments, S.I 72 of 2004; Rules of The Air Order, 2004.

3.3 International Publications

The International Civil Aviation Organisation (ICAO) publishes a vast amount of information relating to flight safety. In the context of this assessment, ICAO provides the relevant information relating to the construction and safeguarding of Instrument Flight Procedures (IFP's) within the following document.

- ICAO PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures.

The Republic of Ireland is a council member state of ICAO and therefore this document forms the basis for this assessment. It is standard practice for any obstacle that has the potential to affect flight safety to be assessed against an aerodromes IFPs, therefore, this document has been used to establish the following:

- How the lateral and vertical dimensions of an IFP is constructed.
    - The importance of constructing an IFP protection area is a key element in the safeguarding process and ensures that new obstacles are safeguarded correctly.
- How an Obstacle Clearance Altitude (OCA) or Minimum Obstacle Clearance Altitude (MOCA) is calculated.

- The OCA or MOCA is the published altitude on charts that aircraft operate at safely. The OCA or MOCA provides clearance from all obstacles that are located within the protection area and is determined by a range of factors such as the type of procedure (approach / departure / arrival etc), the segment of the procedure and the type of aircraft flying the procedure.
- Typically, the OCA or MOCA is calculated by adding a Minimum Obstacle Clearance (MOC) onto terrain and obstacles located within a protection area. Depending on the type of procedure, the MOC can range from 30 m up to 300 m.

4 Instrument Flight Procedures

4.1 Overview

An IFP is series of predetermined manoeuvres by an aircraft flying in accordance with Instrument Flight Rules (IFR). IFPs are published in the state Aeronautical Information Package (AIP) and are designed to achieve and maintain an acceptable level of safety in aviation operations.

IFPs can be categorized into two groups; those that are predicated on conventional ground-based navigational aids and those that are predicated on the use of satellite technology.

4.2 Conventional Navigation

Conventional navigation is the form of navigation made by references to ground-based infrastructure such as Instrument Landing System (ILS), VHF Omnidirectional Range (VOR), Non-Directional Beacon (NDB) and Distance Measuring Equipment (DME). This form of navigation often requires aircraft to overfly such infrastructure to provide the pilot with the navigational data required and thus does not provide flexibility on a route.

4.3 Satellite Based Navigation

This type of navigation utilizes the earths satellite constellations to provide accurate positioning of an aircraft. Unlike conventional navigation, this method provides flexibility to a procedure as aircraft can navigate between specified points on a route.

4.4 Types of Procedures

There are numerous types of IFPs which are outlined in the sections below, these procedures can be used with both conventional navigation and satellite-based navigation techniques. The importance of this manifests itself in the associated protection areas that they require, and thus which the safeguarding of obstacles needs to consider. The aerodromes assessed within this report have numerous types of procedures which are predicated on different navigation techniques.

4.4.1 Instrument Approach Procedures (IAP)

IAPs are a series of predetermined manoeuvres undertaken by an aircraft with reference to flight instruments. Typically, they begin at the Initial Approach Fix (IAF) down to a position from which a landing may be completed, or if not possible, to a point at which holding or en-route obstacle clearance criteria is applied; this is referred to as a Missed Approach.

IAPs can be categorized as follows:

- Non-precision Approach Procedures (NPA)
  - An NPA is an IFP designed for two-dimensional (2D) instrument approach operations. An NPA provides lateral guidance to the pilot typically through the use of ground-based navigation aids such as a

VOR or Localiser (LOC), but also some satellite-based procedures such Lateral Navigation (LNAV).

- Precision Approach Procedures (PA)
    - A PA is a procedure which provides the pilot with three-dimensional (3D) approach information. A PA provides lateral and vertical guidance to the aircraft typically using ground-based navigation aids such as such as an ILS and some forms of satellite-based procedures such as Localiser Performance with vertical guidance (LPV).

4.4.2 Standard Instrument Departures (SIDs)

SIDs are a designated IFR departure route linking an aerodrome to a specified point within the airspace network, normally on a designated Air Traffic Service (ATS) route, at which the aircraft enters the en-route phase of a flight.

4.4.3 Standard Instrument Arrivals (STARs)

STARs are designated IFR arrival routes linking a specified point, normally on an ATS route, with a point from which a published IAP can be commenced.

5 Methodology

5.1 Approach

All assessments conducted were desk based. IFP information pertaining to the three aerodromes; Dublin, Casement and Weston can be found in the IAA Integrated Aeronautical Information Package (IAIP). All IFPs for each aerodrome were assessed and are listed in Table 2 below. The procedures are identified by the type of procedure (e.g. ATCSMAC / departure / arrival / approach), the navigation specification (e.g. RNAV, VOR, ILS), the Runway in use (e.g. RWY 28) and the aircraft categories applicable to the procedure (e.g. CAT A, B).

Integrated Aeronautical Information Package

30 November 2023 - 21 February 2024

Airport	Procedure	Reference
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 28L CAT A, B – ICAO	EIDW AD 2.24-10.1
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 28L CAT C, D – ICAO	EIDW AD 2.24-11
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 28R CAT A, B – ICAO	EIDW AD 2.24-12
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 28R CAT C, D – ICAO	EIDW AD 2.24-13.1
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 10L CAT A, B – ICAO	EIDW AD 2.24-14.1
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 10L CAT C, D – ICAO	EIDW AD 2.24-15
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 10R CAT A, B – ICAO	EIDW AD 2.24-16.1

Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 10R CAT C, D – ICAO	EIDW AD 2.24-17
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 16 CAT A, B – ICAO	EIDW AD 2.24-18.1
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 16 CAT C, D – ICAO	EIDW AD 2.24-19
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 34 CAT A, B – ICAO	EIDW AD 2.24-20.1
Dublin Airport	Standard Departure Chart – Instrument RNAV RWY 34 CAT C, D – ICAO	EIDW AD 2.24-21
Dublin Airport	Standard Arrival Chart – Instrument RNAV RWY 28 L/R – ICAO	EIDW AD 2.24-22.1
Dublin Airport	Standard Arrival Chart – Instrument RNAV RWY 28 L/R – ICAO	EIDW AD 2.24-22.4
Dublin Airport	Standard Arrival Chart – Instrument RNAV RWY 10 L/R – ICAO	EIDW AD 2.24-23.1
Dublin Airport	Standard Arrival Chart – Instrument RNAV RWY 10 L/R – ICAO	EIDW AD 2.24-23.5
Dublin Airport	Standard Arrival Chart – Instrument RNAV RWY 16 – ICAO	EIDW AD 2.24-24
Dublin Airport	Standard Arrival Chart – Instrument RNAV RWY 34 – ICAO	EIDW AD 2.24-25
Dublin Airport	Instrument Approach Chart – RNP RWY 28L – ICAO	EIDW AD 2.24-26.1
Dublin Airport	Instrument Approach Chart – ILS CAT I & II or LOC RWY 28L CAT A, B, C, D – ICAO	EIDW AD 2.24-27

Dublin Airport	Instrument Approach Chart – VOR RWY 28L – ICAO	EIDW AD 2.24-28
Dublin Airport	Instrument Approach Chart – RNP RWY 28R CAT A, B, C, D – ICAO	EIDW AD 2.24-29.1
Dublin Airport	Instrument Approach Chart – ILS CAT I & II or LOC RWY 28R CAT A, B, C, D – ICAO	EIDW AD 2.24-30.1
Dublin Airport	Instrument Approach Chart RNP RWY 10L – ICAO	EIDW AD 2.24-32.1
Dublin Airport	Instrument Approach Chart ILS CAT I & II or LOC RWY 10L CAT A, B, C, D – ICAO	EIDW AD 2.24-33.1
Dublin Airport	Instrument Approach Chart – RNP RWY 10R CAT A, B, C, D – ICAO	EIDW AD 2.24-35.1
Dublin Airport	Instrument Approach Chart – ILS CAT I & II or LOC RWY 10R CAT A, B, C, D- ICAO	EIDW AD 2.24-36
Dublin Airport	Instrument Approach Chart VOR RWY 10R CAT A, B, C, D – ICAO	EIDW AD 2.24-37
Dublin Airport	Instrument Approach Chart RNP RWY 16 CAT A, B, C, D – ICAO	EIDW AD 2.24-38
Dublin Airport	Instrument Approach Chart – ILS CAT I or LOC RWY 16 CAT A, B, C, D – ICAO	EIDW AD 2.24-39
Dublin Airport	Instrument Approach Chart VOR RWY 16 CAT A, B, C, D – ICAO	EIDW AD 2.24-40
Dublin Airport	Instrument Approach Chart RNP RWY 34 – ICAO	EIDW AD 2.24-41
Dublin Airport	Instrument Approach Chart VOR RWY 34 CAT A, B, C, D – ICAO	EIDW AD 2.24-42
Dublin Airport	ATC Surveillance Minimum Altitude Chart - ICAO	EIDW AD 2.24-43.1

Dublin Airport	Visual Approach Chart– ICAO	EIDW AD 2.24-44
Dublin Airport	Instrument Approach Chart VOR T RWY 28L CAT A, B, C, D – ICAO	EIDW AD 2.24-45.1
Casement Aerodrome	INSTRUMENT DEPARTURE CHART RWY 28,10,22,04 CAT A, B – ICAO	EIME AD 2.24-8
Casement Aerodrome	INSTRUMENT DEPARTURE CHART RWY 28, 10, 22, 04 CAT C, D – ICAO	EIME AD 2.24-9
Casement Aerodrome	INSTRUMENT APPROACH CHART ILS Z RWY 10 CAT A, B – ICAO	EIME AD 2.24-10
Casement Aerodrome	INSTRUMENT APPROACH CHART ILS Y RWY 10 CAT C, D – ICAO	EIME AD 2.24-11
Casement Aerodrome	INSTRUMENT APPROACH CHART VOR/DME RWY 10 CAT A, B, C, D – ICAO	EIME AD 2.24-15
Casement Aerodrome	INSTRUMENT APPROACH CHART VOR/DME RWY 28 CAT A, B, C, D – ICAO	EIME AD 2.24-16
Casement Aerodrome	INSTRUMENT APPROACH CHART VOR/DME RWY 22 CAT A, B, C, D – ICAO	EIME AD 2.24-17
Casement Aerodrome	INSTRUMENT APPROACH CHART SRA RWY 10 CAT A, B, C – ICAO	EIME AD 2.24-20
Casement Aerodrome	ATC Radar Vectoring Chart	EIME AD 2.24-22
Casement Aerodrome	Missed Approach With Communications Failure Chart	EIME AD 2.24-25

Table 2 - IFPs Assessed

Weston Airport do not currently have any IFPs published in the AIP. Historically, Weston had a 'VOR B', 'VOR C' and 'VOR D' published, which were assessed within the Issue 3 version of this report including a Circling and MSA assessment.

Each individual IFP chart details the information required in order to ascertain whether the Dublin Array will pose an impact to the procedure. Once these procedures are re-constructed with the use of IFP design software, then the following can be established.

- If the Dublin Array would lie within the lateral confines of the IFP protection areas.
- If the Dublin Array lies within the protection area for any of the procedures, is a change to the published procedures required or alternatively, what would be the maximum permitted WTG elevation.

If the Dublin Array does not fall within the protection area for any of the IFPs then there will be no effect to operations[1]. An OCA or MOCA only considers obstacles that are located within the protection area for a procedure. If the Dublin Array lies within any of the protection areas and the associated OCA or MOCA is affected, then an advisory maximum permitted elevation for the WTGs will be provided.

During the assessment, conversions of the altitudes published on procedures will be made from feet (ft) to m by multiplying by 0.3048. This is the ICAO recognised conversion method and allows any elevation restrictions for the development to be considered in the same units as the planned development.

5.2 Exclusions

This report assesses the Dublin Array against the extant IFPs only for the three aerodromes and does not consider the implementation of future procedures.

[1] The effect to operations in the context of this report is limited to IFPs only and does not consider Communication, Navigation and Surveillance Systems; however, the IAA have been consulted on this potential impact and a response is awaited.

6 IFP Assessment – Dublin Airport

6.1 Overview

Dublin Airport is owned and operated by the Dublin Airport Authority (DAA) who also operate Cork Airport. Dublin Airport operates three runways designated 10L/28R, 10R/28L and 16/34, the longest runway is 10L/28R at 3,109 m.

Dublin Airport is located approximately 23 kilometres (km) northwest of the Dublin Array, measured from the closest point of the development site boundary to Threshold 34.

6.2 Departures

The published SIDs for Dublin Airport are predicated on both Global Navigation Satellite System (GNSS) and DME/DME navigation.

- GNSS is an umbrella term used for various types of satellite-based navigation.
- DME is a radio navigation aid that measures a distance between the ground station and the aircraft. DME/DME technology is where two or more DMEs can be used to establish an aircraft's horizontal position.

The SIDs in this report have been considered against both means of navigation as the accuracy provided (and therefore the associated protection areas) varies between the two techniques.

When considering the obstacles to assess for the procedures, a standard 3.3% Procedure Design Gradient (PDG) is used to determine an aircraft's altitude at a given point during the departure. This gradient is defined in ICAO PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures as the standard to be used for assessing obstacles.

The obstacle clearance to be used for a SID depends on the phase of the departure and the distance of the obstacle in relation to the aerodrome. The maximum MOC to be applied in a SID is 300 m.

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6.2.1 Standard Departure Chart – Instrument RNAV RWY 28L CAT A, B – ICAO - EIDW AD 2.24-10.1

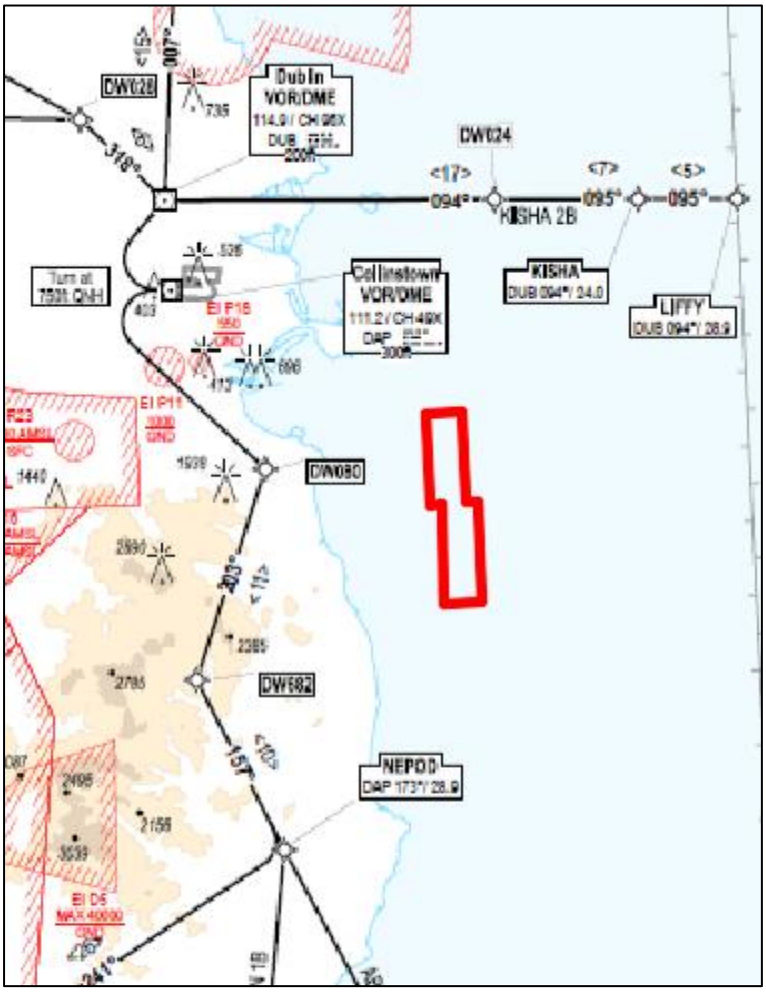

Figure 2 – Standard Departure Chart – Instrument RNAV RWY 28L CAT A, B – ICAO - EIDW AD 2.24-10.1[2]

[2] All Figures shown in this report (from this page onwards) that contain an Aerial Map Background, are from Autodesk AutoCAD 2019 embedded Online Maps Data – unless specified otherwise.
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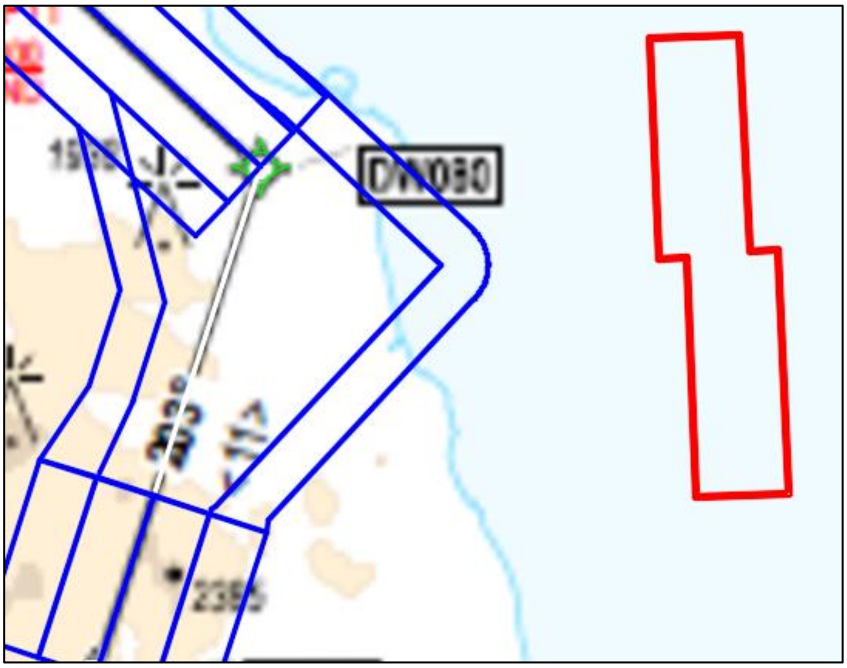

Figure 3 – Standard Departure Chart – Instrument RNAV RWY 28L CAT A, B – ICAO - EIDW AD 2.24-10.1and Dublin Array

The development would lie outside of the protection area illustrated in Figure 3 for the RWY 28L Departure CAT AB procedure. The procedure would be unaffected.

6.2.2 Standard Departure Chart – Instrument RNAV RWY 28L CAT C, D – ICAO - EIDW AD 2.24-11

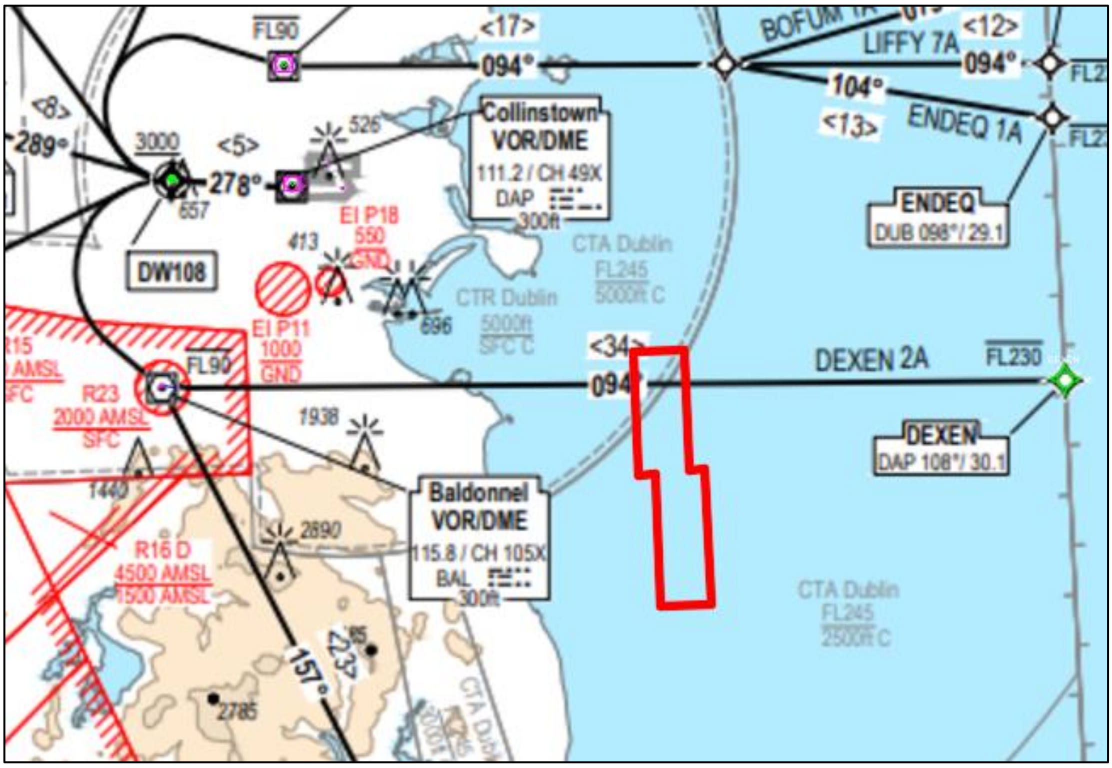

Figure 4 – Standard Departure Chart – Instrument RNAV RWY 28L CAT C, D – ICAO - EIDW AD 2.24-11

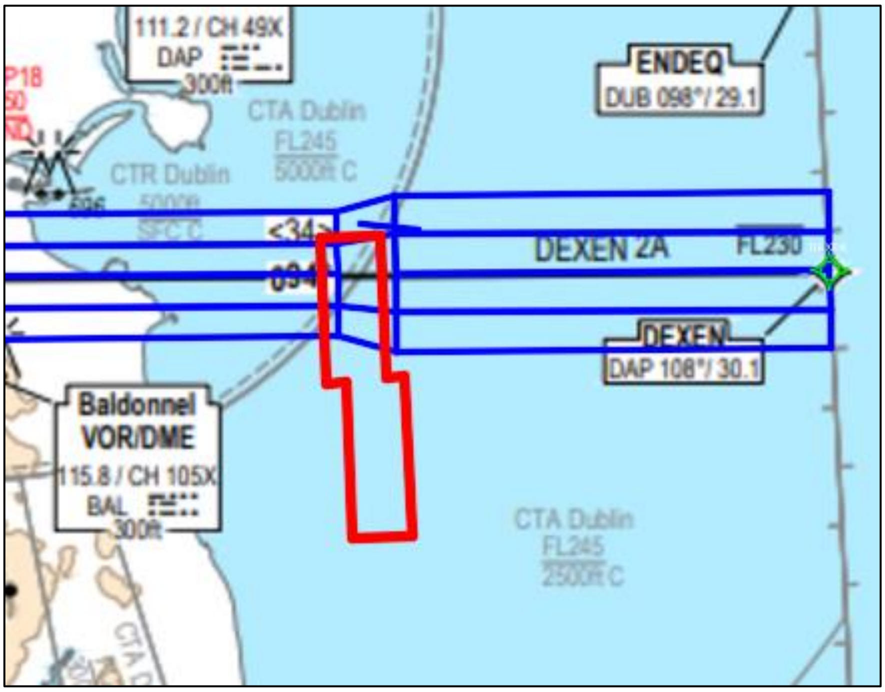

Figure 5 – Standard Departure Chart – Instrument RNAV RWY 28L CAT C, D – ICAO - EIDW AD 2.24-11 and Dublin Array

The development would lie inside the protection area (see Figure 5) for the RWY 28L Departure CAT CD procedure to 'DEXEN' (a reporting point where the SID terminates); however, aircraft would have greater than 300 m clearance from the proposed WTGs with an elevation of 309.6 m amsl.

A conservative assessment can be used for all SIDs where the development would lie within the protection area. This considers the shortest distance from the airport to the development (23 km) and a climb gradient of 3.3%.

The protection area for SIDs begins at the Departure End of Runway (DER) at an altitude of ground level + 5 m. In the absence of aerodrome survey data and thus the accurate elevations of the DER locations for each Runway, the published Threshold elevations can be used as an approximate elevation to use in the assessment. Any differences in elevation between THR and DER are negligible in comparison to the distance from development and the minimum clearances documented are such that this difference can be disregarded.

- Lowest approximate starting elevation = 66.5 m
  - Lowest published runway Threshold[3] – (RWY 34 = 202ft / 61.5m) + 5 m
- Height gain = 759 m
  - 23000 m* 0.033 = 759 m
- Minimum aircraft elevation at development = 825.5 m
  - 759 m + 61.5 + 5m = 825.5 m
- Minimum clearance from development = 515.9 m
  - 825.5 m – 309.6 m (WTG elevation) = 515.9 m

[3] The IAIP Dublin Entry section EIDW AD 2.12 is utilised to establish the physical characteristics of the runways.

As the clearance is over 300 m from proposed WTGs with an elevation of 309.6 m amsl, the procedure would be unaffected.

6.2.3 Standard Departure Chart – Instrument RNAV RWY 28R CAT A, B – ICAO - EIDW AD 2.24-12

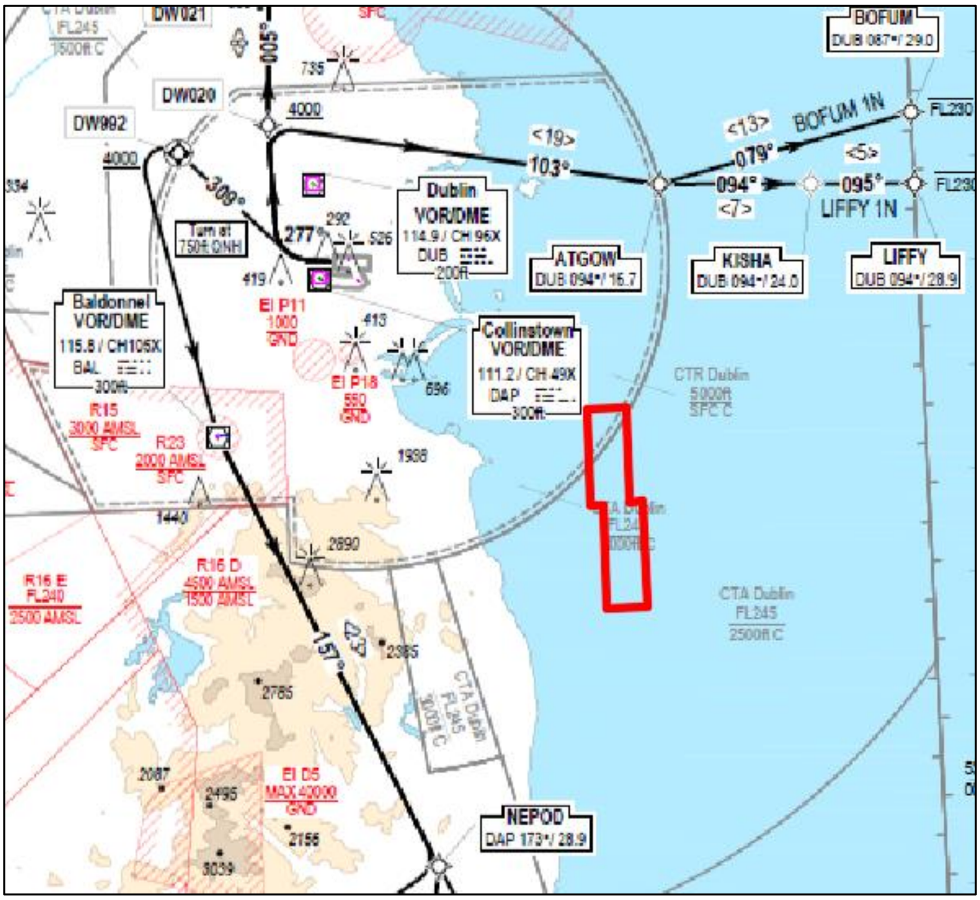

Figure 6 - Standard Departure Chart – Instrument RNAV RWY 28R CAT A, B – ICAO - EIDW AD 2.24-12

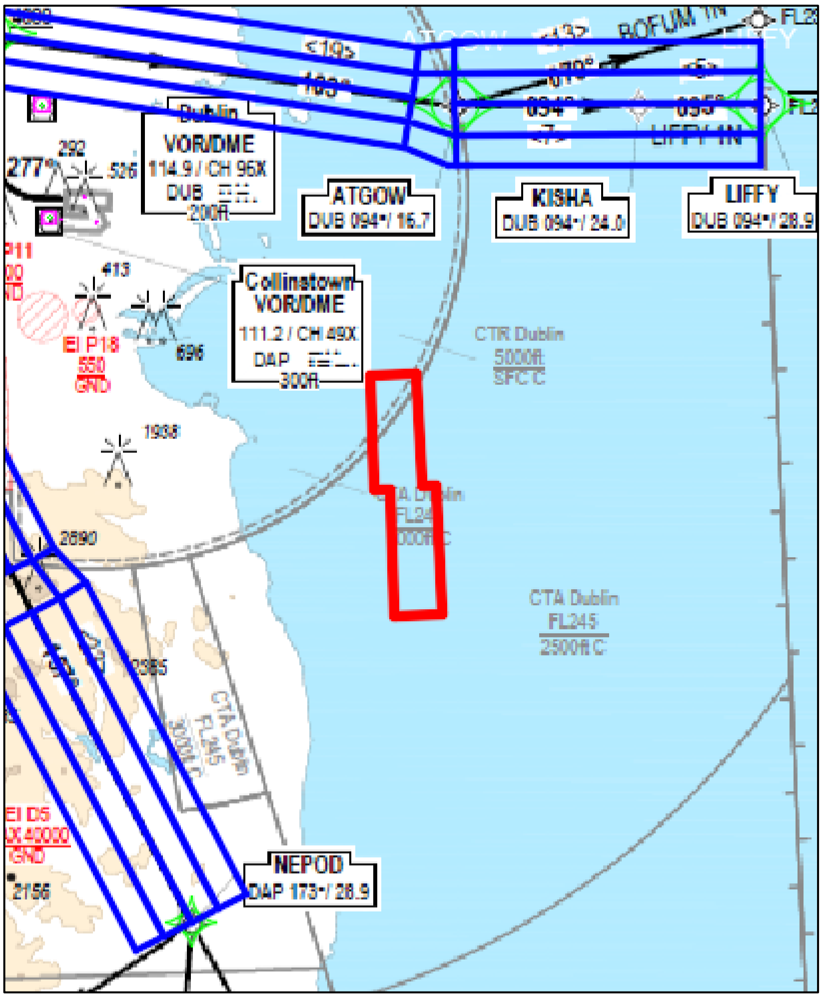

Figure 7 – Standard Departure Chart – Instrument RNAV RWY 28L CAT A, B – ICAO - EIDW AD 2.24-10.1and Dublin Array

The development would lie outside of the protection area illustrated in Figure 7 for the RWY 28R Departure CAT AB procedure. The procedure would be unaffected.

6.2.4 Standard Departure Chart – Instrument RNAV RWY 28R CAT C, D – ICAO - EIDW AD 2.24-13.1

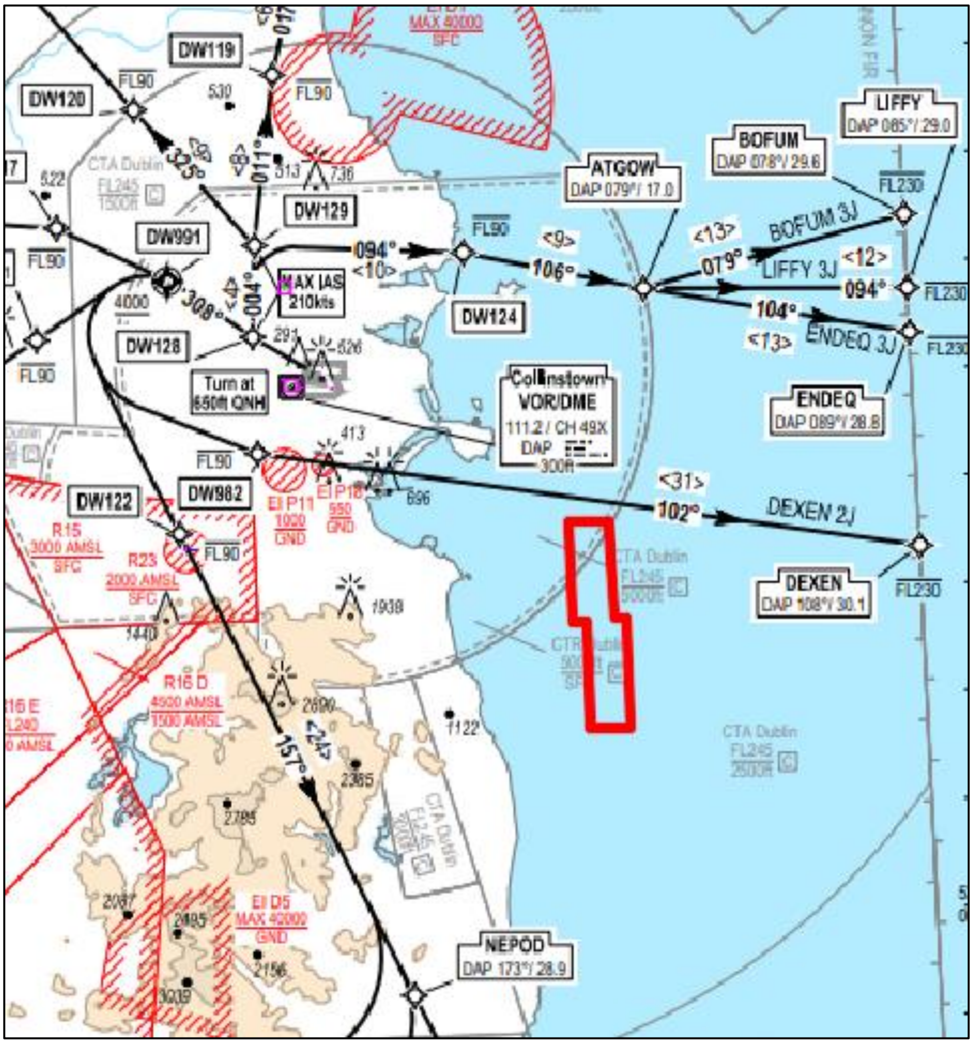

Figure 8 – Standard Departure Chart – Instrument RNAV RWY 28R CAT C, D – ICAO - EIDW AD 2.24-13.1

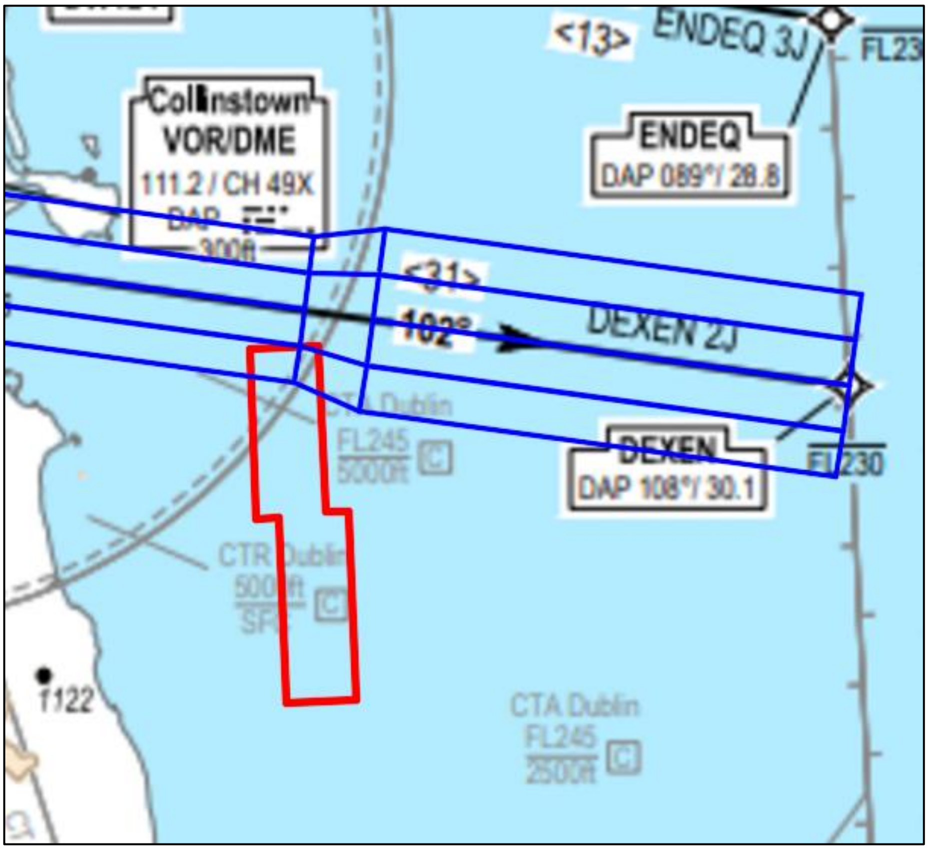

Figure 9 – Standard Departure Chart – Instrument RNAV RWY 28R CAT C, D – ICAO - EIDW AD 2.24-13.1 and Dublin Array

The development would lie inside the protection area (see Figure 9) for the RWY 28R Departure CAT CD procedure to 'DEXEN' (a reporting point where the SID terminates); however, aircraft would have greater than 300 m clearance from the proposed WTGs with an elevation of 309.6 m amsl.

A conservative assessment can be used for all SIDs where the development would lie within the protection area. This considers the shortest distance from the airport to the development (23 km) and a climb gradient of 3.3%.

The protection area for SIDs begins at the DER at an altitude of ground level + 5 m. In the absence of aerodrome survey data and thus the accurate elevations of the DER locations for each Runway, the published Threshold elevations can be used as an approximate elevation to use in the assessment. Any differences in elevation between THR and DER are negligible in comparison to the distance from development and the minimum clearances documented are such that this difference can be disregarded.

- Lowest approximate starting elevation = 66.5 m
    - Lowest published runway Threshold[4] – (RWY 34 = 202ft / 61.5m) + 5 m
- Height gain = 759 m
    - 23000 m* 0.033 = 759 m
- Minimum aircraft elevation at development = 825.5 m
    - 759 m + 61.5 + 5m = 825.5 m
- Minimum clearance from development = 515.9 m

[4] The IAIP Dublin Entry section EIDW AD 2.12 is utilised to establish the physical characteristics of the runways.

- 825.5 m – 309.6 m (WTG elevation) = 515.9 m

As the clearance is over 300 m from proposed WTGs with an elevation of 309.6 m amsl, the procedure would be unaffected.

6.2.5 Standard Departure Chart – Instrument RNAV RWY 10L CAT A, B – ICAO - EIDW AD 2.24-14.1

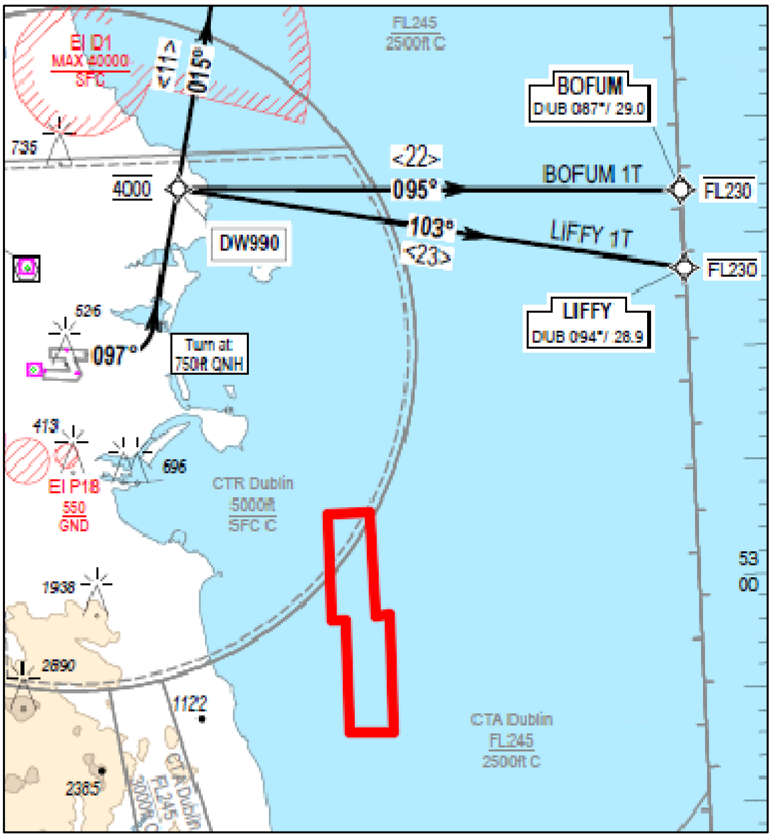

Figure 10 – Standard Departure Chart – Instrument RNAV RWY 10L CAT A, B – ICAO - EIDW AD 2.24-14.1

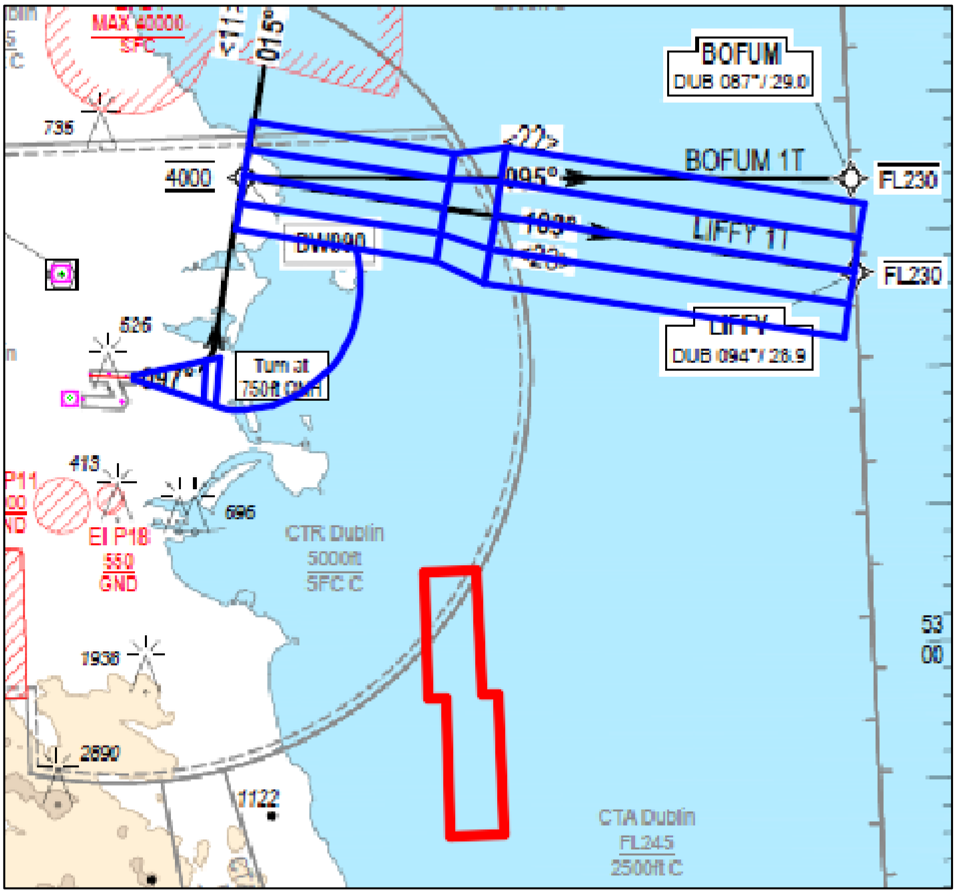

Figure 11 – Standard Departure Chart – Instrument RNAV RWY 10L CAT A, B – ICAO - EIDW AD 2.24-14.1 and Dublin Array

The development would lie outside of the protection area illustrated in Figure 11 for the RWY 10L Departure CAT AB procedure. The procedure would be unaffected.

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6.2.6 Standard Departure Chart – Instrument RNAV RWY 10L CAT C, D – ICAO - EIDW AD 2.24-15

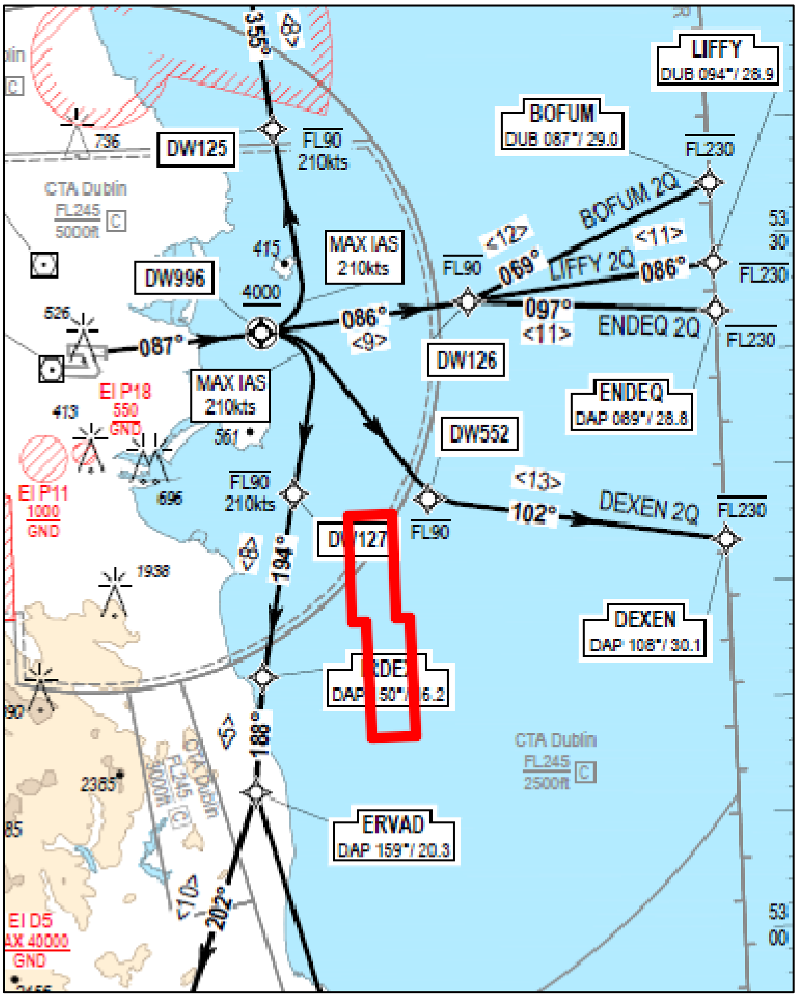

Figure 12 – Standard Departure Chart – Instrument RNAV RWY 10L CAT C, D – ICAO - EIDW AD 2.24-15

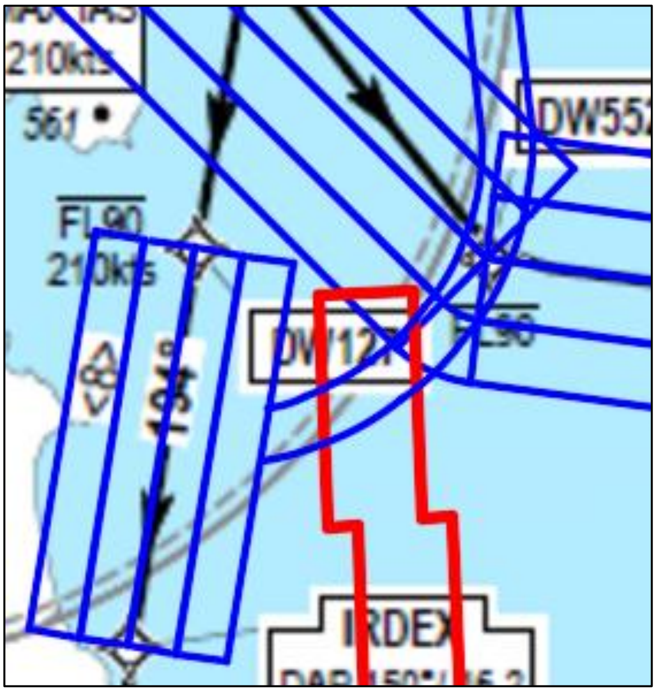

Figure 13 – Standard Departure Chart – Instrument RNAV RWY 10L CAT C, D – ICAO - EIDW AD 2.24-15 and Dublin Array

The development would lie inside the protection area (see Figure 13) for the RWY 10L Departure CAT CD procedure routing to 'DEXEN' and 'IRDEX' (reporting points for the SID); however, aircraft would have greater than 300 m clearance from the proposed WTGs with an elevation of 309.6 m amsl.

A conservative assessment can be used for all SIDs where the development would lie within the protection area. This considers the shortest distance from the airport to the development (23 km) and a climb gradient of 3.3%.

The protection area for SIDs begins at the DER at an altitude of ground level + 5 m. In the absence of aerodrome survey data and thus the accurate elevations of the DER locations for each Runway, the published Threshold elevations can be used as an approximate elevation to use in the assessment. Any differences in elevation between THR and DER are negligible in comparison to the distance from development and the minimum clearances documented are such that this difference can be disregarded.

- Lowest approximate starting elevation = 66.5 m
  - Lowest published runway Threshold[5] – (RWY 34 = 202ft / 61.5m) + 5 m
- Height gain = 759 m
  - 23000 m* 0.033 = 759 m
- Minimum aircraft elevation at development = 825.5 m
  - 759 m + 66.5 + 5m = 825.5 m
- Minimum clearance from development = 515.9 m
  - 825.5 m – 309.6 m (WTG elevation) = 515.9 m

As the clearance is over 300 m from proposed WTGs with an elevation of 309.6 m amsl, the procedure would be unaffected.

[5] The IAIP Dublin Entry section EIDW AD 2.12 is utilised to establish the physical characteristics of the runways.

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6.2.7 Standard Departure Chart – Instrument RNAV RWY 10R CAT A, B – ICAO - EIDW AD 2.24-16.1

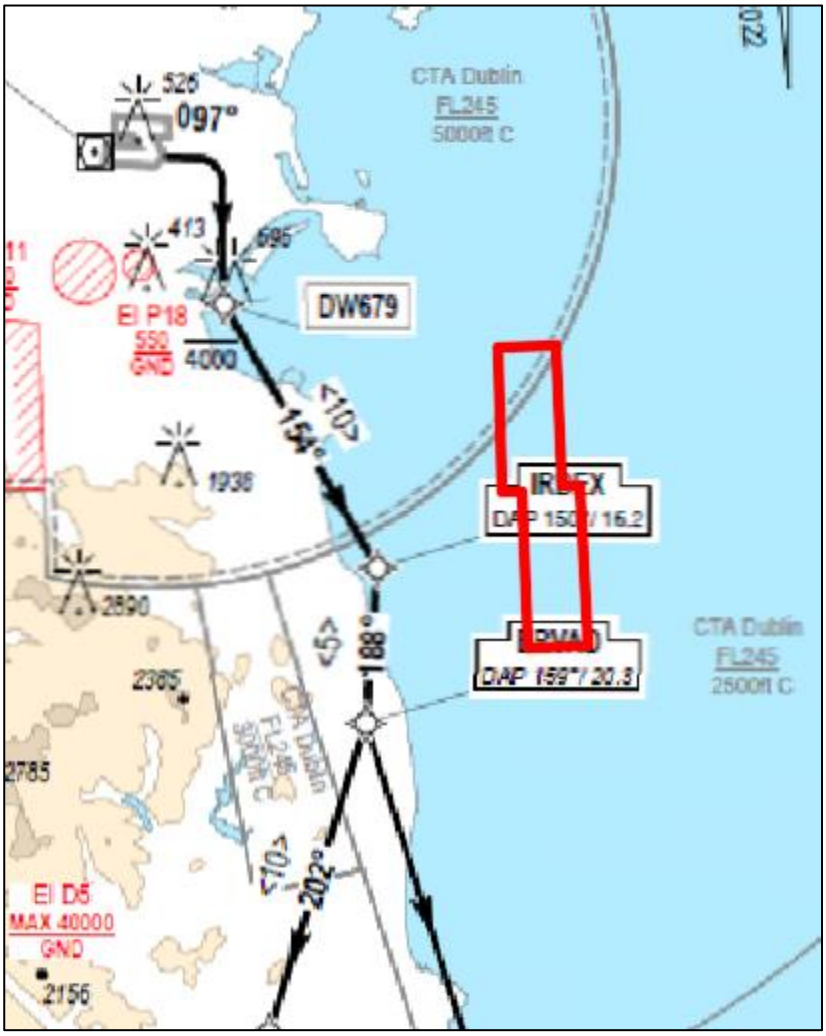

Figure 14 – Dublin RWY 10R Departure CAT AB

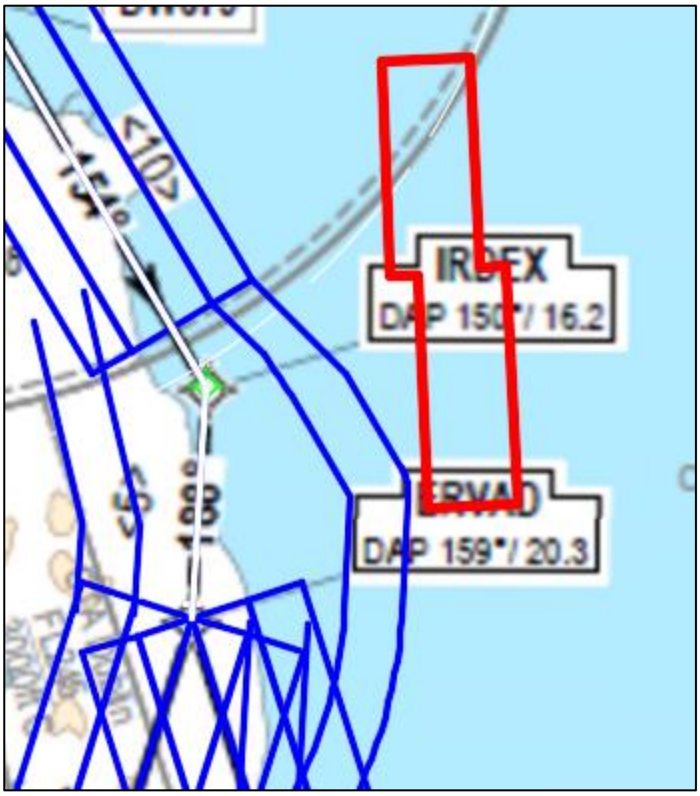

Figure 15 – Dublin RWY 10R Departure CAT AB and Dublin Array

The development would lie outside of the protection area (see Figure 15) for the RWY 10R Departure CAT AB procedure. The procedure would be unaffected.

6.2.8 Standard Departure Chart – Instrument RNAV RWY 10R CAT C, D – ICAO - EIDW AD 2.24-17

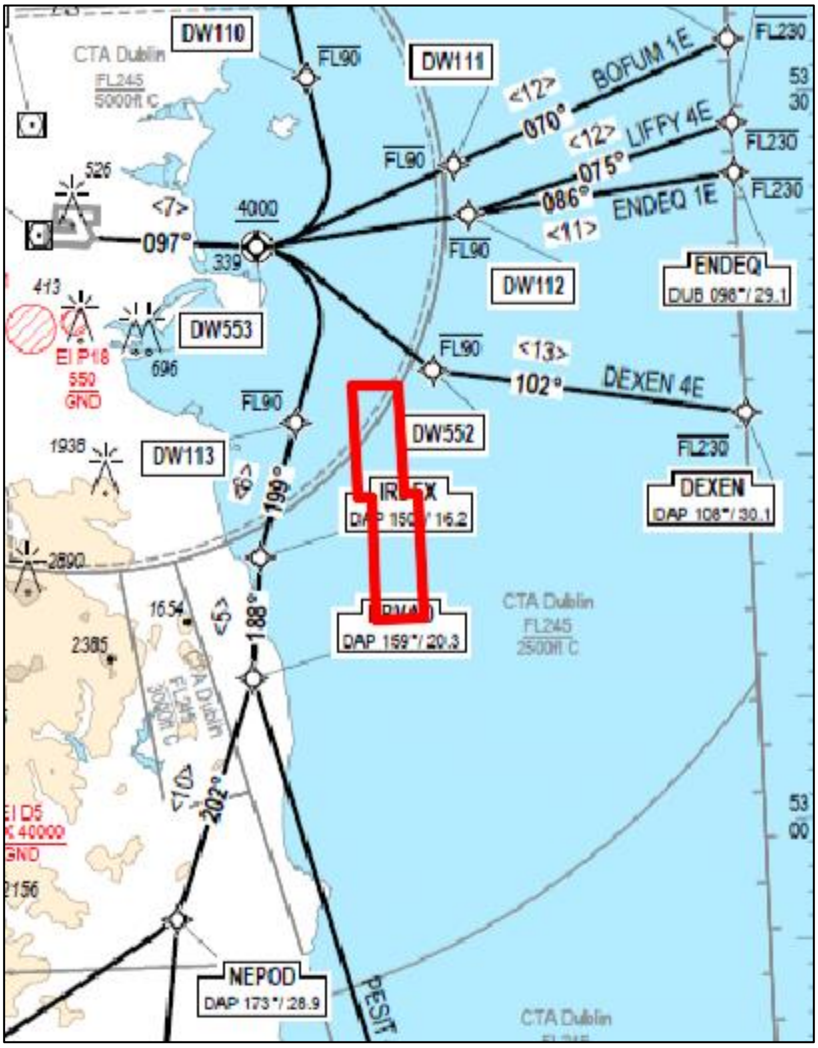

Figure 16 – Dublin Array RWY 10R Departure CAT CD

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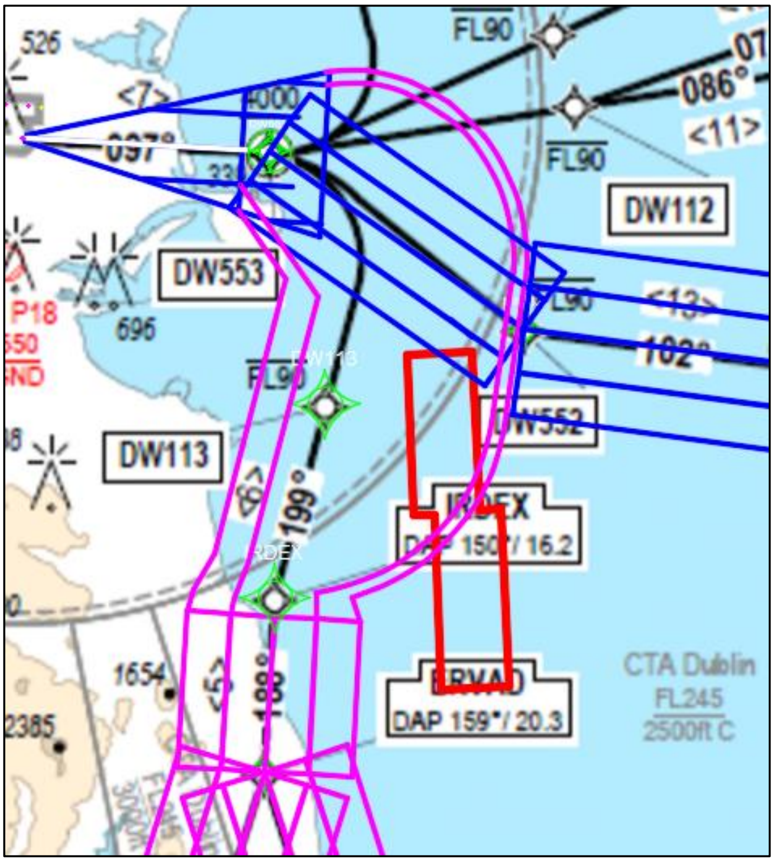

Figure 17 – Dublin RWY 10R Departure CAT CD and Dublin Array

The development would lie inside the protection area (see Figure 17) for the RWY 28 Departure CAT CD procedure to the reporting points 'DEXEN', 'PESIT', 'BEPAN' and 'OLONO'; however, aircraft would have over 300 m clearance from proposed WTGs with an elevation of 309.6 m amsl, the procedure would be unaffected.

A conservative assessment can be used for all SIDs where the development would lie within the protection area. This considers the shortest distance from the airport to the development (23 km) and a climb gradient of 3.3%.

The protection area for SIDs begins at the DER at an altitude of ground level + 5 m. In the absence of aerodrome survey data and thus the accurate elevations of the DER locations for each Runway, the published Threshold elevations can be used as an approximate elevation to use in the assessment. Any differences in elevation between THR and DER are negligible in comparison to the distance from development and the minimum clearances documented are such that this difference can be disregarded.

- Lowest approximate starting elevation = 66.5 m
  - Lowest published runway Threshold[6] – (RWY 34 = 202ft / 61.5m) + 5 m
- Height gain = 759 m
  - 23000 m* 0.033 = 759 m
- Minimum aircraft elevation at development = 825.5 m
  - 759 m + 66.5 + 5m = 825.5 m
- Minimum clearance from development = 515.9 m

[6] The IAIP Dublin Entry section EIDW AD 2.12 is utilised to establish the physical characteristics of the runways.

- 825.5 m – 309.6 m (WTG elevation) = 515.9 m

6.2.9 Standard Departure Chart – Instrument RNAV RWY 16 CAT A, B – ICAO - EIDW AD 2.24-18.1

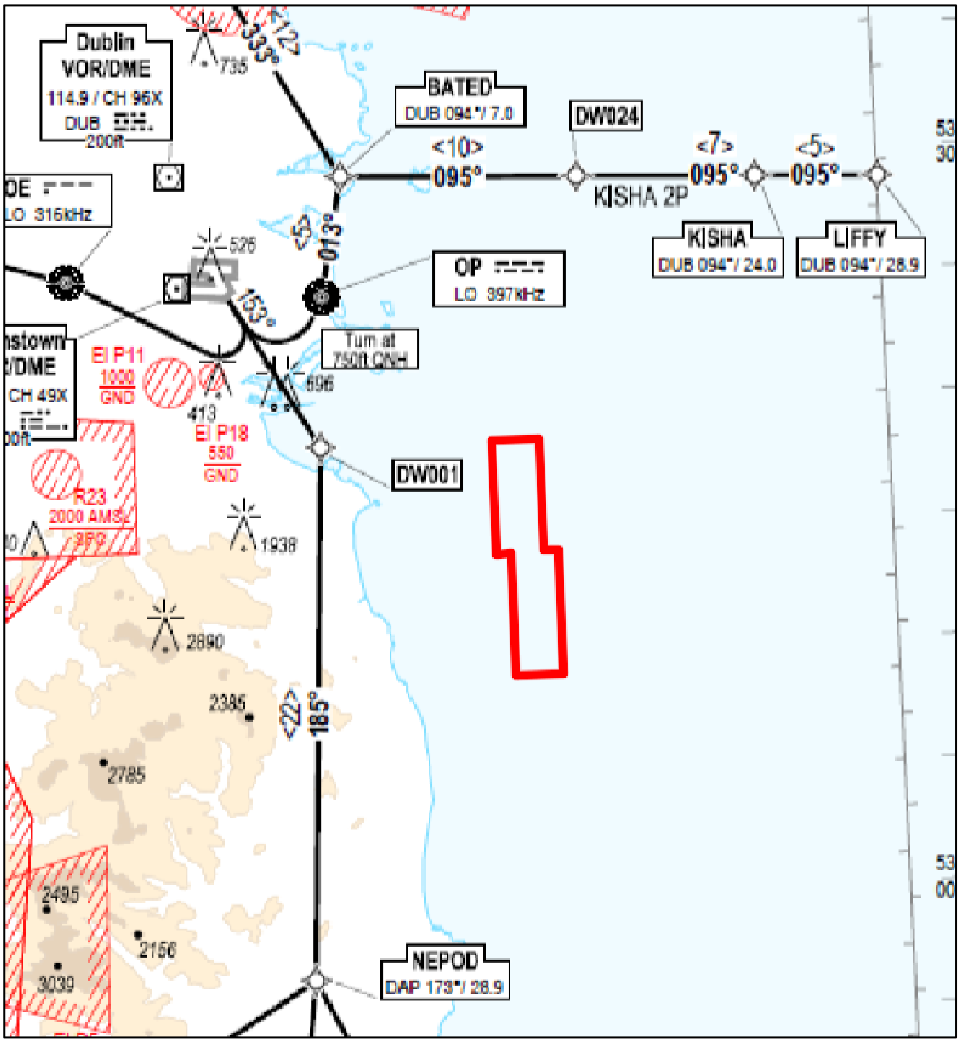

Figure 18 – Dublin RWY 16 Departure CAT AB

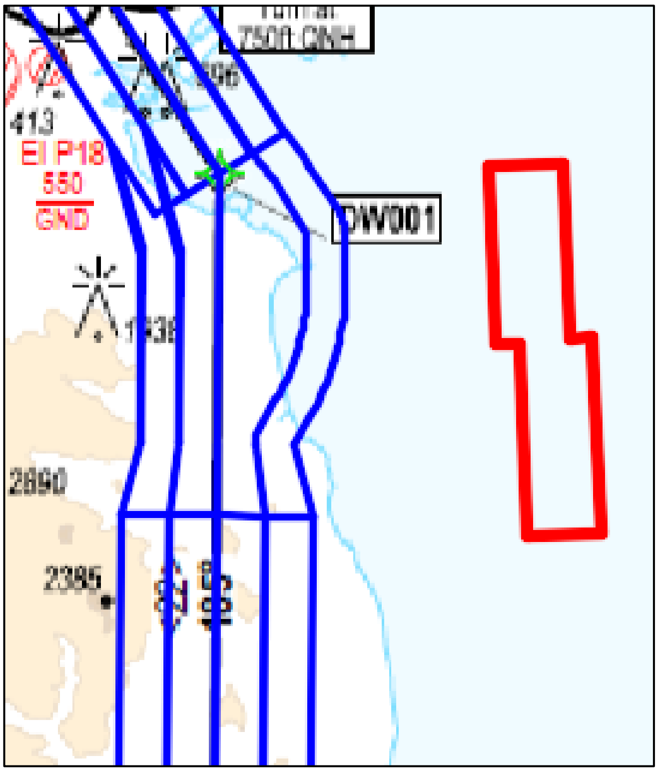

Figure 19 – Dublin RWY 16 Departure CAT AB and Dublin Array

The development would lie outside of the protection area (see Figure 19) for the RWY 16 Departure CAT AB procedure. The procedure would be unaffected.

6.2.10 Standard Departure Chart – Instrument RNAV RWY 16 CAT C, D – ICAO - EIDW AD 2.24-19

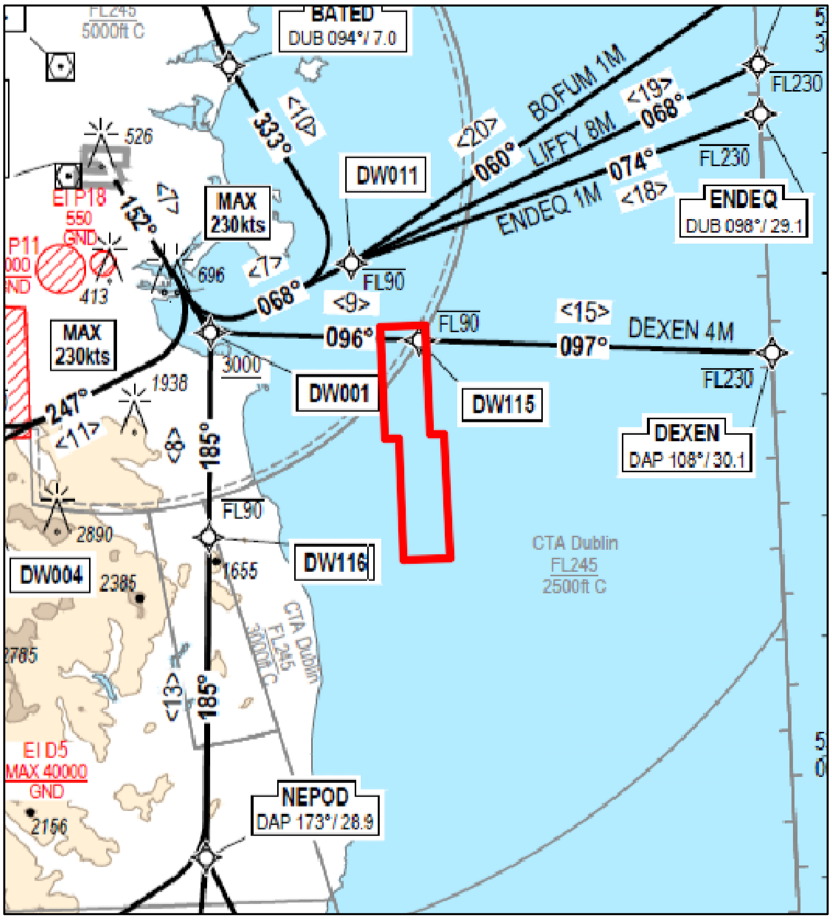

Figure 20 – Dublin RWY 16 Departure CAT CD

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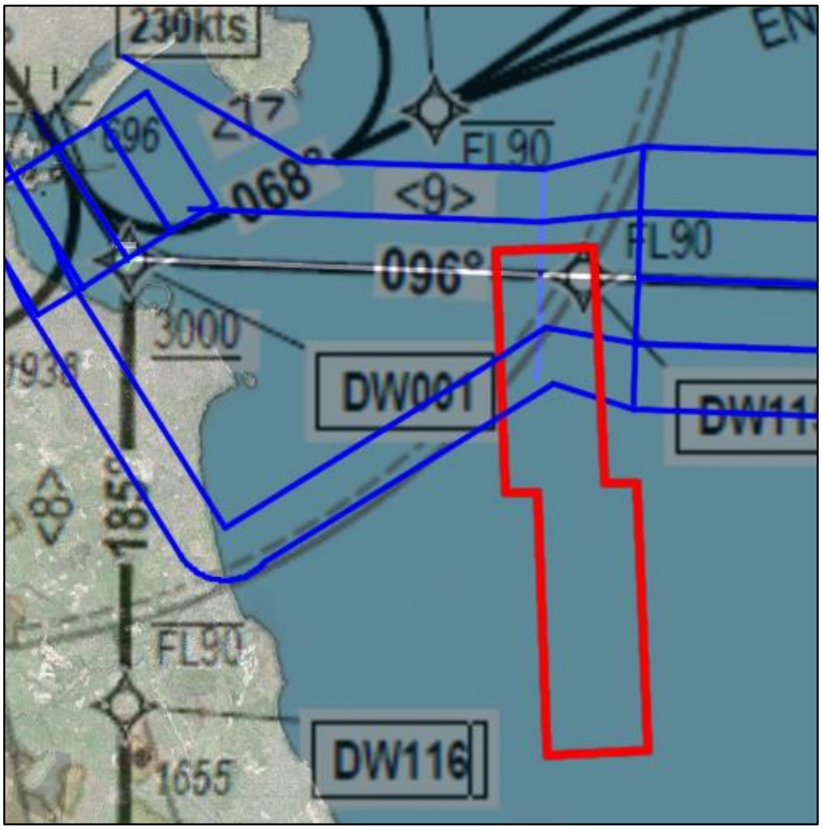

Figure 21 – Dublin RWY 16 Departure CAT CD and Dublin Array

The development would lie inside the protection area (see Figure 21) for the RWY 16 Departure CAT CD procedure to 'DEXEN'; however, aircraft would have over 300 m clearance from proposed WTGs with an elevation of 309.6 m amsl, the procedure would be unaffected.

A conservative assessment can be used for all SIDs where the development would lie within the protection area. This considers the shortest distance from the airport to the development (23 km) and a climb gradient of 3.3%.

The protection area for SIDs begins at the DER at an altitude of ground level + 5 m. In the absence of aerodrome survey data and thus the accurate elevations of the DER locations for each Runway, the published Threshold elevations can be used as an approximate elevation to use in the assessment. Any differences in elevation between THR and DER are negligible in comparison to the distance from development and the minimum clearances documented are such that this difference can be disregarded.

- Lowest approximate starting elevation = 66.5 m
  - Lowest published runway Threshold[7] – (RWY 34 = 202ft / 61.5m) + 5 m
- Height gain = 759 m
  - 23000 m* 0.033 = 759 m
- Minimum aircraft elevation at development = 825.5 m
  - 759 m + 66.5 + 5m = 825.5 m
- Minimum clearance from development = 515.9 m

[7] The IAIP Dublin Entry section EIDW AD 2.12 is utilised to establish the physical characteristics of the runways.

- 825.5 m – 309.6 m (WTG elevation) = 515.9 m

As the clearance is over 300 m from proposed WTGs with an elevation of 309.6 m amsl, the procedure would be unaffected.

6.2.11 Standard Departure Chart – Instrument RNAV RWY 34 CAT A, B – ICAO - EIDW AD 2.24-20.1

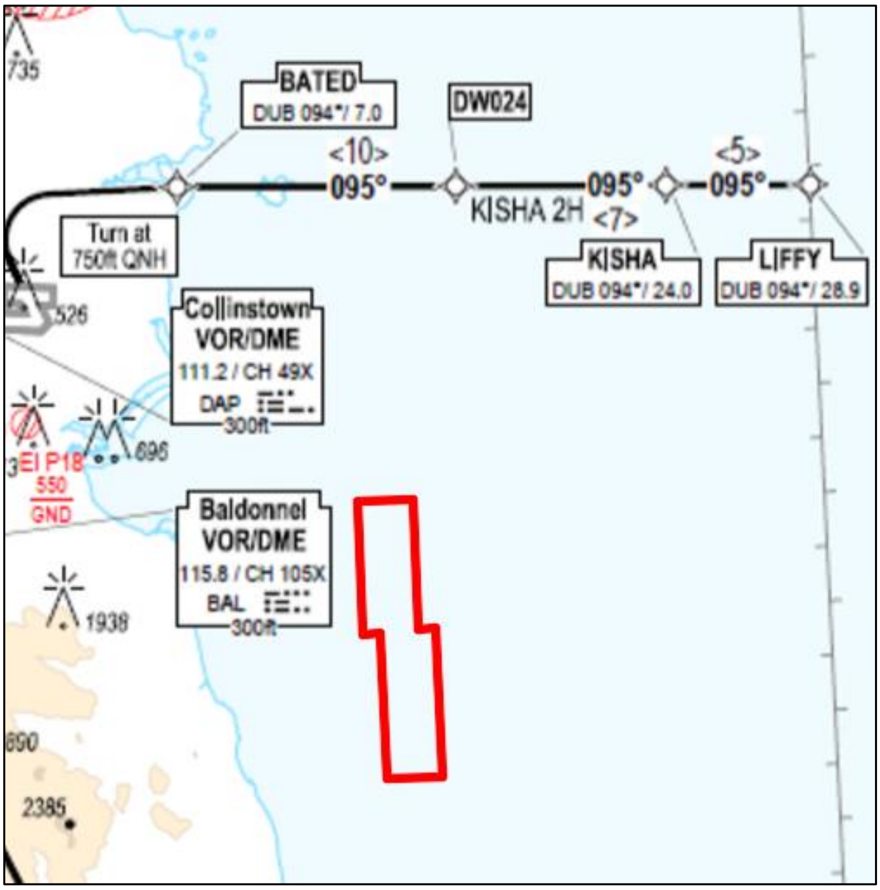

Figure 22 – Dublin RWY 34 Departure CAT AB

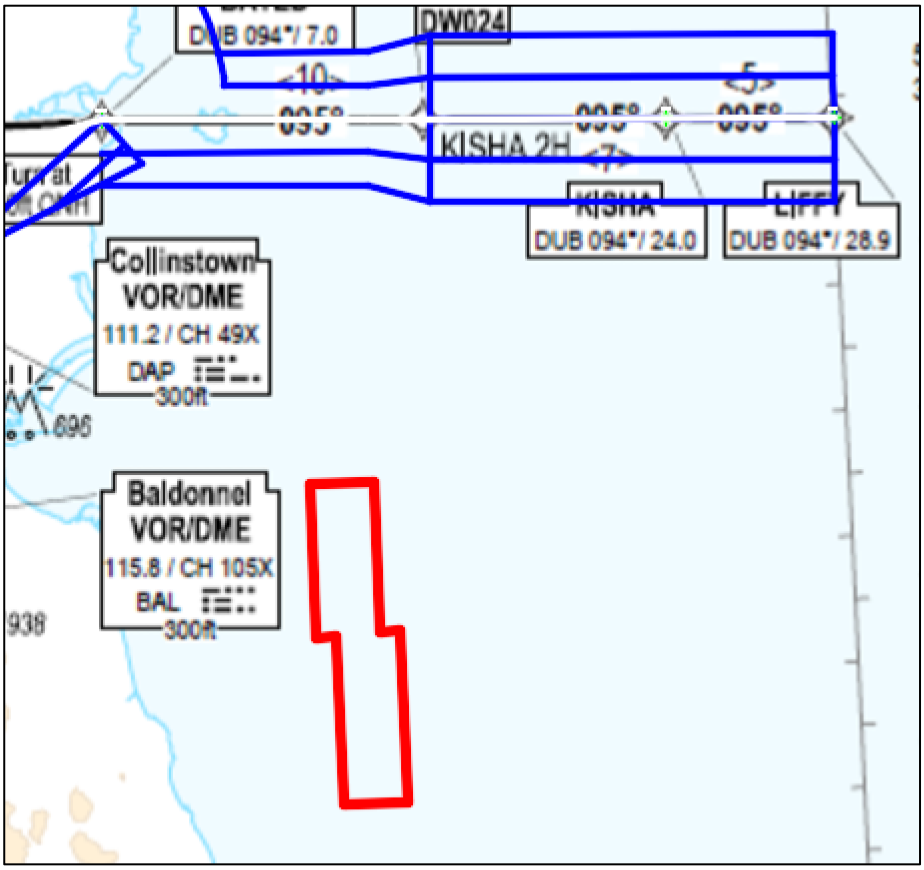

Figure 23 – Dublin RWY 34 Departure CAT CD and Dublin Array

The development would lie outside of the protection area (see Figure 23) for the RWY 34 Departure CAT AB procedure. The procedure would be unaffected.

6.2.12 Standard Departure Chart – Instrument RNAV RWY 34 CAT C, D – ICAO - EIDW AD 2.24-21

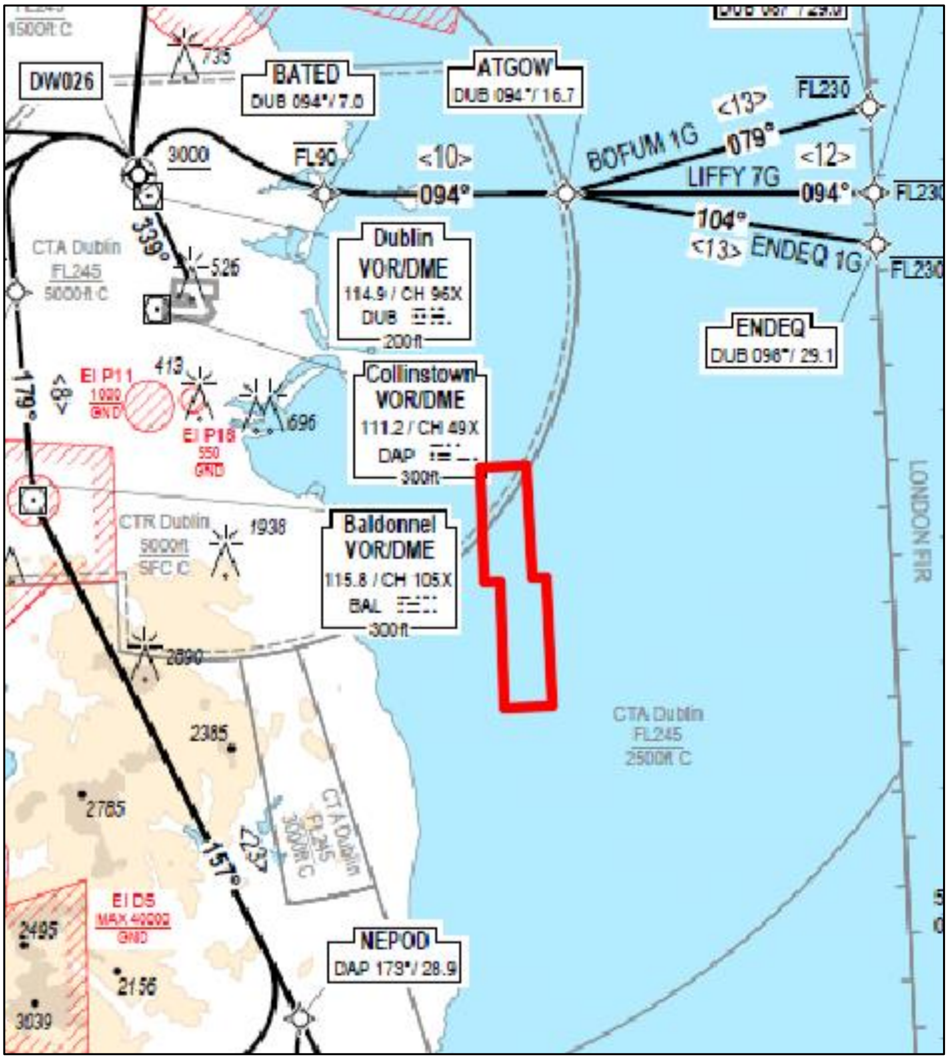

Figure 24 – Dublin RWY 34 Departure CAT CD

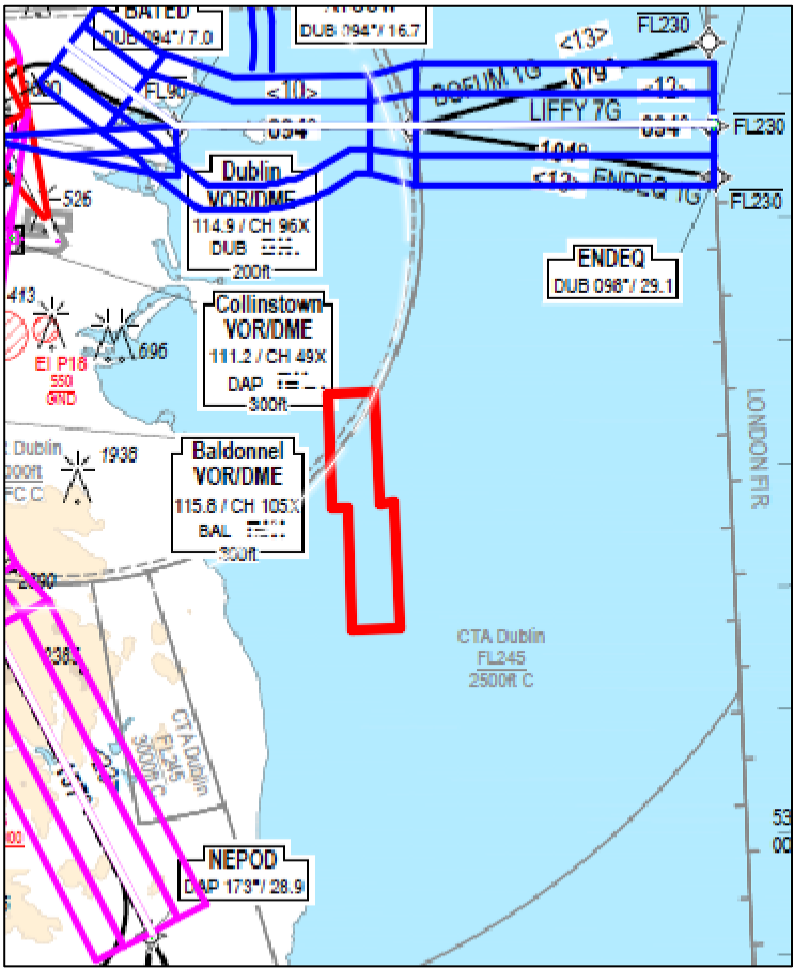

Figure 25 – Dublin RWY 34 Departure CAT CD and Dublin Array

The development would lie outside of the protection area (see Figure 25) for the RWY 34 Departure CAT CD procedure. The procedure would be unaffected.

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6.3 Dublin Arrivals

6.3.1 Standard Arrival Chart - Instrument RNAV RWY 28 L/R – ICAO - EIDW AD 2.24-22.1

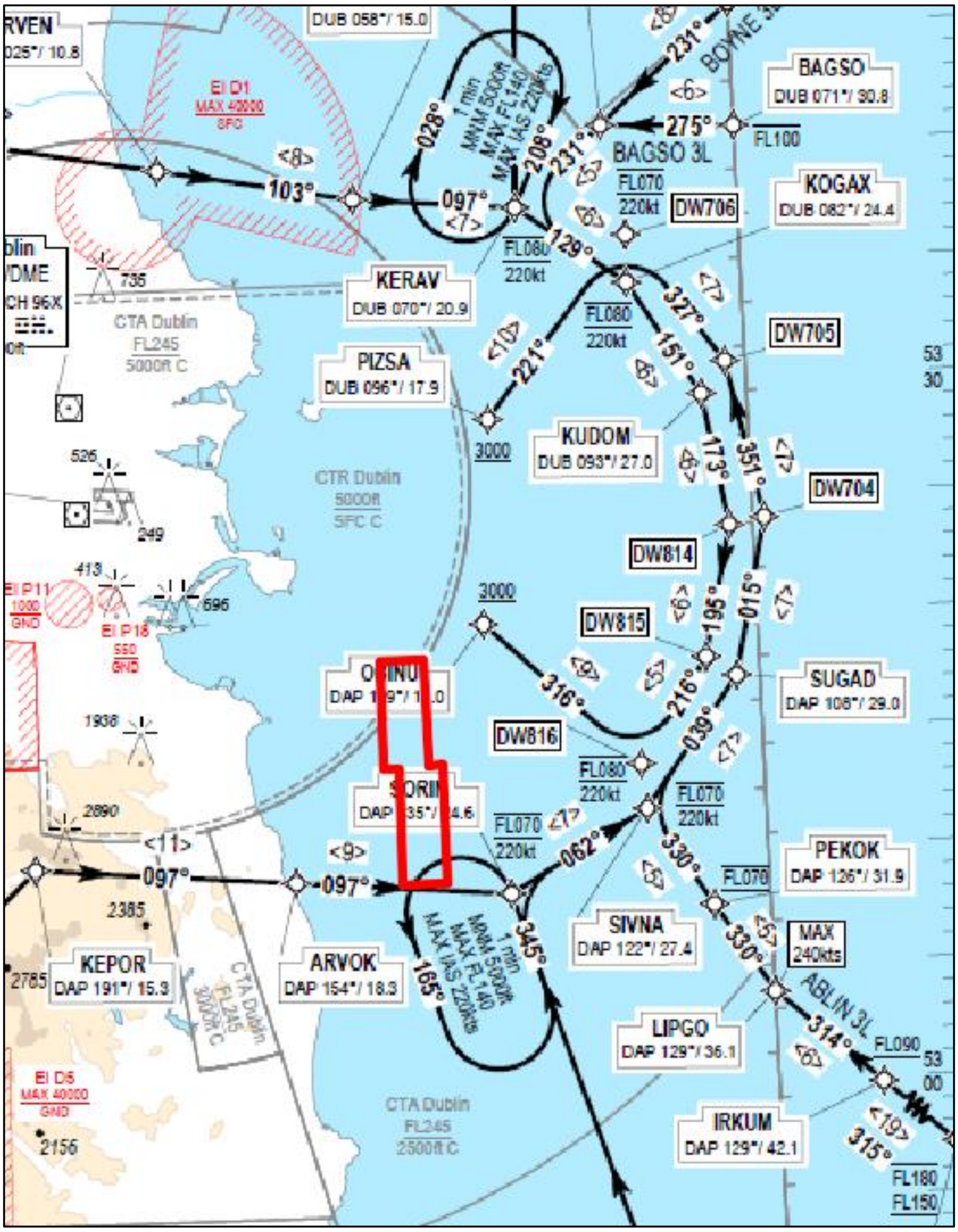

Figure 26 – Dublin RWY 28LR RNAV STAR (EIDW AD 2.24-22.1)

The development would lie within the protection area for the RWY 28LR RNAV Arrival procedure (EIDW AD 2.24-22.1); however, would not affect the published altitudes (lowest altitude 3000 ft, published at the waypoint 'OBINU' and 'PIZSA'). The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

6.3.2 Standard Arrival Chart – Instrument RNAV RWY 28 L/R – ICAO - EIDW AD 2.24-22.4

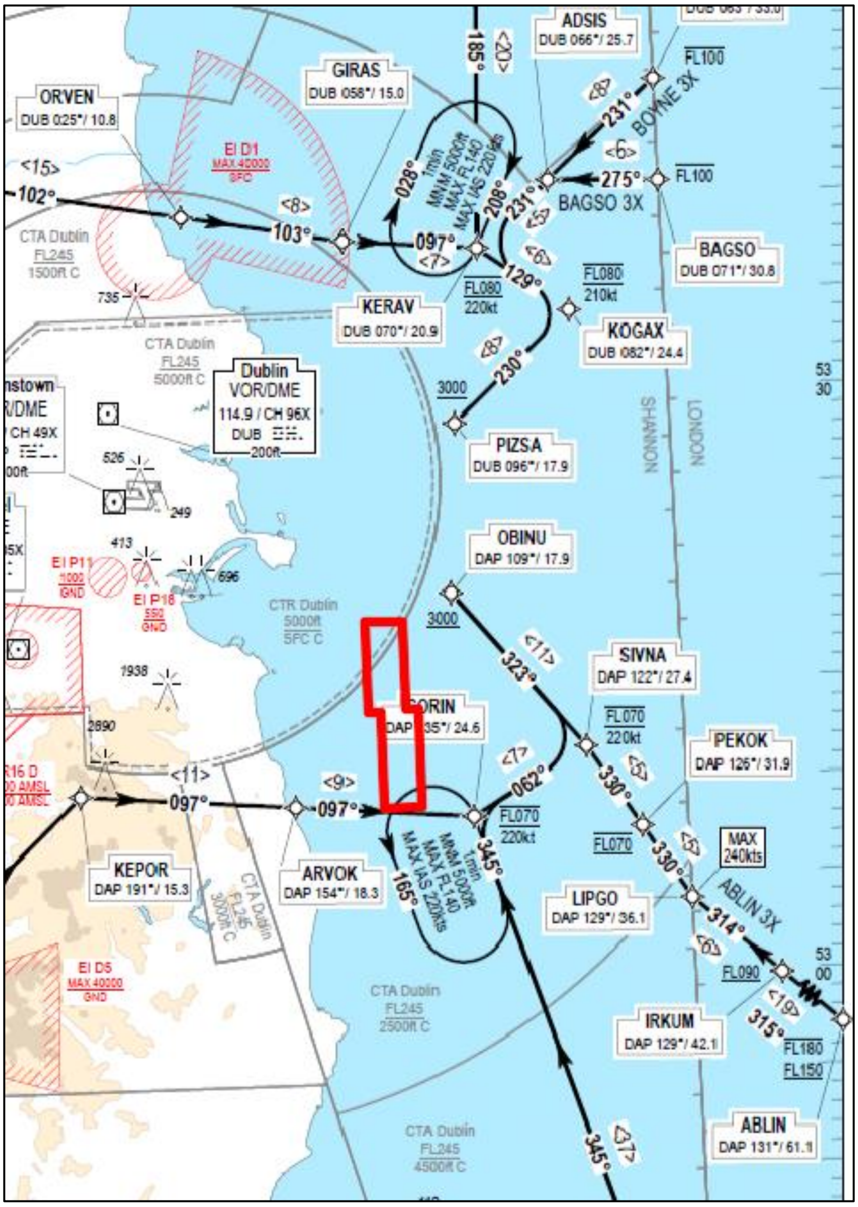

Figure 27 – Dublin RWY 28LR RNAV STAR (EIDW AD 2.24-22.4)

The development would lie within the protection area for the RWY 28LR RNAV Arrival procedure (EIDW AD 2.24-22.4); however, would not affect the published altitudes (lowest altitude 3000 ft, published at the waypoint 'OBINU' and 'PIZSA'). The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

6.3.3 Standard Arrival Chart - Instrument RNAV RWY 10 L/R – ICAO - EIDW AD 2.24-23.1

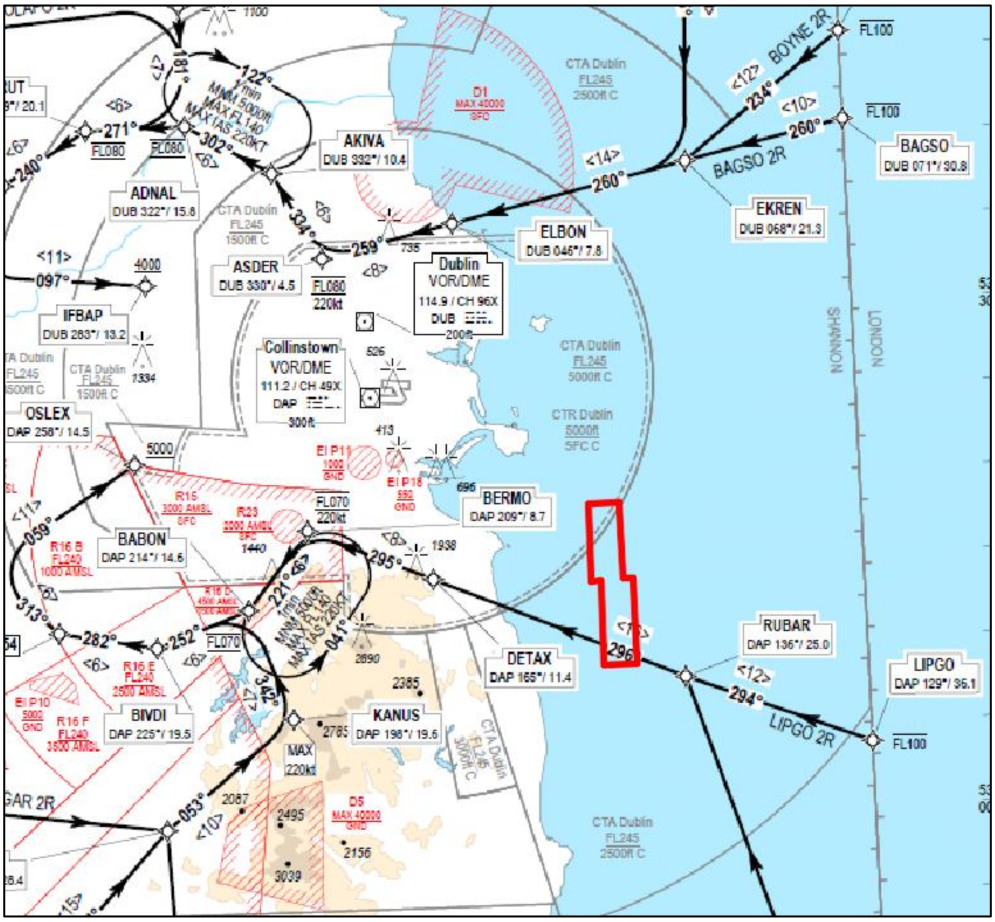

Figure 28 – Dublin RWY 10LR RNAV STAR (EIDW AD 2.24-23.1)

The development would lie within the protection area for the RWY 10LR RNAV Arrival procedure (EIDW AD 2.24-23.1); however, would not affect the published altitudes (lowest altitude 4000 ft, published at the waypoint 'IFBAP'. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

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6.3.4 Standard Arrival Chart – Instrument RNAV RWY 10 L/R – ICAO - EIDW AD 2.24-23.5

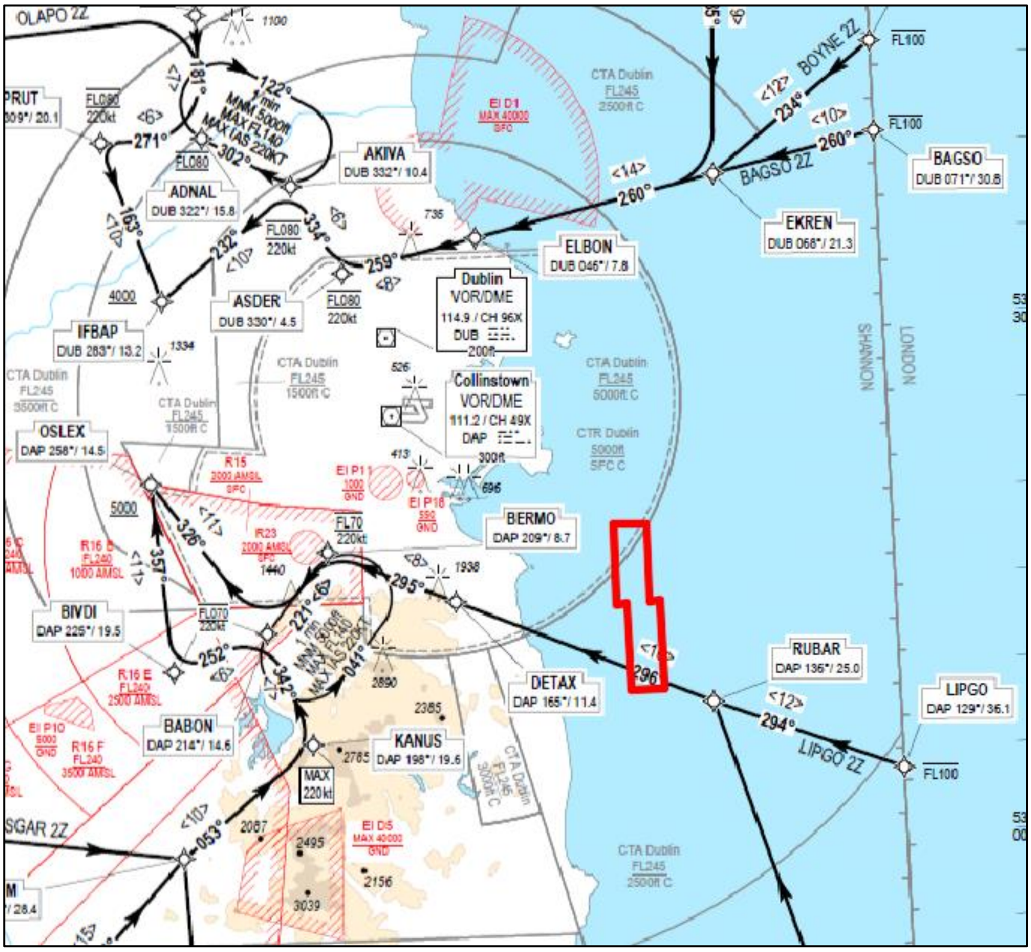

Figure 29 – Dublin RWY 10LR RNAV STAR (EIDW AD 2.24-23.5)

The development would lie within the protection area for the RWY 10LR RNAV Arrival procedure (EIDW AD 2.24-23.5); however, would not affect the published altitudes (lowest altitude 4000 ft, published at the waypoint 'IFBAP'. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

6.3.5 Standard Arrival Chart - Instrument RNAV RWY 16 – ICAO - EIDW AD 2.24-24

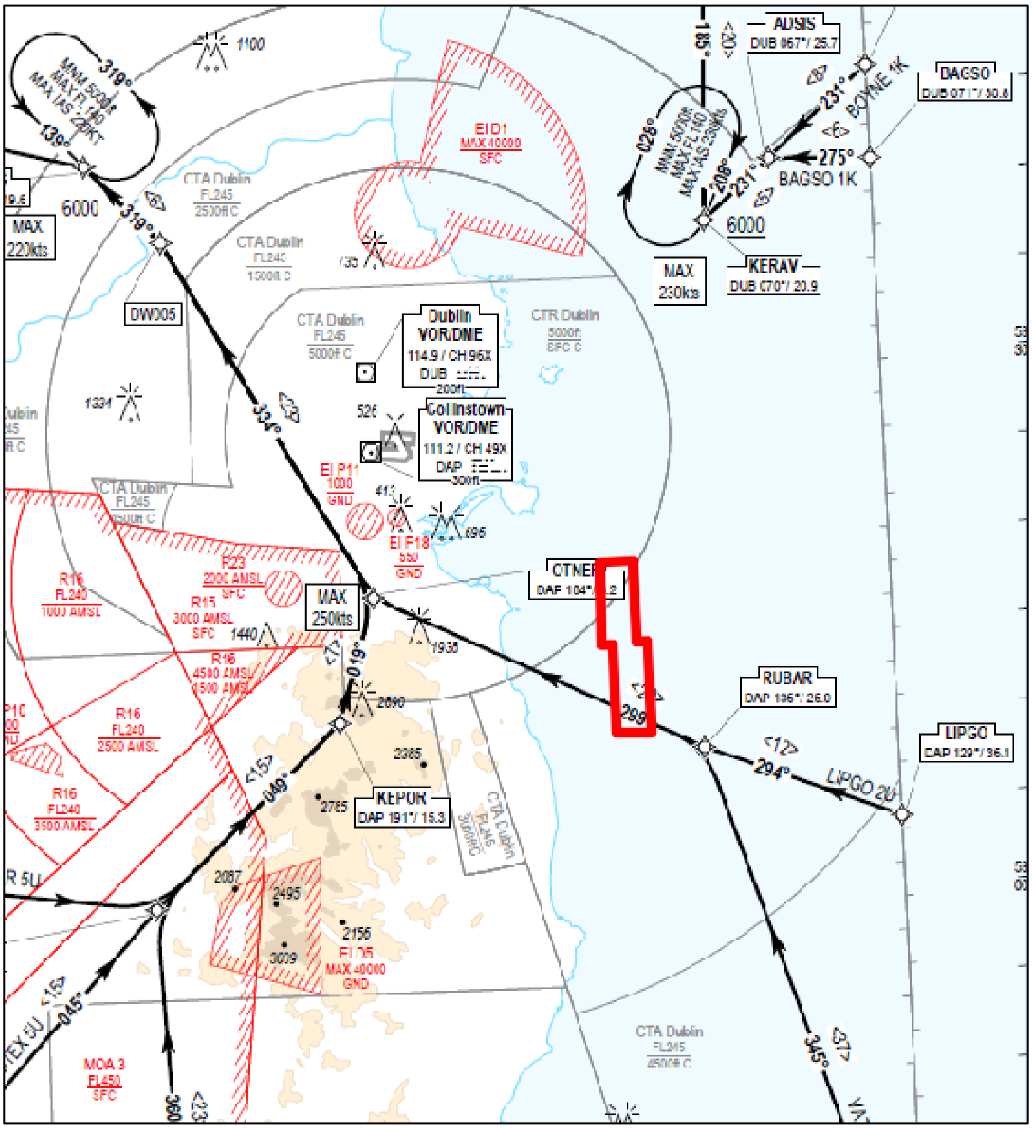

Figure 30 – Dublin RWY 16 RNAV Arrival

The development would lie within the protection area for the RWY 16 RNAV Arrival procedure; however, aircraft would be at a minimum altitude of 5000 ft at the point of transiting the development, therefore there would be no effect on the published altitudes. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

6.3.6 Standard Arrival Chart - Instrument RNAV RWY 34 – ICAO - EIDW AD 2.24-25

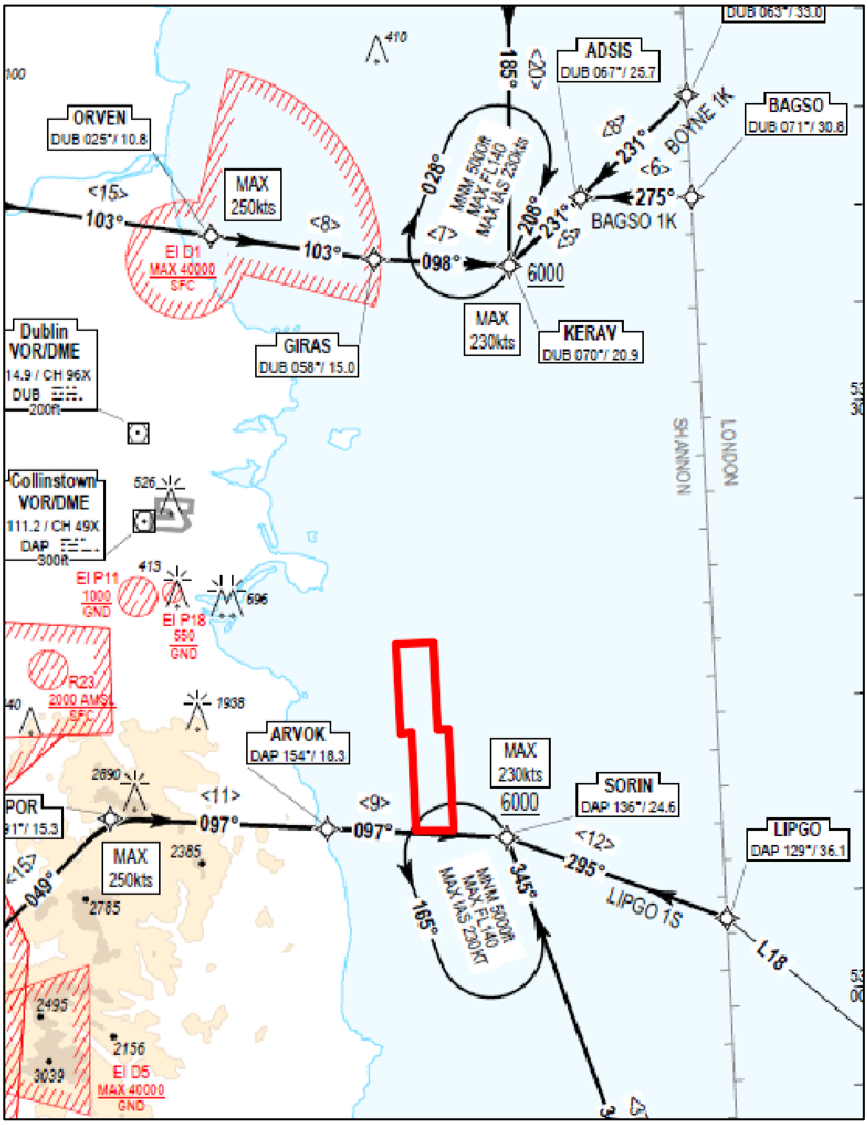

Figure 31 – Dublin RWY 34 RNAV Arrival

The development would lie within the protection area for the RWY 34 RNAV Arrival procedure; however, aircraft would be at a minimum altitude of 5000 ft at the point of transiting the development, therefore there would be no effect on the published altitudes. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

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6.4 Dublin Approaches

6.4.1 Instrument Approach Chart - RNP RWY 28L – ICAO - EIDW AD 2.24-26.1

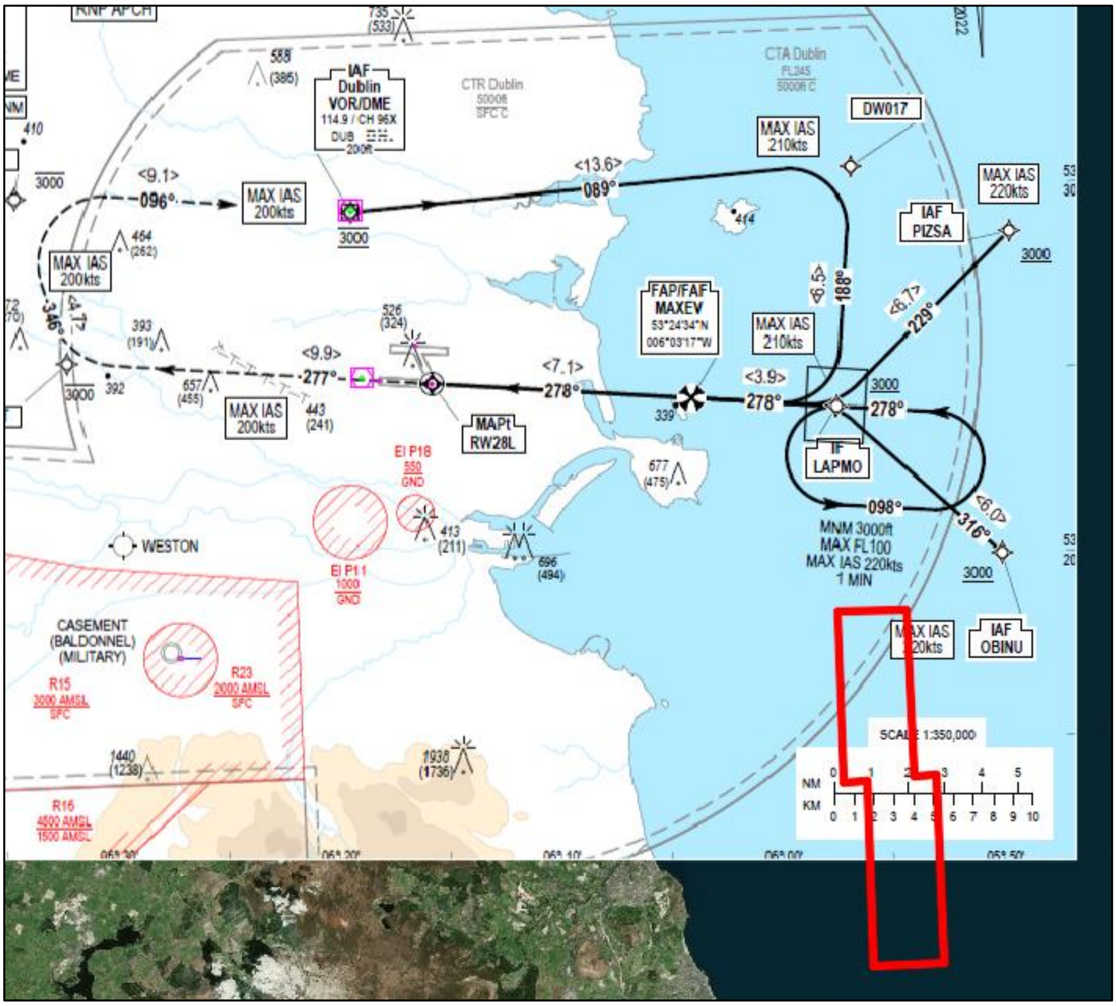

Figure 32 – Dublin RWY 28L RNP

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure; however, would lie within the protection area (see Figure 33) for the Hold at 'LAPMO'. The minimum holding altitude is 3000 ft, therefore the development would not affect the published altitude. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

The MOCA before LAPMO is 2000 ft, this would be unaffected when considering a MOC of 300 m.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

There would be no effect on the published altitudes. The procedure would be unaffected.

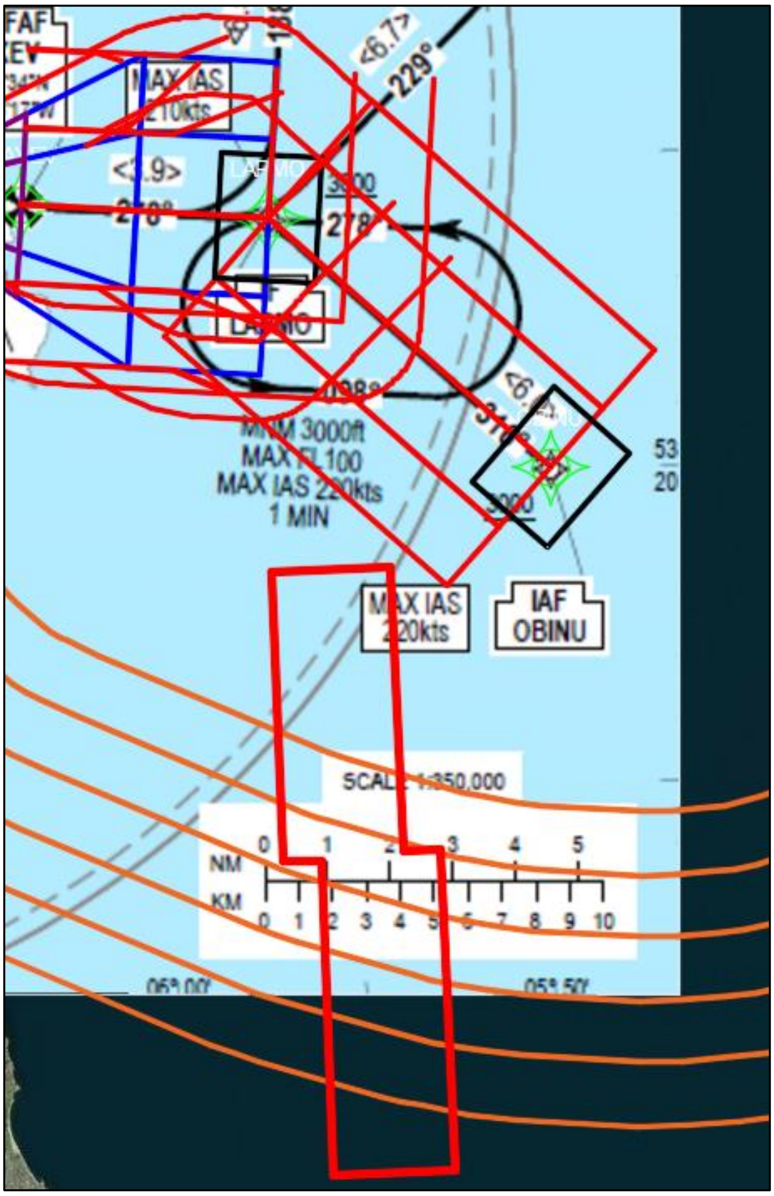

Figure 33 – Dublin RWY 28L RNP and Dublin Array

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6.4.2 Instrument Approach Chart - ILS CAT I & II or LOC RWY 28L CAT A, B, C, D – ICAO - EIDW AD 2.24-27

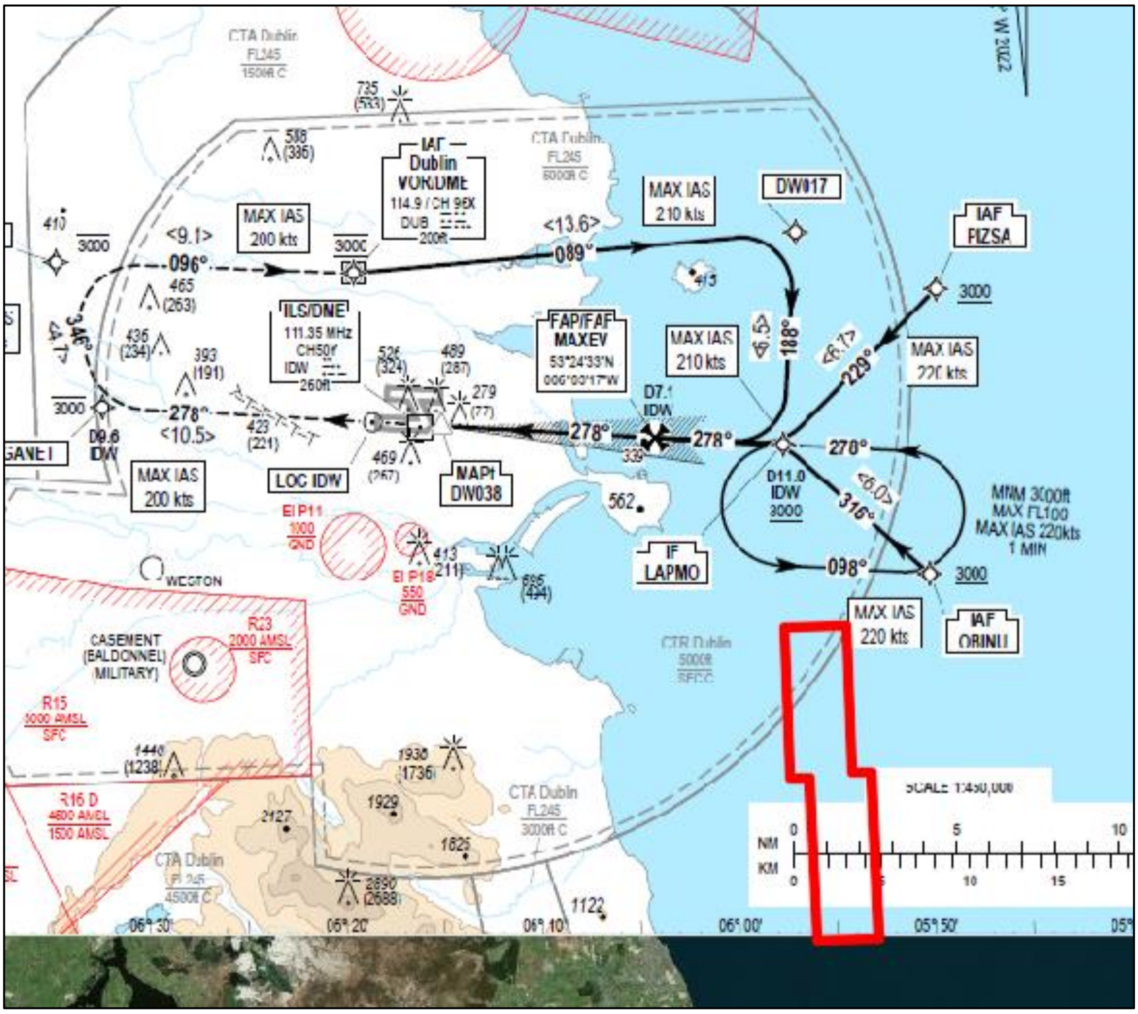

Figure 34 – Dublin RWY 28L ILS CAT I & II or LOC

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure; however, would lie within the protection area (see Figure 35) for the Hold at ‘LAPMO’. The minimum holding altitude is 3000 ft, therefore the development would not affect the published altitude. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

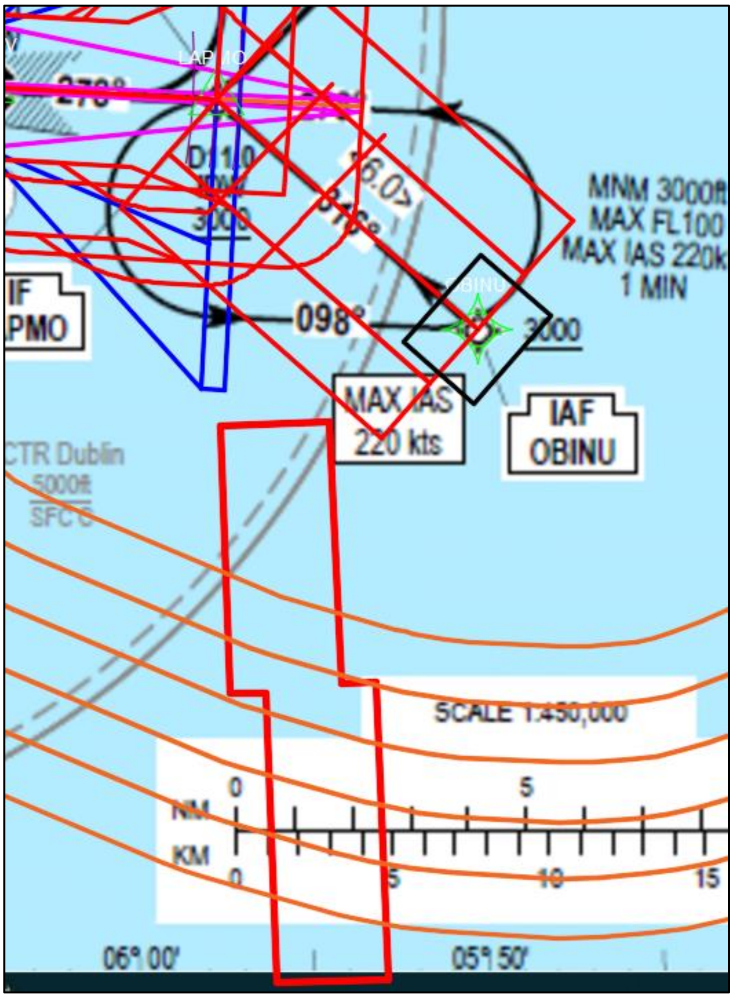

Figure 35 – Dublin RWY 28L ILS CAT I & II or LOC and Dublin Array

6.4.3 Instrument Approach Chart - VOR RWY 28L – ICAO - EIDW AD 2.24-28

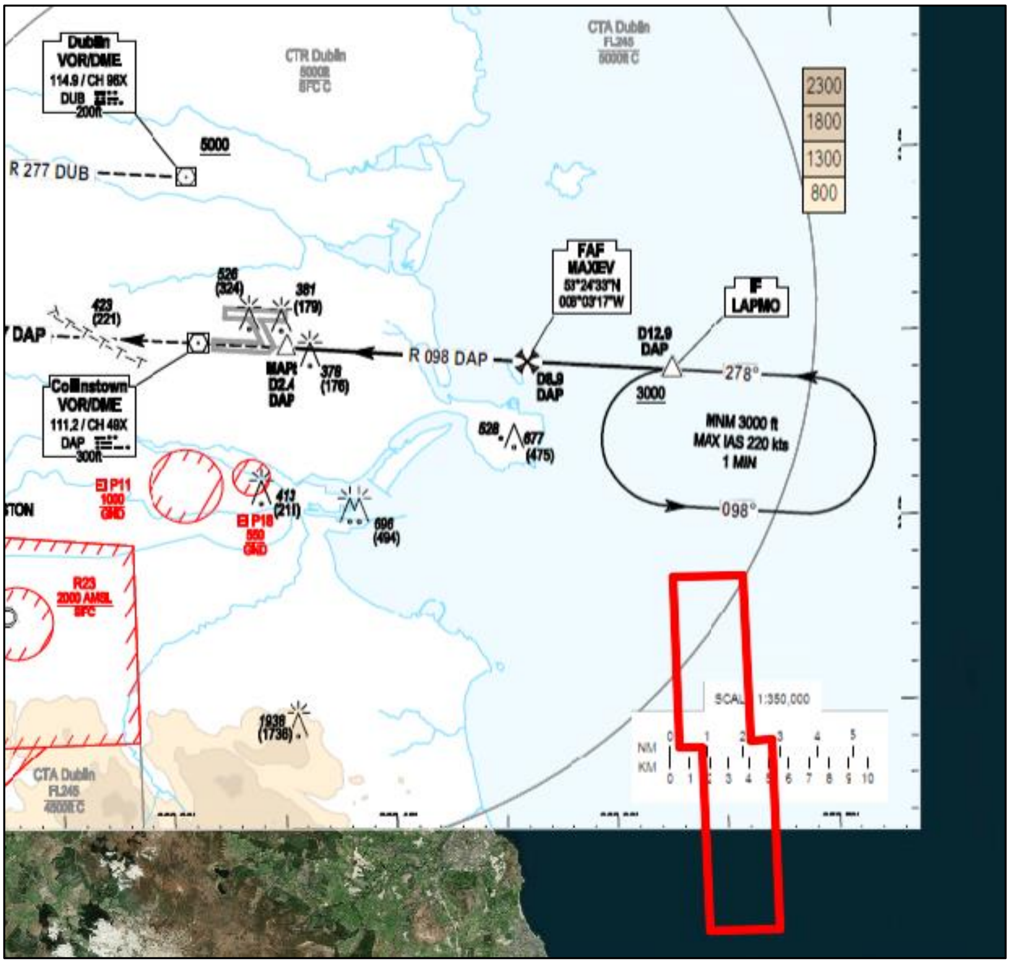

Figure 36 – Dublin RWY 28L VOR

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure; however, would lie within the protection area (see Figure 37) for the Hold at 'LAPMO'. The minimum holding altitude is 3000 ft, therefore the development would not affect the published altitude. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

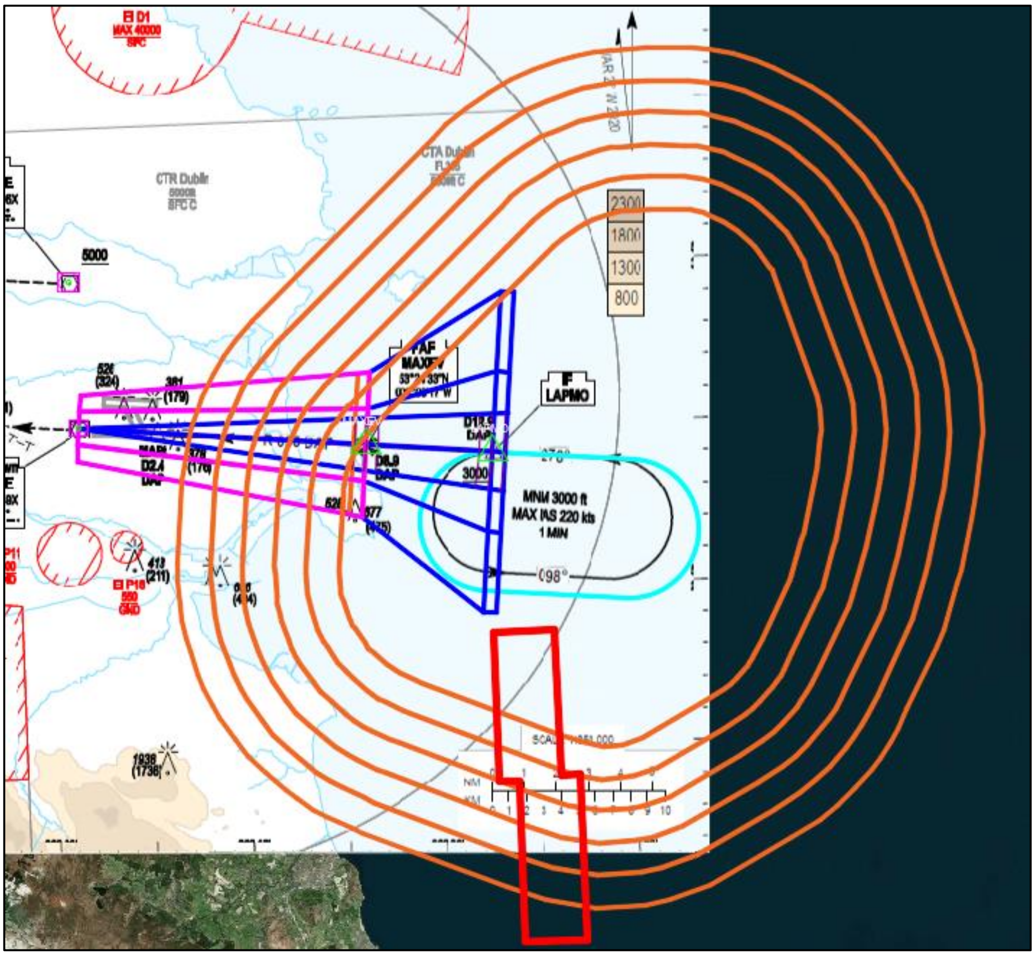

Figure 37 – Dublin RWY 28 VOR and Dublin Array

6.4.4 Instrument Approach Chart - RNP RWY 28R CAT A, B, C, D – ICAO - EIDW AD 2.24-29.1

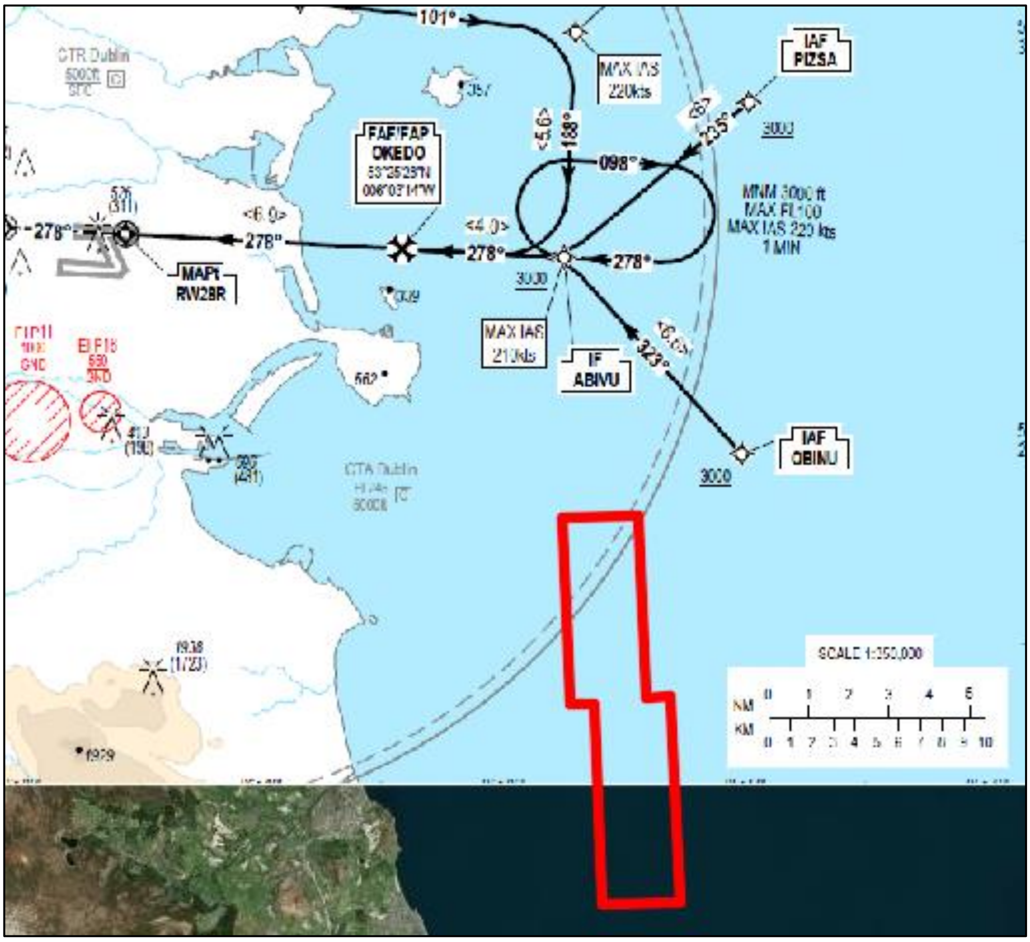

Figure 38 – Dublin RWY 28R RNP

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure; however, would lie within the protection area (see Figure 39) for the Hold at 'ABIVU'. The minimum holding altitude is 3000 ft, therefore the development would not affect the published altitude. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

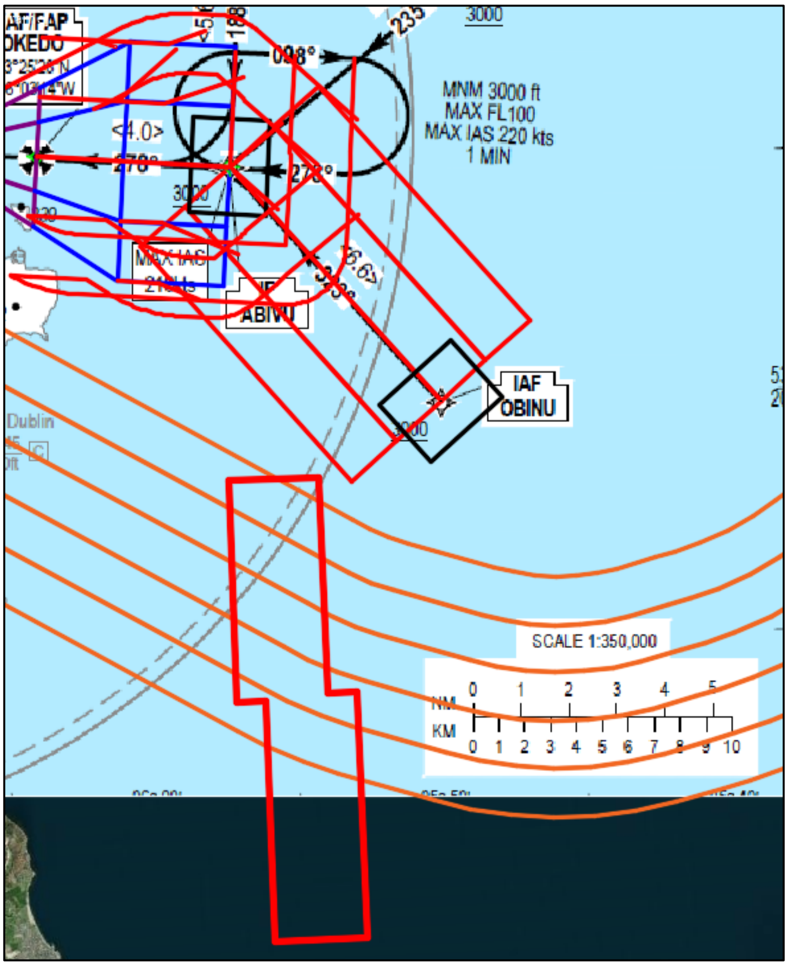

Figure 39 – Dublin RWY 28R RNP and Dublin Array

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6.4.5 Instrument Approach Chart – ILS CAT I & II or LOC RWY 28R CAT A, B, C, D – ICAO - EIDW AD 2.24-30.1

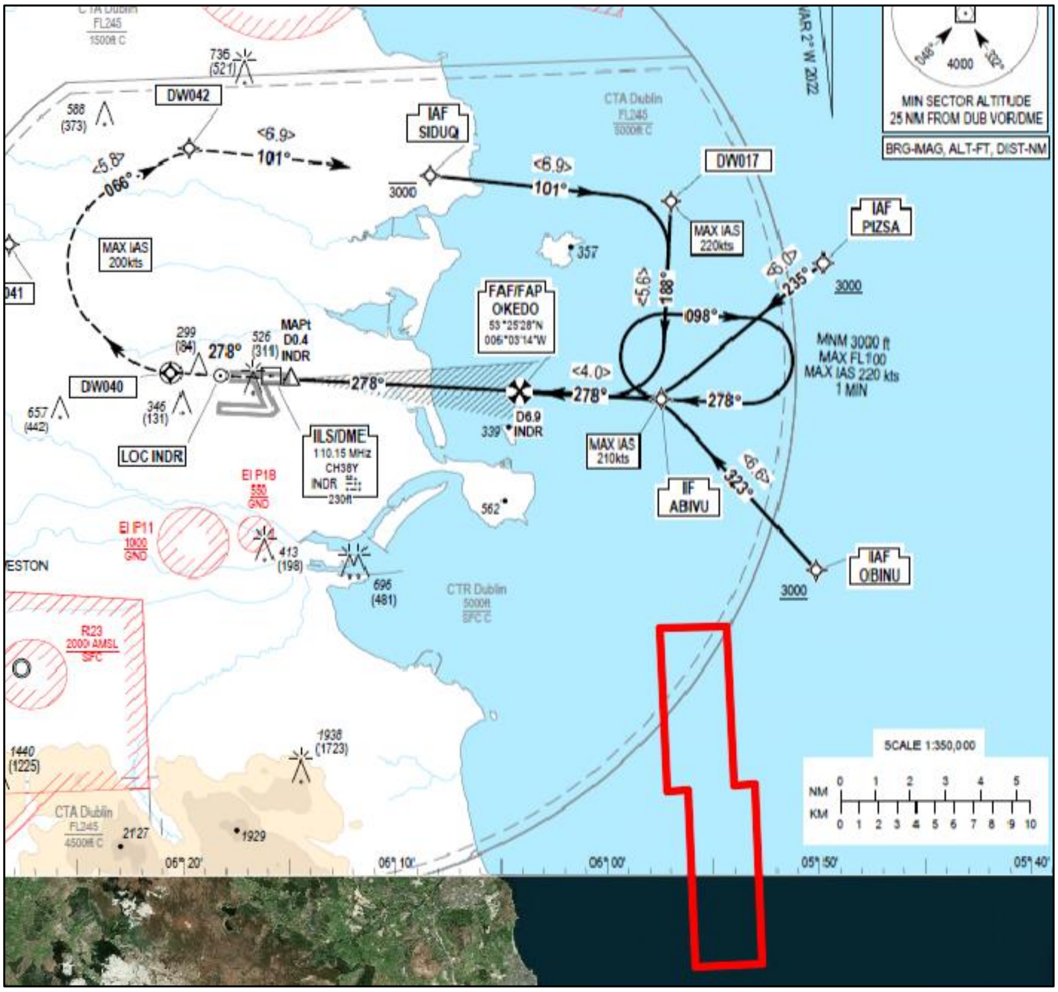

Figure 40 – Dublin RWY 28R ILS CAT I & II or LOC

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure; however, would lie within the protection area (see Figure 41) for the Hold at 'ABIVU'. The minimum holding altitude is 3000 ft, therefore the development would not affect the published altitude. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

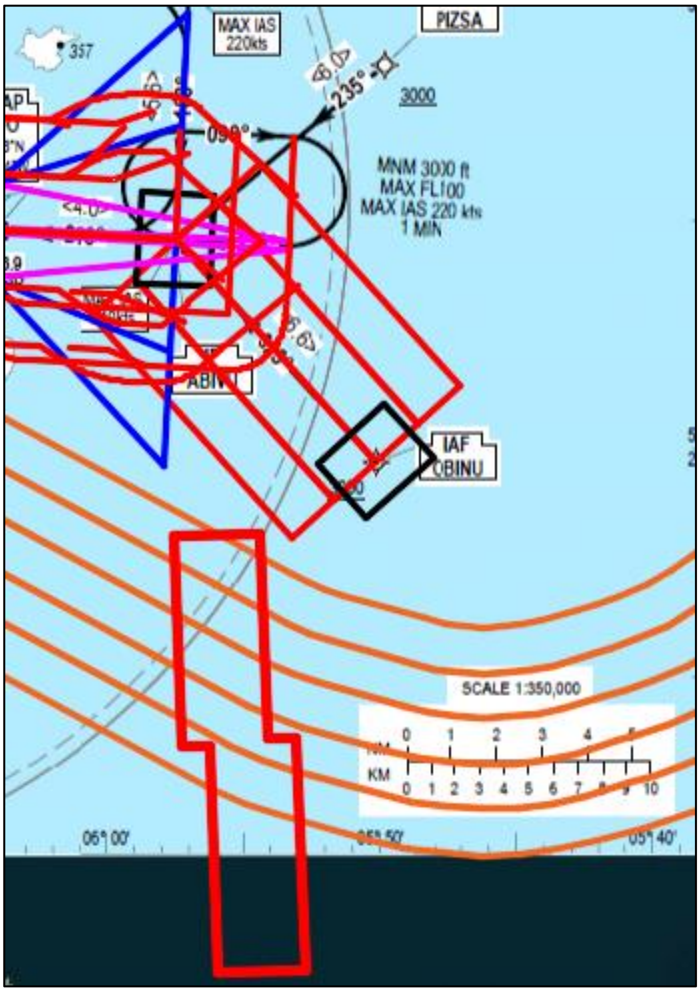

Figure 41 – Dublin RWY 28R ILS CAT I & II or LOC and Dublin Array

6.4.6 Instrument Approach Chart RNP RWY 10L – ICAO - EIDW AD 2.24-32.1

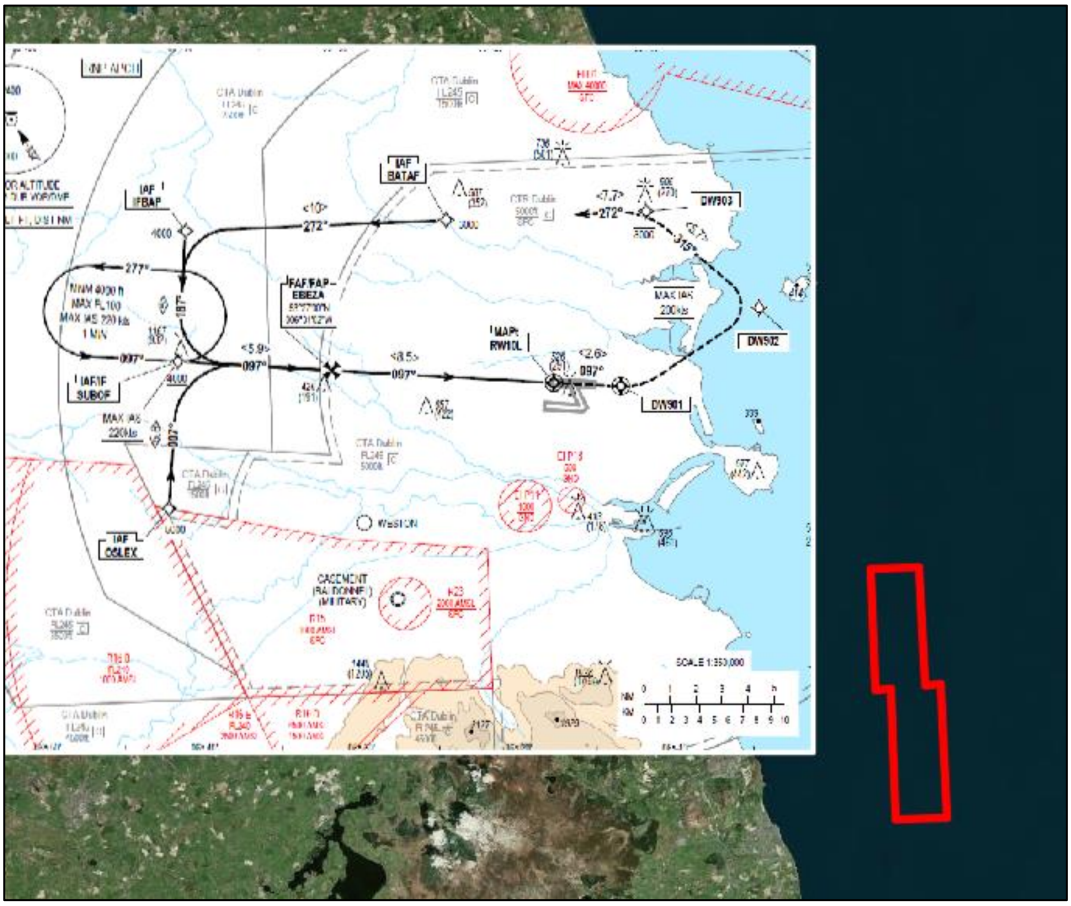

Figure 42 – Dublin RWY 10L RNP

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure, see Figure 43. The procedure would be unaffected.

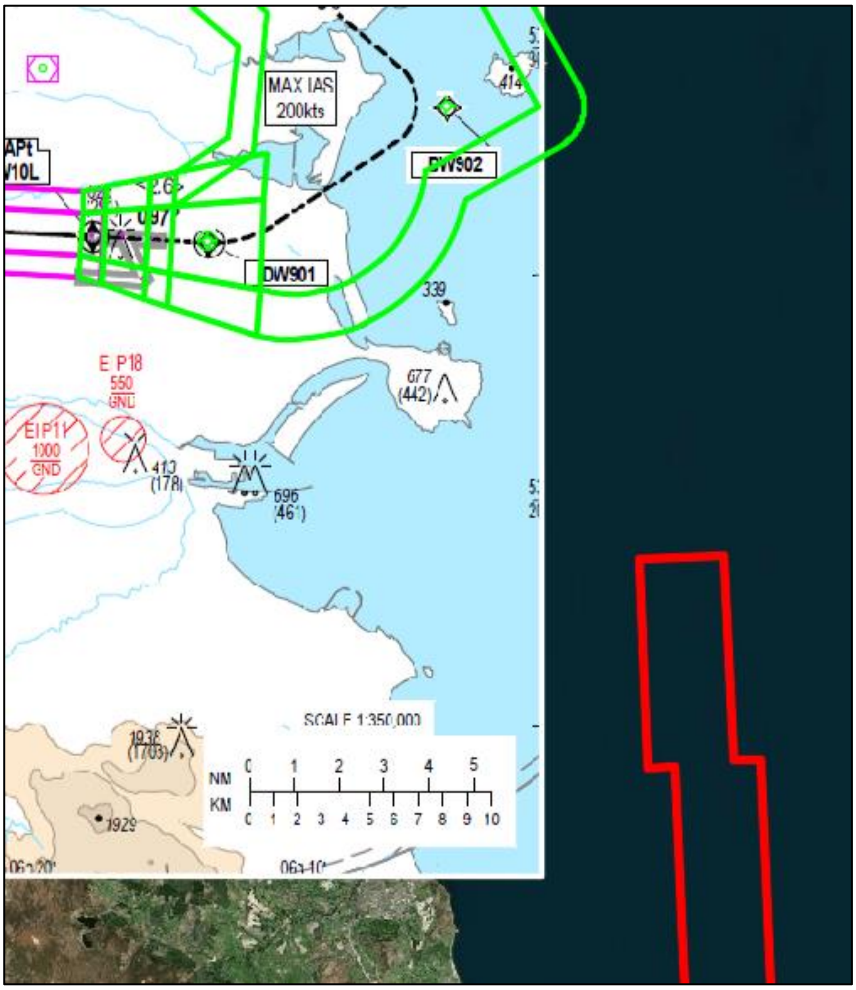

Figure 43 – Dublin RWY 10L RNP and Dublin Array

6.4.7 Instrument Approach Chart ILS CAT I & II or LOC RWY 10L CAT A, B, C, D – ICAO - EIDW AD 2.24-33.1

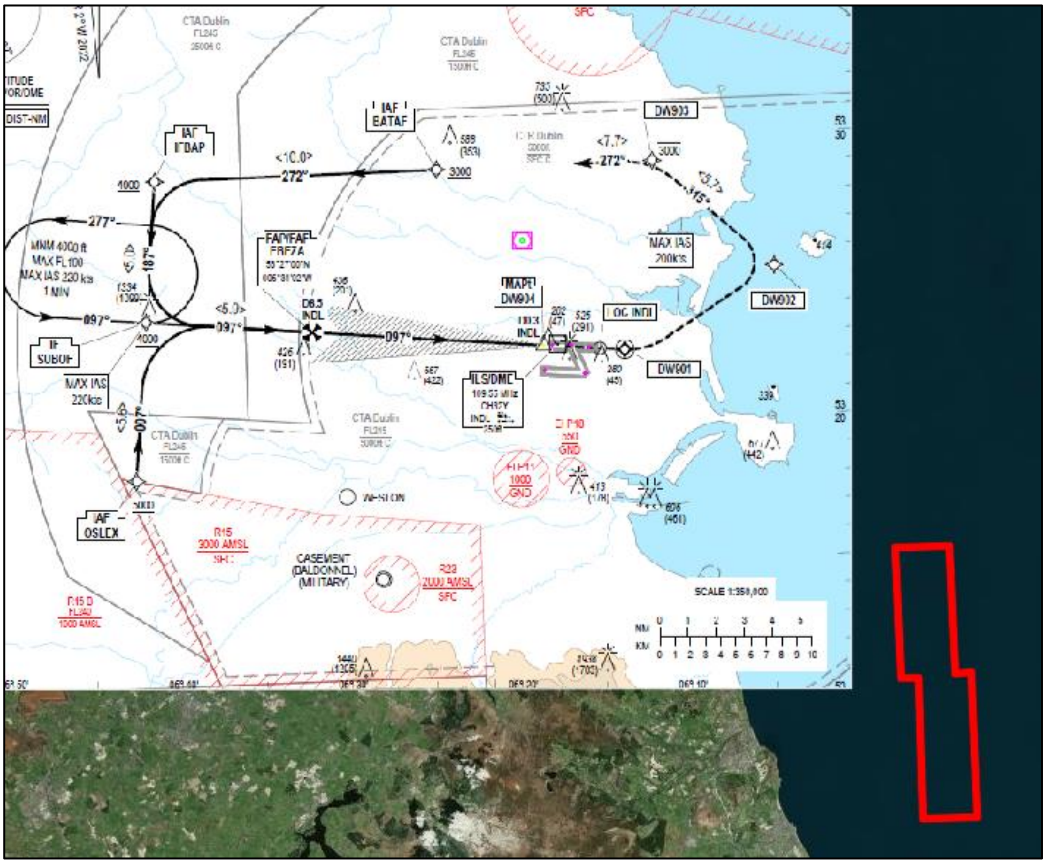

Figure 44 – Dublin RWY 10L ILS CAT I & II or LOC

The development would lie outside of the protection area for the Approach and Missed Approach part of the procedure, see Figure 45. The procedure would be unaffected.

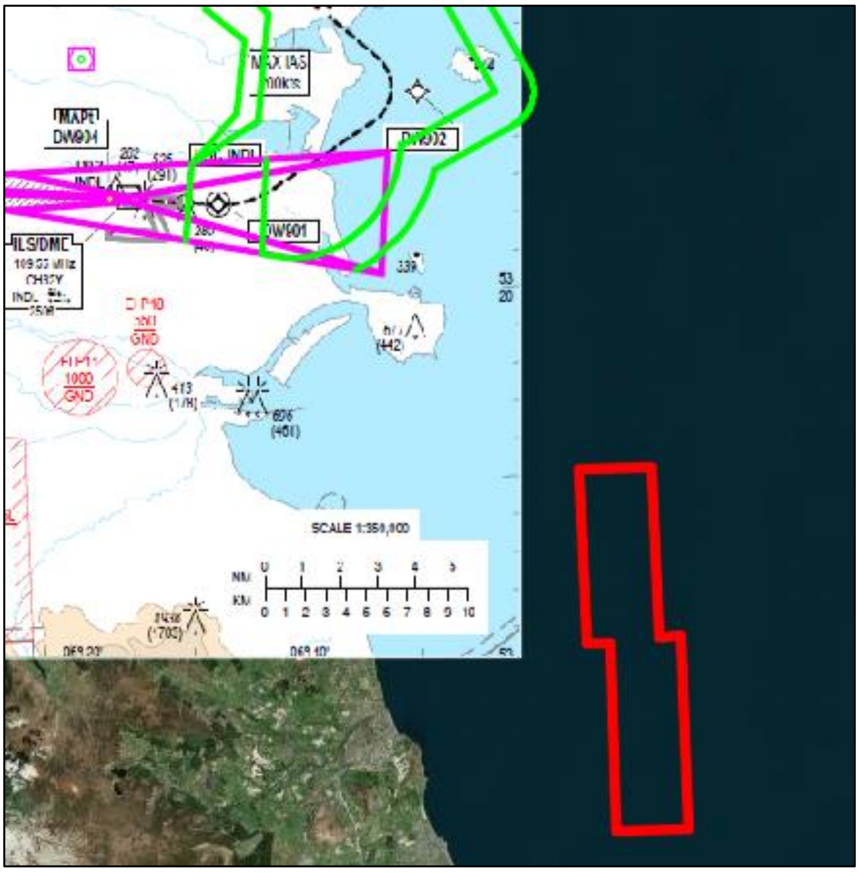

Figure 45 – Dublin RWY 10L ILS CAT I & II or LOC and Dublin Array

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6.4.8 Instrument Approach Chart – RNP RWY 10R CAT A, B, C, D – ICAO - EIDW AD 2.24-35.1

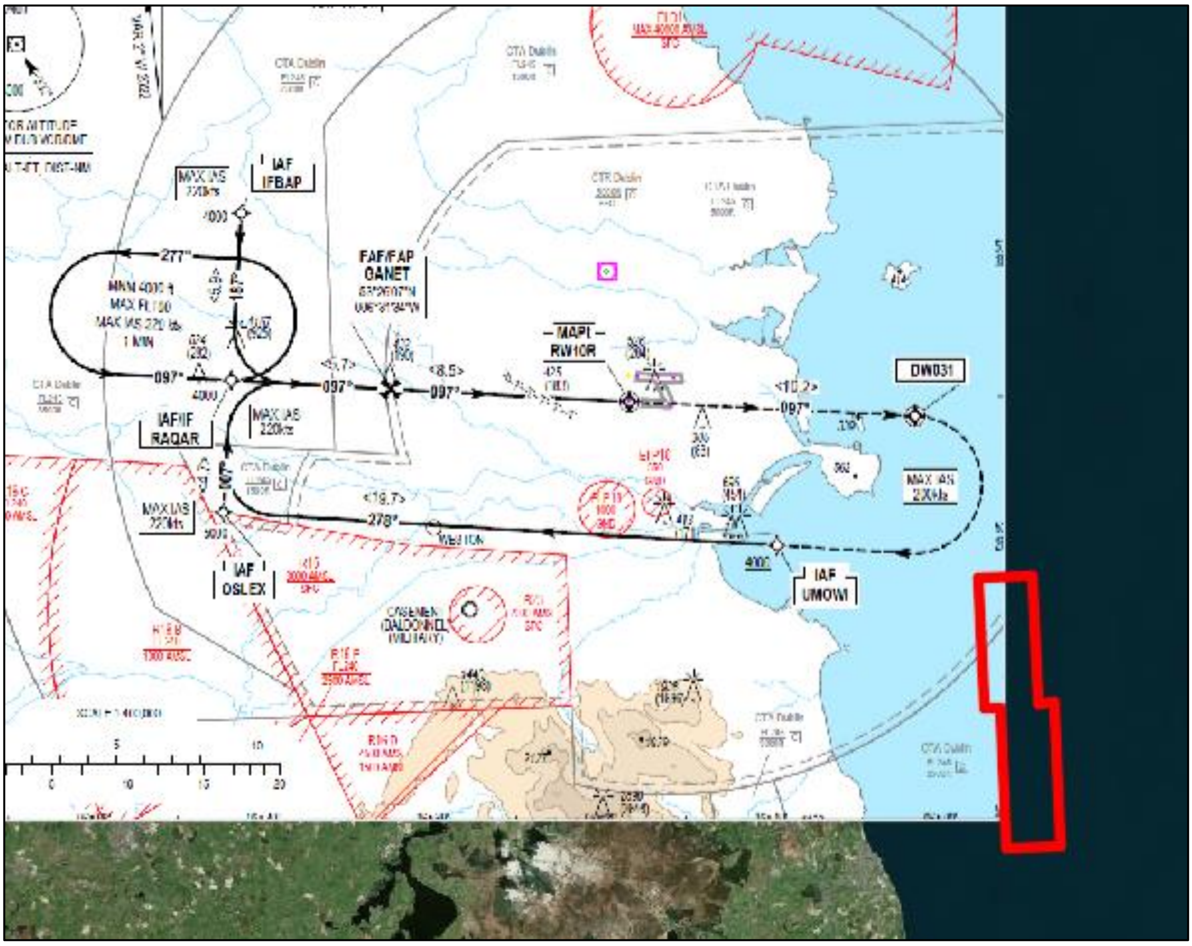

Figure 46 – Dublin RWY 10R RNP

The development would lie within the Missed Approach protection area (see Figure 47) for the procedure; however, aircraft would have sufficient clearance from the development. The procedure would be unaffected.

To assess the Missed Approach procedure, there are multiple parameters that must be calculated and considered to accurately assess obstacles that are located within the protection area, these parameters are shown below.

- Latest Start of Climb (SOC) = 2303 m after Threshold (1856 m after Missed Approach Point Tolerance - calculated from the CAT D LNAV procedure).
    - In procedure design, the SOC is the calculated point on a Missed Approach procedure where it is assumed the pilot will initiate a climb. The calculation of the SOC is determined by a range of factors such as the type of procedure and the aircraft category.

Aerodrome elevation (ft)	Final Approach IAS (kt)	Final Approach TAS (kt)	Metres per second	3 seconds (m)	15 seconds (m)	SOC Location
243	185	190.44	103	309	1547	-1856m

Table 3 – Runway 10R LNAV SOC Calculation

- Lowest SOC elevation = 121.5 m (calculated from the CAT A LNAV / VNAV procedure) ((530ft OCA x 0.3048) – 40 m Height Loss).
  - The SOC elevation is calculated to ascertain the altitude at the point a climb is initiated and the altitude an aircraft would be at a specific point on the Missed Approach.
- Shortest distance to development = 22793 m.
  - The distance to an obstacle is required to establish the height gain from the SOC to the position of the obstacle.
- Height gain = 22793 * 0.025 = 569.8 m.
  - A standard 2.5% (0.025) climb is always used in the assessment of the Missed Approach. This gradient is defined in ICAO PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures as the standard to be used for assessing obstacles.
- Elevation at development = 691.3 m.
  - SOC elevation + height gain from SOC to obstacle.
- Elevation required = 309.6 m (WTG elevation) + 50 m = 359.6 m.
  - In the turn area of a Missed Approach a 50 m MOC is required.

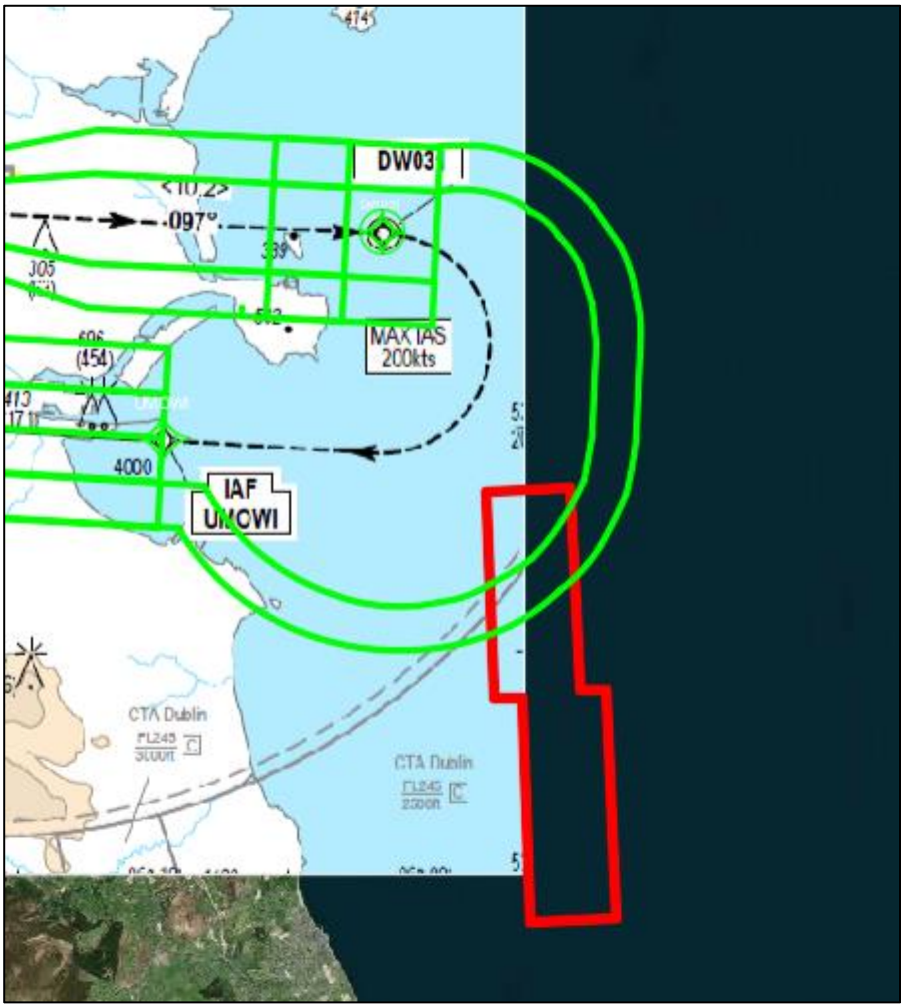

Figure 47 – Dublin RWY 10R RNP and Dublin Array

6.4.9 Instrument Approach Chart - ILS CAT I & II or LOC RWY 10R CAT A, B, C, D- ICAO - EIDW AD 2.24-36

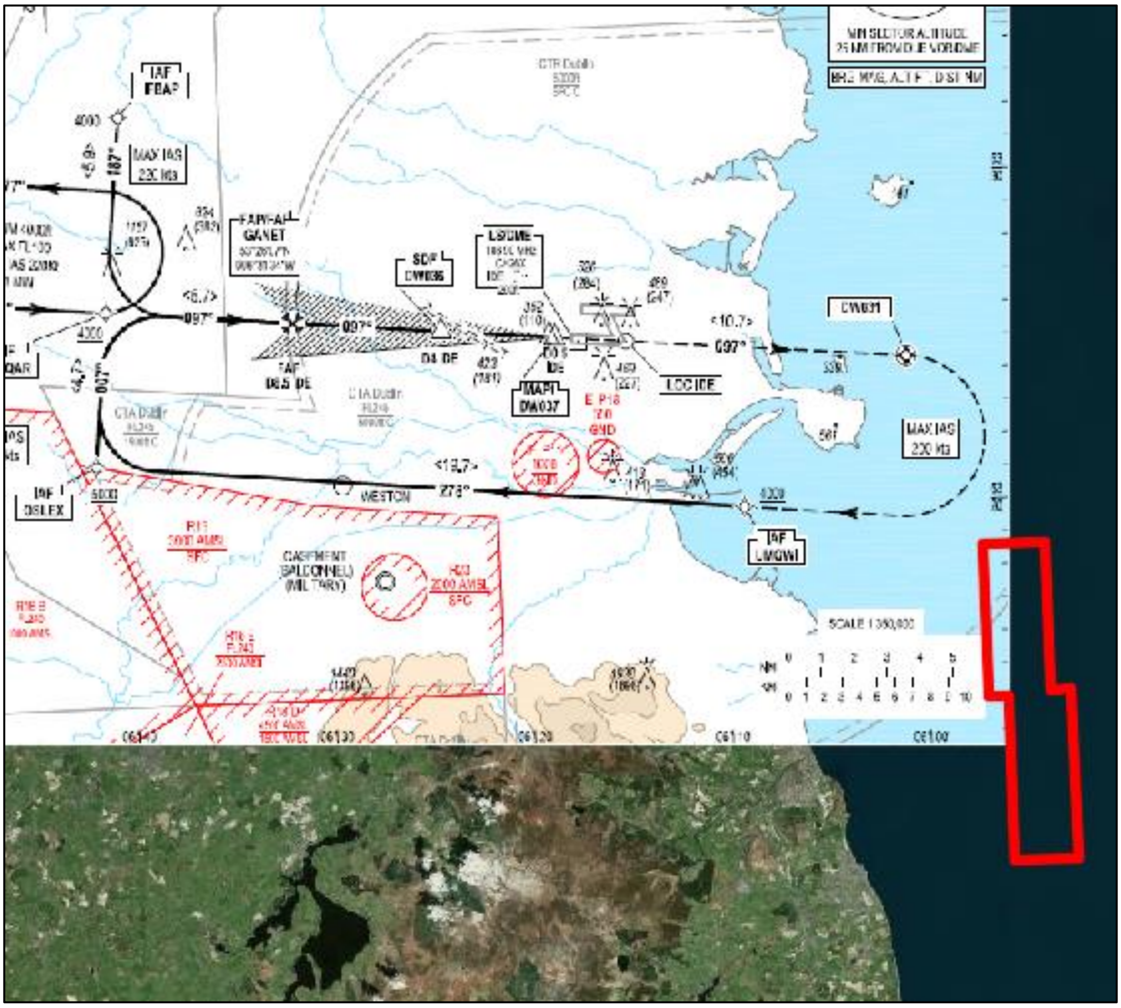

Figure 48 – Dublin RWY 10R ILS CAT I & II or LOC

The development would lie within the Missed Approach protection area (see Figure 49) for the procedure; however, aircraft would have sufficient clearance from the development. The procedure would be unaffected.

To assess the Missed Approach procedure, there are multiple parameters that must be calculated and considered to accurately assess obstacles that are located within the protection area, these parameters are shown below.

- Latest Start of Climb (SOC) = 1417 m after Threshold (1856 m after Missed Approach Point Tolerance - calculated from the CAT D LOC procedure).
    - In procedure design, the SOC is the calculated point on a Missed Approach procedure where it is assumed the pilot will initiate a climb. The calculation of the SOC is determined by a range of factors such as the type of procedure and the aircraft category.

Aerodrome elevation (ft)	Final Approach IAS (kt)	Final Approach TAS (kt)	Metres per second	3 seconds (m)	15 seconds (m)	SOC Location
243	185	190.44	103	309	1547	-1856m

Table 4 – Runway 10R LOC SOC Calculation

- Lowest SOC elevation = 78.6 m (calculated from the CAT B CAT II procedure) ((317ft OCA x 0.3048) – 18 m Height Loss).
    - The SOC elevation is calculated to ascertain the altitude at the point a climb is initiated and the altitude an aircraft would be at a specific point on the Missed Approach.
- Shortest distance to development = 23904 m.
    - The distance to an obstacle is required to establish the height gain from the SOC to the position of the obstacle.
- Height gain = 23904 * 0.025 = 597.6 m.
    - A standard 2.5% (0.025) climb is always used in the assessment of the Missed Approach. This gradient is defined in ICAO PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures as the standard to be used for assessing obstacles.
- Elevation at development = 676.2 m.
    - SOC elevation + height gain from SOC to obstacle.
- Elevation required = 309.6 m (WTG elevation) + 50 m = 359.6 m.
    - In the turn area of a Missed Approach a 50 m MOC is required.

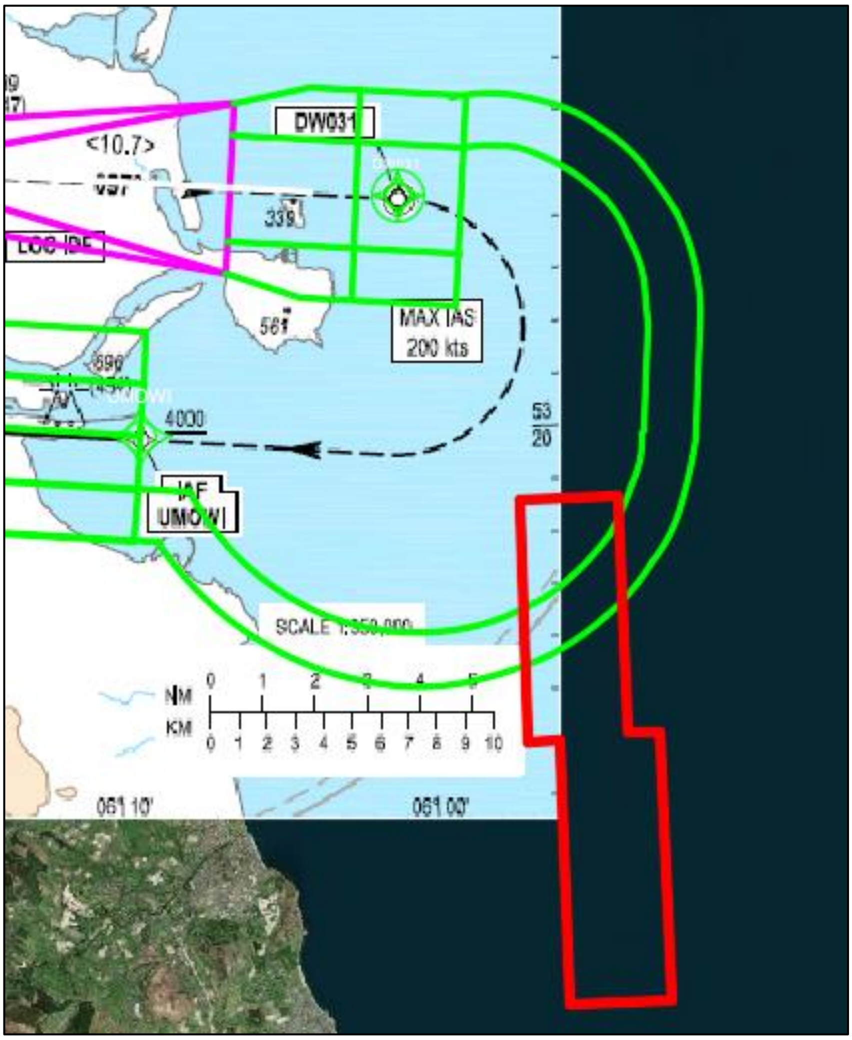

Figure 49 – Dublin RWY 10R ILS CAT I & II or LOC and Dublin Array

6.4.10 Instrument Approach Chart VOR RWY 10R CAT A, B, C, D – ICAO - EIDW AD 2.24-37

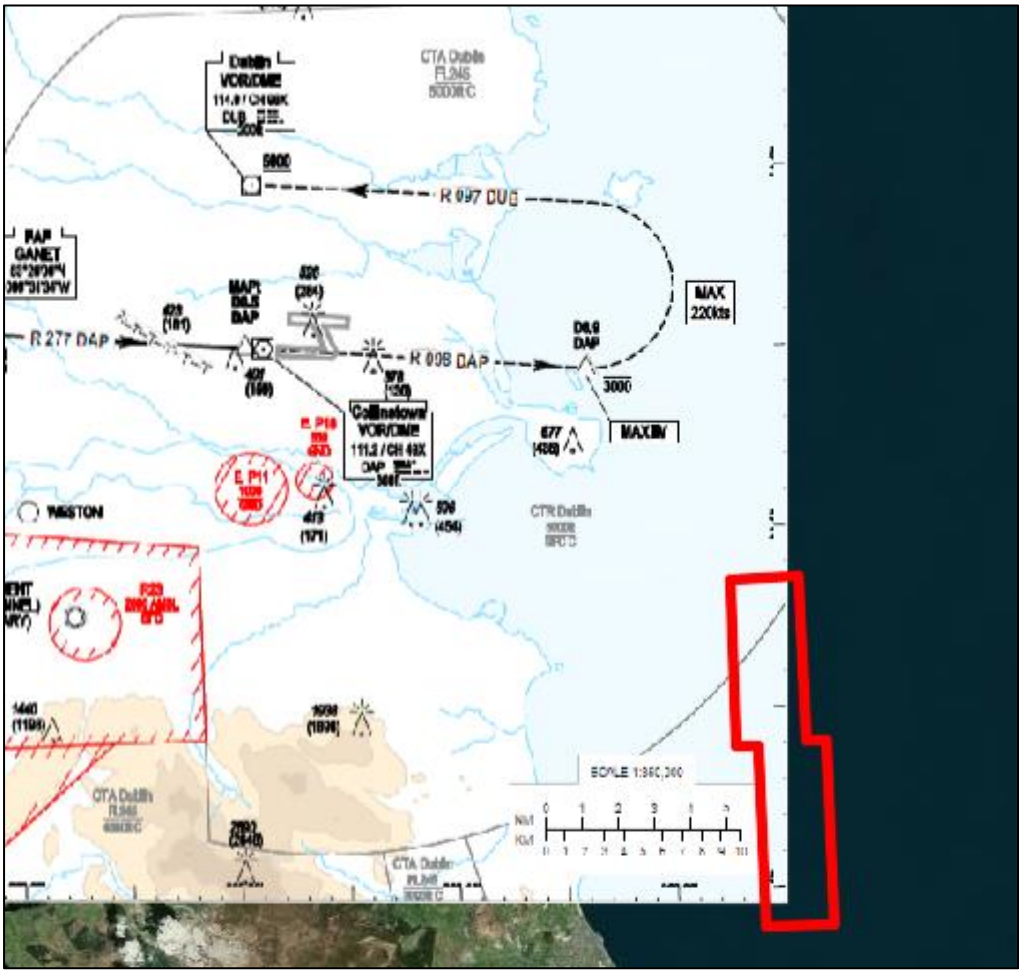

Figure 50 – Dublin RWY 10R VOR

The development would lie outside of the protection area (see Figure 51) for the procedure. The procedure would be unaffected.

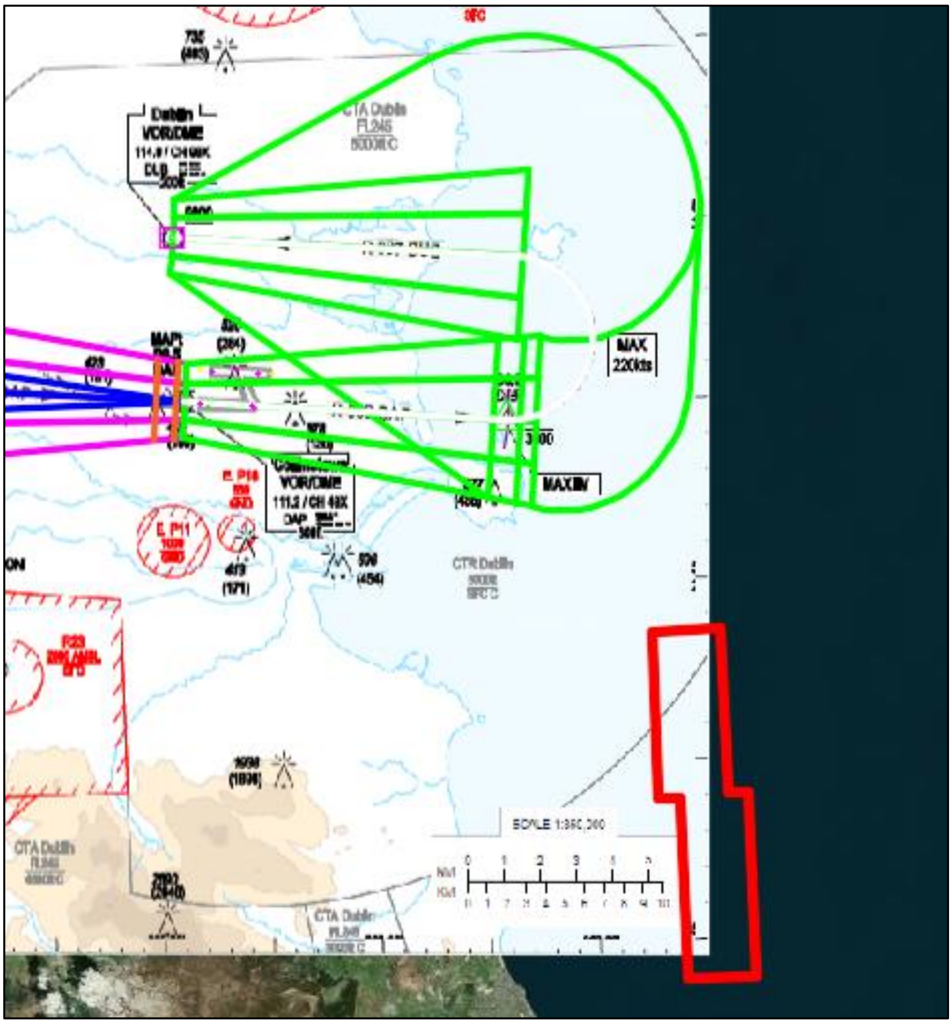

Figure 51 – Dublin RWY 10R VOR and Dublin Array

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6.4.11 Instrument Approach Chart RNP RWY 16 CAT A, B, C, D – ICAO - EIDW AD 2.24-38

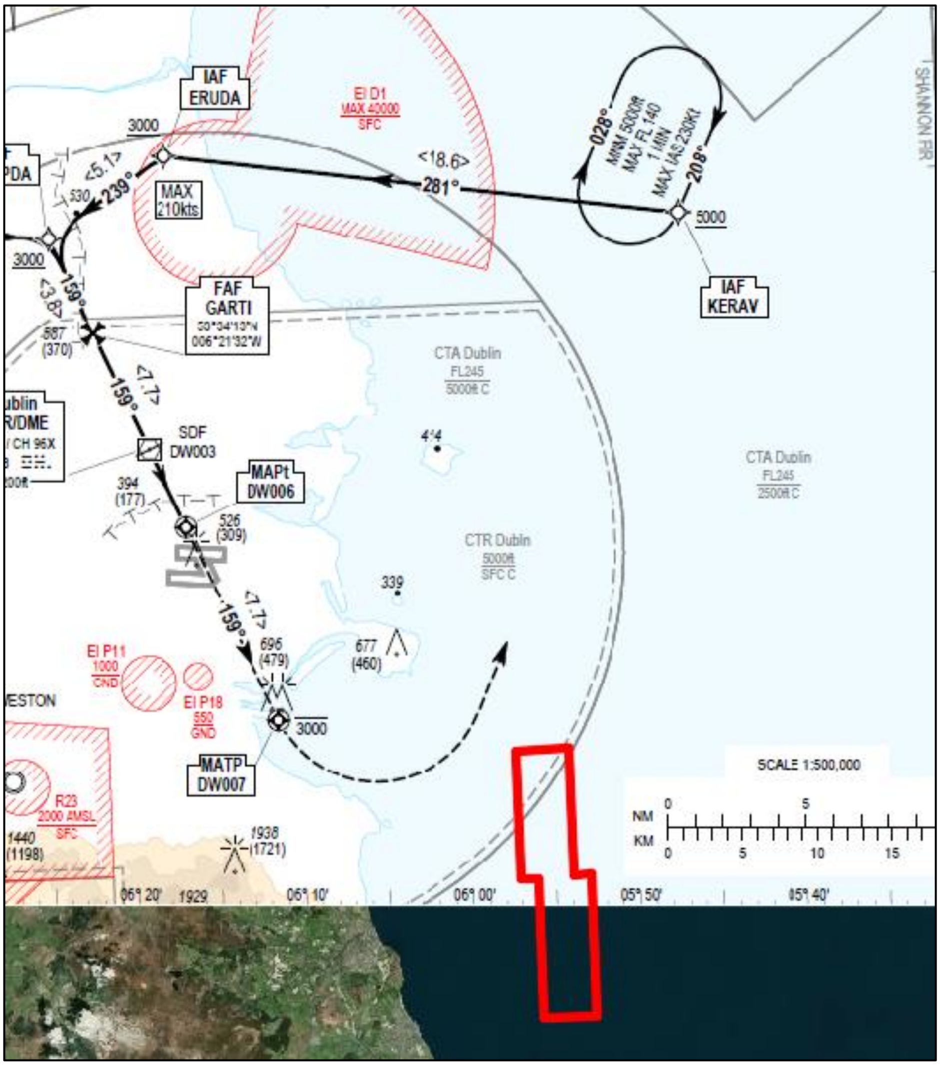

Figure 52 – Dublin RWY 16 RNP

The development would lie within the Missed Approach protection area (see Figure 53) for the procedure; however, aircraft would have sufficient clearance from the development. The procedure would be unaffected.

To assess the Missed Approach procedure, there are multiple parameters that must be calculated and considered to accurately assess obstacles that are located within the protection area, these parameters are shown below.

- Latest Start of Climb (SOC) = 2300 m after Threshold (1856 m after Missed Approach Point Tolerance - calculated from the CAT D LNAV procedure).
  - In procedure design, the SOC is the calculated point on a Missed Approach procedure where it is assumed the pilot will initiate a climb. The calculation of the SOC is determined by a range of factors such as the type of procedure and the aircraft category.

Aerodrome elevation (ft)	Final Approach IAS (kt)	Final Approach TAS (kt)	Metres per second	3 seconds (m)	15 seconds (m)	SOC Location
242	185	190.44	103	309	1547	-1856m

Table 5 – Runway 16 LNAV SOC Calculation

- Lowest SOC elevation = 85.7 m (calculated from the CAT D LPV procedure) ((442ft OCA x 0.3048) – 49 m Height Loss).
    - The SOC elevation is calculated to ascertain the altitude at the point a climb is initiated and the altitude an aircraft would be at a specific point on the Missed Approach.
- Shortest distance to development = 21862 m.
    - The distance to an obstacle is required to establish the height gain from the SOC to the position of the obstacle.
- Height gain = 21862 * 0.025 = 546.5 m.
    - A standard 2.5% (0.025) climb is always used in the assessment of the Missed Approach. This gradient is defined in ICAO PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures as the standard to be used for assessing obstacles.
- Elevation at development = 632.2 m.
    - SOC elevation + height gain from SOC to obstacle.
- Elevation required = 309.6 m (WTG elevation) + 50 m = 359.6 m.
    - In the turn area of a Missed Approach a 50 m MOC is required.

Figure 53 – Dublin RWY 16 RNP and Dublin Array

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6.4.12 Instrument Approach Chart - ILS CAT I or LOC RWY 16 CAT A, B, C, D – ICAO - EIDW AD 2.24-39

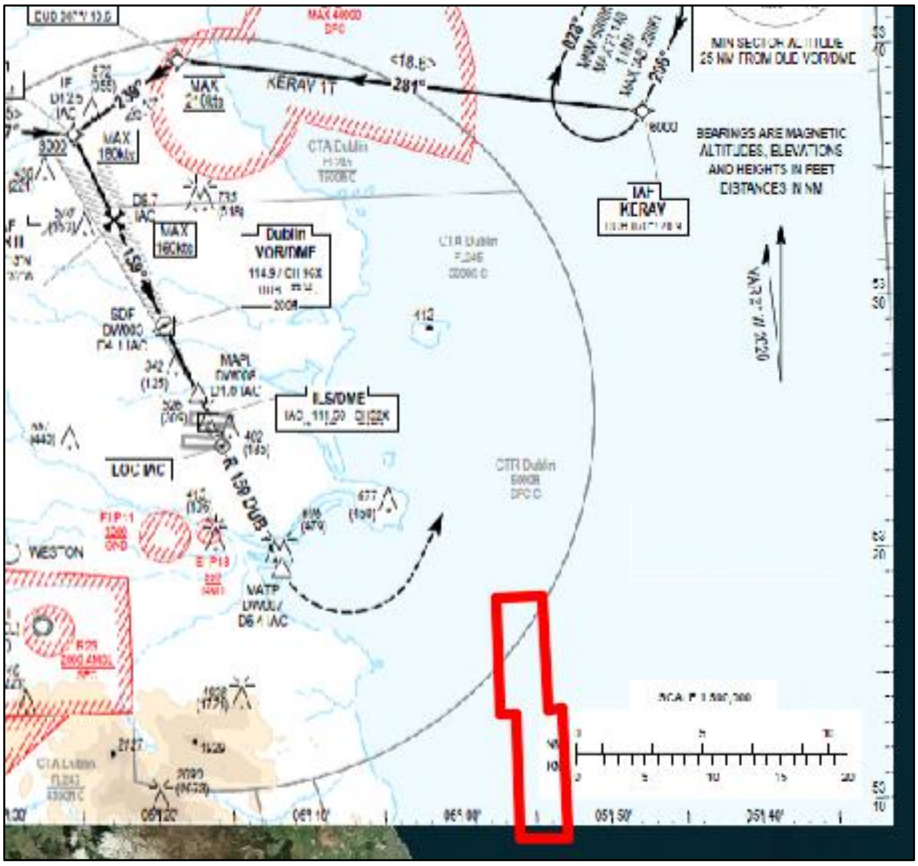

Figure 54 – Dublin RWY 16 ILS CAT I & LOC

The development would lie within the Missed Approach protection area (see Figure 55) for the procedure; however, aircraft would have sufficient clearance from the development. The procedure would be unaffected.

- Latest SOC = 674 m after Threshold. (calculated from the CAT B ILS procedure).
  - - 900 m + ((180 ft OCH x 0.3048) – 43 m) / tan3°.
- Lowest SOC elevation = 78.0 m (calculated from the CAT B procedure).
  - 397 ft OCA * 0.3048 – 43 m.
- Shortest distance to development = 23668 m.
- Height gain = 23668 m * 0.025 = 591.7 m.
- Elevation at development = 669.7 m.
  - 591.7 m + 78.0 m
- Elevation required = 309.6 m (WTG elevation) + 50 m = 359.6 m.

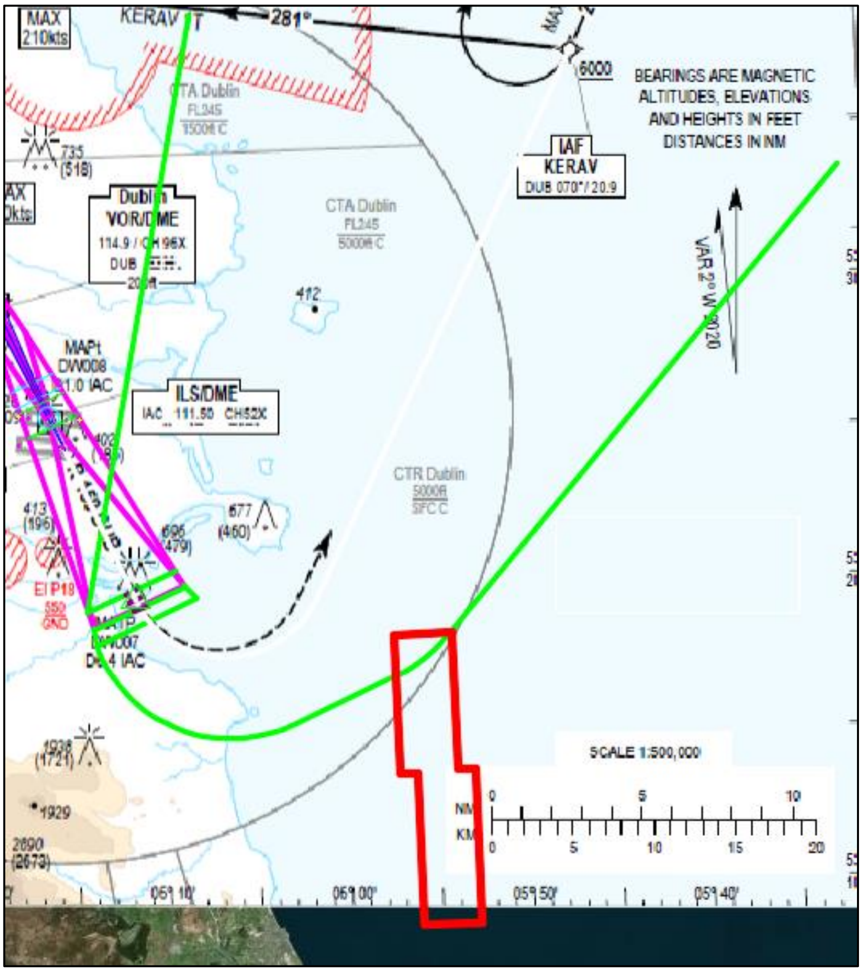

Figure 55 – Dublin RWY 16 ILS & LOC and Dublin Array

6.4.13 Instrument Approach Chart VOR RWY 16 CAT A, B, C, D – ICAO - EIDW AD 2.24-40

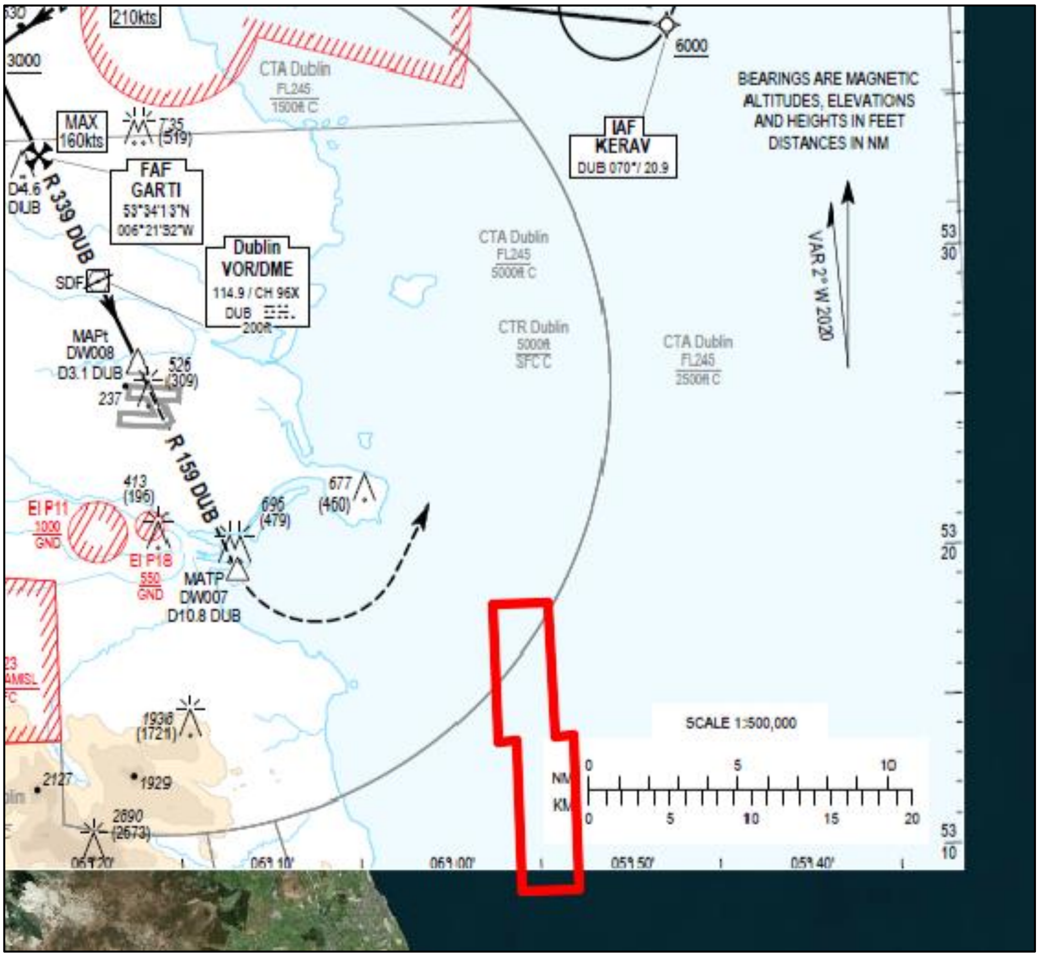

Figure 56 – Dublin RWY 16 VOR

The development would lie within the Missed Approach protection area (see Figure 57) for the procedure; however, aircraft would have sufficient clearance from the development. The procedure would be unaffected.

- Latest SOC = 566 m after Threshold (1856 m after Missed Approach Point Tolerance - calculated from the CAT D procedure).

Aerodrome elevation (ft)	Final Approach IAS (kt)	Final Approach TAS (kt)	Metres per second	3 seconds (m)	15 seconds (m)	SOC Location
242	185	190.44	103	309	1547	-1856m

Table 6 – Runway 16 VOR SOC Calculation

- Lowest SOC elevation = 185.9 m.
    - 610 ft OCA x 0.3048
- Shortest distance to development = 23139 m.
- Height gain = 23139 * 0.025 = 578.4 m.

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- Elevation at development = 764.3 m.
  - 185.9 m + 578.4 m
- Elevation required = 309.6 m (WTG elevation) + 50 m = 359.6 m.

Figure 57 – Dublin RWY 16 VOR and Dublin Array

6.4.14 Instrument Approach Chart RNP RWY 34 – ICAO - EIDW AD 2.24-41

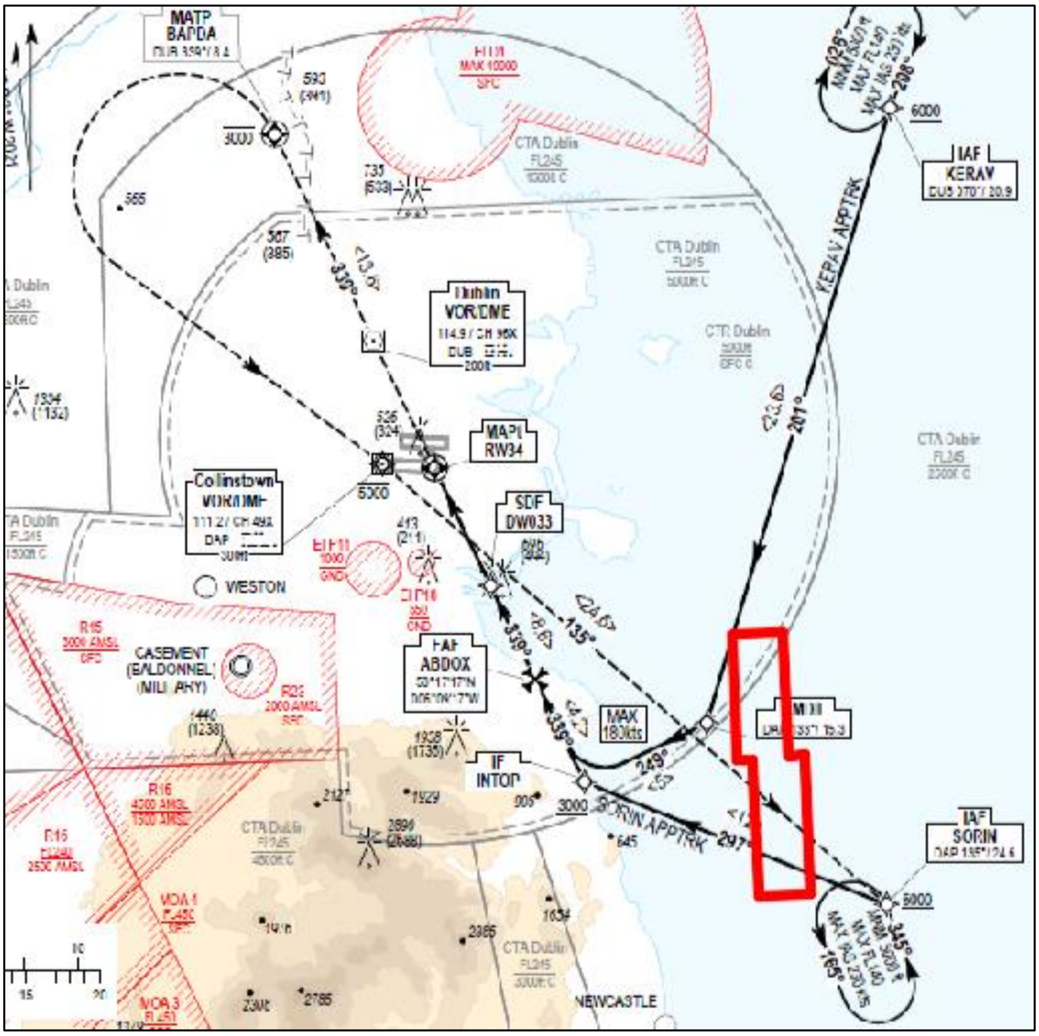

Figure 58 – Dublin RWY 34 RNP

The development would lie within the protection area for the RWY 34 RNP Approach procedure (see Figure 59); however, aircraft would be at a minimum altitude of 3000 ft at the point of transiting the development.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

The MOCA before the Final Approach Fix (FAF) is 1600 ft, this would be unaffected when considering a MOC of 150 m.

- 309.6 m (WTG elevation) + 150 m MOC = 459.6 m / 1508 ft.

There would be no effect on the published altitudes. The procedure would be unaffected.

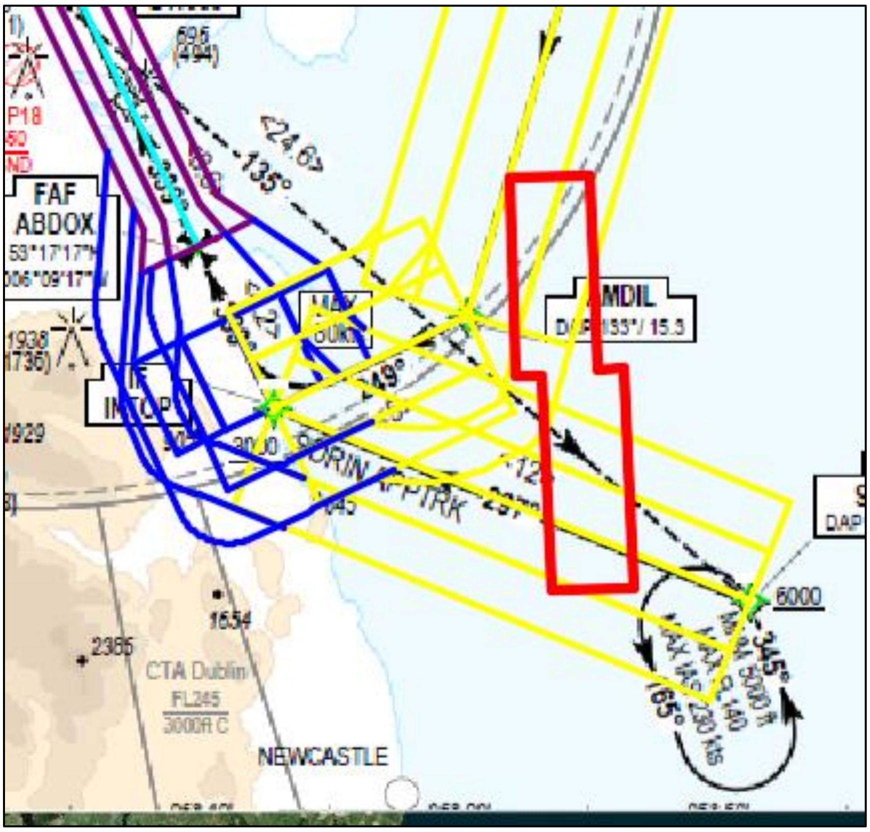

Figure 59 – Dublin RWY 34 RNP and Dublin Array

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6.4.15 Instrument Approach Chart VOR RWY 34 CAT A, B, C, D – ICAO - EIDW AD 2.24-42

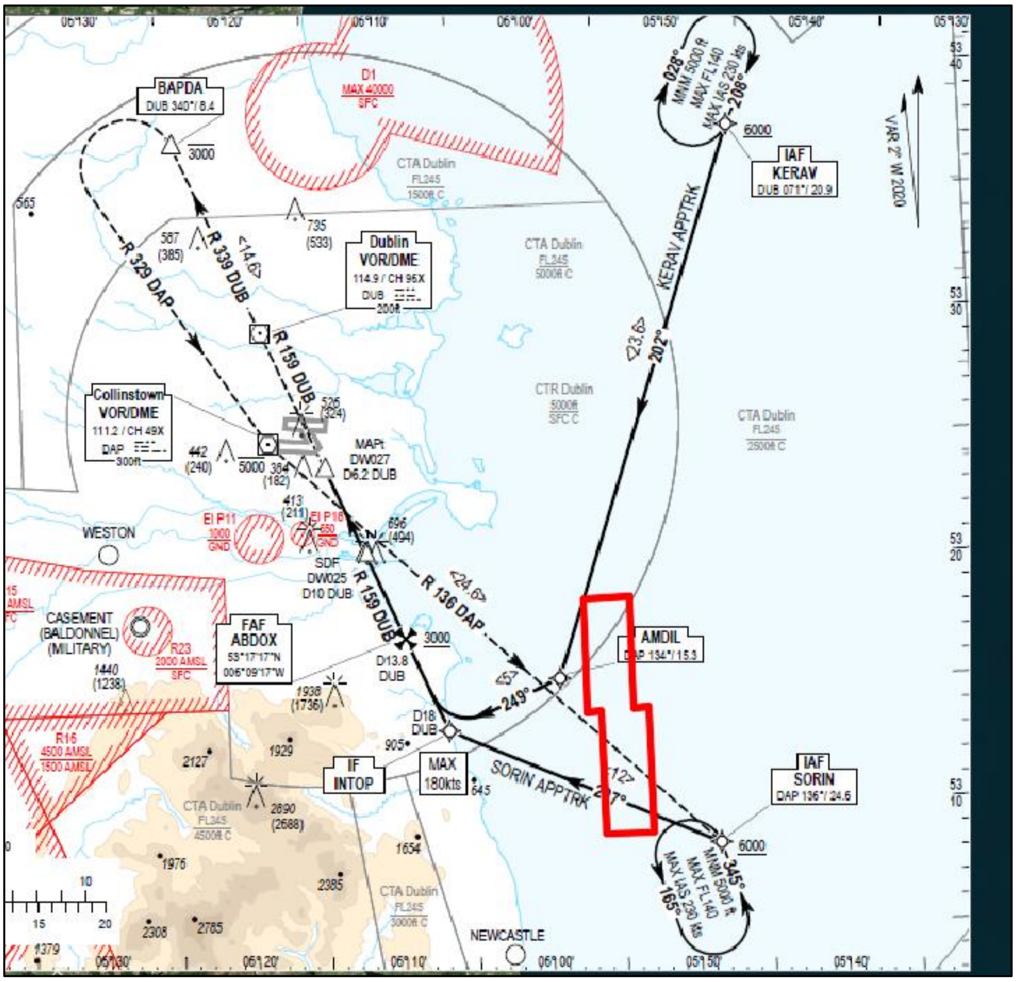


Figure 60 – Dublin RWY 34 VOR

The development would lie within the protection area for the RWY 34 VOR Approach procedure (see Figure 61); however, aircraft would be at a minimum altitude of 3000 ft at the point of transiting the development.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

The MOCA before the FAF is 1900 ft, this would be unaffected when considering a MOC of 150 m.

- 309.6 m (WTG elevation) + 150 m MOC = 459.6 m / 1508 ft.

There would be no effect on the published altitudes. The procedure would be unaffected.

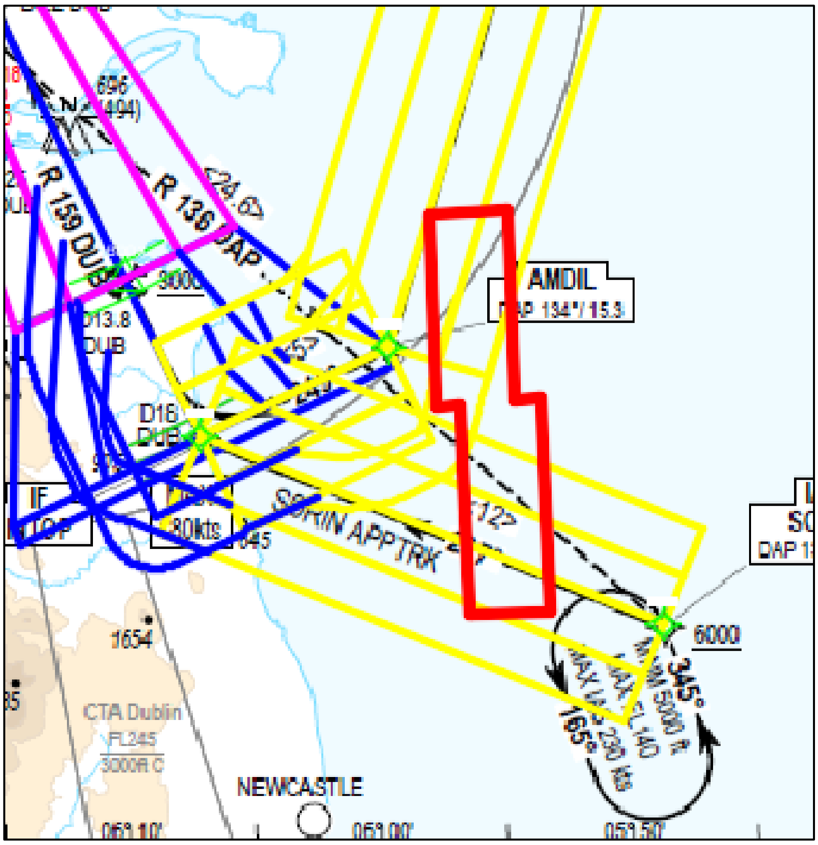


Figure 61 – Dublin RWY 34 VOR and Dublin Array

6.4.16 ATC Surveillance Minimum Altitude Chart – ICAO - EIDW AD 2.24-43.1

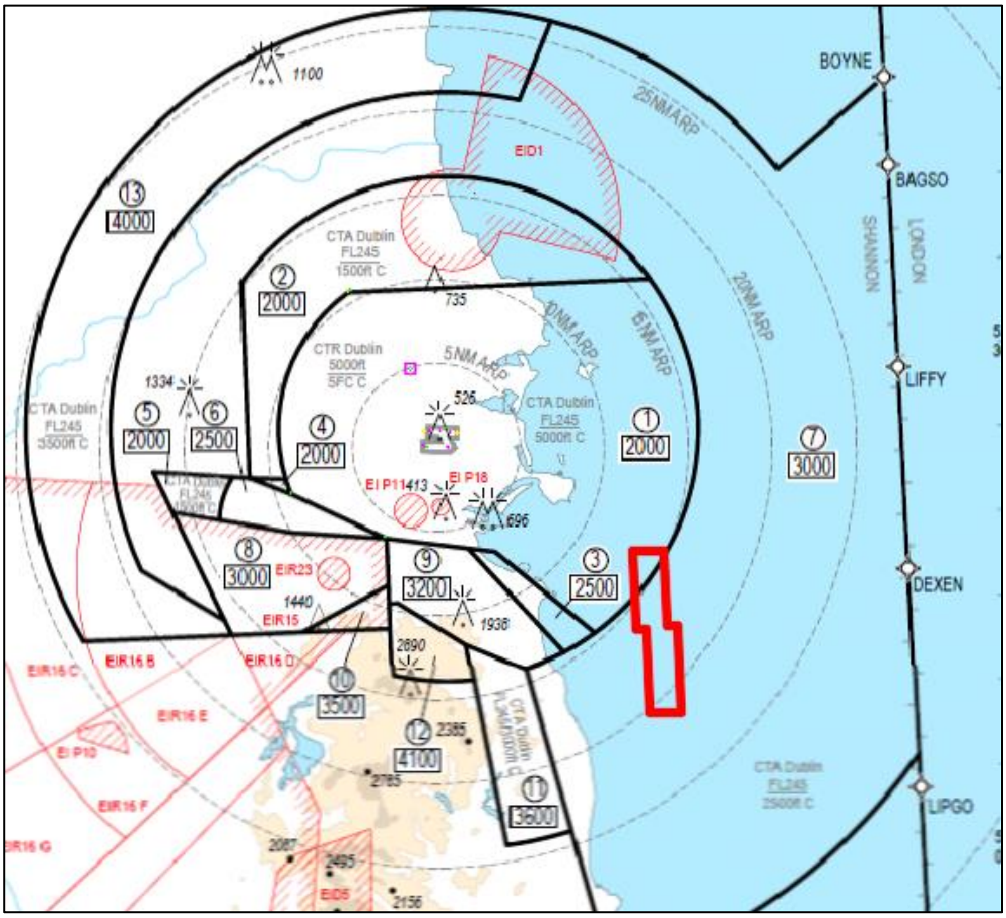


Figure 62 – Dublin ATCSMAC and Dublin Array

The Dublin ATCSMAC is the chart used by ATC to determine the minimum safe altitude for radar vectoring aircraft within the aerodrome environs. It has a complex shape which has likely been defined by several factors including the obstacle environment and airspace.

The IAA confirmed in March 2021 that the radar separation minima applied for the ATCSMAC is 3 NM (5556 m). This is the buffer value that shall be applied to controlling obstacles for assessment.

The proposed wind farm lies within Surveillance Minimum Altitude Area (SMAA) Sectors 1 and 7 and within the surveillance buffer of Sector 3. These Sectors have published altitudes of 2000 ft, 3000 ft and 2500 ft, respectively. Obstacles located in these sectors require a MOC of 300 m, therefore, the development would produce a MOCA of 2000 ft.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

The ATCSMAC would be unaffected by the development.

6.4.17 Visual Approach Chart– ICAO - EIDW AD 2.24-44

Flights in accordance with Visual Flight Rules (VFR) requires an aircraft to be flown in accordance with the Visual Meteorological Conditions (VMC) minima appropriate to the classification of airspace.

VFR pilots operating within the Class G uncontrolled airspace are legally obligated to be familiar with, and conform to, the airspace structure and associated restrictions, this is detailed in the IAA (Rules of the Air) Order 2004. In addition, VFR pilots may be in receipt of an ATS, but pilots are ultimately responsible for their own terrain and obstacle clearance, as stipulated within the Irish IAIP. In line with ICAO standards, the IAA Rules of The Air Order 2004 stipulates the Low Flying Rule such that aircraft shall not be flown closer than 500 ft to any person, vehicle, obstacle or structure. Hence, VFR pilots operating in the vicinity of the proposed windfarm are legally obliged to avoid the WTGs by 500 ft, this can be achieved through prudent planning and routine 'lookout'.

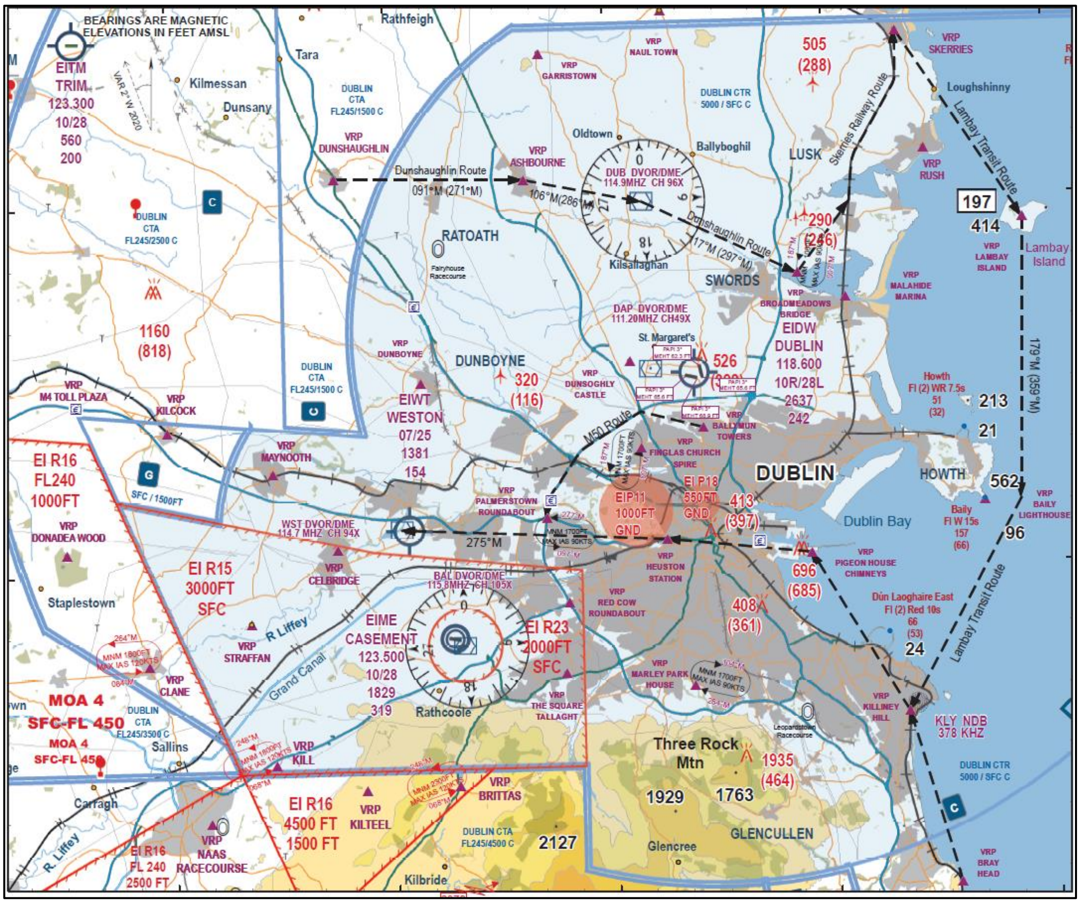


Figure 63 – Dublin Visual Approach Chart

6.4.18 Instrument Approach Chart VOR T RWY 28L CAT A, B, C, D – ICAO - EIDW AD 2.24-45.1

See Section 6.4.3. The segments applicable for assessment for the RWY 28L VOR T procedure are the same as the RWY 28L VOR procedure.

6.5 Dublin Circling

Figure 64 – Dublin Circling Protection Area and Dublin Array

The development would lie outside of the protection areas (see Figure 64) for the Circling procedure by approximately 13.6 km. The procedure would be unaffected.

6.6 Dublin Minimum Sector Altitude

The development would lie within the protection area (see Figure 65) for both the 2400 ft and 4000 ft sector for the MSA. The development would not affect the published altitudes. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

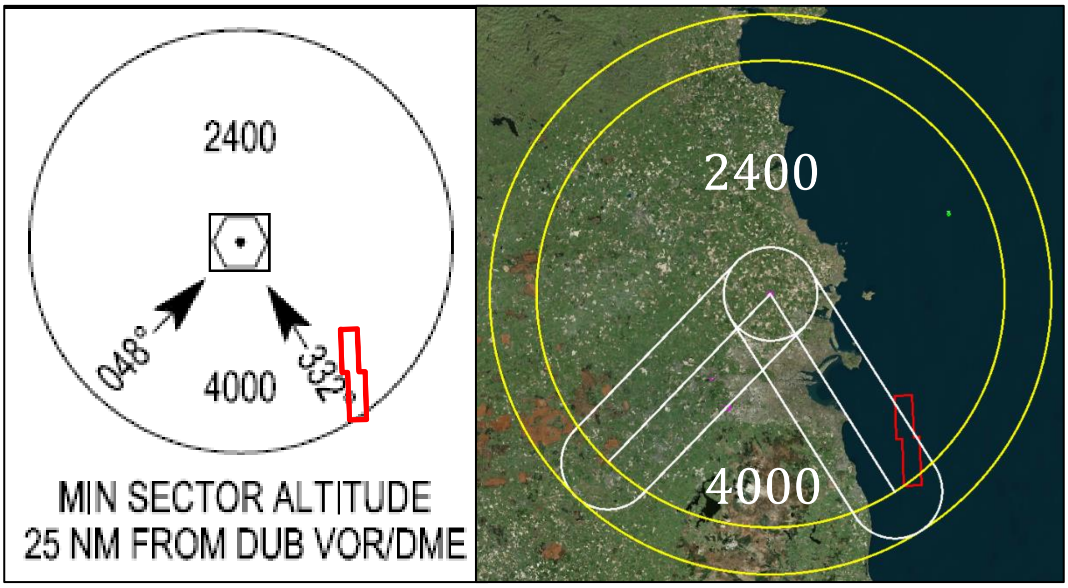


Figure 65 – Dublin MSA

6.7 Dublin Airport Summary

The summary of the Dublin IFP Assessment is shown in Table 7 below.

	ATCSMAC	Departures	Arrivals	Approaches	Circling	MSA
Procedure affected by 309.6 m amsl turbine tip height? (Yes / No)	No	No	No	No	No	No

Table 7 – Dublin Airport Assessment Summary

7 IFP Assessment – Casement (Baldonnel)

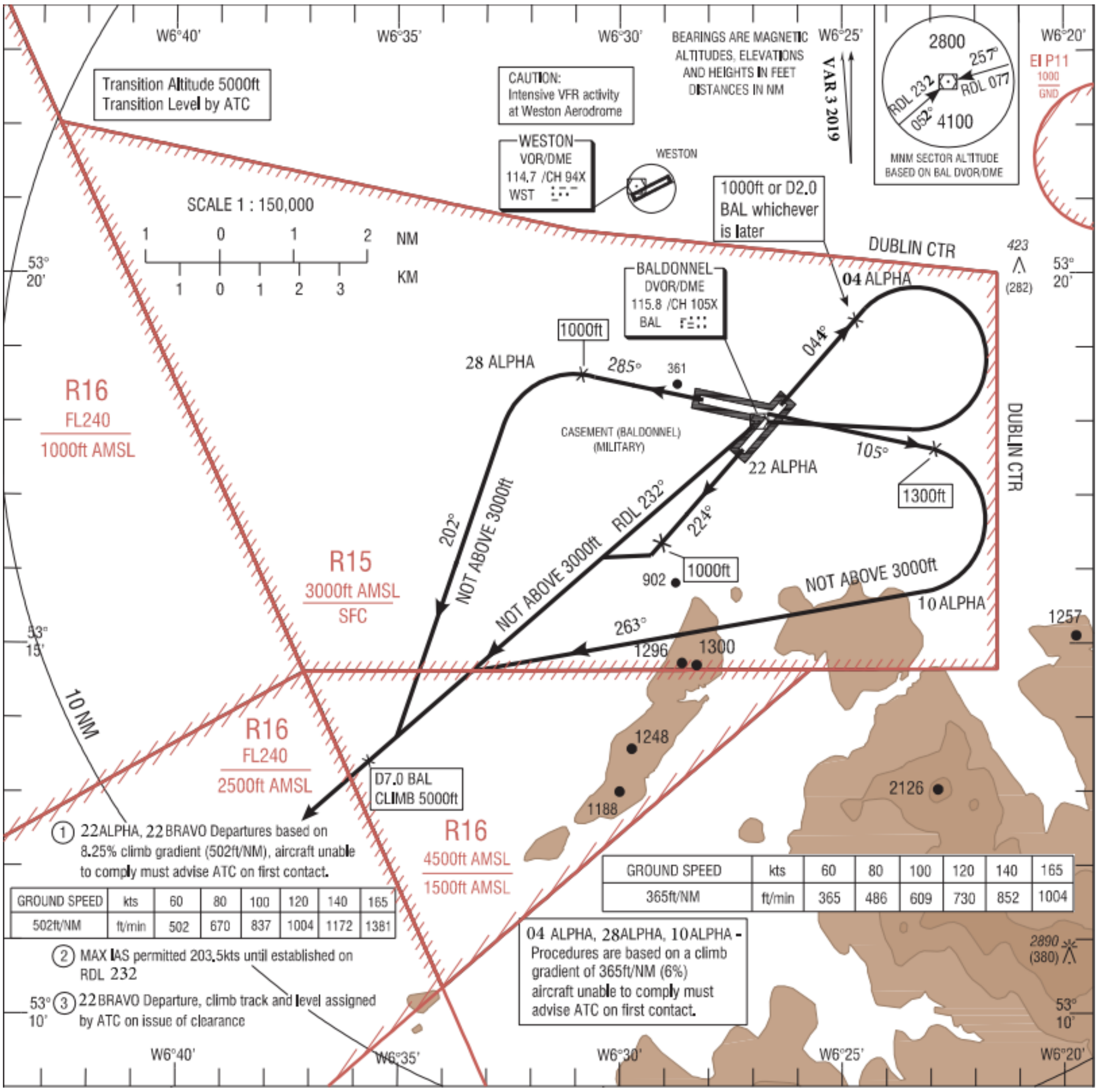
7.1 Overview

Casement (Baldonnel) Aerodrome is a military airfield located 12 km southwest of the City of Dublin and serves as the headquarters and operating base of the Irish Air Corps. Casement Aerodrome has two runways of orientation 04/22 and 10/28 and respective lengths of 1,828 m and 1,462 m.

Casement Aerodrome is located approximately 32 km west of the Dublin Array, measured from the closest point of the development site boundary to Threshold 22.

7.2 Casement Departures

7.2.1 Instrument Departure Chart - RWYS 04/10/22/28, CAT A, B - (EIME AD 2.24-8)



GROUND SPEED	kts	60	80	100	120	140	165
502ft/NM	ft/min	502	670	837	1004	1172	1381

GROUND SPEED	kts	60	80	100	120	140	165
365ft/NM	ft/min	365	486	609	730	852	1004

Figure 66 - Casement Departures CAT AB

The development would lie outside of the protection area (see Figure 68) for the procedure. The procedure would be unaffected.

7.2.2 Instrument Departure Chart - RWYS 04/10/22/28, CAT A, B - EIME AD 2.24-9

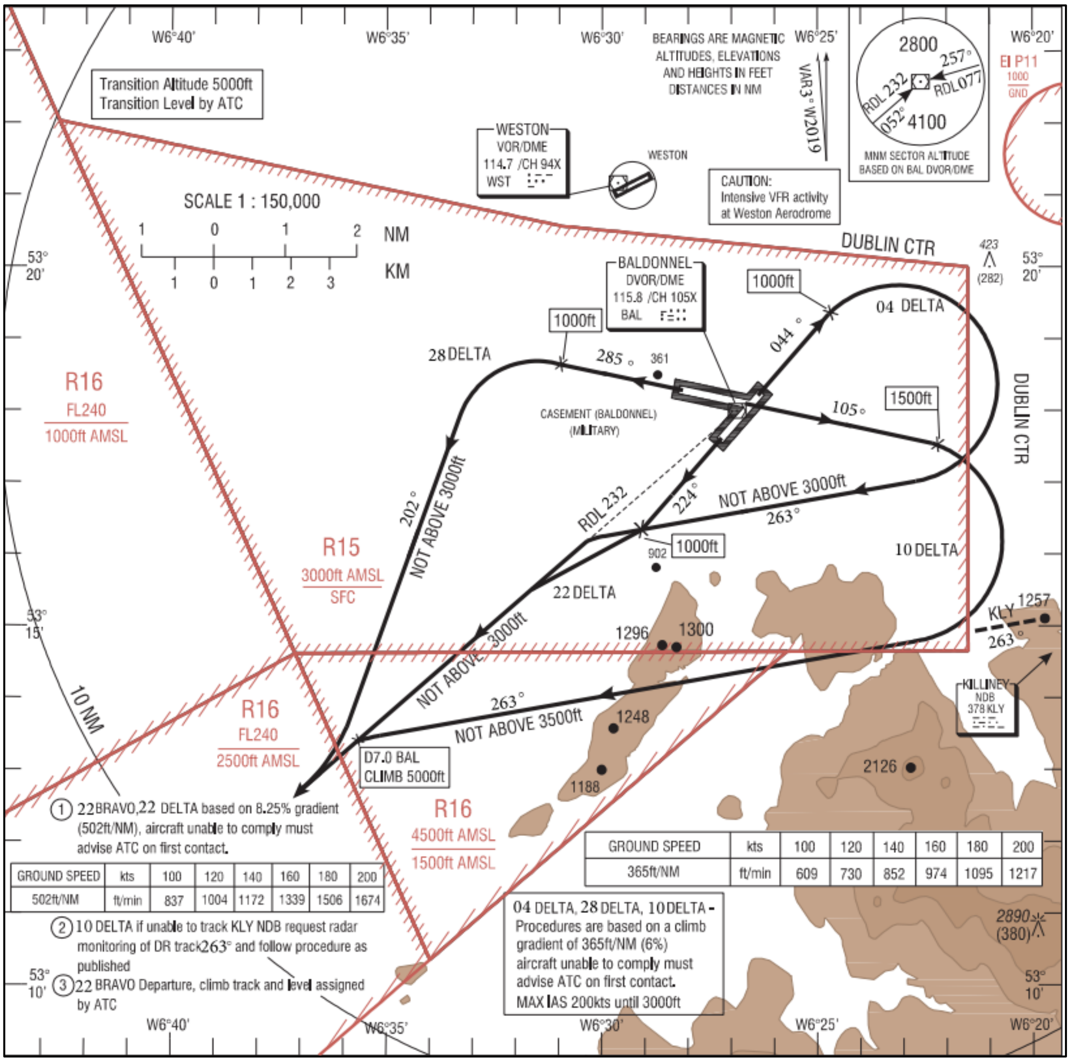


Figure 67 – Casement Departures CAT CD

The development would lie outside of the protection area (see Figure 68) for the procedure. The procedure would be unaffected.

Figure 68 – Casement Departures CAT AB & CD and Dublin Array

7.3 Casement Approaches

7.3.1 Instrument Approach Chart - ILS Z RWY 10, CAT A, B - EIME AD 2.24-10

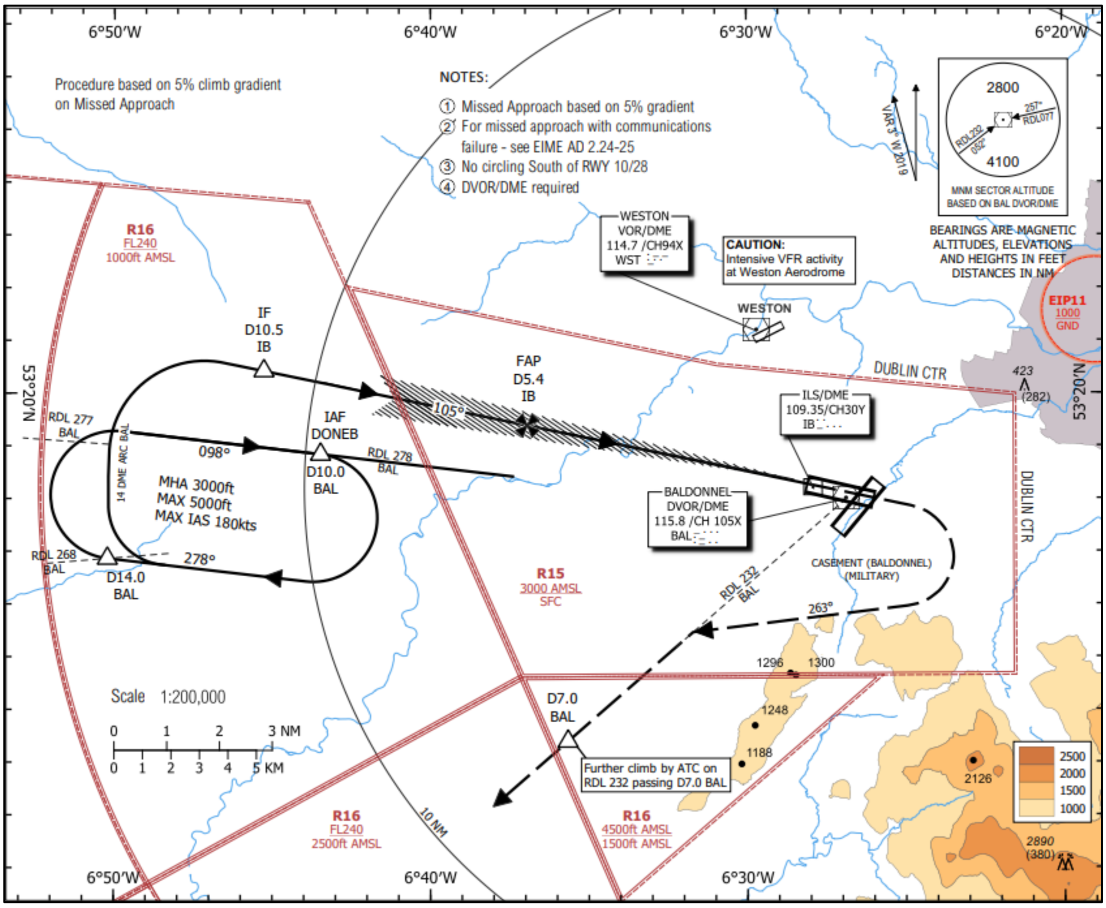


Figure 69 – Casement RWY 10 ILS z

The development would lie outside of the protection area (see Figure 71) for the procedure. The procedure would be unaffected.

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7.3.2 Instrument Approach Chart - ILS Y RWY 10, CAT C, D - EIME AD 2.24-11

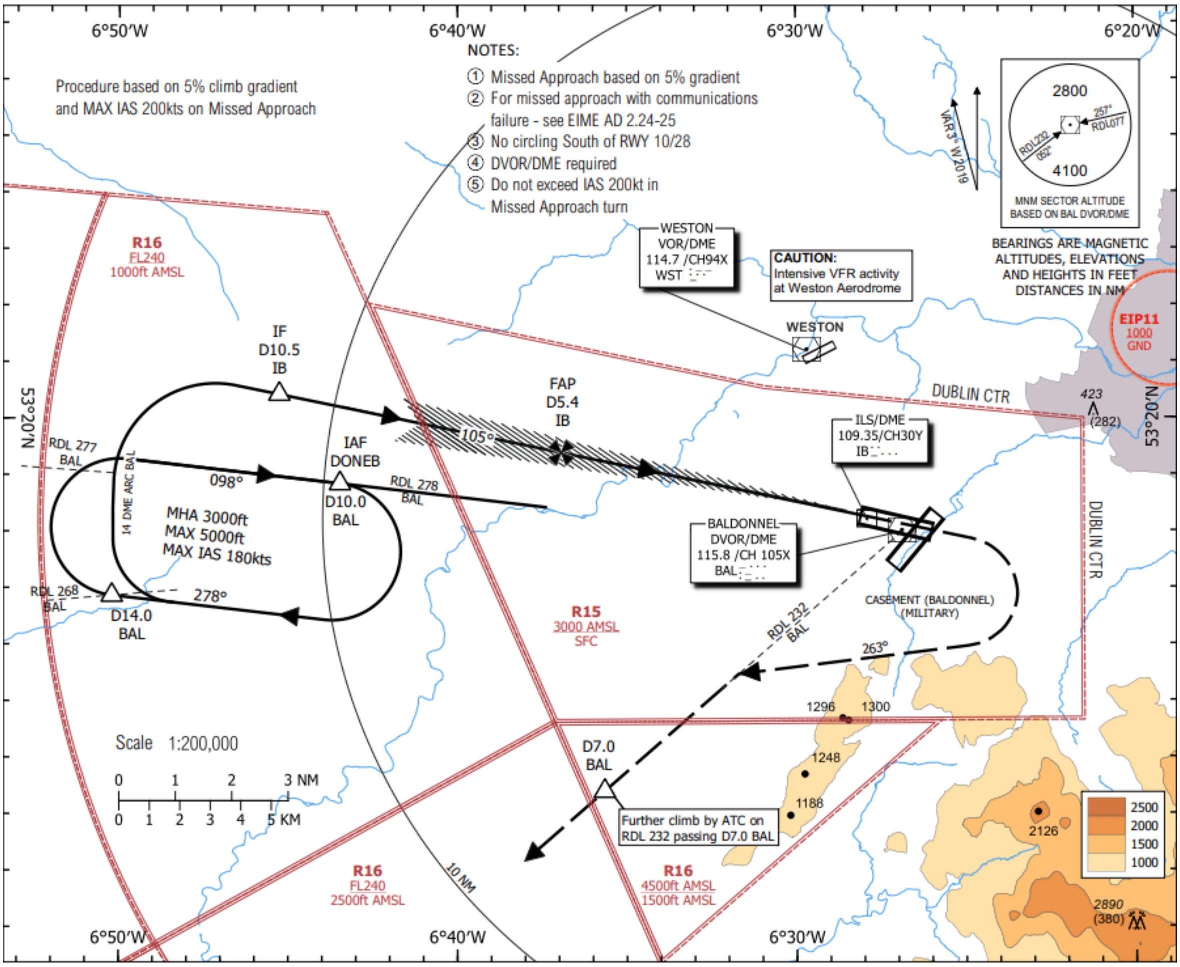

Figure 70 – Casement RWY 10 ILS y

The development would lie outside of the protection area (see Figure 71) for the procedure. The procedure would be unaffected.

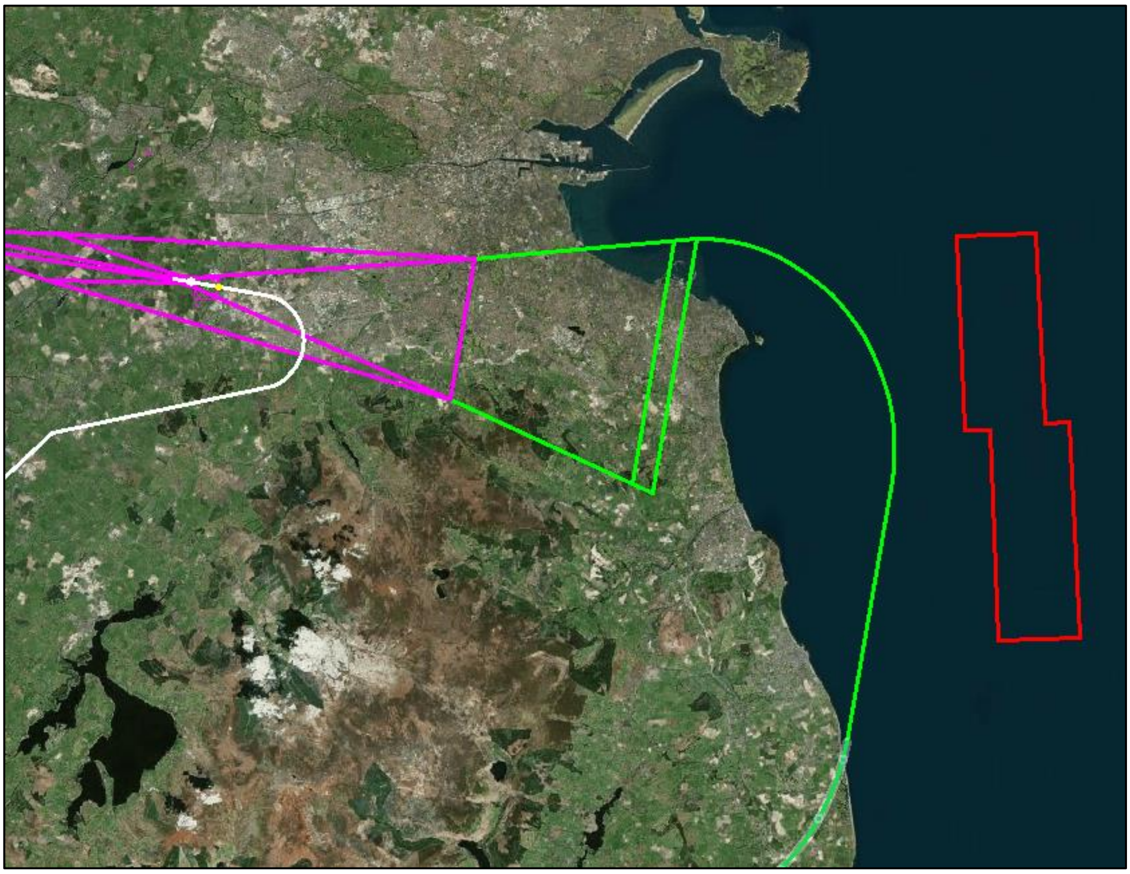

Figure 71 – Casement RWY 10 ILS y & z and Dublin Array

7.3.3 Instrument Approach Chart - VOR RWY 10 - EIME AD 2.24-15

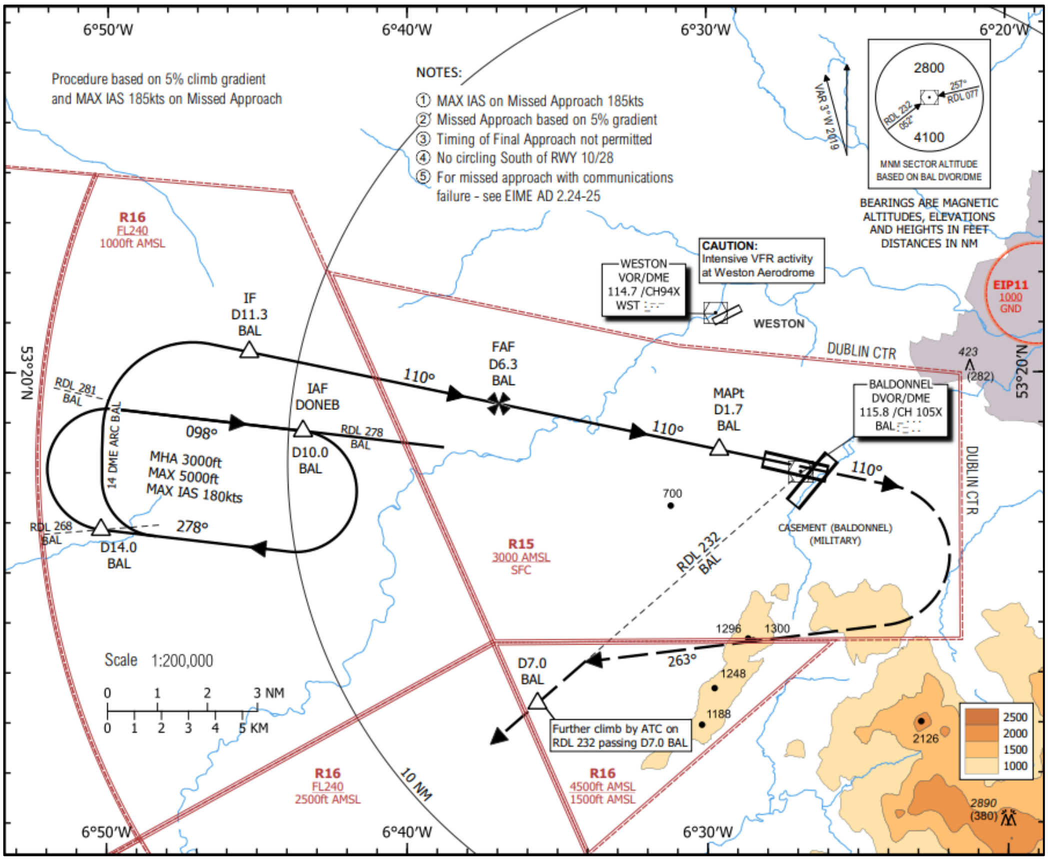

Figure 72 – Casement RWY 10 VOR/DME

The development would lie outside of the protection area (see Figure 73) for the procedure. The procedure would be unaffected.

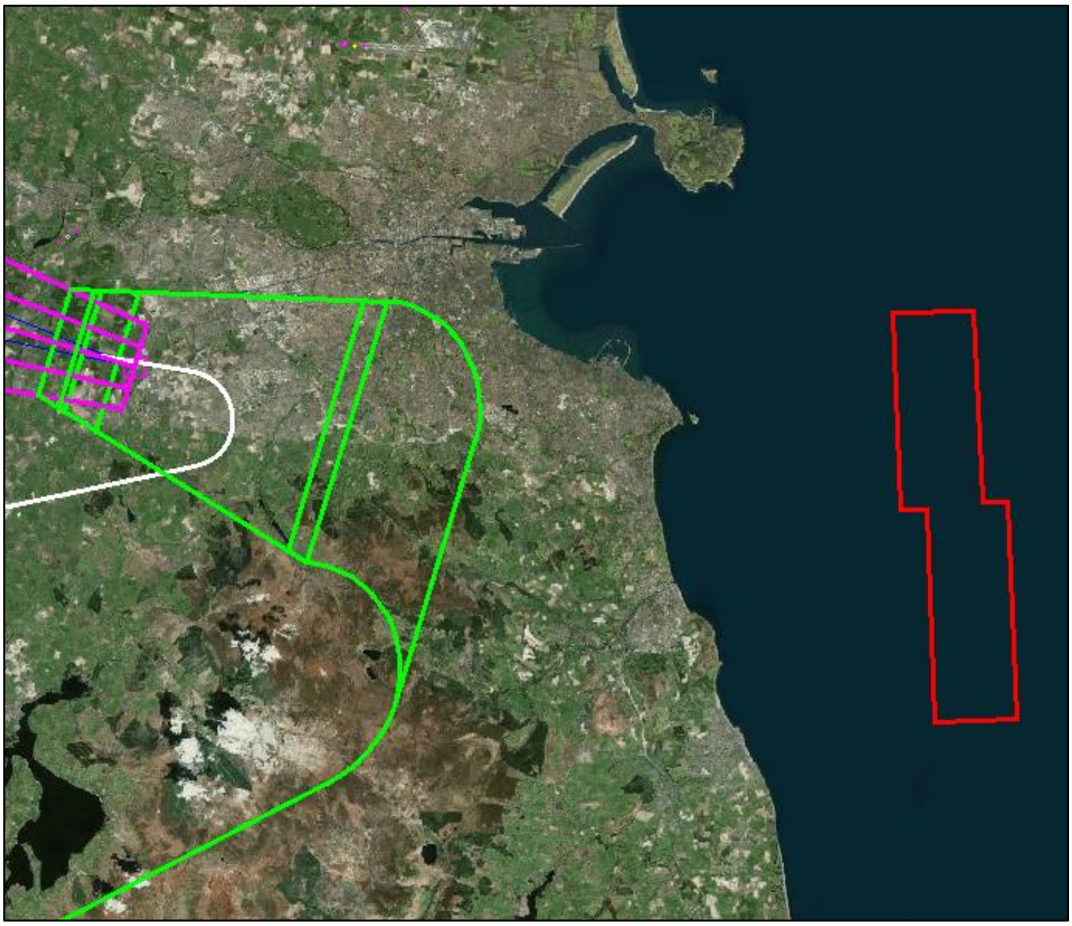

Figure 73 – Casement RWY 10 VOR/DME and Dublin Array

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7.3.4 Instrument Approach Chart - VOR RWY 28 - EIME AD 2.24-16

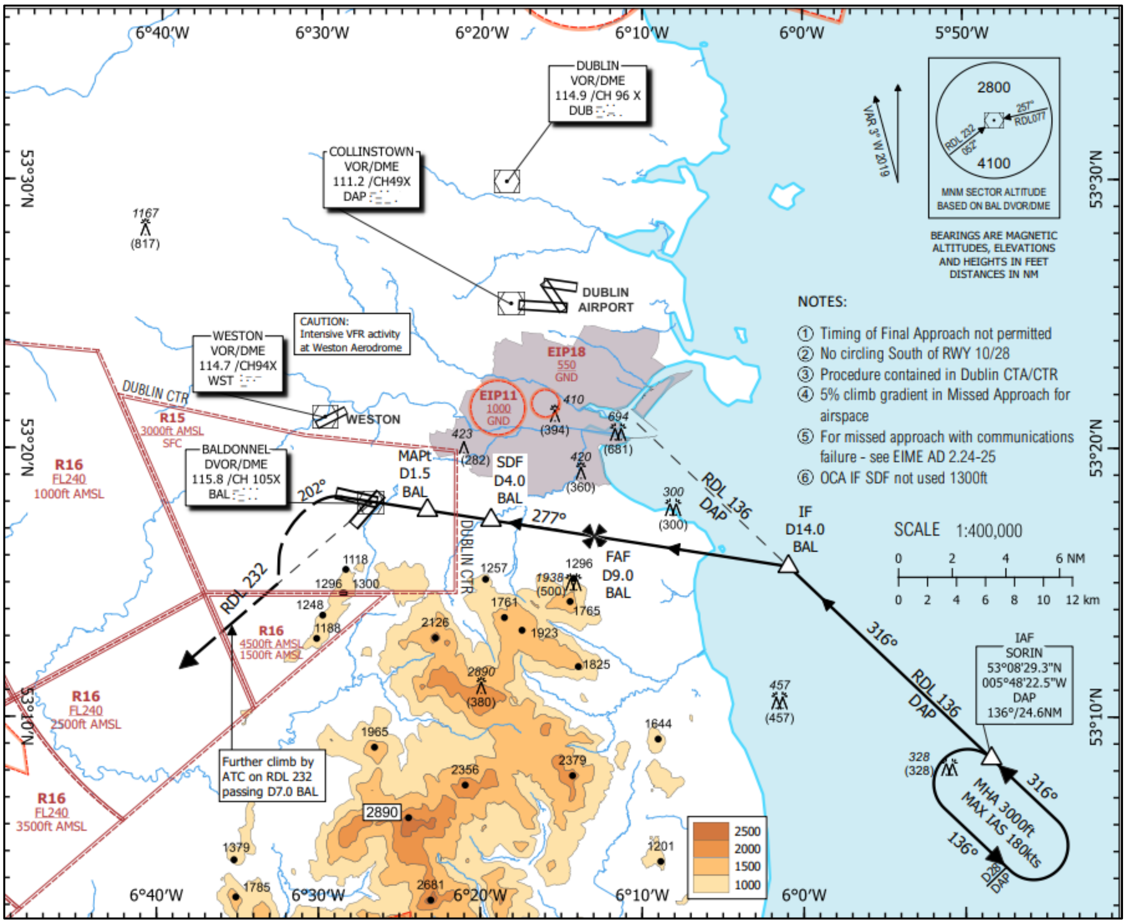

Figure 74 – Casement RWY 28 VOR/DME

The development would lie within the protection area (see Figure 75) for the procedure; however, aircraft would be at a minimum altitude of 3000 ft at the point of transiting the development, therefore there would be no effect on the published altitudes. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

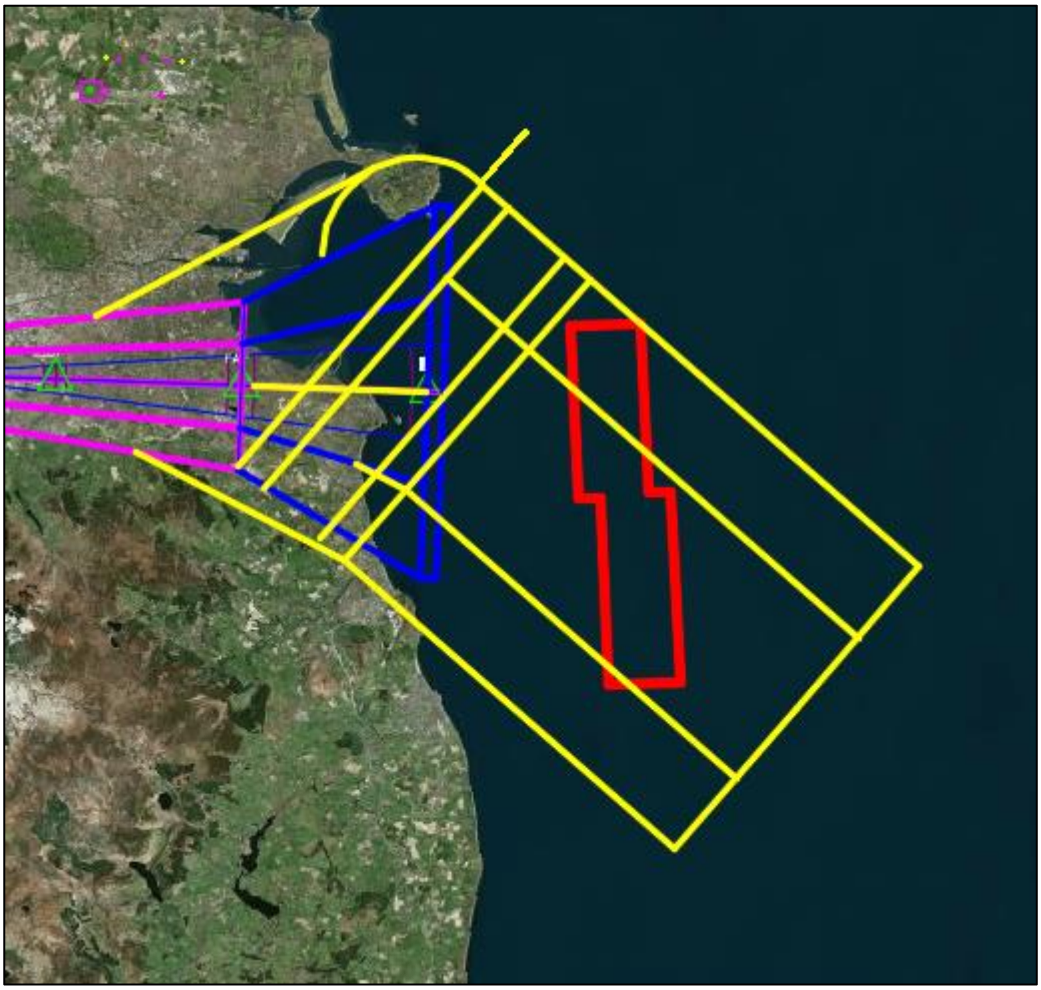

Figure 75 – Casement RWY 28 VOR/DME and Dublin Array

7.3.5 Instrument Approach Chart - VOR RWY 22 - EIME AD 2.24-17

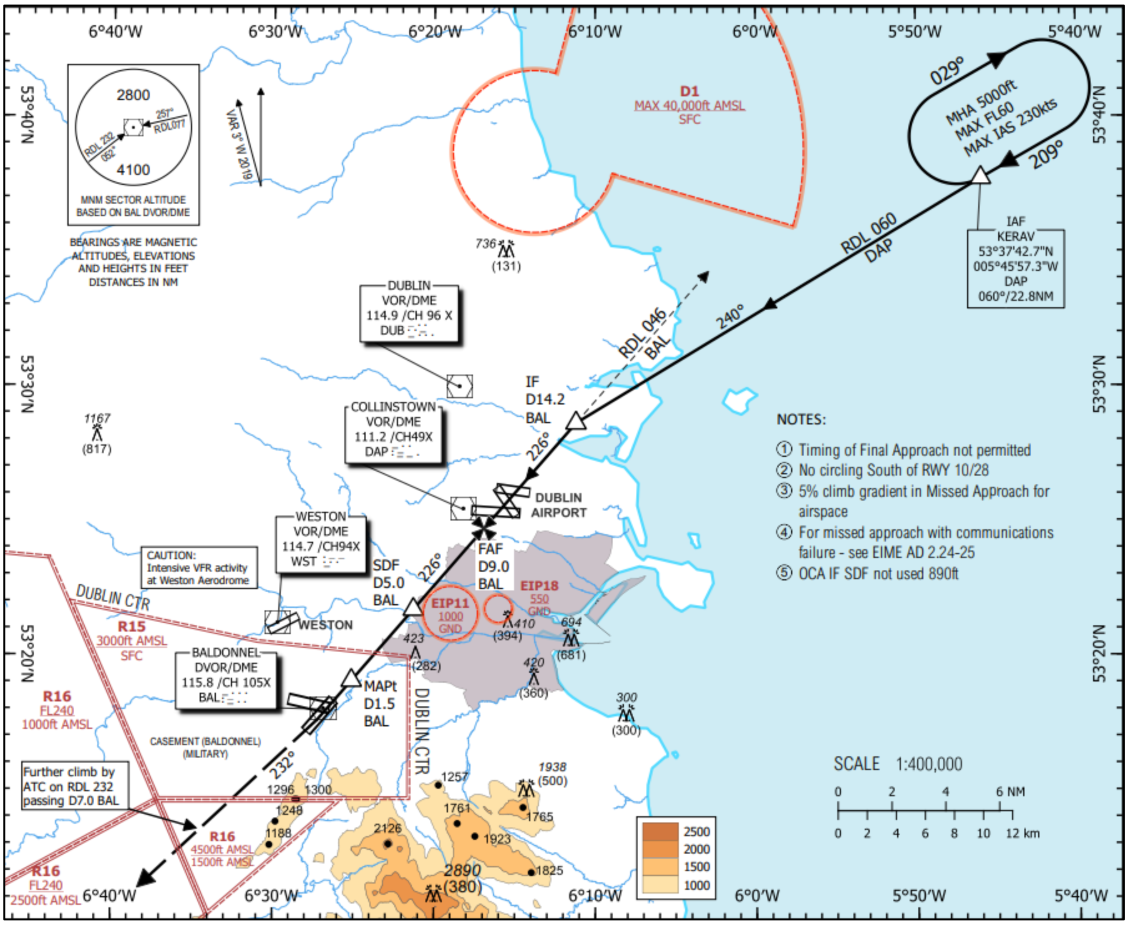

Figure 76 – Casement RWY 22 VOR/DME

The development would lie outside of the protection area (see Figure 77) for the procedure. The procedure would be unaffected.

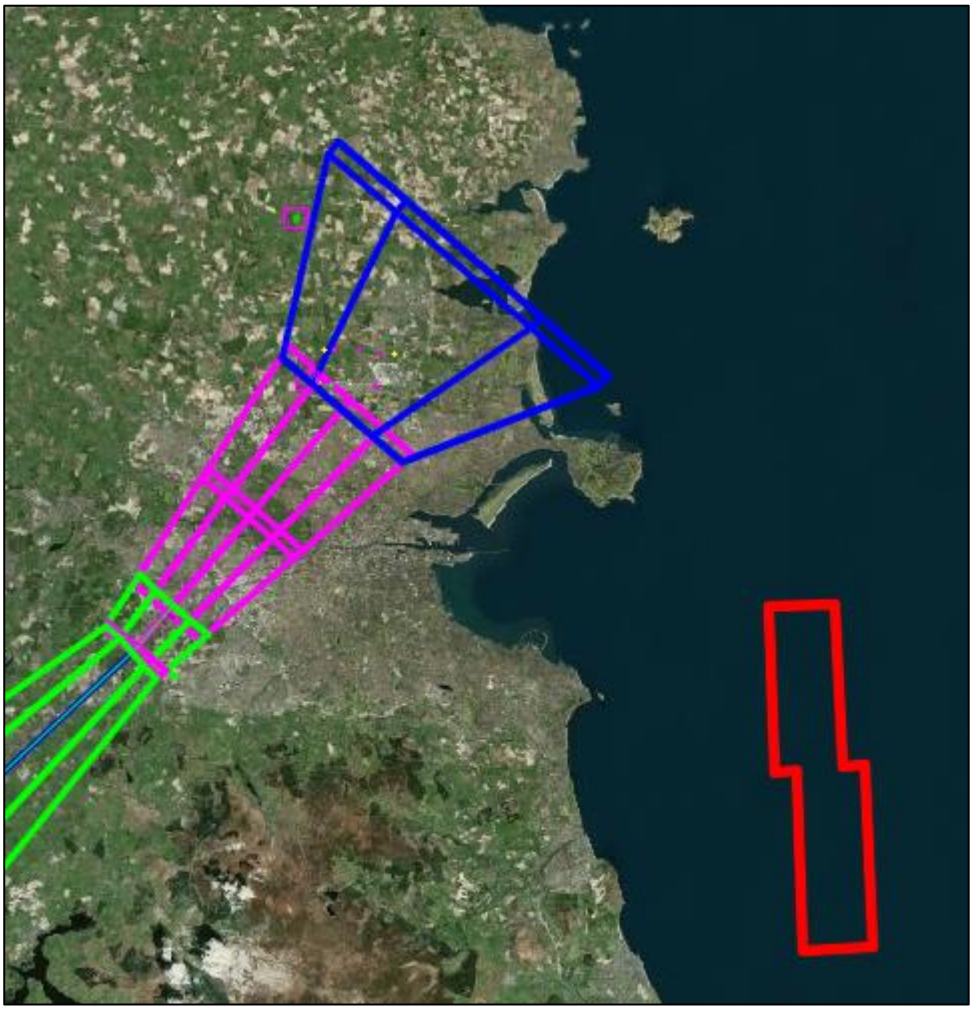

Figure 77 – Casement RWY 22 VOR/DME and Dublin Array

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7.3.6 Instrument Approach Chart - SRA RWY 10 - EIME AD 2.24-20

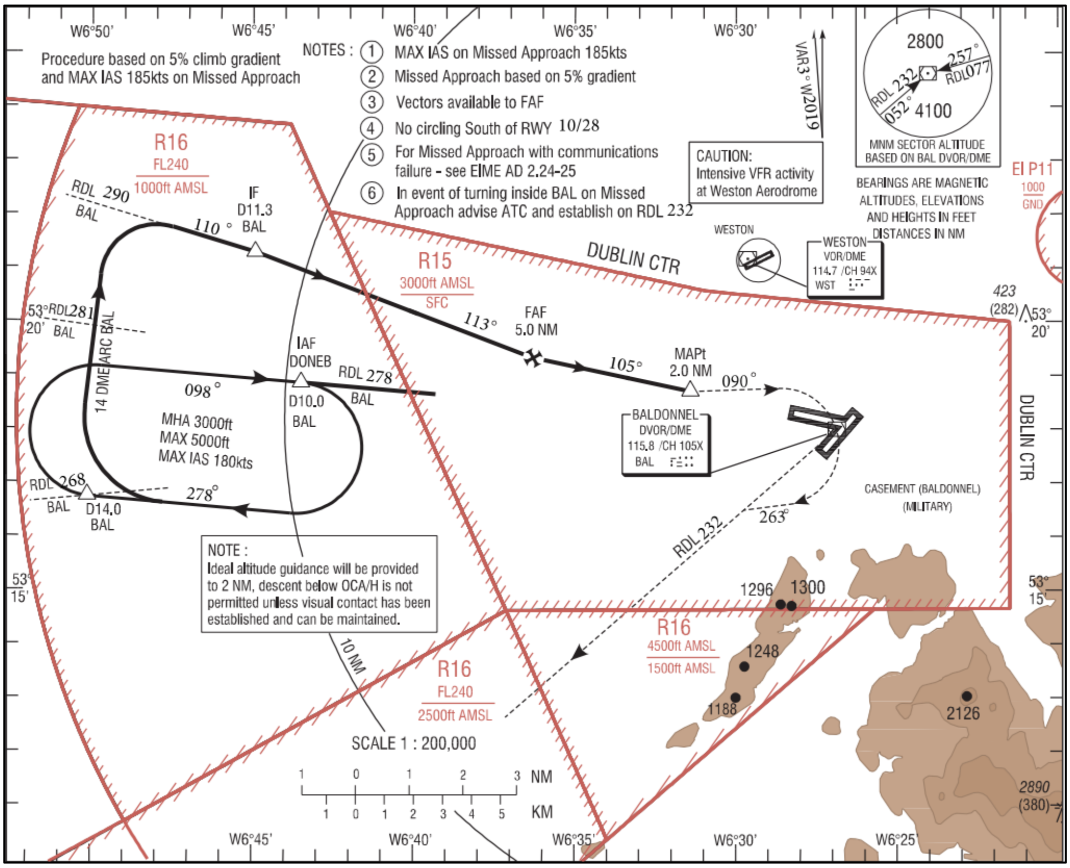

Figure 78 – Casement RWY 10 SRA

The development would lie outside of the protection area (see Figure 79) for the procedure. The procedure would be unaffected.

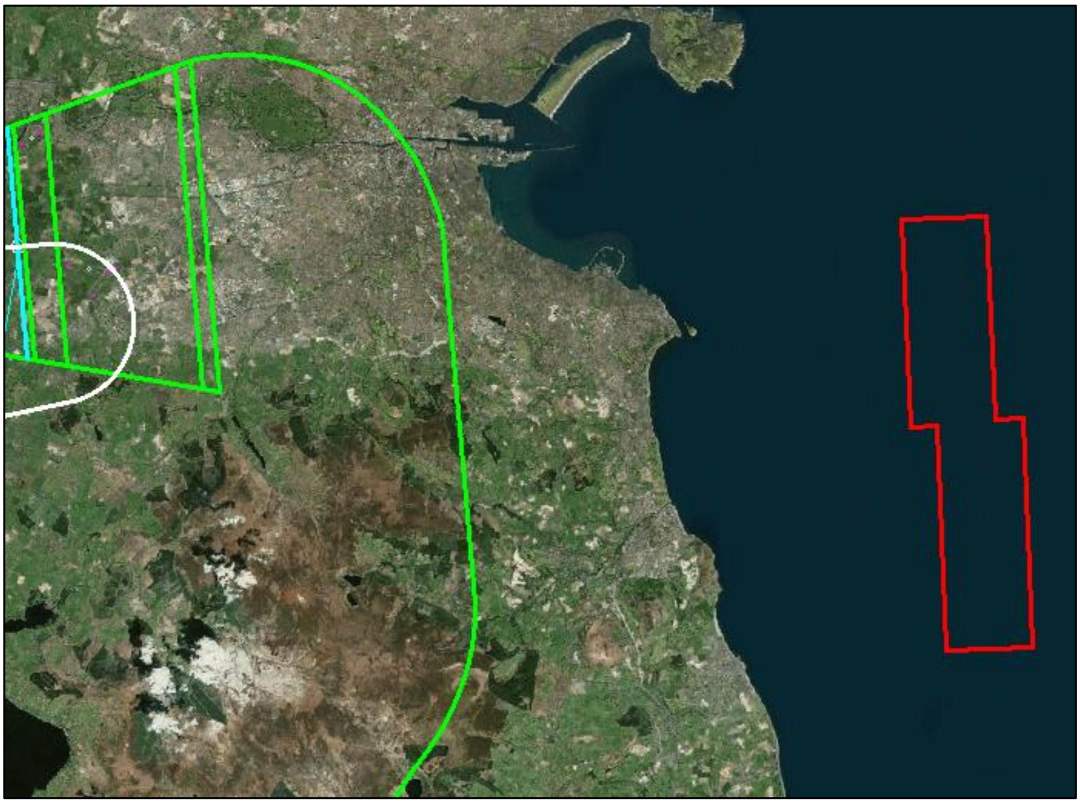

Figure 79 – Casement RWY 10 SRA and Dublin Array

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7.4 ATC Radar Vectoring Chart - EIME AD 2.24-22

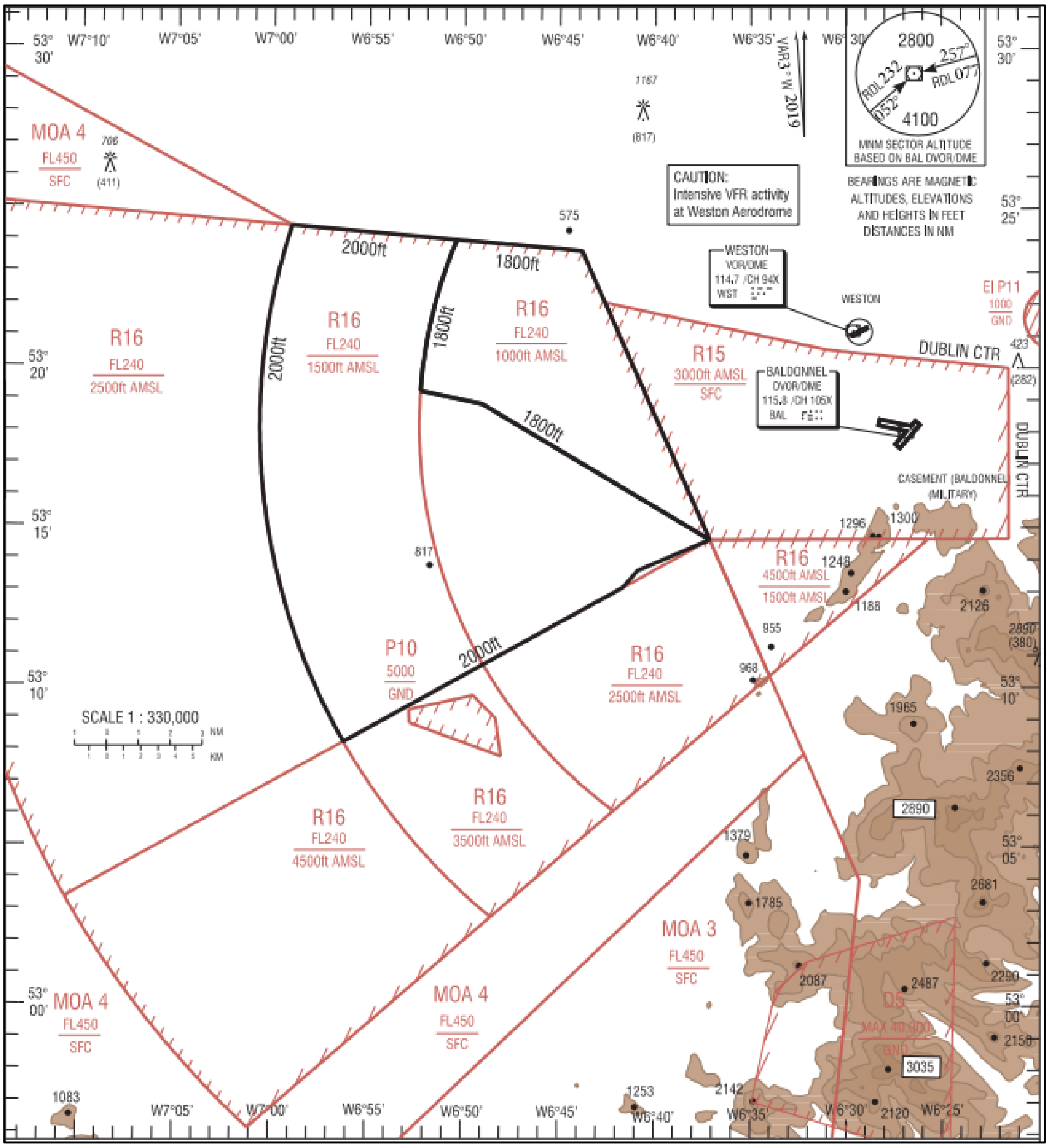

Figure 80 – Casement Radar Vectoring Chart

The development would lie outside of the protection area for the Radar Vectoring chart.

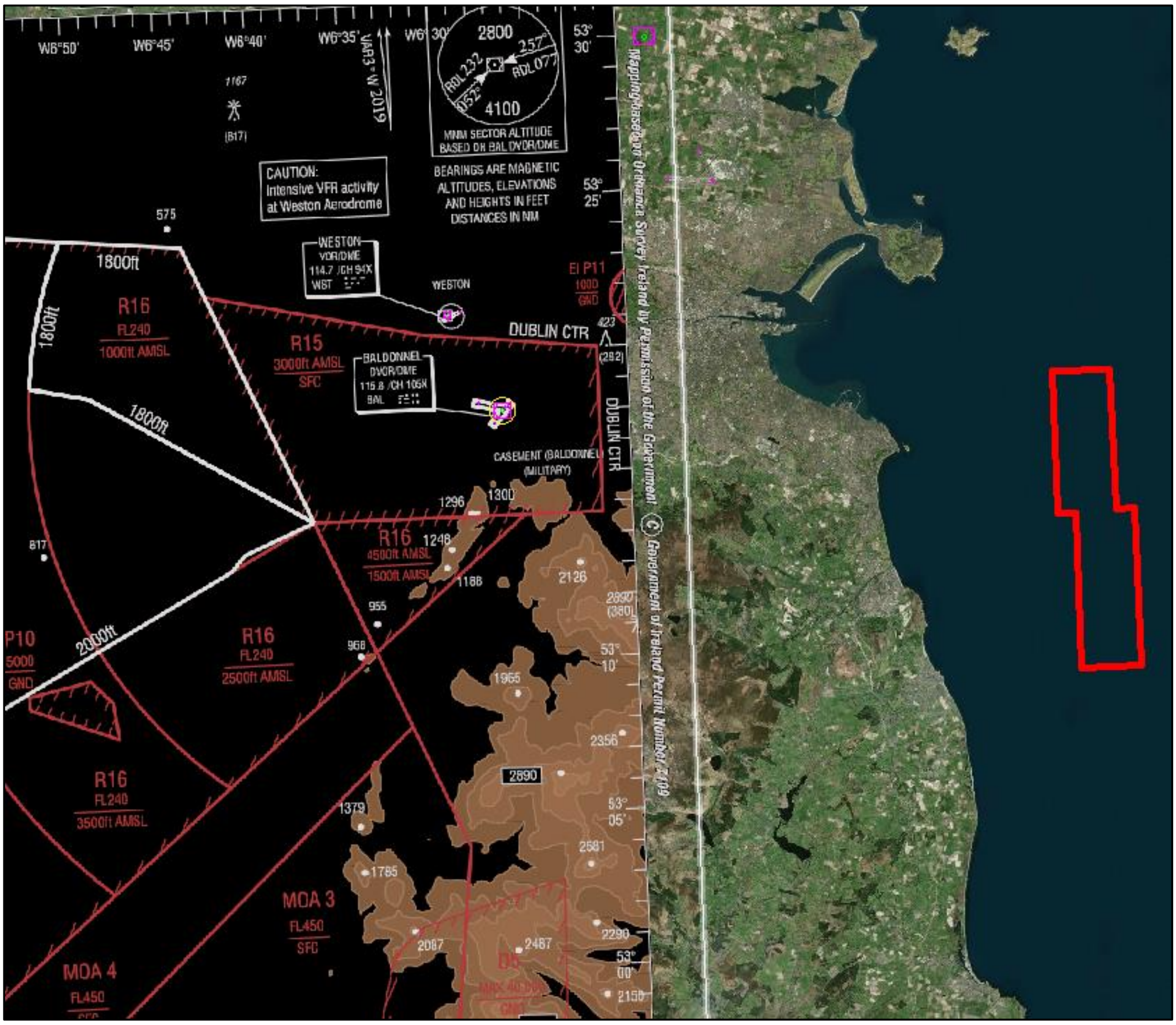

Figure 81– Casement Radar Vectoring Chart & Dublin Array

7.5 Missed Approach With Communications Failure Chart - EIME AD 2.24-25

The Missed Approach with Communications Failure procedure is as follows;

'Squawk 7600. Carry out missed approach as per procedure. Passing 13D outbound on R-232 BAL climb to 4000'. Passing 17D BAL climb 5000'. At 5000' route to DONEB and carry out one hold. Self-position for on approach to the appropriate runway at Dublin Airport'.

This is applicable for the following procedures;

- ILS y ILS z RWY 10
- VOR / DME RWY 10
- VOR / DME RWY 22
- VOR / DME RWY 28
- SRA RWY 10

The Communications Failure Missed Approach follows the same routing as for the main procedure (BAL Radial 232), routing away from the Dublin Array to an altitude of 5000ft. At 5000ft, the Dublin Array would not impact the procedure.

7.6 Casement Circling

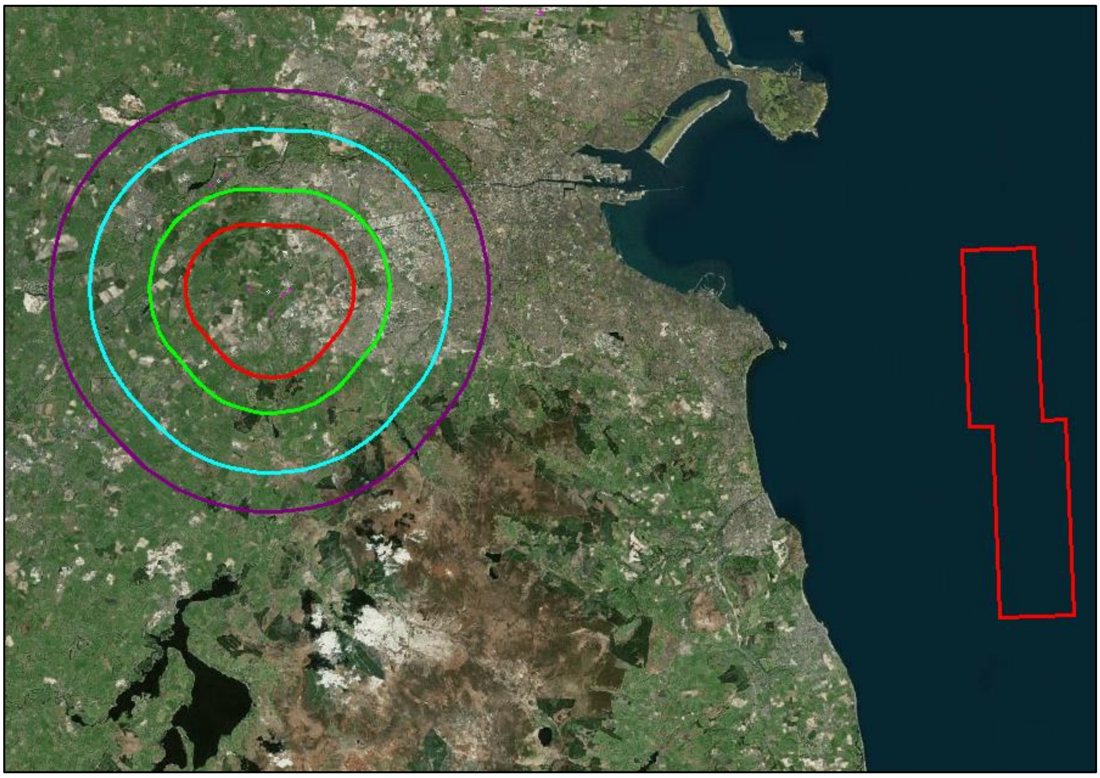

Figure 82 – Casement Circling Protection Area and Dublin Array

The development would lie outside of the protection area (see Figure 82) for the Circling procedure by approximately 22.8 km. The procedure would be unaffected.

7.7 Casement MSA

The development would lie within the protection area (see Figure 83) for both the 2800 ft and 4100 ft sector for the MSA. The development would not affect the published altitudes. The procedure would be unaffected.

- 309.6 m (WTG elevation) + 300 m MOC = 609.6 m / 2000 ft.

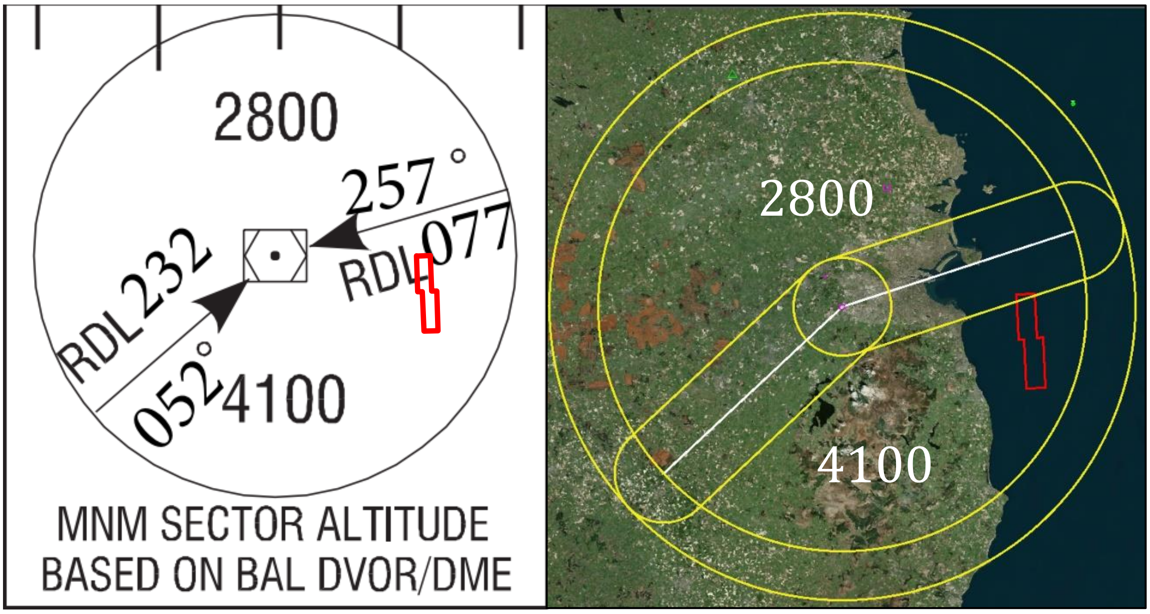

Figure 83 – Casement MSA

7.8 Casement Aerodrome Summary

The summary of the Casement IFP assessment is shown in Table 8 below.

	Radar Vectoring Chart	Departures	Arrivals	Approaches	Circling	MSA
Procedure affected by 309.6 m amsl turbine tip height? (Yes / No)	No	No	No	No	No	No

Table 8 – Casement Aerodrome Assessment Summary

8 IFP Assessment – Weston

8.1 Overview

Weston Airport is a licensed general aviation airport serving Dublin and its environs. Aircraft operating from the airport are primarily private and commercial flight training and business aviation. Weston Airport has one runway which is designated 07/25 and has a length of 924 m.

Weston Airport is located approximately 35 km west of the Dublin Array, measured from the closest point of the development site boundary to Threshold 25.

8.2 Weston Approaches

Nil.

Weston Airport do not currently have any IFPs published in the AIP. Historically, Weston had a 'VOR B', 'VOR C' and 'VOR D' published, which were assessed within the Issue 3 version of this report including a Circling and MSA assessment.

9 Summary

9.1 Overview

The Dublin Array lies within the protection area for IFPs which serve Dublin Airport and Casement Aerodrome. For most procedures, aircraft will be above 3000 ft at the point of transiting over the development, thus providing over the 1000 ft of mandated obstacle clearance.

This 2023 assessment concludes that the previously determined maximum blade tip elevation of 309.6m amsl is still applicable for the entire project envelope.

10 Construction Processes

10.1 WTG Installation

While the exact construction process is unknown at this stage, WTG installation for the Dublin Array is likely to be conducted with the use of a jack-up vessel and components would be lifted into place by crane.

The use of cranage and any other tall equipment would have to conform to the safeguarding restrictions imposed by the aerodrome and ICAO document PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures. Given the scale of the project, it would be expected that cranage in place would have a similar elevation to the WTGs being constructed.

Following a meeting with the IAA in March 2021, it was confirmed by RWE that the crane boom height will not exceed the upper blade tip elevation of 309.6m amsl, which will be applied to the entire project envelope.

10.2 Notice to Airmen

A NOTAM is a form of notice issued at licensed aerodromes to highlight any potential hazards to flight safety. During the construction and decommissioning process, it may be required to issue such a notice to highlight any temporary obstructions that may be in place. A coordinated effort between the developer and aerodrome is key to ensure the accuracy of key data pertaining to flight safety is captured.

11 References

- Irish Aviation Authority (IAA) Statutory Instruments, S.I 215 of 2005; Obstacles to Aircraft in Flight Order.
- Irish Aviation Authority (IAA) Statutory Instruments, S.I 423 of 1999; En-route Obstacles to Air Navigation.
- Irish Aviation Authority (IAA) Statutory Instruments, S.I 72 of 2004; Rules of The Air Order, 2004.
- ICAO PANS OPS DOC 8168 Vol II: Construction of Visual and Instrument Flight Procedures. Seventh Edition 2020, Amendment 9, Corrigenda 1.