AVIATION REPORT

South Dublin County Council – Dub 14 and Dub 15 v1.0

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Issue

In respect of the proposed development of a data centre and administration building in areas Dub 14 and Dub 15 within the South Dublin County Council Development Plan 2016 – 2022, South Dublin County Council (SDCC) have requested further information[1].

> *"(a) Due the proximity to Casement Aerodrome, Military Air Traffic Services requests an Aviation Impact Assessment on all potential emissions. The assessment should cover the effects of potential exhaust plumes and any other associated impact on flight operations at Casement Aerodrome. (b) The applicant is requested to demonstrate how the obstacle limitation surfaces and inner zone have been taken into account."*

It should be noted that this request does not constitute an objection to the development and in providing the requested information this report has been purely desk based and utilises information in the SDCC Development Plan and elsewhere in the public domain; no correspondence or communication has been undertaken with SDCC or the Department of Defence (DoD) or the Irish Air Corps (IAC) to expand on operations and/or safeguarding protocols at Baldonnel Casement. This approach has been adopted for expediency, and as a result of national conditions at the time of writing, in providing the requested information but the author would welcome the opportunity to discuss and provide any further information needed as a result of this report.

[1] South Dublin County Council's PLANNING & DEVELOPMENT ACT, 2000 (as amended) AND PLANNING REGULATIONS THEREUNDER, (Decision Order Number 0006), dated 6 January 2021

Executive Summary

This is a desk based repost addressing the request for further information from South Dublin County Council in respect of the proposed development at Dub 14 and Dub 15.

There are three distinct elements within the report, all in relation to operations at Baldonnel Casement Aerodrome namely, the Obstacle Limitation Surfaces surrounding the aerodrome, the Inner Zone and the effect of any plume.

Flight operations at an aerodrome and within the vicinity of an aerodrome, can be affected by obstacles inside and outside the aerodrome's boundary. Regulation on aviation is determined by various global, European and national bodies and The Irish Aviation Authority issues regulatory guidance on how aerodromes should manage operations in relation to obstacles and the licensing of an aerodrome depends on the extent to which these areas are free from current or new obstacles.

It should be noted that the Irish Air Corps are not subject to civil regulation but operate, independently, under regulation as determined by the Department of Defence/GoC IAC. However, in terms of safeguarding the IAC implement civil regulation where it does not affect operations or operational capability.

Physical safeguarding which is the protection of the aerodrome against vertical development which could have an effect of flying in the vicinity of the aerodrome or on the aerodrome procedures. Obstacle Limitation Surfaces (OLS) are the hypothetical boundaries which indicate the extent of a volume of airspace which must be kept free of obstacles, so far as is reasonably practicable, to facilitate the safe passage of aircraft. It is used collectively to refer to other terms which are fully defined in Chapter 4 of Annex 14 to the Chicago Convention, EASA regulation and incorporated into IAA aviation regulation and which are adopted at Baldonnel Casement by DoD/IAC.

The OLS in question and pertaining to the development is the Inner Horizontal Surface (IHS), a horizontal plane located 45 m above the elevation of the specified datum at the aerodrome. Where the main runway is 1800m or more in length, circles of radius 4000m are described centred on the strip ends of the runway. These circles are joined by common tangents parallel to the runway centreline to form a racetrack pattern.

In attempting to determine the specified datum the available local information uses differing terminologies all of which can have subtly differing meanings. In determining the elevation of the IHS, and thereby the clearance between that and the proposed development, this report considered the clearances of the proposed development against the maximum elevation of the aerodrome and against the lowest runway threshold elevation. By this means it is considered that, by calculation of the clearances for the possible maximum and minimum values for the aerodrome datum, the results will satisfy the requirement of further information against the obstacle limitation surfaces.

In all possible configurations of maximum building elevation against IHS the proposal does not infringe on the OLS for the aerodrome.

In respect of the Inner Zone applied by the IAC at the aerodrome the assessment has been slightly complicated by the lack of available information regarding the datums, lateral and vertical, to be used in the application of that zone. It was not possible to find any comparable defined zone within any extant aviation regulation in the public domain against which the proposed development could be assessed. In applying requirement in the most restrictive means (to the development) which could be envisaged the report shows the maximum and minimum clearances for the proposed development against this additional IAC safeguarding zone.

The proposed development should not infringe this local additional OLS.

In respect of the plumes the AWN Consulting research has concluded that any effects will have completely dissipated within 6m. In an aviation sense, the implications are clear; any plume will not affect any OLS nor would any aircraft be flown within 6m of the building. To do so would create an inexplicable flight safety hazard to the aircrew and people on the ground. There should be no impact on operations at Baldonnel Casement based on the 6m plume.

To put these considerations in perspective there are developments in the immediate vicinity of the proposed development which are comparable in terms of building height and with similar flue stacks and which are similarly below the IHS and which do not appear to have affected operations at Baldonnel Casement.

Security of the aerodrome, and the methods and measures enforced to meet that security requirement, is a matter solely for DoD and GoC IAC.

Background Information

There are various agencies referred to within documentation pertinent to the information requested by SDCC. It might be useful in the context of this paper to provide an outline of the main agencies and government bodies which have roles and responsibilities for airspace and aviation regulation on a global, European and national level.

The International Civil Aviation Organisation (ICAO) is the aviation agency of the United Nations and is charged and funded by national governments to provide best advice, on a global basis, on civil aviation policy and civil aviation standardisation. ICAO was established (on a provisional basis due to the ongoing war) in Chicago in 1944 by the then participating 54 nations, hence the term "Chicago Convention". Annexes to the Chicago Convention now account for over 12,000 international agreed and recognised standards and recommended practise (SARPS). Ireland is a member state of ICAO.

The European Aviation Safety Agency (EASA) is the European Union aviation body charged with standardising the aviation regulations and practises within the EU member states to ensure the highest level of common safety standards. Ireland is a member state of EASA.

The Irish Aviation Authority (IAA) is the Regulator for all civil aviation matter within Ireland and Irish airspace for both General Aviation and Commercial Aviation. From December 2017 the IAA has implemented EASA regulation, reflecting ICAO regulation, but some documentation will still refer to either body or regulation number.

The Department of Defence regulates the Irish Air Corps (IAC) and civil regulations are not binding on either but, as is increasing the case by military forces on a global basis, the IAC will apply civil regulation and guidance, as best practise, where there is no impact on operations or operational effectiveness.

There are some subtle differences between EASA and ICAO regulations and where these are encountered within this report will apply the most restrictive in terms of the proposed development.

Introduction

Flight operations at an aerodrome and within the vicinity of an aerodrome, can be affected by obstacles inside and outside the aerodrome's boundary. The IAA issues regulatory guidance on how aerodromes should manage operations in relation to obstacles[2] and the licensing of an aerodrome depends on the extent to which these areas are free from current or new obstacles.[3]

The regulatory guidance states that certain areas of airspace surrounding an aerodrome should be assessed and that volumes of airspace must be defined to assess the significance of existing or proposed obstacles within specified distances and heights above the aerodrome[4]; these are Obstacle Limitation Surfaces (OLS). The OLS are determined according to the classification of the aerodrome and its runway length. The safeguarded areas are represented by a number of complex planes around the aerodrome within which the absence of obstacles contributes to the safety of both visual and instrument-based flight operations in the vicinity of the aerodrome.

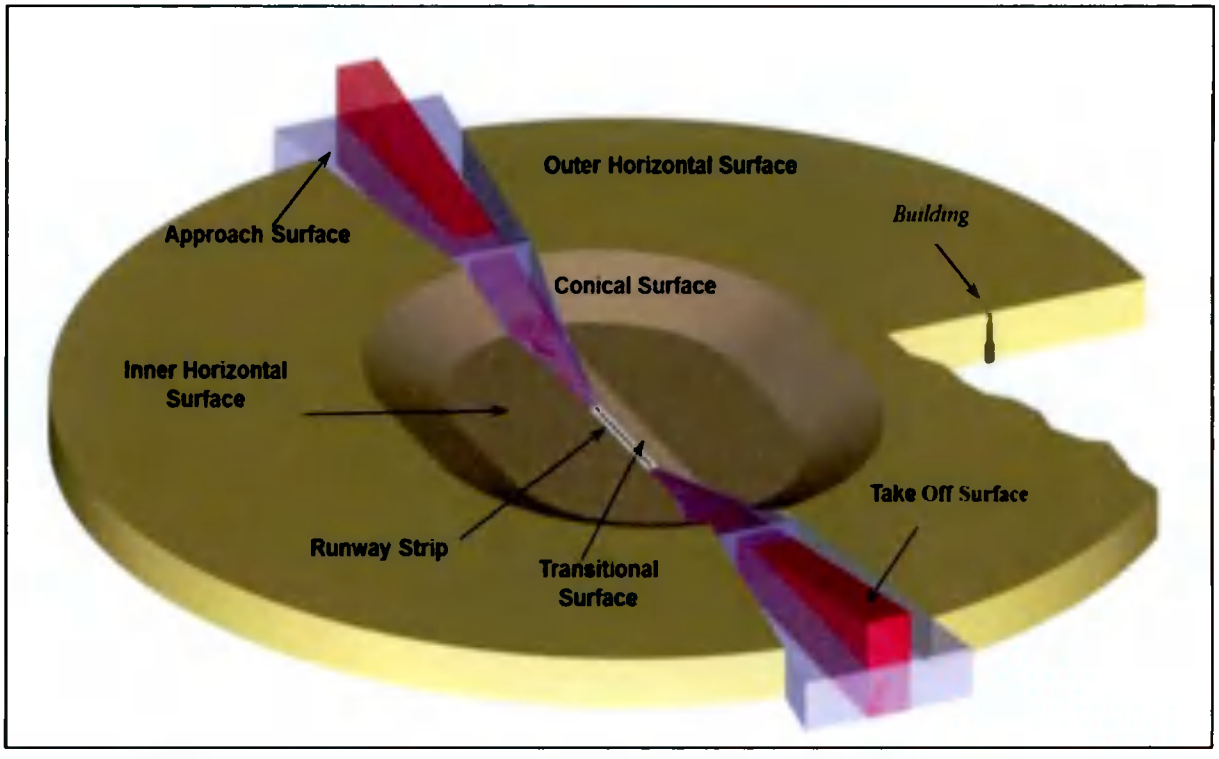

Figure 1 – obstacle limitation distances surrounding airports where the runway is greater than 1800m in length.

[2] IAA Aerodrome Licensing Manual dated January 2014, Aeronautical Services Advisory Memorandum dated January 2015 *et al.*

[3] It should be noted that there is no requirement for a civil licence for Baldonnel Casement.

[4] In aviation distances (either vertical or horizontal) are expressed, variously, in feet, metres, kilometres and nautical miles.

Physical Safeguarding – Obstacle Limitation Surfaces

Physical safeguarding which is the protection of the aerodrome against vertical development which could have an effect of flying in the vicinity of the aerodrome or on the aerodrome procedures. OLS are the hypothetical boundaries which indicate the extent of a volume of airspace which must be kept free of obstacles, so far as is reasonably practicable, to facilitate the safe passage of aircraft. It is used collectively to refer to other terms which are fully defined in Chapter 4 of Annex 14 to the Chicago Convention, EASA regulation and incorporated into IAA aviation regulation and which are adopted at Baldonnel Casement by DoD/IAC.

The OLS comprise of approach surface, balked landing surface, conical surface, inner approach surface, outer horizontal surface, inner horizontal surface, inner transitional surface, take-off climb surface and transitional surface. These distances are measured from the airfield reference point, the designated datum or, if one is not defined, from the mid-point of the longest runway.

It is not proposed to go into any detail regarding the definitions and complexity of each of the surfaces that surround airfields but an Inner Horizontal Surface (IHS) is a horizontal plane located above an aerodrome and its vicinity. It represents the level above which consideration needs to be given to the control of new obstacles and the removal or marking of existing obstacles to ensure safe visual manoeuvring of aeroplanes prior to landing.

The IHS is contained in a horizontal plane located 45m above the elevation of the specified datum. Where the main runway is 1800m or more in length, circles of radius 4000m are described centred on the strip ends of the runway. These circles are joined by common tangents parallel to the runway centreline to form a racetrack pattern. Where there is more than one runway there will be more than one racetrack pattern and it is the boundary of this pattern, or overlapping patterns, which is the boundary of the IHS.

South Dublin County Council (SDCC) Development Plan 2016 - 2022

In providing the requested further information the baseline environment and criteria contained within the SDCC Plan has, as far as possible, been the primary source of data to be adopted in relation to the aerodrome at Baldonnel Casement; this is then correlated with extant regulation as determined by the IAA, EASA and ICAO.

The South Dublin County Council (SDCC) Development Plan 2016 – 2022 lists the runways at Baldonnel Casement as 11/29 and 05/23[5]. In February 2019, Baldonnel Casement's runway designations were changed due to a shift in the earth's magnetic variation; its main runway (formerly 11/29, as in the SDCC Development Plan) was redesignated as 10/28 and the subsidiary runway (formerly 05/23) was redesignated as 04/22. In this paper we use the new 2019 designators but they refer to the same runways as in the SDCC Plan.

The safeguarding requirements of the DoD/IAC are outlined in the SDCC Development Plan 2016 – 2022 in Sections 7.8.0 *et al* (page 135) and 11.6.6 of that Plan (page 227). Notwithstanding Variation No2 to the Development Plan, the Plan variously uses differing terms for the same requirement on differing pages and it is considered that it might be useful to establish a common understanding within this paper and again, an opportunity to discuss any differences with the Council staff would be welcomed if there is any need for further clarification of any understanding on the part of the author of this paper.

For clarity of understanding

- In Section 11.6.6 (i) (Aerodromes) the Plan states that the Authority will refer applications to IAA or DoD for any development exceeding an Ordnance Datum (OD) height 45 metres above the level of the aerodrome(s).

- Similarly "45m OD for Casement" is assumed to mean 45m above Casement elevation (OD); this would imply that the datum to be used in determining the IHS is the aerodrome elevation.

- This is then expanded on within Variation No2 which states that the Inner Horizontal Surface is 45m above the threshold altitude of runway 11 (now runway 10).

- The Plan then states that all of these surfaces have been established for Casement and it is assumed that this has been done by the IAC, or with IAC input, and the specified

[5] Runway designators are the True Bearing of the runway heading rounded to the nearest ten degrees and presented as a two-digit number.

datum of the threshold altitude contained within Variation No.2 is the only reference to which datum is to be used which appears to have direct input from the IAC and which the author has been able to find within the public domain within time available. (Civil regulation require that aerodrome operators register/declare the selected specified datum with the civil regulator but that does not apply to Casement as a military aerodrome.)

- In Section 11.6.6 (i) (Aerodromes) the Plan states that the Authority will refer applications to IAA or DoD for any development which is underneath the Approach Surfaces/Funnels. This is assumed not to limit consultation or to infer that consultation is not needed, on developments under all of the relevant Obstacle Limitation Surfaces as detailed in Section 11.6.6 (ii).

- In Section 11.6.6 (Aerodromes), page 230, Inner Horizontal Surface, the Plan states that the Inner Horizontal Surface of Casement is at 86.6m. This is considered to be an error/misprint.

- There are various terms used to specify the vertical position of an aircraft and height, elevation, altitude have different meanings in aviation and the definition of aerodrome level is not articulated in this statement within the Plan. This report will consider the clearances of the proposed development against the maximum elevation of the aerodrome and against the lowest runway threshold elevation[6]. By this means it is considered that, by calculation of the clearances for the possible maximum and minimum values for the aerodrome datum, the results will satisfy the requirement of further information against the obstacle limitation surfaces.

The following SDCC Development Plan Index Map illustrates the extent of the IHS and presumably reflects the extent designated by the DoD/IAC. The map is available at the following link:

https://sdcc.ie/en/download-it/publications/south-dublin-county-council-development-plan-2016-2022-index-map.pdf.

[6] Unless specified otherwise all elevations quoted have not been subject to detailed topographical modelling on the part of the author and are accepted as the relevant agency figures.

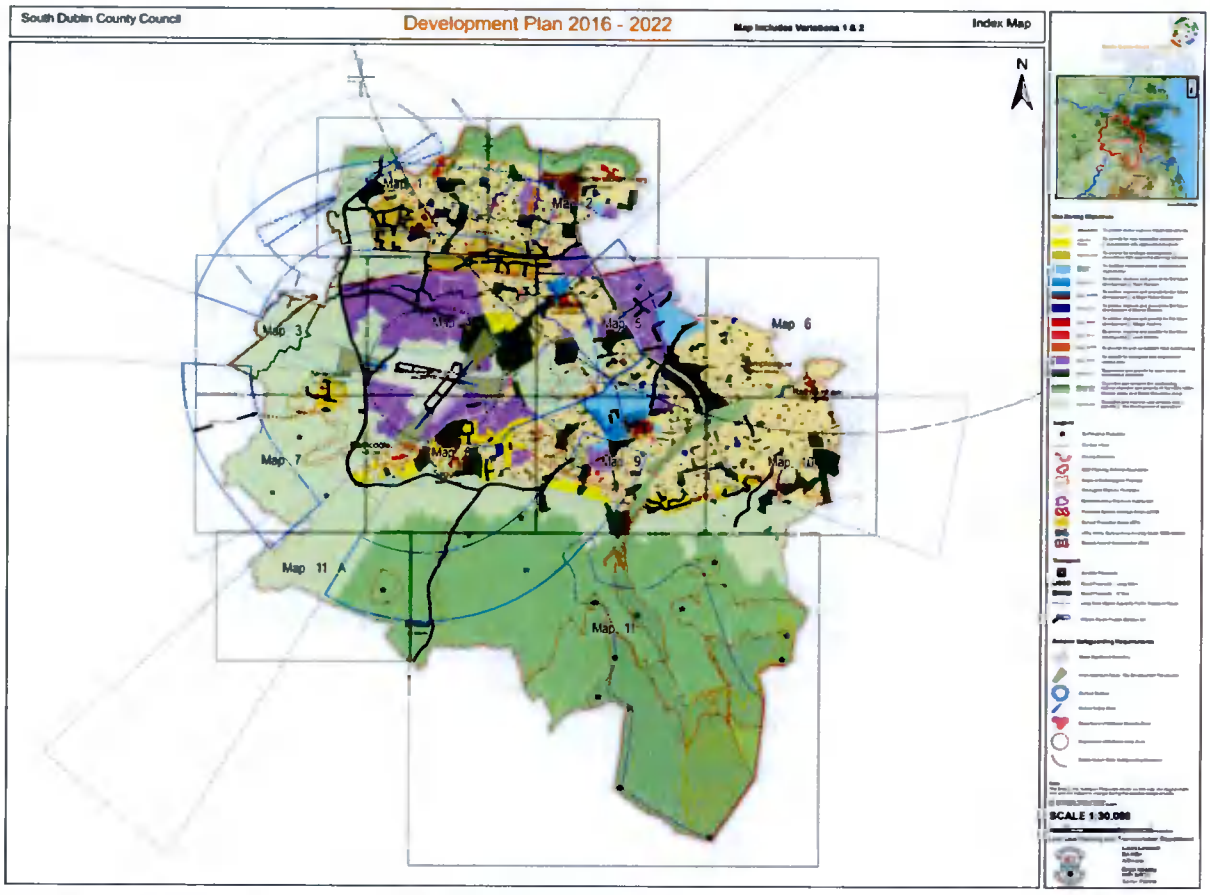

Figure 2 – Baldonnel Casement Inner Horizontal Surface
Source: South Dublin County Council Development Plan

Baldonnel Casement Aerodrome

Baldonnel Casement Aerodrome is a military airfield located approximately 13km southwest of the city of Dublin. The Aerodrome serves as the Headquarters and the main operating base of the Irish Air Corps.

Baldonnel Casement Aerodrome has two runways of orientation 04/22 and 10/28 and respective lengths of 1,829m and 1,463m; a runway length of over 1,800m (for runway 10/28) results in an assumed Aerodrome Reference Code of 4 if the civilian guidance stipulated in the IAA regulation were applied.[7]

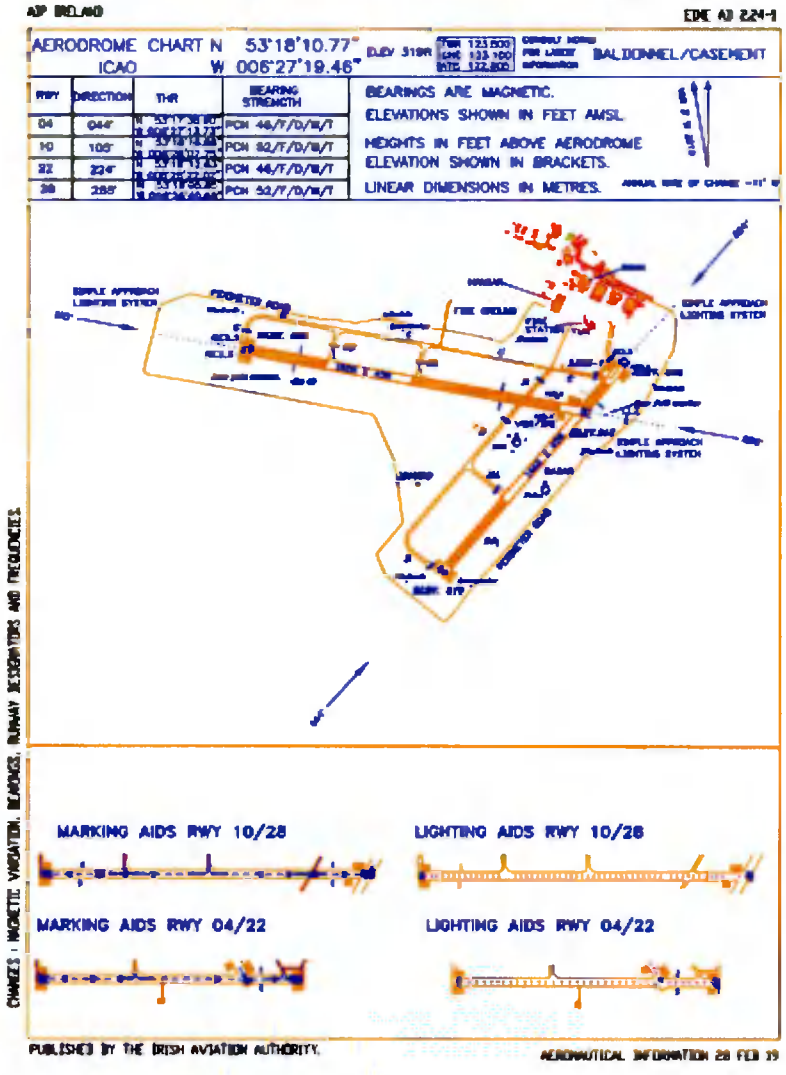

Figure 3 – Baldonnel Casement Aerodrome chart
Source: IAA IIP, 3 Dec 20

[7] Runway 04/22 is a Code 3 runway but for simplicity this assessment will treat the aerodrome as Code 4 *in toto*.

The Development Site(s)

The closest point of the development site (Dub 14) to the Airfield Reference Point is approximately 1.92km and the furthest point of the second development site (Dub 15) is 3.34km which places the proposed development at both locations under the IHS. No other OLS needs to be considered.

Figure 4 – The Proposed development sites in relation to Baldonnel Casement Aerodrome
Source: Google Earth

The average elevations at the two sites are 68m for Dub 14 and 61m for Dub 15. The maximum height for construction at the sites will be 30.75m at Dub 14 and 25m at Dub 15. From detailed survey work undertaken for the application those heights above ground level results in a maximum construction elevation of 98.0m and 92.25m amsl respectively.

Inner Horizontal Surface

Under IAA regulation the height of the IHS shall be 45m above the elevation datum established for that purpose. Under extant ICAO and EASA regulation it is acknowledged that alternative datums can be used but that, where no such datum is specified, the IHS is to be above the elevation of the lowest runway threshold, existing or proposed, for the aerodrome.[8] Within the available guidance and regulation differing countries/regulators adopt differing practices around the globe within the available options of

a. the elevation of the highest point of the lowest threshold of the related runway,
b. the elevation of the highest point of the highest threshold of the related runway,
c. the elevation of the highest point of the runway, or,
d. the aerodrome elevation.

It is not apparent from the Baldonnel Casement aerodrome entry within the IAA AIP which elevation is used by the IAC when conducting safeguarding assessments but, for the purposes of this paper, the figure for the lowest published threshold elevation will be calculated i.a.w. IAA, ICAO and EASA regulation and as implied within SDCC Development Plan Variation No.2. However, for completeness, the figures will also be calculated for the maximum airfield elevation.

Dub 14

Lowest threshold datum

The lowest published threshold elevation is that of runway 10 at 283ft amsl or 86.25m amsl. If 45m is added to this elevation, the IHS is 131.23m amsl which results in 33.23m clearance between the maximum construction elevation and the relevant obstacle limitation surface. (131.23m – 98.0m = 33.23m).

Aerodrome elevation datum

The aerodrome elevation is stated in the IAA AIP to be 319ft above mean sea level (amsl) or 97.23m amsl. If 45m is added to this elevation, the IHS is 142.23m amsl which results in 44.23m clearance between the maximum construction elevation and the relevant obstacle limitation surface. (142.23m – 98.0m = 44.23m).

[8] Guidance on determining the elevation datum is contained in the ICAO Airport Services Manual, Part 6 (Doc 9137)

Dub 15

Following the same methodology, the same considerations to the elevation of the datum to be used for calculation of the IHS apply.

Lowest threshold datum

Using the lowest available threshold as the datum results in 38.98m clearance between the maximum construction elevation and the relevant IHS obstacle limitation surface. (131.23m – 92.25m).

Aerodrome elevation datum

Using the aerodrome elevation as the datum results in 49.89m clearance between the maximum construction elevation and the relevant IHS obstacle limitation surface. (142.23m – 92.25m).

In both cases, irrespective of whether the highest or lowest possible datum value is used, the proposed development is well below the relevant obstacle limitation surface.[9] Based on extant regulation designed to ensure safe operations at aerodromes there will be no effect on operations at Baldonnel Casement.

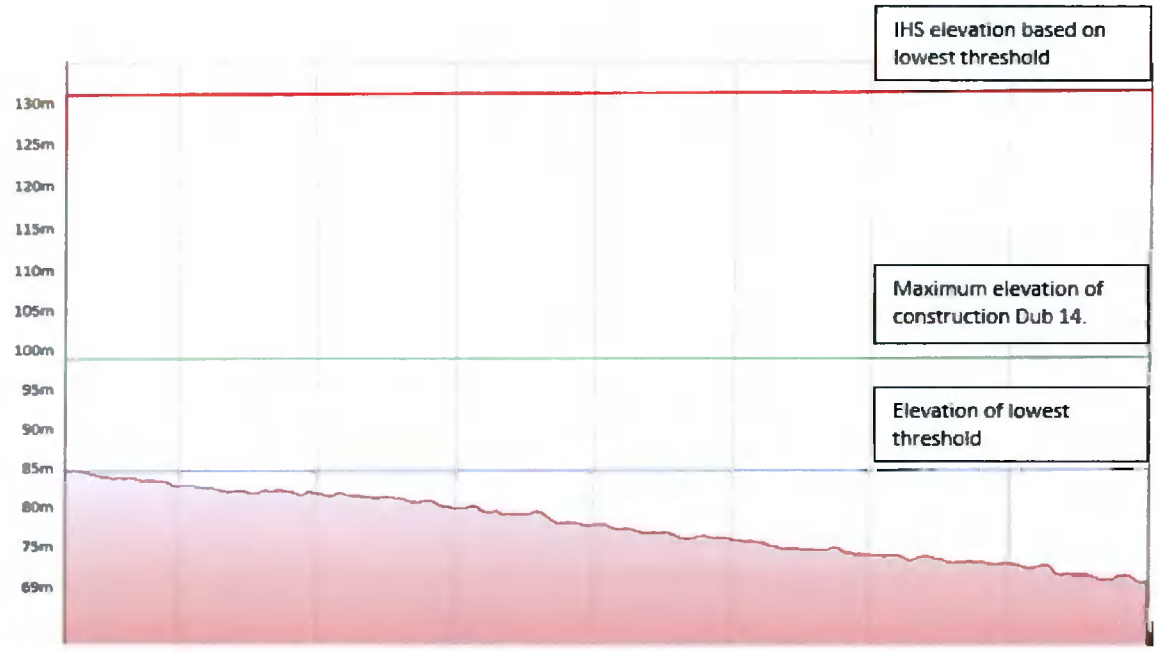

Figure 5 - illustration of the IHS above maximum construction elevation at Dub 14 based on a lowest threshold datum. Heights amsl. Not to scale

Additionally within the SDCC Development Plan, Section 7.8.0, page 136 states:

[9] These are the extreme values that could be used for the purposes of a specified datum. If any of the other datums permitted under ICAO and EASA regulation are used the resulting clearances between the IHS and the constructed infrastructure at either site will be between the illustrated results for each site.

Additionally, the Department of Defence applies two further restricted areas of its own, a circular 'Inner Zone' of 2km radius, and a 'Security Zone' more closely aligned with the flight strips, which are the areas around the runways.

The Inner Zone

This is defined within the SDCC Plan at Section 7.8.1, page 137, IE8 Objective 5 states that due to the volume of helicopter operations and aircraft movements:

> *" Within the Department of Defence Inner Zone (delineated on Development Plan Index Map), in addition to the Obstacle Limitation Surfaces for the Aerodrome, no buildings or structures exceeding 20m in height above ground level should be permitted except where specifically agreed following consultation with the Department of Defence that the proposed development will not affect the safety, efficiency or regularity of operations at the aerodrome."*

with further explanation at page 230, but which appears to apply this Inner Zone only to structures such as high mast lighting and antennae. Variation No2 to the Development Plan then, again, refers to buildings. The requirement for this additional safeguarding surface would appear to be based on aircraft operations rather than as part of any security measure.

It is noted that this Inner Zone is in addition to the globally adopted and regulated obstacle limitation surfaces and designated Public Safety Zones. We are not aware of equivalent any zone, established in additional to the established protective surfaces, in place in Europe or North America. There are similar zones within Indian, Liberian and Ghanan regulation and guidance but there is little, if any, direct read across to what the IAC have implemented at Baldonnel Casement. We have examined the Building Restricted Area policies in place within Federal Aviation (FAA) Regulation in America, within EASA Regulation for Europe, UK Civil Aviation Authority, Australian Civil Aviation Authority, amongst others, and can find no commensurate Inner Zone applied by either civil or military regulators. Consequently, the criteria and methodology for the application of this are unclear. From the SDCC Plan it is not readily apparent how the Inner Zone is to be applied laterally, and from what point the vertical datum is to be applied, in determining the 20m building limitation. Furthermore, the restrictions specified within the Inner Zone as detailed within the Plan, are not consistent with additional comments with Variation No2, Section 2, which states that

> *".....development of 20m in height would normally be permissible in most areas (from an aviation safeguarding point of view). Additional heights may also be possible below the 110m contour (depending on actual ground elevation)* ***up to the elevations of the lowest Obstacle Limitation Surface (i.e. the Inner Horizontal Surface or the Conical Surface for either Weston or Casement Aerodromes as indicated on Index Map)."*** (emphasis added)

In general, in terms of aviation regulation and guidance, it would appear that the consensus policy is that any such zoning restrictions, additional to OLS, can only be applied where airport

operators or sponsors have direct jurisdictional control over uses of property and land in the vicinity of airports/aerodromes. Such operators can request to be consulted over development within areas near their facility but they are not vested with a right of veto for development outside the obstacle limitation zones or, if one is in place, their agreed safeguarding map. This is not, by any means, to seek to reduce the compatibility of the operation of the aerodrome with development in the area but the accepted standard, globally, are the mandated obstacle limitation surfaces and the compliance requirements within those. Many countries have established enhanced Public Safety Zones, determined by risk assessment methods, around aerodromes and airports but most extend the current regulations further into the approach path. In Europe, the regulators in Ireland, the UK and The Netherlands, and in the USA, have a history of enhancement to existing measures based on such factors as permanent population density, temporary/transitory population (work sites), number of aircraft movements etc. but which are in relation to the runway strip, more akin to the dimensions of the Casement Security Zone.

Without a specified reference datum the methodology of the 20m height restriction is not fully understood and it is, therefore, slightly problematic to prove any lack of infringement of that without knowing what aerodrome datum that 20m height above ground level at the development is to be measured against. It cannot, logically, solely be above ground level at the location of any development in question otherwise e.g. a building 19.9m above ground level 2.0km to the south-east at Cooldown Commons on ground elevation 105m amsl would not be subject to the required assessment by IAC where as a building, for example, in Dub 14 on the proposed development site and at an elevation of approximately 68 metres would require consent even the though the maximum elevation extent of the former is approximately 37 metres higher than the latter and is much closer to the IHS.

Similarly, the 2km distance is not defined from a specific point, e.g. the proposed building at Dub 14 would fall into the category needing IAC approval if the measurement is from the Airfield Reference Point (ARP) but would remain outside the 2km consultation if the threshold of runway 10 is used as the elevation datum.

However, if it is accepted that the 20m building height is to be applied then it is possible to consider that as a hypothetical additional safeguarding consideration. This is done without prejudice. If the lowest threshold is assumed to be the reference datum for the 20m building restriction (as it seems to be for the other OLS) then, with a threshold elevation of 86.25m, the restriction would place the maximum elevation of any building within 2km of 106.25m amsl (20m above threshold elevation runway 10). The maximum constructed elevation of the proposed development is at Dub 14 at an elevation of 98.0m amsl; the proposed development will be well below any IAC requirement for a 20m building height restriction within 2km, even for the lowest possible reference datum.

The Security Zone surrounding Baldonnel Casement Aerodrome

Security of the aerodrome is not an aviation safeguarding matter and the methods and measures enforced to meet that security requirement is a matter solely for DoD and GoC IAC.

The Effects Of Emissions/Exhaust Plumes

The IAC have not objected to the proposed development on the basis of the effects from the proposed plumes/flues but are seeking further information on the potential effects that might arise.

AWN Consulting have prepared a technical assessment of the plumes that can be associated with the proposed development. This section should be read in conjunction with that work. In recent years there has been significant research on the potential aviation consideration in relation to flues/plumes/stacks following initial Federal Aviation Authority (FAA) involvement and trials. Within aviation the accepted modelling on the potential affects are (a) MITRE - Expanded Model For Determining The Effects of Vertical Plumes On Aviation Safety and, (b) the Australian Civil Aviation Safety Authority Guidelines For Conducting Plume Rise Assessments (2012 *et al*) and studies and modelling techniques by Cambridge environmental Research Consultants.

The AWN Consulting research concludes that the maximum combined risk zone for all parameters of oxygen, temperature and vertical velocity is 6m above the top of the proposed development. In applying those findings to aviation operations at Baldonnel Casement it should be explained that there are two forms of conduct of flights and the conditions and circumstances under which they may/must be adopted.

In simple terms:

- Visual Flight Rules (VFR) flight is when the pilot operates the aircraft in weather conditions which are clear enough to allow him to see where the aircraft is going and to see other aircraft, terrain and obstacles such that he can "see and avoid" anything representing a risk of collision or hazard to the aircraft. These weather conditions are known as Visual Meteorological Conditions (VMC).

- When flight under VFR is not possible due to weather or when the airspace classification demands it flights can be conducted under Instrument Flight Rules (IFR). The main purpose of flight in Instrument Meteorological Conditions (IMC) is to ensure safe separation of aircraft when the pilot cannot see or when traffic conditions are complex enough to demand ATC control.

It is fair to say that, in general, aviators would prefer to have a landscape free from any man made obstructions such as power lines, radio masts, power station cooling towers, wind turbines etc.; however, this is not a realistic ambition. Tall obstructions are part of the modern day life and, so that pilots can avoid collision with such obstructions, there are Rules of the Air which must be obeyed; these rules are a matter of law and it is a criminal offence to contravene them. It is often the case that pilots have concerns in respect of developments close to airfields based on their understanding of what constitutes an obstruction or their perception of potential interference with flight. It is down to the developer to ensure that there can be no effect from proposed development and to illustrate that, conclusively, to

aircrew but, setting aside the emotion which can often pervade such concerns, it is necessary to examine and understand what the regulations actually state.

S.I.72/2004 Irish Aviation Authority (Rules of the Air) Order 2004 states that the minimum heights that can be flown are no closer than 150metres (500ft) to any person, vehicle, vessel or structure, or at a height less than 150 metres (500ft) above the ground or water.

These IAA Rules of the Air are the minimum that should be flown and that minimum height and avoidance of obstacles should be used to assess potential effects. Consequently, unless in very remote areas, pilots will fly at a minimum of 150m (500ft) above ground level (agl) since it is impossible to guarantee the Requirement that an aircraft shall not be flown less than 150m (500) feet above the highest obstacle (which could be a fence, mast, structure) by simple visual observation alone unless in remote areas that have been previously cleared.[10]

It is important to note the distance of 150m (500ft) is measured in any direction, not just the vertical and pilots are required by law to plan their flights in such a way that they do not fly closer than 500 feet to any obstacle **except** when landing or taking-off in accordance with normal aviation practise; this exemption applies to aircraft in the visual circuit (although good airmanship would dictate that any vertical obstacle is not directly overflown). In any instance where it is felt that an aircraft has breached the Rules of the Air the Irish Aviation Authority/DoD may be able to investigate the matter and, where it is appropriate, take legal/disciplinary action.

The proposed development is well clear of any of the instrument approach paths as defined with the OLS; only VFR flight should be assessed. Within the vicinity of the aerodrome the Inner Horizontal Surface is established to ensure safe visual manoeuvring of aeroplanes prior to landing.

Procedures at Baldonnel Casement, as detailed in the IAA AIP aerodrome section, state that fixed wing circuits are normally to be carried out at 1300ft QNH with helicopters operating in the vicinity of the aerodrome to do so not above 800ft QNH[11]. Helicopters joining the circuit will route to the airfield at 800ft QNH and do so at one of the visual holding points delineated on the aerodrome chart. (It is presumed that this is to ensure separation on any fixed-wing operations above the helicopter whilst ensuring separation from terrain, obstacles, for noise abatement reasons and to ensure that there is sufficient space to ensure that there is no hazard presented to people or property caused by rotor downwash effects.) These are VFR procedures in airspace protected from obstacles by the established IHS.

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[10] It should be noted that, within Ireland, military air bases, personnel and flight operations are regulated in accordance with regulations established by the Director of Military Aviation (GOC Air Corps), which are not required to comply with civil regulations and that IAC operations are in accordance with Air Regulations Manuals.

[11] 1300ft QNH equates, approximately, to 1000ft above aerodrome ground level, 800ft QNH equates, approximately, to 500ft above aerodrome ground level.

If the figures calculated previously in determining the clearance between the physical building and the IHS are used then by adding the determined maximum combined risk zone of 6m to the maximum construction elevation the maximum elevation of any plume effect and the clearance between that and the IHS can be determined.

Dub 14

The clearance between the maximum extent of any plume and the IHS will be:

- 38.23m if the IHS datum is aerodrome elevation
- 27.23 if the IHS datum the lowest published threshold elevation

Dub 15

The clearance between the maximum extent of any plume and the IHS will be:

- 43.89m if the IHS datum is aerodrome elevation
- 32.98 if the IHS datum the lowest published threshold elevation

Given that the emissions from the flues will dissipate so quickly and so far below the IHS they can have no effect on the visual manoeuvring of aircraft preparing to land and flying, safely and professionally above that IHS as they are required so to do. The findings of AWN in their site specific modelling have determined that the effects of any plume would have completely dissipated within 6m maximum extent; the effects of any plume should not add to, or complicate the extant aviation considerations. Regardless of the Regulations to which the IAC or any aircraft inbound to Baldonnel Casement fly, the existing regulations should preclude the flight being affected by the stack or the plume; in avoiding the existing hazards the aircraft should always be well clear of the plumes.

Irrespective of the separation between the IHS and the flue, for the lowest case, namely that of helicopters at 800ft QNH, the procedures at Baldonnel Casement should ensure an approximate vertical separation between the helicopter and the maximum extent of the plume of 500ft as it does for other development in the area such as the nearby Pfizer plant which is believed to be taller. (The accurate extent of vertical separation will depend on barometric pressure.) There can be no effect on aircraft operations at Baldonnel Casement for aircraft operating within the published procedures at Baldonnel Casement and/or applying the recognised avoidance criteria for building and such flues. Adherence to published obstacle clearances must be practiced by all aviators, whether in the vicinity of an aerodrome or not, as not do so would be detrimental to flight safety and any aircraft flying at or closer than 6m separation from the proposed buildings is inconceivable.

Conclusions

In addressing the request for further information there are three distinct elements, in terms of safeguarding and the safe operation of aircraft at Baldonnel Casement, given the proposed development, namely the OLS, the Inner Zone and the effect of any plume.

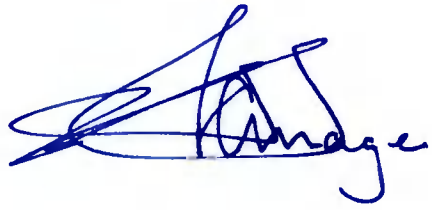
In respective of OLS it is the Inner Horizontal Surface which is the relevant plane to be considered. There is some conflating of aviation terms within the SDCC Development Plan and, in the absence of a specified datum on which to base that IHS, two values representing the extremes of maximum and minimum possible datums were used. In all possible configurations of maximum building elevation against IHS the proposal does not infringe on the OLS for the aerodrome.

In respect of the Inner Zone applied by the IAC at the aerodrome the assessment has been complicated by the lack of available information regarding the datums, lateral and vertical, to be used in the application of that zone. There is no comparable defined zone within any extant aviation regulation in the public domain against which the proposed development could be assessed. In applying requirement in the most restrictive means (to the development) which could be envisaged the report determined the maximum and minimum clearances for the proposed development against this additional IAC safeguarding zone. The proposed development should not infringe this local additional OLS.

In respect of the plumes the AWN Consulting research has concluded that any effects will have completely dissipated within 6m. In an aviation sense, the implications are clear; any plume will not affect any OLS nor would any aircraft be flown within 6m of the building. To do so would create an inexplicable flight safety hazard to the aircrew and people on the ground. There should be no impact on operations at Baldonnel Casement based on the 6m plume.

To put these considerations in perspective there are developments in the immediate vicinity of the proposed development which are comparable in terms of building height and with similar flue stacks and which are similarly below the IHS and which do not appear to have affected operations at Baldonnel Casement.

Security of the aerodrome, and the methods and measures enforced to meet that security requirement, is a matter solely for DoD and GoC IAC.



Aviation Consultant
DBS Consulting
shane.dbsconsulting@outlook.com

References

South Dublin County Council (SDCC) Development Plan 2016 - 2022

Variation No2 to the Above

South Dublin County Council's Planning & Development Act, 2000 (As Amended) And Planning Regulations Thereunder, (Decision Order Number 0006), Dated 6 January 2021

IAA IAIP Dated 3 Dec 2020

Irish Aviation Authority (Standardised Rules Of The Air) Order, 2019, S.I. No 266 Of 2019

IAA Aerodrome Licensing Manual Dated January 2014, Aeronautical Services Advisory Memorandum Dated January 2015 *Et Al.*

Si72/2004 Irish Aviation Authority (Rules Of The Air) Order 2004 *Et Al*

ICAO Annex 14 To The Chicago Convention

ICAO European Guidance Material On Managing Building Restricted Areas

EASA CS-ADR-DSN Issue 4, Aerodrome Design

UK Civil Aviation Authority, Safety And Airspace Regulation Group, Safeguarding Of Aerodromes Cap 738, 2020

Federal Aviation Authority Safety Risk Analysis Of Aircraft Overflight Of Industrial Exhaust Plumes, January 2006.

Federal Aviation Authority Safety Risk Analysis Of Aircraft Overflight Of Industrial Exhaust Plumes, January 2006. Abstract, Page Ii.

FAA Memorandum, Technical Guidance And Assessment Tool For Evaluation Of Thermal Exhaust Plume Impact On Airport Operations September 2015

CASA (2012) Guidelines For Conducting Plume Rise Assessments Ac139-05(1) April 2012

CRC (2016) Adms-5 User Guide

MITRE (2012) Expanded Model For Determining The Effects Of Vertical Plumes On Aviation Safety

N.B. THIS REPORT IS AS SUBMITTED FOR APPLICATION OF APPROVED SCHEME SD20A\0283

INCLUDED WITH THIS APPLICATION **FOR REFERENCE ONLY**

*CONTENT & SCOPE OF REPORT IS UNCHANGED & UNAFFECTED BY SCOPE OF PROPOSED DEVELOPMENT I.E. BY THE MODIFICATIONS PROPOSED TO THE APPROVED SCHEME.

FORGESOLAR GLARE ANALYSIS

Report by Macroworks

FORGESOLAR GLARE ANALYSIS

Project: **Baldonnel/Casement AB**
Site configuration: **Grangecastle**
Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 17:26 on 26 Jan, 2021.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis parameters and observer eye characteristics (for reference only):

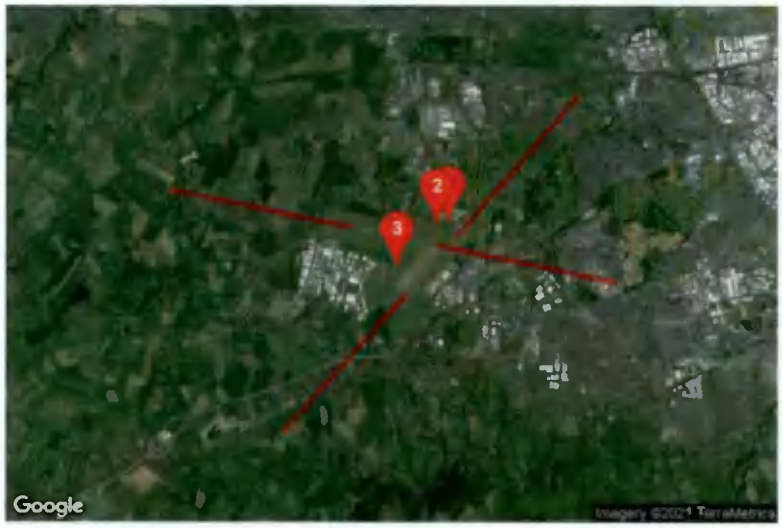
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 48581.3487



PV Array(s)

Name: Admin Building
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.321140	-6.454514	67.70	17.83	85.53
2	53.321144	-6.454758	67.70	19.27	86.97
3	53.321266	-6.454754	67.70	19.27	86.97
4	53.321263	-6.454513	67.70	17.83	85.53
5	53.321140	-6.454514	67.70	17.83	85.53

Flight Path Receptor(s)

Name: Baldonnel 04 Runway
Description: None
Threshold height: 15 m
Direction: 42.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.293853	-6.453457	98.20	15.20	113.40
Two-mile	53.272306	-6.485749	152.40	129.70	282.10

Name: Baldonnel 10 Runway
Description: None
Threshold height: 15 m
Direction: 101.6°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.304625	-6.468289	86.30	15.30	101.60
Two-mile	53.310419	-6.515747	73.70	196.50	270.20

Name: Baldonnel 22 Runway
Description: None
Threshold height: 15 m
Direction: 222.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.303267	-6.439792	93.40	15.20	108.60
Two-mile	53.325072	-6.407981	62.40	214.90	277.30

Name: Baldonnel 28 Runway
Description: None
Threshold height: 15 m
Direction: 281.6°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301694	-6.445155	96.10	15.20	111.30
Two-mile	53.295880	-6.397707	107.60	172.40	280.00

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.305525	-6.441821	90.00	9.00
2-ATCT	2	53.305009	-6.445142	92.30	28.00
3-ATCT	3	53.298162	-6.455575	94.60	25.00

Map image of 1-ATCT

Map image of 2-ATCT

Map image of 3-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Admin Building	30.0	180.0	78	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Baldonnel 04 Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 22 Runway	78	0
Baldonnel 28 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0

Results for: Admin Building

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 04 Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 22 Runway	78	0
Baldonnel 28 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0

Flight Path: Baldonnel 04 Runway

0 minutes of yellow glare

0 minutes of green glare

Flight Path: Baldonnel 10 Runway

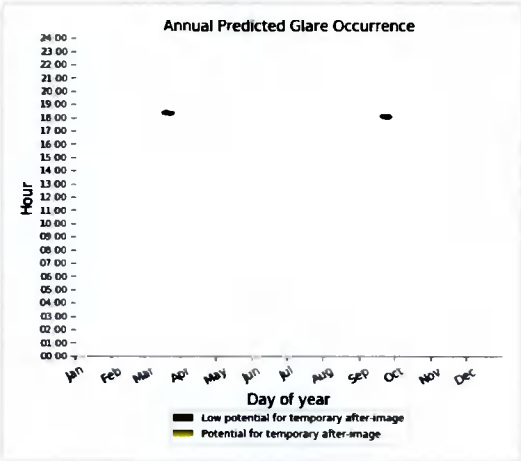
0 minutes of yellow glare

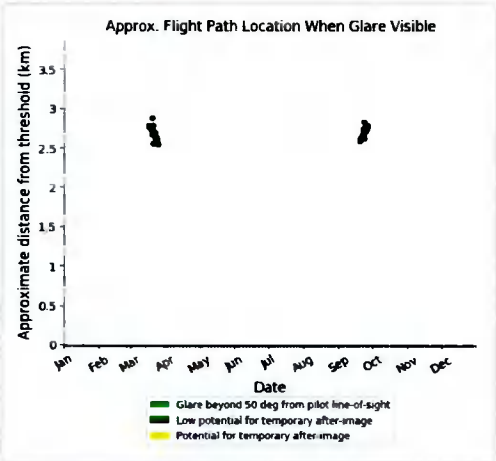
0 minutes of green glare

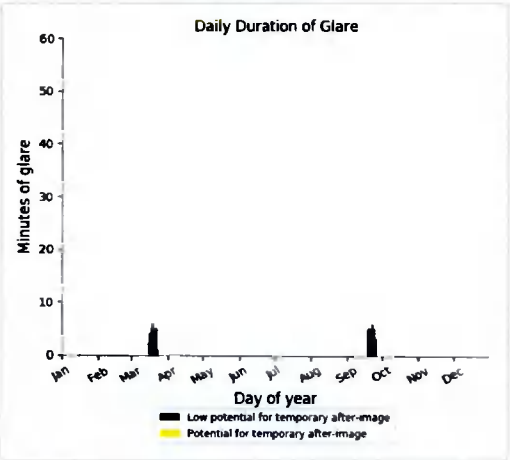
Flight Path: Baldonnel 22 Runway

0 minutes of yellow glare

78 minutes of green glare







Flight Path: Baldonnel 28 Runway

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.