

# Lighting and Marking Plan



# Codling Wind Park Lighting and Marking Plan

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## **Abbreviations**

Abbreviation	Definition
AIS	Automatic Identification System
ASAM	Aeronautical Services Advisory Memorandum
САА	Civil Aviation Authority
САР	Civil Aviation Publication
cd	Candela
CWP	Codling Wind Park
EU	European Union
НАТ	Highest astronomical tide
ΙΑΑ	Irish Aviation Authority
IALA	International Association of Marine Aids to Navigation and Lighthouse Authority
IPS	Intermediate peripheral structure
IRCG	Irish Coast Guard
LMP	Lighting and Marking Plan
m	Metre
m²	Square metre
МАС	Maritime Area Consent
МСА	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MSDA	Marine Safety Demarcation Area
mm	Millimetre
MSO	Marine Survey Office
nm	Nautical mile
NVIS	Night Vision Imaging System
OREI	Offshore renewable energy installation
OSS	Offshore substation
s	Second
S.I.	Statutory Instrument
SAR	Search and rescue

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Abbreviation	Definition	
SPS	Significant peripheral structure	
UK	Jnited Kingdom	
UPS	Uninterrupted power supply	
WGS84	World Geodetic System of 1984	
WTG	Wind turbine generator (and / or its foundation)	



## 1 Introduction

Codling Wind Park Ltd (hereafter 'the Developer') is the developer of the proposed Codling Wind Park (CWP) Project, a proposed offshore wind farm located in the Irish sea approximately 7 nautical miles (nm) from the coast of County Wicklow, on the east coast of Ireland.

As detailed in Volume 3, **Chapter 16 Shipping and Navigation** and the Navigation Risk Assessment (NRA) process, lighting and marking is a key mitigation to manage hazards to shipping and navigation users.

This Lighting and Marking Plan (LMP) sets out the proposed marine and aviation lighting and marking of the offshore aspects of the CWP Project. The marine and aviation lighting and marking schemes are based on the relevant guidance and recognised industry standards, as set out in **Section 2**, noting that final lighting and marking will be as directed by Irish Lights, the Irish Aviation Authority (IAA), and the Irish Coastguard (IRCG).

Lighting and marking schemes are proposed for both wind turbine generator (WTG) layout options, for which consent is being sought by the Developer.

Further details of the associated layouts are provided in Volume 2, **Chapter 4 Project Description**, with a summary as follows:

- WTG Layout Option A: 75 WTGs and three offshore substations (OSSs); and
- WTG Layout Option B: 60 WTGs and three OSSs.



# 2 Guidance and consultation

This section summarises guidance that has been adhered to in this LMP in relation to both marine and aviation aspects.

The primary guidance for marine lighting and marking is considered to be the International Association of Marine Aids to Navigation and Lighthouse Authority (IALA) G1162 (IALA, 2022). The primary guidance for aviation obstruction lighting is considered to be the IAA Guidance Material on Off-Shore Wind Farms, Aeronautical Services Advisory Memorandum (ASAM) No 18. Issue 2 (IAA, 2015).

Relevant United Kingdom (UK) guidance has also been taken into consideration, where appropriate, notably from the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 and Annexes (MCA, 2021), noting that key stakeholders (including the Marine Survey Office (MSO) and Irish Lights) have indicated that UK guidance should be applied *in lieu* of equivalent Irish guidance, which at the time of writing (March 2024) is in draft format and pending finalisation. The draft guidance closely resembles MGN 654 (MCA, 2021) and therefore aligns with the approach taken for the LMP.

Industry standards of relevance to lighting and marking of offshore wind farms applied in the UK have also been considered and applied where necessary, noting that the guidance detailed below has taken precedence.

#### 2.1 Marine

The marine navigation lighting and marking detailed in **Section 3.1** and **4.1** follows the following guidance documents:

- IALA Recommendations O-139 on the Marking of Offshore Man-Made Structures (IALA, 2021) and Guidance G1162 on the Marking of Offshore Man-Made Structures (IALA, 2022);
- IALA R1001 The IALA Maritime Buoyage System. Edition One. (IALA, 2017); and
- MCA MGN 654 and Annexes Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response (MCA, 2021).

#### 2.2 Aviation

The aviation lighting and marking, including that related to Search and Rescue (SAR), detailed in **Section 4.2** follows the requirements set out in the following guidance documents:

- IAA Guidance Material on Off-Shore Wind Farms, ASAM No 18. Issue 2 (IAA, 2015);
- Statutory Instrument. (S.I.) No. 215/2005 IAA (Obstacles to Aircraft in Flight) Order, 2005 (IAA, 2005).
- MCA MGN 654 and Annexes Offshore Renewable Energy Installations (OREIs) Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA, 2021);



 In particular, SAR Annex 5: Offshore Renewable Energy Installations: Requirements, guidance and operational considerations for SAR and Emergency Response (MCA, 2024).

Civil Aviation Authority (CAA) guidance has also been referenced where relevant, noting that it is mentioned within MGN 654 (MCA, 2021); however, the IAA guidance is applied on a primary basis.

#### 2.3 Consultation

It is noted that, in addition to consideration and compliance with the relevant guidance, the preparation of this LMP has also been informed by consultation with the Marine Survey Office (MSO), Irish Lights and Irish Coast Guard (IRCG), who are considered key stakeholders of relevance to lighting and marking.

The key stakeholder meeting related to lighting and marking occurred with Irish Lights on the 23 October 2023 and its key points are summarised below.

- Irish Lights noted that buoyage may be required to mark gaps on the periphery but that this would depend on the overarching lighting and marking (mitigation agreed to be implemented and included in Table 4.1).
- Irish Lights suggested that there may be a need to remove or move the existing buoyage marking the Codling Bank depending on the final layout (mitigation agreed to be implemented and included in Table 4.1).
- Irish Lights stated that an Automatic Identification System (AIS) may be required on selected turbines, especially at the corners (mitigation agreed to be implemented and included in Table 4.1).

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# **3 Construction phase**

This section describes the marine (**Section 3.1**) and aviation (**Section 3.2**) lighting and marking to be implemented during the construction phase.

#### 3.1 Marine

The marine lighting and marking to be implemented during the construction phase is summarised in **Table 3.1**, which also includes a guidance column, listing the relevant guidance / stakeholder for each lighting and marking aspect where appropriate, noting that the guidance provides the full proposed technical specifications.

Construction buoyage shall be established eight weeks prior to the CWP Project commencing construction to allow time for passing traffic to become familiar with the buoyed construction area, noting that this is in accordance with best practice. The buoyage shall remain in place until the operational marking requirements have been installed, then inspected and passed by Irish Lights. Precise buoyage locations will be as directed by Irish Lights, noting that it is anticipated that they will be located within the Marine Safety Demarcation Area (MSDA), as illustrated in **Figure 3.1**.

The Developer will seek statutory sanction from Irish Lights in advance of the establishment, alteration, or removal of any aid to navigation.

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### Table 3.1: Construction phase lighting and marking

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Lighting and marking aspect	Relevant structures	Specifications	Relevant guidance or stakeholder requirements
Temporary construction lighting	All WTGs and OSSs	<ul> <li>All structures marked with a temporary light during construction and until operational lighting is commissioned.</li> <li>Yellow 2.5 second (s) flash (FL. Y. 2.5s).</li> <li>At least 2 nm range.</li> <li>360° visibility (multiple lights per structure may be required to achieve this).</li> </ul>	<ul> <li>UK Industry Standard</li> </ul>
Construction buoyage – numbers and types	Marking periphery of array site	<ul> <li>Buoy types as directed by Irish Lights.</li> <li>At least 5 nm range.</li> <li>Pillar shaped.</li> <li>Some buoys may be required to transmit via AIS.</li> <li>Removed once Irish Lights have confirmed that they are happy with operational lighting and marking.</li> <li>Positions as directed by Irish Lights but anticipated to be within the 'Marine Safety Demarcation Area'.</li> <li>Up to 15 construction buoys anticipated.</li> </ul>	<ul> <li>UK Industry Standard</li> <li>IALA R1001 – The IALA Maritime Buoyage System. Edition One. (IALA, 2017)</li> </ul>



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#### Figure 3.1: MSDA overview





#### 3.2 Aviation

No specific aviation lighting and marking will be implemented during the construction phase as risks are managed via promulgation of information, with relevant information on the CWP Project be provided to aviation stakeholders (noting this aligns with UK industry standard practice). In particular, as required under S.I.215/2005 (IAA, 2005) (see **Section 2.2**), the IAA will be notified of any *en-route* obstacles (including mobile cranes) above 45 m in height, giving at least 30 days' notice, or as soon as is practicable if 30 days' notice cannot be provided.

The following details will be provided:

- Geographic latitude;
- Geographic longitude;
- Elevation; and
- Height.

Further, in line with ASAM No 18 (IAA, 2015), at least three months in advance of the installation of the WTGs and OSSs, the following information will be supplied to the IAA:

- Positional data representing the estimated position of each machine or structure (WTGs and OSSs) to be erected. The geodetic datum to which all obstructions shall be referred is the World Geodetic System of 1984 (WGS84). Co-ordinates will be provided in degrees, minutes, seconds, and decimals of a second, as appropriate;
- The estimated maximum elevation of each structure (WTG and OSS) in feet and metres;
- Proposed lighting details for each structure;
- Proposed marking details for each structure;
- Whether it is proposed that a radar enhancer / transponder / reflector or radar / AIS is to be fitted;
- Minimum and maximum spacing between structures (WTGs and OSSs);
- Planned earliest date of erection; and
- Any other information considered relevant for air navigation.



# 4 **Operational phase**

This section presents the marine (**Section 4.1**) and aviation (**Section 4.2**) lighting and marking to be implemented during the operational phase.

### 4.1 Marine

The marine operational lighting and marking to be implemented for the WTGs and OSSs are summarised in **Table 4.1** and **Table 4.2**, respectively. These include a guidance column listing the relevant guidance / stakeholder for each lighting and marking aspect where appropriate, noting that this guidance will provide the full technical specifications required by the relevant stakeholders. The proposed marine lighting and marking is then illustrated in **Figure 4.1** for Layout A and **Figure 4.2** for Layout B.

The Developer will seek statutory sanction from Irish Lights in advance of the establishment, alteration, or removal of any aid to navigation.

#### 4.1.1 Failure of marine lighting

The Developer will ensure that appropriate redundancy and / or back-up capability is utilised to ensure the appropriate IALA availability categories, as set out in **Table 4.1** and **Table 4.2**, are met. In the event of a significant loss of an aid to navigation such that a significant risk to navigation is considered likely to occur, consultation shall be undertaken with Irish Lights, IRCG, and the MSO to determine the need for any additional mitigation, which may include the promulgation of navigational warnings, deployment of temporary aids to navigation or use of a guard vessel.

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### Table 4.1: Operational phase WTG marine lighting and marking summary

Lighting and marking aspect	Relevant structures	Specifications	Relevant guidance or stakeholder requirements
Significant peripheral structure (SPS) lighting	Select peripheral structures	<ul> <li>Marine lights marking selected periphery WTGs as required under IALA.</li> <li>Yellow 5 s flash;</li> <li>At least 5 nm range;</li> <li>360° visibility;</li> <li>Synchronised;</li> <li>Located not less than 6 m and not more than 30 m above highest astronomical tide (HAT), and below the lowest point of any arc of rotor blades;</li> <li>At least IALA Category 2 (&gt; 99.0%); and</li> <li>At least 96 hours back up / uninterrupted power supply (UPS) capability.</li> <li>If directed by Irish Lights, select peripheral structures not marked as SPS may be marked as intermediate peripheral structures (IPS) as per IALA G1162 (IALA, 2022).</li> </ul>	<ul> <li>IALA G1162 (IALA, 2022).</li> </ul>
Hazard Warning Signals	Select peripheral structures	<ul> <li>Deployed if directed by Irish Lights;</li> <li>Located not less than 6 m and not more than 30 m above HAT;</li> <li>Minimum range of two nm;</li> <li>Character Mo (U) 30 s with a minimum duration for the short blast of 0.75 s; and</li> <li>Operated when the meteorological visibility is 2 nm or less.</li> </ul>	<ul> <li>IALA G1162 (IALA, 2022).</li> </ul>

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Lighting and marking aspect	Relevant structures	Specifications	Relevant guidance or stakeholder requirements
AIS	Select peripheral structures	<ul> <li>At least IALA Category 3 (&gt; 97.0% availability).</li> </ul>	<ul> <li>IALA G1162 (IALA, 2022).</li> </ul>
ID marker boards	All structures	<ul> <li>ID system will be agreed with Irish Lights and IRCG;</li> <li>ID panels with black letters on yellow background;</li> <li>Letters 1 m high;</li> <li>Visibility in all directions; and</li> <li>Illuminated by a low intensity light:         <ul> <li>Uniformity factor – better than 1:4</li> <li>Mean luminance – 5 cd/m<sup>2</sup> ≤ Lmean ≤ 10 cd/m<sup>2</sup></li> <li>Colour temperature – 2500 K–3500 K</li> <li>Hooded or baffled to avoid unnecessary light pollution or confusion with navigation marks.</li> </ul> </li> </ul>	<ul> <li>IALA G1162 (IALA, 2022).</li> <li>MGN 654 (MCA, 2021).</li> </ul>
WTG paint	All structures	<ul> <li>Foundations painted yellow (RAL 1023) all round from HAT to a height of at least 15 m above HAT; and</li> <li>Remainder painted light grey (RAL 7035).</li> </ul>	<ul> <li>IALA G1162 (IALA, 2022); and</li> <li>UK Industry standard.</li> </ul>
Operational buoyage	In proximity to array site	<ul> <li>This may be the establishment of new cardinal /special marks, or the alteration of position of currently existing cardinal marks; and</li> </ul>	<ul> <li>IALA R1001 – The IALA Maritime Buoyage</li> </ul>

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Lighting and marking	Relevant	Specifications	Relevant guidance	or
aspect	structures		stakeholder requirements	s
		<ul> <li>Requirements will be discussed with Irish Lights prior to the operational phase.</li> </ul>	System. Edition (IALA, 2017)	One.

#### Table 4.2: Operational Phase OSS Marine Lighting and Marking Summary

Lighting and Marking	Relevant	Specifications	Relevant Guidance or Stakeholder
Aspect	Structures		Requirements
ID marker boards	All OSSs	<ul> <li>ID system will be agreed with Irish Lights and IRCG, noting that it will align with the requirements of MGN 654 (MCA, 2021), i.e., a "spreadsheet" format, e.g., A01, A02, A03, B01, B02, B03, etc.);</li> <li>ID panels with black letters on yellow background;</li> <li>Letters 1 m high;</li> <li>Visibility in all directions; and</li> <li>Illuminated by a low intensity light: <ul> <li>Uniformity factor – better than 1:4</li> <li>Mean luminance – 5 cd/m<sup>2</sup> ≤ Lmean ≤ 10 cd/m<sup>2</sup></li> <li>Colour temperature – 2500 K</li> </ul> </li> </ul>	<ul> <li>IALA G1162 (IALA, 2022).</li> <li>MGN 654 (MCA, 2021).</li> </ul>



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Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or Stakeholder Requirements
		<ul> <li>Hooded or baffled to avoid unnecessary light pollution or confusion with navigation marks.</li> </ul>	
Substation paint	All OSSs	<ul> <li>Foundations painted yellow (RAL 1023) all round from HAT to a height of at least 15 m above HAT; and</li> <li>Remainder painted light grey (RAL 7035), excludes topside structures such as work cabins, cranes etc.</li> </ul>	<ul> <li>IALA G1162 (IALA, 2022); and</li> <li>UK Industry standard.</li> </ul>

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#### Figure 4.1: Marine operational lighting and marking, Layout A



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Figure 4.2: Marine operational lighting and marking, Layout B





#### 4.2 Aviation

The aviation operational lighting and marking to be implemented for the WTGs and OSSs are summarised in **Table 4.3** and **Table 4.4**, respectively. These include a guidance column listing the relevant guidance / stakeholder for each lighting and marking aspect where appropriate, noting that this guidance provides the full technical specifications required by the relevant stakeholders. The proposed aviation lighting and marking is then illustrated in **Figure 4.3** for Layout A and **Figure 4.4** for Layout B.

The key IAA guidance is ASAM No 18 (IAA, 2015), which provides aviation lighting requirements for offshore wind farms that are not located:

- within 8 nm of publicly licensed aerodromes;
- within 32 nm of Air Navigation Services Radar and other radio navigation facilities; or
- within 4 nm of any permanent offshore helipads.

The array site satisfies these criteria and therefore IAA guidance ASAM No 18 (IAA, 2015) applies.

#### 4.2.1 Failure of aviation lighting

ASAM No 18 (IAA, 2015) states that "any light which fails shall be repaired or replaced as soon as is reasonably practicable. An alerting system for light failure will be put in place, such as remote monitoring or other suitable method agreeable to the IAA". Appropriate maintenance and reporting procedures will therefore be discussed and agreed with the IAA, with the expectation being the implementation of an equivalent to the UK industry standard, which is 8 hours UPS, and reporting to IAA if outages expected for longer than 14 days. 
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### Table 4.3: Operational phase WTG aviation lighting and marking summary

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Lighting and	Relevant	Specifications	Relevant guidance or stakeholder
marking aspect	structures		requirements
Aviation warning lighting	All SPS (select peripheral structures)	<ul> <li>In accordance with the International Civil Aviation Organisation Annex 14 standards, on a 24-hour basis, high-intensity Type A lighting will be required. The hazard warning lights will have the following specification: <ul> <li>Mounted on the highest point practicable of the structure;</li> <li>White with flash rate of 40–60 flashes per minute;</li> <li>Effective intensity of: <ul> <li>200,000 candela (cd) ± 25% when background luminance above 500 cd per square metre (m<sup>2</sup>);</li> <li>20,000cd ± 25% when background luminance between 50 and 500 cd/m<sup>2</sup>; and</li> <li>at least 2,000 cd when background luminance below 50 cd/m<sup>2</sup>.</li> </ul> </li> <li>Light fittings baffled so that practically no light will be emitted below the horizontal, or as otherwise agreed with the IAA;</li> <li>All lights across the array site will flash in synchronisation and reductions in light intensity will occur simultaneously if practicable;</li> </ul> </li> </ul>	ASAM No 18 (IAA, 2015) It is noted that there are potential intentions to align with the approach taken in the wider European Union (EU) or in the UK. Given that the draft guidance closely resembles MGN 654 (MCA, 2021), as detailed in <b>Section 2</b> , UK requirements for aviation lighting under CAA Civil Aviation Publication (CAP) 764 (CAA, 2016) are provided for reference in Appendix A.

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Lighting and marking aspect	Relevant structures	Specifications	Relevant guidance or stakeholder requirements
		<ul> <li>Visible through 360° in azimuth; and</li> <li>Compatible with Night Vision Imaging System (NVIS).</li> </ul>	
SAR lights	All structures	<ul> <li>SAR lighting is an MCA requirement for UK projects under MGN 654.</li> <li>Specifications shown as per MGN 654: <ul> <li>200 cd red light, steady when in use, off otherwise;</li> <li>Remotely controllable;</li> <li>360° visibility; and</li> <li>Compatible with NVIS.</li> </ul> </li> </ul>	MGN 654 (MCA, 2021)
Blade markings	All WTGs	<ul> <li>Specification under MGN 654:</li> <li>Red marks (preferably dots) at 10, 20 and 30 m from hub end;</li> <li>Displayed near trailing edge of blades;</li> <li>Contrasting colour to blades, recommended red (RAL 3020);</li> <li>Minimum 600 millimetres (mm) in diameter; however, may need to be larger dependent on overall size, shape of turbine and blades; and</li> <li>Blade tip also marked in red (RAL 3020), approximately 2% of blade length.</li> </ul>	MGN 654 (MCA, 2021)
ID markings	All WTGs	<ul> <li>ID numbers will be marked on the WTG nacelle roofs.</li> </ul>	MGN 654 (MCA, 2021)

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Lighting and marking aspect	Relevant structures	Specifications	Relevant guidance or stakeholder requirements	
		<ul> <li>ID system will be agreed with Irish Lights and IRCG.</li> <li>Not less than 1.5 m in height, with proportional width.</li> </ul>		
Hoist area lighting and marking	Intended that UK	nded that UK standards under CAP 437 (CAA, 2023) will be applied.		

#### Table 4.4: Operational phase OSS aviation lighting and marking summary

Lighting and marking	Relevant	Specifications	Relevant guidance or stakeholder
aspect	structures		requirements
SAR Lights	All OSSs	<ul> <li>SAR lighting is an MCA requirement for UK projects under MGN 654. Specifications shown as per MGN 654:</li> <li>200 cd red light, steady when in use, off otherwise;</li> <li>360° visibility; and</li> <li>Compatible with NVIS.</li> </ul>	MGN 654 (MCA, 2021)

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Lighting and marking aspect	Relevant structures	Specifications	Relevant guidance or stakeholder requirements
ID Markings	All OSSs	<ul> <li>ID numbers will be marked such that they are recognisable from an aircraft flying 500 feet (152 m) above the highest part of the structure, likely adjacent to heli hoist platform.</li> <li>ID system will be agreed with Irish Lights and IRCG.</li> <li>Not less than 1.5 m in height, with proportional width.</li> </ul>	MGN 654 (MCA, 2021)
Hoist area markings	Intended that UK standards under CAP 437 (CAA, 2023) will be applied, if agreed with IAA.		

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Figure 4.3: Aviation operational lighting and marking, Layout A



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#### Figure 4.4: Aviation operational lighting and marking, Layout B

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# Appendix A UK CAA aviation hazard lighting requirements

As detailed in **Section 4.2**, there are potential intentions to align with the approach taken in the wider EU or in the UK for aviation lighting, given that the upcoming wind farm guidance is understood to closely resemble MGN 654 (MCA, 2021), as detailed in **Section 2**.

Therefore, for reference, a summary of UK requirements for aviation hazard lighting under CAA CAP 764 (CAA, 2016) is detailed as follows:

- Red 2,000 cd light displayed at night<sup>1</sup>.
- Dimmable to 200 cd when visibility is greater than 5 km at night.
- Off during the day.
- Synchronised flashing Morse 'W'<sup>2</sup>.
- 360° visibility.
- Compatibility with NVIS.
- If agreed with CAA, lights located only on periphery structures. Such lighting, where achievable, shall be spaced at longitudinal intervals not exceeding 900m.

UPS of 8 hours required to maintain all aviation warning lights<sup>3</sup>.

<sup>&</sup>lt;sup>1</sup> Definition of night / day as per Air Navigation Order (CAA, 2016)

<sup>&</sup>lt;sup>2</sup> Industry standard, from CAP 764: "To resolve concerns from the maritime community, work has been undertaken to develop an aviation warning lighting standard which is clearly distinguishable from maritime lighting. Where it is evident that the default aviation warning lighting standard (article 220) may generate issues for the maritime community, a developer can make a case, that is likely to receive CAA approval, for the use of a flashing red Morse Code Letter 'W' instead".

<sup>&</sup>lt;sup>3</sup> Not specified in CAP 764, but recognised as the industry standard and a CAA requirement.