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Australian Government
Civil Aviation Safety Authority

MULTI-PART ADVISORY CIRCULAR AC 139.E-01 AND AC 175.E-02 V2.0

Objects and structures that affect aviation safety

File ref: D25/101024

August 2025

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Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to Elders past, present and emerging.

Artwork: James Baban.

Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

This advisory circular (AC) applies to:

- a person who owns, controls or operates an object or structure, including buildings, telecommunications towers and wind turbines
- a person who owns, controls or operates any plant or equipment which may release a hazardous plume into airspace utilised by aircraft
- Airservices Australia (AA)
- certified instrument flight procedure designers
- Department of Infrastructure, Transport, Regional Development, Communication and the Arts
- local government planning bodies
- Commonwealth, State, Territory or local government authorities
- aerodrome operators
- Department of Defence (Defence).

Purpose

The purpose of this AC is to provide guidance to those authorities and persons involved in the planning, approval, erection, extension or dismantling of objects and structures or sources of hazardous plumes so that they may understand the vital nature of the information they provide, in relation to the impact on safety of aircraft operations.

Information on objects and structures is managed by AA. Information is provided to pilots, aircraft operators and a range of aviation organisations so that objects and structures can be identified in the Aeronautical Information Publication (AIP), on aeronautical charts, in NOTAM or included in aeronautical databases.

For further information

For further information or to provide feedback on this AC, visit CASA's contact us page.

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Status

This version of the AC is approved by the National Manager, Flight Standards Branch.

> **Note:** Changes made in the current version are not annotated. The document should be read in full.

Table 1: Status

Version	Date	Details
v2.0	August 2025	This version of this document replaces AC 139.E-01 v2.0 and is the first AC on reporting of tall objects and structures under Part 175 of CASR . It provides updated guidance on the collection and reporting of obstacle data on tall objects and structures. The content of AC 139.E-05 v1.1 - *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome* has been amalgamated into this AC.
v1.0	December 2021	This version of this document replaces AC 139-08 v2.0 - *Reporting of tall structures and hazardous plume sources* and has been renumbered to reflect the Part 139 advisory circular standard practices.
v2.0	March 2018	Revised to reflect requirements in Part 175 of CASR.
(0)	April 2005	Initial AC on this subject.

Contents

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Table 2: Acronyms

Acronym	Description
AC	advisory circular
AGL	above ground level
AIP	Aeronautical Information Publication
ALARP	as low as reasonably practicable
ALoS	Acceptable Level of Safety
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
DAA	Defence aviation area
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communication and the Arts
ICAO	International Civil Aviation Organization
IFPD	instrument flight procedure design
MOS	Manual of Standards
NASF	National Aerodromes Safety Framework
OLS	obstacle limitation surfaces
PANS-OPS	Procedures for air navigation - aircraft operations
RD	rotor diameter
TIFP	terminal instrument flight procedure
VOD	vertical obstruction data

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation have been reproduced for ease of reference, these are identified by 'grey shading'. Should there be a discrepancy between a definition given in this AC and the civil aviation legislation, the definition in the legislation prevails.

Table 3: Definitions

Term	Definition
NOTAM	a notice issued by the NOTAM Office containing information or instructions concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.
obstacles	Fixed (whether temporary or permanent) and mobile objects, structures, and parts of such objects and structures, that: (a) are located on an area intended for the surface movement of aircraft or (b) extend above a defined surface intended to protect aircraft in flight; or (c) stand outside the defined surfaces mentioned in paragraphs (a) and (b) and that have been assessed as being a hazard to air navigation. **Note:** The defined surfaces in b. include obstacle limitation surfaces (OLS) and PANS-OPS surfaces.
obstacle limitation surfaces	A series of planes, associated with each runway at an aerodrome, that defines the desirable limits to which objects or structures may project into the airspace around the aerodrome so that aircraft operations at the aerodrome may be conducted safely
Objects and structures that affect aviation safety	An object or structure: a. that has a maximum height of at least 100 m above ground level; or b. that penetrates an obstacle limitation surface of an aerodrome; or c. that penetrates an obstacle data collection surface, as mentioned in Appendix 8 of Annex 15 to the Chicago Convention; or d. that is an obstacle that is required to be included on an Aerodrome Obstacle Chart—ICAO Type A, as mentioned in Annex 4 to the Chicago Convention; or e. that is an obstacle that is required to be included on an Aerodrome Obstacle Chart—ICAO Type B, as mentioned in Annex 4 to the Chicago Convention; or f. if AA requires data about the object or structure in the interests of aviation safety.
plume rise	A rise in an air mass due to the temperature difference between the point of release (from the stack) and the ambient air. The resultant energy may pose a hazard for aircraft.
Vicinity of an aerodrome	The defined limits of an aerodrome means the area enclosed by the perimeter of the surfaces specified below: a. the surface 45 metres above the elevation of the nearest limit of the landing area and extending horizontally outward for a distance of 3,000 metres; b. the surface extending outward from the end of a landing strip having the following dimensions and slopes: i in the case of an aerodrome open only to aircraft making non-instrument approaches—the width of the landing strip at the landing strip end; a width of 750 metres at a point 3,000 metres outward from the end of the landing strip and a slope of 1 in 40 rising outward from the end of the landing strip; or ii in the case of an aerodrome open to aircraft making instrument approaches—the width of the landing strip at the landing strip end, a width of 1,200 metres at a point 3,000 metres outward from the end of the landing strip and a slope of 1 in 50 rising

Term	Definition
	outward from the end of the landing strip; c. the surface sloping upwards and outwards from the edge of the surface specified in paragraph b. to the intersection with the surface specified in paragraph a. and having a slope of 1 in 7; and d. the surface sloping upwards and outwards from the boundary of the landing area to the intersection with the surface specified in paragraph a. and having a slope of 1 in 7.

1.3 References

Legislation

Legislation is available on the Federal Register of Legislation website https://www.legislation.gov.au/

Table 4: Legislation references

Document	Title
Airports Act 1996	
Part 91 of CASR	General operating and flight rules
Part 139 of CASR	Aerodromes
Part 175 of CASR	Aeronautical information management
Airports (Protection of Airspace) Regulations 1996	
Civil Aviation (Buildings Control) Regulations 1988	
Part 139 Manual of Standards	Aerodromes

International Civil Aviation Organization documents

International Civil Aviation Organization (ICAO) documents are available for purchase from http://store1.icao.int/

Many ICAO documents are also available for reading, but not purchase or downloading, from the ICAO eLibrary (https://elibrary.icao.int/home).

Table 5: ICAO references

Document	Title
ICAO Annex 4	Aeronautical Charts
ICAO Annex 14	Aerodromes
ICAO Annex 15	Aeronautical Information Services
ICAO Doc 8168	PANS-Aircraft Operations (PANS-OPS) Volume II

Document	Title
ICAO Doc 10066	PANS-Aeronautical Information Management (PANS-AIM)

Advisory material

CASA's advisory materials are available at https://www.casa.gov.au/publications-and-resources/guidance-materials

Table 6: Advisory material references

Document	Title
AC 139.E-02	Plume rise assessments
The National Airports Safeguarding Framework - Guideline D	Managing the Risk of Wind Turbines Farms as Physical Obstacles to Air Navigation
The National Airports Safeguarding Framework - Guideline F	Managing the Risk of Intrusions into the Protected Airspace of Airports
AS 3891.1:2021	Air navigation - Cables and their supporting structures - Marking and safety requirements: Part 1: Marking of overhead cables and supporting structures
AS/NZS ISO 31000:2018	Risk Management and Guidelines

2 Background

2.1 Risk to aviation operations

2.1.1 Under regulation 91.265 of the *Civil Aviation Safety Regulations 1998* (CASR), pilots must fly at a minimum height of 1,000 ft over cities or populous areas and under regulation 91.267 of the *Civil Aviation Safety Regulations 1998*(CASR) can fly as low as 500 ft above terrain or obstacles in other areas, with certain exceptions (refer below). Pilots must consider objects and maintain a height of 500 ft above known obstacles. At night, under the Visual Flight Rules (VFR), under regulation 91.277 of the *Civil Aviation Safety Regulations 1998* (CASR), an aircraft must not be flown at a height of less than 1,000 ft above the highest obstacle located within 10 NM of the aircraft vicinity.

2.1.2 However, pilots are permitted to descend below these altitudes during take-off and landing manoeuvres to/from an aerodrome. Subject to regulatory approval, some pilots are also given special permission to fly below 500 ft. Such operations occur throughout Australia and include but are not limited to:

- specialist flying activities (e.g., crop-dusting, cattle mustering, pipeline or powerline inspection, firefighting)
- search and rescue operations
- military low-level flying operations.

2.1.3 The minimum height of 500 ft translates to a height of 150 m AGL (AGL). Therefore, any buildings or structures including wind turbines that are 150 m or more above the ground are generally considered a hazard for aircraft. Under the civil aviation safety regulations all objects 100 m or more AGL are required to be reported and published. Additionally, for low-level civil and military operations other objects and structures below 100 m in height AGL such as power transmission lines can create a hazard given they are very thin and difficult to observe with the naked eye. It is recommended that these objects and structures are reported as well.

2.1.4 Introduced turbulence is also a risk to aircraft operations. Studies have proven that for wind turbines of less than 30 m Rotor Diameter (RD) the wake vortices will impact aircraft located up to 5 RD downwind and 2 RD vertically. Turbulence is site specific and information on wake vortices for different turbines may be available from the turbine manufacturer. Wind farm operators should be aware that depending on size, wind turbines may create turbulence noticeable up to 16 RD from the turbine. However, the level of turbulence and the potential impact on aircraft and aerodrome operations at this distance is not known with certainty. Wind farms can also affect the performance of communications, navigation and surveillance (CNS) equipment operated by AA or Defence.

2.2 Regulatory framework

Part 139 of CASR

2.2.1 Subpart 139.E of CASR has a number of requirements in relation to the determination of hazards to aircraft operations:

- any object or structure that extends to a height of 100 m or more above local ground level, must be notified to CASA by the proponent or owner
- any activity that generates a gaseous efflux with a velocity exceeding 4.3 metres per second must be notified to CASA by the proponent or owner
- CASA may determine that the existing or proposed objects or structures, that are 100 m or more AGL, or gaseous effluxes that exceed 4.3 metres per second, are a hazard to aircraft operations; and

- Additionally, Annex 14 Volume I to the Chicago Convention considers any object that extends to a height of 150 m or more above AGL should be regarded as an obstacle unless an aeronautical study indicates that it does not constitute a hazard. The height of 150 m (500 ft) AGL is consistent with the minimum permissible height for flights over non-populous areas under regulation 91.267 of CASR (lower heights are permitted - refer Paragraph 2.2.1).

Part 175 of CASR

2.2.2 Subpart 175.E of CASR specifies the obstacle data collection and publication requirements about objects and structures that pose a risk to aviation safety, including:

- have a maximum height of at least 100 m AGL
- penetrate the obstacle limitation surface (OLS) of an aerodrome
- penetrate an obstacle data collection surface, as mentioned in Appendix 8 of Annex 15, Aeronautical Information Services to the Chicago Convention on International Civil Aviation
- an obstacle that is required to be included on an Aerodrome Obstacle Chart—ICAO Type A, as mentioned in Annex 4 to the Chicago Convention
- an obstacle that is required to be included on an Aerodrome Obstacle Chart—ICAO Type B, as mentioned in Annex 4 to the Chicago Convention; and
- if AA requires data about the object or structure in the interests of aviation safety.

Airports (Protection of Airspace) Regulations

2.2.3 Around leased federal airports, i.e. (airports regulated under the *Airports Act 1996*), the *Airports (Protection of Airspace) Regulations 1996* also apply. Activities that could penetrate the protected airspace of leased federal airports must be approved before the proposed penetration is permitted to occur. Those regulations require the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (the Department) to assess applications to carry out controlled activities and to impose conditions on any approval granted. The Department may delegate the assessment and approval of temporary intrusions—of less than three months—to the relevant airport operator. The Department may also refuse to approve any activity that affects the safety or accessibility of aircraft operations at leased federal airports. The Department has published National Airports Safeguarding Framework (NASF) Guideline F *Managing the Risk of Intrusions into the Protected Operational Airspace of Airports* to provide guidance to State/Territory and local government decision makers as well as airport operators to jointly address the issue of intrusions into the operational airspace of airports by tall structures, such as buildings and cranes, as well as trees in the vicinity of airports. Further, this Guideline provides advice on activities that could cause air turbulence, where the turbulence could affect the normal flight of aircraft operating in the protected airspace and other activities that could cause the emission of steam, other gas, smoke, dust or other particulate matter, where the smoke, dust or particulate matter could affect the ability of aircraft to operate in the prescribed airspace in accordance with Visual Flight Rules (VFR).

Civil Aviation (Buildings Control) Regulations

2.2.4 Six major or secondary capital city airports (i.e. Sydney/Kingsford Smith, Bankstown, Melbourne, Moorabbin, Essendon Fields and Adelaide) are also subject to the *Civil Aviation (Buildings Control) Regulations 1988*. These regulations are administered by the Department and require prior approval for a building or structure to be constructed in specified areas where a building, structure or object constitutes or may constitute an obstruction, hazard or potential hazard to aircraft flying in the vicinity of the nominated aerodromes, the owner of the building, structure or object can be directed to provide marking or lighting for the building, structure or object.

Defence Act and Regulations

2.2.5 Under the *Defence Act 1903* and *Defence Regulation 2016*, the Minister for Defence may declare an area of land, sea or airspace in or adjacent to Australia to be a defence aviation area (DAA). A declaration of a DAA may also specify height restrictions that apply in relation to buildings, structures and objects (including trees and other natural obstacles) within the DAA. The Defence Regulation also affects buildings, structures or objects that generate plumes or air turbulence, or causes plumes or air turbulence to be generated, above the applicable height restrictions.

2.2.6 DAAs are established for all permanent air bases and for Defence exercises.

2.3 Protected airspace

Obstacle Limitation Surface (OLS)

2.3.1 Every aerodrome certified under Part 139 of CASR is required to establish an OLS. The broad purpose of these surfaces is to define the volume of airspace that should ideally be kept free from obstacles in order to minimise the dangers presented by obstacles to an aircraft, either during an entirely visual approach or during the visual segment of an instrument approach. The OLS is a series of surfaces, associated with the aerodrome and each runway at an aerodrome, that define the desirable limits to which objects or structures may project into the airspace around the aerodrome so that aircraft operations at the aerodrome may be conducted safely.

2.3.2 Aerodrome operators are required to monitor their OLS both within the aerodrome boundary and outside the boundary. Aerodrome operators can control the development of objects and structures (obstacles) within the aerodrome boundary and if third parties propose to erect objects and structures likely to infringe the OLS outside the aerodrome boundary, it is in the interests of aerodrome operator to liaise as soon as possible with the proponents and the relevant planning authorities, with a view to ensuring the preservation of the OLS and limiting the introduction of new obstacles. Figure 1 below depicts the surfaces surrounding an aerodrome which comprise the OLS. The outer horizontal surface extends to 15 km from the aerodrome reference point (ARP) which is effectively the geographical centre of the aerodrome.

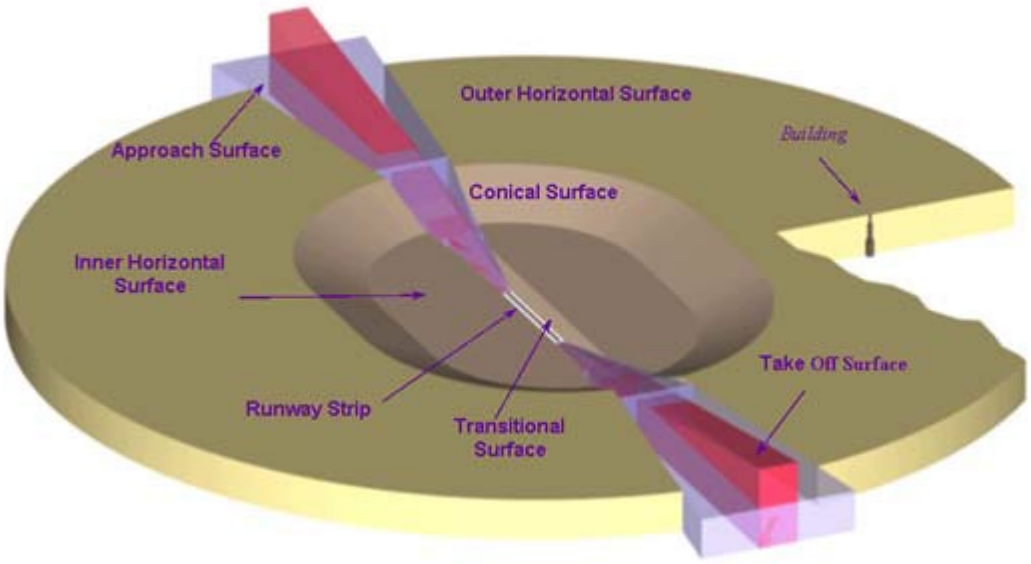

Figure 1: Obstacle limitation surfaces

2.3.3 The OLS of leased federal airports are protected under the Airports (Protection of Airspace) Regulations 1996. The OLS of Defence aerodromes are protected by the DAAs declared through *Defence Regulation 2016*.

PANS-OPS surfaces

2.3.4 The PANS-OPS surfaces are intended for use by CASR Part 173 instrument flight procedure designers primarily in the construction of instrument flight procedures which are designed to safeguard an aeroplane from collision with obstacles when flying on instruments. The PANS-OPS surfaces are generally above the OLS and are designed to safeguard an aircraft when the aircraft's flight may be guided solely by instruments and/or in conditions of poor visibility.

2.3.5 The PANS-OPS surfaces of leased federal airports are also protected under the *Airports (Protection of Airspace) Regulations 1996.* The PANS-OPS surfaces of Defence aerodromes are protected by the DAAs declared through *Defence Regulation 2016*.

3 Reporting of objects, structures and hazardous plume sources

3.1 What do I need to report?

3.1.1 The hazards that objects, structures or gaseous effluxes may pose to aircraft requires assessment. CASA routinely performs such assessments however CASA needs to be first notified of the obstacle, structure or source of a hazardous plume.

3.1.2 If you are the person who owns, controls, operates or is proposing an object, structure or source of a hazardous plume which is either present, planned or has been approved for erection/construction, details need to be provided about:

- the construction, extension or dismantling (including construction equipment) of objects and structures if the top is:
  - 100 m or more AGL; or
  - affects the obstacle limitation surface of an aerodrome as defined in Part 139 of CASR; and
- gaseous effluxes (plume rises) with a velocity of more than 4.3 metres per second affecting either:
  - airspace higher than 100 m or more AGL; or
  - the obstacle limitation surface of an aerodrome.

3.1.3 In addition, objects and structures may pose a specific hazard for the operation of low-flying civil and Defence aircraft or to the flight paths of arriving/departing aircraft (refer paragraph 2.1.2 and 2.1.3). Therefore, the Defence and AA require information on structures that are 30 m or more AGL.

3.1.4 Also, around all aerodromes, objects and structures can impact on flight paths to/from the aerodrome, therefore if you are proposing a building development, crane operation, wind farm or other structure in the vicinity of an airport or aerodrome, AA can review your application and provide advice to ensure your proposal does not compromise safe operations at the aerodrome. This service is available at: Development Application Submission Form - Airservices (airservicesaustralia.com)

3.1.5 Under Part 173 of the CASR, there are a number of certified instrument flight procedure design (IFPD) organisations, other than AA. You can identify the relevant IFPD organisation for a particular aerodrome by looking at the logo at the bottom of the instrument approach chart and accessing their details on CASA's website: Certified instrument flight procedure designers | Civil Aviation Safety Authority.

3.1.6 The Vertical Obstruction Data (VOD) is a database where airlines and aircraft operators can seek information on obstacles. Information provided for the database should be accurate and readily interpreted. The VOD reporting form has been designed to help owners and/or developers in this respect. The VOD form is available on the AA website (including a spreadsheet for reporting multiple structures) at: Civil Aviation Safety Regulation Part 175 — Airservices and You - Airservices.

3.1.7 Information about other obstacles that might affect aviation safety, such as power transmission lines and wind monitoring masts, should also be reported to AAs in the methods mentioned above, even if these objects and structures are less than 100 m AGL.

3.2 Why do I need to report?

3.2.1 If, following the assessment by CASA, the building, structure or wind turbine is determined as posing a hazard to aircraft operations, a recommendation will be made as to whether the risk to aircraft can be mitigated by marking or lighting of the building, structure or wind turbine.

3.2.2 Plume rises can pose a hazard to air navigation if the energy they release exceeds the capability of the aircraft and/or the pilot to maintain normal operation. Mitigation against hazardous plume sources is more challenging and may require further analysis between CASA and the proponent. This process is outlined further in AC 139.E-02 - Plume rise assessments.

3.2.3 In addition to the risk to aircraft operations, a collision with an object or structure poses several other risks, such as:

- business continuity if the services provided from the tall structure are unavailable e.g., communications services
- costs associated with repair/erection of a new structure, or
- liability issues.

3.2.4 The risk an object or structure poses to aircraft safety can be minimised if information about the tall structure is conveyed to pilots, so they can fly at a safe height above the structure. This information can be made available to pilots if an obstacle, including wind turbines, is published on aeronautical charts or included in an obstacle database.

4 Assessment of hazards

4.1 Wind turbines

4.1.1 This AC augments the information in the National Aerodromes Safety Framework (NASF) Guideline D *Managing the Risk of Wind Turbines Farms as Physical Obstacles to Air Navigation* and provides additional guidance on the assessment of wind turbine developments and guidance for establishing what reasonable measures may be put in place to mitigate any adverse effect the wind farm development could be to aviation safety.

4.1.2 Planning authorities should consider wake vortices when assessing the location of wind turbines in proximity to an aerodrome, airstrip and associated circuit areas. The risk to the safety of air navigation from wind turbine turbulence should be mitigated to an acceptable level of safety particularly during critical phases of flight such as landing and taking off. Mitigation may include relocation of turbines away from the aerodrome or airstrip sensitive areas, such as the take off and approach areas, reduction in size of the turbines in question or removal of turbines that may cause a turbulence hazard.

4.2 Review by development proponent

4.2.1 In the early stages of planning for an object or structure, it is recommended that the proponent engages an aviation consultant to conduct an aeronautical study to determine if the proposed development location will create a risk to aviation safety. It is critical for the proponent to consult with operators nearby to proposed structures and wind farms to prevent adverse impacts to aviation and to ensure the viability of the project. For example, the proposed location might be situated close to:

- a certified aerodrome or military aerodrome
- a high-density VFR lane or VFR reporting point
- uncertified aerodrome(s) or landing area(s) used by the local community.

4.2.2 An aeronautical study will identify any aviation safety risks, and the need for mitigation of those risks. The study should provide a detailed assessment of the potential impacts of the proposed development on aviation activities and demonstrate how an acceptable level of aviation safety can be maintained. The aeronautical study should:

- assess the impact of the object or structure on any aviation activity
- conduct a risk analysis using AS/NZS ISO 31000:2018 *Risk Management and Guidelines*
- consult with nearby aerodrome (certified and un-certified) operators and aircraft operators known to fly in the area (low flying activities that may include fire spotting and control)
- consult with AA and Defence to determine whether any nearby aeronautical communications, navigation or surveillance equipment may be affected, or potential impacts to instrument flight procedures
- provide details of proposed mitigation to ensure an acceptable the level of safety analysis of the effectiveness of each risk control measure
- recommend operating procedures/restrictions or other means to mitigate risks.

4.2.3 All proposed mitigation measures should be assessed to demonstrate they are adequate to reduce risks to an acceptable level.

4.2.4 Cumulative effects of other wind farms in close proximity to a new wind farm development should also be considered.

4.3 Planning authority process

4.3.1 A proponent of an object or structure is required to submit a development application to the relevant planning authority for approval. The planning authority will assess the proposal and review the detailed aeronautical study that should be provided as part of the development application.

4.3.2 The planning authority may seek advice from CASA on the risk to aviation created by the development or the proposed mitigation plan if a risk has been identified.

4.3.3 CASA will review the development application and aeronautical study using the airspace risk assessment process described at section 4.5 and provide advice to the planning authority. CASA may also consult with other aviation stakeholders such as AA and Defence during this stage.

4.3.4 The planning authority will usually specify that the proponent will need to ensure that any aviation hazard lighting implemented is to the satisfaction of the CASA. CASA has no authority or powers in relation to an object or structure approval outside a certified aerodrome but advice from CASA will inform the planning authority in regard to any decisions or conditions on any approval the planning authority might place on a development.

4.3.5 Regardless of CASA advice, planning authorities make the final determination via conditions of consent as to whether an object or structure not in the vicinity of a CASA regulated aerodrome will require lighting or marking. If there is a dispute about the number of, or need for, aviation hazard lighting to be implemented, the matter should be referred to the state's Planning Secretary for resolution.

4.4 Independent accredited audit

4.4.1 Typically, aviation safety assessments are reliant on proponent engaged consultants preparing reports and other information for the proponent to submit for consideration by the relevant planning authority and CASA.

4.4.2 The reliability of these consultant prepared reports is highly dependent on several factors, such as the accuracy and precision of the assumptions used, correct application of any calculations, the accuracy of the data used and the skills of the expert in interpreting and analysing data.

4.4.3 Where an aviation safety assessment supplied by the proponent and a CASA assessment differ in recommendation, it may be appropriate for the planning authority to consider appointing an independent auditor to review and assess the consultant’s aeronautical study and the associated documents to assist the planning authority to draft conditions.

4.4.4 In addition, once a structure has been approved and constructed, a further audit should be undertaken of the aviation safety requirements, as prescribed and issued by the planning authority, to ensure such measures have been properly implemented.

4.5 CASA airspace risk assessment process

4.5.1 The CASA airspace risk assessment process identifies potential airspace risks or risks to the safety of air navigation and is a five-step process.

4.5.2 The risk assessment will be assessed in accordance with the risk assessment methodology, as found in AS/NZS ISO 31000:2018 *Risk Management - Principles and Guidelines*.

Step 1: Preliminary assessment

4.5.3 The preliminary assessment by CASA considers:

- location and height of object or structure
- location, height, and number of the wind turbines / monitoring masts / tall structures

- terrain in the vicinity of the development
- volume and type of flying operations in the area
- potential for aircraft to operate in the vicinity of the development
- proximity to certified aerodromes, helicopter landing sites and aircraft landing areas (ALA)
- urban (built up area) or rural setting
- wind turbine turbulence effect
- effect on communication, navigation, and surveillance equipment
- effect on the OLS
- effect on instrument flight procedures
- being able to see the development in low visibility conditions
- local weather conditions
- inclusion of light management systems in the proposal (in relation to wind turbines) - radar detection or visibility monitoring.

Step 2: Stakeholder engagement

4.5.4 The proponent will need to engage with aviation stakeholders to inform the CASA airspace risk assessment. For example, local flying schools and/or agricultural operators to understand the type of flying operations being conducted in the vicinity of the proposed wind farm. Any proposal which requires adjustment to instrument flight procedures or airspace minima for a nearby certified aerodrome should be supported by the aerodrome operator and Airservices (through airport.developments@airservicesaustralia.com).

Step 3: Risk assessment

4.5.5 CASA will conduct an airspace risk assessment that will identify any potential hazards and assess the likelihood and consequence of any risk. The risk assessment will also consider and assess risk control measures.

Step 4: Mitigating the impact of the proposal

4.5.6 If potential risks to the safety of air navigation or aircraft safety are identified, these should be reduced to As Low As Reasonably Practicable (ALARP) to achieve an Acceptable Level of Safety (ALoS) using mitigation and control measures. An example of the measures that could be undertaken (in most cases) are:

a. obstacle lighting and marking of the object or structure
b. technology solutions, such as radar activated alerting/lighting systems (in relation to wind turbines)
c. advice to local operators (information bulletins)
d. notification to AA: as-constructed obstacle database email (vod@airservicesaustralia.com)
e. NOTAM
f. Advice in AIP, particularly in entries for nearby aerodromes
g. Chart symbols.

Step 5: Advice and recommendations

4.5.7 Finally, CASA will generally provide advice on the outcomes of the airspace risk assessment to the relevant planning authority. CASA does not generally provide advice directly to the proponent but may do so through their consultant.

5 Aviation hazard mitigation

5.1 A certified aerodrome operator is responsible for monitoring the OLS and PANS-OPS airspace and must advise CASA in the event of an actual or proposed OLS penetration, and the terminal instrument flight procedure designer in the event of an actual or proposed penetration into the PANS-OPS airspace. Following CASA or instrument flight procedure designer assessment of any resulting hazard from the penetration, it is the responsibility of the aerodrome operator to advise the relevant planning authority of the result of the assessment and liaise with that authority to ensure that hazardous obstacles that are an unacceptable risk to aviation are not approved; or that hazardous objects or structures are appropriately mitigated, e.g. through marking, lighting or charting.

5.2 Obstacle lighting

5.2.1 When a decision has been made that an object or structure can penetrate the OLS subject to lighting being provided, section 9.27 of the Part 139 MOS sets out the requirements for the provision of obstacle lighting. Under section 7.19 of the Part 139 MOS CASA can also determine that an object or structure within the OLS of an aerodrome is a hazard to aircraft operations and if any lighting is required.

5.2.2 Obstacles outside the OLS of a certified aerodrome that are 150 m or more AGL would normally automatically be considered an obstacle that impacts aviation safety as they intrude into navigable airspace and should be lit (refer paragraph 2.1.3). It is recommended that flashing white high-intensity obstacle lights are used on objects or structures whose height exceeds 150 m AGL.

5.2.3 Appendix A details the types and locations where obstacle lighting should be placed.

5.2.4 Owners of tall buildings or structures whose summit is below the OLS, or that is less than 100 m AGL, may, of their own volition, provide obstacle lighting to indicate the presence of such buildings or structures at night. To ensure consistency, avoid confusion to pilots, and further the interests of safety both in the air and on the ground, such obstacle lighting should conform with the standards specified in the Part 139 MOS.

5.2.5 As mentioned in paragraph 2.1.3, powerlines can be a hazard to low-level aircraft operations. AS 3891.1 provides specific air navigation guidance on the standards for the marking and safety requirements (including lighting) of overhead cables and their supporting structures. This guidance includes the OLS, proximity to a certified or non-certified aerodrome and declared Defence Aviation Areas. The requirements include colour and location of aircraft warning markers and lights. Appendix A depicts the ICAO requirements for location of high-intensity obstacle lights on towers supporting overhead wires.

5.3 Obstacle marking

5.3.1 Any fixed object or structure, whether temporary or permanent in nature, extending above the OLS must be marked in accordance with Chapter 8 Division 10 of the Part 139 MOS. Additionally, a certified aerodrome operator must notify CASA of all obstacles at a certified aerodrome so that CASA can assess each obstacle and determine if it is a hazard to aircraft and if any marking is required.

5.3.2 Additionally, CASA may determine, following an assessment, that an object or structure on, or within the immediate vicinity of, the aerodrome is a hazardous obstacle and if markings are required.

5.3.3 In accordance with Chapter 9 of the Part 139 MOS, obstacle lighting may be used during the day instead of obstacle marking.

5.3.4 Appendix B illustrates how a mast, pole or tower can be marked.

5.4 Obstacle publication

5.4.1 Lighting and marking of obstacles provide pilots with a visual cue of the physical presence of an obstacle in the aerodrome environment. Another mitigator for the presence of obstacles is through publication on aeronautical charts. Publication on aeronautical charts is required for objects and structures that are 100 m or more AGL. Charting obstacles allows pilots to take them into consideration in pre-planning their flights and air navigation.

5.4.2 While traditional charting of obstacles has been sufficient for flight planning and navigation purposes most airline flight dispatch sections use digital obstacle data sets to ingest obstacle data into their flight planning systems. This allows these systems to calculate take-off performance, including emergency planning such as engine-out performance calculations. Additionally, digital obstacle data can be incorporated in ground proximity warning systems and on-board databases.

6 Reporting of objects and structures

6.1 Obstacle database

6.1.1 The aviation community has identified a need to have information on objects and structures available for publication on aeronautical charts and, more importantly, available in an obstacle database.

6.1.2 The information about objects and structures is held in a central database that is managed by AA and any requests for data are available on the AA website: Data,Airservices portal - Airservices Australia.

6.2 Aeronautical Information Publication (AIP)

6.2.1 Aerodrome obstacle data is published in the AIP (available on the AA website) in the En Route Supplement Australia (ERSA).

6.3 Aeronautical charts

6.3.1 Aerodrome obstacle data is published on the visual charts and those associated with an aerodrome:

- World Aeronautical Chart (WAC) - 1:1,000,000 series
- Visual Navigation Chart (VNC) - 1:500,000 series
- Visual Terminal Chart (VTC) - 1:250,000 series
- Aerodrome Obstacle Chart – ICAO Type A and B (from the aerodrome operator when provided)
- Aerodrome Terrain and Obstacle Chart – ICAO (Electronic) - when available
- Aerodrome and Terminal Instrument Flight Procedure (TIFP) Charts (included in Departure and Approach Procedures (DAP)

6.4 NOTAM

6.4.1 The primary purpose of a NOTAM is to alert pilots and other airspace users to temporary changes or potential hazards that could affect safety of flight operations. They can also be issued permanently if the information is to be incorporated in the AIP, aeronautical charts and obstacle databases.

6.4.2 Under the Part 139 MOS aerodrome operators are required to issue a NOTAM when a new obstacle is identified that penetrates the OLS. NOTAM are also required when there is an obstacle light outage to inform pilots of the hazard. The obstacle owner is responsible for requesting the issuing of obstacle light outage NOTAMs.

6.4.3 Instrument flight procedure designers publish NOTAMs when their TIFPs require adjustment in relation to an obstacle that penetrates the PANS-OPS surface.

6.4.4 AA is responsible for issuing NOTAMs for new or updated obstacles 92 m (300 ft) or more AGL.

Appendix A
Obstacle Lighting

A.1 Types of obstacle lighting

A.1.1 The following types of obstacle lights must be used to light hazardous obstacles, when required in accordance with the Part 139 MOS, and are recommended in other cases:

a. low-intensity

b. medium-intensity

c. high-intensity

d. a combination of low, medium or high-intensity.

A.1.2 Low-intensity obstacle lights:

a. are steady red lights

b. must be used on non-extensive objects or structures whose height above the surrounding ground is less than 45 m.

A.1.3 Medium-intensity obstacle lights must be:

a. flashing white lights;

or

b. flashing red lights;

or

c. steady red lights.

> **Note:** CASA recommends the use of flashing red medium-intensity obstacle lights.

A.1.4 Medium-intensity obstacle lights must be used if:

a. the object or structure is an extensive one; or

b. the top of the object or structure is at least 45 m but not more than 150 m above the surrounding ground; or

c. CASA determines in writing that early warning to pilots of the presence of the object or structure is desirable in the interests of aviation safety.

> **Note:** For example, a wind farm or group of buildings is regarded as an extensive object.

A.1.5 For paragraph A.1.4, low-intensity and medium-intensity obstacle lights may be used in combination.

A.1.6 High-intensity obstacle lights:

a. must be used on objects or structures whose height exceeds 150 m; and

b. must be flashing white lights.

A.1.7 Despite paragraph A.1.6b., a medium-intensity flashing red light may be used if necessary to avoid an adverse environmental impact on the local community.

A.2 Location of obstacle lights

A.2.1 Obstacle lights must be located:

a. as close as possible to the top of the object or structure; and

b. in such numbers, and in such arrangements, as to ensure that the lights clearly indicate at least the points or edges of the object or structure that are highest above the OLS.

A.2.2 Subject to subsection A.2.3, for the following objects or structures:

a. a structure to the top of which an appurtenance is attached, for example, a lightning rod, flag, antenna, or aerial

b. a structure from at or near the top of which a contaminating substance is emitted, for example, smoke, gas or fumes

the top lights must be placed as close to the top of the structure as is consistent with minimising the likelihood of visual obstruction from:

a. the attachment

or

b. the emissions.

A.2.3 If an appurtenance, for example, a lightning rod, flag, antenna, or aerial, on a tower-like structure (including an antenna):

a. extends more than 12 m above the structure

b. is such that it is impossible to attach a high-intensity obstacle light to the top of the appurtenance

then the high-intensity obstacle light must be attached to the highest possible point of the appurtenance.

A.2.4 For the following:

a. an extensive object or structure

b. a group of closely-spaced objects or structures

the obstacle lights must be located in such numbers, and in such arrangements, as to ensure that the lights clearly indicate at least:

c. the points or edges of the object or structure that are highest above the OLS

d. the general definition and extent of the object or structure

e. if 2 or more edges are at the same height — the edge nearest to the runway threshold.

A.2.5 For A.2.4:

a. if low-intensity lights are used — the lights must be spaced at longitudinal intervals not exceeding 45 m

b. if medium-intensity lights are used:

i. the lights must be spaced at longitudinal intervals not exceeding 900 m

ii. at least 3 lights must be displayed as a line of lights, horizontally on the side of an extensive object or structure that is nearest to the runway threshold.

A.2.6 For wind turbines in a wind farm, medium-intensity obstacle lights must:

a. mark the highest point reached by the rotating blades

b. be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m

c. all be synchronised to flash simultaneously

d. be seen from every angle in azimuth.

> **Note:** This is to prevent obstacle light shielding by the rotating blades of a wind turbine and may require more than 1 obstacle light to be fitted.

A.2.7 If it is physically impossible to light the rotating blades of a wind turbine:

a. the obstacle lights must be placed on top of the generator housing

b. a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.

A.2.8 If the top of an object or structure is more than 45 m above:

a. the surrounding ground (ground level)

or

b. the top of the tallest nearby building (building level)

then the top lights must be medium-intensity lights, and additional low-intensity lights must be:

c. provided at lower levels to indicate the full height of the structure

d. spaced as equally as possible between the top lights and the ground level or building level, but not so as to exceed 45 m between lights.

A.2.9 If high-intensity obstacle lights are used:

a. on an object or structure that is not a tower supporting wires or cables — the spacing between the lights must not exceed 105 m

b. on an object or structure that is a tower supporting wires or cables — the lights must be located on the tower as follows:

i. at the top of the tower

ii. at the point of the tower that is the lowest level of the catenary of the wires or cables

iii. at approximately midway between the 2 levels referred to in subparagraphs i and ii.

> **Note:** In some cases, paragraph b. may require the bottom and middle lights to be located off the tower on stand-alone supports.

A.2.10 For paragraph A.2.9:

a. the number and arrangement of lights at each level mentioned in subparagraphs A.2.9b. i, ii and iii must be such that the object or structure is indicated from every angle of azimuth

b. if a light would be shielded in any direction by an adjacent object or structure, the light so shielded may be omitted, provided that such additional lights are used as are necessary to retain the general definition of the object or structure.

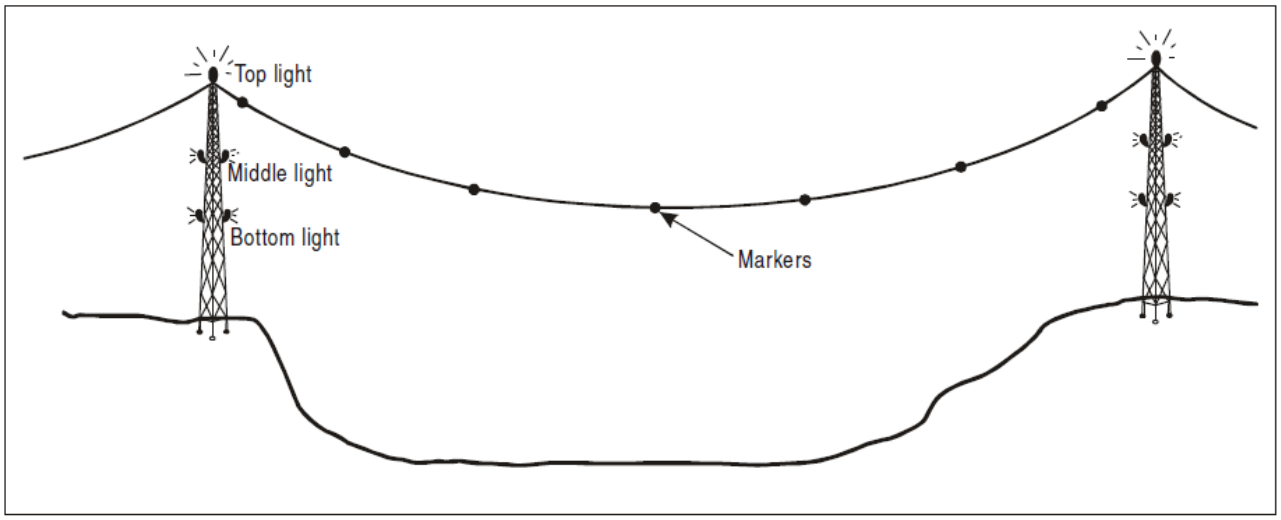

Figure 2: Location of high-intensity obstacle lights on towers supporting overhead wires

[Source: ICAO Aerodrome Design Manual (Doc 9157)

Appendix B
Obstacle Marking

Long, narrow structures like wind-monitoring masts, poles and towers which are hazardous obstacles should be marked in contrasting colour bands so that:

a. the darker colour is at the top

b. the bands:

   i. are, as far as physically possible, marked at right angles along the length of the long, narrow structure

   ii. have a length ("z" in Figure 3) that is, approximately, the lesser of:

      A. 1/7 of the height of the structure

      or

      B. 30 m.

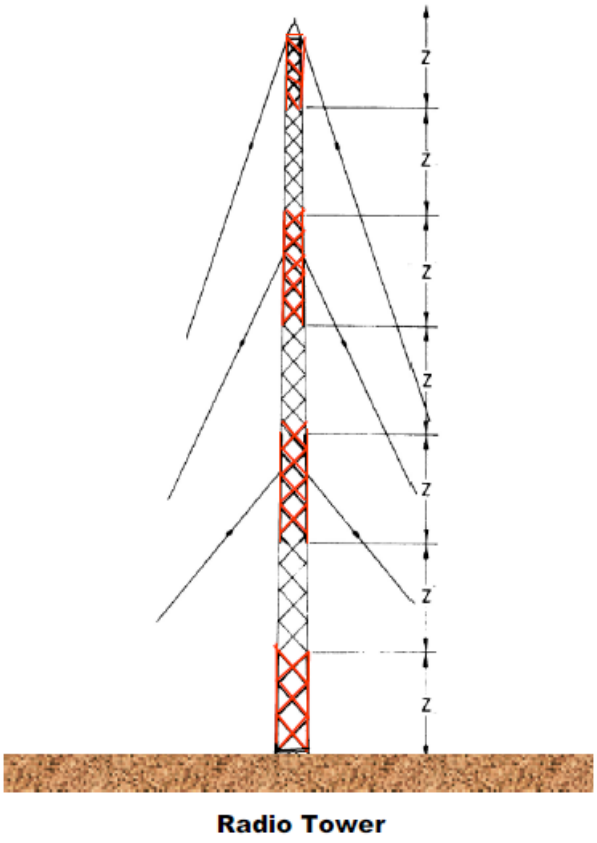

Figure 3: Marking of mast, pole and tower