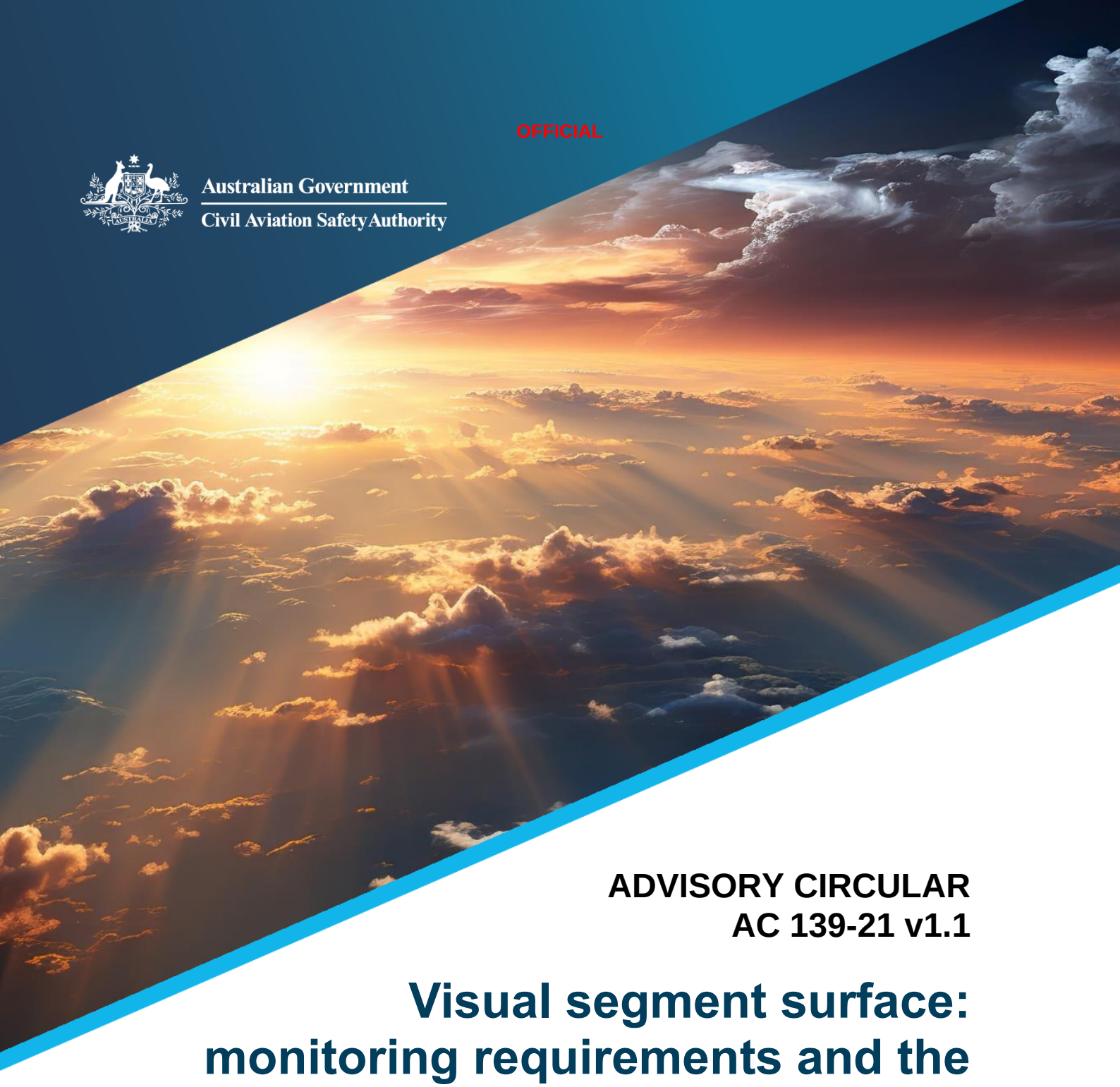

Australian Government
Civil Aviation Safety Authority

ADVISORY CIRCULAR
AC 139-21 v1.1

Visual segment surface: monitoring requirements and the reporting of obstacles

File ref: D24/316316

September 2024

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:

- operators of certified and registered aerodromes that have a published runway aligned instrument approach procedure
- aerodrome personnel that are tasked to monitor obstacles in their visual segment surface (VSS)
- personnel engaged by the aerodrome operator to survey for obstacles in their VSS on behalf of their procedure designer
- holders of an instrument flight procedure design certificate under Part 173 of the *Civil Aviation Safety Regulations 1998 (CASR*).

Purpose

The purpose of this AC is to provide general information to aerodrome operators on the VSS. For certain instrument flight procedures, the VSS forms part of the airspace defined through the Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS).

PANS-OPS airspace is used by aircraft flying under the Instrument Flight Rules (IFR). For example, aircraft flying an instrument approach procedure in less than Visual Meteorological Conditions (VMC) or conforming to an instrument approach procedure to ensure adequate terrain clearance in either Instrument Meteorological Conditions (IMC) or Visual Meteorological Conditions. Where pilots are using an instrument flight procedure to perform an instrument approach to a runway with an aligned procedure, the VSS is an additional segment of airspace that needs to be kept clear of obstacles.

This AC also provides clarification on how aerodrome operators can comply with the Part 139 Manual of Standards (MOS) with regard to monitoring their PANS-OPS airspace, particularly with regard to the VSS.

For further information

For further information, contact CASA's Personnel Licensing, Aerodromes and Air Navigation Standards (telephone 131 757).

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 Branch Manager, Flight Standards.

Note: Changes made in the current version are annotated with change bars.

Table 1: Status

Version	Date	Details
v1.1	September 2024	Regulation and approach chart references updated. References to registered aerodromes removed. New CASA style template applied.
v1.0	July 2015	Initial release.

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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.

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
AIP	Aeronautical Information Publication
CAR	*Civil Aviation Regulations 1988*
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
DAP	Departure and Approach Procedures
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
LOC	Localiser
MOS	Manual of Standards
NDB	Non-directional beacon
NPA	Non Precision Approach
OCH	Obstacle Clearance Height
OLS	Obstacle Limitation Surface
PA	Precision Approach
PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
RNAV	Area Navigation
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Range
VSS	Visual Segment Surface

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
Instrument runway	A runway intended for the operation of aircraft using a runway aligned instrument approach procedure.
Obstacle Clearance Height	The lowest height above the elevation of the relevant runway threshold or the aerodrome elevation as applicable. It is used to establish compliance with the appropriate obstacle clearance criteria. **Note:** Obstacle clearance height is referenced to the threshold elevation or in the case of non-precision approach procedures to the aerodrome elevation or the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. An obstacle clearance height for a circling approach procedure is referenced to the aerodrome elevation.
Non-precision approach runway	An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach. (ICAO)
Straight-in approach	Where an aircraft manoeuvres to approach the runway for landing without visual circling or flying a circuit and can be conducted in either IMC or VMC conditions. **Note:** Straight-in instrument approaches are not always designed to align with the runway centreline.
Visual segment surface	A PANS-OPS design segment of a straight-in instrument approach procedure, which needs to be monitored and kept clear of any penetrations by obstacles.

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
Regulation 91.395 of CASR	Straight-in approaches at non-controlled aerodromes
Part 139 of CASR	Aerodromes
Part 173 of CASR	Instrument flight procedure design
Chapter 7 of the Part 139 MOS	Obstacle restriction and limitation

Document	Title
Part 173 MOS	Standards Applicable to Instrument Flight Procedure Design

2 General

2.1 Quick reference guide

2.1.1 Operators of a certified aerodrome may have one or more instrument flight procedures published for their aerodrome. If so, it is likely that these instrument flight procedures incorporate a design element known as the visual segment surface (VSS). Refer to section 4 for further information.

2.1.2 If a VSS has been included in the instrument flight procedure design, it needs to be monitored by both the aerodrome operator and the procedure designer. This is to ensure no hazards, such as obstacles, are present.

2.1.3 PANS-OPS airspace monitoring needs to be done as a partnership between the aerodrome operator and their procedure designer as:

- the procedure designer has the technical data on the VSS design and is responsible for its ongoing integrity but cannot directly monitor for any new or proposed obstacles that may be present at the relevant aerodrome.
- the aerodrome operator is best placed to monitor any new or proposed obstacles that may be present at their aerodrome and is required to support the ongoing integrity of any published instrument flight procedures.

2.1.4 The first step that an aerodrome operator should take is to ascertain if it has any published instrument flight procedures. Refer to section 3.1.2 for more information.

2.1.5 If the aerodrome has a published procedure, the next step is to ascertain if the procedure incorporates a VSS element. This information needs to be confirmed in conjunction with the procedure designer. Refer to section 5.4 for more information.

2.1.6 When monitoring the VSS and assessing it for hazards, the recommended approach is as shown in Figure 1.

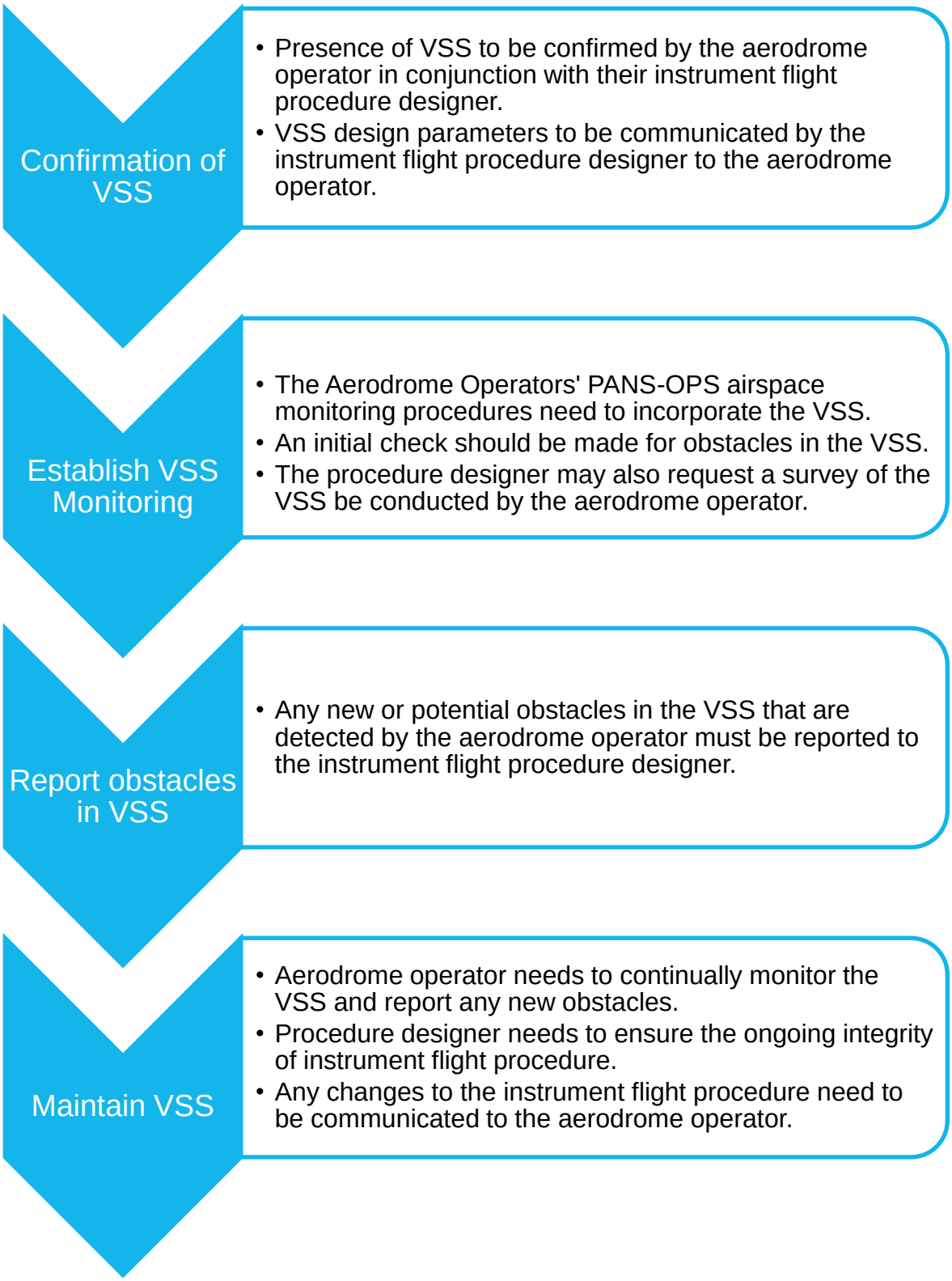

Figure 1: Recommended approach for VSS obstacle monitoring

2.1.7 Each of these aspects and relevant background information is expanded throughout the remainder of this AC. A compliance reference checklist is also included in Appendix A.

3 Background

Figure 2: Confirmation of VSS

3.1 Introduction to instrument flight procedures

3.1.1 For the purposes of improving safety and enhancing access to aerodromes by aircraft, a procedure known as an 'instrument flight procedure' can be developed for an aerodrome. These instrument flight procedures can then be utilised by properly equipped aircraft that are flown by a qualified instrument pilot:

- in instrument meteorological conditions (IMC)
- where visibility to the aerodrome is limited (e.g. at night)

  or

- where the pilot elects to fly under instrument flight procedures rather than by visual means.

3.1.2 Instrument and non-instrument runways

3.1.2.1 Runways at certified aerodromes are categorised in terms of their status as an instrument or non-instrument runway.

3.1.2.2 Instrument runways can be identified by a published instrument flight procedure that includes a runway designation in its title. These instrument flight procedures will include a VSS.

3.1.2.3 Some aerodromes have a published instrument flight procedure that is not aligned with a particular runway designation. This is a circling procedure and may be associated with either an instrument or a non-instrument runway. These instrument flight procedures will NOT include a VSS.

3.1.2.4 All the published instrument flight procedures for Australian aerodromes are published on the Airservices Australia website.[1] For more information, refer to the departure and approach procedures (DAP), which forms part of the Aeronautical Information Publication (AIP).

3.1.2.5 An example of a DAP chart published for an aerodrome is shown in Figure 3. By referring to the top right hand corner of the DAP chart (RWY 25), it shows the procedure has been designed for Runway 25 at Albury Aerodrome in New South Wales. This indicates that Runway 25 **is an instrument runway and will feature a VSS.**

3.1.2.6 Another indication that the example shown in Figure 3 is for an instrument runway is the presence of a ‘LNAV minima’. These details can be located in the **CATEGORY** section of the plate that has been highlighted by the long red box:

[1] Airservices Australia website is available at: http://www.airservicesaustralia.com/aip/aip.asp

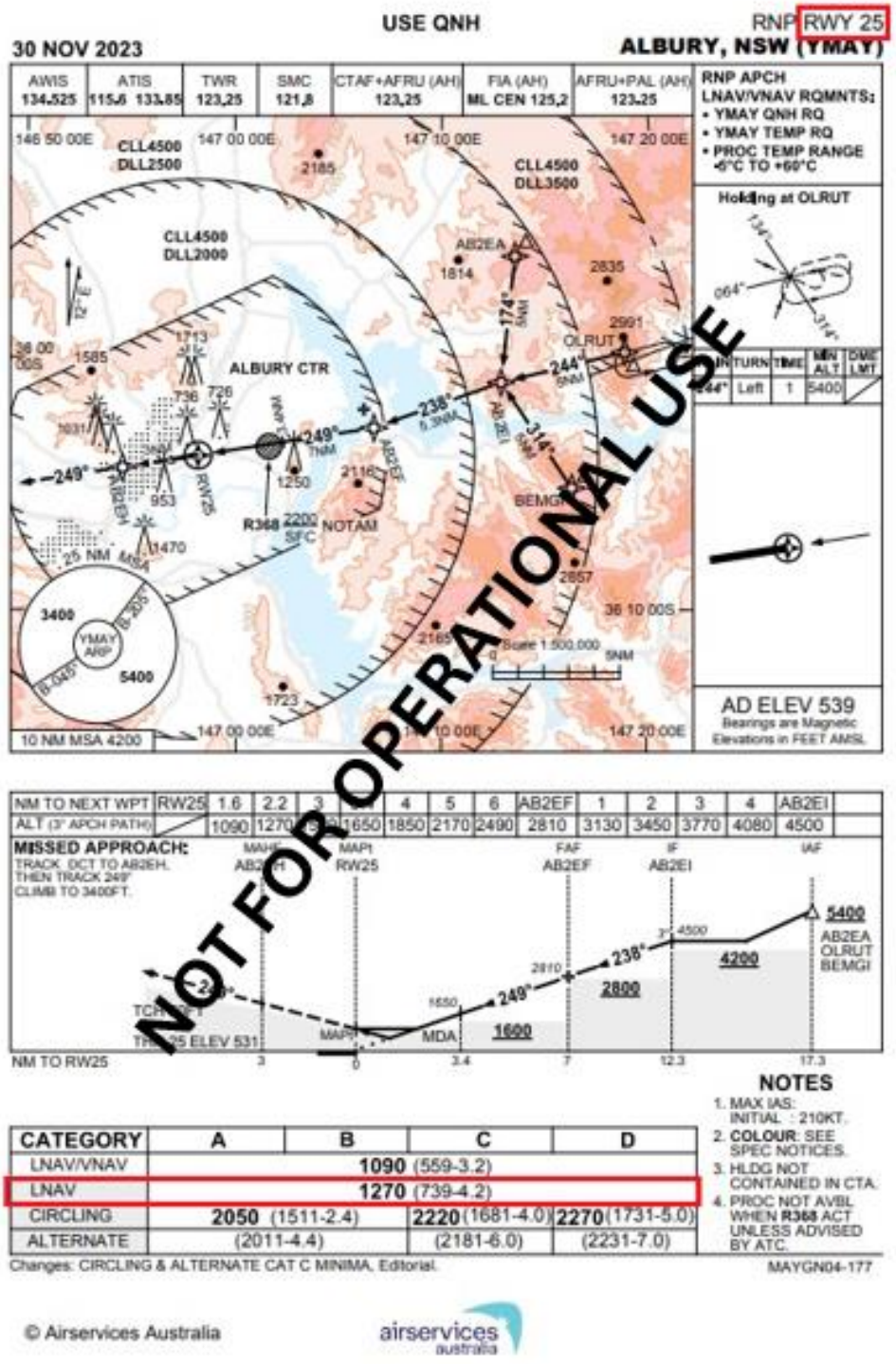

Figure 3: DAP approach chart (plate) showing a procedure to an instrument runway

3.1.2.7 In the next example (Figure 4), the top right hand corner of the DAP approach chart (RNP E) shows the procedure has been designed for an eastern sector of Quirindi Aerodrome, in New South Wales. Although the procedure appears to align with Runway 32, it is not titled for this particular runway designation. The omission of a straight-in minima is another indication that

this procedure allows for circling only (as highlighted in the Category section at the bottom of the chart) and will not include a VSS:

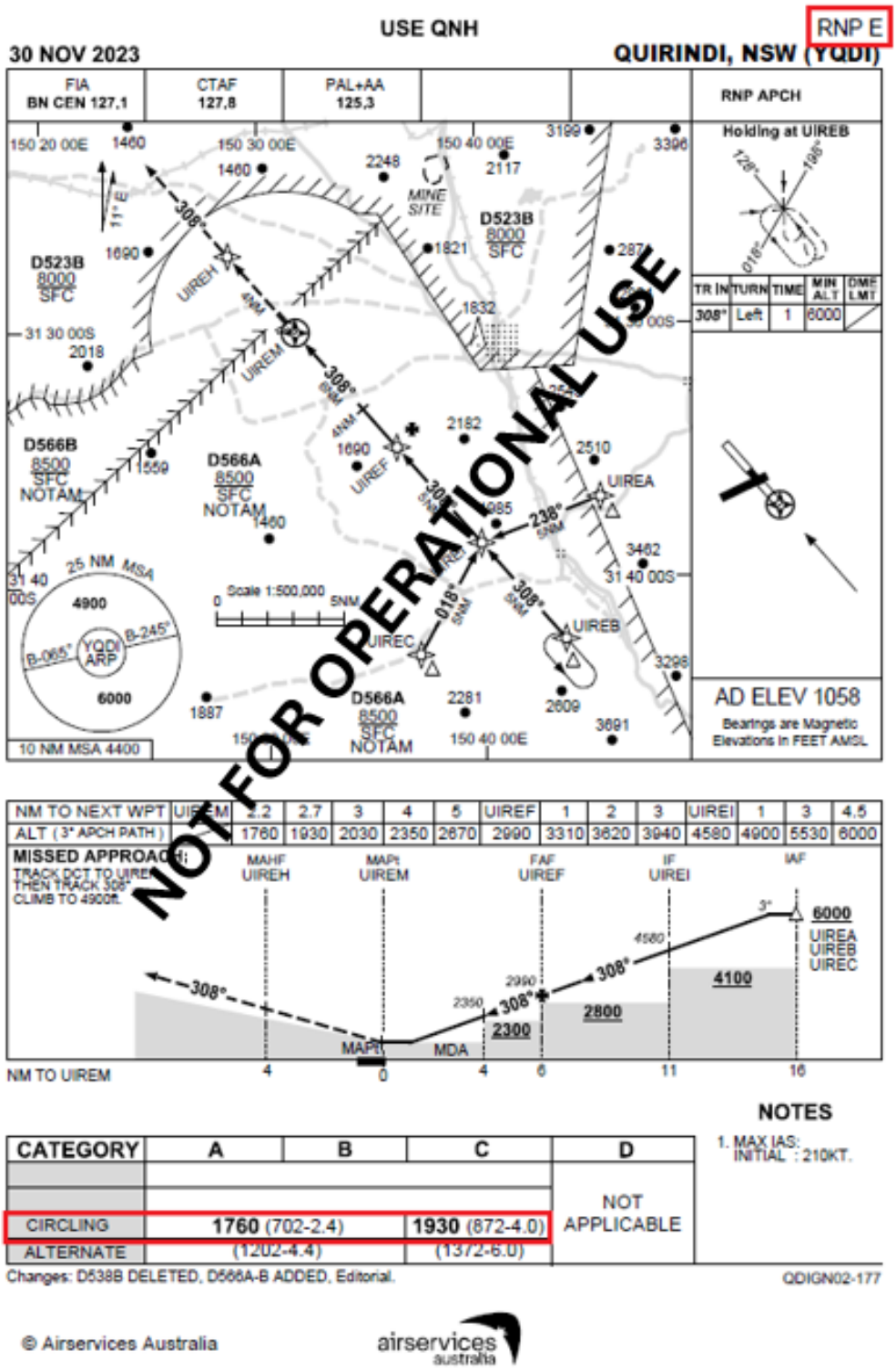

Figure 4: DAP approach chart (plate) showing a procedure to a non-instrument runway

3.1.2.8 If no other published procedure features a designation to a particular runway, then the runway is non-instrument and no VSS will need to be established.

3.1.3 Straight-in approaches using an instrument flight procedure

3.1.3.1 A pilot may fly a straight-in approach in IMC when an instrument flight procedure for that runway has been published. In general terms, this means that a pilot does not need to fly a 'circuit' prior to landing on that runway. Refer to regulation 91.395 of CASR, for more information.

3.1.3.2 Whilst a pilot may be flying under IMC using a runway aligned instrument approach procedure, they may still need to manoeuvre prior to landing, rather than continue on a straight-in approach. The need to do this could depend on:

- changing weather conditions at the aerodrome
- on or at what altitude the aerodrome becomes visible to the pilot
- other aircraft traffic present in the vicinity of the aerodrome

  and/or
- any other operating conditions of that flight.

3.2 Instrument flight procedure design

3.2.1 Design certification

3.2.1.1 Under Part 173, CASA grants a procedure design certificate to a certified designer. This certificate allows the certified designer to design instrument flight procedures.

3.2.1.2 The certified designer must follow the Part 173 MOS and Part 173 when designing a new instrument flight procedure.

3.2.2 Straight-in approaches and the VSS

3.2.2.1 The Part 173 MOS requires that straight-in approaches are designed in accordance with ICAO PANS-OPS. This document specifies the requirement to design the procedure with consideration to any obstacles in the VSS.

3.2.3 Ongoing responsibility for the procedure

3.2.3.1 Once an instrument flight procedure has been designed, it is subject to ongoing integrity monitoring by the procedure designer. The procedure designer must take action to amend the procedure if any obstacles penetrate the PANS-OPS airspace.

3.2.4 Monitoring of the procedure by the designer

3.2.4.1 As the procedure designer cannot physically monitor the obstacles around the aerodrome on a continuous basis, they require the assistance of the aerodrome operator to perform this task.

3.2.4.2 Therefore, monitoring of PANS-OPS airspace for critical obstacles is also the responsibility of the aerodrome operator in almost all cases. Refer to section 5 for more information.

4 Visual segment surface

4.1 Overview

4.1.1 The VSS concept originated from an ICAO working panel. From 15 March 2007, ICAO mandated that all new straight-in instrument approach procedures must feature VSS protection. From 15 March 2012, VSS was mandated for all existing straight-in instrument approach procedures.

4.1.2 The purpose of a VSS is to protect the aircraft from ground-based obstacles prior to landing, while the pilot transitions from flying on instruments to using the visual references available at the aerodrome.

4.1.3 Under the Part 173 MOS, the procedure designer must provide the VSS parameters to the aerodrome operator. Information on lateral and vertical parameters can be found in sections 4.2 to 4.3.

4.2 Lateral parameters of the VSS

4.2.1 The lateral (horizontal) parameters of the VSS come in two categories:

- runway-aligned procedures with a localiser (or look-alike lateral guidance), such as that provided from a precision approach system or an approach with vertical guidance
- any other runway aligned procedure that can be flown using a straight-in approach.

4.2.2 Determining the lateral (horizontal) category of the VSS

4.2.2.1 To determine which category applies, reference again should be made to the top right-hand corner of the AIP-DAP approach chart. Refer to the following table and the example chart (Figure 5 - RNP) for more information:

Table 5: Lateral category of the VSS

Lateral guidance type	Category:	AC reference:
• LOC • ILS • GLS	Runway aligned procedures with a localiser or like lateral guidance	0
• RNP • VOR • NDB	Other runway aligned procedure which can be flown using a straight-in approach	4.2.4

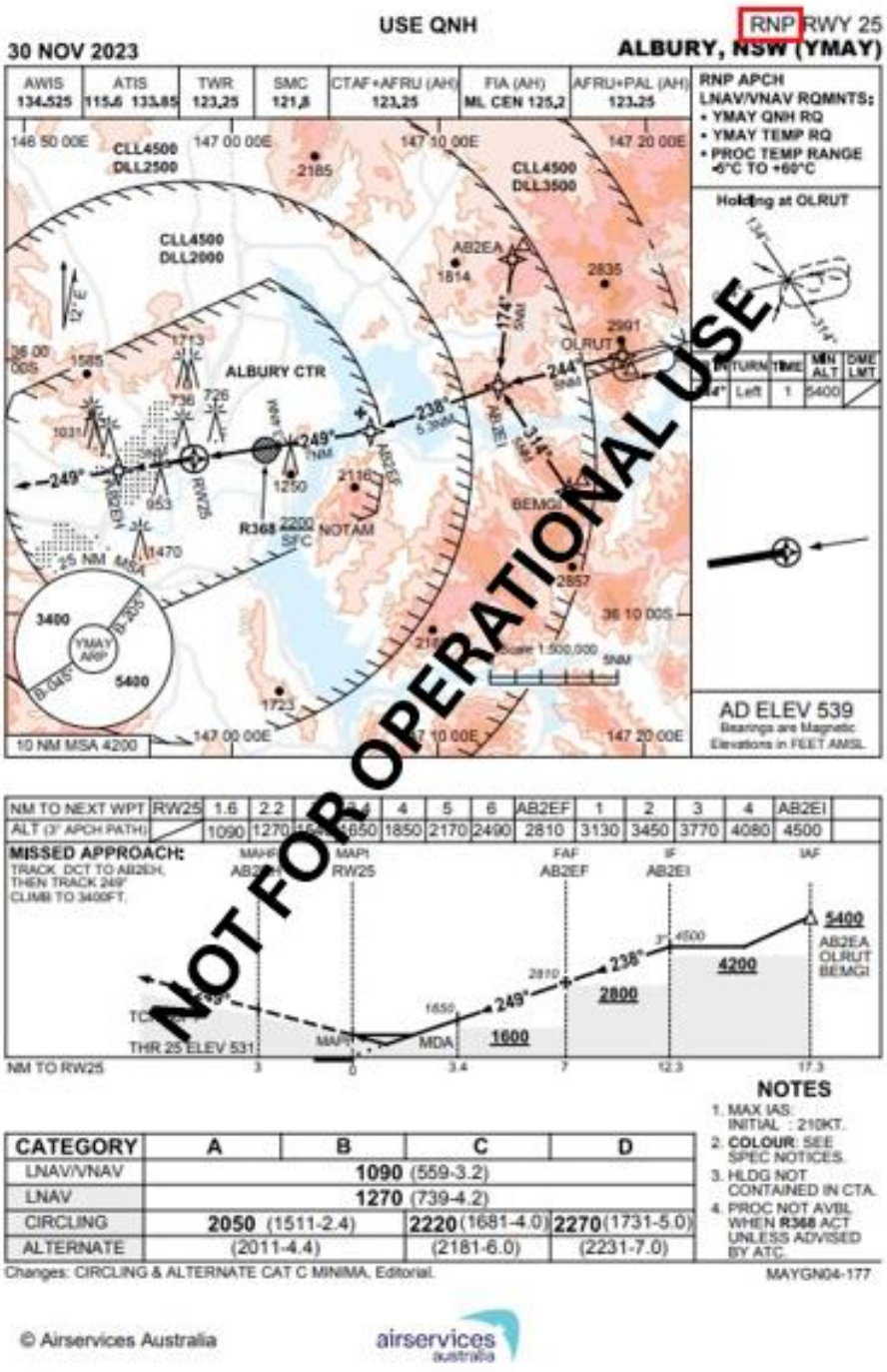

Figure 5: DAP approach chart (plate) showing where the guidance type details can be located

4.2.3 Runway aligned procedures with a localiser or look-alike lateral guidance

4.2.3.1 Sub-paragraph 5.4.6.1 (a) of Vol II to PANS-OPS states:

For procedures with localiser or localiser look-alike lateral guidance approaches where the final approach track is aligned with the runway centre line, with a base width equal to the inner approach surface as defined in Annex 14, originating 60 m prior to the runway threshold, extending parallel to the extended runway centre line, and terminating at the point where the height of the surface reaches the OCH.[3]

4.2.3.2 In plain terms, this type of VSS originates along the baseline for the 'inner approach surface', which forms part of the obstacle limitation surface (OLS).

> **Note:** For more information on the inner approach surface refer to paragraph 7.10 of the Part 139 MOS.

4.2.3.3 Therefore, each side of the VSS runs parallel to the runway centreline, at a width equal to the inner approach baseline.

4.2.3.4 The VSS continues to move away from the inner approach baseline until the distance where the vertical component of the VSS reaches the OCH.

4.2.3.5 A diagram of the lateral parameters for this category of VSS has been provided at the lower part of Figure 6 below:

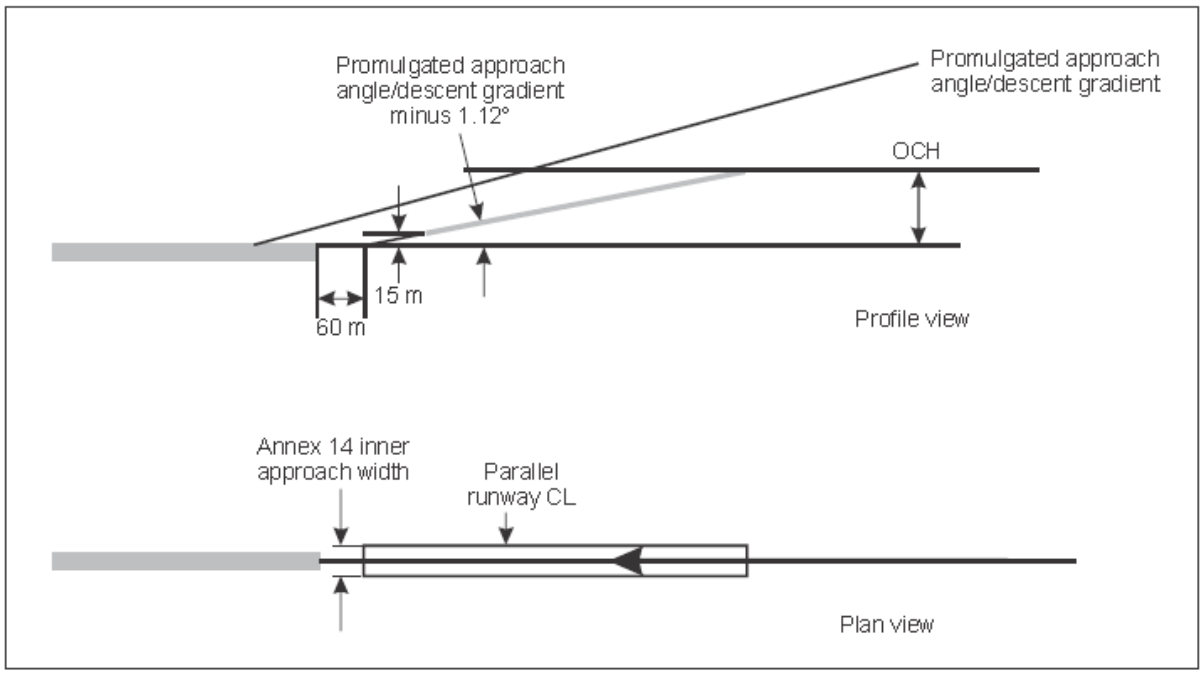

Figure 6: The VSS of procedures with localizer or localizer look-alike lateral guidance aligned with the runway centreline[4]

[3] OCH stands for obstacle clearance height

[4] Figure sourced from PANS-OPS Vol II

4.2.4 Other runway aligned procedures that can be flown using a straight-in approach

4.2.4.1 Sub-paragraph 5.4.6.1 (b) to Vol II of the PANS-OPS states:

for all other straight-in instrument approach procedures:

1) a base width equal to the runway strip width originating 60 m prior to the runway threshold, splaying 15 per cent on either side of the extended runway centre line, and terminating at the point where the height of the surface reaches the OCH

2) where the final approach course is offset and intersects the extended runway centre line, the splay on the side closest to the final approach course is increased by the offset angle; and

3) where the final approach course is offset but does not intersect the extended runway centre line, the splay closest to the final approach course is increased by an amount equal to the final approach course offset at 1 400 m from the runway threshold.

4.2.4.2 In plain terms, this type of VSS originates along the baseline for the 'approach surface', which forms part of the OLS.

> **Note:** For more information on the approach surface, refer to paragraph 7.08 of the Part 139 MOS.

4.2.4.3 The width of the baseline should refer to the greater of the actual or published runway strip.

4.2.4.4 Unlike the VSS for localiser or look-alike lateral guidance, each side of the VSS diverges away from the approach baseline along a 15% splay. Refer to the lower part of Figure 7 below.

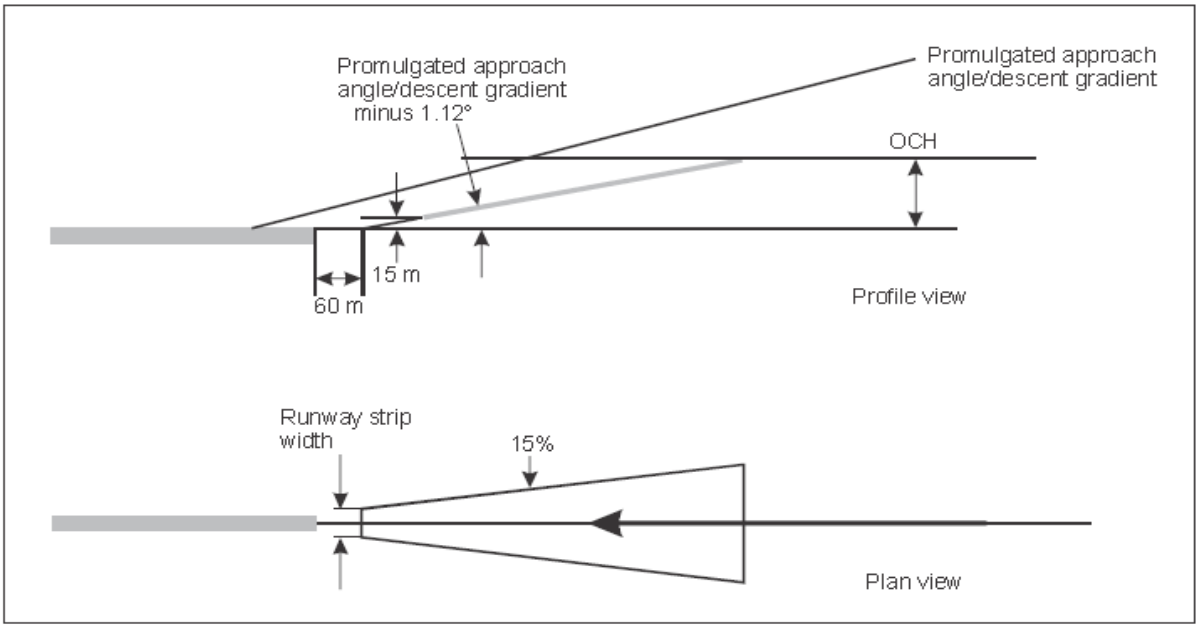

Figure 7: The VSS of other approach procedures for a normal straight-in approach[5]

[5] Figure sourced from PANS-OPS Vol II

4.2.4.5 The VSS continues to move away from the inner approach baseline until the distance where the vertical component of the VSS reaches the OCH.

4.2.4.6 In the case of an offset approach angle that is different to the runway centreline, refer to:

- subparagraphs 5.4.6.1 (b) (2) and (3) of Vol II to PANS-OPS
- Figure 8 and Figure 9 below

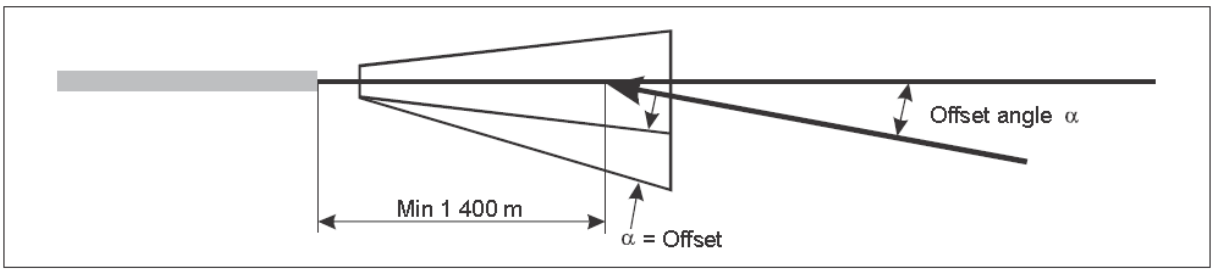

Figure 8: Plan view of VSS for an offset final approach with a runway centre line crossing[6]

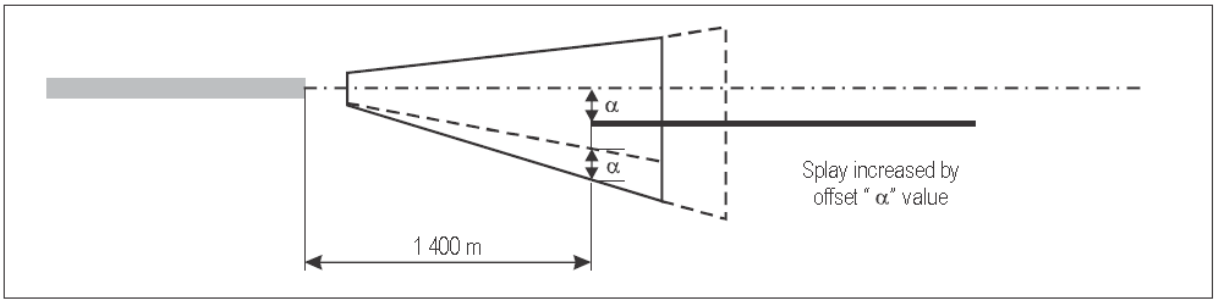

Figure 9: Plan view of VSS with an offset final approach parallel to the runway centre line[7]

4.3 Vertical parameters of the VSS

4.3.1 Vertically, the VSS originates at the runway threshold height and has a slope of 1.12 degrees less than the promulgated approach procedure angle. Refer to the upper parts of Figure 6 and Figure 7.

4.3.2 As specified in paragraph 5.4.6.4 to Vol II of PANS-OPS, only obstacles that are higher than a plane measured at **15 metres** above the height of the relevant runway threshold, and which penetrate the VSS need to be considered.

4.3.3 Determining the promulgated approach procedure angle

4.3.3.1 This information is also contained on the AIP DAP approach chart (plate) and is located in two sections. These have been highlighted in red boxes within Figure 100. In this example, the approach slope is 3 degrees:

[6] Figures sourced from PANS-OPS Vol II

[7] Figure sourced from PANS-OPS Vol II

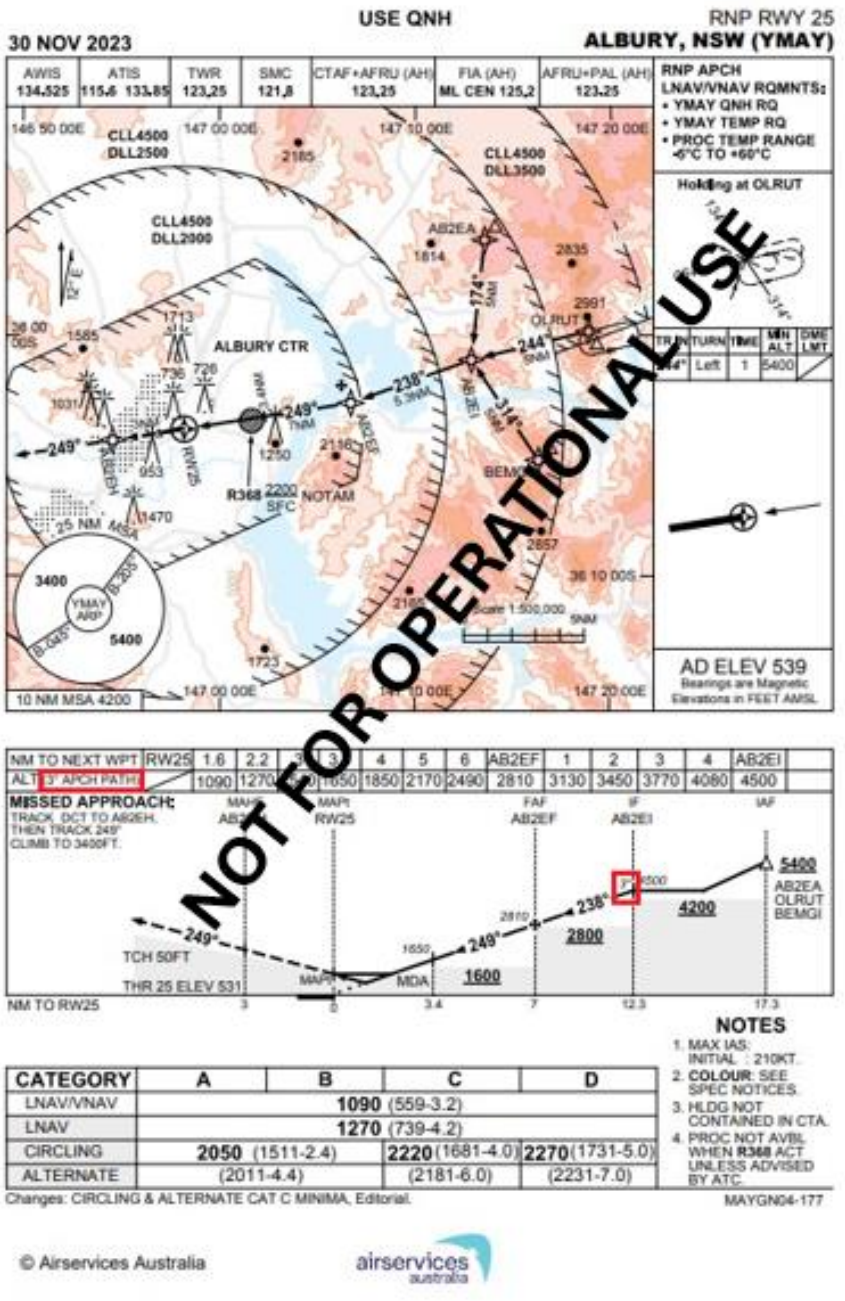

Figure 10: DAP approach chart (plate) showing where the designed approach slope details can be located

5 Monitoring of the VSS

Figure 11: Establish VSS Monitoring

5.1 Regulatory requirements

5.1.1 For certified aerodromes, procedures for monitoring obstacles associated with all instrument runways must be documented in the aerodrome manual (refer to subsection 11.06 of the Part 139 MOS).

5.1.2 Further requirements for the monitoring of the PANS-OPS airspace by the aerodrome operator are contained in subsection 11.06 (2) of the Part 139 MOS.

5.2 Types and sources of obstacles

5.2.1 Future penetrations of the VSS could result from natural vegetation growing above a height of 15 m above the runway threshold, or from man-made developments such as a building, mast, tower or other structure.

5.2.2 The VSS therefore, needs to be monitored against any development applications in the vicinity of the aerodrome which are lodged to the applicable local, state, territory or federal planning body.

5.3 Monitoring parameters and procedure

5.3.1 As with all airspace surfaces which form part of PANS-OPS, under Part 173 MOS the procedure designer must provide details of the VSS parameters to be monitored by the aerodrome operator.

5.3.2 An example format for how this information could be presented to the aerodrome operator is provided in Table 2.

Table 6: VSS parameters and values

VSS Parameter	Value
Inner edge (metres):	i.e. 150 metres
Start point from threshold (metres):	i.e. 60 metres
Divergence - Left (percent / degrees):	i.e. 15% (8.53 degrees)
Divergence - Right (percent / degrees):	i.e. 15% (8.53 degrees)
End point from threshold (metres):	Distance until the vertical component of the VSS reaches the OCH (metres)

VSS Parameter	Value
Height of end point above threshold elevation (feet / meters):	Height of OCH above the height of the threshold (feet / metres)
Nominal descent gradient (degrees):	The approach gradient of the relevant procedure (i.e. 3.00 degrees)
Surface gradient (degrees):	The actual approach gradient less 1.12 degrees (i.e. 1.88 degrees)

5.3.3 A list of controlling obstacles used to design the instrument flight procedure also provides useful information.

5.3.4 Once this table (or similar) is completed by the procedure designer, it needs to be sent to the aerodrome operator. For convenience, a blank table is provided in Appendix B.

5.3.5 Upon receipt of this information, the aerodrome operator needs to ensure their procedures are appropriate to monitor for obstacles in their VSS. It is recommended that these procedures consider the following:

- Routine visual assessments of the VSS from the aerodrome. This could involve either
  - a trained and competent person such as an Aerodrome Reporting Officer who is familiar with the VSS

  or

  - a surveyor who has been briefed on the VSS.
- Ensuring the VSS (and the other PANS-OPS airspace) is considered for any development applications that could impact upon the instrument flight procedures published for the aerodrome.

Note: For many aerodromes, protection of the VSS (and the other PANS-OPS airspace) will involve more than one planning authority. In these cases, procedures for liaising with these external planning authorities is considered essential.

5.3.6 For runways with more than one VSS, which may also include those from different instrument flight procedure designers, the PANS-OPS airspace monitoring procedures should consider the extremities of the combined surfaces. The designer of the instrument flight procedure can be determined by the logo at the bottom on the chart.

5.3.7 As an additional measure, it is recommended that the integrity of the PANS-OPS airspace, including the VSS, is checked routinely by the aerodrome operator. As the VSS and the OLS will generally share a common survey baseline, checking the VSS during their annual survey of the approach and take-off surfaces (that form part of the OLS) may provide an efficient approach for many aerodrome operators.

5.4 Conducting an initial survey of the VSS on the request of the procedure designer

Figure 12: Maintain VSS

5.4.1 When designing a new instrument flight procedure or establishing the VSS for an existing procedure, the designer may request additional obstacle information from the aerodrome operator or engage a surveyor, as appropriate.

5.4.2 For convenience, a blank table is provided in Appendix B. This table can be used to brief the surveyor on the VSS parameters to be the surveyed.

6 Reporting of existing or potential obstacles

Figure 13: Report obstacles in VSS

6.1 When to report

6.1.1 Any existing or potential penetration of the VSS needs to be reported to the instrument flight procedure designer.

6.2 Managing a VSS penetration

6.2.1 If a penetrating obstacle can be readily addressed by either the aerodrome operator, relevant planning authority or responsible person (i.e. development application rejected or the obstacle removed from the VSS), the instrument flight procedure should no longer be affected.

6.2.2 If the obstacle cannot be readily addressed, depending on the nature and extent of the penetration, the instrument approach procedure may need to be redesigned or adjusted. The Part 173 procedure designer, who is responsible for the instrument flight procedure, will need to advise the aerodrome operator accordingly.

6.2.3 In consultation with CASA, an aeronautical assessment related to the continued safety of the instrument flight procedure may also need to be conducted as appropriate by:

- the instrument flight procedure designer
- the aerodrome operator

  and/or
- the owner/proponent of the obstacle.

6.2.4 If the obstacle presents an unacceptable risk and the obstacle cannot be addressed or the procedure amended, the instrument flight procedure may then need to be withdrawn by the designer.

Appendix A
Optional VSS compliance checklist

Table 7: VSS checklist for an aerodrome operator

VSS	Item	Checked	Notes
Confirmation of VSS	Does the aerodrome have an instrument flight procedure for an instrument runway?		
	If yes, have the VSS parameters been obtained from the procedure designer?		
Establish VSS monitoring	Has the person responsible for monitoring been briefed in the VSS parameters?		
	Has the initial VSS been checked and is subject to routine monitoring?		
Report obstacles in VSS	Is the VSS infringed by an obstacle(s)?		
	If yes, has the instrument flight procedure designer been informed of the obstacles penetrating the VSS?		
Maintain VSS	If yes, did the instrument flight procedure designer advise of any impact to the procedure?		
	Are procedures in place to monitor the VSS for penetrations from future obstacles?		

Appendix B
VSS parameters template: for monitoring or survey

B.1 VSS PARAMETERS

Table 8: Aerodrome details

Aerodrome data	Details
Name of aerodrome:	
ICAO identifier (Y_ _ _):	
Aerodrome operator:	
Runway designation:	
Type of instrument flight procedure:	

Table 9: VSS parameters

VSS Parameters	Value
Inner edge (metres):	
Start point from threshold (metres):	
Divergence - Left (percent / degrees):	
Divergence - Right (percent / degrees):	
End point from threshold (metres):	
Height of end point above threshold elevation (feet / meters):	
Nominal descent gradient (degrees):	
Surface gradient (degrees):	

Please provide this sheet to the aerodrome operator for monitoring purposes or prior to any survey activity being conducted.

Each VSS should be completed on a separate sheet.