



**Australian Government**

**Australian Transport Safety Bureau**

# Flight below minimum altitude occurrences

40 km south of Cairns Airport, Queensland on 24 and 26 October 2022

## **ATSB Transport Safety Report**

Aviation Occurrence Investigation (Defined)

AO-2022-051

Interim – 28 February 2023

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

#### Publishing information

**Published by:** Australian Transport Safety Bureau  
**Postal address:** GPO Box 321, Canberra, ACT 2601  
**Office:** 12 Moore Street, Canberra, ACT 2601  
**Telephone:** 1800 020 616, from overseas +61 2 6257 2463  
Accident and incident notification: 1800 011 034 (24 hours)  
**Email:** [atsbinfo@atsb.gov.au](mailto:atsbinfo@atsb.gov.au)  
**Website:** [www.atsb.gov.au](http://www.atsb.gov.au)

© Commonwealth of Australia 2023



#### Ownership of intellectual property rights in this publication

Unless otherwise noted, copyright (and any other intellectual property rights, if any) in this publication is owned by the Commonwealth of Australia.

#### Creative Commons licence

With the exception of the Coat of Arms, ATSB logo, and photos and graphics in which a third party holds copyright, this publication is licensed under a Creative Commons Attribution 3.0 Australia licence.

Creative Commons Attribution 3.0 Australia Licence is a standard form licence agreement that allows you to copy, distribute, transmit and adapt this publication provided that you attribute the work.

The ATSB's preference is that you attribute this publication (and any material sourced from it) using the following wording: *Source:* Australian Transport Safety Bureau

Copyright in material obtained from other agencies, private individuals or organisations, belongs to those agencies, individuals or organisations. Where you want to use their material you will need to contact them directly.

#### Addendum

Page	Change	Date

# Interim report

This interim report details factual information established in the investigation's early evidence collection phase, and has been prepared to provide timely information to the industry and public. Interim reports contain no analysis or findings, which will be detailed in the investigation's final report. The information contained in this interim report is released in accordance with section 25 of the *Transport Safety Investigation Act 2003*.

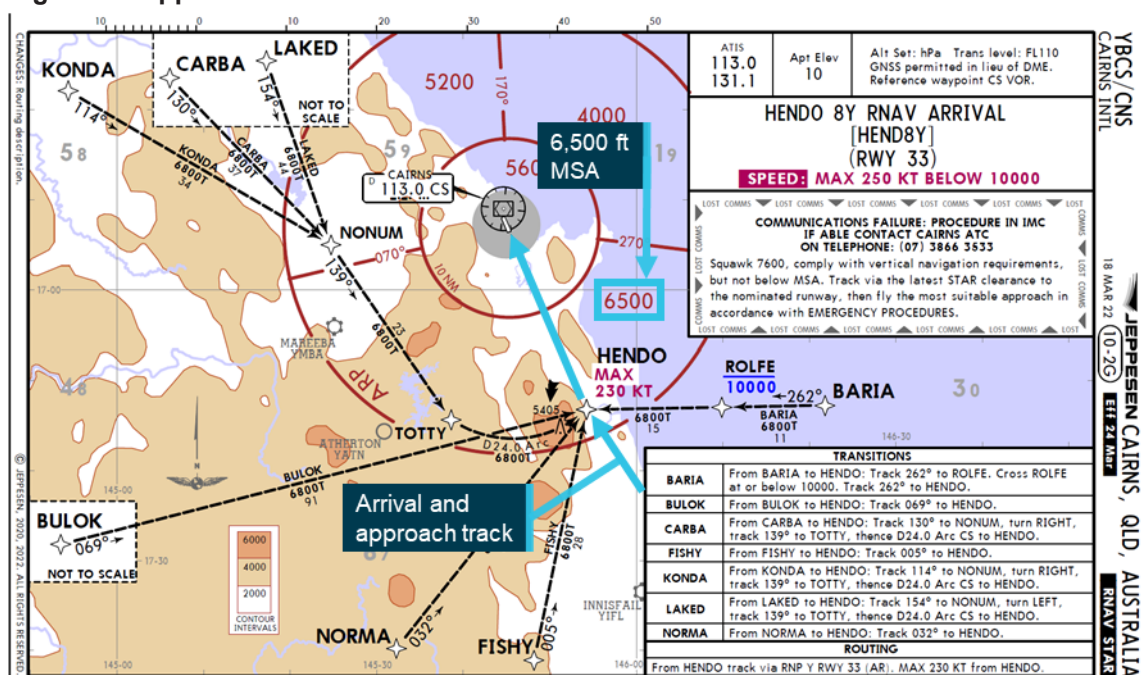
## The occurrences

### 24 October 2022

On the evening of 24 October 2022, a Virgin Australia Airlines Boeing 737-800 registered VH-VUT operated a flight from Brisbane to Cairns, Queensland. The captain was acting as pilot flying from the right flight crew seat, the first officer was undertaking command training and operating as pilot monitoring in the left flight crew seat.<sup>1</sup>

At 1945 local time, the aircraft was cruising in darkness at flight level (FL)<sup>2</sup> 380 about 215 NM to the south of Cairns. At that time, air traffic control (ATC) provided the crew with clearance to conduct the Cairns HENDO 8Y standard arrival (STAR) via the BARIA waypoint<sup>3</sup> transition (Figure 1).

Figure 1: Jeppesen HENDO 8Y standard arrival – VH-VUT



Note: Both Virgin Australia and Qantas (see 26 October occurrence) were using procedure charts provided by Jeppesen.  
Source: Virgin Australia, annotated by ATSB

The flight crew entered the HENDO 8Y STAR into the flight management computer (FMC) and selected the BARIA transition. The HENDO 8Y STAR progressed into the required navigation

<sup>1</sup> Pilot Flying (PF) and Pilot Monitoring (PM): procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and the aircraft's flight path.  
<sup>2</sup> Flight level: at altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 380 equates to 38,000 ft.  
<sup>3</sup> Waypoint: A defined position of latitude and longitude coordinates, primarily used for navigation.

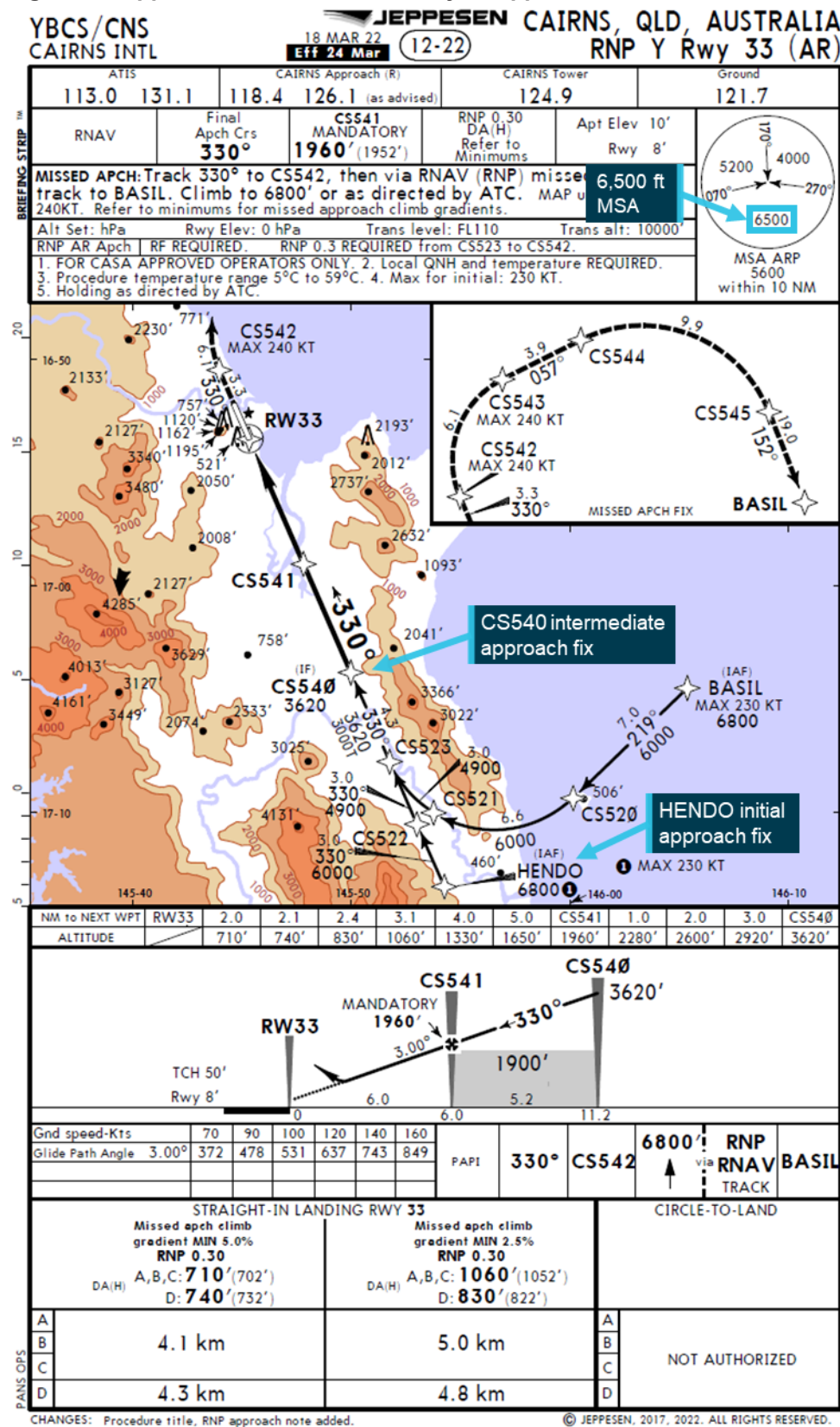
performance (RNP) Y instrument approach for runway 33 at Cairns. While clearance for the approach had not been provided at that time, the crew anticipated the clearance and loaded the approach into the FMC. From HENDO, the minimum altitude for commencing the RNP Y approach was 6,800 ft above mean sea level (AMSL). The HENDO waypoint was located within the 6,500 ft minimum sector altitude (MSA)<sup>4</sup> segment to the south of Cairns.

The approach procedure had two different initial approach fixes (IAF) (Figure 2) with associated paths to a common intermediate fix (IF) at waypoint CS540. From the BASIL IAF, the approach proceeded via CS520, CS521 and CS523, and from the HENDO IAF via CS522 and CS523. In order to load either path into the FMC, the flight crew needed to select one of the two approach transitions (see the section titled *Flight management computer*).

---

<sup>4</sup> Minimum sector altitude (MSA) and lowest safe altitude (LSALT) are calculated to provide 1,000 ft obstacle clearance for instrument flight rules flights and are published on aeronautical charts and in the Aeronautical Information Publication (AIP) for pilot and controller reference.

Figure 2: Jeppesen Cairns RNP Y runway 33 approach chart



Source: Virgin Australia, annotated by ATSB

The flight crew did not recognise that an approach transition selection was required and consequently did not select one. As a transition had not been selected, the FMC presented a discontinuity in the entered flight path at the HENDO waypoint (see the section titled *Flight*

*management computer*). The flight crew misidentified the approach IF, CS540, as the IAF and resolved the FMC discontinuity by connecting HENDO to CS540. This selection removed the 6,800 ft descent altitude constraint associated with HENDO in the RNP approach programming.

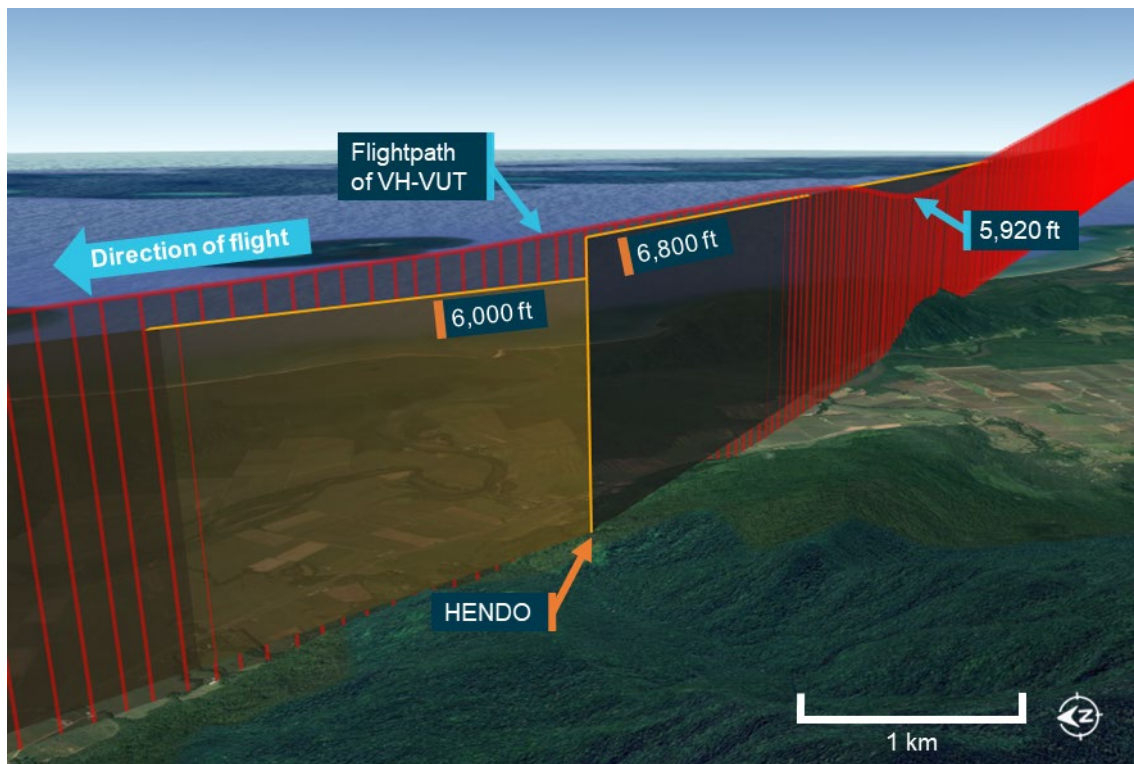
At 1954, when the aircraft was 136 nm south of HENDO, ATC cleared the flight to track direct to the HENDO waypoint and 6 minutes later the crew commenced descending the aircraft. At 2010:51, when the aircraft was about 11 NM southeast of HENDO, ATC provided the crew with clearance to conduct the RNP Y runway 33 approach.

One minute later, the aircraft approached HENDO descending through about 7,300 ft with the autopilot engaged and an altitude of 6,800 ft selected in the autopilot mode control panel. At about that time, the captain selected the approach's minimum descent altitude of 800 ft, but sensed that this selection was incorrect and therefore reselected an altitude of 6,800 ft. The captain then reviewed the approach briefing, confirmed that the aircraft was tracking as intended and the vertical navigation autopilot mode was active and again selected 800 ft.

At 2011:38, about 7 NM prior to crossing HENDO, the aircraft descended below 6,800 ft (Figure 3) and 9 seconds later descended below the 6,500 ft MSA. Six seconds later, at 2011:53, ATC observed that the aircraft had descended below 6,800 ft and contacted the crew to confirm the aircraft's altitude. The captain then reselected 6,800 ft and manually arrested the descent. ATC then issued a low altitude alert to the crew and advised them to climb immediately. Three seconds later, at 2012:07, the aircraft stopped descending at about 5,920 ft and then commenced a climb. At 2012:28, the aircraft climbed back above 6,800 ft. No ground proximity warning system alerts were generated during the incident.

A missed approach was then commenced, and the crew conducted a second approach without further incident.

**Figure 3: Flight path of VH-VUT**



Source: Virgin Australia, Airservices and Google Earth, annotated by ATSB

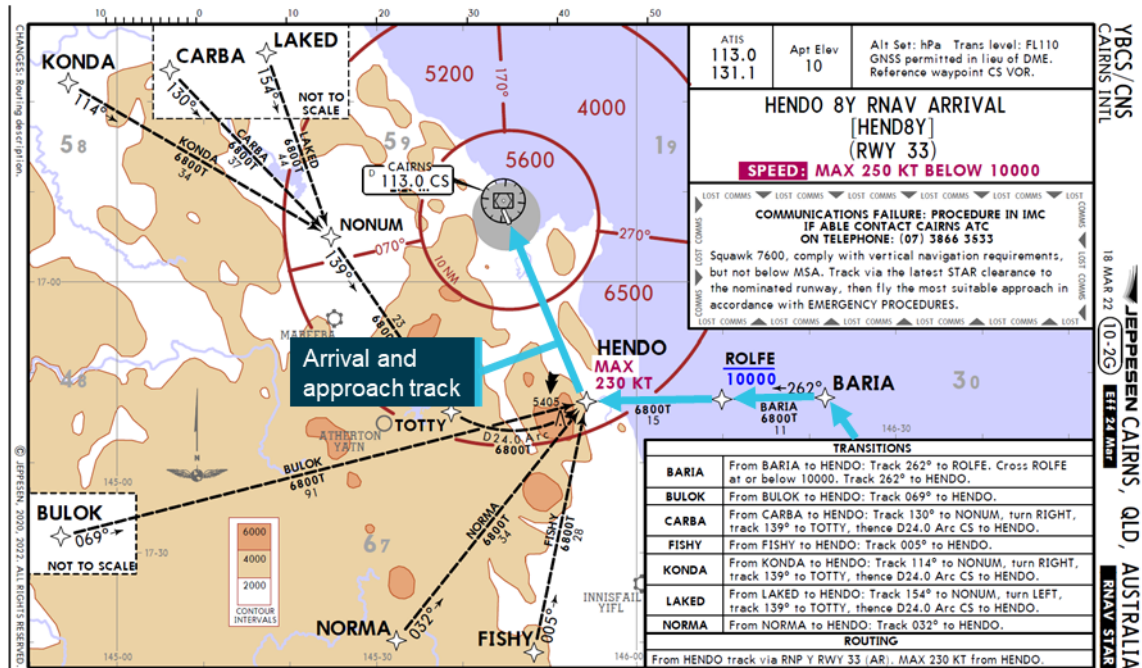


**26 October 2022**

On the morning of 26 October 2022, a Qantas Airways Boeing 737-800 registered VH-VZA operated a flight from Brisbane to Cairns. The captain was acting as pilot flying, and the first officer was acting as pilot monitoring.

At 0739, in daylight, while the aircraft was in cruise at FL 380 about 225 NM to the south of Cairns, ATC provided the crew with clearance to conduct the Cairns HENDO 8Y STAR via the BARIA waypoint transition (Figure 4).

**Figure 4: Jeppesen HENDO 8Y standard arrival – VH-VZA**



Source: Virgin Australia, annotated by ATSB

The flight crew entered the HENDO 8Y STAR into the FMC and selected the BARIA transition. While clearance for the RNP Y runway 33 approach had not been provided at that time, the crew anticipated the clearance and loaded the approach. The crew believed that they had only been cleared for the BARIA STAR transition and had not yet received clearance for the HENDO approach transition, and therefore did not select that transition. As the selection had not been made, the FMC did not load the instrument approach segment from the IAF to the IF and presented a discontinuity between HENDO and the IAF waypoint CS540 (see the section titled *Flight management computer*).

The crew noted that the waypoints CS522 and CS523 were missing from the track presented on the navigation display and contacted ATC to request confirmation of the STAR clearance. ATC then provided a clearance for the HENDO 8Y STAR with a FISHY transition. The crew reviewed the STAR chart and assessed that they could not achieve the required descent profile to proceed via FISHY and requested confirmation of the STAR transition. ATC then confirmed the STAR transition was via BARIA.

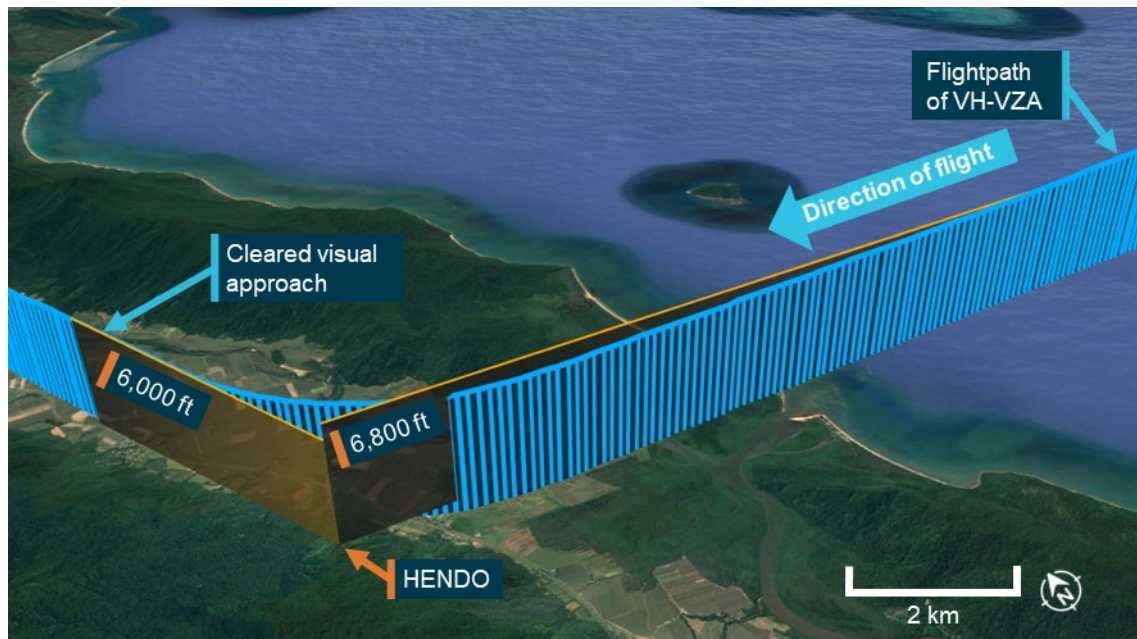
The flight crew noted that the track from HENDO to CS540 passed over the locations of CS522 and CS523. As there was no cloud along the flight path and terrain was visible, the crew were not reliant on FMC programming for terrain clearance. As such, the crew decided to join the discontinuity at HENDO to CS540 to proceed with the approach. The captain also selected an altitude 6,800 ft in the autopilot mode control panel.

At 0808:20, when the aircraft was 18 NM east of HENDO with the autopilot engaged and descending through about FL110, ATC provided the crew with clearance to conduct the RNP Y runway 33 approach.

At 0810:42, when the aircraft was about 7 NM east of HENDO, the captain selected 5,500 ft in the autopilot mode control panel and the aircraft descended below 6,800 ft, and 34 seconds later below the 6,500 ft MSA.

The aircraft passed HENDO at 0811:56 at an altitude of about 6,125 ft (Figure 5). Eleven seconds later, ATC contacted the crew to confirm that the aircraft had passed HENDO at the correct altitude. ATC then confirmed with the crew that the flight was operating in visual conditions and provided clearance for a visual approach. The aircraft landed at Cairns without further incident.

**Figure 5: Flight path of VH-VZA**



Source: Qantas, Airservices and Google Earth, annotated ATSB

## Flight management computer

The approach procedure (Figure 2) had two different IAFs with associated paths to a common IF (CS540), from BASIL through waypoints CS520, CS521 and CS523, or from the HENDO through CS522 and CS523. Therefore, the flight crew needed to select one of the two approach transitions (Figure 6). If a transition was not selected, the segment of the approach from the IAF to the IF would not be loaded (the component of the instrument approach from the common IF onwards was automatically loaded).



Figure 6: Flight management computer approach transitions



Source: Virgin Australia, annotated by ATSB

As the crews did not select an approach transition, a discontinuity (Figure 7) was created at the HENDO waypoint associated with the HENDO 8Y STAR. Both crews resolved this discontinuity by connecting HENDO to CS540. This selection removed the 6,800 ft descent altitude constraint associated with HENDO in the RNP approach programming. The segment minimum safe altitudes associated with waypoints CS522 (6,000 ft) and CS523 (4,900 ft) were also removed.

**Figure 7: Flight management computer (left) and navigation display (right) showing the discontinuity**



Source: Virgin Australia, annotated by ATSB

## Safety action

The ATSB has been advised of the following proactive safety action in response to these occurrences.

### Virgin Australia

Virgin Australia updated flight crew operation notice information for Cairns with detailed guidance for the conduct of the HENDO 8Y arrival and RNP Y runway 33 approach. Virgin Australia also provided guidance to all Boeing 737 flight crew for the conduct of arrivals and approaches where the selection of an approach transition was required.

### Qantas

Qantas issued an internal notice to flight crew providing guidance for the conduct of arrivals and approaches where the selection of an approach transition was required.

## Further investigation

To date, the ATSB has:

- interviewed the involved flight crews
- examined recorded flight data
- reviewed recorded air traffic control audio and surveillance data
- reviewed operator and air traffic control procedures

The investigation is continuing and will include further review and examination of:

- flight crew actions and recency
- recorded flight data
- operator and air traffic control procedures
- instrument procedure and waypoint naming processes and standards
- arrival and approach chart information and presentation

Should a critical safety issue be identified during the course of the investigation, the ATSB will immediately notify relevant parties so that appropriate and timely safety action can be taken.

A final report will be released at the conclusion of the investigation.

# General details

## Occurrence details – 24 October

Date and time:	24 October 2022 – 2011 Eastern Standard Time	
Occurrence class:	Incident	
Occurrence categories:	Flight below minimum altitude, aircraft preparation	
Location:	40 km south of Cairns, Queensland	
	Latitude: 17° 13.150' S	Longitude: 145° 54.16' E

## Occurrence details – 26 October

Date and time:	26 October 2022 – 0811 Eastern Standard Time	
Occurrence class:	Incident	
Occurrence categories:	Flight below minimum altitude, aircraft preparation	
Location:	40 km south of Cairns, Queensland	
	Latitude: 17° 13.150' S	Longitude: 145° 54.16' E

## Aircraft details – 24 October

Manufacturer and model:	The Boeing Company 737-8FE	
Registration:	VH-VUT	
Operator:	Virgin Australia Airlines	
Serial number:	36608	
Type of operation:	Air transport operations – larger aeroplanes (CASR Part 121)	
Departure:	Brisbane, Queensland	
Destination:	Cairns, Queensland	
Persons on board:	Crew – Unknown	Passengers – Unknown
Injuries:	Nil	Nil
Aircraft damage:	None	

## Aircraft details – 26 October

Manufacturer and model:	The Boeing Company 737-838	
Registration:	VH-VZA	
Operator:	Qantas Airways	
Serial number:	34195	
Type of operation:	Air transport operations – larger aeroplanes (CASR Part 121)	
Departure:	Brisbane, Queensland	
Destination:	Cairns, Queensland	
Persons on board:	Crew – Unknown	Passengers – Unknown
Injuries:	Nil	Nil
Aircraft damage:	None	

# Australian Transport Safety Bureau

## About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

## Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

## Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.