Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2007-060
Final

Collision with terrain
Uaroo Station, Pilbara, WA
16 November 2007
VH-TCS
Cessna Aircraft Company 172M

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Abstract

At about 0730 Western Daylight-saving Time, on 17 November 2007, the wreckage of a Cessna Aircraft Company C172M aircraft, registered VH-TCS, was discovered on the side of a hill, at Uaroo Station, in the Pilbara region of WA, about 500 m from the property air strip. The aircraft had been destroyed by impact forces and a post-impact fire. The pilot, who was the sole occupant, had been fatally injured.

Information obtained from persons that knew the pilot indicated that he had most likely taken-off from the airstrip during the morning of 16 November 2007, however, the actual time of the takeoff could not be determined. There were no reported witnesses to the takeoff, any subsequent flight, or the accident. Tyre marks made by the aircraft indicated that the aircraft had taken-off from runway 27 to the west.

There was no evidence of an engine or aircraft system problem which could have contributed to the accident. There was no evidence that the pilot had a pre-existing physiological condition that could have contributed to the accident. The aircraft manufacturer's tabulated takeoff data showed that the aircraft should have had sufficient performance to takeoff from runway 27 and climb clear of terrain.

There is evidence to indicate the possibility of adverse meteorological phenomena such as strong wind gusts and willy-willies in the area on the days before, during and subsequent to the accident. The willy-willies were reported to be difficult to see, form and dissipate rapidly, and travel in the same direction as the prevailing wind.

While the reason that the aircraft impacted terrain could not be conclusively determined, it is probable that the aircraft encountered adverse meteorological phenomena such as strong wind gusts and willy-willies, after takeoff from runway 27.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

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

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, 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.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site http://www.atsb.gov.au/.

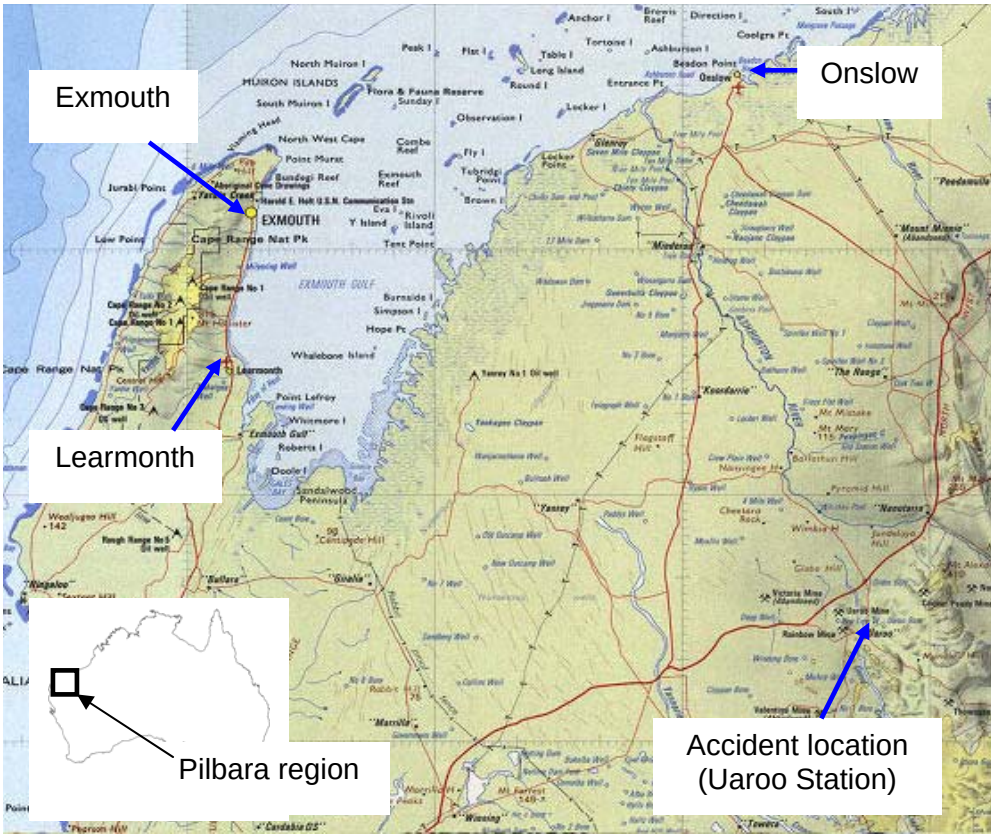
FACTUAL INFORMATION

History of the flight

At about 0730 Western Daylight-saving Time[1], on 17 November 2007, the wreckage of a Cessna Aircraft Company C172M aircraft, registered VH-TCS, was discovered on the side of a hill at Uaroo Station, in the Pilbara region of WA (Figure 1). The wreckage was located about 500 m from the property airstrip (Figure 2). The aircraft had been destroyed by impact forces and a post-impact fire. The pilot, who was the sole occupant, had been fatally injured.

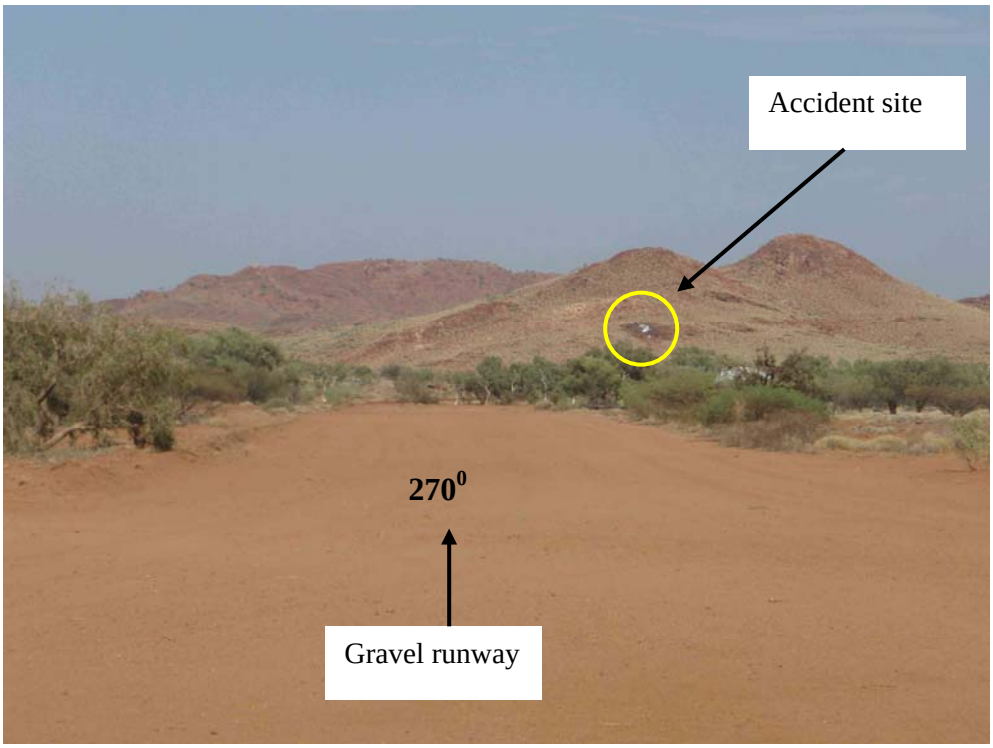
Information obtained from persons that knew the pilot indicated that he had most likely taken off during the morning of 16 November 2007; however, the actual time of the takeoff could not be determined. There were no reported witnesses to the takeoff, any subsequent flight, or the accident. Tyre marks made by the aircraft indicated that the aircraft had taken off from runway 27.

Figure 1: Accident location



1 The 24-hour clock is used in this report to describe the local time of day, Western Daylight-saving Time, as particular events occurred. Western Daylight-saving Time is Coordinated Universal Time (UTC) + 9 hours.

Figure 2: Accident location – view to the west



Pilot information

The pilot held an Australian private pilot (aeroplane) licence, issued in 1984. He was appropriately endorsed to fly the C172M aircraft type and held a valid Civil Aviation Safety Authority (CASA) Class 2 aviation medical certificate, which included a requirement for the pilot to wear distance vision correction.

The investigation was unable to determine the pilot's aeronautical experience at the time of the accident because:

- the pilot's flying logbook could not be found
- there were inconsistencies in reported hours flown contained in the pilot's previous aviation medical records
- the aircraft maintenance release on which the pilot records the aircraft's flying hours could not be found
- there were no flying hours entered by the pilot on the previous aircraft maintenance release.

Witnesses who spoke to the pilot the day before the accident reported that he was in good spirits and was looking forward to travelling to Perth the following week.

Airstrip information

The airstrip at the property included two gravel runways aligned 195/015 degrees and 1,100 m (3,600 ft) long, and 270/090 degrees and 400 m (1,300 ft) long (Figure 3). A line of hills, which ran in a north-south direction, was located to the west of the airstrip. The tops of those hills were about 46 m (150 ft) above the level of the

airstrip. A gap in the line of hills was located about 50 m to the south of the accident site.

Figure 3: Accident location

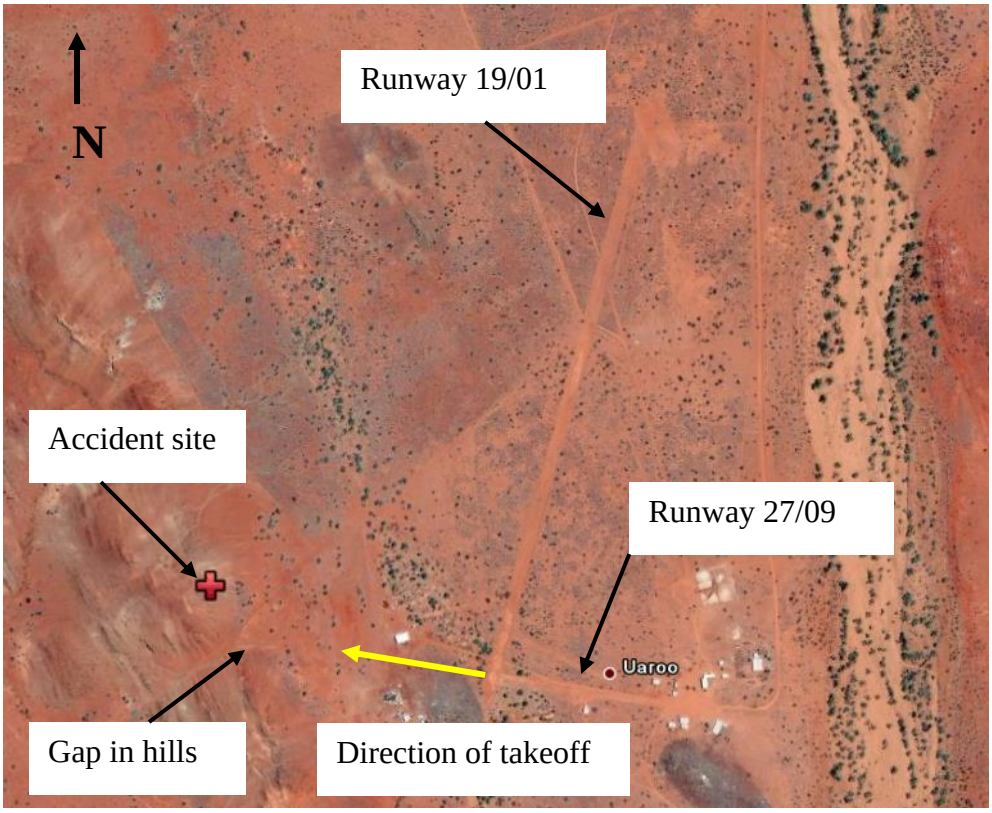


Image courtesy of Google Earth™

Operational information

Persons that knew the pilot reported that he used the aircraft to monitor cattle, windmills, and trough water levels on the property. They also reported that the pilot normally flew in the morning when the temperature was cooler and there was less air turbulence, and for approximately 45 minutes at a time.

It was also reported that the pilot was known to take off to the west and, on occasion, fly through the gap in the line of hills. In addition, it was reported that he was aware of frequent hot gusty winds in the area, particularly around the line of hills, and that willy-willies[2] often formed in the area.

A number of 200-litre drums of aviation fuel were located at the airstrip. The drums had previously been filled from a fuel tanker. There was no evidence that the pilot had refuelled the aircraft immediately prior to the flight. A fuel sample drawn from one of the drums was analysed in an approved laboratory and determined to be suitable for continued use.

2 Willy-willies (also known as dust devils or dust whirls) may be defined as revolving masses of air resulting from local atmospheric instability, such as that caused by intense heating of the air mass adjacent to the ground by the sun on a hot day.

Due to the level of destruction of the aircraft, the aircraft fuel tank quantity at the time of the accident could not be determined. However, an intense post-impact fire and significant quantities of fuel residue at the accident site indicated that there was sufficient fuel on board the aircraft to ensure continued flight. The aircraft's weight and balance, based on a full fuel load, was calculated to be within the prescribed limitations.

At an ambient temperature of about 35 degrees C (refer Meteorological information), one person on board and full fuel tanks, the aircraft manufacturer's tabulated takeoff data showed that the aircraft should have had sufficient performance to take off from runway 27 and climb clear of terrain.

Aircraft information

The aircraft was a Cessna Aircraft Company C172M, manufactured in 1974, powered by a Textron Lycoming 150 hp engine and fitted with a fixed-pitch propeller.

Manufacturer	Cessna
Model	172M
Serial Number	17264194
Registration	VH-TCS
Year of manufacture	1974
Certificate of airworthiness	Issue date 3 July 1975
Certificate of registration	Issue date 11 November 2005
Maintenance Release: A61690	Valid to hours/date 8,052.8hrs or 31 August 2007 (whichever came first)
Total airframe hours:	Could not be determined

The pilot had purchased the aircraft in November 2005 and the aircraft had accrued 7,952.8 hours at the last periodic inspection on 1 September 2006. Due to the destruction of the tachometer hour meter gauge, the aircraft hours at the time of the accident could not be determined. The last aircraft maintenance release was issued on 1 September 2006, and had expired on 31 August 2007.

The last maintenance to be conducted on the aircraft was on 23 November 2006, and comprised of engine oil and filter changes and some minor maintenance.

Engine information

Manufacturer	Textron Lycoming
Model	0-320-E2D
Type	4-cyclinder normally-aspirated
Serial Number	L-3623-27A
Time since overhaul	Could not be determined
Total time in service	Could not be determined

Engine hours since overhaul at the time of the last periodic inspection were 2,120.3. The engine manufacturer's recommended time between overhaul was 2,000 hours. The engine hours at the time of the accident could not be determined due to the destruction of the aircraft.

Propeller information

Manufacturer	McCauley
Model	ICI60DTM7557
Type	Fixed pitch
Serial Number	7280ZY
Time since overhaul	New at 7,692 aircraft hours
Total time in service	Could not be determined

The twin-bladed fixed-pitch propeller had been fitted new to the aircraft on 1 April 2003. The propeller manufacturer's recommended time between overhaul was 2,200 hours.

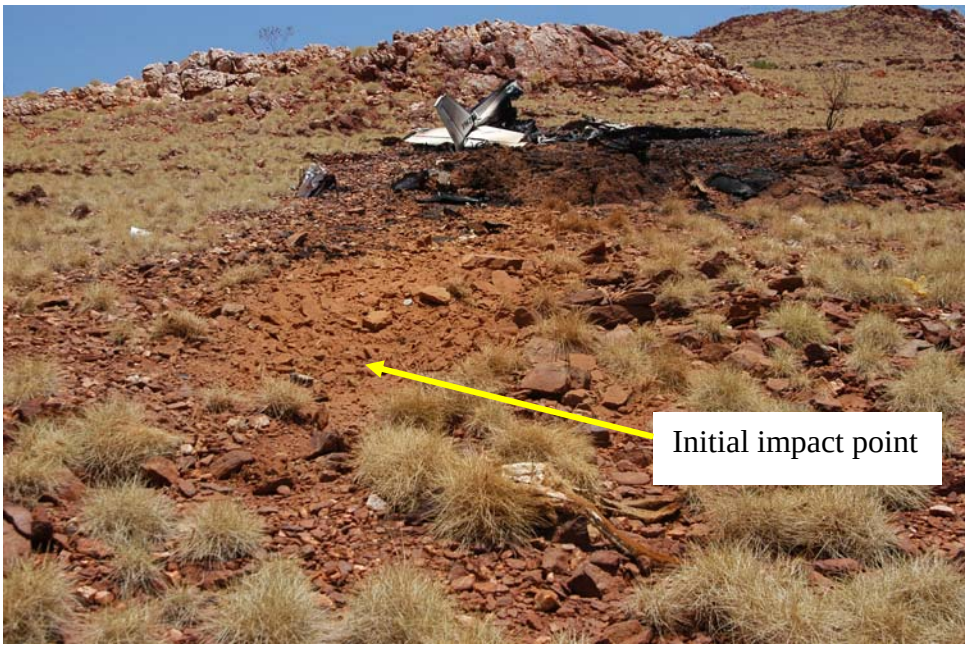
Wreckage and impact information

The aircraft impacted the hillside heading in a westerly direction, in a slightly nose-down, left wing-low attitude, with a slight left yaw. The aircraft came to rest 29 m from the initial point of impact (Figure 4). The initial impact point was at a height of about 12 m (40 ft) above the level of the airstrip. The hillside slope was at an angle of about 22 degrees.

An on-site examination of the aircraft engine and propeller indicated that the engine was operating at high power at the time of impact.

Flight control cable run continuity to the ailerons, rudder, elevator, and elevator trim was established from the forward part of the empennage, and the remains of the inboard wing sections. The extent of damage to the cockpit and cabin prevented any meaningful information being obtained regarding aircraft instrumentation, the cockpit control positions at impact, and control cable run integrity in this area.

Figure 4: Accident site – westerly view in direction of impact



Impact forces and the subsequent fire resulted in disintegration of the right wing, cabin and cockpit of the aircraft. The left wing, which came to rest on the right side of the accident site, retained some integrity (Figure 5). The empennage was also damaged by impact forces.

The elevator trim tab, wing flap, and aileron positions at impact could not be determined due to the extent of damage.

Figure 5: Accident site – easterly view towards property buildings

The engine and engine mounts had broken from the fuselage structure and came to rest at the forward section of the empennage. A number of engine components were destroyed by the impact and the post-impact fire.

A witness reported that, due to the pilot's height, he normally positioned his seat at the most rearward setting. The seat position could not be confirmed due to the destruction of the wreckage.

Engine examination

The engine was examined at an approved maintenance facility under the supervision of the Australian Transport Safety Bureau (ATSB). Although there were a number of missing components, including the induction system, there was no evidence of internal failure observed that may have contributed to the accident.

Propeller examination

During the impact sequence, the two-bladed, fixed-pitch propeller had been torn from the engine, complete with the propeller attachment flange. The propeller exhibited severe hammering and deep gouging damage along the leading edges of both blades and chordwise scoring had occurred to the front aerofoil surfaces of each blade. A large section of propeller blade approximately one-third of the total blade length, had fractured from the propeller assembly. A smaller section had also fractured from the tip of the opposite blade.

Medical information

The accident was not survivable due to impact forces and the post-impact fire. Post-mortem examination and toxicological testing of the pilot did not reveal any evidence of a pre-existing physiological condition that may have contributed to the accident.

Meteorological information

Meteorological conditions recorded on the adjoining property[3] for 16 November 2007, indicated fine conditions, 2 to 6 oktas[4] of cloud cover, moderate southerly winds in the morning and north-westerly winds in the afternoon. Ambient temperature was recorded as 32.9° C at 0900 and 43.5° C at 1500.

Witnesses in the general area, but not at Uaroo Station, reported that local conditions on the day of the accident were fine and very hot with strong south-westerly winds, and large, intense, willy-willies occurring throughout the day. In addition, the investigation team noted a number of very large, intense, willy-willies coming from the south to south-westerly direction throughout the days while conducting the on-site investigation. They were noisy and formed and dissipated

3 The adjoining property was a Bureau of Meteorology weather observation station.

4 Cloud cover is measured in eights or oktas.

rapidly, with the majority only visible when moving through the trees 40 m from the accident site.

The prevailing wind was from the west and came through the gap in the hills towards the homestead. The investigation team observed strong, hot wind gusts from the south and south-west along the line of the hills, and turning more westerly in the afternoon.

A witness reported that the number of willy-willies in the region at that time of the year was more numerous than in previous seasons. The witness also reported observing a large 200 m high willy-willy at the accident site on a subsequent occasion.

Willy-willies

Willy-willies occur as a result of hot air at ground level expanding, becoming less dense, and rising rapidly. Sideways movement (such as a light wind) in the initial upward surge of the air, establishes a vortex and a twisting, rising column is formed. Willy-willies are only seen by the naked eye when dust or debris is picked up within the vortex (Figure 6). As a result, not all willy-willies are visible.

Figure 6: Images of willy-willies

Willy-willies are capable of vertical development in excess of 1,000 feet above ground level, with reports of grass lifted in willy-willies being observed up to 8,000 feet. The air within willy-willies is very unstable, with rapid rising thermals and downdrafts created.

A 1988 research paper into the effect of meteorological phenomena such as willy-willies (also known as dust devils) on light aircraft was published in the US publication, *Journal of Aircraft*.[5] The research focussed on the structure, behaviour

5 Spillane, K.T. and Hess, G.D., Fair Weather Convection and Light Aircraft, Helicopter and Glider Accidents in *Journal of Aircraft* Vol 25, No 1, Washington, Jan 1988, p. 55-61.

and effects of the updrafts and downdrafts that occur within them. This predominately affects low-altitude operations.

The research paper stated that loss of lift encountered at a critical time during landing or takeoff could result in landing hard, landing short of the runway, and hitting the boundary fence. This problem of loss of lift or directional stability can occur without warning and can affect even experienced pilots.

The report also stated that in the cases studied which fell into the fair weather category, the possible influence of random convection-induced gusts in initiating the accident could not be excluded.

The significance of the research findings to aviation was seen in the occurrence of downdrafts of greater than 2 m/s (approximately 394 ft/min) at a height of 140 m (459 ft) for 2% of the time.

A 1990 Bureau of Meteorology Research Report[6] confirmed the findings of the previous research paper and added further data highlighting the following:

- the major hazard willy-willies pose to aviation is during the critical stages of flight such as takeoff and landing, where airspeed is relatively low and the time available to recover from sudden gusts is reduced
- not all willy-willies are visible
- willy-willies of convective origin mainly occur between 1000 and 1500 local time
- there is a tendency for willy-willies to form near the edge or over runways.

Previous accident

A previous accident involving an encounter of a Cessna 172 aircraft with willy-willies occurred at Mt Vernon Station, WA, on 1 September 2006, and is addressed in the ATSB Investigation Report BO/200605133, which is available at http://www.atsb.gov.au/publications/investigation_reports/2006/AAIR/aair200605133.aspx.

6 Spillane, K.T. and Hess, G.D., A Survey of Australian Dust Devils in *BMRC Research Report No. 20* Bureau of Meteorology Research Centre, Melbourne, June 1990.

ANALYSIS

There was no evidence of an engine or aircraft system problem which could have contributed to the accident. The fracture and separation of both propeller blades and the torsional fracture of the crankshaft is consistent with the engine operating at high RPM and developing power at the time of impact.

There was no evidence that the pilot had a pre-existing physiological condition that could have contributed to the accident. Aircraft wheel marks indicated that the aircraft took off from runway 27 towards the west. The aircraft was estimated to be within the prescribed weight and balance limitations and the aircraft manufacturer's tabulated take-off data showed that the aircraft should have had sufficient performance in the prevailing conditions to take off from runway 27 and climb clear of terrain.

There is evidence to indicate the presence of adverse meteorological phenomena such as strong wind gusts and willy-willies in the area on the days before, during and subsequent to the accident. Willy-willies are difficult to see, form and dissipate rapidly, and travel in the same direction as the prevailing wind.

The aircraft flight path towards the west would have placed the aircraft in the vicinity of the line of hills. Had there been adverse meteorological phenomena present on the day of the accident, any adverse effects on aircraft performance and flight characteristics would have been more severe in the vicinity of the line of hills.

While the reason that the aircraft impacted terrain could not be conclusively determined, it is probable that the aircraft encountered adverse meteorological phenomena during or after takeoff.

FINDINGS

From the evidence available, the following findings are made with respect to the collision with terrain of the Cessna 172M aircraft, registered VH-TCS, and should not be read as apportioning blame or liability to any particular organisation or individual.

Contibuting safety factors

- There were adverse meteorological phenomena such as strong wind gusts and willy-willies in the general area throughout 16 November 2007.
- It is probable that the aircraft encountered adverse meteorological phenomena such as strong wind gusts and willy-willies, after take-off from runway 27.

Other safety factors

- The aircraft maintenance release had expired prior to the day of the accident.

APPENDIX A: SOURCES AND SUBMISSIONS

Sources of information

The sources of information during the investigation included:

- the Bureau of Meteorology
- the telephone service provider
- the Western Australia Police
- family and friends of the pilot
- the aircraft maintenance organisation
- the Civil Aviation Safety Authority
- the Office of the State Coroner of Western Australia
- a fuel testing laboratory.

References

Spillane, K.T. and Hess, G.D., Fair Weather Convection and Light Aircraft, Helicopter and Glider Accidents in *Journal of Aircraft* Vol 25, No 1, Washington, Jan 1988, p. 55-61.

Spillane, K.T. and Hess, G.D., A Survey of Australian Dust Devils in *BMRC Research Report No. 20* Bureau of Meteorology Research Centre, Melbourne, June 1990.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the family of the aircraft pilot, the Civil Aviation Safety Authority, and the US National Transport Safety Board.

A submission was received from the Civil Aviation Safety Authority. The submission was reviewed and where considered appropriate, the text of the report was amended accordingly.