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What happened

Early in the morning on 15 July 2015, the crew of a Boeing 737-800, registered VH-YIU and operated by Virgin Australia International, prepared for a flight from Christchurch, New Zealand, to Brisbane, Queensland. The captain was the pilot flying and the first officer (FO) was the pilot monitoring.[1]

The flight usually departed Christchurch at 0650 New Zealand Standard Time (NZST), but the scheduled departure was delayed on this occasion to 0815, due to a crew change. The crew change, which had been planned by the operator during the evening prior, required the captain of the flight to fly to Christchurch as a passenger that morning. The captain arrived in Christchurch at about 0730 and proceeded directly to the waiting aircraft.

Meanwhile, the FO had arrived at the airport at about 0700 and checked the flight plan package,[2] including the flight plan, weather and NOTAMs.[3] The FO then ordered the required amount of fuel for the flight, and proceeded to the aircraft. The FO had noticed two NOTAMs dealing with runway works at Christchurch, but assessed that neither NOTAM would affect the flight.

After arriving at the aircraft, the FO commenced normal pre-flight duties. As part of preparation for the flight, the FO prepared the take-off reference data for departure from the runway 02/A6 taxiway intersection, anticipating that the full length of the runway would be available. The FO used the 24K (24,000 lb) engine thrust rating[4]/flaps 5 take-off reference data from the runway 02/A6 intersection table in the operator's Airport Analysis Manual (AAM).

The captain went straight to the aircraft and met the FO. The captain then checked the flight plan, fuel load and weather information, and conducted a pre-flight inspection of the aircraft. The captain did not read the NOTAMs but was advised by the FO that there was nothing significant. The aircraft was pushed back from the gate at about 0815.

At about the time the aircraft was pushed back from the gate, air traffic control (ATC) advised the crew that there was a change in the ATIS[5] and that runway 02 was operating at a reduced length. The reduction in runway length was associated with works in progress (WIP) that reduced the runway length available from 3,288 m to 1,920 m, with the northern 1,368 m of the runway closed (Figure 1).

1 Pilot flying and pilot monitoring are procedurally assigned roles with specifically assigned duties at specific stages of a flight. The pilot flying does most of the flying, except in defined circumstances. The pilot monitoring carries out support duties and monitors the actions of the pilot flying and the aircraft flightpath.

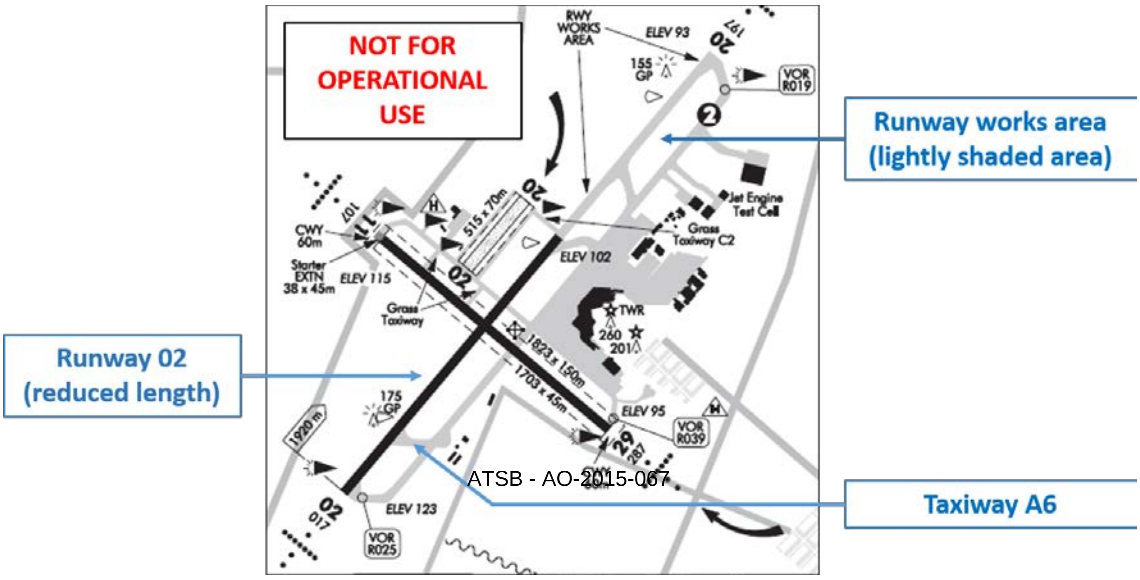
2 The flight plan package was produced by the operator's flight dispatch department at 0642 on the day of the incident.

3 A NOTAM (Notice to Airmen) advises personnel concerned with flight operations of information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to safe flight.

4 24K is a derated thrust setting. Engine thrust settings less than the maximum available thrust are often used during take-off. Take-off operations conducted at thrust settings less than the maximum take-off thrust available may provide substantial benefits in terms of engine reliability, maintenance and operating costs (FAA Advisory Circular 25-13).

5 The ATIS (Automatic Terminal Information Service) is an automated broadcast of prevailing airport weather conditions that may include relevant operational information for arriving and departing aircraft.

Figure 1: Christchurch Airport showing runway 02 works in progress - north



Source: CAA NZ - annotated by ATSB

Before starting the engines, the crew reviewed the take-off reference data considering the revised ATIS and the reduced runway length (due to the runway works). The crew again referred to the AAM, expecting to find inserted yellow pages that provided take-off reference data to be used while runway works were in progress (see section titled *Airport analysis manual*). The crew found that there were no yellow pages available for Christchurch.

In the absence of reduced runway length data related to the runway works (yellow pages), the crew elected to use full thrust during the departure, and commence their take-off from the threshold of runway 02. The crew then used the 26K (26,000 lb – full rated thrust)/flaps 5 take-off reference data from the AAM that was based upon the full length of the runway being available. The FO determined the amended take-off reference speeds from the AAM, and in accordance with company procedures, the figures were cross-checked by the captain.

During taxi and while lining up on the runway, the crew did not see any personnel, equipment or obstructions on the runway. At 0827, the aircraft departed without incident.

Following departure, the crew heard ATC advise the crew of an aircraft that was inbound to Christchurch, that the full length of the runway would be available for their arrival. This prompted the captain to review the NOTAMs that had earlier been reviewed by the FO. The captain found NOTAM B3805/15 NZCH (Figure 2) referring to runway works at Christchurch, which had relevance to their flight.

From the NOTAM, the captain ascertained that the runway length at the time of their departure was reduced to 1,920 m due to WIP. The NOTAM was effective from 14 July 2015 at 2000 UTC (15 July 2015 at 0800 NZST) until 15 July 2015 at 0225 UTC (1425 NZST). The captain also noticed that there was an associated relevant company remark (immediately following the NOTAM and highlighted in Figure 2) regarding a requirement to request On-Board Performance Tool (OPT)[6] take-off reference data during works in progress.

[6] For the purpose of this report, an OPT means that the crew were required to request take-off reference data (for departure under conditions where the runway length was reduced due to the works in progress) from the operator's flight dispatch staff. That request could be made using on-board aircraft communication systems, or by telephone.

Figure 2: NOTAM B3805/15 dealing with runway 02 reduced length (and closure of runway 20) due to works in progress[7]

```
B3805/15 NZCH     FROM: 14JUL15 20:00   TO: 15JUL15 02:25
E) RWY 20 CLSD LDG AND TKOF DUE WIP.
RWY 02 REDUCED LEN LDG AND TKOF DUE WIP. LDG RWY 02, EXIT TWY A4.
FULL LEN AVBL FOR SKED WIDE BODY ACFT WITH 20 MIN PN TO ATC.
ALL OTHER OPS FLW DECLARED DISTANCES AND EFFECTIVE OPR LENGTHS
APPLY. RWY   TORA   ASDA   TODA   LDA    TAKE OFF DIST TO OBSTACLE
GRADIENT                                     1:50          1:62.5
02     1920M  1920M  1920M  1920M      1870M         1827M
20     CLSD   CLSD   CLSD   CLSD       CLSD          CLSD
CRITICAL OBST ON RWY 02 IS A VEHICLE 2070M FM START OF TKOF.
HGT 12FT AGL)
DECODE - QMRLC - RWY           - CLOSED

>> VBG COMPANY REMARK ON ABOVE NOTAM <<
B737/E190 - REQUEST OPT/EPOP, USE 02 WIPN IDENT.
-APG.
```

Source: Aircraft operator, highlight added by ATSB

While still en route, the crew contacted company flight dispatch staff and requested OPT take-off reference data that should have been used during operations while runway works were in progress. The OPT take-off reference data revealed that different take-off reference speeds should have been used under those circumstances (Table 1).

The flight continued uneventfully to Brisbane. On arrival in Brisbane, the captain notified relevant airline staff of the occurrence.

Table 1: Differences between OPT take-off reference data and the data used by the crew

	OPT take-off reference data	Actual take-off reference data used
V_1	142 kt	145 kt
V_R	144 kt	147 kt
V_2	152 kt	151 kt
Take-off weight	72,668 kg	72,490 kg
Thrust setting	26K (full rated thrust)	26K (full rated thrust)
Flap setting	Flap 5	Flap 5
Runway length	1,920 m (reduced length due to runway works)	3,288 m (full runway length)

[7] NOTAMs and other aeronautical information typically use Coordinated Universal Time (UTC) as a time reference. NZST is UTC plus 12 hours.

Take-off reference speeds

Take-off reference speeds or V speeds assist pilots in determining when a rejected take-off can be initiated, and when the aircraft can rotate, lift-off and climb. The definitions of V speeds can be quite complex, but in broad terms:

- V_1 is often referred to as the critical engine failure speed or decision speed. V_1 is the maximum speed at which a rejected take-off can be initiated. If an engine failure is detected above V_1, the take-off should be continued.
- V_R is the speed at which the rotation of the aircraft is initiated to the take-off attitude. The speed cannot be less than V_1, and takes into account a number of other critical speeds that relate to aircraft performance and handling.
- V_2 is often referred to as the take-off safety speed. It is the minimum speed at which a transport category aircraft complies with those handling criteria associated with climb, following an engine failure. V_2 is normally obtained by factoring other critical speeds, to provide a safe margin with respect to aircraft controllability.

Airport analysis manual (AAM)

The crew commented that a recent change in the holder of the Air Operator's Certificate (AOC) from Virgin Australia Airlines – New Zealand (VANZ) to Virgin Australia International Airlines (VAI) had seen numerous procedural changes. The changes related primarily to the integration of VANZ and VAI procedures, to establish consistency across the company's operations. With reference to this incident, the crew commented that prior to the change in AOC holder, AAMs included yellow pages that provided take-off reference data to be used when operating from a reduced length runway (such as during runway works). When the crew discovered that the departure runway was operating at a reduced runway length due to runway works, they initially referenced the AAM with an expectation of finding a relevant yellow page, but without that page, they elected to use 26K (full rated thrust)/full runway length data instead.

The operator's draft report dealing with the incident commented that since the transition from VANZ to VAI, yellow pages in the AAM dealing with runway works have been removed. A note has been added to relevant NOTAMs regarding the requirement to request OPT reference data.

The flight crew commented that while a two-day training course was provided to transition crews from VANZ to VAI, the scope of the training was limited, and crews were continuing to discover procedural variations in the months following the transition. The operator advised that the course included a section on aircraft performance as well as training in AAM use. As part of their investigation, the operator reviewed relevant material presented to the flight crew and found no deficiencies, but they could not assess the efficacy of the training.

Flight plan package

The absence of yellow pages in the AAM aside, the crew expected that if OPT take-off reference data was required, it would be provided with the flight plan package. In the experience of the crew, OPT take-off reference data was usually provided with the flight plan package when required, without specifically being requested by the crew. The only reference to the requirement for the crew to request OPT take-off reference data on this occasion was a remark at the end of the NOTAM dealing with the runway works on that day. There were no other relevant prompts in the package that might have alerted the crew to the requirement to request OPT take-off reference data. Contrary to the expectations of the crew, flight dispatch staff considered that it was the responsibility of the crew to request OPT take-off reference data, when it was required.

Flight crew operational notices

During the positioning flight to Christchurch, the captain reviewed the operator's Flight Crew Operational Notices (FCON),[8] including the notices relevant to Christchurch. Even though there were NOTAMs in place addressing runway works, there was no reference to any runway works in the Christchurch FCON entry. In contrast, the FCON entry for Cairns, Queensland (directly before the Christchurch entry) included reference to runway works at Cairns. The Cairns entry included a statement that during the works, AAM take-off and landing data was not valid. The entry also stated:

> There are no scheduled departures during the works period, however if take-off data is required request OPT …

If the FCON had included a similar reference to the runway works at Christchurch, it may have prompted the crew to review the possible implications of the runways works more closely prior to departure.

The operator advised that runway works at Christchurch were not addressed in the FCON because the anticipated time of the works referred to in NOTAM 3528/15 NZCH (see following section dealing with NOTAMs), did not conflict with the normal departure time for the flight. The operator's investigation found that for the Cairns entry, there were also no scheduled departures during the works period, but it was close to scheduled aircraft arrival times, which required associated landing data. The operator's draft investigation report stated that the temporary landing data for Cairns would potentially have been required daily during the works period, whereas for Christchurch the data was only required on an ad hoc basis.

The operator's investigation found that while the aim was to avoid repeating information in a NOTAM remark and the FCON, it was not clear which was the primary source of information for the flight crew.

Notice to Airmen (NOTAM)

Pre-flight NOTAM review

The operator's procedures required that both crew members review the relevant NOTAMs prior to a flight. The crew commented that in practice, review of flight plan material including the NOTAMs, is typically done as a team. Following a review of the material, the crew members discuss factors of relevance as part of their preparation for the flight.

Normally, the captain and FO would have met in a crew room facility to discuss the flight, before proceeding to the aircraft. However, to minimise the delay, the flight crew met at the aircraft on this occasion. The captain had limited recent familiarity with Christchurch and was unaware of the runway works, until advised by ATC during push-back.

Despite the arrangements that required the captain to travel to Christchurch during the morning of the flight, and the associated late departure, the flight crew reported that they did not feel rushed as they prepared for the flight.

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[8] FCONs are company NOTAMs which are issued to flight crew by the flight operations department to convey new operational and technical information which is of an urgent nature. Flight crew are required to obtain and review a copy of the current FCONs at the commencement of duty each day.

NOTAMs

In addition to NOTAM 3805/15 (Figure 2), a second NOTAM B3528/15 NZCH (Figure 3), stated that works were expected to commence at 0930 UTC (2130 NZST) in the evening, and finish at 1630 UTC (0430 NZST) each morning, with a NOTAM to be issued advising of activation times. The departure time of the flight during which the incident occurred, was outside those times (both the normally scheduled and delayed departure times). As the scheduled departure time also fell outside the times specified in NOTAM 3805/15, this may have influenced the FO to expect that the works would not affect their departure.

Figure 3: NOTAM (B3528/15) dealing with runway works, identifying the expected times of runway works, and advising that activation times would be notified by separate NOTAM with the location of the works (north or south)[9]

```
B3528/15 NZCH    FROM: 03JUL15 02:01   TO: 04AUG15 04:00
E) RWY 02/20 WIP. DAILY RWY WORKS INVOLVING RWY RESTRICTIONS
COMMENCED 9 FEB 2015 AND WILL LAST APRX 18 MONTHS. THE WIP IS
EXPECTED TO COMMENCE DAILY AT 0930 UTC AND FINISH AT 1630 UTC.
RWY 02/20 WILL BE CLOSED BY NOTAM FOR 30 MIN EITHER SIDE OF THE
DAILY WORKS PERIOD TO SET UP AND CLEAR WORKS. A NOTAM ADVISING
ACTIVATION OF WIP LOCATION (WIP NORTH/WIP SOUTH) WILL BE ISSUED AT
LEAST 12 HOURS IN ADVANCE. REF AIP NZCH AD YELLOW PAGES)
DECODE - QFAHW - AERODROME     - WIP
```

Source: Aircraft operator

Safety message

The operator's investigation found that the ability to reject the take-off or maintain obstacle clearance safely in the event of an engine failure was compromised by the use of the incorrect take-off reference speeds. Inaccurate take-off reference data has potentially serious consequences. ATSB Aviation Research and Analysis Report AR-2009-052 (*Take-off performance calculation and entry errors: A global perspective*) documents a number of accidents and incidents where take-off performance data was inaccurate. The report analyses those accidents and incidents, and concludes:

> … it is imperative that the aviation industry continues to explore solutions to firstly minimise the opportunities for take-off performance parameter errors from occurring and secondly, maximise the chance that any errors that do occur are detected and/or do not lead to negative consequences.

This incident highlights the importance of a consistency in the expectations of flight crew and the services provided by an operational support system. A disconnect on this occasion substantially diminished the defences that might otherwise have prevented the incident. In a broader sense, the incident provides an example of how changed procedures can introduce latent procedural deficiencies or misunderstandings. Robust crew training and follow-up standardisation are critical to the safe and effective introduction of new or revised operational procedures.

The ATSB SafetyWatch highlights the broad safety concerns that come out of our investigation findings and from the occurrence data reported to us by industry. One of the safety concerns relates to data input errors.

SafetyWatch

[9] The reference to yellow pages in this NOTAM relates to relevant Aeronautical Information Publication NZ aerodrome charts (that depict the works in progress and provide associated operational information), not the operator's AAM yellow pages referred to elsewhere in this report.

General details

Occurrence details

Date and time:	14 July 2015 – 0825 NZST	
Occurrence category:	Incident	
Primary occurrence type:	Pre-flight planning event	
Location:	Christchurch International Airport, New Zealand	
	Latitude: 43° 30.00' S	Longitude: 172° 30.90' E

Aircraft details

Manufacturer and model:	Boeing 737-8FE
Registration:	VH-YIU
Operator:	Virgin Australia International Airlines
Serial number:	40699
Type of operation:	Air Transport High Capacity

Turboprop aircraft

Weather related event involving a Bombardier DHC-8, VH-XFQ

What happened

On 23 June 2015, at about 0638 Western Standard Time (WST), a Bombardier DHC-8, registered VH-XFQ, departed from Perth, on a charter flight to Darlot, Western Australia. The first officer was the pilot flying, and the captain was the pilot monitoring.[1]

The aircraft arrived in the Darlot area soon after 0800. As they neared their descent point, the crew could see that a layer of low cloud had formed over the Darlot area. Nonetheless, conditions above the low cloud were clear and the crew expected to be able to land. The crew conducted an RNAV (GNSS)[2] approach to runway 14, but contrary to their earlier expectations, they were unable to establish the required visual references, due to the low cloud. The crew conducted a missed approach accordingly.

Rather than make any further attempts to land at Darlot, the crew commenced a diversion to Leinster. Leinster was their planned alternate aerodrome, located about 30 NM west of Darlot. Advice from the crew of another aircraft on the ground at Leinster, suggested that the weather at Leinster was deteriorating. Despite the deteriorating conditions, it still appeared probable that an approach would be successful.

The crew positioned the aircraft for an RNAV (GNSS) approach to runway 28 at Leinster, which required minimal manoeuvring from their inbound track from Darlot. The approach proceeded normally, but the crew were unable to establish the required visual references due to low cloud, and conducted a missed approach.

Based upon what the crew had been able to see during their approach to Leinster, and advice about the conditions from the other crew on the ground, the crew elected to attempt an approach to the reciprocal runway (runway 10). Although there was substantial cloud over the eastern end of the aerodrome, the conditions over the western end appeared to be more favourable.

The crew then conducted an RNAV (GNSS) approach to runway 10. During the later stages of that approach, while the aircraft was still clear of cloud, but approaching wispy low cloud ahead, an EGPWS 'terrain terrain pull-up pull-up' warning triggered (see section titled ***EGPWS warning***). The crew believed at the time that the EGPWS warning was spurious, but commenced a missed approach in response to the warning.

Following the missed approach, the captain assessed that low cloud was continuing to move over the area from the south. Given the increasing extent and low base of the cloud, the captain determined that further attempts to land at Leinster were unlikely to be successful.

Based upon the conditions that the crew had encountered since arriving in the Darlot and Leinster area, the captain had continued to monitor Flight Management System time, distance and fuel information, as it related to other diversion options. The conditions to the north appeared to be clear, with no signs of the low cloud that was apparent over Darlot and Leinster. Clear conditions to the north were consistent with the captain's interpretation of the weather information reviewed as part of the flight planning process. Accordingly, the crew elected to divert to Wiluna, about 78 NM to the north-northwest of Leinster.

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1 Pilot flying and pilot monitoring are procedurally assigned roles with specifically assigned duties at specific stages of a flight. The pilot flying does most of the flying, except in defined circumstances. The pilot monitoring carries out support duties and monitors the actions of the pilot flying and the aircraft flight path.

2 RNAV (GNSS) means area navigation (global navigation satellite system). In this context, it refers to a published non-precision instrument approach procedure.

Having commenced a diversion to Wiluna, the crew obtained updated weather information from air traffic control to confirm that the conditions at Wiluna were suitable. Other pilots in the vicinity also advised the crew that conditions in the Wiluna area appeared to be clear. The flight proceeded to Wiluna, and landed uneventfully at about 0925.

The aircraft landed with about 600 lbs of fuel remaining, above the operator's minimum fixed fuel reserve of 450 lbs. The crew added fuel at Wiluna and the aircraft returned to Darlot later that morning, when the weather at Darlot had cleared sufficiently.

Pre-flight planning and forecast weather

About an hour prior to the planned departure time, the captain had reviewed weather information pertinent to the flight, including relevant terminal area forecasts (TAFs).[3] There was no TAF available for Darlot, so the captain was required to nominate an alternate aerodrome, and carry sufficient fuel to safely divert to that aerodrome. The captain reviewed the TAF for Leinster, and was satisfied that Leinster was a suitable alternate aerodrome, so the flight was planned on that basis.

The Leinster TAF (Figure 1) indicated that if the crew diverted there after attempting to land at Darlot, they could expect broken[4] (BKN) cloud to be developing (from 0800), with a base at 2,000 ft above the aerodrome. The visibility was forecast to remain 10 km or more, and the wind was forecast to remain light, from a south to south-easterly direction.

Figure 1: Leinster TAF referred to during pre-flight planning[5]

```
LEINSTER (YLST)
    TAF YLST 222024Z 2222/2311
    18005KT CAVOK
    FM230000 15007KT 9999 BKN020
    FM230600 13010KT 9999 SCT020
    RMK
    T 05 09 12 13 Q 1025 1026 1026 1025
```

Source: Aircraft operator

While planning the flight, the captain was mindful that although Leinster was a suitable alternate aerodrome to Darlot, the relatively proximity of the two aerodromes meant that similar conditions could reasonably be expected at both. Accordingly, the captain reviewed the TAFs for other aerodromes in the general area, to provide options in the event that unsuitable weather conditions were encountered at both Darlot and Leinster.

The captain reviewed the TAF for Wiluna (Figure 2), which indicated that Wiluna would be suitable if the crew were unable to land at Darlot or Leinster. The TAF for Wiluna forecast CAVOK[6] conditions, with scattered[7] (SCT) cloud expected to develop from 1000, with a base at 2,000 ft above the aerodrome.

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3 Aerodrome forecasts are a statement of the meteorological conditions expected for a specific period of time, in the airspace within a radius of 5 NM (9 km) of the aerodrome.

4 Cloud cover is normally forecast using expressions that denote the extent of cover. The expression broken indicates that more than half to almost all the sky will be covered.

5 Aviation weather forecasts and reports use Coordinated Universal Time (UTC) as a time reference. WST is UTC plus 8 hours.

6 CAVOK means ceiling and visibility OK. This means that the visibility, cloud and weather are better than prescribed conditions. For a TAF, those conditions are broadly summarised as:
- Visibility 10 km or more.
- No significant cloud (and no cumulonimbus or towering cumulus cloud).
- No significant weather.

7 Cloud cover is normally forecast using expressions that denote the extent of cover. The expression scattered indicates that more than a quarter but less than a half of the sky will be covered.

Figure 2: Wiluna TAF referred to during pre-flight planning

```
WILUNA (YWLU)
    TAF YWLU 222040Z 2222/2311
    17007KT CAVOK
    FM230200 14010KT 9999 SCT020
    FM230600 11010KT 9999 SCT040
    RMK
    T 06 08 15 15 Q 1024 1025 1025 1024
```

Source: Aircraft operator

The captain also reviewed relevant area forecasts (ARFOR)[8] in preparation for the flight, in order to build an appreciation of the overall weather picture. This included the ARFORs for areas 61 and 66 (Figure 3). In broad terms, the ARFORs indicated that the crew could expect low cloud and fog in area 61, and the southern part of area 66, until 0900. Beyond 0900, some cloud was still forecast in both areas, but with a higher base and unlikely to have any operational implications for the flight.

Figure 3: Extract from Planning Chart Australia showing relevant locations and ARFOR area boundaries

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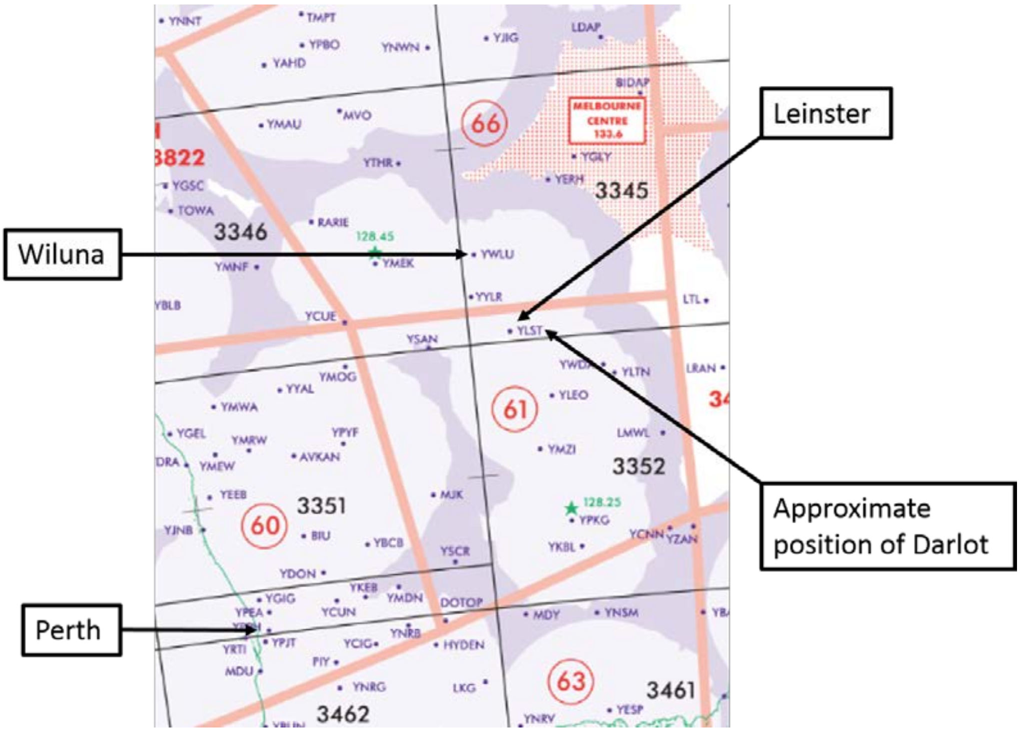


Source: Airservices Australia, with additions by the ATSB

Fuel planning

Based upon assessment of the weather, the captain elected to load additional fuel, in excess of the minimum regulatory fuel requirements. This was to ensure that options were available if the crew were unable to land at Darlot or Leinster. Although Wiluna did not appear on the flight plan, the captain elected to load sufficient fuel to divert there if necessary. According to the flight plan, the minimum fuel required for the flight was 2,574 lbs, which included reserve requirements and sufficient fuel for a diversion to Leinster. In view of the conditions, the captain elected to increase the fuel load to the maximum amount that could be carried given the expected payload. This amounted to a fuel load of 3,450 lbs.

8 Area forecasts are issued for the purpose of providing aviation weather forecasts to pilots. Australia is divided into a number of forecast areas.

Actual weather conditions at Leinster

The actual weather conditions encountered by the crew at Leinster were worse than had been forecast on the TAF. Most notably, while the TAF forecast cloud with a base at 2,000 ft above the aerodrome, the crew encountered cloud with a base around 400 to 500 ft above the aerodrome.

The Leinster aerodrome weather reports reflected the changing conditions that took place during the morning at Leinster (Figure 4). While the 0800 METAR[9] stated no cloud detected (NCD), a SPECI[10] was issued at 0827 indicating that broken cloud had formed, with a base at 400 ft above the aerodrome. This would have been around the time that the aircraft arrived in the Leinster area. The extent of cloud cover had grown by 0900, to become overcast[11] (OVC) with a base at 400 ft above the aerodrome. After 0900, the cloud slowly lifted and cleared. According to the aerodrome weather reports, the visibility remained 10 km or more throughout the morning.

Figure 4: Selected Leinster aerodrome weather reports from morning of the incident flight

0730 WST	METAR YLST 222330Z AUTO 18005KT 9999 // NCD 06/05 Q//// RMK RF//./////./
0800 WST	METAR YLST 230000Z AUTO 17008KT 9999 // NCD 07/06 Q//// RMK RF//./////./
0827 WST	SPECI YLST 230027Z AUTO 16009KT 9999 // BKN004 06/06 Q//// RMK RF//./////./
0830 WST	SPECI YLST 230030Z AUTO 16009KT 9999 // BKN004 06/06 Q//// RMK RF//./////./
0900 WST	SPECI YLST 230100Z AUTO 15009KT 9999 // OVC004 07/06 Q//// RMK RF//./////./
0930 WST	SPECI YLST 230130Z AUTO 15007KT 9999 // OVC005 08/07 Q//// RMK RF//./////./
1000 WST	SPECI YLST 230200Z AUTO 13008KT 9999 // BKN008 09/07 Q//// RMK RF//./////./

Source: Bureau of Meteorology

Amended TAFs. The Bureau of Meteorology issued amended TAFs for Leinster, one at 0826, followed by another at 0840 (Figure 5). Those TAFs indicated that low cloud could be expected (from the time the TAFs were issued), with a base at 800 ft and 500 ft above the aerodrome respectively. Both amended TAFs forecast that the cloud base would lift to 2,500 ft above the aerodrome, from 1000.[12]

9 A METAR is a routine meteorological report issued at fixed times, hourly or half-hourly.

10 A SPECI is a special meteorological report issued whenever weather conditions fluctuate about or are below specified criteria. Those conditions include when there is broken or overcast cloud below an aerodromes highest alternate minimum cloud base or 1,500 ft, whichever is higher.

11 Cloud cover is normally forecast (or reported) using expressions that denote the extent of cover. The expression overcast (OVC) indicates that sky will be (or is) completely covered.

12 The Bureau of Meteorology commented that since this incident, forecasters are now receiving satellite images more frequently and with higher resolution. Although the extent to which these improvements may have affected this incident are unclear, the improved information will assist forecasters in the future.

Figure 5: Amended TAFs for Leinster, issued at 0826 (upper) and 0840 (lower)

```
TAF·AMD·YLST·230026Z·2300/2311¶
15007KT·9999·BKN008¶
FM230200·16005KT·9999·BKN025¶
FM230400·13010KT·9999·SCT020¶
RMK¶
T·06·11·13·14·Q·1026·1027·1025·1026¶
```

```
TAF·AMD·YLST·230040Z·2301/2311¶
15007KT·9999·BKN005¶
FM230200·16005KT·9999·BKN025¶
FM230400·13010KT·9999·SCT020¶
RMK¶
T·08·12·13·13·Q·1026·1027·1025·1026¶
```

Source: Airservices Australia

EGPWS warning

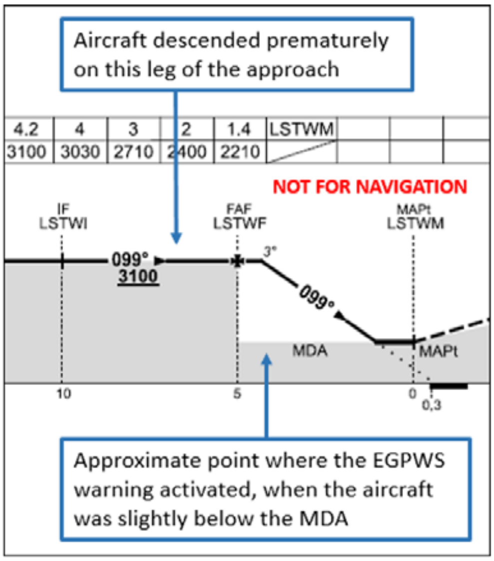
During the RNAV (GNSS) approach to runway 10 at Leinster, the crew received an EGPWS 'terrain terrain pull-up pull-up' warning. They responded to that warning by commencing a missed approach. At the time the crew received the EGPWS warning, they were clear of cloud and could see the ground beneath, but there was wispy low cloud ahead, partially obscuring their view of the runway environment. The crew were assessing the conditions ahead, and the feasibility of safely continuing the approach, when the EGPWS warning activated. The crew elected to make a missed approach with go-around power, rather than conduct a terrain escape manoeuvre,[13] given that the missed-approach flight path of the aircraft was visually clear of terrain and obstacles.

Subsequent analysis of the flight data by the operator revealed that during the RNAV (GNSS) approach to runway 10, the crew descended prematurely to the relevant Minimum Descent Altitude (MDA).[14] In doing so, the crew descended beneath the 3,100 ft altitude constraint between the intermediate fix (LSTWI) and the final approach fix (LSTWF) (Figure 3). The crew overflew LSTWF just above the MDA, and then levelled momentarily at the MDA. Soon after, a brief and shallow descent developed, at which time the EGPWS warning was triggered. At the time the EGPWS warning was triggered, the aircraft was about 4.5 NM from the runway, and the radio altimeter indicated that the aircraft was slightly less than 500 ft above the underlying terrain.

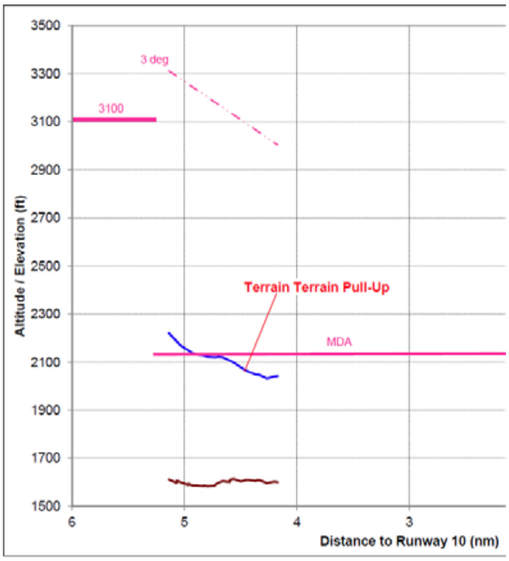
13 A terrain escape manoeuvre is a more aggressive manoeuvre, typically involving the application of maximum thrust and a high climb angle.

14 The MDA used by the crew at the time was 2,110 ft. This figure was 100 ft lower than the published MDA, only usable provided the crew complied with certain conditions related to the accuracy of the altimeter subscale (QNH) setting.

Figure 6: Excerpt from approach chart and vertical profile of the aircraft (in part) showing where EGPWS warning was triggered



Source: Airservices Australia with annotations by ATSB



Source: Aircraft operator

Crew comments

The crew commented that a number of factors in combination probably contributed to their descent below the altitude constraint between LSTWI and LSTWF. These factors are broadly summarised as follows:

- Workload during positioning for the approach was high, particularly noting that this was a third approach in relatively quick succession. Although the workload was high, the crew commented that all checklist procedures were carried out, the approach was briefed, and all relevant radio broadcasts were made.
- The circumstances at the time generated a sense of urgency, given that the extent of cloud cover appeared to be growing rapidly. Furthermore, the crew were keen to descend to the MDA expeditiously in an attempt to establish and maintain visual contact with the runway environment, beneath the intervening wisps of low cloud.
- Although the captain remained confident that sufficient fuel was available to divert to Wiluna, suitability of the conditions at Wiluna had not been recently confirmed. An element of doubt about the continuing suitability of Wiluna left the captain feeling slightly uneasy about the circumstances, particularly after encountering unexpected low cloud at Leinster.
- Management of the approach profile was probably compromised to some extent by the manner in which the approach was conducted in visual conditions, but with the intent of complying with an instrument procedure. The attention of the crew during the approach was probably substantially drawn to ongoing assessment of how to effectively contend with the low cloud ahead.

ATSB comment

Following a small number of safety occurrences where unforecast weather events have led to unforeseen diversions or holding, the ATSB commenced a research investigation (*Reliability of aviation weather forecasts*) to examine how often weather events are not forecast in enough time allow pilots to make appropriate decisions (carry additional fuel, make a timely diversion or delay departure). Although the research investigation will focus on weather data for major Australian airports, the results should help operators better understand how much reliance can be given to forecast weather at destination airports at the time of pre-flight planning. This research investigation is linked in part to ATSB investigation AO-2015-100 (*Weather related operational* *event involving B737s VH-YIR and VH-VYK at Mildura Airport, Victoria on 18 June 2013*). On that occasion, the two aircraft involved diverted from Adelaide, South Australia, to Mildura, Victoria, due to poor weather in Adelaide. Unforecast weather was encountered when the aircraft subsequently arrived at Mildura.

In another weather-related incident, the ATSB found that the onset of fog at Perth Airport at the estimated time of arrival of a flight, was not forecast until after the aircraft had passed the point when it had insufficient fuel remaining to divert to a suitable alternate aerodrome. Before that point, there had been no requirement for the aircraft to carry fuel to continue to a suitable alternate (see ATSB investigation AO-2012-073 *Weather-related operational event involving Boeing 717, VH-NXO, Perth Airport, Western Australia on 1 June 2012*). The safety message attached to that investigation report included '…pilots should be alert to the fact that the actual weather conditions can differ significantly from forecasts.'

Pilots are also encouraged to make an Air-Report (AIREP) as soon as possible after encountering meteorological conditions that they believe may affect the safety of other operations. AIREPs contribute to the timely distribution of significant weather information that may assist with the operational decision making of other flight crews. More information about AIREPs is available in the Airservices Australia Aeronautical Information Publication.

Safety message

This incident highlights the importance of lateral thinking during flight planning, particularly where operations to remote areas are planned, and when an alternate aerodrome is close to the planned destination. In this case, the captain assessed the broader weather picture, and added fuel above the minimum requirements on the basis of that assessment. That additional fuel ultimately provided the crew with a safe option, despite encountering unexpected conditions that prevented a landing at the planned alternate aerodrome.

The circumstances leading to the EGPWS warning provide a reminder of the complications that can arise while endeavouring to follow an instrument procedure in visual conditions, particularly where significant attention is focussed on marginal conditions ahead that appear likely to affect the outcome of the approach. The circumstances can be further complicated when surrounded by a sense of urgency, and doubt about the suitability of other diversion options.

General details

Occurrence details

Date and time:	23 June 2015 – 0845 WST	
Occurrence category:	Incident	
Primary occurrence type:	Unforecast weather	
Location:	Leinster Airport, Western Australia	
	Latitude: 27° 50.60' S	Longitude: 120° 42.20' E

Aircraft details

Manufacturer and model:	De Havilland Canada DHC-8-106	
Registration:	VH-XFQ	
Operator:	Skippers Aviation	
Serial number:	306	
Type of operation:	Charter	
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Piston aircraft

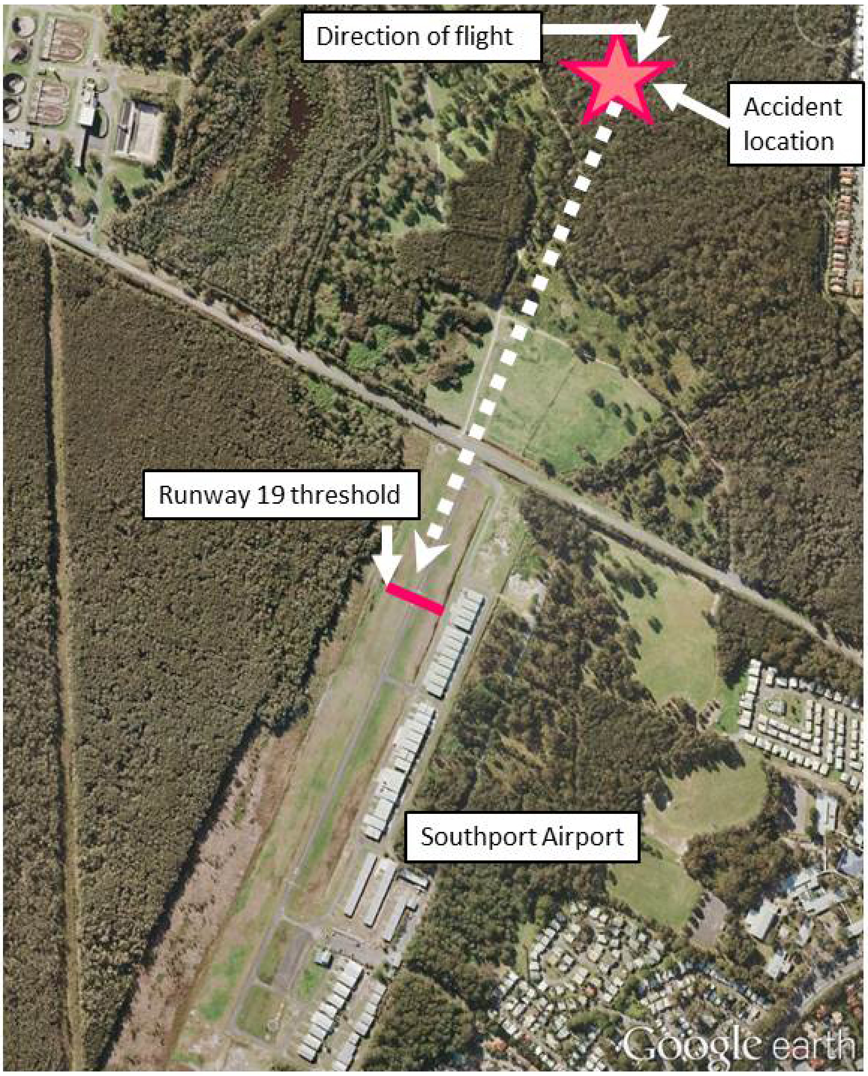
Collision with terrain involving a Beech A36, VH-PAK

What happened

On 16 August 2015, the pilot of a Beech A36 aircraft, registered VH-PAK (PAK), conducted a private flight from Pacific Haven to Southport, Queensland. The pilot reported that the aircraft engine ran normally throughout the cruise. At about 0945 Eastern Standard Time, the pilot joined the circuit at Southport Airport, with the intention to land on runway 19.

About 800 m from the runway threshold, at about 150 ft above ground level, the aircraft's engine stopped. The pilot broadcast a Mayday[1] and conducted a forced landing (Figure 1). The aircraft collided with trees, resulting in substantial damage and the pilot was not injured (Figure 2).

Figure 1: Southport Airport and accident location



Source: Google earth – annotated by the ATSB

[1] Mayday is an internationally recognised radio call for urgent assistance.

Pilot comments

The pilot provided the following comments:

- The pre-flight inspection was normal.
- Prior to the flight, there were 10 quarts of oil in the engine, with 12 quarts full oil capacity, and the aircraft operable to a minimum of 6 quarts.
- The engine had been running well during the flight.
- The pilot was ferrying the aircraft to Southport for its scheduled annual inspection.
- Due to the relatively short runway, the pilot conducted a shallow approach, to reduce the landing distance required.
- When the engine stopped, as the flaps and landing gear were extended, the aircraft sank quickly.
- The aircraft was fitted with an engine analyser (see *Engine data* section), which would generate a message to the GPS unit if a fuel tank was low on fuel. The pilot did not receive any fuel warnings.

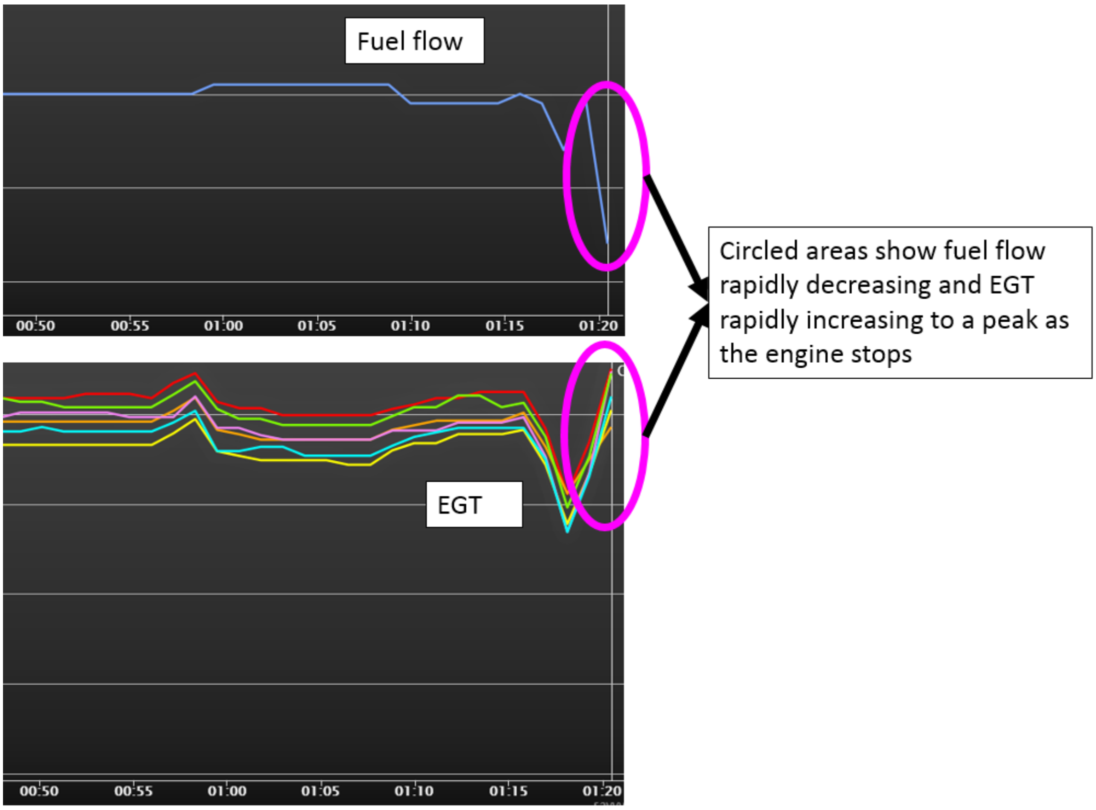
Figure 2: Beech A36 aircraft, VH-PAK accident site

Source: Queensland Police

Engine data

The aircraft's engine data was reviewed for the flight. Figure 3 shows the recorded exhaust gas temperatures (EGT) and fuel flow for the flight. During the cruise, the fuel/air mixture was leaned to achieve a fairly constant EGT around 1,500 ° Fahrenheit (816 °C). Towards the end of the flight, as the aircraft descended, the EGT decreased. About 2 minutes before the engine stopped, the EGT climbed rapidly. The peak EGT, of about 1,552 °F (844 °C), occurred as the engine stopped (Figure 3). Simultaneously, the fuel flow dropped to zero and the engine rpm increased rapidly. This is indicative of an overly lean fuel/air mixture, and is consistent with fuel starvation.

Figure 3: Engine data



Source: Provided to the ATSB

Post-accident inspection

The engine appeared intact, with all connections also intact. There was no evidence of oil loss from the engine.

During the post-accident inspection, the engineer found that only a few drops of fuel remained in the fuel control unit. The engineer drained the right main fuel tank and airframe fuel filter bowl. Less than 2 L of fuel drained from the right fuel tank, and less than 20 ml from the fuel filter bowl. The right main fuel tank was selected in the cockpit at the time of the accident.

The tip tanks and left main fuel tank were ruptured as a result of the collision, and no fuel remained in them. However, there was no evidence of fuel contamination at the accident site, and only a slight smell of fuel.

Aircraft fuel status

The aircraft had a total fuel capacity of 432 L. It had two main fuel tanks, each capable of holding 140 L of usable fuel. The aircraft was also fitted with two wing-tip tanks, each with the capacity to carry 76 L of fuel, all of which was usable.

The pilot provided a fuel receipt, which showed 389 L of fuel had been purchased on 1 July 2015 at Bundaberg. There was no evidence recorded on the maintenance release to show that the aircraft had been in Bundaberg that day. The pilot had recorded four flights from that date, including the incident flight, totalling 3 hours and 55 minutes flight time with four take-offs and three landings (not including the accident).

The pilot reported that the fuel consumption rate used for planning was 60 L per hour for the cruise, and 80 L per hour for take-off and the first hour. The pilot also stated that the fuel gauges indicated that about half fuel remained at the time of the accident.

ATSB comment

The pilot reported that about half of the aircraft's fuel capacity remained at the time of the accident. However, the subsequent inspection found a total of about 2 L of fuel remained in the intact (and selected) right main fuel tank. The recovered engine data indicated that fuel starvation occurred at the time the engine stopped. The ATSB could not resolve the difference between the pilot's account and the fuel state found after the accident.

Safety message

The pilot commented that if the aircraft had been higher on final approach, it would have been able to glide to the runway.

The ATSB research publication *Starved and exhausted: Fuel management aviation accidents*, states that accurate fuel management starts with knowing exactly how much fuel is on board at the commencement of each flight. It also relies on a method of knowing how much fuel the aircraft consumes. The likelihood of fuel starvation is reduced by adhering to procedures, maintaining a record of the fuel tank selections during flight and ensuring appropriate tank selections, particularly for take-off and landing.

General details

Occurrence details

Date and time:	16 August 2015 – 0945 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	Near Southport Airport, Queensland	
	Latitude: 27° 55.30' S	Longitude: 153° 22.28' E

Aircraft details

Manufacturer and model:	Beech Aircraft Corporation A36	
Registration:	VH-PAK	
Serial number:	E-1060	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

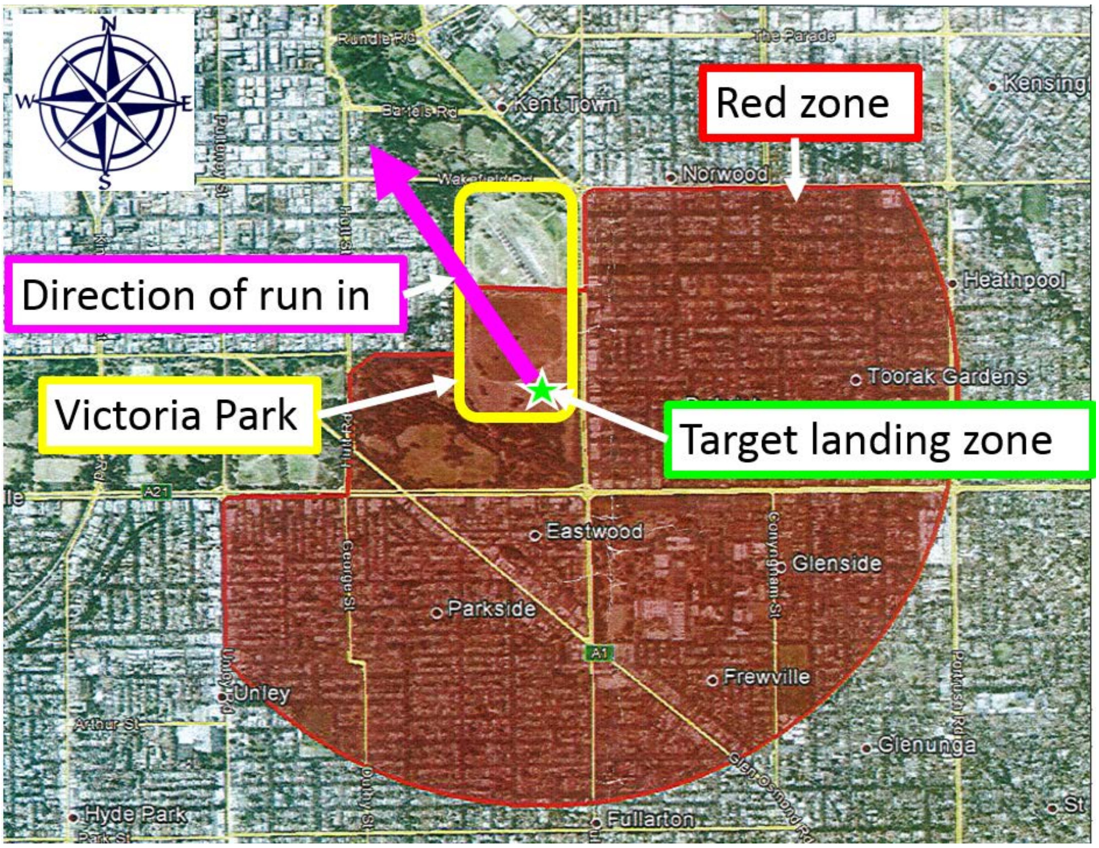
Fuel exhaustion event involving a Cessna 182, VH-DNZ

What happened

On 2 October 2015, the pilot of a Cessna 182 aircraft, registered VH-DNZ (DNZ), was tasked to conduct parachute operations. The pilots of two aircraft, the Cessna 182 along with a Cessna 206 (C206), planned to depart from Parafield Airport, and drop parachutists to land at Victoria Park, Adelaide, before returning to land at Parafield, South Australia. A total of four similar 'sorties' were planned for the day.

The target landing zone for the parachutists was Victoria Park, which would require the pilots to obtain a clearance from Adelaide air traffic control (ATC) to enter Adelaide control zone. Parachute operations normally included a drop area of a 1 NM radius around the target landing zone. However, the north-western corner of that 1 NM radius circle from Victoria Park infringed on the separation required for aircraft arriving and departing on runway 05/23 at Adelaide Airport. Therefore, the drop area agreed between Airservices Australia and the Australian Parachute Federation (APF) for the operation was as depicted by the red zone in Figure 1.

Figure 1: Drop area agreed between Australian Parachute Federation and Airservices Australia



Source: Australian Parachute Federation – annotated by ATSB

On the day, the wind was from the northwest, which required the parachute aircraft to run in to the northwest, in order to drop the parachutists upwind of the target zone. Operating to the northwest of the agreed red zone, would place the parachute aircraft in the main runway separation zone at Adelaide, with the possibility of associated delays in ATC providing a clearance.

The pilots of the two aircraft arrived at Parafield at about 0930 Central Daylight-saving Time (CDT) and discussed the details for the day's operations. These details included the direction of the jump run, ATC clearances, two 'staging areas' – one north and one south of the drop zone at Victoria Park, where the aircraft could hold if required, and different inbound and outbound flightpaths to assist in ensuring separation between the two aircraft.

At about 1030, the pilot of DNZ conducted a daily inspection of the aircraft, and did not find any defects. The pilot added fuel to bring the total to 110 L of fuel on board the aircraft. The pilot assessed that was more than adequate for the proposed 28-minute sortie (see *Fuel calculations* for further information).

After preparing the aircraft, the two pilots spoke to the nominated contact person from Adelaide ATC and the APF ground personnel at Victoria Park to coordinate the day's plans.

At about 1220, the parachutists arrived at Parafield Airport. After the parachutists boarded the aircraft, the C206 was to depart first, followed about 10 minutes later by DNZ. The pilot of DNZ observed the C206 engine start, and then shut down again almost immediately. The reason for the engine shut down was that ATC had advised the C206 pilot that, due to aircraft arriving at Adelaide, if they departed now, there would be a 20-minute delay. ATC also advised that if the aircraft took off at 1320, they would not have to wait. The C206 subsequently departed at about 1320.

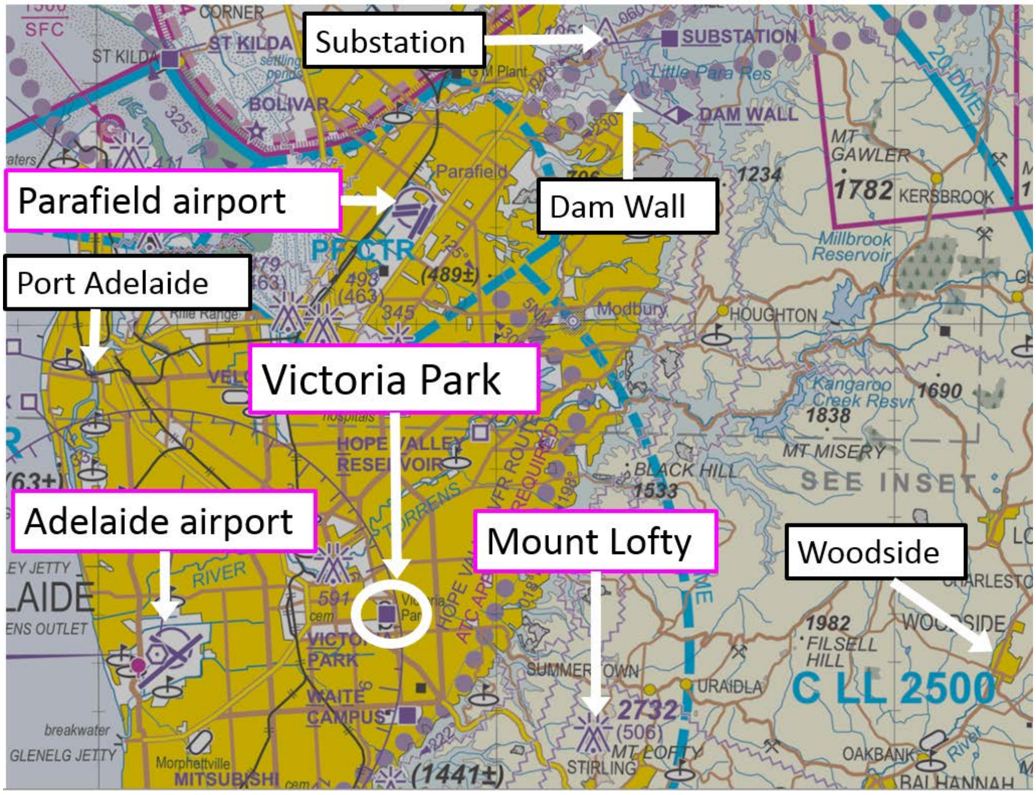
At about 1327, the pilot of DNZ started the aircraft's engine, and DNZ departed from Parafield at 1331, with the pilot and four parachutists on board. The aircraft tracked outside controlled airspace, overhead Substation, then towards Woodside (Figure 2). At about 1337, when about 2 NM north of Woodside, at 2,500 ft, the pilot of DNZ contacted Adelaide Approach air traffic control, and requested an airways clearance to enter controlled airspace to complete the parachute drop. The approach controller advised the pilot of DNZ to remain outside Class C airspace.

At about 1340, the approach controller cleared the pilot of DNZ to track from their current position to Woodside then to Staging Area South and climb to 3,500 ft. The Staging Area South was overhead Mt Lofty. The C206 was already holding in Staging Area South at 4,500 ft. The pilot of DNZ communicated with the C206 pilot on the company radio frequency, sighted that aircraft, and maintained visual contact with it.

At about 1355, the approach controller cleared the pilot of the C206 to track for the drop point and, about 2 minutes later, cleared the pilot to conduct the drop. After completing the drop, the C206 was cleared to the northern staging area, then to return to Parafield.

The pilot of DNZ continued to hold at Mt Lofty, at 3,500 ft, conducting orbits of 3-4 minutes duration each.

Figure 2: Adelaide visual terminal chart with relevant locations



Source: Airservices Australia annotated by the ATSB

At about 1406, after completing seven orbits, the pilot of DNZ was advised to expect about a 30-minute delay, with a drop time of 1445. The pilot calculated the approximate fuel remaining, and assessed that they would be approaching the minimum fuel required to return safely to Parafield. The pilot contacted the APF ground personnel at Victoria Park to advise them of the requirement for further holding. They responded that they would phone the ATC representative and then let the pilot know what they would like them to do.

About 2 minutes later, the approach controller revised the estimated drop time to 1433. At about 1411, the pilot of DNZ asked the approach controller whether an earlier clearance would be available if they amended the run in to the original red zone (Figure 1). Remaining within the red zone would increase the distance of DNZ from aircraft on final approach to runway 23 at Adelaide, and potentially expedite a clearance. The controller replied that if they could remain in the original area, they could expect a drop time of 1426. The controller confirmed again at 1417 that they had reports the wind was suitable (to operate within the red zone), so the pilot of DNZ could expect a clearance only into the original red zone.

At about 1420, the approach controller asked the pilot of DNZ to confirm they were maintaining 3,500 ft. At that time, the engine ran roughly, and the aircraft momentarily descended. The pilot conducted emergency checks; changing the selected fuel tank from right to both and then left, assessing the full range of throttle and rpm, and switching between the magnetos, but the engine continued to run roughly. The engine temperature and pressure gauges were indicating in the normal range. The pilot decided to abandon the parachute drop and requested a clearance to track directly from their current position to Parafield, due to fuel. About 1 minute later, the approach controller asked the pilot of DNZ whether they could accept a clearance to track to Port Adelaide, over other traffic that was on final approach to runway 23 at Adelaide, and the pilot replied ‘affirm’. At about 1422, the controller cleared the pilot of DNZ to track to Port Adelaide at 3,500 ft.

The rough running then got worse, so at about 1424, the pilot requested a landing at Adelaide Airport although did not, at that stage, declare an emergency. The approach controller advised the pilot to expect a clearance to land at Adelaide, and advised that traffic was a Conquest at 5 miles, landing on runway 23, and to report sighting that aircraft. The pilot replied 'not sighted, where again sorry?' and the approach controller replied 'your 12 o'clock[1], 4 miles on final for runway 23'.

The pilot continued to attempt to resolve the engine issues, and communicated with the ground personnel to advise of the situation. The pilot reported also looking for a suitable landing site in case the engine stopped completely and a forced landing was required. At about 1425, the approach controller cleared the pilot of DNZ to descend to 2,000 ft. Twenty-six seconds later, the approach controller cleared the pilot of DNZ for a visual approach to left base for runway 23.

Just then, the engine stopped completely. The pilot had sighted Victoria Park racecourse out to the right side of the aircraft, so turned immediately towards it. At about 1426, the pilot made a MAYDAY[2] call to Adelaide Approach, advising that they were conducting a forced landing at Victoria Park. The pilot secured the aircraft engine, and told the parachutists to bring their weight forwards and to brace for impact.

The pilot aimed to land the aircraft in 'pit straight' on the racecourse, which was directly into the north-westerly wind, but as the aircraft lined up with the straight, the pilot saw a car on the bitumen. The pilot conducted a turn to the right then to the left and landed the aircraft on grass. The pilot reported that it was a very heavy landing, and that the aircraft landed either flat or nose wheel first. The nose wheel broke off, the propeller struck the ground, and the aircraft slewed to the left. Two of the parachutists were ejected from the aircraft during the impact. Two of the parachutists sustained serious injuries, and two were uninjured. The pilot sustained minor injuries and the aircraft was substantially damaged (Figure 3).

Figure 3: Accident site showing damage to Cessna 182, VH-DNZ

Source: South Australia Police

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1 The clock code is used to denote the direction of an aircraft or surface feature relative to the current heading of the observer's aircraft, expressed in terms of position on an analogue clock face. Twelve o'clock is ahead while an aircraft observed abeam to the left would be said to be at 9 o'clock.

2 Mayday is an internationally recognised radio call for urgent assistance.

Fuel calculations

During the pre-flight inspection, the pilot dipped the fuel tanks to determine the amount of fuel in the tanks. The dipstick indicated that about 80 L of fuel remained in the aircraft's right fuel tank and zero in the left fuel tank. The pilot reported that this correlated with the fuel log from the previous day's flight along with the aircraft being parked on a slope leaning slightly to the right. The pilot added 30 L of fuel to the left tank, so there was a total of 110 L of fuel on board the aircraft. Based on a planned fuel consumption rate of 65 L/hr for parachute operations, the pilot calculated that there was sufficient fuel for 1.7 hours of flight. The pilot assessed that was more than adequate for the planned 28-minute sortie.

The engine started surging about 50 minutes after the aircraft departed from Parafield, and stopped completely about 5 minutes later.

The planned fuel consumption rate of 65 L/hr was used for parachute operations. The actual fuel consumption recorded for the aircraft in cruise flight was less, due to operating at a reduced power setting and a leaner fuel/air mixture. The aircraft handbook stated the cruise performance with the mixture leaned at 5,000 ft above mean sea level (AMSL) and 2,000 rpm and 20 inches manifold pressure, was about 32 L/hr. The pilot reported that about 10-11 L of fuel in each tank was unusable.

Phone communications between APF and ATC

At about 1100, the ground representative from the APF rang the nominee from ATC, and advised that due to wind of 25 kt from 310°, they would need to extend the boundaries from the original 'red zone', to about 1 NM north-west of the target landing site. The APF representative also stated that they were aware that the extended area would incur delays due to jet aircraft operating into Adelaide Airport.

The APF representative advised ATC that the pilots had fuelled up so they could hold.

When the pilot of DNZ was advised of a 30-minute hold, the ground representative from the APF rang ATC, and asked whether they could operate in accordance with the red zone (rather than the extended zone), as the wind was not as strong as forecast. The ATC nominee advised that they would be able to get a clearance for that in about 15 minutes and the APF representative advised that the pilot would have sufficient fuel for that.

Pilot comments

The pilot of DNZ provided the following comments:

- The pilot reported that after start-up, the fuel gauge indications corresponded with having 80 L and 30 L of fuel in the tanks. The pilot did not look at the fuel gauges again at any stage of the flight, or include the fuel gauges in the instrument scan while performing emergency checks.
- During the emergency procedures, changing the fuel tank selector from Right to Both and to Left did not make the rough running of the engine any better or worse.
- The pilot did not apply carburettor heat at any time.[3]
- The pilot requested a clearance to track direct to Parafield rather than tracking outside controlled airspace to the east, because there were no suitable places to conduct a forced landing due to steep, hilly terrain.
- During the flight, the pilot had kept a mental fuel log based on time in the air and estimated fuel remaining, but not a written log.

3 The Bureau of Meteorology provided the ATSB with a report of the weather conditions at the time of the incident, including temperature, dew point and relative humidity. There was no risk of carburettor icing.

- While holding over Mt Lofty, the pilot had the engine set at about 20 inches manifold pressure and 2,100-2,200 rpm, and estimated holding for about 40-45 minutes at that power setting. The pilot had leaned the fuel mixture to slightly rich of peak exhaust gas temperature.
- The planned duration of the sortie, from Parafield to drop the parachutists and return, was 28 minutes, so the pilot expected that with holding that might increase to about 45 minutes.
- The pilot was not aware that the APF ground personnel advised ATC that the pilots were able to accept significant delays.
- The pilot heard a commotion with the parachutists in the back, and after the incident, realised that the parachutists had been asking to exit the aircraft.

Parachutist comments

One of the parachutists, who was also a licenced pilot and owner of Cessna 182 aircraft, provided the following comments:

- The communications prior to commencing the flight were poor. The parachutists were advised they would be dropped from 6,000 ft, which was not their preferred height for the operation.
- There was little to no communication with the pilot prior to departure, including no safety briefing to the parachutists. A safety briefing card or placard in the aircraft, detailing emergency procedures, may assist in an emergency.
- As the aircraft became airborne, the parachutist, who had been struggling to fasten the single point harness, realised that it was unserviceable. This resulted in parachutists being ejected from the aircraft during the collision.
- When holding around Mt Lofty, the parachutist was concerned that the pilot had an unusually high power setting for holding. That may have significantly increased the fuel consumption. The sound of the high power setting did not change until the engine coughed and spluttered a few minutes before it stopped.
- As soon as they heard the engine issues, the parachutists asked the pilot if they could jump, as they had sighted suitable safe landing areas below. The pilot reportedly rejected their request. They made a further request to jump when approaching 1,500 ft above ground level, as their lowest safe exit height, but again the pilot refused the request.
- The pilot extended flap and then retracted it late in the approach, which resulted in a very high rate of descent. The aircraft's left wingtip came into very close proximity with a building at that time.

Australian Parachute Federation report

A representative of the Australian Parachute Federation aircraft committee inspected the aircraft following the accident. The representative found that the aircraft impacted the ground very heavily in a nose-down attitude. About half a litre of fuel was drained from the system after the aircraft was removed from the site.

The report stated that the aircraft should still have had fuel on board, based on taking off with 110 L on board, and at the maximum consumption rate. However, while holding and conducting continuous right orbs, fuel may have been lost from the tanks due to venting from the fuel valve.

Video footage

The ATSB obtained video footage of the incident taken from inside the aircraft. During the approach, the aircraft banked steeply to the right towards a built-up area, then to the left towards the landing site. As the aircraft wings levelled, the nose pitched up and the left wing appeared to come into close proximity with a building. At that time, the pilot retracted the flaps. The aircraft then descended rapidly and collided with the ground in a nose-down attitude.

CASA investigation

The Civil Aviation Safety Authority (CASA) also conducted an investigation into the incident. At the time of publication of the ATSB report, CASA had not finalised its investigation. CASA advised the ATSB that two fuel dipsticks appear to have been in use by the aircraft operator. One dipstick had fuel quantity depicted in 10 L increments, the other in 20 L increments. If the pilot had calculated the fuel on board based on 20 L increments, but used a dipstick with 10 L increments, rather than having 110 L of fuel on board at start-up, there would have been 55 L. That fuel quantity correlated with the length of time the engine ran before fuel exhaustion occurred. Additionally, the same aircraft had been involved in a similar fuel starvation incident in 2011, where the CASA investigation found that there was probably more than one dipstick in use at the time.

Safety message

The ATSB SafetyWatch highlights the broad safety concerns that come out of our investigation findings and from the occurrence data reported to us by industry. One of the safety concerns relates to aircraft fuel management.

Pilots are reminded of the importance of careful attention to aircraft fuel state. ATSB Research report AR-2011-112 Avoidable accidents No. 5 *Starved and exhausted: Fuel management aviation accidents*, discusses issues surrounding fuel management and provides some insight into fuel related aviation accidents. The report includes the following comment:

> Accurate fuel management also relies on a method of knowing how much fuel is being consumed. Many variables can influence the fuel flow, such as changed power settings, the use of non-standard fuel leaning techniques, or flying at different cruise levels to those planned. If they are not considered and appropriately managed then the pilot's awareness of the remaining usable fuel may be diminished.

This incident also highlights that a timely decision to conduct a precautionary landing may be better than having no choice but to conduct a forced landing.

General details

Occurrence details

Date and time:	2 October 2015 – 1430 CST	
Occurrence category:	Accident	
Primary occurrence type:	Fuel exhaustion	
Location:	Adelaide, South Australia	
	Latitude: 34° 56.02' S	Longitude: 138° 37.02' E

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 182H	
Registration:	VH-DNZ	
Serial number:	18256174	
Type of operation:	Private – parachute operations	
Persons on board:	Crew – 1	Passengers – 4
Injuries:	Crew – 1 minor	Passengers – 2 serious, 2 nil
Damage:	Substantial	

Fuel management issue, involving a PA-31-350, VH-HJH

What happened

Piper Chieftain VH-HJH

Source: South East QLD Aviation News

On the morning of 12 October 2015, the pilot completed flight planning, then prepared a PA-31-350 (Piper Chieftain) aircraft, registered VH-HJH, for an aerial survey flight in the southern highlands area of New South Wales. As the flight was to be conducted at 10,000 ft above mean sea level, the pilot also discussed airspace requirements with both Sydney and Canberra Air Traffic Control (ATC) units. Due to potential conflicts with jet traffic at that level, ATC requested the pilot delay the departure from Bankstown, New South Wales, for a few minutes.

Prior to departure, the pilot delivered a safety briefing to the client's three personnel who would be on board the flight. The pilot reported spending extra time briefing one of the group (Passenger 3) who had not flown in a light aircraft before.

After departure from Bankstown, at about 1300 Eastern Standard Time (EST), ATC initially provided vectors to the pilot, then cleared the aircraft to the first of many planned waypoints in the area. The pilot reported that both towering cumulus (TC) and cumulus (CU) clouds were beginning to form in the area, and this produced some turbulence, but nothing substantial. However, the pilot remained concerned about Passenger 3, seated at the rear of the aircraft, who appeared to find the conditions difficult to tolerate.

The pilot's workload remained high. Apart from the pre-planned waypoints, additional 'landmarks' were being relayed to the pilot from the client's operator on the ground. The pilot had to check the landmarks on the chart, translate these requests into usable GPS coordinates, and then enter them into the GPS unit. The pilot then requested an amended clearance from ATC. The pilot visually manoeuvred the aircraft around cloud, and kept the aircraft as 'smooth' as possible, so that the survey operators on board could gain the necessary data from their equipment. The pilot also continued to monitor the wellbeing of the passengers, and in particular, passenger 3.

The aircraft was fitted with a main tank (inboard) and an auxiliary tank (outboard), for each of the two engines. As was the pilot's normal routine, they kept a very detailed fuel log, and continually cross-checked the fuel flow, fuel used, and time remaining in each of the four fuel tanks. The power settings required for the survey were less than normal cruise performance settings.

As the plan was to return to Bankstown at the completion of the survey, the pilot kept a continual awareness of the slowly deteriorating weather there. The pilot reported that the potential alternates of Camden, Goulburn, Canberra and Bathurst remained as options. Thunderstorms were now developing in the Sydney Basin area, although Camden Airport automatic terminal information service (ATIS) still advised of clear conditions at that location. One of the passengers (Passenger 1), seated behind the pilot, discussed the thunderstorms and their impact on the flight with the pilot. As the pilot had kept a detailed fuel log and awareness of the surrounding weather, they were able to reassure the passenger that there was plenty of fuel available to complete the survey and, if necessary, divert to an alternate should a return Bankstown not be possible.

After a little over 2 hours, the clients had almost completed their work, and the pilot prepared to fly to the last waypoint before the return to Bankstown. The weather in the immediate area had now deteriorated even further, and the pilot reported having to divert off track to avoid thunderstorms, although all the alternates remained viable options.

As the pilot was about to make a scheduled fuel tank change from the auxiliary (outboard) tanks to the main tanks, the pilot again checked the fuel log. There was 16 minutes of fuel remaining in the left auxiliary tank (slightly more in the right auxiliary)

The pilot momentarily reflected on the weather versus fuel situation. As the weather between the aircraft's current location and Bankstown had deteriorated even further, the pilot elected to alter their original plan, and keep the auxiliary tanks selected in order to use another few minutes of the remaining 16 minutes of fuel. This would leave the maximum fuel available in the main tanks. The main tanks in this aircraft are required to be selected during the descent, approach and landing, and, in this case, a possible diversion to an alternate.

During this period, as the pilot diverted around large banks of cloud to keep the aircraft in clear weather and discussed the necessity to fly to the last waypoint with passenger 1, the left auxiliary tank ran dry and the engine surged. This temporary asymmetric situation caused the aircraft to yaw. The pilot reacted immediately and changed the fuel selectors to the main tanks. The engine responded, and power was restored.

The pilot then continued with the remainder of the flight and landed without incident back at Bankstown Airport. At the time of landing, all reserves were intact with ample fuel remaining.

Pilot comments

In hindsight, the pilot reported that the decision to run the last few minutes from the auxiliary tanks may have not been necessary, and probably over-conservative. There had been no operational pressure for them to deviate from the scheduled fuel selection plan. The pilot reported that, due to the combination of distractions, they did not notice the low fuel warning light come on. This may have been further influenced by the amount of light in the cockpit at the time perhaps 'dimming' the effect of the red warning light situated on the instrument panel near the compass.

The pilot reported that this was a 'non-standard' high workload flight, coupled with deteriorating weather. Although the pilot had over 7,500 flying hours, with about 400 hours on Chieftain aircraft, they found themselves momentarily 'caught out'. However, due to the aircraft's altitude at the time, and the pilot's quick reaction, there was no danger to the aircraft or the occupants.

The pilot also debriefed all passengers when on the ground.

Operator comments

The Chief Pilot advised that the pilot followed all company fuel planning procedures as outlined in the company operations manual. There are no procedures in the manual to advise pilots when they must change tanks to prevent a fuel starvation event. The aircraft landed with 279 litres of fuel, from a total of 690 litres of useable fuel. This equates to 104 minutes, less reserves, using the consumption rate of 160 litres per hour.

The Chief Pilot advised of the importance of regular enroute checks, particularly in a distracting environment.

Safety message

In this incident, the pilot followed all the key suggestions in the ATSB's Avoidable Accident Series No 5 – Starved and exhausted: Fuel management aviation accidents. These being that they knew

- exactly how much fuel was on board
- how much / what rate fuel was being consumed
- the aircraft fuel system and kept a detailed fuel log of the four tanks during flight.

However, a high workload, deteriorating weather, and untimely distractions led to a change of a planned procedure and an unplanned outcome of temporary fuel starvation of the left engine.

Another ATSB investigation involving fuel starvation resulted in a more serious outcome, with the aircraft substantially damaged. In that accident, the pilot was also distracted from their scheduled fuel management due to weather; however the aircraft was at significantly lower altitude. Due to the delayed engine response at low level, the pilot had to conduct a forced landing through fog. The investigation (AO-2015-042) can be found on the ATSB website.

General details

Occurrence details

Date and time:	12 October 2015 at 1523 ESuT	
Occurrence category:	Incident	
Primary occurrence type:	Fuel Starvation	
Location:	North of Goulburn Airport, New South Wales	
	Latitude: 34°S 38.83'	Longitude: 149° 46.18' E

Aircraft details

Manufacturer and model:	Piper Aircraft Corporation PA-31-350
Registration:	VH-HJH
Serial number:	31-7752127
Type of operation:	Aerial Survey

Wheels-up landing involving a Cessna 172RG, VH-HTP

What happened

On 14 October 2015, the pilot of a Cessna 172RG aircraft, registered VH-HTP (HTP), conducted a private flight from Ramingining to Elcho Island, Northern Territory, with two passengers on board (Figure 1). The aircraft tracked along the coast from Ramingining, at about 1,500 ft above mean sea level.

Figure 1: Ramingining and Elcho Island, Northern Territory

Source: Google earth – annotated by the ATSB

When about 10 NM from Elcho Island, the pilot broadcast an inbound call on the common traffic advisory frequency (CTAF). The flight crew of an aircraft inbound from Darwin also broadcast on the CTAF, with an estimated arrival time about 3 to 5 minutes earlier than HTP.

At about 1050 Central Standard Time (CST), the pilot of HTP manoeuvred the aircraft to make a straight-in approach to runway 10 at Elcho Island aerodrome. When HTP was passing about 1,300 ft on descent, and 3 NM from the runway threshold, the pilot sighted the other aircraft ahead on the runway.

As the pilot of HTP commenced the pre-landing checks, the flight crew of the landed aircraft broadcast that they were backtracking the full length of the runway. The pilot considered whether it was necessary to make an orbit to allow the aircraft ahead to clear the runway. The pilot elected to continue the approach, closely monitoring the aircraft backtracking on the runway, as well as the aiming point, aircraft profile and position, and airspeed.

As the aircraft ahead taxied clear of the runway, the pilot continued the approach, and selected 10° of flap. However, the pilot omitted to extend the landing gear. The pilot reported the approach was normal, and the conditions were smooth with a light breeze and no turbulence. As the pilot flared the aircraft for landing, the belly of the aircraft contacted the tarmac and the aircraft skidded along the runway. On hearing the scraping sound, the pilot initially applied full power, but the aircraft remained on the ground and came to rest on the gravel beside the runway. The pilot did not hear the stall or landing gear warning horn at any time.

The pilot and passengers were uninjured, and the aircraft sustained substantial damage (Figure 2).

Figure 2: Cessna 172RG aircraft, VH-HTP accident site

Source: Aircraft operator

Pilot comments

At the point in the pre-landing checks when they would normally extend the landing gear, the pilot assessed they would have to conduct an orbit to give the aircraft ahead time to clear the runway.

The landing gear indication light was located behind the control column and below the pilot's normal visual field during the approach. The pilot first realised that the landing gear was retracted when the aircraft contacted the runway.

Landing gear warning horn

The Cessna 172RG pilot operating handbook stated that the aircraft was fitted with a landing gear warning system, designed to help prevent the pilot from inadvertently making a wheels-up landing. The system consisted of two switches. One switch would be actuated when the throttle was retarded below 12 inches of manifold pressure. If the landing gear was retracted (or not down and locked), an intermittent tone would sound on the aircraft's speaker. A second switch in the wing flap system would also sound the horn when the flaps were extended beyond 20° with the landing gear retracted.

Safety message

Initially assessing that an orbit was required led to a break in the pilot's normal pre-landing checks. The pilot was then distracted monitoring the aircraft on the ground, and the approach. When the pilot assessed that the other aircraft would be clear of the runway and elected to continue the approach, the pilot did not complete the pre-landing checks, and omitted to extend the landing gear.

Generally, distraction is defined as a process, condition or activity that takes a pilot's attention away from the task of flying. Research conducted by the Australian Transport Safety Bureau identified 325 occurrences between 1997 and 2004, which involved distractions. Of these, 54 occurred during the landing phase of flight.

The Flight Safety Foundation suggests that, after a distraction source has been recognised and identified, the next priority is to re-establish situation awareness by conducting the following:

- *Identify*: What was I doing?
- *Ask*: Where was I distracted?
- *Decide/act*: What decision or action shall I take to get back on track?

The following provide additional information on pilot distraction:

- *Dangerous Distraction: An examination of accidents and incidents involving pilot distraction in Australia between 1997 and 2004*
- Flight Safety Foundation Approach-and-landing Briefing Note 2.4 – *Interruptions/Distractions*
- The United States Federal Aviation Administration (FAA) pamphlet *On Landings Part III*

General details

Occurrence details

Date and time:	14 October 2015 – 1030 CST	
Occurrence category:	Accident	
Primary occurrence type:	Wheels-up landing	
Location:	Elcho Island Aerodrome, Northern Territory	
	Latitude: 12° 01.17' S	Longitude: 135° 34.23' E

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 172RG	
Registration:	VH-HTP	
Serial number:	172RG0918	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Flight path infringement involving a Cessna 172M, VH-EJM and a vehicle

What happened

On 10 September 2015, at about 0930 Eastern Standard Time (EST), an instructor and student pilot of a Cessna 172M aircraft, registered VH-EJM (EJM), were conducting circuits at Townsville Airport, Queensland.

The student was flying the aircraft and on mid-final for a touch-and-go landing on runway 07, when the instructor noticed a truck on the perimeter road, near the threshold to runway 07. The truck had not held at the stop sign. The stop sign required all vehicles to stop, look for aircraft, and not proceed unless there was no aircraft landing (Figure 1).

Shortly after the instructor sighted the truck, the Townsville Tower air traffic controller advised the pilots of EJM that there was a truck on the perimeter road. The instructor acknowledged the controller and they proceeded with the landing.

The aircraft conducted a touch-and-go and continued with several more circuits without incident.

Figure 1: Townsville airport perimeter road near runway 07

Source: Google earth, modified by the ATSB

Instructor and aircraft operator comments

The instructor commented that another vehicle on the perimeter road, ahead of the truck, also did not stop at the stop sign.

The operator reported this could potentially have been a more serious issue if the student pilot was conducting their first solo flight, as there would be greater risk that the student might get low on the approach and might not see the truck.

Department of Defence investigation

The Department of Defence conducted an investigation into the serious incident. They determined that a contractor, driving a truck on the western perimeter road, failed to stop at the stop sign near the threshold of runway 07. VH-EJM missed the top of the truck by about 4 to 5 metres and the aircraft landed without incident.

The Department of Defence also conducted a subsequent investigation into an incident where a contractor driving a truck on the western perimeter road failed to stop at the stop sign near the threshold of runway 07. The pilot of a Cessna C172RG aircraft that was on short final, saw the truck coming towards their approach path and informed air traffic control. Air traffic control acknowledged the transmission. The truck stopped almost directly under the path of the arriving aircraft and the aircraft landed without incident.

The investigation determined that the stop signs located on the perimeter road on approach to runway 07 provided drivers with clear direction to stop, observe and give way to approaching aircraft. The failure of the drivers of the vehicles in these incidents to observe those protocols created the potential for a collision between the vehicle and the aircraft.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Department of Defence

As a result of this occurrence, the airport operator has advised the ATSB that they are taking the following safety actions:

- briefing material for contractors has been updated placing greater emphasis on safety around runways.
- flashing lights have been installed on the stop signs, for the under-run service road, to improve observation of the sign by drivers.

ATSB comment

At the time of writing this report, two other similar events occurred on 8 and 10 December 2015. The occurrences were subsequent to the update of briefing material for contractors and the installation of flashing lights on the stop signs. The Department of Defence are conducting a review of their safety actions to see if there are any other options to prevent a re-occurrence.

Safety message

The International Civil Aviation Organization (ICAO) has identified runway safety as one of its priorities and has been working with countries and aviation organisations globally to reduce runway safety accidents. ICAO has developed a runway safety website, which offers a range of information and products to assist the aviation community to improve runway safety.

In addition, ICAO has published a *Manual on the Prevention of Runway Incursions Doc 9870 AN/463*, available from the ICAO website. The manual includes information on the prevention of runway incursions. The manual discusses that deficiencies in design, training, technology, procedures, regulations and human performance can result in a system break down and safety being compromised. A pilot, as part of the last line of defence, cannot assume that anyone will do the right thing, like the driver of the truck stopping at the stop sign, and they need to be prepared to re-evaluate the planned flight.

Additional information on runway safety is also available from the Airservices Australia webpage Runway safety.

In addition, Airservices Australia has published a guide for airside drivers, *The Airside Drivers Guide to Runway Safety*, which focuses on four aspects of operating safely on an aerodrome:

1. planning your aerodrome operation
2. aerodrome procedures
3. communications
4. aerodrome markings, signs and lights.

General details

Occurrence details

Date and time:	10 September 2015 – 0930 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Runway events – other	
Location:	Townsville Airport, Queensland	
	Latitude: 19° 15.15' S	Longitude: 146° 45.92' E

Aircraft details

Manufacturer and model:	Cessna 172M	
Registration:	VH-EJM	
Serial number:	17262423	
Type of operation:	Flight training – training dual	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Partial engine failure involving a Gippsland Aeronautics GA-8, VH-FGN

What happened

On 21 October 2015, a Gippsland Aeronautics GA-8 aircraft, registered VH-FGN (FGN), was conducting parachute operations at Busselton Airport, Western Australia (Figure 1). Prior to commencing the day's operations, a company pilot conducted a pre-flight inspection of the aircraft, with no defects found.

Figure 1: Gippsland Aeronautics GA-8 aircraft, VH-FGN

Source: Aircraft operator

At about 1500 Western Standard Time (WST), FGN took off from Busselton Airport with a pilot and seven parachutists on board. As the aircraft climbed through about 2,000 ft, the pilot observed a decrease in the engine manifold pressure. The manifold pressure was still in the green arc, or normal operating range, but indicating about 30 inches. The normal manifold pressure during the climb was about 38 inches. The fuel flow also increased from about 120 L/hr to 154 L/hr. As the aircraft was tracking south towards forested terrain, the pilot elected to turn back towards the aerodrome, and continue the climb, in case the engine issue worsened. The pilot conducted the standard engine checks, but the engine continued to produce only partial power. The pilot broadcast a Mayday[1] on the Melbourne Centre air traffic control (ATC) frequency.

[1] Mayday is an internationally recognised radio call for urgent assistance.

The pilot advised the parachutists that they would establish the aircraft in the drop run overhead the aerodrome at about 4,000 ft (instead of the planned FL 140[2]) to allow the parachutists to exit the aircraft. As the pilot subsequently reduced engine power to allow the parachutists to exit the aircraft, the engine ran roughly. Six of the parachutists exited normally and landed safely at the drop zone, while the seventh, who was also a company pilot and seated in the front passenger seat, remained in the aircraft with the pilot in command.

The pilot then increased the aircraft's power until the engine ran smoothly, although only producing partial power, while continuing the descent to the aerodrome. The pilot also advised ATC that they did not require immediate assistance and downgraded to a PAN[3], as the engine continued to produce some power. The aircraft landed safely at Busselton at about 1514.

After shutting down the engine, the pilot consulted with the maintainer, and found that the intake tube on the No. 4 cylinder was loose.

Aircraft maintenance and engineering inspection

On 10 October 2015, a licensed aircraft maintenance engineer had completed a 100-hourly inspection on the aircraft, including a 'top overhaul' of the engine.

After the incident, the engineer completed the following:

- removed the bolts and inspected the wire thread (Helicoil) inserts, and found no damage
- fitted a new intake gasket and o-ring to the intake tube, and resecured the tube to the No. 4 cylinder with new spring washers
- checked the torque of all other intake tube bolts, and found none loose.

Safety message

This incident highlights the importance of having thoroughly rehearsed emergency procedures, particularly for parachute operations. The parachutists had, in accordance with standard procedures, removed the single point restraints during the climb, and were prepared to exit the aircraft quickly.

For pilots, this provides a reminder that constant monitoring of the engine instruments can provide early indication of a problem. Acting quickly on this information may reduce the impact of partial or total power loss on flight safety.

The ATSB publication *Avoidable Accidents No. 3 – Managing partial power loss after takeoff in single-engine aircraft*, provides information also relevant to partial losses of power in flight as well as after take-off. Following a complete engine failure, a forced landing is inevitable. For a partial power loss, pilots are faced with deciding whether to continue the flight or land immediately.

2 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 140 equates to 14,000 ft.

3 An internationally recognised radio call announcing an urgency condition which concerns the safety of an aircraft or its occupants but where the flight crew does not require immediate assistance.

General details

Occurrence details

Date and time:	21 October 2015 – 1514 WST	
Occurrence category:	Incident	
Primary occurrence type:	Engine failure or malfunction	
Location:	near Busselton Airport, Western Australia	
	Latitude: 33° 41.23' S	Longitude: 115° 24.02' E

Aircraft details

Manufacturer and model:	Gippsland Aeronautics GA-8
Registration:	VH-FGN
Serial number:	GA8-03-025
Type of operation:	Private – Parachute Operations

Aircraft control issue involving a Liberty XL-2, VH-CZS

What happened

On 29 October 2015, a pilot who held a restricted pilot licence, and a flight instructor, prepared for a training flight at Camden Airport, New South Wales. The plan was to conduct circuits at Camden, in a Liberty XL-2 aircraft, registered VH-CZS (CZS). The pilot conducted a pre-flight inspection of the aircraft, with no defects found.

At about 1140 Eastern Daylight-saving Time (EDT), after the pilot had completed the normal pre-flight checks, and received the required air traffic control clearances, the aircraft took off for the first circuit. The pilot completed two normal circuits with touch-and-go landings on runway 06, and climbed out on runway heading for the third circuit.

During the initial climb, the pilot felt backward pressure on the control stick, and selected the electric pitch trim to a slightly nose down position. The aircraft was then in a stable climb, at an airspeed of 75 to 80 kt. As the aircraft passed about 500 ft above mean sea level (AMSL), the pilot retracted the flaps.

Passing about 700 ft, the pilot commenced a climbing turn onto the downwind leg. As the pilot rolled the wings level on downwind, the aircraft was still about 100 ft below the circuit altitude of 1,300 ft AMSL. The pilot therefore continued a shallow climb with the wings level, at an airspeed of about 95 kt. Suddenly, the control stick came back towards the pilot, and the aircraft pitched to a nose-up attitude.

The pilot pushed forward on the stick with both hands, to a full forward position. They also asked the instructor to adjust the pitch trim to a more nose-down position, to try to return the aircraft to a level attitude. The pilot stated there was something wrong and handed control of the aircraft to the instructor, who also assessed that there was a control issue. The aircraft descended rapidly in a nose-up attitude, and the aircraft then pitched nose-down.

The aircraft descended to about 700 ft, and the pilot broadcast a Mayday[1] to the Camden tower controller advising them of a control issue. The controller asked whether they could make it back to land on runway 06, and the pilot replied ‘negative’. The pilot and instructor elected to conduct a precautionary landing in a paddock ahead of the aircraft. The instructor sighted powerlines and overflew them before extending full flap and landing in the paddock.

During the landing roll, the aircraft collided with two fences and came to rest in a stand of trees. The pilot and instructor were uninjured, and the aircraft sustained substantial damage (Figure 1).

Engineering inspection

An engineer conducted a post-accident inspection of the aircraft, and did not find any obvious defect that may have contributed to the control issue.

[1] Mayday is an internationally recognised radio call for urgent assistance.

Figure 1: Accident site of Liberty XL-2 aircraft, registered VH-CZS

Source: Insurance assessor

Pilot comments

The pilot and instructor provided the following comments:

- Once they had moved the trim to the full nose-down position, the instructor elected to leave it there and not try to move it, in case it made controlling the aircraft more difficult.
- The pilot initially assessed there was a problem with the stabilator, as it felt as if something had jammed in it.
- They assessed that it was preferable to land with a slight tailwind in the paddock, than to attempt to turn the aircraft and land into wind.
- At the commencement of the flight, the aircraft was about 20 kg below the maximum take-off weight and within the normal centre of gravity range.
- The aircraft flight manual included a checklist for partial control failure or malfunction, but they did not have sufficient time to access the manual during the incident. The checklist advised the pilot to check the trim setting and the circuit breakers, to control the aircraft with power and whichever controls were operational, and to land as soon as possible. The instructor also stated that they did not have time to check the circuit breakers, which were on the right side of the instrument panel.
- The instructor reported that as well as the pitch, or elevator, control issue, the aileron, or roll control felt overly sensitive. When the instructor applied light pressure to roll the aircraft to the left, it was overly responsive. This influenced the decision to land in the paddock ahead, rather than attempt to turn the aircraft into wind or to return to land on the runway.

Operator comments

The operator assessed that the way the pilots used the trim may have led to the control difficulties.

Safety message

The pilot and instructor both commented that their communication during the incident was very good, and that played a key role in getting the aircraft safely to the ground. Faced with an abnormal situation, the pilots communicated effectively, and collaborated to share the workload.

General details

Occurrence details

Date and time:	29 October 2015 – 1200 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Aircraft control – Control issues	
Location:	Camden Airport, New South Wales	
	Latitude: 34° 02.42' S	Longitude: 150° 41.23' E

Aircraft details

Manufacturer and model:	Liberty Aerospace Incorporated XL-2
Registration:	VH-CZS
Serial number:	0090
Type of operation:	Flying training – dual

Helicopters

Collision with terrain involving a Robinson R22, VH-NCL

What happened

On 6 November 2015, the pilot of a Robinson R22 helicopter, registered VH-NCL, prepared to conduct a private flight with one passenger on board, from Newman Airport in Western Australia.

At about 0830 Western Standard Time (WST), the helicopter lifted off to about 10 ft above ground level, and the pilot commenced hover-taxiing. As the helicopter started to move forwards, it encountered a gust of wind from behind and sank rapidly. The helicopter landed heavily, then bounced and rotated rapidly to the right. During the accident sequence, the main rotor blade severed the tail, and the helicopter sustained substantial damage (Figure 1). The pilot and passenger were not injured.

Figure 1: Accident site showing damage to VH-NCL

Source: Airservices Australia - Aviation Rescue Fire Fighting

Loss of tail rotor effectiveness

Loss of tail rotor effectiveness (LTE) causes a yaw to the right in helicopters with a counter-clockwise rotating main rotor. When operating at airspeeds below 30 kt, a tailwind may result in an uncommanded turn, if the tail rotor is unable to provide adequate thrust to maintain directional control. To reduce the onset of LTE, the United States Federal Aviation Administration (FAA) Helicopter Flying Handbook, advises pilots to:

> *Avoid tailwinds below an airspeed of 30 knots. If loss of translational lift occurs, it results in an increased power demand and additional anti-torque pressures.*

To recover from LTE:

> *If the rotation cannot be stopped and ground contact is imminent, an autorotation may be the best course of action. Maintain full left pedal until the rotation stops, then adjust to maintain heading.*

General details

Occurrence details

Date and time:	6 November 2015 – 0830 WST	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	at Newman Airport, Western Australia	
	Latitude: 23° 25.07' S	Longitude: 119° 48.17' E

Helicopter details

Manufacturer and model:	Robinson Helicopter Company R22
Registration:	VH-NCL
Serial number:	4430
Type of operation:	Private

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: 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 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 identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

It is not a function of the ATSB to apportion blame or determine 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.

About this Bulletin

The ATSB receives around 15,000 notifications of Aviation occurrences each year, 8,000 of which are accidents, serious incidents and incidents. It also receives a lesser number of similar occurrences in the Rail and Marine transport sectors. It is from the information provided in these notifications that the ATSB makes a decision on whether or not to investigate. While some further information is sought in some cases to assist in making those decisions, resource constraints dictate that a significant amount of professional judgement is needed to be exercised.

There are times when more detailed information about the circumstances of the occurrence allows the ATSB to make a more informed decision both about whether to investigate at all and, if so, what necessary resources are required (investigation level). In addition, further publically available information on accidents and serious incidents increases safety awareness in the industry and enables improved research activities and analysis of safety trends, leading to more targeted safety education.

The Short Investigation Team gathers additional factual information on aviation accidents and serious incidents (with the exception of 'high risk operations), and similar Rail and Marine occurrences, where the initial decision has been not to commence a 'full' (level 1 to 4) investigation.

The primary objective of the team is to undertake limited-scope, fact gathering investigations, which result in a short summary report. The summary report is a compilation of the information the ATSB has gathered, sourced from individuals or organisations involved in the occurrences, on the circumstances surrounding the occurrence and what safety action may have been taken or identified as a result of the occurrence.

These reports are released publically. In the aviation transport context, the reports are released periodically in a Bulletin format.

Conducting these Short investigations has a number of benefits:

- Publication of the circumstances surrounding a larger number of occurrences enables greater industry awareness of potential safety issues and possible safety action.
- The additional information gathered results in a richer source of information for research and statistical analysis purposes that can be used both by ATSB research staff as well as other stakeholders, including the portfolio agencies and research institutions.
- Reviewing the additional information serves as a screening process to allow decisions to be made about whether a full investigation is warranted. This addresses the issue of 'not knowing what we don't know' and ensures that the ATSB does not miss opportunities to identify safety issues and facilitate safety action.
- In cases where the initial decision was to conduct a full investigation, but which, after the preliminary evidence collection and review phase, later suggested that further resources are not warranted, the investigation may be finalised with a short factual report.
- It assists Australia to more fully comply with its obligations under ICAO Annex 13 to investigate all aviation accidents and serious incidents.
- Publicises ***Safety Messages*** aimed at improving awareness of issues and good safety practices to both the transport industries and the travelling public.

Australian Transport Safety Bureau

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Investigation

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