



**Australian Government**

**Australian Transport Safety Bureau**

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

Leinster Airport, Western Australia, 23 June 2015

**ATSB Transport Safety Report**  
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#### **Addendum**

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# 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.<sup>1</sup>

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)<sup>2</sup> 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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<sup>1</sup> 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.

<sup>2</sup> 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).<sup>3</sup> 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<sup>4</sup> (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<sup>5</sup>**

```
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<sup>6</sup> conditions, with scattered<sup>7</sup> (SCT) cloud expected to develop from 1000, with a base at 2,000 ft above the aerodrome.

<sup>3</sup> 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.

<sup>4</sup> 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.

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

<sup>6</sup> 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.

<sup>7</sup> 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**

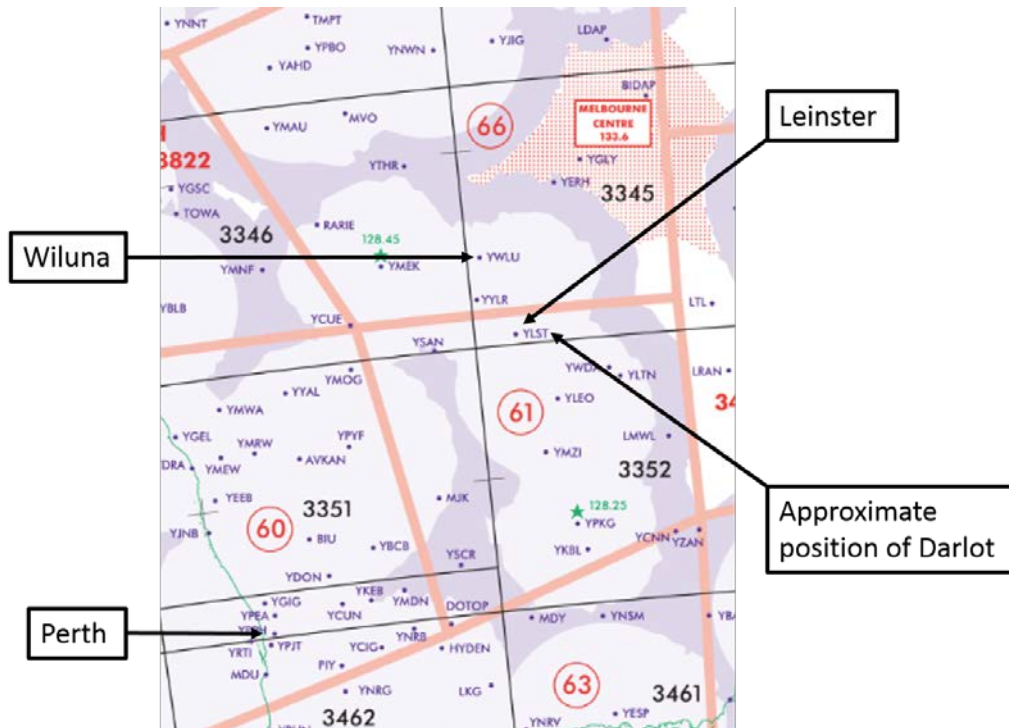
```

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)<sup>8</sup> 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**



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.

<sup>8</sup> 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<sup>9</sup> stated no cloud detected (NCD), a SPECI<sup>10</sup> 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<sup>11</sup> (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////<br>RMK RF//.////./    |
| 0800 WST | METAR YLST 230000Z AUTO 17008KT 9999 // NCD 07/06 Q////<br>RMK RF//.////./    |
| 0827 WST | SPECI YLST 230027Z AUTO 16009KT 9999 // BKN004 06/06 Q////<br>RMK RF//.////./ |
| 0830 WST | SPECI YLST 230030Z AUTO 16009KT 9999 // BKN004 06/06 Q////<br>RMK RF//.////./ |
| 0900 WST | SPECI YLST 230100Z AUTO 15009KT 9999 // OVC004 07/06 Q////<br>RMK RF//.////./ |
| 0930 WST | SPECI YLST 230130Z AUTO 15007KT 9999 // OVC005 08/07 Q////<br>RMK RF//.////./ |
| 1000 WST | SPECI YLST 230200Z AUTO 13008KT 9999 // BKN008 09/07 Q////<br>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.<sup>12</sup>

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

<sup>10</sup> 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.

<sup>11</sup> 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.

<sup>12</sup> 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)**

|   |
|---|
| <p>TAF ·AMD ·YLSY ·230026Z ·2300/2311¶<br/>                 15007KT ·9999 ·BKN008¶<br/>                 FM230200 ·16005KT ·9999 ·BKN025¶<br/>                 FM230400 ·13010KT ·9999 ·SCT020¶<br/>                 RMK¶<br/>                 T ·06 ·11 ·13 ·14 ·Q ·1026 ·1027 ·1025 ·1026¶</p> |
| <p>TAF ·AMD ·YLSY ·230040Z ·2301/2311¶<br/>                 15007KT ·9999 ·BKN005¶<br/>                 FM230200 ·16005KT ·9999 ·BKN025¶<br/>                 FM230400 ·13010KT ·9999 ·SCT020¶<br/>                 RMK¶<br/>                 T ·08 ·12 ·13 ·13 ·Q ·1026 ·1027 ·1025 ·1026¶</p> |

Source: Airservices Australia

**EGPWS warning**

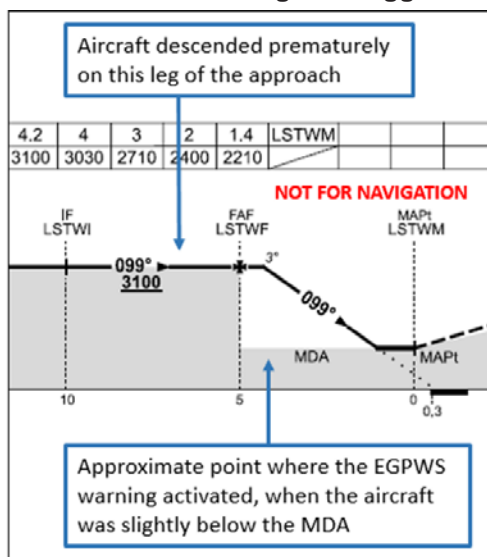
During the RNAV (GNSS) approach to runway 10 at Leinster, the crew received an EGPWS ‘terrain terrain pull-up pull-up’ warning. They responded to that warning by commencing a missed approach. At the time the crew received the EGPWS warning, they were clear of cloud and could see the ground beneath, but 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,<sup>13</sup> 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).<sup>14</sup> 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.

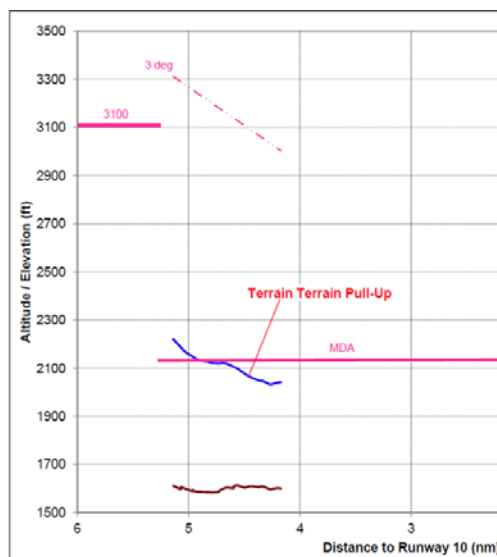
<sup>13</sup> A terrain escape manoeuvre is a more aggressive manoeuvre, typically involving the application of maximum thrust and a high climb angle.

<sup>14</sup> 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 01 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**

### **About the ATSB**

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB 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; and 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.

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.

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 report**

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.