Australian Government
Australian Transport Safety Bureau

Pre-flight planning event involving a Boeing 737, VH-YIU

Christchurch Airport, New Zealand, 15 July 2015

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2015-078
Final – 28 January 2016

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

Publishing information

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Addendum

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Pre-flight planning event involving a Boeing 737, VH-YIU

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).

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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.

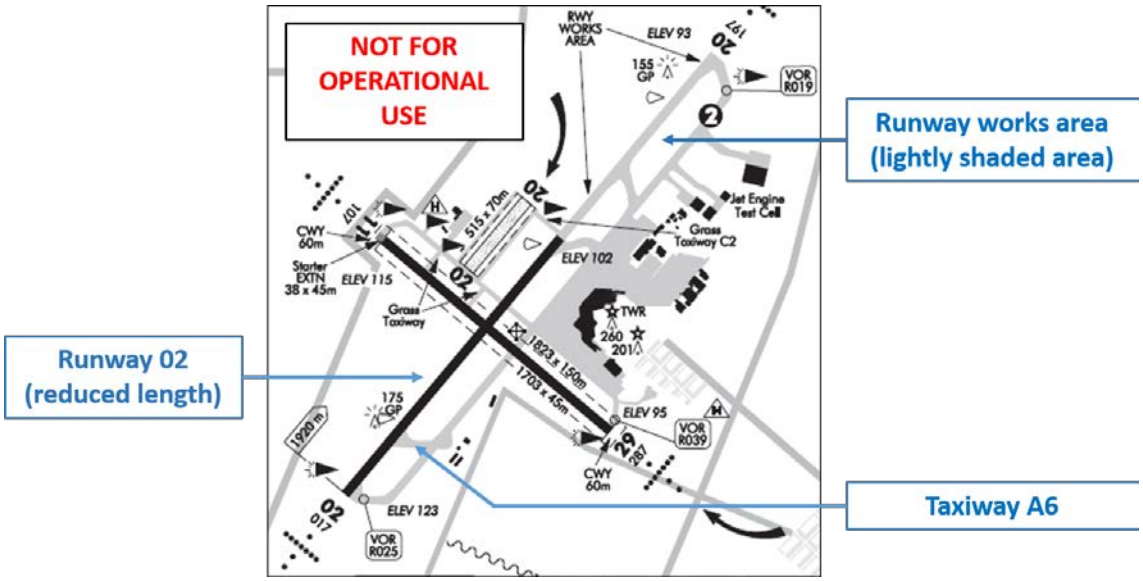
2 The flight plan package was produced by the operator's flight dispatch department at 0642 on the day of the incident.

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.

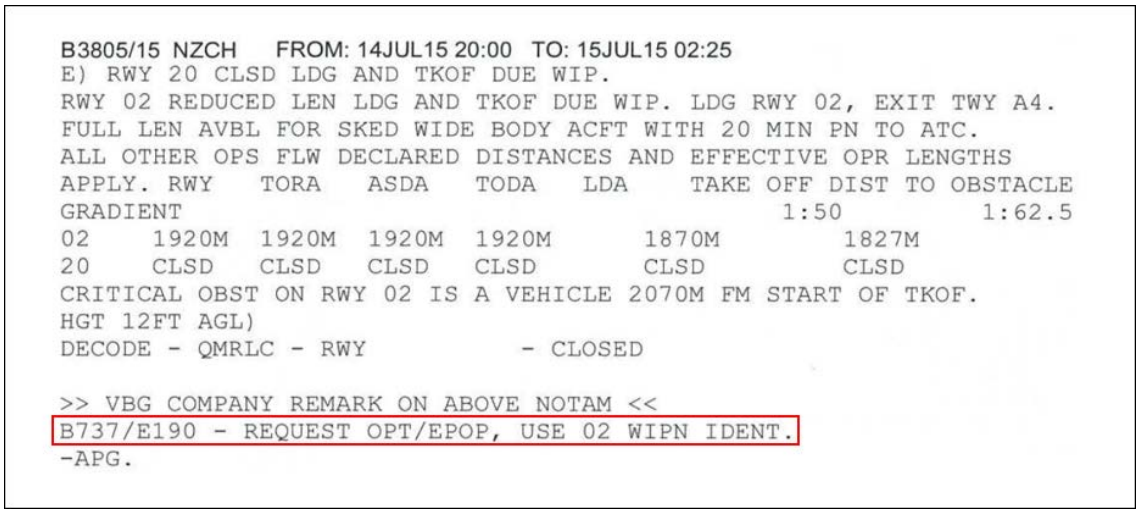
During taxi and while lining up on the runway, the crew did not see any personnel, equipment or obstructions on the runway. At 0827, the aircraft departed without incident.

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]



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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.
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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]

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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

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.