Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

Air Transportation Safety Investigation Report A18Q0100

COLLISION WITH TERRAIN

Air Saguenay (1980) inc.
de Havilland DHC-2 (Beaver), C-FYYT
Manic-Cinq, Quebec, 44 nm WSW
01 July 2018

About the investigation

The Transportation Safety Board of Canada (TSB) conducted a limited-scope investigation into this occurrence to advance transportation safety through greater awareness of potential safety issues. It is not the function of the Board to assign fault or determine civil or criminal liability.

History of the flight

On 01 July 2018, the de Havilland DHC-2 (Beaver) aircraft (registration C-FYYT, serial number 1569), operated by Air Saguenay (1980) inc. (Air Saguenay), was conducting a round-trip flight under visual flight rules between Lake Margane, Quebec, and Jules Lake, Quebec, located 55 nautical miles (nm) to the northeast (Jules Lake is 44 nm west-southwest of the Manic-Cinq dam), to bring back 3 passengers and their luggage. The weather conditions forecasted for that day were favourable for the flight.

The pilot's duty time began at 0800[1] at Lake Margane, and he conducted the pre-flight check of the aircraft. Approximately 45 imperial gallons of fuel was on board.[2]

The aircraft took off from Lake Margane at 0928 with only the pilot on board. At about 1007, it landed on Jules Lake and was then docked at a cottage on the lake's north shore.

Once the luggage was loaded, the passengers boarded the aircraft. One passenger sat in front, to the right of the pilot, and the 2 other passengers sat in the seats behind the pilot and the front passenger.

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1 All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours).

2 One imperial gallon is equal to 4.5 L.

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At approximately 1020, the pilot started the aircraft's engine and taxied east on the water. Soon after, the aircraft was positioned facing south, and the pilot quickly began the take-off run.

Once take-off speed was reached, the pilot manoeuvred to lift the floats off the water. However, the pilot considered that the remaining distance on the lake was insufficient to complete the takeoff and climb safely, and therefore decided to shut off the engine to reject the takeoff. The aircraft continued straight ahead and could not be stopped in time to avoid colliding with trees (Figure 1).

Figure 1. The aircraft after colliding with trees (Source: Air Saguenay)

The emergency locator transmitter (ELT) activated on impact, and the 1st signal was received by the Joint Rescue Coordination Centre (JRCC) in Halifax, Nova Scotia, at 1023.

Neither the passengers nor the pilot was injured, and they were able to evacuate the aircraft without difficulty.

At 1025, the pilot called the company dispatcher on the high-frequency radio to report the accident.

At 1035, JRCC Halifax called the company to report the distress signal received from the occurrence aircraft's ELT.

At 1200, one of the company's other aircraft landed on Jules Lake to pick up the passengers and the pilot.

After the aircraft returned to Lake Margane, the weight of the aircraft's occupants and luggage was verified.[3] The amount of fuel remaining in the aircraft's tanks was 35 imperial gallons. According to the TSB's calculations, the aircraft weighed 4892 pounds at the time of the accident, and its weight and centre of gravity were both within the prescribed limits.[4]

Meteorological information

The weather station at Manouane Est, Quebec, is located about 25 nm northwest of Jules Lake. At 1000, it indicated a temperature of 20 °C, a dew point of 10 °C, and surface winds from 120° true at 6 knots. There was nothing to indicate that weather conditions contributed to this occurrence.

Pilot information

Records indicate that the pilot was certified and qualified for the flight in accordance with existing regulations. He had logged 4450 total flight hours, including 3505 hours as pilot-in-command. He was hired by Air Saguenay in 2017, where he completed his aircraft type rating on the DHC-2 and

[3] The total weight of the aircraft's occupants was 807 pounds, and the luggage weighed 410 pounds.

[4] The maximum authorized take-off weight was 5090 pounds.

accumulated 387 hours on type. On 01 June 2018, the pilot passed a proficiency check[5] as part of his recurrent training that included take-off exercises on water, of which at least 1 was executed on a small lake and at least 1 was a rejected-takeoff exercise.

Before being hired at Air Saguenay, the pilot flew mainly light wheeled aircraft between aerodromes with paved runways. He also had experience with instrument flight.

The pilot's experience at Jules Lake was limited to 2 flights, the week before the accident, to drop off passengers. The 2 takeoffs for the return flights were made while the aircraft was empty.[6] The pilot was not comfortable with these takeoffs because of the short distance available.

Lakes "with limiting conditions"

Seaplanes can land on various types of lakes, some of which have characteristics that increase the degree of flying difficulty at landing or takeoff. Air Saguenay has compiled a list of lakes to which its aircraft frequently travel that have only a short take-off distance but that the company deems within safe limits for its operations. The company refers to these as lakes "with limiting conditions."

To mitigate the risks associated with these lakes, Air Saguenay has taken measures including the following:

- The chief pilot or the chief pilot's representative must evaluate the pilot's experience and skills in flight before authorizing the pilot to conduct takeoffs or landings on lakes "with limiting conditions".
- To the extent possible, pilots are assigned to the same aircraft and to a single base of operations so that they can familiarize themselves with the specific characteristics of their aircraft and of the lakes within their operating area.
- Customers on an aircraft travelling to a lake "with limiting conditions" are informed that the flight may be subject to restrictions or even cancelled.

These measures were applied in this occurrence. The chief pilot had determined that the pilot was capable of conducting flights on this lake "with limiting conditions" in light of his overall experience, despite the fact that the pilot had only limited bush-flying experience on the DHC-2.

Jules Lake, considered a lake "with limiting conditions" by Air Saguenay, is rectangular, with its longest part measuring about 3400 feet and its narrowest about 650 feet. Its elevation is 2200 feet above sea level, and the surrounding terrain is 100 to 200 feet higher than the lake. Air Saguenay has transported passengers to this lake using Beaver aircraft for a number of years without incident.

Air Saguenay provides its pilots with access to a computer with internet at each base of operations so that they can obtain information about the various lakes for pre-flight planning. The lakes that the company's aircraft regularly land on are loaded into the Google Earth application, which usually allows the user to view the desired lake.

In the bush-flying industry, it is not common practice to formally document recommendations on lakes "with limiting conditions." Instead, limiting conditions and recommendations for these lakes are

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[5] The proficiency check is administered by the chief pilot or the chief pilot's representative. It must be conducted at the same time as the training, whether initial or recurrent, and is not a flight test. The training must continue until the pilot is considered "competent" in performing a specific manoeuvre.

[6] An empty takeoff is a takeoff conducted without passengers, luggage, or goods on board.

discussed verbally among pilots or with the chief pilot when pilots seek further details for their pre-flight planning.

In this occurrence, after the pilot received his flight assignment for Jules Lake on 30 June, he did not discuss the lake with other pilots or the chief pilot in preparation for the next day's flight, because he had flown to this lake twice during the previous week.

Aircraft performance

Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations. There were no anomalies noted in the aircraft journey log, and no technical problems had been reported.

Take-off flight path

Before landing on a lake, seaplane pilots must fly over the area at low altitude to perform visual reconnaissance[7] and determine whether it will be possible to take off from the lake. The pilot will also determine the best take-off flight path based on wind direction and the longest usable distance, and identify a visual reference point to use if the takeoff is rejected when the usable distance is short. For DHC-2s, the visual reference is generally situated between the halfway point and two thirds of the chosen take-off flight path.

This estimate may vary depending on the type of seaplane. If the aircraft is past this point when the takeoff is rejected, the remaining distance may be insufficient to allow the aircraft to come to a complete stop, resulting in a risk of collision with the shore. In this occurrence, the pilot did fly over the area at low altitude before landing.

In this occurrence, the initial intention was to take off in an arc from the bay northeast of the cottage toward the lower terrain. However, according to the information gathered, the actual take-off path was largely in a straight line until the point of impact. The flight path toward the higher terrain required the aircraft to fly over the higher terrain at low altitude or to turn left immediately after takeoff to avoid the higher terrain. Furthermore, a greater take-off distance may have been required because the aircraft was heavier.

Calculations based on the take-off performance chart for an aircraft equipped with floats (as published by the manufacturer, de Havilland Aircraft of Canada Ltd., in the DHC-2 flight manual[8,9]) indicate that the total take-off distance to clear a 50-foot obstacle is 1590 feet.[10,11] Of this distance, about 1100 feet are with the floats touching the surface of the water (Point A, Figure 2).

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[7] A visual reconnaissance flyover is a low-altitude flight above the planned landing area; it allows the pilot to evaluate all of the factors that could affect safety and to confirm that a takeoff will be possible.

[8] The DHC-2 is designed for short takeoffs and landings.

[9] Viking Air Limited, *DHC-2 Beaver Airplane Flight Manual*, PSM1-2-1, revision 11 (08 July 2002), Appendix, p. IV. The de Havilland Aircraft Company of Canada was the original manufacturer of the DHC-2. Viking Air Ltd. acquired the type certificate in 1983.

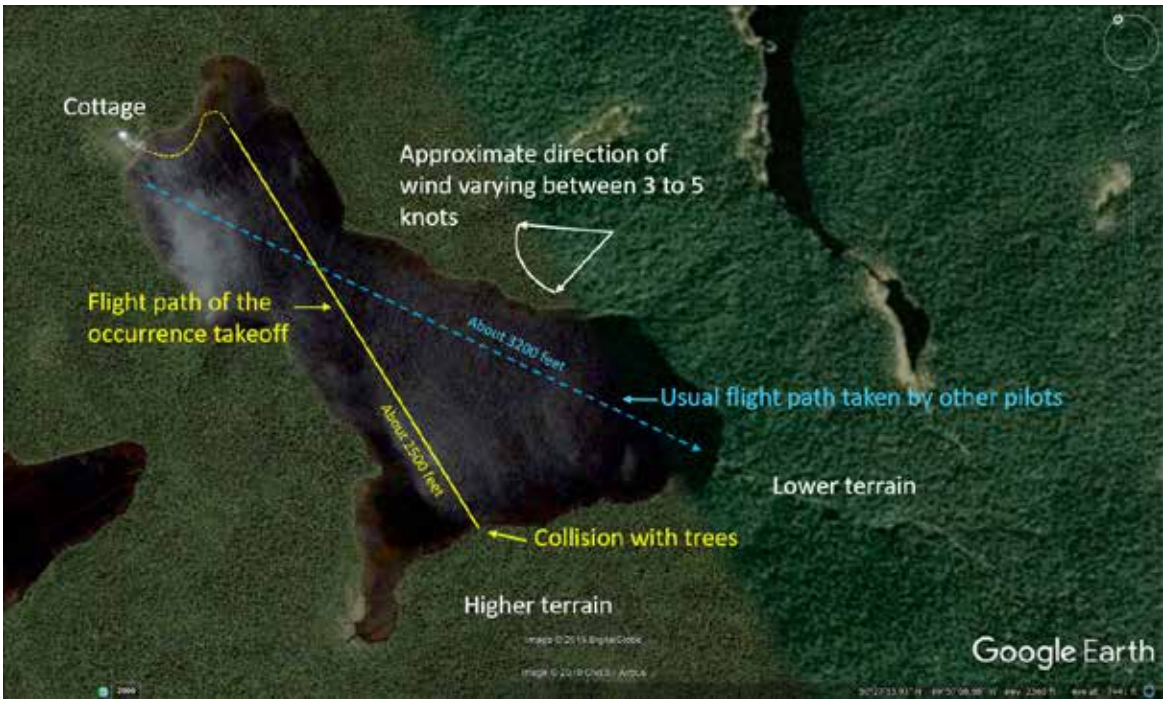
[10] Based on the following data: weight of 4892 pounds, pressure-altitude of 2200 feet, temperature of 20 °C, and no headwind.

[11] The performance charts were created based on the assumption that the take-off technique consists of not lifting the aircraft's nose until a speed equivalent to 1.2 times the take-off speed has been reached.

According to these calculations, the usable take-off distance was sufficient; however, the chart does not take into account factors such as the rate of climb required to safely fly over higher terrain located along the take-off flight path, or the skills pilots need in order to conduct a short takeoff. Pilots must consider the factors that are not taken into account in the performance chart but that could affect the distance travelled during takeoff, then add a margin of safety if necessary.

The investigation determined that when the winds are from the southeast, as in this occurrence, the flight path taken by other company pilots is oriented differently to provide a greater take-off distance and fly over the lower terrain, allowing them to avoid having to make a turn during the initial climb (Figure 2).

Figure 2. Diagram showing the flight path of the occurrence takeoff on Jules Lake in relation to the usual flight path taken by other pilots, as well as estimates of the minimum distance required for takeoff from the surface of the water (A) and the optimal point for a rejected takeoff (B) according to the performance tables (Source: Google Earth, with TSB annotations)



Legend

Estimates based on performance tables:

A Minimum distance required for takeoff from the surface of the water (1100 feet)

B Optimal point for a rejected takeoff (910 feet)

In case an unexpected situation arises during the take-off run, pilots identify a visual reference point that represents the point where the takeoff will be rejected, taking into account the distance that will be travelled on the water from the moment the engine is shut off to the moment the aircraft comes to a complete stop. This distance can be estimated using the water-landing performance table in the

flight manual[12,13,14] (Point B, Figure 2). However, this distance may be shorter if drag is increased, for example by orienting the aircraft into the wind or by deliberately shifting the attitude forward to increase the resistance of the floats on the water, while remaining within the prescribed limits. In this occurrence, the engine was shut off after the aircraft had passed the rejected-takeoff point, and the aircraft could not be slowed down sufficiently to avoid a collision with the shore and trees.

Human factors and decision making

Decision making is a complex cognitive process that requires pilots to concentrate, particularly when they are performing a complex task such as a takeoff, during which events happen quickly and decisions must be made and executed accordingly. In addition to concentration, adequate planning and knowledge of the factors that influence decision making can help pilots take the appropriate action in the circumstances.

When assigned a flight, commercial pilots invariably feel self-induced pressure to conduct the assigned flight. Other external pressures may also be felt, such as from the company, peers, customers, or weather conditions. Pressure—whether self-induced or external—can negatively affect situational awareness and decision making.

In this occurrence, this 3rd assignment to Jules Lake, which included a takeoff from a lake "with limiting conditions" with more weight than the 2 previous takeoffs, made the pilot feel uneasy.

The investigation did not find that there was undue pressure, whether from the company or customers, on the pilot to accept the flight to Jules Lake, but it did note the possibility of self-induced pressure to accept the assignment despite the pilot's unease.

Furthermore, the fact that the engine was not shut off immediately demonstrates that the pilot's attention was focused on the takeoff and that the option to reject the takeoff was not considered initially.

Regulatory context and training

Training in human factors and decision making is an asset in managing risks related to human error. Air Saguenay, as an air operator governed by subparts 702 and 703 of the *Canadian Aviation Regulations* (CARs), was not required by regulation to offer such training. However, the company has offered human-factors and decision-making training to its pilots every year since 2013.

Further to TSB Recommendation A09-02,[15] issued following TSB Aviation Investigation Report A07C0001, Transport Canada (TC) issued Advisory Circular 700-042, *Crew Resources* [*sic*] *Management (CRM)*, which is scheduled to come into effect on 31 January 2019. TC intends to require

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[12] Viking Air Limited, *DHC-2 Beaver Airplane Flight Manual*, PSM1-2-1, revision 11, 08 July 2002, Appendix, p. IV.

[13] According to the performance chart for a water landing, the distance travelled on water before the aircraft comes to a complete stop is 910 feet, based on the following values: weight of 4892 pounds, pressure-altitude of 2200 feet, temperature of 20 °C, and no headwind.

[14] The performance chart were created based on the assumption that the water-landing technique consists of maintaining 1.3 times the stall speed for the approach.

[15] The TSB recommended that "the Department of Transport require commercial air operators to provide contemporary crew resource management (CRM) training for Canadian Aviation Regulations (CARs) subpart 703 air taxi and CARs subpart 704 commuter pilots."

operators subject to subparts 702, 703, and 704 of the CARs to add new elements such as decision making to their training, taking into account both single-pilot and multi-crew environments.

Safety messages

The mechanical reliability of aircraft has improved over the years, which has helped to reduce mechanical failures in accidents, but human factors continue to play an important role. In order to more effectively manage the effects of human factors on decision making, whether in a cockpit or during administrative decision making, training on human factors and structured decision making that is adapted to the needs of an air carrier are effective preventative measures.

However, to ensure that this measure is effective, pilots need to be aware of their limits and speak up immediately about any unease they may feel about an assignment, ask questions and even reconsider an assignment.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 16 January 2019. It was officially released on 22 January 2019.

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