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

# AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A22Q0029

## CONTROLLED FLIGHT INTO TERRAIN

Airbus AS350 B2 (helicopter), C-GFBW
Sept-Îles Airport, Quebec, 7.5 NM W
17 March 2022



### History of the flight

At approximately 0630[1] on 17 March 2022, the pilot, accompanied by a passenger, arrived at the Héli-Boréal Inc. (Héli-Boréal) hangar at the Sept-Îles/Héli-Boréal heliport (CHB4), Quebec, to prepare the AS350 B2 helicopter (registration C-GFBW, serial number 9076) and load equipment for a private ferry flight under visual flight rules to Québec/Jean Lesage International Airport (CYQB), Quebec.

A member of the pilot's family then arrived to assist the pilot with the preparations for takeoff.

The aircraft was parked outside the hangar and the upper aft fuselage (engine and main gearbox) was under a winter protective cover. The windshield was not protected and was covered with a layer of rime ice.

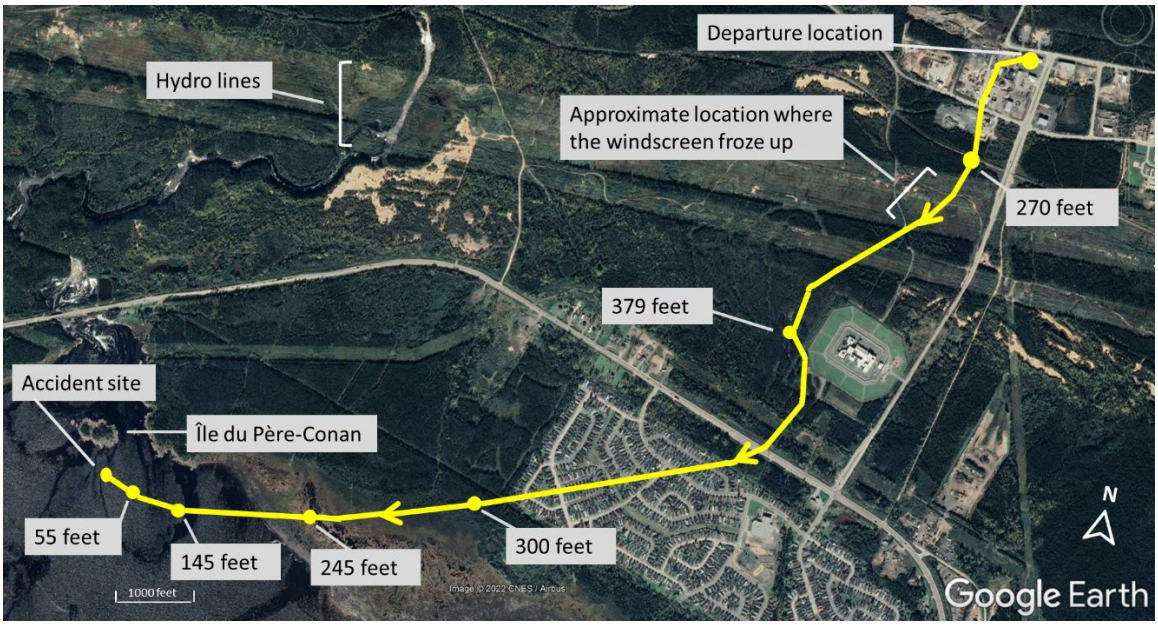
Once the engine was running, the pilot opened the hot air control valves to heat the windshield and the inside of the cabin. The family member who had come to help the pilot poured about a third (approximately 1.25 L) of a full jug of automobile windshield washer fluid onto the windshield to defrost both sides (the passenger side and the pilot side). The family member then wiped the excess

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

fluid with his hand until the windshield was completely free of rime ice, and headed back to the hangar. The helicopter took off at around 0747, flying in a southwesterly direction.

When the aircraft flew over power lines south of CHB4 (Figure 1) at approximately 300 feet above ground level (AGL), the outer surface of the windshield became suddenly covered with frost, except for the lower right corner. Given that forward visibility was limited, the pilot decided to land on the frozen Baie des Sept Îles, a vast open area less than 2 nautical miles away, which he deemed more suitable for a landing under those conditions than the CHB4 heliport.

**Figure 1. Aerial view of the route flown by the occurrence helicopter according to the global positioning system, with altitudes above ground level (Source: Google Earth, with TSB annotations)**




During the descent, the pilot saw Île du Père-Conan in the bay and decided to manoeuvre for a landing close to the trees on the island so that he would have a better visual contrast with the snow-covered surface.

Confident that he was at a safe height, the pilot was preparing to slow down the helicopter's descent and speed sufficiently, with the intention of continuing his crab approach to the island, when he felt himself being flung forward. The helicopter then struck the snow-covered surface and came to rest on its left side. The pilot disconnected the battery power, climbed out of the helicopter, and helped the passenger out. He then called the family member who had come to help with the flight preparations to report the accident. After calling the Héli-Boréal maintenance manager, the family member borrowed a snowmobile and headed to the accident site. Although the pilot and passenger were not injured, they were transported to the Sept-Îles hospital as a precautionary measure.

The 406 MHz emergency locator transmitter on the aircraft activated, and the Canadian Mission Control Centre in Trenton, Ontario, received the first distress signal at 0750.

## Pilot information

The pilot held a commercial pilot licence – helicopter, an airline transport pilot licence – aeroplane, and a valid Category 1 medical certificate. His airline transport pilot licence was endorsed with a Group 1 instrument rating. He had accumulated approximately 2000 helicopter flight hours.

He was conducting the flight in accordance to the general operating and flight rules stipulated in Subpart 602 of the *Canadian Aviation Regulations* (CARs). He held the appropriate licence and ratings for the flight in accordance with existing regulations.

Héli-Boréal had operated the aircraft commercially through a lease agreement. This agreement had ended, and the aircraft needed to be ferried to a new air operator in Alberta. Although he was not an employee of Héli-Boréal, the occurrence pilot had conducted a 2.1-hour training flight on 16 March 2022 with the chief pilot to satisfy the insurer's requirements for this ferry flight. The flight training included simulations of various emergencies, such as engine failure, and winter flying techniques, such as takeoffs and landings on snow-covered surfaces. The training flight was deemed satisfactory by the chief pilot.

## Aircraft information

The occurrence aircraft was manufactured in 2006 by Eurocoptère France (now known as Airbus Helicopters) and was equipped with a Turbomeca Arriel 1D1 turbine engine (serial number 12034). According to the aircraft's journey log, the helicopter had accumulated 8300 flight hours since new. The first stage of the turbine had just been overhauled, and the 2.1-hour training flight was the only flight conducted after the helicopter was returned to service. There were no reported or recorded defects.

The helicopter was equipped with an external basket mounted on the left landing gear using clamps. Based on the aircraft configuration and the information gathered, the helicopter was within its weight and centre-of-gravity limits during the occurrence flight.

An examination of the cabin at the accident site revealed that the control valve for the windshield demister was ¾ open.

There was no indication that a system or component failure was a factor in this occurrence.

## Weather information

Before the flight, the pilot checked weather conditions on the AeroWeather[2] mobile application. Given the poor weather conditions forecast for the flight itinerary that he had originally planned, which was CHB4, Roberval Airport (CYRJ), Quebec, and Val-d'Or Airport (CYVO), Quebec, the pilot modified his flight itinerary, heading to CYQB instead via Baie-Comeau Airport (CYBC), Quebec. According to the aerodrome forecasts (TAFs) for CYBC and CYQB, no freezing precipitation was forecast for the period of the planned flight.

[2] The AeroWeather application displays only the following weather information when it is provided by airports: aerodrome routine meteorological reports (METARs) and aerodrome forecasts (TAFs). Graphic area forecasts (GFAs) are not presented.

The graphic area forecast (GFA) Clouds and Weather Chart issued at 0730 and valid at 0800 forecast the following weather conditions between Sept-Îles and Baie-Comeau:

- overcast clouds at 3000 feet above sea level (ASL);
- visibility between 2 and 4 statute miles (SM) with continuous precipitation in the form of light snow showers;
- isolated ACC (altocumulus castellanus) clouds giving a visibility of ¾ SM in light snow showers with ceilings at 800 feet AGL;
- locally, near the warm front, visibility of 4 SM with precipitation in the form of freezing rain and mist.

The GFA Icing, Turbulence and Freezing level Chart for the same period forecast the following conditions:

- moderate mixed icing between 3000 and 12 000 feet ASL;
- locally, severe clear icing between the surface and 1000 feet ASL due to freezing rain associated with a cloud layer above the freezing point between 1000 and 3000 feet ASL.

Aerodrome routine meteorological reports (METARs) for the Sept-Îles Airport (CYZV) weather station did not indicate the presence of freezing precipitation at 0700 or 0800. At 0800, the visibility reported at CYZV was 10 SM in light snow showers, with broken cloud cover at 1500 feet. The outside air temperature was −9 °C and the dew point was −10 °C. Observers who had experience in aviation indicated that light snow precipitation was present before takeoff and after the accident, with no icing conditions being perceived from the ground. The observers also indicated that visibility in Baie des Sept-Îles was approximately 3 SM.

## Accident site and wreckage examination

The helicopter struck the ground approximately 500 feet southeast of Île du Père-Conan. Other than the island, the terrain around the impact site did not provide enough visual contrast with the snow-covered surface. According to the information gathered, although the helicopter was flying over the bay, there was no indication that flat light[3] conditions were present despite the cloud cover, and the pilot did not perceive any snow being blown by the rotor wash before the impact.

The aircraft was resting on its left side, with the nose pointing east, opposite to the direction of flight. The integrity of the cockpit was not compromised; however, the outer skin of the nose was heavily damaged. The clamps holding the external basket were torn off. The belly, including the cargo hook, showed no visible signs of damage. The tail boom was torn from the fuselage and its tip, consisting of the vertical stabilizer, tail rotor, and gearbox, was severed. The 2 sections were lying near the main fuselage.

No trace of impact with the snow-covered surface was visible when TSB investigators arrived at the site the next day because winds and snow precipitation had swept and covered all tracks. However, in

[3] Flat light is "an optical illusion, also known as '**sector or partial white out**.' [emphasis in original] It is not as severe as 'white out' but the condition causes pilots to lose their depth-of-field and contrast in vision. Flat light conditions are usually accompanied by overcast skies inhibiting any visual clues. […] Flat light can completely obscure features of the terrain, creating an inability to distinguish distances and closure rates." (Federal Aviation Administration, *Aeronautical Information Manual* [19 May 2022], paragraph 7-6-14).

a photo taken by Héli-Boréal, 2 tracks approximately 120 feet long are visible in the snow (Figure 2). The direction of the tracks leading to the fuselage was 292° magnetic (M).

## De-icing aircraft on the ground before takeoff

Atmospheric conditions can cause icing on all exposed parts of an aircraft that is parked outdoors, whether it is a fixed-wing or rotary-wing aircraft.

**Figure 2. Photo taken the day of the occurrence showing tracks left in the snow by the occurrence helicopter (Source: Héli-Boréal, with TSB annotations)**


### Transport Canada guidelines

Transport Canada (TC) published the *Guidelines for Aircraft Ground Icing Operations*. "It is intended that all of those involved in Ground Icing Operations will find some information in this document that will assist them in their understanding of such operations."[4]

Although many of the principles stated in this document apply to both fixed-wing and rotary-wing aircraft, there are differences in the methods to be used for each type. One section is dedicated to issues specific to rotary-wing aircraft, and TC indicates that

> [t]he obvious and most effective method used to maintain the clean helicopter concept is to place the helicopter in a hangar whenever possible. Where operators do not have this option, other measures must be taken.[5]

The other measures suggested include using protective covers and, in consultation with the manufacturer, heating devices.[6]

TC neither approves nor qualifies de-icing or anti-icing fluids. It recognizes only the current specifications of the Society of Automotive Engineers (SAE) International,[7] which requires chemical and physical testing on the fluids in specialized laboratories.

The aircraft manufacturer determines the fluids and application methods allowed, as well as the external surfaces where the fluids can be used. For example, using de-icing or anti-icing fluids on aircraft windshields is generally prohibited.

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4 Transport Canada, TP 14052, *Guidelines for Aircraft Ground Icing Operations*, 6th Edition (August 2021), Foreword, p. 4.

5 Ibid., section 12.7.5: Experience, p. 135.

6 Ibid.

7 Standard AMS1424 applies for type I (de-icing) fluids, and standard 1428 applies for type II, III and IV (anti-icing) fluids.

### Airbus Helicopter instructions

The aircraft flight manual is generally a pilot's first reference because it states operational limitations and any other information that is important for pilots to know.

The "Instructions for Operation in Cold Weather" in the AS350 B2 flight manual supplement[8] includes procedures to be followed if the aircraft is operated in outside air temperatures of 0 °C or below and if the aircraft is exposed, or likely to be exposed, to snow showers or blowing snow, as was the case in this occurrence. The instructions do not discuss the case where a windshield is already covered in ice, nor do they mention the use of any type of de-icing fluid.

However, the *Standard Practices Manual* for the AS350 B2 and the AS350 B3, intended for maintenance personnel (and not generally available to pilots) contains 2 sections on ground de-icing.[9] In one of these sections,[10] the manual states that de-icing should be performed using a glycol-based product that meets SAE International standard AMS1424, among other standards. These sections do not mention automobile windshield washing fluid. The investigation determined that the automobile windshield washing fluid used did not meet the specifications of this standard.

### Windshield washing fluid used

The label on the jug of the windshield washing fluid used claims that it "de-ices 5 times better, with no scraping necessary, reduces ice buildup to −5 °C, and protects to −49 °C."

The material safety data sheet for the product indicates that it contains 30 to 60% methanol and 0.5 to 1.5% ethylene glycol. The other ingredients are not stated given that they are not toxic. The composition of the windshield washing fluid was not analyzed, but water would be the main component of the other ingredients.

Methanol and ethylene glycol are both used as antifreeze in winter windshield washing fluid, but they have different properties, particularly in terms of their volatility.[11] Methanol is more volatile[12] than water, while ethylene glycol is 300 times less volatile than water.[13]

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[8] Airbus Helicopters, *Flight Manual AS 350 B2 Supplement*, SUP. 4, "Instructions for Operation in Cold Weather" (12 October 2020).

[9] Airbus Helicopters, *Standard Practices Manual*, "De-icing/anti-icing protection before helicopter take-off – Safety instructions" (MTC 20-07-02-205) (13 December 2021) and "Methods applicable for de-icing and anti-icing protection – Technical instruction" (MTC 20-07-03-409) (4 February 2019).

[10] Airbus Helicopters, *Standard Practices Manual*, "De-icing/anti-icing protection before helicopter take-off – Safety instructions" (MTC 20-07-02-205) (4 February 2019).

[11] Volatility is a substance's ability to vaporize.

[12] See the complete fact sheet (in French only) for methyl alcohol prepared by the Commission des normes, de l'équité, de la santé et de la sécurité du travail (CNESST) at reptox.cnesst.gouv.qc.ca/pages/fiche-complete.aspx?no_produit=455 (last accessed 20 September 2022).

[13] See the CNESST's complete fact sheet (in French only) for ethylene glycol at reptox.cnesst.gouv.qc.ca/Pages/fiche-complete.aspx?no_produit=41103&no_seq=1&t=%C3%A9thyl%C3%A8ne%20glycol (last accessed 20 September 2022).

When ice comes into contact with windshield washing fluid, it changes to water and mixes with the windshield washing fluid. This means that when methanol evaporates quickly, its de-icing property decreases just as quickly. If the temperature of the surface on which it is used is below the freezing point, and if the surface is not completely dry, any remaining water particles will freeze up again once the methanol has evaporated.

## Safety messages

It is important for pilots to know the properties of the product they use to de-ice the windshield of an aircraft on the ground. Furthermore, if the outside temperature is below the freezing point, it is vital that pilots check to make sure that the windshield is completely dry before takeoff to avoid sudden icing after takeoff.

Pilots who land without good visual cues on a surface with little contrast may have the illusion of being higher than they actually are. The illusion may be stronger if the pilot's visibility is restricted. All pilots must ensure that they execute the final phase of landing near a good visual cue that provides enough visual contrast to reliably estimate the height at which the aircraft is flying.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 19 October 2022. It was officially released on 25 October 2022.

## ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 4 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

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