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

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A23O0028

COLLISION WITH TERRAIN

1401380 Ontario Limited (dba Wilderness North Air)
Cessna 208B Caravan, C-GMVB
Nakina Airport, Ontario, 30.8 NM NNW
28 February 2023

Canada

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Table of contents

1.0 Factual information 6
1.1 History of the flight 6
1.2 Injuries to persons 7
1.3 Damage to aircraft 7
1.4 Other damage 7
1.5 Personnel information 7
1.6 Aircraft information 8
1.6.1 Emergency locator transmitter 9
1.7 Meteorological information 10
1.7.1 Meteorological assessment 10
1.8 Aids to navigation 11
1.9 Communications 11
1.10 Aerodrome information 11
1.11 Flight recorders 11
1.12 Wreckage and impact information 12
1.13 Medical and pathological information 12
1.14 Fire 12
1.15 Survival aspects 13
1.16 Tests and research 13
1.16.1 TSB laboratory reports 13
1.17 Organizational and management information 13
1.17.1 Wilderness North Air 13
1.17.2 Cessna Grand Caravan aircraft operations 14
1.17.3 Flight operations 15
1.17.4 Training 18
1.18 Additional information 19
1.18.1 Pilot decision making 19
1.18.2 Group decision making 20
1.18.3 Spatial disorientation 20
1.18.4 TSB Air transportation safety issue investigation 22

2.0 Analysis 24
2.1 Day visual flight rules operations 24
2.2 Management oversight and acceptance of unsafe practices 25
2.3 Group dynamics 26
2.4 Instrument flying training requirements for air-taxi operators 26
2.5 Cargo restraint 27
2.6 Emergency locator transmitter 27

3.0 Findings 29
3.1 Findings as to causes and contributing factors 29

3.2 Findings as to risk 29

4.0 Safety action 30

4.1 Safety action taken 30

4.1.1 Wilderness North Air 30

Appendices 31

Appendix A – Graphic area forecast - Clouds and Weather Chart GFACN33 issued at 1226 Eastern Standard Time on 28 February 2023 31

Appendix B – Graphic area forecast - Icing, Turbulence, and Freezing Level Chart GFACN33 issued at 1229 Eastern Standard Time on 28 February 2023 32

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Summary

On 28 February 2023, at approximately 1245 Eastern Standard Time, the Cessna 208B Caravan aircraft (registration C-GMVB, serial number 208B0317), operated by 1401380 Ontario Limited, doing business as Wilderness North Air, departed Nakina Airport (CYQN), Ontario, for a daytime visual flight rules flight to Fort Hope Airport (CYFH), Ontario, with 2 pilots on board.

At approximately 1445 Eastern Standard Time, the operator determined that the aircraft was overdue, as it had neither arrived at CYFH nor returned to CYQN and had not been heard from since shortly after departure. The operator reported the missing aircraft to the Joint Rescue Coordination Centre, which initiated an airborne search that continued until 04 March 2023 when the aircraft wreckage was found approximately 30.8 nautical miles north-northwest of CYQN.

Both pilots were fatally injured. The aircraft was destroyed. There was no post-crash fire. There was no emergency locator transmitter on board because it had been removed for recertification.

1.0 FACTUAL INFORMATION

1.1 History of the flight

On 28 February 2023, the Cessna 208B Caravan (208B) aircraft (registration C-GMVB) operated by 1401380 Ontario Limited, doing business as Wilderness North Air (WNA), was scheduled for 2 cargo flights from Nakina Airport (CYQN), Ontario, to Fort Hope Airport (CYFH), Ontario.

The occurrence pilot, who had recently been promoted to pilot-in-command (PIC) on the 208B aircraft, was scheduled to fly alone in daytime visual flight rules (VFR) conditions. After reviewing the weather information with his colleagues at their morning briefing, he assessed that the weather was satisfactory for the flight and noted that the winds were forecast to be gusty. A pilot who was present at the briefing but was not scheduled for flight duty that day offered to accompany him. For all flights that day, the occurrence pilot would be the PIC and occupy the left seat, and the 2nd pilot went along as an extra crew member without any assigned duties, occupying the right seat.

The cargo was loaded onto the aircraft, and the 1st flight of the day departed CYQN at 1020[1] and landed in CYFH at 1055. After unloading the cargo, they departed CYFH at 1120 and returned to CYQN at 1156.

The pilots loaded the aircraft with cargo for their 2nd flight to CYFH. According to the load sheet, there were 3320 pounds of groceries and household goods on board. The pilots refuelled the aircraft and departed from Runway 27 at approximately 1245. A few minutes after departure, it was reported that they made a radio call on the aerodrome traffic frequency, indicating their location and an estimated time of arrival at CYFH of 1330.

Approximately 30 minutes after the occurrence flight departed, a 2nd 208B aircraft (registration C-FUYC) operated by WNA departed also from CYQN to CYFH, with cargo for a different customer. The flight crew encountered snow showers en route, and shortly after they arrived at CYFH at 1400, there was a snow squall, which significantly reduced visibility. At that time, 2 customers were waiting at CYFH for their cargo, and it soon became apparent that the occurrence aircraft had not yet arrived. At approximately 1430, WNA personnel at CYQN were informed that the occurrence aircraft had not arrived at 1330 as expected. At 1445, management at WNA notified the Joint Rescue Coordination Centre (JRCC), in Trenton, Ontario, that the aircraft was overdue. WNA began its own aerial search along the flight path using C-FUYC, which departed CYFH at 1510 with 2 crew members on board, flew along the direct route of flight of the missing aircraft, and returned to CYQN at 1546. They refuelled the aircraft and departed on another search flight at 1620, with 2 additional pilots in the back to act as spotters. They searched along the route of flight until 1840 and returned to CYQN. JRCC had initiated its response at 1500, and the first tasked aircraft arrived in the search area at 1700.

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[1] All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

The search continued over the following 4 days. The occurrence aircraft was found on 04 March 2023, 30.8 nautical miles north-northwest of CYQN along the direct track to CYFH. Both pilots were fatally injured. The aircraft was destroyed by impact forces. There was no post-crash fire. There was no emergency locator transmitter (ELT) on the occurrence aircraft because it had been removed for recertification.

1.2 Injuries to persons

Two pilots were on board. Table 1 outlines the degree of injuries received.

Table 1. Injuries to persons

Degree of injury	Crew	Passengers	Persons not on board the aircraft	Total by injury
Fatal	2	–	–	2
Serious	0	–	–	0
Minor	0	–	–	0
Total injured	2	–	–	2

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

The aircraft impacted terrain in a forested area; several trees were felled or scarred during the impact sequence. Based on the fuel load recorded on the flight sheet, it is estimated that as much as 380 L of jet fuel spilled at the occurrence site.

1.5 Personnel information

The PIC began working at WNA on 21 February 2022 as a ramp worker, with the understanding that he would move into a pilot position when such a position became available. As a ramp worker, he had the opportunity to ride along on the 208B as an extra crew member. He began his 208B ground training on 04 April 2022. WNA normally had its new pilots complete ground school early in their employment so that they would have an understanding of the aircraft and its systems when they had a chance to ride along. The PIC did not begin his 208B flight training until 19 December 2022. He completed a pilot competency check (PCC) on 03 January 2023 and began his line indoctrination the following day. He accumulated 89.7 hours of line indoctrination flight time from 04 January 2023 to 14 February 2023, and a company training captain signed his line indoctrination form on 18 February, allowing him to operate the 208B aircraft for WNA as the sole flight crew member of the aircraft. The day of the occurrence was scheduled to be his 4th day operating the aircraft without a training captain in the right seat.

The 2nd pilot was an experienced pilot within the company who had recently been promoted to a base manager role. He was not scheduled to be on flight duty on the day of the occurrence. According to WNA, his status during the occurrence flight was that of an extra crew member rather than second-in-command or training captain. He was an experienced 208B captain at WNA, although nearly all his recent flight time had been on the Air Tractor AT-802 aircraft, which he had begun flying in April 2020. Although he had not been flying the 208B regularly, he had completed 208B recurrent training between 07 January 2023 and 27 January 2023, and his PCC on 23 February 2023.

Both pilots were certified and qualified for the flight in accordance with existing regulations. The PIC did not hold an instrument rating. The 2nd pilot had an instrument rating, but he did not meet the recency requirements.

The PIC was the sole required crew member on the occurrence flight.

Table 2. Personnel information

	Captain	Other crew
Pilot licence	Commercial pilot licence (CPL)	Commercial pilot licence (CPL)
Medical expiry date	01 August 2023	01 July 2023
Total flying hours	325*	2570*
Flight hours on type	103.6	662*
Flight hours in the 24 hours before the occurrence	1.4	0
Flight hours in the 7 days before the occurrence	1.4	8
Flight hours in the 30 days before the occurrence	51	34.5
Flight hours in the 90 days before the occurrence	103.6	113
Flight hours on type in the 90 days before the occurrence	103.6	31
Hours on duty before the occurrence	6	6
Hours off duty before the work period	14	19

*Approximate times

1.6 Aircraft information

Table 3. Aircraft information

Manufacturer	Cessna Aircraft Company*
Type, model, and registration	208B Grand Caravan, C-GMVB
Year of manufacture	1992
Serial number	208B0317
Certificate of airworthiness issue date	04 December 1992
Total airframe time	28 262.6 hours
Engine type (number of engines)	Pratt & Whitney Canada PT6A-114A (1)
Propeller (number of propellers)	McCauley 3GFR34C703/106GA-0 (1)
Maximum allowable take-off weight	4110.45 kg
Recommended fuel types	Jet A, Jet A-1, Jet B

Fuel type used	Jet A

* The current type certificate holder is Textron Aviation Inc.

The 208B aircraft is a high-wing, fixed-landing-gear aircraft equipped with a turboprop engine. The aircraft type is equipped for day VFR operations but can also be equipped for night and instrument flight rules (IFR) operations, and flights into known icing conditions.

The occurrence aircraft was manufactured in 1992 and was originally equipped for night and IFR operations. Although only a single pilot is required to fly the 208B aircraft, the aircraft was equipped with a full set of flight instruments and a set of controls in front of each of the pilot seats; the pilot would normally be seated in the left seat. Only the left side instruments are required for day VFR operations; however, records indicate that WNA made efforts to maintain all installed instrumentation when issues with non-required instruments were observed and reported.

The aircraft was also equipped with a cargo pod and had been modified to increase the maximum allowable take-off weight to 9062 pounds.

According to the aircraft load sheet completed by the pilot for the occurrence flight, the aircraft was loaded to its gross weight of 9062 pounds and the centre of gravity was within the allowable limits.

Records indicate that there were no outstanding defects with the aircraft at the time of the occurrence. There was no indication that a component or system malfunction played a role in this occurrence.

The approved maintenance schedule required inspections at 100-hour intervals. The most recent inspection on the aircraft had been completed on 10 January 2023. On the morning of the occurrence, the aircraft had flown 56.9 hours since this inspection had been completed. There were 21.5 hours remaining until the next scheduled maintenance, which was an engine overhaul.

1.6.1 Emergency locator transmitter

The ELT had been removed from the occurrence aircraft for recertification on 08 February 2023. ELT recertification is a maintenance task that must be completed every 12 or 24 months depending on the type of ELT.

According to regulations, the ELT may be removed for service for up to 30 days in order to complete this task.[2]

[2] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, paragraph 605.39(2)(b).

1.7 Meteorological information

The nearest weather reporting station to CYQN is at Geraldton (Greenstone Regional) Airport (CYGQ), Ontario, which is 26 nautical miles south-southwest of CYQN. According to the aerodrome routine meteorological report from 1200, conditions were as follows:

- Winds 290° true (T) at 8 knots, with gusts up to 15 knots
- Winds variable between 250°T and 320°T
- Visibility of 5 statute miles (SM)
- Light snow
- Cloud information missing (although an aerodrome special meteorological report 2 minutes later indicates an overcast ceiling at 2200 feet above ground level [AGL])
- Temperature: −5.2 °C
- Dew point: −8.6 °C
- Altimeter setting: 29.50 inches of mercury

During the following hour, several special meteorological reports were issued, with visibilities fluctuating between 5 and 9 SM in light snow, and ceilings as low as 2200 feet AGL.

The Clouds and Weather Chart of the graphic area forecast (GFA) for the area, issued at 1226 and valid at 1300, indicates a possibility of isolated towering cumulus, with associated visibilities of 3 SM in light snow showers, and ceilings of 1500 feet AGL (Appendix A). The Icing, Turbulence, and Freezing Level Chart of the GFA for the same period of validity suggests that there was little chance of icing along the occurrence flight path, with an area of moderate mixed icing between 3000 and 8000 feet above sea level to the east (Appendix B).

1.7.1 Meteorological assessment

The TSB requested that Environment and Climate Change Canada perform a complete meteorological assessment[3] of the prevailing meteorological conditions on the day of the occurrence in the vicinity of the occurrence route of flight and accident site. The assessment included the following information:

- Moderate westerly winds gusting 25-30 knots, indicative of moderate mechanical turbulence, likely up to 4000 feet above sea level.
- Above 1500 feet AGL, likely a layer of broken cumulus, with average ceilings of 2500-3000 feet AGL and tops of 5000 feet AGL. Light to moderate mixed icing would be present in these clouds.
- Towering cumulus clouds with tops likely reaching 5500-7000 feet AGL embedded in the cumulus layer. Data from nearby stations surrounding the planned flight path indicated visibility as low as 5/8 SM, and more broadly 2 SM due to snow flurries.

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3 Environment and Climate Change Canada, *Meteorological Assessment 28 February 2023 Nakina, Ontario* (05 May 2023).

Snow flurries can reduce vertical visibility to 1200 feet or less, making the ceiling as low as 1200 feet AGL.

- If pilots were to enter the embedded towering cumulus clouds, they would likely encounter moderate mixed icing between 2100 feet AGL and 7000 feet AGL, with increased turbulence due to downdrafts and updrafts.

The meteorological conditions encountered by the occurrence pilots could not be determined.

1.8 Aids to navigation

The aircraft was equipped with a Garmin GNX650 GPS (global positioning system), which was the primary means of navigation for flight crews. In addition, flight crews used a tablet-based application that could be used for pre-flight planning and weather retrieval, as well as to display charts and aircraft position during en-route navigation.

1.9 Communications

Pilots flying this route typically used CYQN's aerodrome traffic frequency 122.8 MHz to broadcast their positions and intentions in the vicinity of CYQN, and 126.7 MHz while en route for position reporting and traffic awareness.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, nor was either required by regulation.

While not required by regulations, each aircraft operated by WNA is assigned a portable GPS tracking device that is to be used for every flight to allow for the monitoring of each flight's progress. The devices are configured to log GPS position internally every minute and transmit position data at 2-minute intervals via satellite to an internet-based utility.

Before the occurrence, the device assigned to the occurrence aircraft had been working normally. On the day of the occurrence, the device was neither logging nor automatically transmitting position information. The pilot did use the device to successfully send a text message upon arrival at CYFH after the 1st flight, which indicates that it likely appeared to be functional to the pilot. The message was accompanied with position information, indicating that the device was capable of calculating position and sending data.

The device was recovered from the accident site and examined at the TSB Engineering Laboratory in Ottawa, Ontario. It had been damaged by impact forces, and even though it

could be powered on, it was not fully functional. It could not be determined why position information was not being logged or sent automatically that day.

WNA did not have a policy or procedure in place requiring that these devices be tested or verified to be operational before each flight.

1.12 Wreckage and impact information

The wreckage path was oriented on a heading of approximately 350° magnetic and was approximately 170 feet in length from the point of the initial ground impact to the farthest extent of the wreckage. Debris consisting of fragments of the fuselage and cargo was spread along the path in a fan shape from the point of initial ground impact, widening to about 50 feet on either side of the final aircraft trajectory.

Notable damage to 3 trees south of the impact site aided in confirming the flight path and attitude of the aircraft in the moments before ground impact. It was determined that the aircraft was flying with the right wing low and at an angle of descent of approximately 22° immediately before impact. The wreckage and cargo were severely fragmented, indicating a high-speed impact.

Most of the right wing, aft fuselage, and left wing were found at or just beyond the point of the initial ground impact, whereas the cockpit and engine were found at the farthest extent of the accident site, approximately 170 feet from the point of the initial ground impact. Several trees were knocked down by the forward section of the aircraft before it came to rest.

There were no indications of pre-impact structural or mechanical failure observed at the accident site.

The engine was subsequently sent to the TSB laboratory for an engine teardown inspection. No mechanical issues that would have precluded normal operations were found. The propeller was sent to the manufacturer for further examination, which revealed that, based on the damage to the propeller hub, the propeller blades were at an angle corresponding with normal operations at the time of impact.

1.13 Medical and pathological information

According to information gathered during the investigation, there was no indication that the pilot's performance was affected by medical or pathological factors.

1.14 Fire

Although there were initial reports of a post-crash fire, there were no signs of fire damage or combustion on any part of the wreckage, and no fire-damaged cargo items were found at the crash site.

1.15 Survival aspects

The aircraft was found 4 days after it had gone missing; it was spotted by an observer on a Civil Air Search and Rescue Association aircraft that was participating in the search coordinated by the JRCC. Search and rescue technicians were lowered to the ground from a helicopter to verify that this was the accident site, and to determine whether a rescue could be performed.

The search and rescue technicians found the pilots in their seats with their lap and shoulder harnesses attached, although the seats were no longer attached to any supporting structure.

Given the magnitude of the impact forces, this accident was not survivable.

1.16 Tests and research

1.16.1 TSB laboratory reports

The TSB completed the following laboratory report(s) in support of this investigation:

- LP039/2023 – NVM Recovery – Various
- LP053/2023 – Annunciator Panel Analysis
- LP131/2023 – Engine Teardown and Propeller Hub Examination Report Review

1.17 Organizational and management information

1.17.1 Wilderness North Air

WNA is based in Thunder Bay, Ontario. It was established in June 2001 as a float plane operation with 2 float-equipped aircraft to service their remote fly-in properties. Over the years, other aircraft were added to the fleet as the company expanded its operations. At the time of the occurrence, the WNA fleet consisted of 7 aircraft: 3 Cessna Grand Caravan (208B), 2 Air Tractor (AT-802), 1 de Havilland Otter (DHC-3), and 1 de Havilland Beaver (DHC-2 Mk. I).

WNA is approved by Transport Canada (TC) to operate under Subpart 703 (Air Taxi Operations) of the *Canadian Aviation Regulations* (CARs). This approval is limited to day VFR operations, except for the company's AT-802 aircraft, which are also permitted to fly night VFR.

WNA conducts 3 distinct types of flight operations, all of which are covered by a single air operator certificate, but each with its own set of operating procedures:

1. Float- and ski-plane service, using the de Havilland Otter and Beaver aircraft, in operation for over 30 years
2. Aerial fuel tanker operation, using modified AT-802 aircraft, beginning in 2008
3. CYQN-based cargo and passenger operation, using the 208B aircraft, beginning in 2019

At the time of the occurrence, WNA employed 12 full-time pilots, of which 6 were assigned to the Nakina base.

1.17.2 Cessna Grand Caravan aircraft operations

WNA acquired the 3 CYQN-based 208Bs in March 2019, adding them to its air operator certificate. Those aircraft had been based in CYQN with their previous operator; the customer base and flight routes remained largely unchanged following WNA's acquisition of the 208B aircraft.

WNA continued the service that had been established by the previous operator and began to use the name ZAM for its CYQN operations. This service includes flying freight and offering passenger service to several remote communities in the area, primarily Eabametoong First Nation (Fort Hope, Ontario), Neskantaga First Nation (Lansdowne House, Ontario), Marten Falls First Nation (Ogoki Post, Ontario), and Webequie First Nation.

The 208B pilots regularly fly the same routes multiple times per day to a limited number of destinations and are familiar with their area of operations.

Eight full-time pilots are assigned to the 208B operations. It has been the policy of WNA to recruit pilots for the 208B operations directly from a professional pilot program, from which they receive their *Commercial Pilot Licence – Aeroplane* with at least 200 hours of flight experience. Although some of the pilots do possess an instrument rating, it is not a requirement for pilots at WNA.

1.17.2.1 Management oversight

WNA's management team comprises the operations manager (OM), who is responsible for the supervision of flight operations, and the chief pilot (CP), who reports to the OM and is responsible for the supervision of flight crews. The OM and CP also have regular flying duties, primarily in the summer months.

Since the TC-required management personnel are based at the company office in Thunder Bay, which is approximately 330 km by road from Nakina, day-to-day operations at CYQN were managed remotely. The OM and the CP were accessible throughout the day via a flight operations text messaging group visible to all pilots and company personnel, as well as via telephone or email.

A review of the archived text group communications by investigators indicated that the OM and CP (management) had a daily presence in the group chat and were consistently in communication with the pilot group at CYQN.

1.17.2.1.1 On-site supervision

When WNA acquired the 208B aircraft, it also offered continued employment to 2 pilots who had been working for the previous operator. It was determined by management that it would be useful to appoint one of these pilots, who had considerable experience with the operation, as WNA's 1st base manager so as to provide daily on-site supervision for the pilot group. Along with flying duties, he was involved with training, monitoring, and mentoring a

group of less experienced pilots, with some of these functions being shared with other company-designated training pilots.

Before the retirement of its 1st base manager in late 2021, WNA hired a part-time replacement, a pilot who also had significant experience with the previous operator of the 208Bs and whose primary role at WNA was to assist with the training of new pilots.

In early February 2023, WNA replaced the part-time base manager and promoted 2 of its full-time Nakina-based pilots to the position. These pilots would work opposing schedules to ensure that one of them was always present for day-to-day operations. At the same time, in addition to the 2 base managers, the company promoted another Nakina-based pilot to the role of assistant CP.

Neither the assistant CP or base manager role is required by TC for CARs Subpart 703 operators, nor are they part of the management structure at WNA. In addition, neither role has any defined responsibilities in WNA's COM or any other company document.

1.17.3 Flight operations

1.17.3.1 Operational control

As an air taxi operator, WNA is required under section 723.16 of *Commercial Air Service Standard* 723[4] to use a Type D operational control system where authority over the formulation, execution, and amendment of an operational flight plan in respect of a flight is delegated, by the company operations manager, to the PIC. Therefore, flights are self-dispatched and released by the PIC.

There were no indications of operational pressure to complete flights in weather conditions below the operator's approved minima.

1.17.3.2 Weather briefings

Before flight operations begin each day, the pilots on duty at CYQN meet to review the weather forecasts for the day. WNA expects that each pilot assigned PIC duties conduct their own independent weather review before this meeting. One of the pilots will indicate to management through the text messaging group whether they have assessed the weather as suitable, and if so, when they plan to begin flight operations for the day. On any given day, there could be up to 3 208B aircraft scheduled to fly, with up to 6 pilots with varying levels of seniority being part of the decision-making process. According to both the WNA's COM[5] and the regulations,[6] each PIC is ultimately responsible for their own decision to fly (go/no-go decision).

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4 Transport Canada, *Commercial Air Service Standards*, Standard 723: Air Taxi – Aeroplanes, section 723.16.

5 Wilderness North Air, *Operations Manual*, Amendment 9, November 2020, section 3.1.2: Flight Authorization/Release, p. 3.1.

6 Transport Canada, *Commercial Air Service Standards*, Standard 723: Air Taxi – Aeroplanes, section 723.16.

When evaluating the weather before flight, WNA pilots reported using aerodrome routine meteorological reports and aerodrome forecasts (TAFs) from CYGQ (the closest weather station) in conjunction with the GFA. They had also recently begun to use an icing forecast produced daily by the National Weather Service of the United States to evaluate the risks of in-flight icing.

Although many of the destination airports did not provide weather reporting services, there were weather cameras available at many of them, allowing pilots to evaluate the conditions at those airports before their departure.

1.17.3.3 Cruising altitudes

Pilots reported that, because of the gross weight climb performance of the 208B aircraft, they often chose to fly at approximately 2000 feet mean sea level (MSL), or approximately 1000 feet AGL, when flying at maximum gross weight.

When returning empty to CYQN, they were encouraged to fly at least as high as 5500 feet MSL to record engine parameters for maintenance tracking purposes when the weather allowed. A review of past flights showed that they would sometimes fly as high as 10 000 feet MSL during empty legs to CYQN.

1.17.3.4 Visual flight rules operating minima

The VFR operating minima listed below apply to VFR operation in uncontrolled airspace, which is the type of airspace covering the primary area of operations for WNA's 208B fleet.

Table 4. Summary of the day visual flight rules minima in uncontrolled airspace stipulated in section 602.115 of the *Canadian Aviation Regulations*

Aircraft operating altitude	Minimum flight visibility (SM)	Vertical clearance from cloud	Horizontal clearance from cloud
1000 feet AGL or above	1	500 feet	2000 feet
Less than 1000 feet AGL	2	Clear of cloud	Clear of cloud

If the VFR flight criteria are no longer present during flight, the aircraft has entered instrument meteorological conditions (IMC).

The hazards associated with continuing VFR flight into IMC are well documented. Accidents involving flights that depart under visual meteorological conditions and continue to a point where pilots lose visual reference with the horizon have a high incidence of fatalities. According to data collected by the TSB, these types of flights have resulted in 122 accidents and 137 fatalities in Canada from 1999 to 2023.

1.17.3.4.1 Visual flight rules over-the-top

WNA's COM includes a section on VFR over-the-top (VFR OTT),[7] which is a procedure that allows pilots to plan for the en-route portion of a flight to be conducted above cloud ceilings provided that forecast weather conditions permit.

WNA's 208B aircraft are not approved to use VFR OTT, although the investigation revealed several instances during the winter season of 2022-2023 where WNA's pilots flew above cloud ceilings and indicated to others, via the group chat, that flying over-the-top would be a way to reach their planned destination.

1.17.3.5 Archived flight data

The investigation gained access to the historical flight information provided by the onboard GPS tracking system that was in use at WNA on all their aircraft. The information available for each flight included date, time, speed, course, elevation, and latitude/longitude, recorded at 2-minute intervals. The flight data was compared with archived weather information, and it was noted that the flight routes were almost always flown directly, even during weather conditions that likely would not permit direct routing while maintaining VFR. This indicated that lateral weather deviations were likely not being used as a strategy to remain VFR. However, the data also indicated several instances where a pilot returned to base after encountering unfavourable weather conditions.

1.17.3.6 Extra crew

WNA allows employees to fly as crew, either to assist with unloading cargo at the destination or in a mentoring capacity, as was the case during the occurrence flight. It could not be determined how often pilots requested another pilot to accompany them for mentoring purposes, although there was no evidence that this regularly happened.

The presence of a mentor or senior captain as a crew member can influence a pilot's decision-making process and cockpit dynamics, particularly in situations that require risk assessment.[8] While mentorship is beneficial for skill development, its integration in flights, especially under challenging conditions, must be managed well to ensure it positively reinforces flight safety practices.

1.17.3.7 Cargo placement

Most of the cargo that WNA transports consists of grocery items and household goods in the manufacturer's retail packaging, which results in packages of varying size, shape, and weight. WNA's COM requires that equipment and cargo are "[r]estrained so as to prevent

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7 Wilderness North Air, *Operations Manual*, Amendment 8, November 2019, section 4.3.4: VFR Over The Top, p. 4.5.

8 E.F. Fabre *et al.*, "Hierarchy in the cockpit: How captains influence the decision-making of young and inexperienced first officers," in *Safety Science*, Vol. 146 (2022).

them from shifting during movement of the aircraft on the surface and during take-off, landing and in-flight turbulence."[9]

It was reported that pilots would pack items in such a way that they cannot move around laterally while in flight, and they would also attempt to pack the cargo to a uniform height to prevent items from sliding. Each aircraft is normally loaded to its maximum allowable weight.

Generally, the only physical method of cargo containment in use at the time of the occurrence in WNA's 208B aircraft was a bulkhead and cargo net located immediately behind the pilot seats, separating the pilots from the cargo area. No cargo nets were used to secure the cargo from moving either laterally or vertically. Tie downs were only used when bulky cargo, such as all-terrain vehicles, snowmobiles, or large appliances, was transported.

1.17.4 Training

1.17.4.1 Competency check and instrument training

When operating under CARs Subpart 703, crew members licensed for single-engine day VFR flights are required to hold a valid PCC for the type of aircraft being operated.

Initial training for single-engine air-taxi operations under day VFR requires 6 hours of ground training and 3 hours of aircraft flight training. Recurrent training requires 3 hours of ground training and 1 hour of flight training.

Training and testing toward a PCC includes normal and abnormal flight situations.

WNA training does not include any basic instrument flight proficiency training, instrument flight procedures training, or training on escape manoeuvres in the event of a loss of visual reference, nor is any of this training required under the regulations.

1.17.4.2 Line indoctrination

Given that most pilots begin at WNA with minimal flight experience, WNA management structured its pilot development around an introduction to the operation while working in a non-flying role followed by a lengthy period of line indoctrination that often exceeds 100 hours of flight time although the COM requires only 5 hours.[10] Management's intention is to allow pilots to develop their decision-making and flying skills while under the supervision of a training captain. Line indoctrination begins after the pilot has completed their PCC and continues until a training captain deems the pilot ready to operate the aircraft without a training captain in the right seat.

The investigation did not find any evidence of management pressure on candidates or training captains to complete a line indoctrination on a certain schedule, or any indication

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9 Ibid., section 4.8: Placement and securing of cargo/carry-on baggage, p. 4.29.

10 Wilderness North Air, *Operations Manual*, Amendment 8, November 2019, section 6.6.19: Line Indoctrination, p. 6.17.

that pilots who exceeded a certain number of hours of line indoctrination were subject to any negative consequences such as discipline or termination.

1.18 Additional information

1.18.1 Pilot decision making

Pilot decision making (PDM) is a cognitive process used to select a course of action between alternatives. Several factors, circumstances, and biases can affect PDM, including the flight objective or goal, and the pilot's knowledge, experience, and training.[11] These factors can lead to situations where pilots might prioritize the achievement of the goal over the management of threats, likely resulting in a reduced safety margin.

Managing threats requires risk awareness, evaluation, and mitigation, with safety as the primary motivation. This approach requires discipline and discretion on the part of the crew members because it may conflict with the goal of completing a flight.

Conversely, a focus on achieving a goal or outcome may lead to a reduced sensitivity to risk, especially when high-risk activities repeatedly result in no negative outcomes. Flight crew members may grow accustomed to these risks, altering their perception and acceptance of such risks over time.[12] Without mitigations in place to recalibrate risk perception, the subjective evaluation of low personal risk may lead to increases in high-risk practices.[13]

In an organizational context, if these riskier practices repeatedly lead to successful outcomes without immediate negative repercussions, they can gradually become embedded in the organizational culture. When these practices continue with no negative outcomes, and often yield positive outcomes, such as a successful flight or satisfied customers, they may be perceived as rational and eventually become the norm. This shift in norms and values within the organization necessitates robust countermeasures to maintain safety standards, such as continuous training, independent supervision, and effective risk controls.

WNA recognizes that many flights have an element of risk because the weather in its area of operations can be highly variable, and the available weather forecast products are limited. As a result, weather threats are not avoided but instead assessed through a group decision-making process to determine whether the flights can be safely achieved.

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11 M. R. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems," in *Human Factors*, Vol. 37, No. 1 (1995), pp. 32–64.

12 J. Hollenbeck, D. Ilgen, J. Phillips, J. Hedlund "Decision risk in dynamic two-stage contexts: beyond the status quo," in *Journal of Applied Psychology*, Vol. 79, Issue 4 (1994), pp. 592–598.

13 G. J. S. Wilde, "Homeostasis drives behavioural adaptation," in *Behavioural Adaptation and Road Safety: Theory, Evidence and Action* (2013), Chapter 5, pp. 61–86.

1.18.2 Group decision making

Group decision making is a process where 2 or more people work together to make a decision, enabling better access to information and a greater capacity to process this information. Group decision making is most effective when it draws on a variety of perspectives and adheres to objective hazard and risk assessments.

Group decision making is a more complex process than individual decision making. In a workplace setting, the dynamics of groups can be affected by many variables, such as availability of operationally relevant information, previous experience, commercial needs of a company and social expectations.

Group dynamics may result in the following:[14,15]

- Conformity, if there is an imbalance between experience or seniority, where an individual gradually changes their view to make it more in line with the group norm.
- Compliance, when an individual takes more risk than they wish to, at the request of an individual or group, if that group or individual has previously requested something even riskier.
- Groupthink, when the motivation to maintain group consensus overrides the motivation to evaluate all potential courses of action. Once groupthink develops, individuals can start to view their group as invulnerable, and they engage in collective rationalization, disregarding any views counter to the group.

Group decision making can be enhanced when it has access to reliable information, such as local weather, and employs objective criteria, such as altitude or visibility limitations, to assess potential risks.

Once in flight, decisions on the continued feasibility of flights are also often made as a group. This involves sharing information about current or completed routes, including visibility, cloud presence, and emergence of low-cloud areas. This shared information can shape or reinforce a pilot's expectations and mental model of the route, leading them to focus on specific visual cues, like clear skies after cloud, while potentially overlooking other important cues, such as terrain avoidance.

1.18.3 Spatial disorientation

Humans have the ability to discern the orientation of their body (lying down, standing, leaning, etc.) when they are in physical contact with the ground. Humans are not accustomed to the 3-dimensional environment of flight, and sensory conflicts may arise, thus making it difficult or impossible to maintain spatial orientation. Pilot spatial

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14 R. D. Campbell and M. Bagshaw, *Human Performance and limitations in aviation*, 3rd edition (1991), pp. 138–140.

15 R. A. Baron and D. Byrne, *Social Psychology: Understanding Human Interaction*, 6th edition (1991), pp. 462–463.

disorientation is defined as the "inability of a pilot to correctly interpret aircraft attitude, altitude or airspeed in relation to the Earth or other points of reference."[16]

Humans process information from 3 sensory systems to orient themselves in space:

- the visual system,
- the vestibular system (information from the inner ear), and
- the proprioceptive system (information from muscles, joints, and bones).[17]

The visual system provides 80% of the information used for spatial orientation. If visual information is lost, all that remains is the 20% of information that comes from the vestibular and proprioceptive systems. The information from these 2 systems is less precise and more susceptible to error because they are prone to illusions and misinterpretation.[18]

The *Transport Canada Aeronautical Information Manual* (TC AIM) describes the potential for disorientation. It refers to vision as our strongest orienting sense and stresses that when in whiteout or cloud, this sense is not available, which increases the likelihood of disorientation. It provides the following example:

> [O]nce a turn has been entered and is being maintained at a steady rate, the sensation of turning will disappear. Upon recovering from the turn, pilots may feel as though they are turning in the opposite direction and erroneously re-enter the turn, even causing the aircraft to enter into a spin.[19]

While the conditions mentioned are whiteout and cloud, a similar lack of external visual cues and resultant disorientation can occur in darkness. Spatial disorientation can lead to loss of control of the aircraft or controlled flight into terrain.[20]

To avoid a loss of control, pilots must be familiar with the mechanisms that lead to spatial disorientation, be aware of the potential for disorientation when visibility and ground references are reduced, and understand how to handle such a situation.[21] When visual cues

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16 Australian Transport Safety Bureau, ATSB Transport Safety Investigation Report – Aviation Research and Analysis Report – B2007/0063*, An overview of spatial disorientation as a factor in aviation accidents and incidents* (Canberra City, Australia, 2007), p. vii, at atsb.gov.au/sites/default/files/media/29971/b20070063.pdf (last accessed 12 April 2024).

17 Ibid., p. 4, at atsb.gov.au/sites/default/files/media/29971/b20070063.pdf (last accessed 12 April 2024).

18 Ibid.

19 Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* (TC AIM), AIR – Airmanship (060 October 2022), section 3.7: Disorientation.

20 Australian Transport Safety Bureau, ATSB Transport Safety Investigation Report – Aviation Research and Analysis Report – B2007/0063, *An overview of spatial disorientation as a factor in aviation accidents and incidents* (Canberra City, Australia, 2007), at atsb.gov.au/sites/default/files/media/29971/b20070063.pdf (last accessed 12 April 2024).

21 Ibid.

from the ground are poor or non-existent, spatial disorientation can be overcome by switching to instrument flight.[22]

1.18.4 TSB Air transportation safety issue investigation

1.18.4.1 Accident data

In November 2019, the TSB released the report on its safety issue investigation (SII)[23] into the air-taxi sector. One section of the SII report examines accident types within the air-taxi sector, using data from 167 TSB investigation reports published between 2000 and 2014. Three accident types detailed are potentially relevant to this occurrence. These accident types, along with the related data, are listed in Table 5.

Table 5. Airplane accident types with common accident characteristics, pilots' average total flight time, and hazards and risk factors relevant to this occurrence and selected from all air-taxi sector accidents detailed in TSB Air Transportation Safety Issue Investigation Report A15H0001

Accident type	Characteristics of flights commonly associated with this type of accident	Pilot-in-command average total flight time	Hazards and risk factors most commonly included as findings in published TSB investigation reports
VFR+ loss of visual reference + CFIT No. of accidents: 11	• Weather was forecasted to deteriorate • Flight departed in visual meteorological conditions (VMC) • Darkness, cloud, or precipitation in flight (some flights over water or near mountains) • Lost visual reference to surface, resulting in CFIT	6219 hours	• IMC were encountered • Flying in low-visibility conditions • Departed with weather forecasted to deteriorate, with plan to evaluate en route • Black-hole illusion
VFR + loss of visual reference + loss of control No. of accidents: 6	• Flight departed in VMC • Encountered dark/cloud/precipitation in flight • Lost visual reference with the ground • Lost control in flight • Collided with the ground or water	4170 hours	• Marginal VFR into IMC encountered en route • Lack of instrument flying experience (cited as a causal and contributing factor despite 4 of 6 of the pilots involved holding an instrument rating)
Icing No. of accidents: 5	• Icing forecasted • Single-pilot passenger-carrying flight • Encountered icing in flight • Unable to maintain altitude	2920 hours	• Continued flight into forecasted icing • Marginal weather operations

22 Ibid.

23 TSB Air Transportation Safety Issue Investigation Report A15H0001.

			• Aircraft not certified for flight into known icing conditions • Aerodynamic stall • Operational control self-dispatch

As described in the SII report, "the TSB has investigated many accidents in which flight has been attempted or continued in unsuitable weather conditions. The investigations provide examples of how previous experience of pushing the limits leads to unsafe practices and how these practices can continue if operators tacitly accept them."[24]

1.18.4.2 Weather information

The SII report includes a discussion on the availability of weather information to operators in remote areas. Many air-taxi operators, including WNA, operate in areas where there are minimal weather reporting services, leaving pilots to rely on area forecasts, pilot reports, and weather cameras at destination airports that are so equipped.

Operators who were surveyed as part of the SII indicated that better weather reporting and education of crews and customers on decision making and the risks of flight in adverse weather would help mitigate the risks of flight in these remote areas.

[24] Ibid., section 4.2.10.3.1.

2.0 ANALYSIS

The pilot held the appropriate licence and ratings for the visual flight rules (VFR) flight, as did the accompanying pilot. There was no indication that either pilot's performance was affected by fatigue or medical factors.

Records indicate that there were no outstanding defects with the aircraft at the time of the occurrence. An examination of the aircraft wreckage did not reveal any pre-existing mechanical issues, and the investigation determined that there was no in-flight breakup or separation of control surfaces.

Although it is apparent that a loss of control occurred as evidenced by the high-speed, medium-angle impact, there was insufficient information available to determine the causes of the loss of control.

Finding as to causes and contributing factors

During the en-route portion of the flight, over a remote area, the pilot lost control of the aircraft for an unknown reason, which resulted in the collision with terrain.

Although the specific cause of the occurrence could not be determined, several factors are considered in the analysis below:

- Day VFR operations
- Management oversight and acceptance of unsafe practices
- Group dynamics
- Instrument flying training requirements for air taxi operators

In addition, the analysis will examine issues related to cargo restraint and the emergency locator transmitter (ELT).

2.1 Day visual flight rules operations

Although the *Canadian Aviation Regulations* (CARs) governing day VFR operations, including VFR weather minima, are clear, compliance with them is difficult for an operator to monitor and for the regulator to enforce.

As there was limited weather information available for Wilderness North Air (WNA)'s area of operations, pilots relied heavily upon weather cameras and verbal reports from their destination airports, and it was common practice to depart on a flight if the weather conditions at the airports of origin and destination appeared to be suitable.

Once en route, a pilot's interpretation of in-flight visibility is subjective and can change from moment to moment, meaning that the actual in-flight visibility may be below the minimum specified in the CARs.

The weather analysis conducted by Environment and Climate Change Canada did not depict widespread areas with reduced visibility or precipitation; however, there were isolated areas associated with towering cumulus clouds near the flight path where snow flurries may have reduced the visibility to as low as $^{5}/_{8}$ statute miles with associated ceilings of

1200 feet above ground level. It is not certain that the occurrence flight crew continued into an area of reduced visibility; however, many investigations have shown that continuing a VFR flight into instrument meteorological conditions (IMC) can result in spatial disorientation and loss of control.

Finding as to risk

If pilots flying under VFR choose to proceed into areas where visibility is likely to decrease below VFR minima, there is a risk of spatial disorientation and loss of control.

2.2 Management oversight and acceptance of unsafe practices

While WNA took steps to ensure that there was on-site supervision for the 208B operation through the presence of base managers and an assistant chief pilot, neither role had defined responsibilities in company publications. The absence of defined and objective supervisory responsibilities for on-site supervisors increases the risk that deviations from company procedures and/or regulations may go undetected. As a result, companies that manage flight operations remotely, or without clearly defined supervisory roles, must take adequate steps to ensure that operations are conducted safely and in accordance with the regulations.

WNA employed a Type D pilot self-dispatch system, relying on flight crew experience to ensure safe operations and regulatory compliance. Although the operations manager and chief pilot were available and participated in daily flight operations group chats, they were based in Thunder Bay, Ontario. As a result, they relied on the base managers and the pilot group to maintain compliance with company and regulatory standards. Despite having access to flight data from satellite tracking devices, management did not have a process in place to use these data as a means of monitoring flight operations for compliance with safety standards, nor were they required to by regulation. Had it been monitoring the available information on routes, speeds, and altitudes being flown by the 208B pilots, management may have been able to observe anomalies that could have provided information about how pilots were responding to changing weather conditions.

In addition, the group chat used by pilots and management to communicate operational information included instances where deviations from company policies and regulations occurred or were being considered, such as flying over the top of a cloud ceiling in a 208B, when those operations were not approved. The TSB's investigation into air-taxi operations highlighted that acceptance of unsafe practices and inadequate management of operational hazards were major factors in accidents. Unsafe practices can gradually become accepted as part of the job in an undetected drift away from safe practices, thus reducing the safety margin.

WNA recognized the inherent risk in its operations because of highly variable weather and limited sources for current weather information. This led to a collective assessment of weather hazards, giving pilots considerable latitude in weather-related decisions. However, the focus on completing flights over managing threats likely influenced pilots to accept risks in reaching destinations.

Without comprehensive management oversight, it is difficult for operators to continuously and objectively assess their risks and implement necessary avoidance or mitigation measures. At WNA, some unsafe practices had become well established, such as flying directly into and through areas of reduced visibility even if the visibility was likely to decrease to below regulatory minima, flying over cloud ceilings without approval to do so, and carrying cargo without restraints. Acceptance of these unsafe practices may become normalized in a company culture whereby pilots continue with risky behaviour because it has not resulted in any negative consequences, and therefore is no longer viewed as risky.

Finding as to risk

If air operators do not find ways to continuously assess the safety of daily operations, such as through the use of flight data, monitoring intra-company communications, or providing supervisors with clearly defined responsibilities, there is a risk that unsafe practices will become routine.

2.3 Group dynamics

The 208B aircraft pilot group at WNA met each morning for a briefing of the day's planned activity, where the weather forecast would be reviewed and briefed. This meeting was a relatively informal event that included discussion of operational needs in addition to the weather assessment. After the go/no-go decisions were made, one of the pilots notified management via text about the weather's suitability and planned flight operation start time. On the day of the occurrence flight, the designated pilot-in-command, initially scheduled to conduct the daytime VFR flight unaccompanied, changed plans after the morning briefing revealed gusty winds. He requested the assistance of a more experienced pilot, and an off-duty pilot who had attended the briefing agreed to join him.

Decisions made by and within groups, such as the morning briefing, can be an effective way to reach a safety-critical decision. However, in the absence of effective and reliable objective data, such as local weather reports, to aid in the decision-making process, group biases, such as conformity, compliance, and groupthink, can inadvertently lead to increased risk taking.

In a cockpit, junior pilots may defer to the more senior pilot, and may be influenced to accept more risk than they would individually as sole decision-makers.

Finding as to risk

If safety-critical decisions are made as a group, there is a risk that some pilots become reliant on the assessment of others, leading them to commence or continue a flight in conditions that they would not choose to if they were the sole decision maker.

2.4 Instrument flying training requirements for air-taxi operators

Pilots at WNA are not required to possess an instrument rating and are not trained or checked specifically on instrument flying during their pilot competency check and subsequent line indoctrination. There is no regulatory requirement for VFR pilots working

for CARs Subpart 703 operators, like WNA, to conduct any training related to instrument flying during their pilot competency check or line indoctrination.

While flying VFR in uncontrolled airspace, pilots are permitted, by regulation, to operate in visibility as low as 1 statute mile. Operating in this reduced visibility can be challenging, especially in areas with few visual cues available on the ground, such as can be encountered in remote areas in winter when the ground is covered in snow.

If in-flight visibility falls below the VFR minimum, pilots can be caught in IMC. When these inadvertent encounters occur, pilots need to transition quickly to flight solely by reference to instruments, which can be difficult if the pilots do not have recent training or experience in such conditions.

Finding as to risk

If pilots are not proficient to fly in IMC, they may not possess the skills to handle an inadvertent encounter with these conditions, increasing the risk of spatial disorientation and loss of control.

2.5 Cargo restraint

The practices at WNA regarding cargo securement in 208B aircraft operations were focused around ensuring that the cargo would not shift laterally during flight. Tie downs were only used with bulky cargo such as all-terrain vehicles, snowmobiles, or large appliances.

The risks of carrying cargo without restraining it from vertical movement had not been considered by WNA or its pilots, and there was no means available by which to restrain the cargo from vertical movement.

Finding as to risk

If cargo is left unsecured, there is a risk that it will shift during aircraft movement, which could lead to difficulty in controlling the aircraft.

2.6 Emergency locator transmitter

The occurrence aircraft had been operating without an ELT on the day of the occurrence. Although not required by regulations, WNA utilized a satellite-based tracking system to track each of its aircraft. WNA did not require the system to be tested or verified to be operational before each flight, but it likely appeared functional to the pilot who had used it to transmit a routine message at the end of his 1st flight of the day. The system on board the aircraft was neither logging nor transmitting data during the occurrence flight.

As a result, although the investigation determined that this accident was not survivable owing to impact forces, delays in search and rescue can be life threatening for survivors.

Finding as to risk

If aircraft flown in remote areas are permitted to operate without an ELT or alternate means of transmitting their location, there is a risk that in an emergency potentially life-saving search and rescue services will be delayed.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. During the en-route portion of the flight, over a remote area, the pilot lost control of the aircraft for an unknown reason, which resulted in the collision with terrain.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If pilots flying under visual flight rules choose to proceed into areas where visibility is likely to decrease below visual flight rules minima, there is a risk of spatial disorientation and loss of control.

2. If air operators do not find ways to continuously assess the safety of daily operations, such as through the use of flight data, monitoring intra-company communications, or providing supervisors with clearly defined responsibilities, there is a risk that unsafe practices will become routine.

3. If safety-critical decisions are made as a group, there is a risk that some pilots become reliant on the assessment of others, leading them to commence or continue a flight in conditions that they would not choose to if they were the sole decision maker.

4. If pilots are not proficient to fly in instrument meteorological conditions, they may not possess the skills to handle an inadvertent encounter with these conditions, increasing the risk of spatial disorientation and loss of control.

5. If cargo is left unsecured, there is a risk that it will shift during aircraft movement, which could lead to difficulty in controlling the aircraft.

6. If aircraft flown in remote areas are permitted to operate without an emergency locator transmitter or alternate means of transmitting their location, there is a risk that in an emergency potentially life-saving search and rescue services will be delayed.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Wilderness North Air

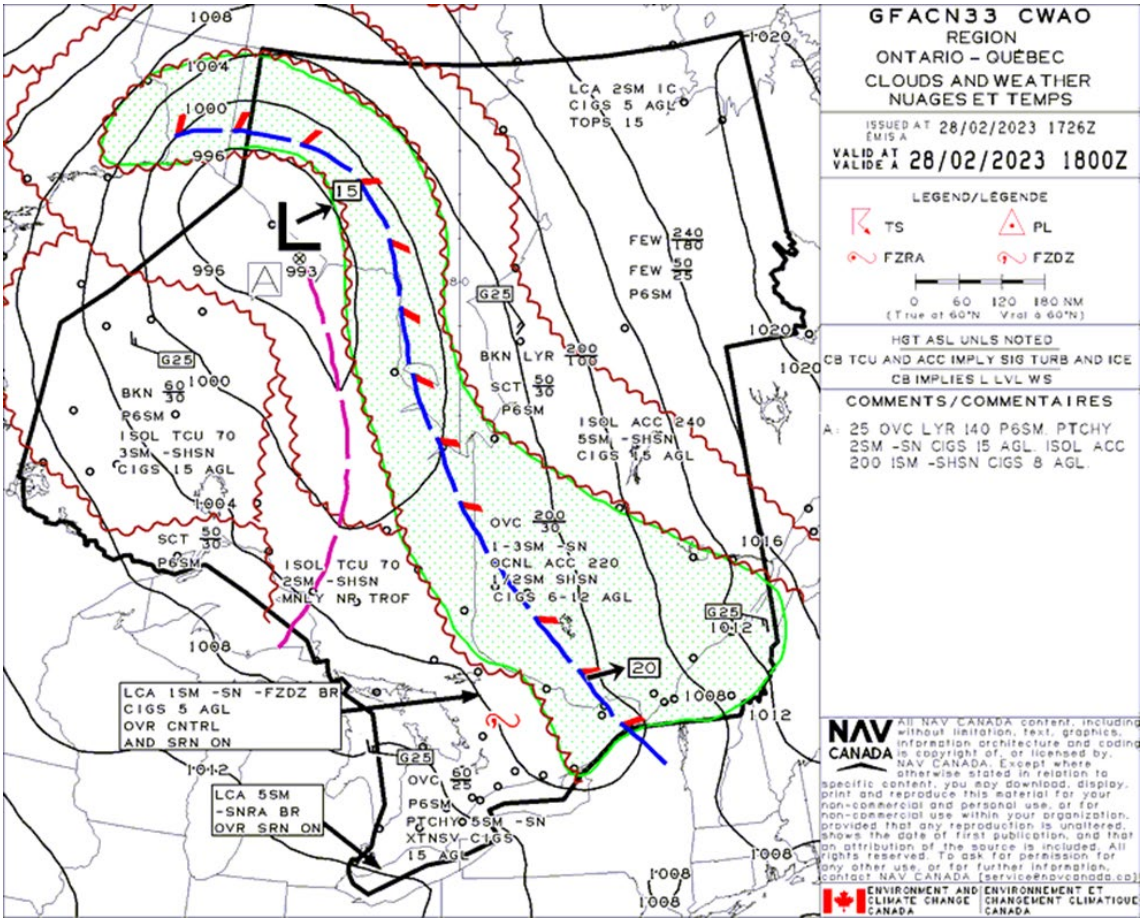
In response to the occurrence, Wilderness North Air (WNA) has taken the following steps to mitigate risks:

1. A company directive was issued requesting the use of cargo netting between each loading zone in the 208B aircraft to prevent cargo from moving fore and aft in the event of an in-flight upset or unusual attitude.
2. Unusual attitude recovery was added to the in-aircraft training syllabus.
3. Two of the company's three 208B aircraft were equipped with synthetic vision and automatic dependent surveillance – broadcast (ADS-B) in/out to enhance pilot situation awareness and improve flight following and data collection. WNA is planning to upgrade its 3rd 208B aircraft as soon as practical.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 26 June 2024. It was officially released on 11 July 2024.

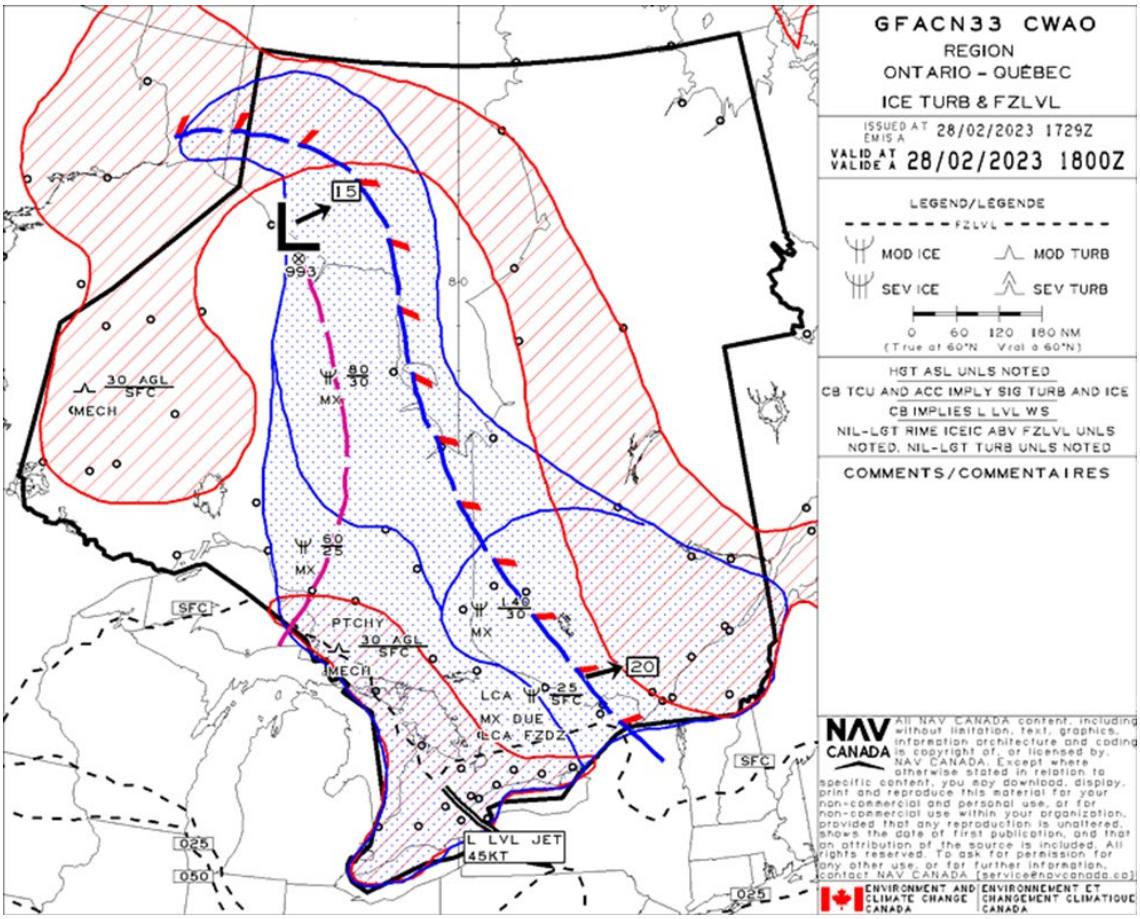
APPENDICES

Appendix A – Graphic area forecast - Clouds and Weather Chart GFACN33 issued at 1226 Eastern Standard Time on 28 February 2023



Source: Environment and Climate Change Canada

Appendix B – Graphic area forecast - Icing, Turbulence, and Freezing Level Chart GFACN33 issued at 1229 Eastern Standard Time on 28 February 2023



Source: Environment and Climate Change Canada