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

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A23W0091

CONTROLLED FLIGHT INTO TERRAIN

Privately registered
Piper Aircraft Corporation PA-32R-301 (Saratoga SP), C-FCCY
Calgary/Springbank Airport (CYBW), Alberta, 30 NM WSW
28 July 2023

Canada

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Transportation Safety Board of Canada
200 Promenade du Portage, 4th floor
Gatineau QC K1A 1K8
819-994-3741; 1-800-387-3557
www.tsb.gc.ca
communications@tsb.gc.ca

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Summary

At 2047 Mountain Daylight Time on 28 July 2023, the privately registered Piper Aircraft Corporation PA-32R-301 (Saratoga SP) (registration C-FCCY, serial number 32R-8013108) departed Calgary/Springbank Airport (CYBW), Alberta, on a visual flight rules flight to the Salmon Arm Aerodrome (CZAM), British Columbia, with the pilot and 5 passengers on board. After departure, the aircraft started to follow the Trans-Canada Highway west en route to the intended destination. Approximately 15 minutes into the flight and 30 nautical miles west-southwest of the departure airport, the aircraft collided with the northeast face of Mount McGillivray. All occupants were fatally injured. The aircraft was destroyed by the impact forces and the post-impact fire. The 121.5 MHz emergency locator transmitter activated and a signal was received by overflying aircraft.

1.0 FACTUAL INFORMATION

1.1 History of the flight

At 2047[1] on 28 July 2023, the privately registered Piper Aircraft Corporation (Piper) PA-32R-301 (Saratoga SP) departed Calgary/Springbank Airport (CYBW), Alberta, on a visual flight rules (VFR) flight to the Salmon Arm Aerodrome (CZAM), British Columbia (BC), with 1 pilot and 5 passengers on board. The recreational flight was to transport the pilot and 5 passengers to a planned social event in Salmon Arm, BC. The pilot did not obtain a weather briefing from a NAV CANADA flight service specialist or file a VFR flight plan with NAV CANADA before departure. However, he did obtain weather from a source(s) on the internet and discussed the weather with an individual at CYBW before leaving a flight itinerary with a responsible person.

The flight had originally been scheduled to depart at 1930 but was delayed due to unfavourable weather,[2] which the pilot had been monitoring. At approximately 2030, the passengers boarded and the luggage was loaded onto the aircraft. At 2038, the pilot made initial contact with a CYBW ground controller. The controller informed the pilot that the active runway was Runway 08 and that the winds were from 080° magnetic at 6 knots. The pilot then requested a departure on Runway 26. When he was queried whether he would accept a 5- to 10-knot tailwind for departure on Runway 26, he subsequently elected to depart from Runway 08.

At 2040, the aircraft taxied past the control tower for the pre-takeoff run-up. Three minutes later, the pilot contacted the ground controller to inform him that the run-up was complete and that he was ready for taxi clearance to the active runway. The CYBW tower controller queried the pilot to verify his planned flight route to CZAM. The pilot confirmed that he was planning to follow the Trans-Canada Highway, a designated VFR route[3] through the Rocky Mountains, westbound at 5500 feet above sea level (ASL). The aircraft then proceeded to take off from Runway 08 at 2047.

After departure, the aircraft completed a turn to the south to acquire the Trans-Canada Highway as a visual reference before commencing a turn to the west to follow the highway toward Ghost Lake, Alberta. At 2049, the pilot contacted the Calgary Terminal controller to provide a position and altitude report. Six minutes later, the Calgary Terminal controller terminated radar services with the aircraft and cleared it en route with a cruising altitude that was at the pilot's discretion. At approximately 2057, radar contact with the aircraft was lost owing to the rising terrain approximately 17.5 nautical miles (NM) west of CYBW. The

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[1] All times are Mountain Daylight Time (Coordinated Universal Time minus 6 hours), unless otherwise indicated.

[2] The weather was below or near the limits defined in section 602.115 of the *Canadian Aviation Regulations* (CARs) for minimum visual meteorological conditions for visual flight rules (VFR) flight in uncontrolled airspace.

[3] For more information about the designated VFR route, see section 1.18.2 *Visual flight rules route*.

aircraft's last recorded altitude and ground speed, approximately 50 seconds earlier, were 5800 feet ASL and 150 knots, respectively (Figure 1).

Figure 1. Radar returns for the occurrence flight (labelled A to I and listed in Table 1), with the accident site and the area under rain showers at the time of the occurrence indicated (Source: Google Earth, with TSB annotations)

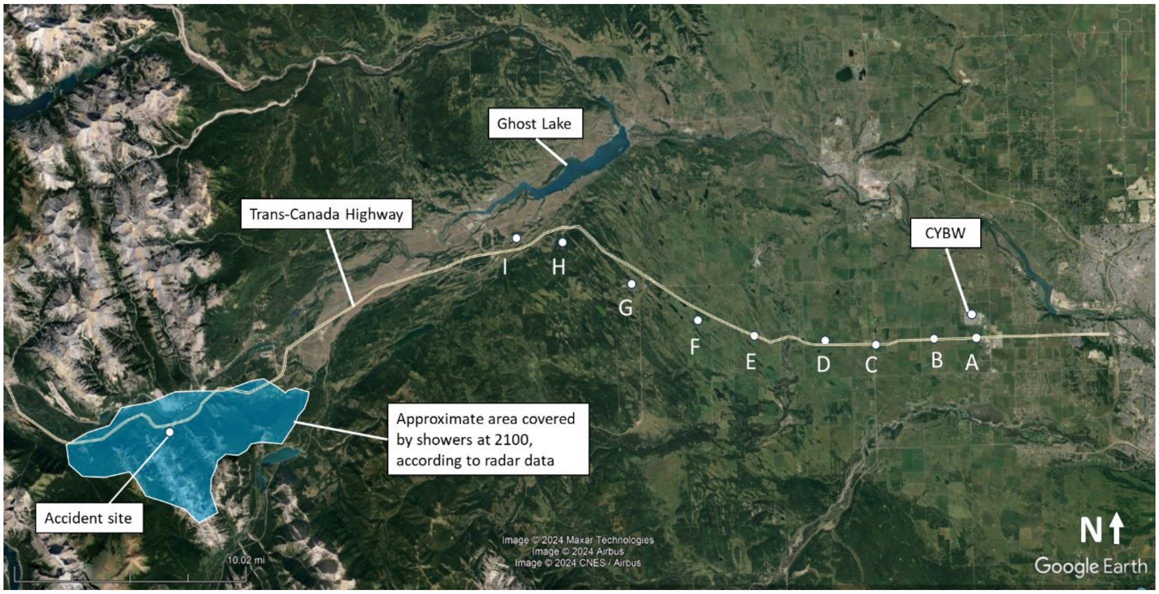

Table 1. Radar data for the occurrence flight

Radar return	Time	Altitude (ft ASL)	Ground speed (kt)
A (1st radar return)	2048:55	4900	90
B	2049:55	5200	110
C	2050:56	5400	130
D	2051:55	5500	140
E	2052:55	5500	150
F	2053:45	5400	150
G	2054:55	5600	150
H	2056:03	5800	150
I (last system-generated position)	2056:53	No altitude recorded	No ground speed recorded

The aircraft continued to fly on a generally westerly heading over the Trans-Canada Highway. At approximately 2103, while the aircraft was at an altitude of approximately 6500 feet ASL, it impacted the northeast face of Mount McGillivray. All occupants were fatally injured. The aircraft was destroyed. At 2137, the 121.5 MHz signal of the emergency locator transmitter[4] was received by crews of overflying aircraft, who reported the signal to NAV CANADA air traffic control personnel.

4 Artex 110-4 121.5/243.0 MHz emergency locator transmitter. The unit was not equipped with a 406 MHz transmitter.

At 2340, the responsible person who had the flight itinerary for the occurrence flight had not heard from the pilot or received confirmation that the aircraft had arrived in Salmon Arm. That person then reported the overdue aircraft to the Joint Rescue Coordination Centre in Victoria, BC, which subsequently coordinated the dispatch of search and rescue assets. The wreckage was located on the morning of 29 July 2023.

1.2 Injuries to persons

There were 1 pilot and 5 passengers on board. Table 2 outlines the degree of injuries received.

Table 2. Injuries to persons

Degree of injury	Crew	Passengers	Persons not on board the aircraft	Total by injury
Fatal	1	5	–	6
Serious	0	0	–	0
Minor	0	0	–	0
Total injured	1	5	–	6

1.3 Damage to aircraft

The aircraft was destroyed by impact forces during the accident sequence and by a post-impact fire.

1.4 Other damage

There was no other damage.

1.5 Personnel information

Table 3. Personnel information

	Pilot
Pilot licence	Private pilot licence – aeroplane
Medical expiry date	01 April 2028
Total flying hours	231.7
Flight hours on type	25.0
Flight hours in the 24 hours before the occurrence	0.3
Flight hours in the 7 days before the occurrence	7.8
Flight hours in the 30 days before the occurrence	21.7
Flight hours in the 90 days before the occurrence	32.8
Flight hours on type in the 90 days before the occurrence	25.0
Hours at work before the occurrence	8.0*

* The pilot had worked a normal work day before conducting the flight in the evening.

The pilot began his flight training toward earning a private pilot licence – aeroplane for single-engine landplanes on 18 November 2017 and successfully completed the flight test for this licence on 10 December 2020. At that point, he had accumulated 108.6 total flying hours. The pilot had also accumulated 5.0 hours total instrument time, which consisted of a combination of in-aircraft experience using a view-limiting device (hood) and experience in a ground-based simulator. All of the instrument time, the most recent of which had been completed 15 December 2020, had been accumulated during the required training for the private pilot licence.

The pilot had also completed training on the PA-32R-301 (Saratoga SP) on 09 June 2023, as required by the aircraft insurance company. This training was conducted by an individual specified by the insurance company who neither held nor was required to hold an instructor rating.

The syllabus for private pilot licence – aeroplane training includes a limited amount of time allocated to flying with reference to the flight instruments. The purpose of this training is to provide VFR-rated private pilots with the opportunity to experience, in a controlled environment, what it would be like to encounter instrument conditions unexpectedly. This training also allows them to learn how to safely remain in control of the aircraft and which procedures should be followed to exit the instrument conditions. With respect to instrument conditions, the exercises covered include:

- the correct technique for applying an instrument scan
- straight and level flight
- climbing and descending, including heading changes
- escape manoeuvres
- recovery from unusual attitudes

The pilot had previously completed 7 round trips to CZAM in 2022 and 1 round trip to CZAM in 2023, all as pilot-in-command in a Piper PA-28-180 (Cherokee) aircraft[5] and all from CYBW.

The pilot held the appropriate licence and rating for the occurrence flight in accordance with existing regulations. He did not have any formal training in mountain flying, nor was it required by regulation. The pilot did not hold a night VFR rating.

The investigation was unable to determine the pilot's work and rest schedule, and it was thus unable to determine whether fatigue was a contributing factor in this occurrence.

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5 The Piper PA-28-180 (Cherokee) aircraft is a light utility aircraft with fixed landing gear and a capacity to carry a pilot and up to 3 passengers.

1.6 Aircraft information

Table 4. Aircraft information

Manufacturer	Piper Aircraft Corporation*
Type, model, and registration	PA-32R-301 (Saratoga SP), C-FCCY
Year of manufacture	1980
Serial number	32R-8013108
Certificate of airworthiness	10 July 2023
Total airframe time	5527.5 hours
Engine type (number of engines)	Lycoming IO-540-K1G5D (1)
Propeller type (number of propellers)	McCauley, B3D36C433/80VSA-1 (1)
Maximum allowable take-off weight	3600 lb (1633 kg)
Recommended fuel type(s)	100, 100LL
Fuel type used	100LL

* Piper Aircraft Inc. currently holds the type certificate for the aircraft type.

The Piper PA-32R-301 (Saratoga SP) is an all-metal, single-engine, piston-powered light aircraft (Figure 2). It has retractable landing gear and a constant-speed propeller and is configured to seat 6 people, including the pilot. The aircraft was equipped with flight instrumentation to permit flight under both VFR and IFR conditions.

Figure 2. Occurrence aircraft (Source: Third party, with permission)

The aircraft had recently been purchased in the United States by the pilot's father and was ferried to Canada in June 2023. The aircraft then went through the process for importing an aircraft to Canada, which was completed on 03 July 2023. At the time of importation, the aircraft had accumulated 5511.1 hours total air time. During the importation, an annual inspection and the Piper 1000-hour maintenance items were completed.

According to the last weight and balance calculation, this aircraft had a useful load of 1391.8 pounds. Although the investigation was unable to determine where the baggage had been stored for the flight, various weight and balance scenarios were calculated. Based on these scenarios, it was determined that the aircraft's weight was within the prescribed limits, and the centre of gravity was likely within the prescribed limits.

According to the pilot's operating handbook, the aircraft's cruise speed at 65% engine power and at an altitude of 6500 feet ASL (the occurrence aircraft's approximate altitude at the time of its collision with terrain) is 145 knots true airspeed. At 75% engine power, its cruise speed at the same altitude is approximately 156 knots true airspeed.[6]

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

1.7 Meteorological information

Person-to-person weather briefings are provided by NAV CANADA flight information centres free of charge. Regional specialists provide interpretive weather briefings, advisory services, and flight plan filing by telephone. Free weather information is also available online.

The investigation determined that NAV CANADA was not contacted by the pilot to obtain a weather briefing for the intended flight; however, it was reported that he had obtained weather information from a source(s) on the internet. The investigation was unable to determine what specific weather information the pilot had obtained or reviewed before commencing the flight.

1.7.1 Weather at departure airport

The weather at CYBW during the afternoon on the date of the occurrence had been variable. According to aerodrome routine meteorological reports (METARs) issued for the airport from 1200 to 1600 that day,

- the winds were consistently blowing from an easterly direction and varied in strength from 8 to 10 knots;
- visibility varied from 3 to 9 statute miles (SM);
- the ceiling varied from 500 feet to 1400 feet above ground level (AGL); and

6 Piper Aircraft Corporation, *Saratoga SP PA-32R-301 Pilot's Operating Handbook and FAA Approved Airplane Flight Manual*, Revision 15 (15 August 1992), section 5: Performance, Figure 5-31: Speed - Cruise Power, p. 5-28.

- light rain showers and mist had been observed periodically throughout the afternoon.

While conditions continued to be variable throughout the day, from 1700 until 2000, they improved somewhat, and the METARs indicated,

- the winds were consistently blowing from an easterly direction and varied in strength from 7 to 9 knots;
- visibility 9 SM;
- the ceiling varied from 2200 feet to 3900 feet AGL; and
- light rain showers had been observed periodically throughout the early evening.

The METAR for CYBW issued at 2000 indicated the following:

- Winds from 100° true at 6 knots
- Visibility 9 SM
- Scattered cloud layer at 1400 feet AGL, scattered cloud layer at 2400 feet AGL, and overcast ceiling at 3700 feet AGL
- Temperature 13 °C, dew point 12 °C
- Altimeter setting 30.28 inches of mercury (inHg)

Sunset at CYBW on the day of the occurrence occurred at 2129.

1.7.2 En-route weather

The graphic area forecast (GFA) valid at the time of the occurrence for the portion of the planned flight route from CYBW, located west of Calgary, all the way to the BC border (Appendix A, Figure A1), noted the following weather conditions:

- Overcast from 4000 to 6000 feet ASL, with tops at 14 000 feet ASL
- Occasional altocumulus castellanus (ACC on the GFA) clouds to 18 000 feet ASL
- Visibility varying from 2½ to 6 SM in light rain showers and mist
- Patchy ceilings from 700 to 1500 feet AGL
- Along the foothills, isolated cumulonimbus (CB on the GFA) clouds to 32 000 feet ASL, with visibility of 2 SM in thunderstorms, rain, and mist

The Icing, Turbulence, and Freezing Chart (Appendix A, Figure A2) from the same GFA for the area and time period forecast patchy areas of moderate mixed icing from the freezing level to 14 000 feet ASL. The freezing level was forecast to be from 10 000 feet to 12 500 feet ASL.

The GFA for the interior of BC along the intended flight route and valid at the time of the occurrence (Appendix A, Figure A3) noted the following forecast weather conditions for that area:

- Broken ceiling of cumulus (CU) clouds from 6000 feet to 12 000 feet ASL, with visibility greater than 6 SM

- Occasional towering cumulus (TCU) clouds to 24 000 feet ASL, with visibility varying from 5 SM to greater than 6 SM in light rain showers and mist
- Isolated cumulonimbus (CB) clouds to 32 000 feet ASL with visibility of 3 SM in thunderstorms and rain, with the potential of wind gusts to 25 knots

1.7.3 Destination weather

CZAM does not have a weather reporting system. The nearest location with an automated weather reporting system is Kamloops Airport (CYKA), BC, located 46 NM west of Salmon Arm. The METAR at 2100 (2000 Pacific Daylight Time [PDT]) was reporting the following weather observations:

- Winds from 120° true at 3 knots
- Visibility 40 SM
- Scattered clouds at 11 000 feet AGL and broken ceiling at 30 000 feet AGL
- Temperature 27 °C, dew point 8 °C
- Altimeter setting 29.95 inHg

The end of evening civil twilight at the destination airport was at 2228 Mountain Daylight Time (2128 PDT).

1.7.4 Meteorological assessment

After the occurrence, the investigation engaged Environment and Climate Change Canada to complete a detailed analysis[7] of the weather conditions present in the late afternoon and evening on the date of the occurrence at the location of the accident.

The meteorological assessment determined that the aircraft took off from CYBW in warm and humid atmospheric conditions, with surface temperatures from 12 to 14 °C and a dew point depression[8] of approximately 1 °C.[9] Surface winds from the east were reported at 5 to 9 knots. Cloud ceilings were observed at heights as low as 1600 and up to 4200 feet AGL. Early in the evening, light rain fell occasionally. Satellite weather imagery showed lower cloud that extended westward from the CYBW area, with no obvious holes in the cloud deck to the Alberta-British Columbia border. Clear skies were present through much of eastern BC, west of the provincial border.

Weather radar images of the area at the time of the occurrence also indicated the presence of a precipitation cell moving through the area of the accident site from 2050 to 2110

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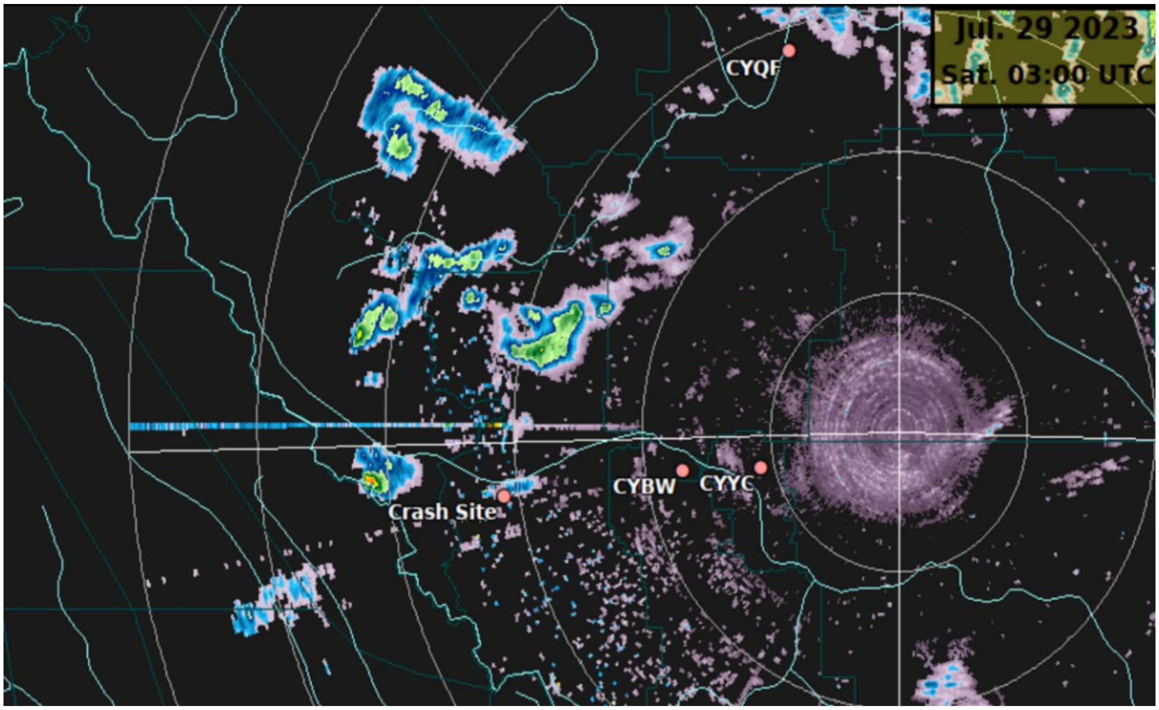
7 Environment and Climate Change Canada, Meteorological Service of Canada, Prediction Services Directorate, *Meteorological Assessment July 28, 2023, Kananaskis Village, Alberta* (08 November 2023).

8 Dew point depression, an indicator of the air's moisture level, is determined by the difference between the air temperature and the dew point temperature.

9 Environment and Climate Change Canada, Meteorological Service of Canada, Prediction Services Directorate, *Meteorological Assessment July 28, 2023, Kananaskis Village, Alberta* (08 November 2023), p. 20.

(Figure 3). Radar echoes of light rain showers falling into this air mass near the time of the accident would have provided additional moisture to the lower atmosphere, increasing humidity and allowing clouds to descend further toward the ground.

Figure 3. Weather radar image of the area of the occurrence at 2100 (Source: Environment and Climate Change Canada, Meteorological Service of Canada, Prediction Services Directorate, *Meteorological Assessment July 28, 2023, Kananaskis Village, Alberta* (08 November 2023), p. 18)



The assessment further explains that

> [t]raveling west into higher terrain, winds remained light at 2 to 6 knots mainly from the northeast, though direction was more variable (coinciding with model forecast winds aloft in numerical guidance profiles) as reported at both Bow Valley and Nakiska Ridgetop [nearby observation stations]. Nakiska Ridgetop's observations indicated a saturated atmosphere, at an elevation of 8,343 feet [ASL], [and] was likely due to the station being in the cloud deck.[10]

The crash occurred at approximately 6500 feet ASL, and the closest cloud ceilings reported at CYBW (which is located at an elevation of 3904 feet) were 5500 to 8100 feet ASL, or 1600 to 4200 feet AGL. As Environment and Climate Change Canada's report concludes,

> [i]t is most likely that cloud ceilings in the Exshaw region [close to the accident site] were lower than what was reported further east. Local highway cameras close to the crash location showed obscured mountain tops in the region as well, which further suggests that mountain peaks near the crash site were well obscured by low level clouds.[11]

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10 Ibid.

11 Ibid., p. 21.

1.7.4.1 Upslope winds

Upslope winds are driven primarily by the orographic effect, which is the result of air being forced to rise as it encounters a mountain or hill. As the air ascends, it cools and expands, leading to the formation of clouds and, often, precipitation. Upslope winds can be relatively gentle or become quite strong, depending on the steepness and height of the terrain, and they can result in the formation of low-level clouds and fog on the windward side of the mountain. These conditions can persist for extended periods, reducing visibility and affecting local weather.

Around the time of the occurrence, there was a high-pressure centre in central Alberta that would have generated easterly surface winds. This easterly flow is considered an upslope flow, which could have enhanced the development of low cloud and low visibilities with the lifting and cooling of air, which then condenses when it reaches saturation. The air over the foothills at this time was close to its saturation, given that the observations at CYBW and Bow Valley both reported a dew point depression of 1 °C or less that evening. As the meteorological assessment states, "[w]ith such a low dewpoint depression, condensation would have occurred rapidly in ascending air leading to the likely development of low clouds, cloud ceilings and low visibilities over the eastern slopes."[12]

Upslope winds causing lifted air, in combination with the light rain showers, likely contributed to a deterioration of conditions, even though the limited number of observations in the region makes it difficult to verify the extent of this deterioration. As the assessment explains, the forced lifting of humid air is usually responsible for the lowering of cloud ceilings and visibility, making it likely that clouds were lower and visibility was more reduced near the crash site than in areas to the east, possibly significantly so.

1.8 Aids to navigation

After departure from CYBW, the pilot began following the Trans-Canada Highway west, a designated VFR flight route through the mountains that is depicted on the VFR Navigation Chart (VNC). Using the highway for navigation requires pilots to maintain a constant visual reference with the ground so as to be certain of their geographic location.

In addition, the aircraft was equipped with a Garmin GNS 430W, a panel-mounted GPS navigation device that also incorporates a communication radio and a navigation radio. This model of GPS has the ability to display basic terrain information and terrain warnings; however, due to the damage incurred in the accident sequence, the information from the non-volatile memory could not be extracted, and it could not be determined if the terrain warning system had been active at the time of the occurrence.

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12 Ibid., p. 7.

1.9 Communications

There were no known communication difficulties.

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.

1.12 Wreckage and impact information

The aircraft had impacted the face of Mount McGillivray. The impact marks on the rock face and crush angles on the wings and fuselage were consistent with the aircraft being in a cruise attitude.[13] The wreckage fell from 200 to 400 feet vertically before coming to rest. The right wing, engine, and upper fuselage were separated from the rest of the aircraft and came to rest at different locations.

The wreckage was recovered and transported to the TSB's regional office located in Edmonton, Alberta. A detailed examination of the wreckage was performed to the extent possible, given the damage. No abnormalities were observed. A reconstruction of the wreckage was performed, and all major components of the aircraft were accounted for. The flaps and landing gear were in the retracted position, which is consistent with the aircraft being in the cruise configuration.

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13 An aircraft is considered to be in cruise attitude when it is in level flight, at a constant altitude, airspeed and cruise power setting, and the wings are level.

Figure 4. Layout of aircraft wreckage at the TSB regional office in Edmonton, Alberta (Source: TSB)

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 physiological factors.

1.14 Fire

Following the aircraft's impact with terrain, there was a brief post-impact fire that damaged components forward of the engine firewall, as well as the aft fuselage and tail sections of the aircraft.

1.15 Survival aspects

The accident was not survivable.

1.16 Tests and research

Not applicable.

1.17 Organizational and management information

Not applicable.

1.18 Additional information

1.18.1 Daytime visual flight rules

Under the *Canadian Aviation Regulations* (CARs), to operate a VFR flight, the pilot must maintain visual reference to the surface, a minimum flight visibility, and a minimum distance from cloud.[14] Flights conducted under day VFR must, by virtue of the definition of day or daylight in the CARs,[15] be completed between the beginning of morning civil twilight and the end of evening civil twilight, which ends when the centre of the sun's disc is 6° below the horizon. The end of evening civil twilight equates to approximately 30 minutes after sunset at the latitudes at which the occurrence flight was operated.

To conduct a VFR flight at night with passengers, a pilot is required to hold a night VFR rating.

1.18.2 Visual flight rules route

NAV CANADA has designated certain flight paths in Canadian airspace as designated VFR routes. The Trans-Canada Highway, one of the designated routes, provides VFR navigation to pilots travelling either east or west through the valleys in the mountains along the Trans-Canada Highway. It is recommended that pilots consider using this route when planning a VFR route through mountainous terrain.

The designated VFR route west of CYBW follows the Trans-Canada Highway to Golden, BC; then to the Salmon Arm of Shuswap Lake via Revelstoke, BC; and then to Canoe, BC. Canoe is approximately 4 NM north of CZAM. The total distance from CYBW to CZAM following the designated VFR route is approximately 250 NM. Had the pilot followed this route with the same departure time, the aircraft would have likely arrived at CZAM between approximately 2123 and 2129 PDT. The beginning of official night (the end of evening civil twilight) at CZAM was 2128 PDT. Given that the VFR route follows the Trans-Canada Highway west, the same trip conducted in a vehicle would take approximately 5.5 hours.

1.18.3 Pilot decision making and risk perception

Pilot decision making (PDM) is a cognitive process used to select a course of action between alternatives. PDM is developed by a process that involves using best practices, personal experience, and available resources to create a realistic plan. Several factors, circumstances, and biases can affect PDM, including the flight objective or goal, and the pilot's knowledge, experience, and training.[16] These factors can result in a pilot operating an aircraft beyond the aircraft's capability or beyond the pilot's abilities. This is especially true for private

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[14] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 602.114.

[15] Ibid., subsection 101.01(1).

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

pilots, who, unlike commercial pilots, have fewer structured safety defences on which to rely in PDM.

Risk is a function of likelihood and adverse consequence. Risk perception is a component of PDM; it is the recognition of the inherent risk in a situation. A pilot's risk perception can be altered by their relative experience of a situation; therefore, as research explains, "situations that present a high level of risk for one person may present only low risk for another."[17] An individual who repeatedly performs a dangerous activity with no, or few, adverse consequences may become desensitized or habituated to the high level of risk. Problems can arise when perceived risks no longer match the actual risks associated with an activity.

Multiple factors, such as the desire to attend the social event in Salmon Arm, the diminishing available daylight, and his familiarity with the VFR route from CYBW, could have influenced the occurrence pilot's PDM and risk perception.

1.18.4 Situation awareness

Situation awareness is a critical component of decision making. As a model, situation awareness is defined as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future."[18]

1.18.5 Inadvertent flight into instrument meteorological conditions

1.18.5.1 Definition

The term "inadvertent flight into IMC" or "inadvertent IMC" (IIMC) refers to situations where a pilot, operating under VFR, unintentionally flies into instrument meteorological conditions (IMC), which are "meteorological conditions less than the minima specified in Division VI of Subpart 2 of Part VI [of the CARs] for visual meteorological conditions, expressed in terms of visibility and distance from cloud."[19] Traditionally, IIMC is often thought of as a situation where a pilot operating under VFR inadvertently enters cloud. While that is accurate, IMC, in practical terms, exist anytime a pilot is required to fly by reference to the flight instruments due to insufficient external visual cues to maintain aircraft control by reference to the surface of the earth.

1.18.5.2 Defences against inadvertent flight into instrument meteorological conditions

The defences against IIMC are based primarily on training. This training can be broken down into 3 general areas of focus.

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[17] M. Martinussen and D. R. Hunter, *Aviation Psychology and Human Factors*, 2nd Edition (2018), pp. 297–301.

[18] M. R. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems", *Human Factors*, Vol. 37, Issue 1 (1995), pp. 32–64.

[19] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subsection 101.01(1).

- Avoidance – This information is focused primarily on the pre-flight planning and information gathering completed in preparation for a flight. Pilots learn which strategies are available to help them avoid the possibility of encountering IMC. These strategies include obtaining a weather forecast from multiple resources and learning about weather conditions that are common in particular geographic areas.
- Identification – During the course of a flight, there is the possibility that the actual weather experienced by the pilot is not what was forecast or that the weather changes earlier than forecast. Pilots receive training on how to identify deteriorating weather while they are in flight and before they enter IMC.
- Recovery – Should pilots be unsuccessful in avoiding IIMC, they receive training on techniques for successfully exiting IMC and returning to VFR conditions. Pilots also learn techniques for maintaining aircraft control when IMC are encountered and explore resources that are available to them (for example, air traffic control assistance) if they encounter these conditions.

Maintaining proficiency in an acquired skill, such as defending oneself against IIMC, requires structured practice.

1.18.5.3 Personal safety minima

Personal safety minima are an individual pilot's set of limits and guidelines used in making decisions that may be more conservative than what the regulations require. Transport Canada has available a checklist[20] to assist pilots in creating personal minima. In addition, according to the Federal Aviation Administration of the United States, "personal minimums should be set so as to provide a solid safety buffer between the skills required for the specific flight [a pilot] want[s] to make, and the skills available to [the pilot] through training, experience, currency, and proficiency."[21] To accomplish this, pilots should review the regulatory minima, assess their experience and comfort level, set a baseline for personal minima, adjust for specific conditions, and then stick to the plan.[22]

Although the CARs stipulate the minimum limits, pilots can set their own personal safety minima that are more restrictive by the inclusion of a safety buffer that reflects their own prior flight experience, including proficiency and recency. As a result, what may be acceptable VFR weather for one pilot may not be acceptable for another.

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20 Transport Canada, Advisory Circular No. 401-004: Conduct of Instrument Proficiency Checks, Issue No. 4 (15 March 2019), Section 5.1: Risk Management and Personal Minimums, paragraph 7.

21 Federal Aviation Administration, "Getting the Maximum from Personal Minimums," in *FAA Aviation News* (May/June 2006), p. 2, at www.faasafety.gov/files/gslac/courses/content/38/472/6.2%20Personal%20Minimums%20MayJun06.pdf (last accessed on 24 July 2024).

22 Ibid., Appendix.

Within the context of mountain flying under VFR, Transport Canada (TC) recommends that pilots receive a detailed weather briefing and expect delays.[23] Therefore, planning for flight in such conditions should include time for in-flight contingencies. Furthermore, once the flight plan is developed, pilots may cross-check the feasibility of their intended flight by consulting a third party, such as a NAV CANADA flight service specialist, before filing a flight plan. Establishing and adhering to personal limits can help pilots to increase their safety margins and defend themselves against various factors that can add undue risk to any flight.

1.18.6 Pilot recency requirements

Maintaining pilot recency (also known as pilot currency) is a fundamental aspect of aviation safety. Pilots are required to meet specific recency requirements to ensure they remain proficient and capable of handling the complex and dynamic challenges of aviation. These requirements vary depending on the type of aircraft, the pilot's certification level, and the specific tasks the pilot is authorized to perform.

To exercise the privilege of a pilot licence, several criteria have to be met:

- The individual must possess the appropriate valid licence for the aircraft that he or she plans to operate. For example, a private pilot with a single-engine landplane rating cannot legally operate a twin-engine aircraft.
- The pilot’s aviation medical certificate must be valid and current.
- The pilot’s aviation document must be current and valid.
- The pilot must meet the recency requirements of the regulations for the 6-month, 24-month, and 5-year timeframe.

The CARs require a private pilot to maintain recency by completing some form of recurrent training every 24 months.[24] This recurrent training can include:

- completing a flight review with a certified flight instructor;
- attending a TC aviation safety seminar;
- completing the online TC self-paced study program;
- participating in a TC-approved recurrent training program;
- completing a training program or pilot proficiency check required by parts IV, VI, or VII of the CARs;
- completing the requirements for the issue of a licence, permit, or rating; and
- passing the written exam for a licence, permit, or rating.[25]

[23] Transport Canada, TP 2228-32E, *Take five… for safety: Flying VFR in the Mountains* (28 June 2018), at https://tc.canada.ca/sites/default/files/2021-07/TAKE_FIVE-FLYING_VFR_IN_THE_MOUNTAINS.pdf (last accessed on 24 July 2024).

[24] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, paragraph 401.05(2)(a).

[25] Ibid., Standard 421: Flight Crew Permits, Licenses and Ratings, subsection 421.05(2).

If a pilot has not met the recency requirements stated in the regulations, the pilot is not allowed to exercise the privileges of the licence until he or she completes a training program.

The occurrence pilot had fulfilled the 6-month recency requirement by completing the required number of takeoffs and landings with passengers. However, a review of the pilot's flying record did not indicate that he had, on the date of the accident, met the 24-month recency requirements stipulated by the CARs.

1.18.7 Mountain flying training

Private pilots with day VFR qualifications are able to bolster their flying skills and capabilities through voluntary specialized training in the form of classroom instruction, simulator work, or in-air flight instruction. Special skills instruction beyond the minimal criteria set by TC is a means for private pilots to sharpen their skills and add some rigour to their personal practice of flying in the general aviation community. Mountain flying courses are an example of specialized training that offers best practices based on regional knowledge of the topography of western Canada and the unpredictable nature of the region's meteorological conditions.

Formal training for mountain flying is offered to licensed pilots by multiple flight instruction facilities in Alberta and BC. Mountain flying courses typically include hands-on flying experience with an instructor. This may involve flight manoeuvres, such as steep turns, slow flight, and high-altitude takeoffs and landings. The intent of the training is to educate licensed pilots on several subjects relevant to conducting flights in regions of mountainous terrain, such as the Rocky Mountains.

In addition to subjects such as aerodynamics and the effects of density altitude, students are instructed on navigation, communications, emergency procedures, and survival training. The majority of the courses focus on the following subjects:

- Decision making and risk management – Courses emphasize sound decision making and risk management in the challenging environment of mountain flying. Pilots learn when to proceed with a flight and when to turn back or divert to a safer location.
- Weather hazards – Mountainous areas are often affected by rapidly changing weather conditions, including those that cause turbulence, downdrafts, and microbursts. Pilots learn how to interpret mountain weather forecasts, recognize signs of impending adverse weather, and make decisions to avoid dangerous conditions.
- Terrain awareness – Navigating mountainous terrain safely is a key focus of the course. The course includes instruction on understanding terrain features, such as ridges, valleys, and passes, and being aware of obstacles, such as power lines and towers.
- Wind patterns – Understanding mountain wind patterns is critical for mountain flying. Upslope and downslope winds, as well as turbulence caused by wind

interacting with terrain, are covered in the course. Pilots learn to adapt their flying techniques to these conditions.

Mountain flying courses are valuable for both new and experienced pilots because they help enhance the skills and confidence to navigate and operate aircraft in complex and demanding mountainous terrain. The specific curriculum and duration of the courses can vary, but the common goal is to prepare pilots to handle the unique challenges posed by mountain flying.

TC does not require mountain flying training, nor does it set standards for mountain flying training course content.

2.0 ANALYSIS

Following the occurrence, the aircraft wreckage was examined to the extent possible, given the level of destruction due to the impact with terrain. The physical examination of the aircraft did not identify any defects with the aircraft that may have contributed to the accident. Aircraft records were also reviewed but did not reflect any pre-existing conditions that may have contributed to the occurrence. As a result, the analysis will focus on the weather on the afternoon and evening of the occurrence date and the factors that may have influenced the pilot's decision to depart and continue on the occurrence flight. Pilot recency will also be discussed.

Owing to the fact that there were no survivors, there was limited first-hand information available to the investigation. The relevant elements of human performance are discussed in the analysis.

2.1 Pilot decision making and risk perception

In general aviation, pilot decision making (PDM) is a responsibility subject to individual capabilities. In comparison to commercial pilots, who are guided by structured defences to support decision making, private pilots rely on their own personal competencies developed over time from a combination of their qualifications, flight experience, training, and recency.

For private pilots, PDM is formed by a process that draws from best practices, personal experience, and the effective use of available resources to create a realistic plan and, in turn, develop the situation awareness required to support this plan. Assessing risk before any flight in a visual flight rules (VFR) environment is a key component underpinning effective PDM: collecting sufficient data to understand expected flight conditions increases the likelihood that a planned VFR flight will be not only feasible, but also resistant to factors that may cause undue pressure or distraction to the pilot.

Several social factors, including the intention of a flight, can contribute to the decision to depart. In particular, the decision to depart on a day VFR flight is made alongside the limiting and time-bound factors related to the statutory requirements to remain within day VFR conditions, such as specific distance from cloud, minimum visibility, and daylight remaining or available.

The occurrence pilot had flown the day VFR route from Calgary/Springbank Airport (CYBW), Alberta, to the Salmon Arm Aerodrome (CZAM), British Columbia, previously and had recently qualified on the Piper PA-32R-301, an aircraft capable of transporting 5 passengers. He likely considered that his previous experience and recent qualification justified his decision to conduct the approximately 1.7-hour flight to CZAM. The combination of experience flying the planned VFR route and relative experience as a private pilot also likely lowered the pilot's perception of risk.

However, because of the prevailing weather conditions at CYBW during the day of the occurrence, the pilot was forced to delay the original departure time. As the early evening arrived, the window of time that would allow the pilot both to depart for his trip and arrive at CZAM in day VFR conditions was diminishing. As he likely monitored the weather conditions at the time using an unknown data source, the pilot likely perceived that a trend toward day VFR weather minima would finally allow for an evening departure and that it would therefore be possible to achieve the overall goal of reaching CZAM before the end of evening civil twilight. Although the weather conditions being reported in the greater CZAM area were well suited to the conduct of a VFR flight, the pilot may not have been aware that the weather conditions to the west of CYBW were not well suited to conducting a VFR flight through the mountains.

NAV CANADA flight information centres provide interpretive weather briefings, advisory services, and flight plan filing by telephone, which, together, represent a reliable defence and provide pilots with significant information required for decision making. In this occurrence, there was no NAV CANADA briefing requested by or provided to the pilot. He likely used other sources of weather data, unknown to the investigation, that contributed to a limited perception, on his part, of the risk that weather along the route could deteriorate beyond day VFR limits.

The pilot's decision to depart was likely shaped by the perception that the weather was improving from earlier that afternoon. However, without the detail usually provided by a thorough briefing from a NAV CANADA flight service specialist on the planned route, the information that the pilot had likely prevented the development of accurate situation awareness relating to atmospheric conditions over the higher elevations to the west of CYBW.

As a result, once the change in local CYBW weather was perceived by the pilot as suitable for a VFR flight, he departed. However, the pilot likely had a lowered comprehension and perception of potential hazards along the route, resulting in an unanticipated encounter with instrument meteorological conditions, for which he was unprepared.

The pilot's decision-making process before departure was likely influenced by a number of factors, including the following:

- The pilot likely did not want to disappoint his passengers, who, along with him, were going to a planned social gathering.
- He had the opportunity to fly the "new" aircraft.
- Although he observed that the weather at CYBW had been improving, he had an incomplete understanding of the weather en route.
- He was familiar with the planned VFR flight route, given that he had completed several successful flights before the occurrence.
- He was under a time pressure to depart so that he would arrive at the destination before official night.

Finding as to causes and contributing factors

The pilot's decision to depart was influenced by an incomplete understanding of the weather, familiarity with the route, time pressure, and a personal desire to complete the flight.

As depicted on the graphic area forecast valid at the time of the occurrence and as explained in the post-occurrence meteorological assessment completed by Environment and Climate Change Canada, the weather in the foothills area of western Alberta was quite variable, with upslope wind conditions present.

The upslope winds caused air to lift and, in combination with light rain showers, likely contributed to a deterioration of conditions, even though the limited number of observations in the region makes it difficult to verify the extent of this deterioration. As the meteorological assessment explains, the forced lifting of humid air usually lowers the cloud ceilings and visibility; therefore, it is likely that the clouds near the accident site were low and the visibility was reduced at the time of the occurrence.

When the pilot encountered this weather en route, he decided to continue the flight. While the pilot's decision making at this time may have been influenced by some of the same factors that affected his decision to depart in the first place, the fact that the decision to continue was made under significant time constraint makes it difficult to determine how much of an influence these factors had on his decision.

Finding as to causes and contributing factors

When the pilot encountered clouds and reduced visibility, for unknown reasons, he decided to continue the flight toward the destination and, subsequently, the aircraft collided with terrain in the cruise attitude.

2.2 Pilot recency

In this occurrence, the pilot possessed the necessary licence, rating, and qualifications for the flight in accordance with existing regulations. However, the investigation was unable to collect any information on the status of the pilot's recency. The pilot had obtained his private pilot licence – aeroplane in December 2020. At that point, the timeframes for his 6-month, 24-month, and 5-year Transport Canada-mandated recency requirements began.

Although the pilot had been flying on a regular basis and had thus met the 6-month recency requirement, the investigation was unable to collect any documentation showing that he had completed any formal training activities that would have satisfied the 24-month recency requirement.

Other finding

The pilot's logbook did not reflect the completion of Transport Canada's 24-month recency requirement.

2.2.1 Training

2.2.1.1 Private pilot licence instrument training

By maintaining visual reference with the ground, a pilot ensures clearance from the terrain on a VFR flight. After having lost visual reference to the ground, the occurrence pilot had limited means to avoid terrain. The Garmin GNS 430W GPS, with which the occurrence aircraft had been equipped, has the ability to display basic terrain information and terrain warnings; however, the investigation was unable to determine if these features were activated at the time of the accident.

Intentionally practising skills for unplanned events is a way in which general aviation pilots can build resilience in their flying. There is no regulatory requirement for private pilots to maintain proficiency on instrument flying skills once they are licensed as a day VFR pilot. Therefore, it is incumbent on them to adopt a regular, personalized approach to maintain their skills, such as avoiding inadvertent flight into instrument meteorological conditions and escaping these conditions once they are encountered.

During the occurrence pilot's training toward his private pilot licence, he practised instrument flying skills in an aircraft, while wearing a view-limiting device (hood), and in a ground-based flight training device. The last time he had practised any instrument flying with a flight instructor was in December 2020.

To maintain proficiency in any acquired skill, individuals need to regularly practise and exercise this skill. Other than the 5 hours of instrument time gained as part of the occurrence pilot's training to obtain his private pilot licence, the investigation was unable to obtain any record of additional instrument flight time.

Finding as to risk

If instrument flying skills are not practised regularly, there is a risk that, should a VFR pilot inadvertently encounter instrument meteorological conditions, the pilot may not be able to maintain aircraft control and navigate to exit those conditions.

2.2.1.2 Mountain flying training

Although not required by the *Canadian Aviation Regulations*, mountain flying training can be very beneficial for a pilot because it provides information on the unique characteristics and challenges of flying in mountainous terrain.

The successful completion of such training does not ensure that every flight through the mountains will be a success, but it would equip a pilot with the pertinent theoretical knowledge and practical experience needed to fly in a mountainous region and recognize the various conditions and factors that the pilot could experience.

Finding as to risk

If pilots do not complete mountain flying training, there is a risk that they will not be adequately prepared for the variability in conditions that aircraft encounter in mountainous terrain.

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. The pilot's decision to depart was influenced by an incomplete understanding of the weather, familiarity with the route, time pressure, and a personal desire to complete the flight.

2. When the pilot encountered clouds and reduced visibility, for unknown reasons, he decided to continue the flight toward the destination and, subsequently, the aircraft collided with terrain in the cruise attitude.

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 instrument flying skills are not practised regularly, there is a risk that, should a visual flight rules pilot inadvertently encounter instrument meteorological conditions, the pilot may not be able to maintain aircraft control and navigate to exit those conditions.

2. If pilots do not complete mountain flying training, there is a risk that they will not be adequately prepared for the variability in conditions that aircraft encounter in mountainous terrain.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. The pilot's logbook did not reflect the completion of Transport Canada's 24-month recency requirement.

4.0 SAFETY ACTION

4.1 Safety action taken

The Board is not aware of any safety action taken following this occurrence.

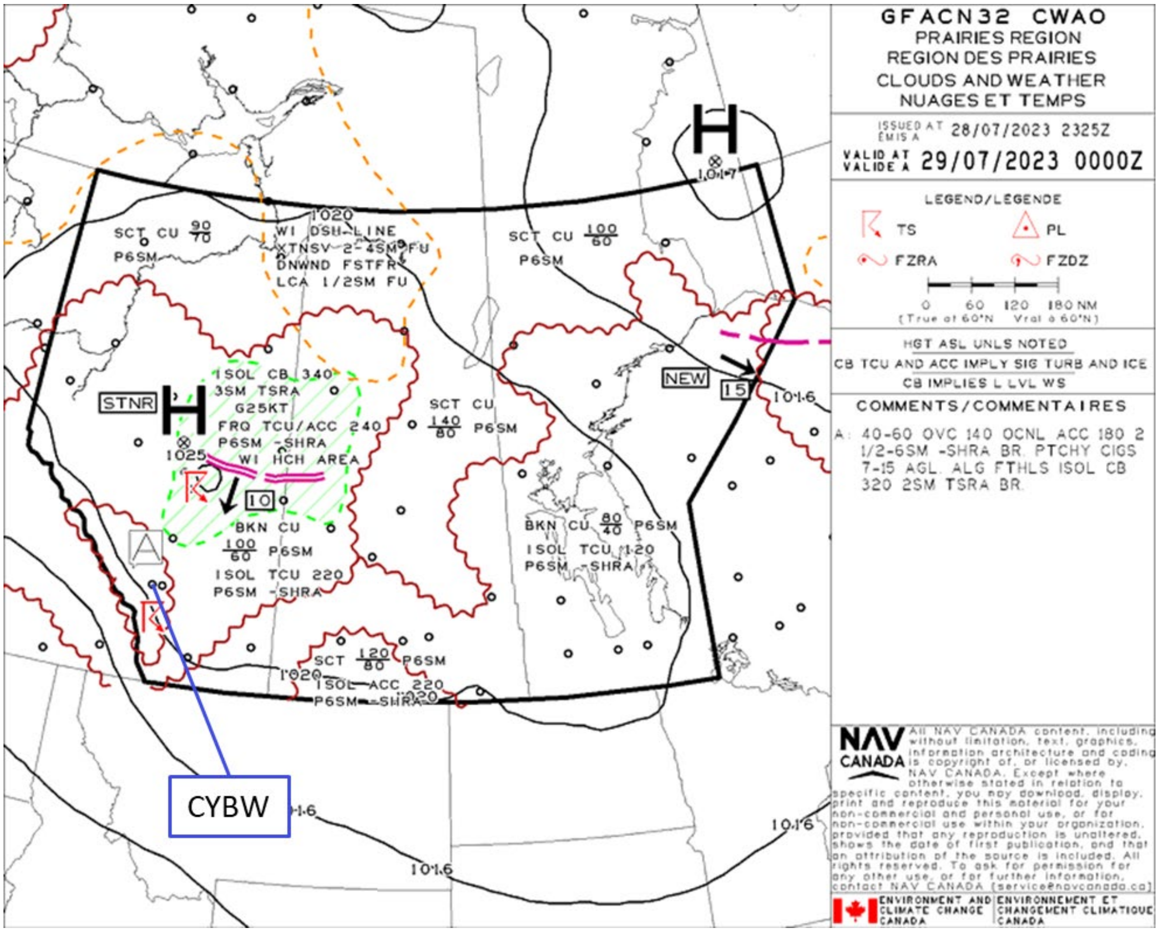
This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 14 August 2024. It was officially released on 02 October 2024.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

APPENDICES

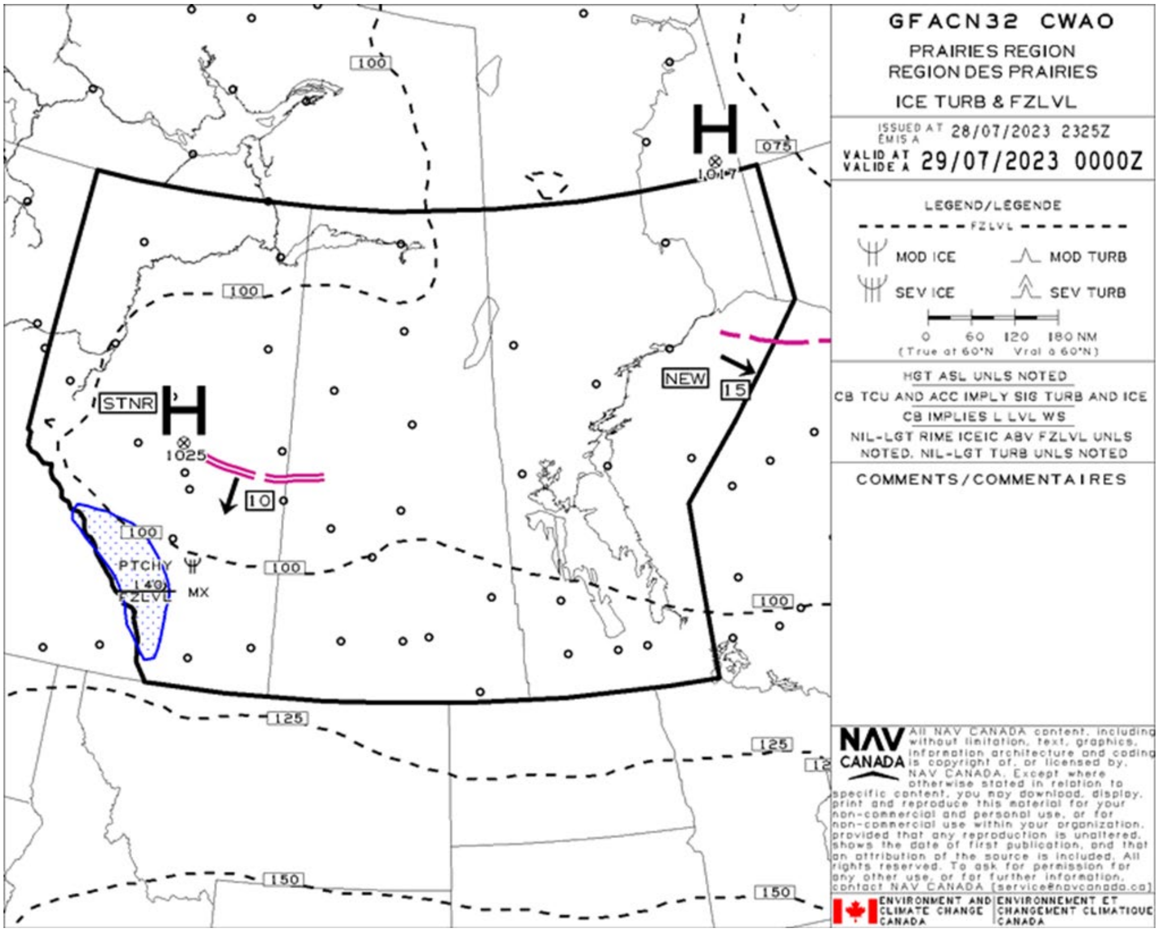
Appendix A – Graphic area forecasts valid on the date of the occurrence

Figure A1. Clouds and Weather Chart for the Prairies Region, valid at 1800 Mountain Daylight Time



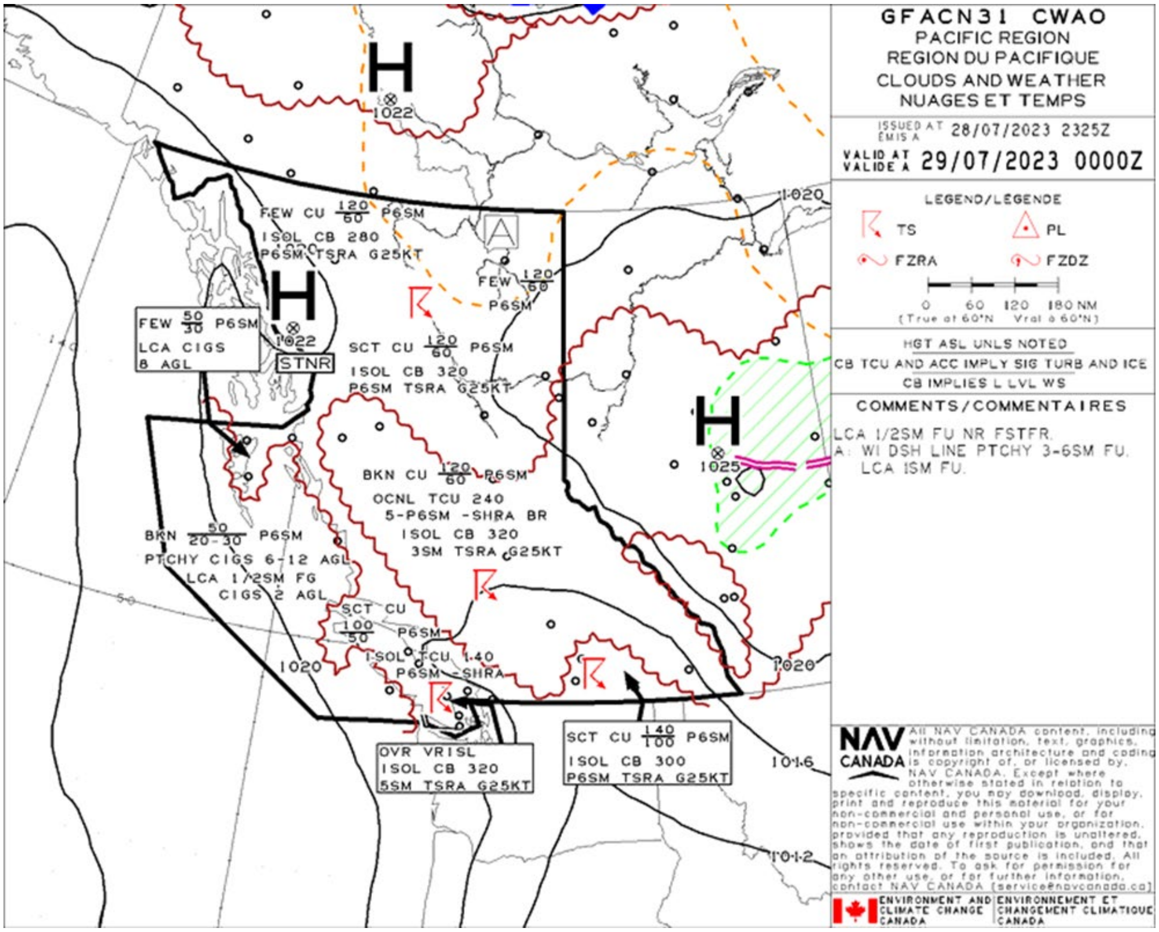
Source: NAV CANADA

Figure A2. Icing, Turbulence, and Freezing Level Chart for the Prairies Region, valid at 1800 Mountain Daylight Time



Source: NAV CANADA

Figure A3. Clouds and Weather Chart for the Pacific Region, valid at 1700 Pacific Daylight Time (1800 Mountain Daylight Time)



Source: NAV CANADA