Transport Canada / Transports Canada

ISSUE 3/2023

AVIATION SAFETY LETTER

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Transport Canada's Flight Crew Recency Requirements Self-Paced Study Program

TP 185E

Cover photo submitted by Noah Muench, taken while at Mitchinson Flight Centre

Canada

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Internet: canada.ca/aviation-safety-letter

Electronic distribution:

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Sécurité aérienne — Nouvelles est la version française de cette publication.

ISSN: 0709-8103
TP 185E

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The Power of the Spoken Word

by Elizabeth Lakoff Paquette, Manager, Safety Business Partner NAV CANADA, Rachelle Léger, Manager, Safety Programs and Product Implementation NAV CANADA, and Nicolas Jean, Manager, Area Control Centre Operations NAV CANADA

> *On July 16, 2019, at 14:26:02Z, Carrier 3396 contacted the Terminal Departure (DE) controller at NAV CANADA and was instructed to climb to flight level 210 and to turn right direct a fix, on course. Just over three minutes later, Carrier 3296, who had departed the same airport, contacted the same DE controller and was instructed to climb to 9 000 ft (as there was conflicting arrival traffic descending to 10 000 ft) and to turn right direct the same fix, on course.*
>
> *At 14:31:21Z, as Carrier 3396 reached the vertical boundary of the DE controller's airspace, the DE controller instructed Carrier 3396 to contact the adjacent controller. However, Carrier 3296 mistakenly acknowledged the change in frequency. This was the first instance of call sign confusion to occur in this scenario.*

Although the carrier was disidentified in this scenario, this is an actual example of a safety event that occurred because of call sign confusion.

An aircraft call sign is a group of alphanumeric characters—a unique identifier—that is used to identify an aircraft in air-ground communications. Call signs come in various forms: some are the aircraft's civil registration (such as C-GAPG, spoken: "Charlie Golf Alpha Papa Golf"); some are three-letter telephony call signs (such as ACA, for Air Canada); some are two-letter call signs (AB for Air Bravo); and some are military (like Voodoo or Batman).

The allocation of call signs to aircraft, which seems logical for managing, tracking or scheduling of multiple aircraft in a fleet, can have such unintended consequences on the ground or in the air, as similar call signs can result in call sign confusion.

Call sign confusion was formally identified as one of NAV CANADA's top operational safety risks as far back as 2018 and has remained a risk since that time. This risk, which is not limited to Canada, is a contributing factor in some safety-related events.

What is call sign confusion? Call sign confusion involves two or more aircraft, having similar call signs, operating on the same frequency or under the responsibility of the same controller or specialist, and one of the following situations occurs:

- A pilot takes and executes a clearance intended for another aircraft without air traffic services (ATS) noticing it.
- Air traffic control (ATC) clears or instructs the wrong aircraft, believing it is the correct one, and neither pilot identifies the error.

In either case, the similarity of the call signs creates a hazardous situation that could result in an event jeopardizing the safety of aircraft.

> *When Carrier 3396 queried the DE controller to confirm the frequency change was for them, the DE controller responded, "Carrier 3296 just remain with me then, thank you, and maintain nine thousand [feet], traffic." Although Carrier 3396 rightly questioned the DE controller, the DE controller did not realize that it was Carrier 3396 that called them and that they were talking to, not Carrier 3296. Unfortunately, Carrier 3396 did not correct the DE controller.*

Common causes of call sign confusion can take different forms:

- operator or flight schools allocate consecutive call signs (C-GMFC and C-FMFC)
- operator schedule flights with similar call signs to be in the airspace at the same time (ABC123 and XYZ123)
- call signs coincidentally contain the same alphanumeric characters in a different order (same company - ABC123 and ABC132, or two different companies - AB1234 and BA2314)
- call signs containing repeated digits (ABC555)

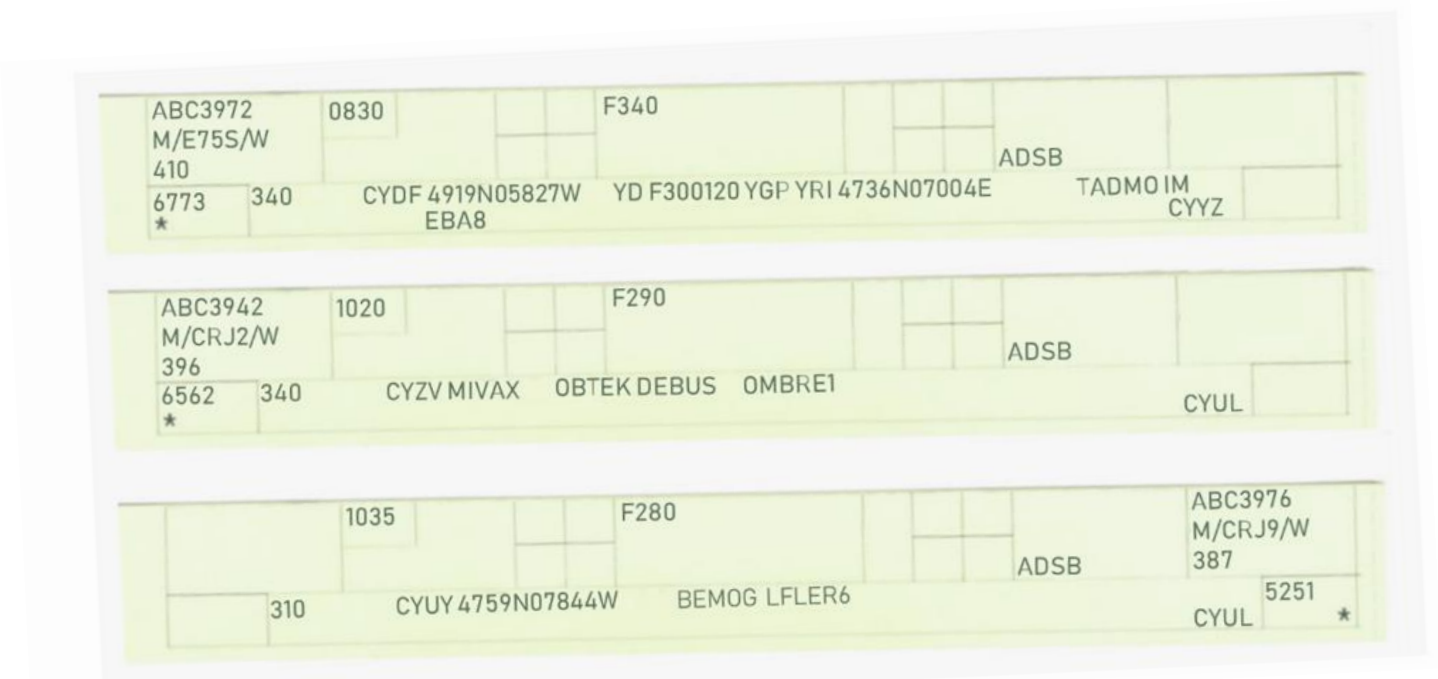


Figure 1: Example of de-identified flight strips, where three aircraft with similar sounding idents were in the same controller's airspace.

In the last year, NAV CANADA identified 34 safety-related events of call sign confusion by the specialist/controller, the pilot or both. In each instance, similar call signs were the main contributing factor.

Other contributing factors were:

- failure of operator to identify the risk of similar call signs (numbering process)
- expectations and/or anticipations (confirmation bias)
- sub-optimal situation awareness
- poor radio transmission techniques
- deviation from proper phraseology
- delays in schedules

At 14:31:40Z, Carrier 3296 made initial contact with the adjacent controller, who was busy speaking to someone else on another line at the time. A few seconds later, the adjacent controller proceeded to instruct Carrier 3396 to proceed direct to another fix and to climb to flight level 250. Carrier 3296 read back the instructions. Again, Carrier 3296 accepted instructions for Carrier 3396. Despite being cleared to a fix that was not on their flight plan, Carrier 3296 did not identify that the instructions were not intended for them. The controller, seeing only Carrier 3396 in their airspace and expecting Carrier 3396 to respond, did not capture the error either.

At almost the same time, the DE controller instructed Carrier 3296 to "stay with me, maintain nine thousand ft." Carrier 3296 did not respond. This perplexed the DE controller, and they then queried whether Carrier 3396 was still on their frequency. Carrier 3396 responded that they believed that Carrier 3296 had accidentally taken their assigned frequency. This was the moment the DE controller seemed to realize what had occurred and immediately called for Carrier 3296 who, again, did not respond.

Call sign confusion impacts the performance and cognitive load of both pilots and air traffic service professionals. Plus, in an environment where pilot, controller and/or specialist workload and interruption or distraction occur, it can be easy for any individual to miss that an error has occurred.

At 14:32:12Z, the DE controller made a call to the adjacent controller on the hotline, as surveillance data indicated that Carrier 3296 had started climbing out of 9 000 ft; this was the moment where the aircraft would leave a safe altitude and potentially conflict with the arriving aircraft. The adjacent controller answered the hotline call, and the DE controller immediately instructed them to transfer Carrier 3296 back to their frequency and to "stop them at nine; descend them to nine now." Then, the DE controller immediately instructed the Arrival controller to turn the conflicting traffic near the path of Carrier 3296.

What is most concerning is that the exposure to similar sounding call signs is rising. There has been an alarming increase in the number of similar call sign instances reported and captured at NAV CANADA. With increased exposure comes increased risk of call sign confusion for both ATS personnel and the pilot.

At 14:32:27Z, the adjacent controller requested the DE controller to clarify to which aircraft they were referring. The DE controller advised that Carrier 3296 was on their frequency, climbing and in conflict

with an arriving aircraft. The adjacent controller stated that they were not talking to Carrier 3296. The adjacent controller had no idea that they were actually speaking to Carrier 3296 and not to Carrier 3396, as their display would have shown Carrier 3396 in their airspace, not Carrier 3296.

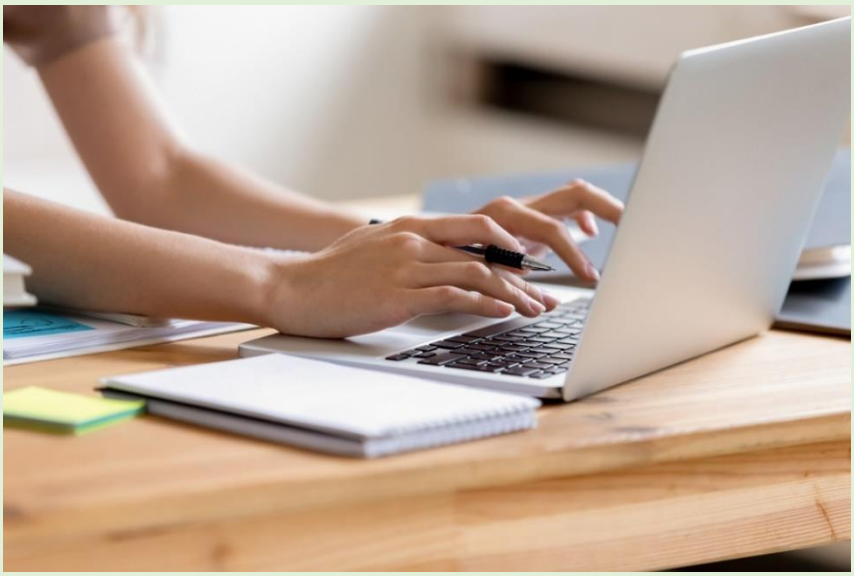
At 14:33:04Z, surveillance data indicated that the lateral spacing between Carrier 3296 and the conflicting arriving aircraft had reduced to 3.1 miles laterally, increasing; vertical spacing between the aircraft was 800 ft and increasing in airspace, where 1 000 ft vertical and 5 miles lateral spacing were required.

As Canada's air navigation service provider, NAV CANADA has implemented several risk controls, such as procedures for when a specialist/controller identifies similar sounding idents as well as established new aviation occurrence reporting procedures for capturing instances of call sign confusion. NAV CANADA is also working with carriers to help identify cases of similar sounding idents and has produced reports for two of Canada's major carriers. These reports contain a national snapshot of the risk, including the number of aviation occurrence reports of call sign confusion.

NAV CANADA remains unwavering in our efforts to reduce call sign confusion in commercial operations. Carriers, operators and flight schools can all help by increasing the awareness of those that plan, schedule or assign call signs to try to reduce and eliminate the occurrence of similar sounding idents.

We believe that through collaboration and with commitment from all stakeholders to reduce the exposure to similar sounding idents, we can successfully see a reduction in potential instances of call sign confusion. △

Transport Canada's Flight Crew Recency Requirements Self-Paced Study Program



Since last year, the Flight Crew Recency Requirements Self-Paced Study Program is no longer published in its entirety in the *Aviation Safety Letter* (ASL). With the expansion of the exam and technological advances, it was determined to be more convenient to complete the exam online. Each year, a reminder will be published in the ASL with a link to the exam to remind readers that it is available online.

It is important to note that a printable version of the exam is still available online as a PDF.

If you have any questions or comments regarding the Flight Crew Recency Requirements Self-Paced Study Program, please send an e-mail to the flight crew licensing group at: PilotLicensing-LicencesdePilote@tc.gc.ca. △

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Miscommunication Errors can be Prevented

by Christopher Rieken, Director, Operational Safety, NAV CANADA *and Anthony McKay, Vice President and Chief Safety and Quality Officer, NAV CANADA*

Aviation safety, in the air and on the ground, is a shared responsibility between all aviation stakeholders. Communications are essential to safety, and safety investigations often cite communications as a primary contributing factor in safety events. It is easy to forget that the voice on the other end of the radio is a person, too. If everyone begins with the same foundation of standard phraseology, there is less room for error or misinterpretation.

Miscommunications can happen between even the most experienced professionals. Increasing awareness of some of the potential miscommunication errors identified as contributing hazards in safety events may prevent them from reoccurring. Some of these opportunities for miscommunication can be mitigated by using standard phraseology and communications, including:

- Flight plans or NOTAMs being filed using incorrect local time rather than Zulu/UTC

  All of aviation, including air traffic services (ATS) staff and their systems, use Zulu/UTC as the primary time datum. When filing a flight plan, submitting a NOTAM or advising ATS of planned aviation activity, Zulu/UTC shall be used to avoid misfiling and activation of a flight plan or NOTAM or negating alerting services for a flight.

- Flight plans or NOTAMs being filed using spoken letters from the alphabet or the airport name rather than using phonetics from the airport ident Figure 1

  Was that Sidney or Sydney? Over the phone or VHF, C-Y-Q-Y sounds a lot like C-Y-Q-I. CHARLIE – YANKEE – QUEBEC – YANKEE is very clear. Do it right the first time, and “slow down to go faster” so that if something goes wrong, Search and Rescue is looking for you around Sydney instead of the miscommunicated Yarmouth.

- Readback/hearback errors

  While not all air traffic control (ATC) clearances and instructions require a pilot to readback the instruction, it is easy for a pilot or ATS to hear what they expect to hear. Miscommunication risk is increased on busier frequencies, when ATS or pilots speak too fast or when vigilance is reduced due to complacency when operating in a familiar or routine operation.

- Similar sounding call signs

  Aircraft civil registrations or commercial air operator call signs can often sound similar. Identical letters or numbers at the beginning or the end of a call sign and call sign "anagrams" can lead to a pilot mistakenly responding to or actioning a clearance from ATS intended for another aircraft. The risk of miscommunication can be increased by abbreviating a callsign in a readback or by grouping numbers. ATS will endeavour to inform pilots when similar sounding call signs may be on the same frequency to raise awareness and attention. It is imperative that civil idents use phonetics for the full registration and that call signs use the correct and full aircraft call sign prior to the number.

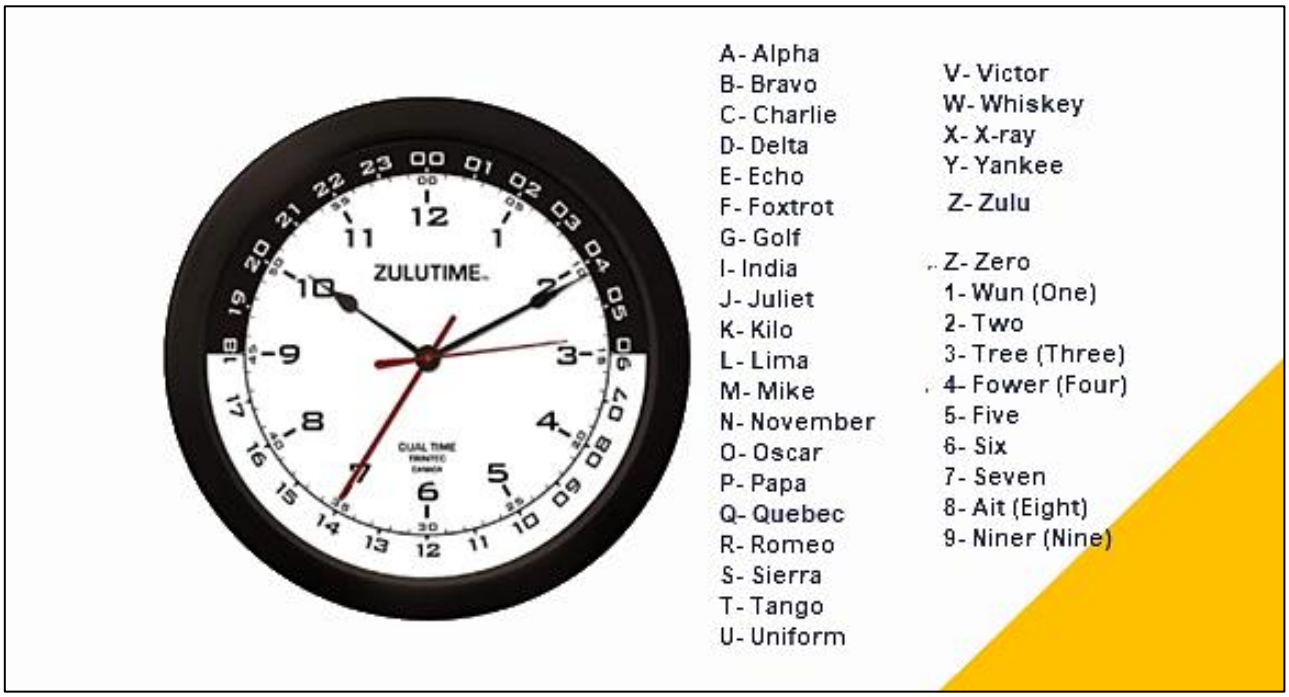

Figure 1: Zulu/UTC clock and phonetics alphabet

NAV CANADA has worked extensively with flight training units, commercial aviation leaders and aviation councils to develop several Operational Guides and reference materials for critical areas of communication, such as instrument flight rules (IFR), visual flight rules (VFR) and ground traffic phraseology, NOTAMs, flight planning, and Aviation Weather Services. These guides are learning tools and reference documents supporting standardized communications between pilots, ATS and other aviation stakeholders. The guides are on the NAV CANADA website at NAVCANADA.CA—Operational Guides. △

Figure 2: NAV CANADA phraseology guides

REGULATIONS AND YOU

Transport Canada documents published recently

Document number (R-Revised)	Issue number (Date issued)	Subject
AC 302-032	Issue 02 2023-08-11	Designation of International Airports in Canada
AC 700-053	Issue 02 2023-08-11	SA CAT II: Special Authorization/Specific Approval and Guidance
AC 700-005	Issue 04 2023-08-04	Use of Portable Electronic Devices
AC 700-063	Issue 02 2023-06-15	North Atlantic—High Level Airspace Operations (NAT HLA): Special Authorization/Specific Approval and Guidance
CASA 2023-03	Issue 01 2023-08-11	Safety Valve—Opening During Normal Operation and Ingestion of Insulation Blankets
CASA 2023-02	Issue 01 2023-07-19	Oxygen—Portable Protective Breathing Equipment (PBE)—Missing PBE in the Forward Area of the Aeroplane

Submission of Aviation Safety Letter (ASL) articles

Do you have an aviation safety topic you are passionate about? Do you want to share your expert knowledge with others? If so, we would love to hear from you!

Credit: iStock

General information and guidance

The ASL's primary objective is to promote aviation safety. It includes articles that address aviation safety from all perspectives, such as safety insight derived from accidents and incidents, as well as safety information tailored to the needs of all holders of a valid Canadian pilot licence or permit, to all holders of a valid Canadian aircraft maintenance engineer (AME) licence and to other interested individuals within the aviation community.

If you are interested in writing an article, please send it by e-mail to TC.ASL-SAN.TC@tc.gc.ca in your preferred language. Please note that all articles will be edited and translated by the Transport Canada Civil Aviation (TCCA) Aviation Terminology Standardization Division and will be coordinated by the ASL team.

Photos

In order to captivate our readers' interest, we recommend that you include one or two photos (i.e., photo, illustration, chart or graphic) for each article, if possible. Please send us your photos as an e-mail attachment (preferably as a jpeg).

We look forward to receiving your articles! △

INSTRUCTOR'S CORNER

The purpose of the ASL instructor's corner is for instructors to share past instructing/teaching experience with the ASL readership.

Submitted articles can be addressed to a variety of readers, instructors, student pilots, private pilots, and glider, ultra-light or commercial pilots. In fact, this issues's article is for any type of student that an instructor may encounter in the course of their career, whether it be for a licence or a rating. The most important thing is that, at the end of the article, a lesson has been learned.

Your submissions can be as basic as attitude and movement for private pilot training, to night rating, multi-IFR or seaplane rating, teaching tips for instructors. It can also be tips to increase aviation safety or to be better prepared for a flight.

It's up to you, as long as you have your instructor's hat when you're writing your piece.

If you would like to submit an article or would like more information, please send an email to the following address: jim.mulligan@tc.gc.ca △

Cold Weather Operations

The cold weather is upon us, and so is the season for de-icing and anti-icing. Past incidents and research have demonstrated that even small amounts of contamination on an aircraft's critical surfaces can have a very large effect on the aircraft's performance and handling qualities. Contamination such as frost with thickness as small as 0.40 mm (1/64 in.) can disrupt air flow over the lift and control surfaces of an aircraft, potentially leading to increased drag, lift loss and impaired manoeuvrability. This is especially true during the takeoff and initial climb phases of flight. Ice can also significantly increase aircraft weight, interfere with the movement of control surfaces, and prevent the functionality of critical aircraft sensors.

The holdover times for SAE-qualified de-icing and anti-icing fluids are obtainable in the Transport Canada holdover time (HOT) guidelines by visiting the Holdover time (HOT) guidelines for de-icing and anti-icing aircraft page or by requesting a copy of the winter 2023-2024 Holdover Time Guidelines at services@tc.gc.ca. △

Credit: iStock

TSB FINAL REPORTS SUMMARIES

The following summaries are extracted from final reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified. Unless otherwise specified, all photos and illustrations were provided by the TSB. For the benefit of our readers, all the occurrence titles are hyperlinked to the full report on the TSB Web site. —Ed.

TSB Final Report A22W0027—In-flight icing and collision with terrain

History of the flight

At 1427Z on 22 April 2022, a Mooney M20K (Mooney 231) aircraft departed Runway 35 at Calgary/Springbank, Alta. (CYBW) for a local round-robin flight on an instrument flight rules (IFR) flight plan, with two pilots on board. The aircraft had recently been purchased, and the purpose of this flight was for the right-seat pilot to become familiar with operating the Mooney 231 and learn from the pilot-in-command, who was occupying the left seat and had experience on the aircraft type. The aircraft was later to be relocated to its new owner in Fort St. John, B.C., where the right-seat pilot was to provide type-specific instruction to the new owner.

After takeoff, the aircraft turned left toward the TURNY waypoint, climbing to a cruising altitude of 9 000 ft above sea level (ASL). It flew over High River Aerodrome, Alta. (CEN4), and headed northeast toward the EBGAL waypoint. The aircraft then turned left and proceeded back toward the TURNY waypoint. When the aircraft was flying just northwest of Okotoks, Alta. (CFX2) at an altitude of approximately 8 000 ft ASL, it turned slightly to the right to cross the initial approach waypoint (SEKEM) and return to CYBW for an instrument approach and landing on Runway 35 (Figure 1).

At 1509Z, before crossing SEKEM, the pilot-in-command contacted air traffic services (ATS) and requested a lower altitude because the aircraft was "picking up a little ice." ATS cleared the aircraft to descend with a restriction of not below 6 200 ft ASL.

The aircraft crossed SEKEM at an altitude of 6 100 ft ASL, travelling at a ground speed of 97 kt. It then crossed the step-down waypoint (XUBUM) at an altitude of 5 900 ft ASL, travelling at a ground speed of 114 kt, and crossed the final approach waypoint (TARTI) at an altitude of 5 800 ft ASL, approximately 500 ft above the vertical path angle and still travelling at a ground speed of 114 kt.

The aircraft continued to descend and passed below the vertical path and ultimately below the decision altitude of 4 190 ft ASL. At 1518Z, it struck the bank of a ditch on the north side of the Trans-Canada Highway, 0.6 nautical miles (NM) south of the threshold of the runway and slid to a halt in a pasture. The pilot-in-command was fatally injured from the impact forces, and the right-seat pilot received serious injuries.

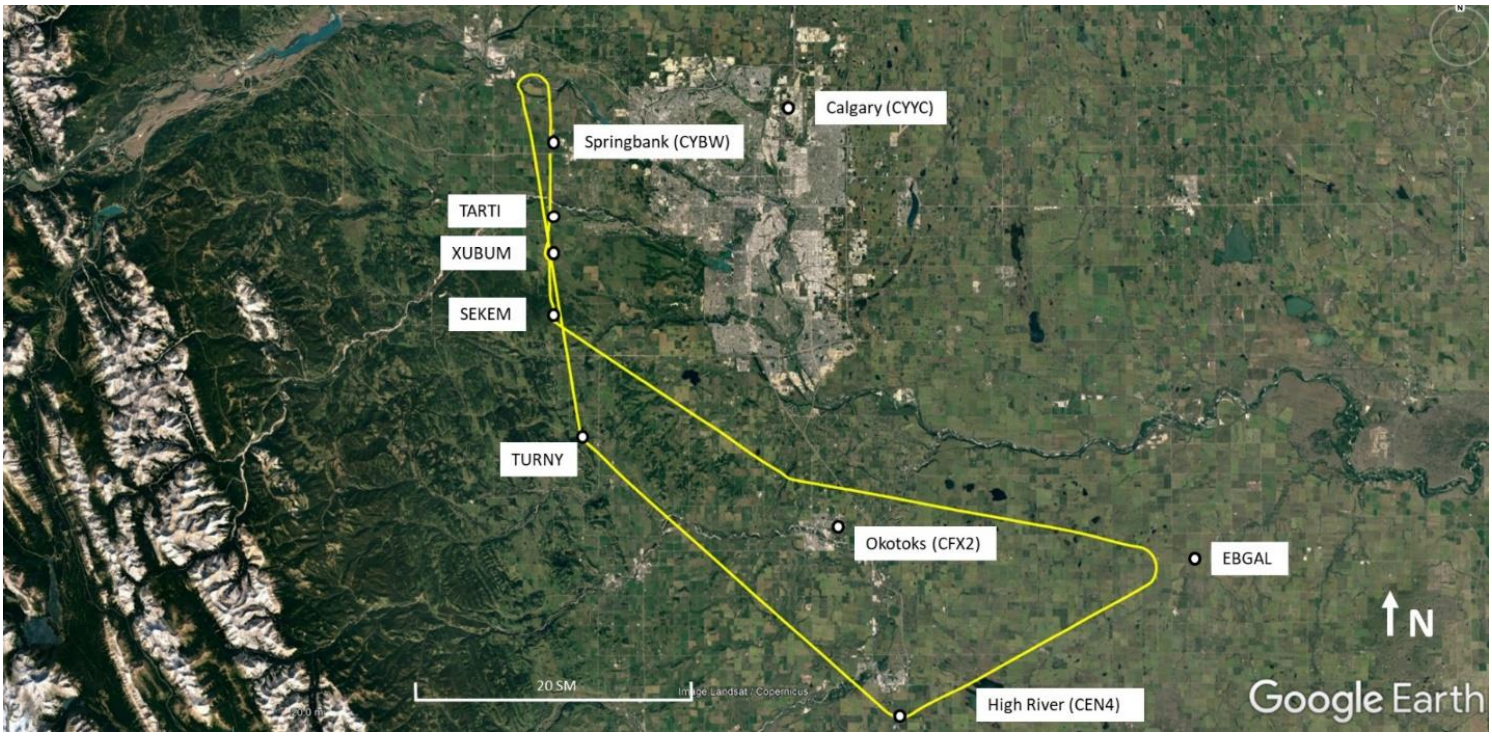

Figure 1: Area map showing the occurrence flight path (yellow line)
(Source: Google Earth, with TSB annotations)

Figure 2: Accident site looking northwest (Source: TSB)

Pilot information

The pilot-in-command held a valid private pilot licence, endorsed with a group 1 instrument rating and a multi-engine rating. The pilot met the recency requirements for the group 1 instrument rating.

The right-seat pilot held a valid commercial pilot licence, endorsed with a group 1 instrument rating, a multi-engine rating and a class 3 flight instructor rating.

Aircraft information

The Mooney M20K is a low-wing, single-engine, four-seat, general aviation aircraft with retractable tricycle landing gear. It is powered by a turbocharged six-cylinder piston engine. The occurrence aircraft was manufactured in 1981.

The investigation did not identify any issues related to the aircraft's equipment or maintenance that would have prevented it from operating normally during the occurrence flight. The aircraft had been purchased by a new owner in March 2022 and, as part of that process, had gone through extensive maintenance, including an annual inspection.

The aircraft was not equipped or certified for flight into known or forecast icing conditions. The *Canadian Aviation Regulations* stipulate that where icing conditions are reported to exist or are forecast to be encountered, the aircraft must be adequately equipped to operate in icing conditions.

Impact and wreckage information

The aircraft collided with the bank of a ditch on the north side of the westbound lanes of the Trans-Canada Highway. The aircraft hit the ground in right-wing-low, nose-down attitude, went through a barbed wire fence and came to rest 68 ft north of the ditch, facing a southerly direction (Figure 2).

Royal Canadian Mounted Police (RCMP) officers from the Cochrane detachment responded shortly after the accident. Several photos were taken of the exterior of the aircraft and shared with the Transportation Safety Board (TSB). The photos revealed a build-up of mixed ice on the aft very high frequency (VHF) communication antenna, the leading edges of the horizontal stabilizer and the leading edge of the left wing (figures 3 and 4). The investigation estimated the build-up of the mixed ice on the VHF communication antenna to be between ¾ and 1 in. thick.

The aircraft's digital tachometer was sent to the TSB Engineering Laboratory in Ottawa, Ont. for analysis. The data recovered from the unit indicated that the engine was operating normally for the duration of the flight.

Weather

At 1316Z, an amended aerodrome forecast (TAF) was issued for CYBW, forecasting the following:

- visibility more than 6 statute miles (SM) in light snow
- scattered clouds at 600 ft above ground level (AGL) and overcast ceiling at 2 500 ft AGL
- temporarily between 1300Z and 1500Z, visibility 1 SM in light rain showers, snow and mist
- broken ceiling at 600 ft AGL, overcast cloud layer at 1 500 ft AGL

Figure 3: Mixed ice accumulation on aft VHF (very high frequency) communication antenna (Source: Royal Canadian Mounted Police, with TSB annotations)

Figure 4: Horizontal stabilizer mixed ice (Source: Royal Canadian Mounted Police, with TSB annotations)

Between 1300Z and 1400Z, the automated weather observation system (AWOS) at CYBW issued 9 aerodrome special meteorological reports (SPECIs), reporting significant changes in the weather.

The CYBW automatic aerodrome routine meteorological report (METAR AUTO) issued at 1400Z reported the following:

- visibility 9 SM in light rain
- overcast ceiling at 900 ft AGL
- temperature 1.2°C, dew point 0.0°C
- altimeter setting 29.90 in. Hg

At 1400Z, the CYBW automatic terminal information service (ATIS) was reporting information "Papa," which included the weather information from the METAR issued at 1400Z and reported the Runway 35 surface condition as 100% covered in 1/8 in. of slush.

At 1500Z, 18 minutes before the accident, the CYBW ATIS was reporting information "Quebec," with the following conditions:

- winds from 030° magnetic (M) at 5 kt
- visibility 9 SM
- overcast ceiling at 1 000 ft AGL
- temperature 1.1°C, dew point −0°C
- altimeter 29.91 in. Hg
- runway 35 surface condition reported as 100% wet

At 1516Z, the AWOS issued a SPECI, reporting the following conditions:

- visibility 9 SM in light rain
- overcast ceiling at 800 ft AGL
- temperature 0.8°C, dew point -0.1°C

The Clouds and Weather Chart of the graphic area forecast (GFA) valid at the time of the occurrence indicated frequent altocumulus castellanus clouds in the vicinity and to the west of CYBW. These clouds continued all the way to the border of British Columbia, with a visibility of 1 to 4 SM in light snow showers, and patchy ceilings between 800 and 1 500 ft AGL. A note below the legend on the Clouds and Weather Chart states: "CB TCU AND ACC IMPLY SIG TURB AND ICE" (cumulonimbus, towering cumulus and altocumulus castellanus imply significant turbulence and icing).

The Icing, Turbulence, and Freezing Level Chart of the GFA did not depict any areas of moderate or severe icing conditions in the vicinity of CYBW; however, it did indicate the freezing level to be at 5 000 ft ASL. A note below the legend on the Icing, Turbulence, and Freezing Level Chart states: "NIL-LGT RIME ICEIC ABV FZLVL UNLS NOTED" (nil to light rime icing is to be expected in cloud above the freezing level unless noted).

In addition to the weather information products mentioned above, pilots can consult NAV CANADA's automated supplementary enroute weather predictions (ASEP) page from the Aviation Weather website. Appendix A provides samples of the graphic depictions of the conditions between 0900Z and 1200Z on the day of the occurrence. These graphics depict the potential for an aircraft to experience in-flight icing in the vicinity of the planned flight route and at the planned altitude.

The investigation was unable to determine with certainty what weather information the pilots consulted before the occurrence flight; however, the pilots had not contacted a NAV CANADA flight information centre for a weather briefing before departure. The *Canadian Aviation Regulations* require that the pilot-in-command be familiar with the available weather information appropriate for the intended flight.

In-flight icing

Ice can form on aircraft in flight, mainly as a result of three processes: super cooled water droplets, freezing of liquid water or the transition of vapour directly to ice. Depending on the process involved and the conditions, these accretions are normally classified into four categories: clear ice, rime ice, mixed ice and hoarfrost. All of these types of accretions degrade performance, although to varying degrees, and all aircraft are affected negatively when accumulating ice in flight.

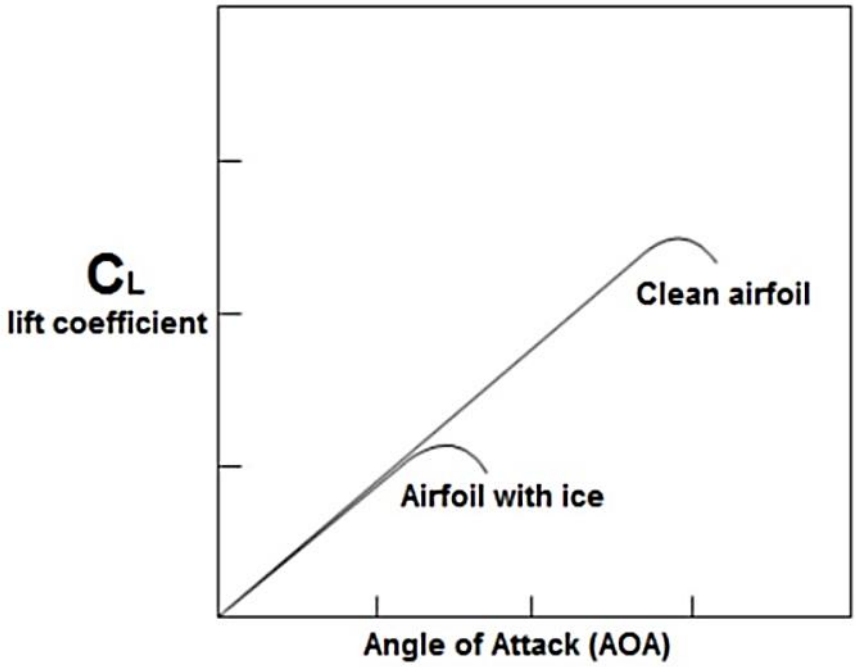

Figure 5: Graph showing how ice affects the coefficient of lift for an airfoil (Source: Federal Aviation Administration, Advisory Circular AC 91-74B: Pilot Guide: Flight in Icing Conditions [August 2015], Figure 3-5.)

Structural aircraft icing occurs when the various parts of an aircraft (wings, stabilizers, antenna, etc.) accumulate ice during flight. The effects of structural icing on aircraft performance have been well-documented. In August 2015, the U.S. Federal Aviation Administration published Advisory Circular (AC) 91-74B: Pilot Guide: Flight in Icing Conditions, which provides "essential information concerning safe flight in icing conditions, what conditions a pilot should avoid, and how to avoid or exit those conditions if encountered."[1]

As described in AC 91-74B, the accumulation of even a small amount of ice on an airfoil[2] in flight significantly reduces the maximum amount of lift available at any given airspeed or angle of attack and significantly reduces the angle of attack at which a stall occurs (Figure 5). It is not unusual for the maximum coefficient of lift to be reduced by 30 percent.[3]

The accumulation of ice also has a detrimental effect on the drag of an airfoil (Figure 6). This means that as ice accumulates on the surface of the airfoil, the drag increases significantly and quickly as the angle of attack increases. It is not unusual for drag to increase by 100 percent.

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[1] Federal Aviation Administration, Advisory Circular AC 91-74B: Pilot Guide: Flight in Icing Conditions (August 2015), section 1-1: Purpose.

[2] A cross-section of a wing is an airfoil; therefore, ice that accumulates along the span of the wing will have the same effect.

[3] Federal Aviation Administration, Advisory Circular AC 91-74B: Pilot Guide: Flight in Icing Conditions (August 2015), section 3-2: General Effects of Icing on Airfoils.

In addition, AC 91-74B notes the following:

An aircraft with a completely unprotected wing is unlikely to be certificated for flight in icing conditions, but may inadvertently encounter icing conditions. […] The ice causes an increase in drag, which the pilot detects as a loss in airspeed or an increase in the power required to maintain the same airspeed. (The drag increase is also due to ice on other parts of the aircraft). The longer the encounter, the greater the drag increase; even with increased power, it may not be possible to maintain airspeed. If the aircraft has relatively limited power (as is the case with many aircraft with no ice protection), it may soon approach stall speed and a dangerous situation.

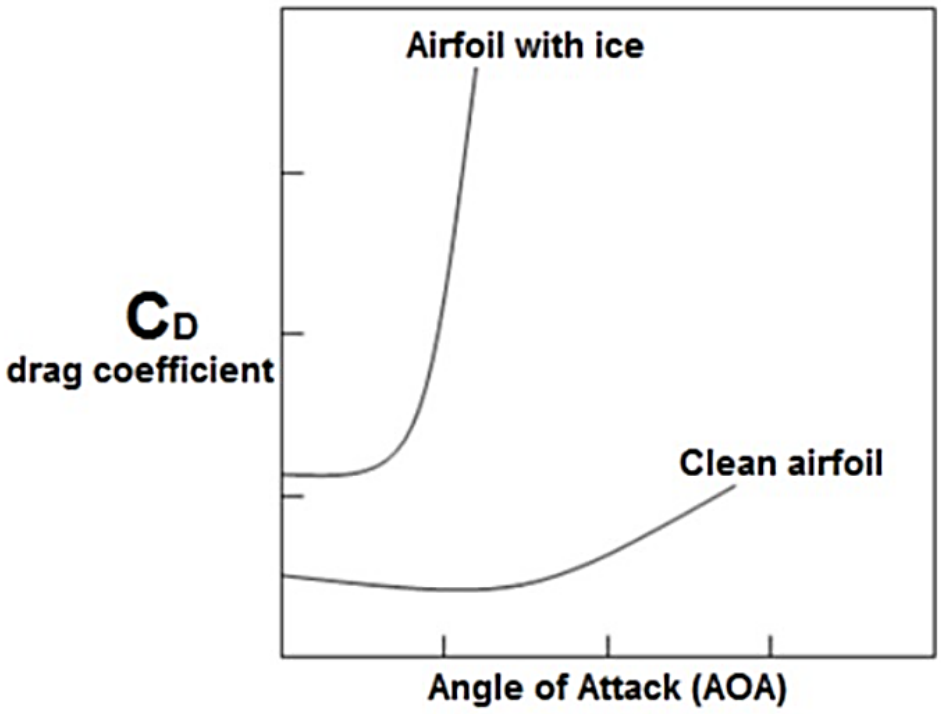

Figure 6: Graph showing how ice affects the drag coefficient of an airfoil (Source: Federal Aviation Administration, Advisory Circular AC 91-74B: Pilot Guide: Flight in Icing Conditions [August 2015], Figure 3-6.)

TSB laboratory reports

The TSB completed the following laboratory reports in support of this investigation:

- LP044/2022–Radar Analysis
- LP036/2022–NVM Recovery–Various Devices

Safety messages

Pilots must be diligent when checking the weather before a flight by consulting all available weather resources, including NAV CANADA flight information centres, and reviewing all available weather products, including pilot reports and special weather reports, for the area of the planned flight.

Weather conditions that are conducive to icing are difficult to predict. If icing is encountered when flying aircraft that are not certified for icing conditions, it is imperative that pilots exit the icing conditions immediately. Additionally, pilots should treat this situation as an emergency and declare it as such in order to obtain all available assistance.

Appendix A—Automated supplementary en route weather predictions (ASEP) for the occurrence flight

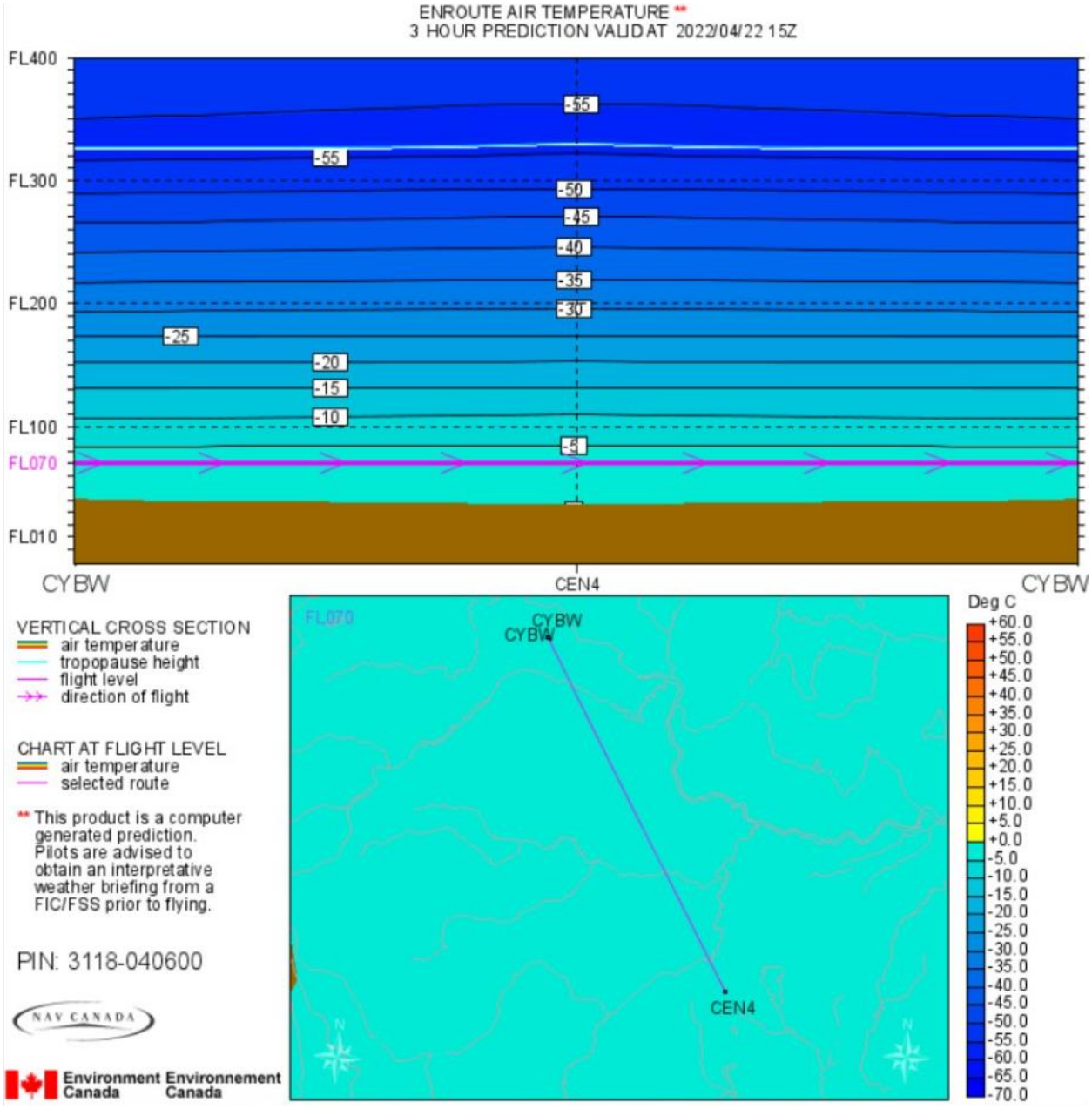

Figure A1: Enroute air temperature chart (Source: NAV CANADA)

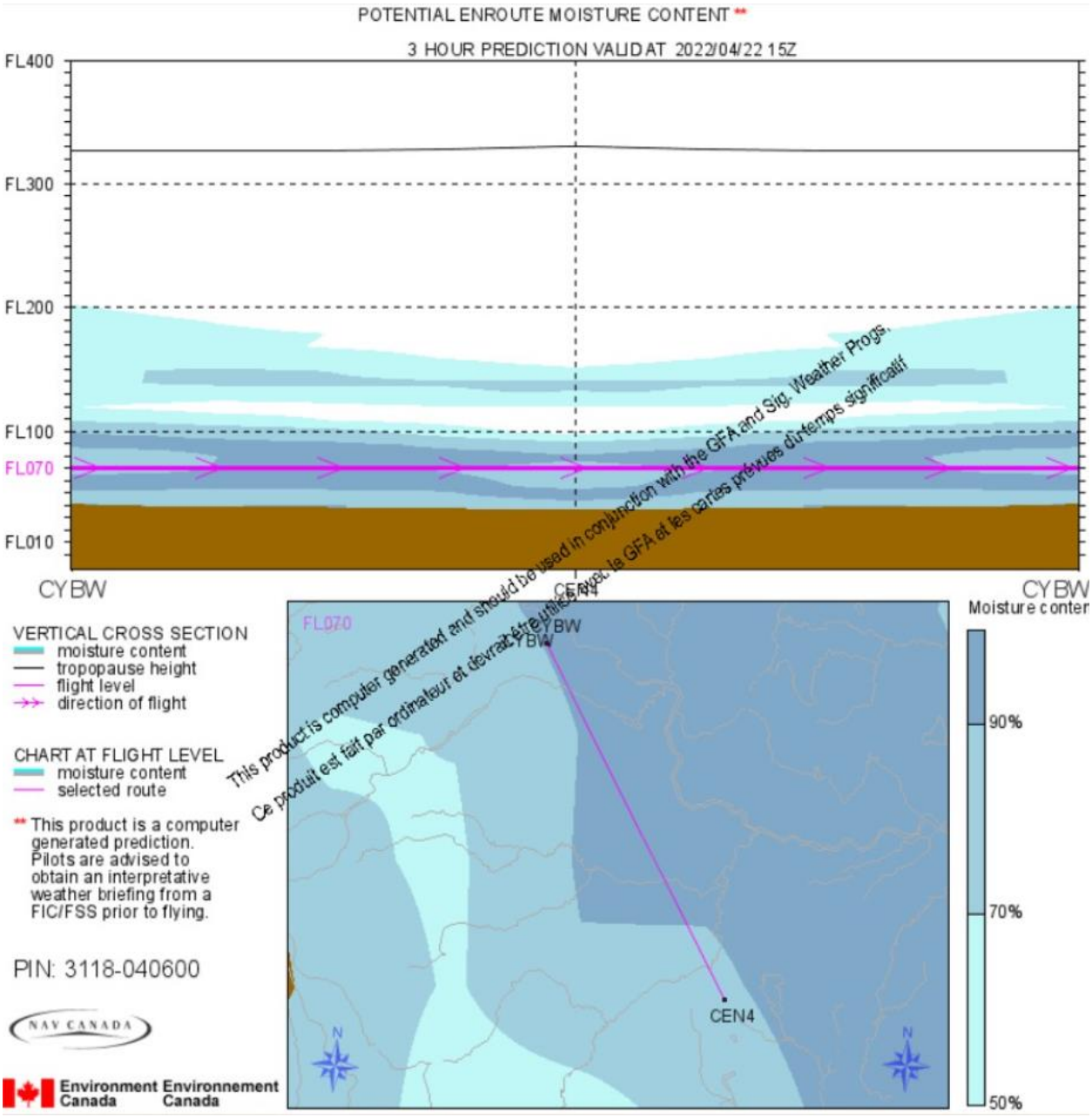

Figure A2: Potential enroute moisture content chart (Source: NAV CANADA)

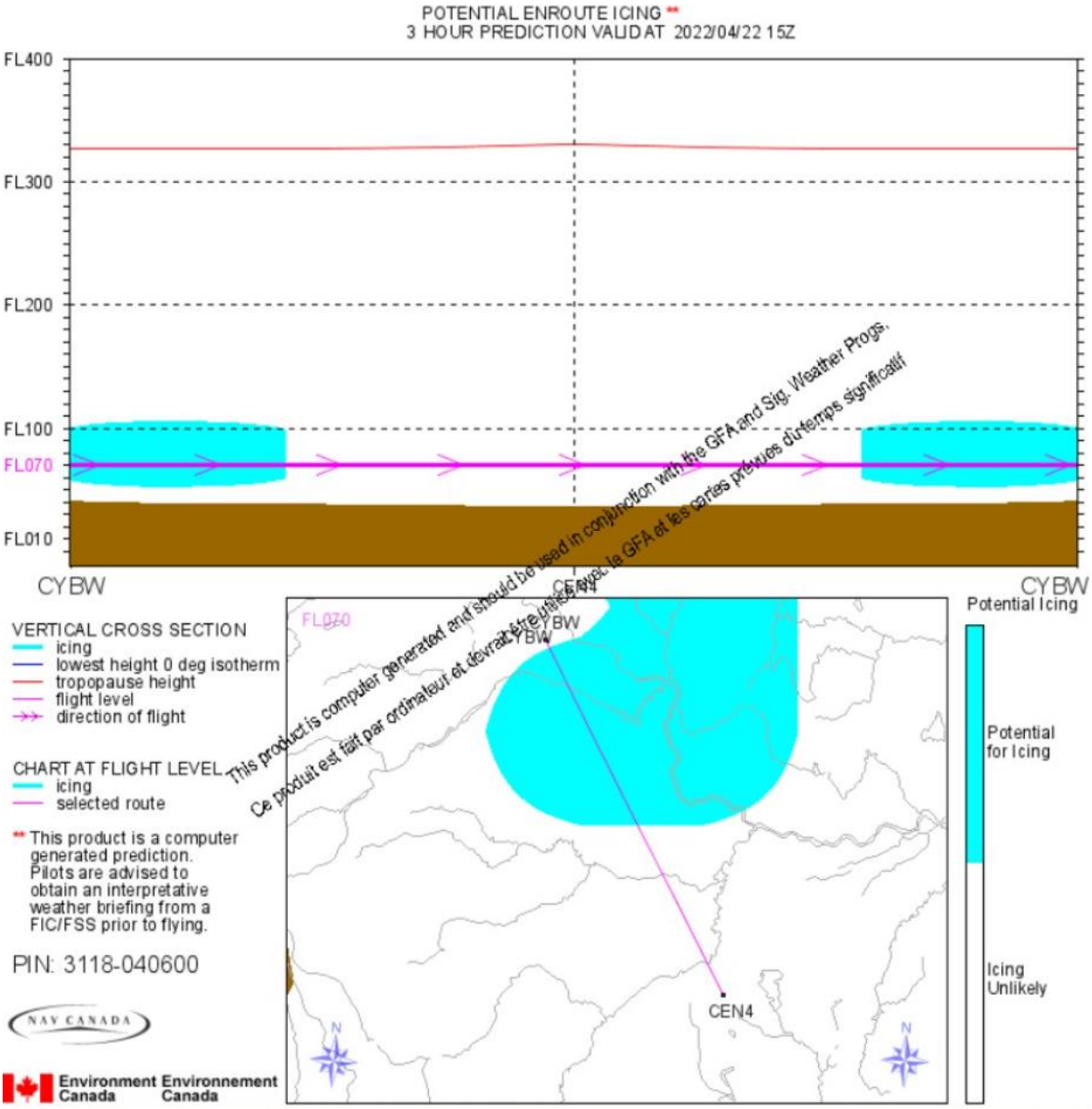

Figure A3: Potential enroute icing chart (Source: NAV CANADA)

TSB Final Report A22C0082—Collision with Obstacle

History of the flight

On 18 September 2022, a Cessna 172 aircraft was conducting a visual flight rules (VFR) flight consisting of multiple legs from Swift Current, Sask. (CYYN) to Estevan Regional Aerodrome, Sask. (CYEN). The purpose of the flight was to gather electronic data on pipeline infrastructure for a client along a predetermined route that extended southeast of Shaunavon, Sask., then eastward to Estevan.

The aircraft departed CYYN at 0827Z with two pilots on board.[1] At approximately 1003Z, the aircraft struck a communications tower approximately six nautical miles south–southwest of Shaunavon (Figure 1). The aircraft's last recorded position on its flight tracker (at 10:01:30Z) was 1.2 nautical miles west-northwest of the communications tower at an altitude of 3 741 ft above sea level (ASL), which was 572 ft above ground level (AGL). The aircraft was destroyed. Both pilots were fatally injured.

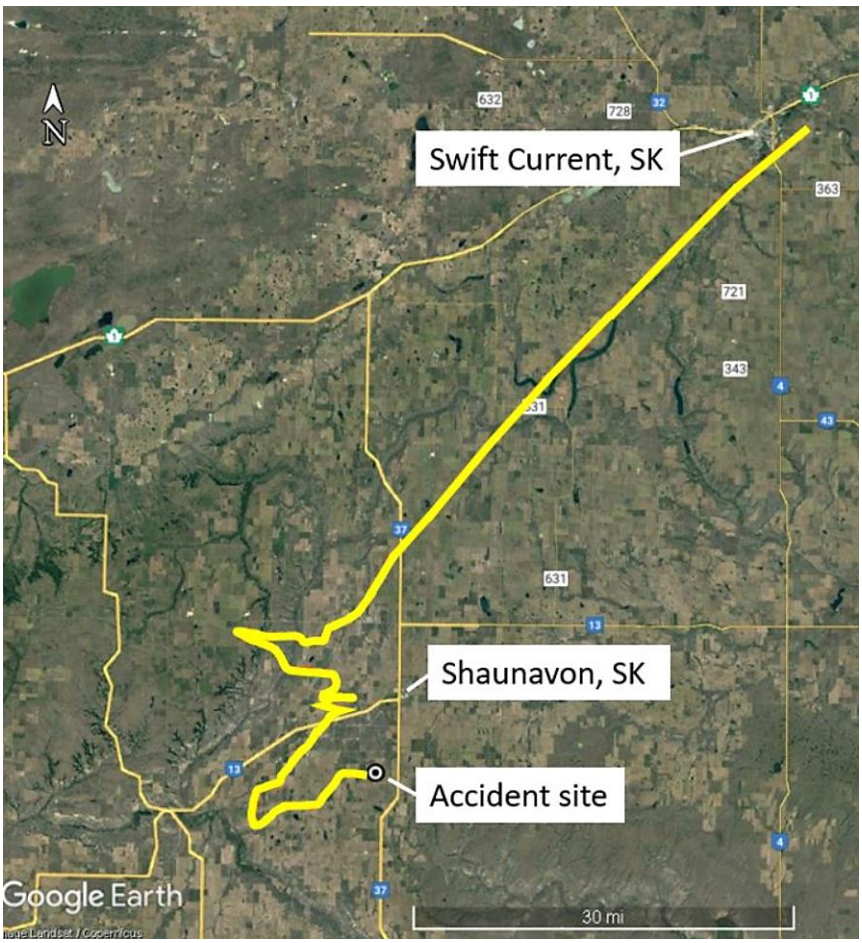

Figure 1: Occurrence flight route
(Source: Google Earth, with TSB annotations based on flight tracker data)

Pilot information

The pilot flying, who occupied the left seat at the time of the occurrence, held a Canadian commercial pilot licence. Their licence was endorsed for single- and multi-engine aircraft. They also held a Group 1 instrument rating. Records indicate that they had accumulated a total of 355 hours of flight time, 77 of which were on the Cessna 172 for Airborne Energy Solutions Inc. Records also indicate that they were well-rested before the flight. According to information gathered during the investigation, there was no indication that the pilot's performance was affected by medical factors.

[1] Normally, a Cessna 172 does not require two pilots; however, the contract in this case required that there be two pilots on board: one to fly the aircraft, the other to monitor the captured electronic data and assist with navigation duties. The pilots switched seats and duties on alternating flight legs.

The other pilot, who was monitoring the captured electronic data and assisting with navigation duties from the right seat of the aircraft, also held a Canadian commercial pilot licence. They had accumulated a total of 536 hours of flight time, 529 of which were on the Cessna 172.

Communications tower

The height of the communications tower was 3 840 ft ASL, or 440 ft AGL. It was marked and lit in accordance with the *Canadian Aviation Regulations*. The tower was also depicted on the Regina VFR navigation chart (Figure 2). A VFR navigation chart is used by pilots flying in accordance with VFR, and it illustrates obstacles and other navigational information. The investigation was unable to determine if the pilots had consulted the chart while flight planning or during the flight.

Client-specified flight parameters

The client's aerial service provider job form listed several flight parameters to be followed while conducting flight operations. Among them was a specified flight height of 550 ft AGL (±50 ft). The aircraft was equipped with an altimeter, which indicates the aircraft's altitude in ft ASL; however, it was not equipped with instrumentation that indicates the aircraft's height in ft AGL.

Impact and wreckage information

The occurrence aircraft was travelling on a track of 88° true (T) when it struck the communications tower approximately 25 ft below the tower's highest point. A four-foot section of the aircraft's right wing was shorn off

and was discovered at the base of the tower. The fuselage then travelled approximately 240 m on a track of 174°T before impacting the ground. A post-impact fire ensued, which consumed most of the remaining fuselage.

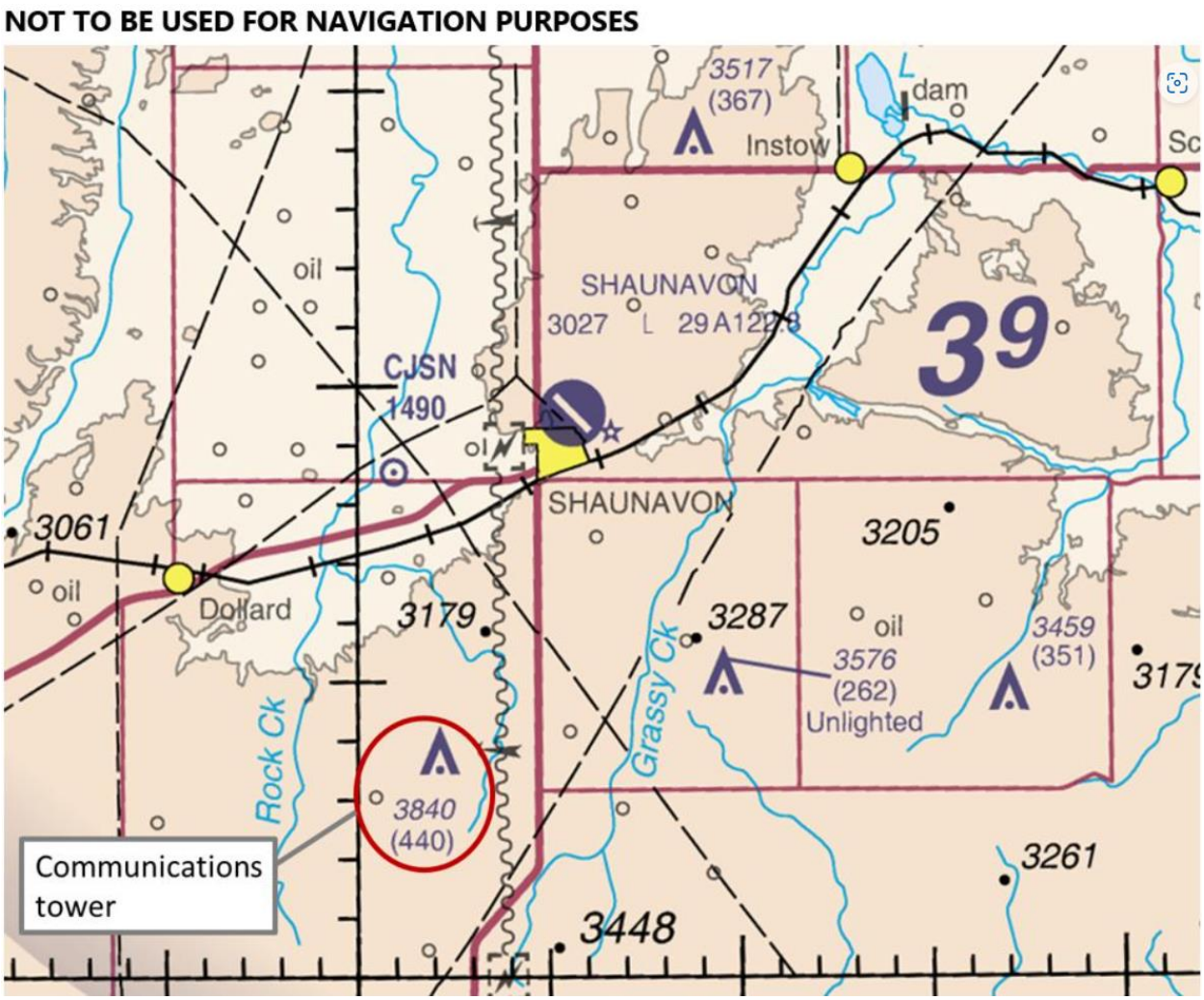

Figure 2: Magnified view of the Regina VFR navigation chart (AIR 5006), showing the depiction of the communications tower (Source: NAV CANADA, Regina VFR navigation chart [AIR 5006], 34th edition [February 2022], with TSB annotations)

Weather information

The aerodrome forecast (TAF) for CYYN, issued at 0540Z and valid from 0600Z until 1800Z on 18 September 2022, indicated the following from 1000Z:

- winds variable at 3 kt
- visibility greater than 6 statute miles
- scattered cloud layer at 25 000 ft AGL

The automatic aerodrome routine meteorological report (METAR AUTO) for CYYN issued at 1000Z indicated the following:

- winds from 360°T at 5 kt
- visibility of 9 statute miles
- clear sky
- temperature 12°C, dew point 5°C
- altimeter setting 29.93 in. of mercury (in. Hg)

The graphic area forecast for the occurrence area, valid from 0600Z, indicated clear sky conditions with visibilities greater than 6 statute miles.

Weather was not considered to be a factor in this occurrence.

Sun position

Sunrise at Shaunavon on 18 September 2022 occurred at 0654Z. The sun's position at the time of the occurrence would have been rising in the east. Solar position calculations indicate that the solar azimuth was 125°T (37° right of the aircraft's track of 88°T), and the solar elevation was 28° at the time of the collision[1] It is possible that glare[2] from the sun obscured the pilot's view of the communications tower.

Safety message

In this occurrence, the aircraft collided with an obstacle that was depicted on the applicable VFR navigation chart. Pilots are reminded of the importance of consulting available navigational charts when flight planning and in flight so as to avoid colliding with obstacles identified on those charts.

[1] National Oceanic and Atmospheric Administration (NOAA), Earth System Research Lab, Solar Position Calculator (last accessed on 04 April 2023).

[2] Glare is "an intrusive light source, irrespective of whether it is viewed directly or indirectly." (Source: D. Gradwell and D. J. Rainford, Ernsting's Aviation and Space Medicine, 5th Edition [CRC Press, 2016], p. 275.)

TSB Final Report A22C0027—Loss of Control and Collision with Terrain

History of the flight

At 2102Z on 29 April 2022, a Piper Cherokee PA-28-140 departed Dryden Regional, Ont. (CYHD), bound for Marathon Aerodrome, Ont. (CYSP), with one pilot and three passengers on board. The aircraft was reported overdue at 0139Z on 30 April 2022. The aircraft had last been observed on radar at 2145Z,[1] flying a zig-zag route over an area with limited cultural lighting (Figure 1). A search was initiated, and the wreckage was found approximately 19 nautical miles south–southeast of Sioux Lookout, Ont. (CYXL). The aircraft had impacted terrain in a wooded area during the hours of darkness. The pilot and three passengers were fatally injured. The aircraft was destroyed.

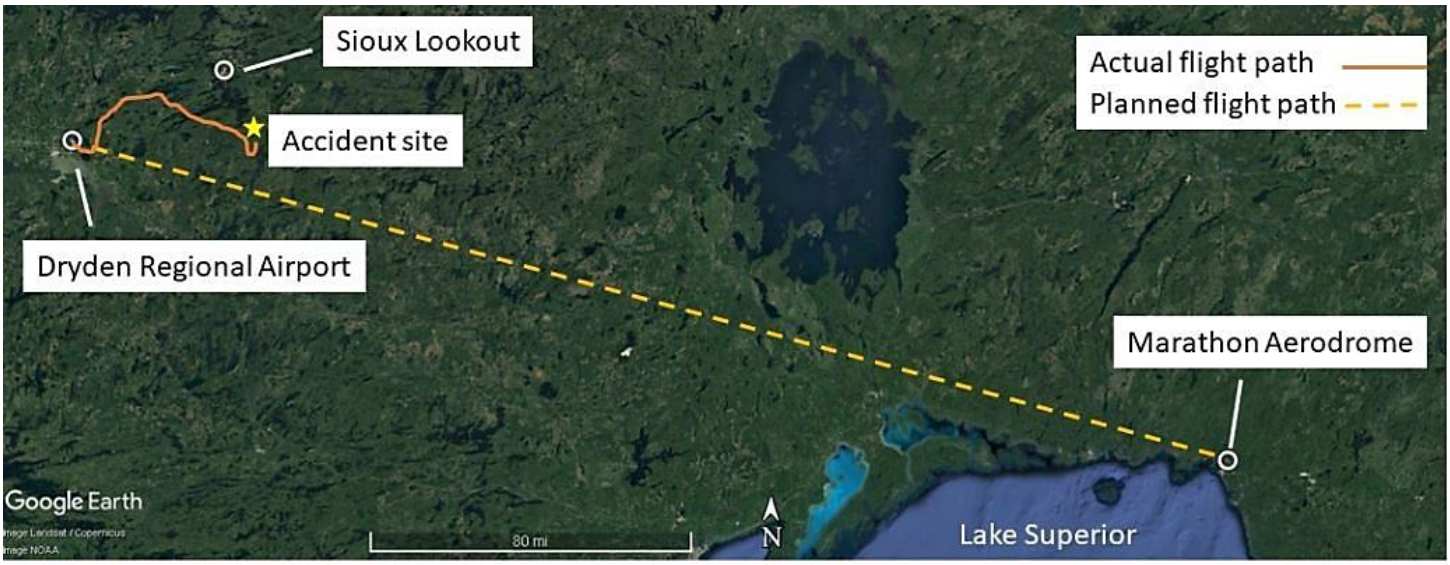

Figure 1: Map showing the flight path and accident location (Source: Google Earth, with TSB annotations)

Pilot information

The pilot held a commercial pilot licence, which had been issued on 18 September 2019. Their licence was endorsed for single- and multi-engine aircraft. They held a valid Category 1 medical certificate. They did not have an instrument rating; therefore, they were not qualified for flight in instrument meteorological conditions (IMC).

In accordance with the *Canadian Aviation Regulations* (CARs), the holder of a pilot licence is required to have completed five night take-offs and five night landings within the six months preceding the flight to fly an aircraft with passengers on board at night.[2] The investigation reviewed the pilot's logbook and did not identify any night flight entries in the six months preceding the accident.

[1] On 29 April 2022, evening civil twilight ended at 2101Z in Sioux Lookout, Ontario. (Source: National Research Council Canada, Sunrise/sunset calculator [last accessed on 24 August 2022])

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

The passenger who was seated in the front right seat also held a commercial pilot licence.

Aircraft Information

The occurrence Piper PA-28-140 was manufactured by the Piper Aircraft Corporation in 1967. It was a single-engine, all-metal, low-wing aircraft, equipped with fixed tricycle landing gear. It was configured to carry four passengers and was certified for a maximum take-off weight of 2 150 lbs. The aircraft weight at the time of the occurrence was calculated to be approximately 2 320 lbs, which is 170 lbs over the aircraft's maximum take-off weight.

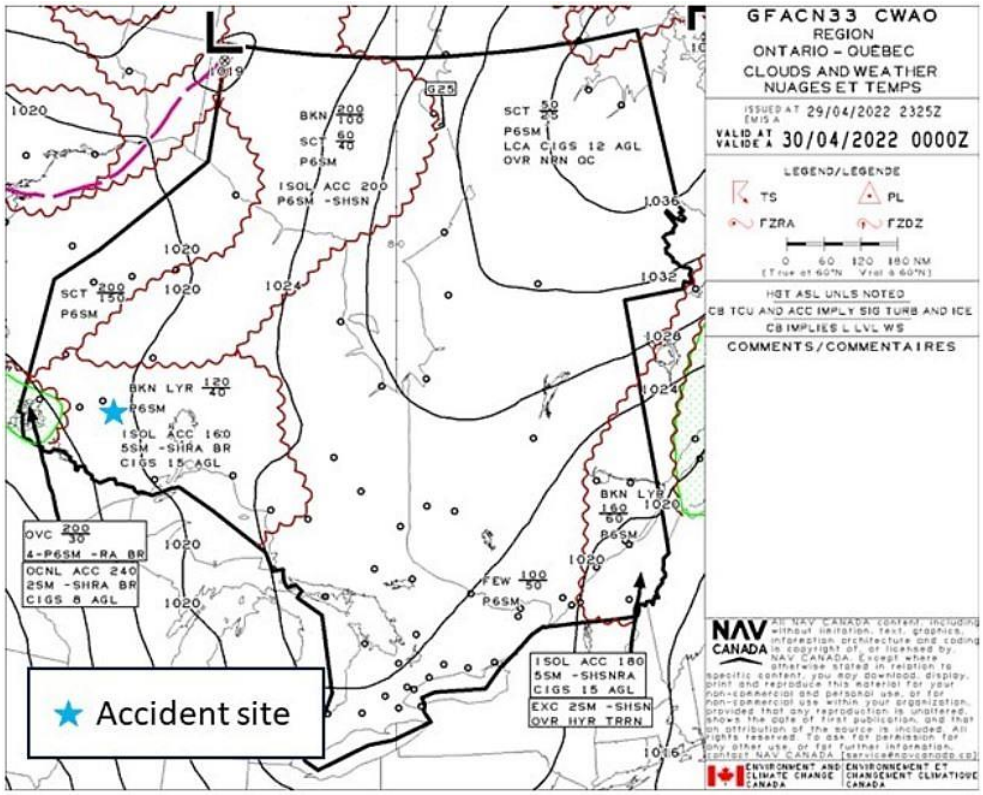

Figure 2: Graphic area forecast valid at the time of the occurrence, with the approximate accident location indicated by a star (Source: NAV CANADA, with TSB annotations)

The aircraft was privately registered and maintained on an annual inspection program as specified in CARs Standard 625.86, Appendix B, Part I. The aircraft had undergone a 50-hour inspection on 08 March 2022 and had a total airframe time of 4 467 hours at the time of the occurrence.

Impact and wreckage information

The investigation determined that the aircraft entered the forest canopy in a 90° angle of bank, indicating that it had departed controlled flight.

The airframe broke apart in a manner consistent with a cartwheeling motion, and both fuel cells ruptured. Analysis of the aircraft components did not reveal any pre-existing anomalies, and the engine was determined to have been operating normally. An inspection of the carburetor heat selector was inconclusive due to the nature of the impact damage. While the investigation did not reveal any signs of carburetor icing, the local weather conditions were consistent with those that could produce carburetor icing.

Weather information

The graphic area forecast for the area around CYHD and CYXL, issued at 1825Z on 29 April and valid at 1900Z, called for broken cloud layers with bases at 4 000 ft above sea level (ASL) and tops at 12 000 ft ASL, visibility greater than 6 statute miles (SM), isolated altocumulus castellanus clouds topping at 16 000 ft ASL with visibility of 5 SM in light rain showers and fog, and ceilings of 1 500 ft above ground level (AGL) (Figure 2).

The aerodrome forecast (TAF) for CYHD, issued at 2040Z on 29 April, indicated the following:

- From 2100Z on 29 April to 0900Z on 30 April:
  - wind from 120° true (T) at 8 kt
  - visibility greater than 6 SM in light rain
  - scattered cloud layer at 2 000 ft AGL and overcast ceiling at 4 000 ft AGL
- Temporarily during the same time period:
  - visibility greater than 6 SM in light rain showers
  - overcast ceiling at 2 000 ft AGL

The TAF for CYXL, issued at 2040Z on 29 April, indicated the following:

- from 2100Z on 29 April to 0900Z on 30 April:
  - wind from 160°T at 8 kt
  - visibility greater than 6 SM
  - scattered cloud layer at 2 000 ft AGL and overcast ceiling at 4 000 ft AGL
- Temporarily during the same time period:
  - visibility greater than 6 SM in light rain showers
  - broken ceiling at 2 000 ft AGL, overcast cloud layer at 4 000 ft AGL

The aerodrome routine meteorological report (METAR) for CYXL issued at 2200Z was:

- wind from 110°T at 5 kt
- visibility 15 SM in light rain
- overcast ceiling at 3 000 ft AGL
- temperature 4°C, dew point 0°C
- altimeter setting 30.05 in. of mercury (in. Hg)

At 2050Z, the pilot called the NAV CANADA Flight Service Station to file a flight plan. During the call, the flight service specialist provided an abbreviated weather briefing and indicated that marginal visual flight rules (VFR) weather could be present on the proposed route of flight.

Night visual flight

Flying VFR at night involves numerous risks owing to poor visual cues. The fact that there are few or no visual references at night can lead to various illusions, causing spatial disorientation due to the lack of discernible horizon. A night VFR flight that is conducted beneath an overcast ceiling, without moonlight, over areas with featureless terrain such as bodies of water or forest, and away from cultural lighting provides inadequate ambient illumination for visual reference to the surface. These areas are referred to as black holes; flying over them is difficult.

In addition, estimating distance from cloud and adverse weather at night or in darkness is difficult for pilots and increases the risk of inadvertent VFR flight into IMC, which can quickly result in spatial disorientation and a loss of control.

Simply put, night VFR flight inherently offers the pilot limited visual cues to be able to see and avoid worsening weather conditions. Flight planning is especially important for night flights, specifically: a review of weather conditions and their corresponding impact on the intended aircraft track, the available moonlight, the estimated flight time over large bodies of water or areas with little or no cultural lighting, and the intended flight track's proximity to rising terrain and significant obstacles.

The principle behind VFR flight is that the pilot uses visual cues (e.g., visual horizon, ground references) outside the aircraft to determine the aircraft's attitude. Therefore, some basic requirements must be met when conducting VFR flight—day or night.

According to sections 602.114 and 602.115 of the CARs, the aircraft must be "operated with visual reference to the surface," regardless of whether it is operated in controlled or uncontrolled airspace. The CARs define surface as "any ground or water, including the frozen surface thereof." However, the term "visual reference to the surface" is open to interpretation, because it is not defined in the regulations. Industry has widely interpreted it to mean visual meteorological conditions (VMC).[1]

Safety messages

Continued flight under night VFR into areas with reduced visual cues, such as areas with limited cultural lighting or deteriorating weather, can lead to spatial disorientation and a loss of control. All pilots—no matter how experienced they are—need to plan ahead and consider strategies to avoid such conditions, as well as have alternate plans should such conditions be encountered.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 19 October 2022. It was officially released on 14 November 2022.

[1] Visual meteorological conditions means "meteorological conditions equal to or greater than the minima specified in Division VI of Subpart 2 of Part VI, expressed in terms of visibility and distance from cloud." (Source: Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subsection 101.01(1).)

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