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

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A21Q0131

LATERAL RUNWAY EXCURSION

Keewatin Air LP
Beechcraft King Air B200, C-FSKO
Sanikiluaq Airport, Nunavut
17 December 2021

Canada

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 3 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

TERMS OF USE

Use in legal, disciplinary or other proceedings

The *Canadian Transportation Accident Investigation and Safety Board Act* states the following:
- 7(3) No finding of the Board shall be construed as assigning fault or determining civil or criminal liability.
- 7(4) The findings of the Board are not binding on the parties to any legal, disciplinary or other proceedings.

Therefore, the TSB's investigations and the resulting reports are not created for use in the context of legal, disciplinary or other proceedings.

Notify the TSB in writing if this investigation report is being used or might be used in such proceedings.

Non-commercial reproduction

Unless otherwise specified, you may reproduce this investigation report in whole or in part for non-commercial purposes, and in any format, without charge or further permission, provided you do the following:
- Exercise due diligence in ensuring the accuracy of the materials reproduced.
- Indicate the complete title of the materials reproduced and name the Transportation Safety Board of Canada as the author.
- Indicate that the reproduction is a copy of the version available at [URL where original document is available].

Commercial reproduction

Unless otherwise specified, you may not reproduce this investigation report, in whole or in part, for the purposes of commercial redistribution without prior written permission from the TSB.

Materials under the copyright of another party

Some of the content in this investigation report (notably images on which a source other than the TSB is named) is subject to the copyright of another party and is protected under the *Copyright Act* and international agreements. For information concerning copyright ownership and restrictions, please contact the TSB.

Citation

Transportation Safety Board of Canada, *Air Transportation Safety Investigation Report* A21Q0131 (released 22 August 2024).

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

Air transportation safety investigation report A21Q0131

Cat. No. TU3-10/21-0131E-PDF
ISBN 978-0-660-73048-6

This report is available on the website of the Transportation Safety Board of Canada at www.tsb.gc.ca

Le présent rapport est également disponible en français.

Table of contents

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A21Q0131

LATERAL RUNWAY EXCURSION

Keewatin Air LP
Beechcraft King Air B200, C-FSKO
Sanikiluaq Airport, Nunavut
17 December 2021

Summary

At 0343 Eastern Standard Time (EST) on 17 December 2021, the Beechcraft King Air B200 aircraft (registration C-FSKO, serial number BB1007) operated by Keewatin Air LP took off from Winnipeg/James Armstrong Richardson International Airport (CYWG), Manitoba, to conduct the instrument flight rules medical evacuation flight KEW204 MEDEVAC to Sanikiluaq Airport (CYSK), Nunavut. Two flight crew members and 2 medical staff members were on board.

At 0632 EST, the aircraft landed on Runway 27 at CYSK and started to drift to the left. The pilot attempted to keep the aircraft on a straight path down the runway, but was unsuccessful. He initiated a go-around to take off again, but the aircraft exited the runway surface, and its left landing gear struck a snowbank. The aircraft came to a stop south of the runway. The emergency locator transmitter activated, and the signal was received by the Canadian Mission Control Centre in Trenton, Ontario, at 0633 EST.

The occupants were able to egress the aircraft safely. One medical staff member received minor injuries. The aircraft was substantially damaged.

1.0 FACTUAL INFORMATION

1.1 History of the flight

At about 2300[1] on 16 December 2021, the Keewatin Air LP (Keewatin) flight follower received a request to charter a medical evacuation flight from Sanikiluaq Airport (CYSK), Nunavut, to Winnipeg/James Armstrong Richardson International Airport (CYWG), Manitoba. The flight follower then contacted the ground personnel at CYSK to request the current local weather conditions, which were reported as follows at 2307: overcast ceiling at 700 feet above ground level (AGL), visibility of 4 statute miles (SM) in snow, and surface winds from 340° true (T) at 22 knots. Given that snow was falling, the flight follower confirmed with the ground personnel at CYSK that the runway would be cleared of snow.

At about 0100 on 17 December, the ground personnel at CYSK called the flight follower to let him know that the runway snow clearing was almost complete. At that time, the weather conditions were similar, but the winds had increased and were blowing at 30 knots, which resulted in a crosswind component[2] of 28 knots on Runway 27. Given that the winds had increased, the flight follower contacted the on-call operations manager to request a flight authorization and informed him of the weather conditions. Based on his experience with northern operations and the company's previous flight authorizations, the on-call operations manager knew that landings had been completed successfully when the crosswind component was over 25 knots. He authorized the flight, and the flight follower contacted the flight crew and medical staff designated for the flight, who were in Winnipeg, and informed them about the medical evacuation flight to be conducted.

The 2 flight crew members went to the company's facilities at CYWG where they began flight preparations. The first officer (FO) carried out a pre-flight inspection and prepared the Beechcraft King Air B200 (King Air B200) aircraft that would be used, while the pilot-in-command (PIC) checked the weather conditions and carried out the flight planning.

The weather report issued at 0200 at CYSK indicated winds from 320°T at 29 knots, gusting to 36 knots. The PIC was aware of the possibility of snowdrifts on the runway on arrival, but he was more concerned about the wind strength. He shared his concern with the flight follower, who told him that the on-call operations manager was aware of the weather conditions and had authorized the flight to allow the flight crew to "go and see" if it was possible to land. Given his experience flying in similar wind conditions, and knowing that the landing would take place a few hours later, the PIC agreed to conduct the flight with the intention to make a final decision about whether or not to land based on the conditions once he arrived at the destination.

The aircraft took off from CYWG at 0343 for the instrument flight rules medical evacuation flight KEW204 MEDEVAC to CYSK with 2 flight crew members and 2 medical staff members

---

1 To make it easier to follow the timeline, all times are Eastern Standard Time (Coordinated Universal Time minus 5 hours), which is the time zone in which the occurrence took place.

2 The crosswind component is the wind component perpendicular to the runway orientation.

on board. At approximately 0504, when they were about halfway to the destination, the flight crew received updated weather conditions at CYSK, which indicated an increase in wind strength to 35 knots, gusting to 46 knots. No updates on the runway surface condition were available.

At approximately 0600, the flight crew carried out the approach briefing and began the descent to CYSK. The flight crew determined that the main threats to the landing were the strength of the crosswind component and the possible presence of snowdrifts on the runway. The PIC and the FO agreed that, before continuing with the landing, they would need to visually confirm that no snowdrifts were on the runway, and agreed that they would conduct a go-around if they experienced difficulty controlling the aircraft's path and speed during the approach and landing.

According to the latest wind update, the winds were from 310°T at 36 knots, gusting to 44 knots. Therefore, it was decided that the approach would be performed at landing reference speed (V_{ref}) plus 20 knots.[3] No updated runway surface conditions were available.

When the aircraft was approximately 4 nautical miles from CYSK at an altitude of about 1500 feet above sea level (ASL), the flight crew saw that the runway edge lights were on for the night approach. The PIC was the pilot flying for the approach and landing because the FO had limited experience on the King Air B200. The FO, who was monitoring the approach, did not notice any deviations or other signs that would require a go-around call. The approach remained stabilized on the normal approach path despite turbulence, and the aircraft's airspeed was kept at about 125 knots. The flight crew did not see any snowdrifts on the runway and continued the approach, certain that they could conduct a go-around if they encountered difficulty controlling the aircraft as a result of the crosswind.

The aircraft landed on Runway 27 at 0632. Shortly after touchdown, the aircraft started to drift to the left. The PIC attempted to keep the aircraft on a straight path down the runway, but was unsuccessful. He initiated a go-around, but the aircraft exited the runway surface and its left landing gear struck a snowbank on the edge of the runway immediately thereafter. The aircraft came to a stop south of the runway, and the PIC immediately ordered an evacuation. The emergency locator transmitter (ELT) activated and the distress signal was received by the Canadian Mission Control Centre in Trenton, Ontario, at 0633.

The aircraft came to a stop, nose down, in the snow left (south) of the runway (Figure 1).

---

3 Based on the aircraft's landing weight, the landing reference speed (V_{ref}) was 99 knots.

Figure 1. Occurrence aircraft where it came to rest in the snow following the runway excursion at the Sanikiluaq Airport, a few hours after the occurrence (Source: Sanikiluaq Airport universal communications facility)

To evacuate, the occupants had to jump from the aircraft from a height of about 5 feet, into the snow. They then walked to the runway and followed it toward the terminal, where they were taken care of by airport staff. One medical staff member received a minor injury during the aircraft's runway excursion.

1.2 Injuries to persons

There were 2 flight crew members and 2 medical staff members on board.

Table 1 outlines the degree of injuries received.

Table 1. Injuries to persons

Degree of injury	Crew	Medical staff members	Persons not on board the aircraft	Total by injury
Fatal	0	0	–	0
Serious	0	0	–	0
Minor	0	1	–	1
Total injured	0	1	–	1

1.3 Damage to aircraft

The aircraft was substantially damaged during the runway excursion, and there was no post-impact fire.

1.4 Other damage

There was no other damage.

1.5 Personnel information

The PIC and FO held the appropriate licences, ratings, and qualifications for the occurrence flight in accordance with existing regulations.

Table 2. Personnel information

	Pilot-in-command	First officer
Pilot licence	Commercial pilot licence – aeroplane	Airline transport pilot licence – aeroplane
Medical expiry date	01 July 2022	01 July 2022
Total flying hours	2905	2314
Flight hours on type	2695	11
Flight hours in the 24 hours before the occurrence	5.4	5.4
Flight hours in the 7 days before the occurrence	8.3	8.3
Hours on duty before the occurrence	6	6
Hours off duty before the work period	11	11

The PIC had been working at Keewatin since February 2018. He was both a pilot and a training pilot. The majority of the flights he conducted from the time he was hired were in northern and remote areas.

The FO had been hired by the company in November 2021 and had completed his initial training in a simulator. His previous flying experience was in environments other than northern regions. On the day of the occurrence, he was conducting his 4th flight on the aircraft type and, even though it was not a training flight, he was paired with a training pilot. The company often did this to provide newly hired pilots with mentorship and additional instruction.

Based on a review of the pilots' work and rest schedules, there was no indication that their performance was degraded by fatigue during the occurrence flight.

1.6 Aircraft information

Table 3. Aircraft information

Manufacturer	Beech Aircraft Corporation*
Type, model, and registration	King Air, B200, C-FSKO

Year of manufacture	1982
Serial number	BB1007
Certificate of airworthiness issue date	11 April 2014
Total airframe time	28 658.2 hours
Engine type (number of engines)	Pratt & Whitney-CAN PT6A-42 (2)
Propeller type (number of propellers)	Hartzell HC-D4N-3A (2)
Maximum allowable take-off weight	12 500 lb (5670 kg)
Recommended fuel types	Jet A, Jet A-1, Jet B
Fuel type used	Jet A-1

* Textron Aviation Inc. currently holds the type certificate for the aircraft type.

The King Air B200 typically seats up to 8 passengers in its standard configuration. The occurrence aircraft was configured for ambulance and medical evacuation service. A bench seat faced the centre aisle on the left side and could accommodate 2 passengers. The right side of the aisle was configured to accommodate a stretcher or incubator as needed.

The pilots did not report any defects or malfunctions during the occurrence flight. The calculated take-off weight was 12 497 pounds and the planned landing weight was 10 851 pounds. The weight and centre of gravity were within the prescribed limits. There were no recorded outstanding defects at the time of the occurrence. In addition, there was no indication that a component or system malfunction played a role in this occurrence.

1.6.1 Take-off and landing performance

Aircraft manufacturers publish aircraft-specific data to help pilots determine the limitations of operations that are considered safe. However, these limitations are affected by extrinsic factors, such as the type of runway surface, for which manufacturers have not carried out tests.

> The *Aircraft Flight Manual* (AFM) performance information (or data) is valid for only the type of surface the aeroplane has been certified to operate from, which is normally a paved, smooth, hard surfaced runway. Operations on unpaved runways may result in a degradation of the certified aeroplane performance. Aeroplane handling qualities may also be degraded because of the interaction of the tires with the unbound, granular or soft surfaces characteristic of unpaved runways.[4]

In this occurrence, all available data on the King Air B200's take-off and landing performance were valid for a hard surfaced runway only.

1.6.1.1 Controllability of the aircraft in a crosswind

The controllability of an aircraft during takeoff and landing in a crosswind depends not only on the wind strength and turbulence, but also on the aerodynamics (design) of the aircraft itself and the traction of the tires on the runway. In addition to publishing a table to determine the strength of the crosswind component (Appendix A), manufacturers are

---

4 Transport Canada, Advisory Circular (AC) 700-011: Operations on Runways with Unpaved Surfaces, Issue No. 01 (16 March 2012), Section 5.0, p. 5.

required by the regulatory certification body[5] to indicate in the aircraft flight manual (AFM) the highest crosswind component that has been satisfactorily tested on an uncontaminated paved runway during aircraft certification. This demonstrated maximum crosswind component is not an aircraft limitation and does not mean that it is impossible to land safely in stronger winds. Some manufacturers publish theoretical limitations to help pilots better assess the aircraft's performance.

In this occurrence, the manufacturer had not published a theoretical crosswind component limitation for King Air B200 landings and takeoffs, nor was it required to do so. It had demonstrated that, in the case of a King Air B200 with a weight of 12 500 pounds, control is adequate during takeoffs and landings with a 25-knot crosswind component on an uncontaminated paved runway.

1.6.1.2 Balked landing procedure

According to the King Air B200 AFM, the procedure to be followed in the event of a balked landing is as follows:

- apply the maximum allowable power;
- rotate when the airspeed is 100 knots;
- retract the flaps;
- retract the landing gear.[6]

Transport Canada's *Air Operator Certification Manual* states the following:

> (1) An aircraft is not certified to successfully complete a go-around once it has entered the low-energy landing regime.
>
> (a) The low-energy landing regime is defined as:
>
> i. aircraft flaps and landing gear are in the landing configuration;
>
> ii. aircraft is in descent;
>
> iii. thrust has stabilized in the idle range;
>
> iv. airspeed is decreasing; and
>
> v. aircraft height is 50 feet or less above the runway elevation. […]
>
> (2) The decision to place an aircraft into the low-energy landing regime is a decision to land.
>
> (a) If there is any doubt regarding the probability of a safe landing, a go-around or balked landing must be initiated prior to entry into this regime.
>
> (3) An attempt to commence a go-around or balked landing while in the low-energy landing regime is a high-risk, undemonstrated maneuver.

---

5 Federal Aviation Administration (FAA), *Code of Federal Regulations*, Title 14, Part 25, Section 23.1583: Operating limitations.

6 Raytheon Aircraft Company, *Beechcraft Super King Air B200 and B200C Pilot's Operating Handbook and FAA Approved Airplane Flight Manual* (May 2000), Section IV: Normal Procedures, p. 4-17.

(a) In the case where such action is required, pilots should be aware that ground contact is likely and any attempt to commence a climb before the engines have achieved go-around thrust may result in a stall.

i. Turbo-fan engines may require as long as eight seconds to accelerate from idle to go-around thrust.[7]

When executing a balked landing procedure, unforeseen events such as wind shear or control difficulties may increase the risk of loss of control and controlled flight into terrain if the aircraft is in a low-energy state (low landing regime).[8]

In this occurrence, after landing, the flight crew realized that the drift to the left could not be controlled and carried out the AFM's balked landing procedure because they were certain that a go-around could stop the drift and lower the risk of a runway excursion.

1.7 Meteorological information

The following weather information was obtained from a weather assessment report prepared by Environment and Climate Change Canada for the TSB as part of this investigation.

1.7.1 Weather forecast for Hudson Bay and James Bay

At 0100 on 17 December, the centre of a deep, occluded low-pressure system was located approximately 120 nautical miles east of CYSK and was moving northeast at approximately 25 knots. While the pressure at the centre of this low-pressure system increased overnight (suggesting a weakening of the system), the pressure gradient remained very strong and caused strong winds and gusts, especially west of the system. Snowfall was observed along the entirety of Hudson Bay and James Bay, reducing visibility to between 1 and 3 SM. Surface isobar analysis indicated sustained surface winds at less than 20 knots east of CYSK along the Hudson Bay coast, and at 30 knots at CYSK.

The graphic area forecast Clouds and Weather Chart issued at 0045 and the Icing, Turbulence and Freezing Level Chart issued at 0058, which were valid starting at 0100 on 17 December, forecast the following weather conditions for Hudson Bay and James Bay:

- Overcast ceiling at 3000 feet ASL with tops at 20 000 feet ASL
- Visibility between 1 and 3 SM in light snow
- Cloud ceilings between 800 and 1500 feet AGL
- Occasional light snow showers and blowing snow that could reduce visibility to as low as ¾ SM
- Surface winds from the west at 25 knots, gusting to 35 knots

---

7 Transports Canada, TP 4711, *Air Operator Certification Manual*, Volume 2 (December 2022), Section 5.52: Low-Energy Awareness Training, pp. 209-210.

8 SKYbrary, "Baulked Landing: Guidance for Flight Crew," at skybrary.aero/articles/baulked-landing-guidance-flight-crew (last accessed on 13 May 2024).

- Moderate mixed icing possible between 3000 and 8000 feet ASL
- Moderate mechanical turbulence between the surface and 4000 feet AGL caused by a low-level jet stream of 55 knots

No pilot weather reports or significant meteorological information messages were issued for the Hudson Bay or James Bay area for the period between 0100 and 0700 on the day of the occurrence.

1.7.2 Weather conditions at Sanikiluaq Airport

Aerodrome routine meteorological reports (METARs) for CYSK were issued from 0800 to 1700 on weekdays, but were available upon request outside of these hours.

After the flight follower's request for weather information, the following METARs were issued (Table 4).

Table 4. Aerodrome routine meteorological reports for Sanikiluaq Airport

Day	Time	Surface winds (direction/speed)	Visibility	Ceiling (AGL)	Temp. (˚C)	Dew point (˚C)	Altimeter setting (inHg)
16 Dec.	2307	340°T/22 kt	4 SM in light snow and drifting snow	Overcast at 700 feet	−2	−2	28.69
17 Dec.	0000	340°T/23 kt	4 SM in light snow and drifting snow	Overcast at 1900 feet	−2	−3	28.70
17 Dec.	0100	320°T/30 kt	5 SM in light snow and drifting snow	Overcast at 1900 feet	−2	−3	28.72
17 Dec.	0200	320°T/29 kt, gusting to 36 kt	4 SM in light snow and blowing snow	Overcast at 800 feet	−2	−3	28.76
17 Dec.	0300	320°T/33 kt	4 SM in light snow and blowing snow	Overcast at 900 feet	−2	−4	28.79
17 Dec.	0400	320°T/32 kt, gusting to 40 kt	1 SM in light snow and drifting snow	Overcast at 1200 feet	−3	−4	28.85
17 Dec.	0500	320°T/35 kt, gusting to 46 kt	1 SM in light snow and blowing snow	Overcast at 1200 feet	−3	−5	28.90
17 Dec.	0600	310°T/36 kt, gusting to 44 kt	1 SM in light snow and blowing snow	Overcast at 1500 feet	−4	−6	28.97
17 Dec.*	0700	310°T/37 kt, gusting to 43 kt	Not reported	Not reported	−4	−7	29.02

* These data come from CYSK's limited weather information system (LWIS).

The *Transport Canada Aeronautical Information Manual* states the following:

> This [wind information] group reports the 2-min mean wind direction and speed, along with gusts. […]

> Gust information will be included if gust speeds, averaged over a 5-second period, exceed the average wind speed by 5 kt or more in the 10-min period preceding the observation and the peak gust reaches a maximum speed of 15 kt or more.[9]

According to the information gathered during the investigation, it is reportedly common practice for some air operators, including Keewatin, to use only the constant wind speed to calculate the crosswind component and to assess the feasibility of landing without taking gusts into account.

Table 5 shows the constant speed of the right crosswind component for Runway 27.[10,11]

Table 5. Constant speed of the crosswind component according to the hourly data from the Sanikiluaq Airport aerodrome routine meteorological reports

Time	Crosswind component constant speed (knots)
0100	28
0200	27
0300	31
0400	30
0500	33
0600	31
0700	32

No aerodrome forecasts are available for CYSK.

1.8 Aids to navigation

Not applicable.

1.9 Communications

There were no known communication difficulties between flight crew members during the flight or between flight crew members and external parties such as the flight follower and CYSK community aerodrome radio station (UNICOM) employees.

1.10 Aerodrome information

CYSK is located approximately 1 km west of the municipality of Sanikiluaq. The airport is at an elevation of 110 feet ASL and is operated by the Government of Nunavut. It has a single

---

9 Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* (TC AIM), MET – Meteorology (07 October 2021), Section 8.3.

10 The wind direction was converted from true to magnetic degrees by adding a declination of 16° west. The magnetic direction of the runway used is 266°.

11 Refer to Appendix A for the crosswind component calculation table.

runway, Runway 09/27, which is gravel and is 3807 feet long and 100 feet wide. Runway 27 slopes down 1.1% for the first 2300 feet, then slopes up 1.3% for the last 1500 feet.[12]

Runway 09/27 is equipped with the following lights:

- White variable-intensity runway edge lights, spaced 196.85 feet (60 m) apart, for the entire length of the runway
- Threshold and runway end lights that appear red in the direction of takeoff and green in the direction of approach and landing
- Unidirectional strobe runway identification lights at each end of the runway

In addition, Runway 27 is equipped with an abbreviated precision approach path indicator.

The airport has a UNICOM, which operates during CYSK's normal operating hours, i.e., from 0800 to 1800, Monday to Friday, except statutory holidays. A contracted service provider is available from 0800 to 1700, Monday to Friday, to perform airport maintenance. Outside of these hours, maintenance services such as snow removal from the runway and UNICOM services are available on request and are then subject to a fee.

At the time of the occurrence, UNICOM service was being provided, Runway 27 had been completely cleared of snow, and the lighting had illuminated as intended when the flight crew activated the pilot-controlled lighting.

1.10.1 Winter maintenance

The take-off and landing phases are critical for an aircraft, because several elements such as runway surface conditions and wind direction and strength can combine and affect the aircraft's performance during these phases.

In winter conditions, the presence of contaminants on a runway such as snow or ice can seriously affect tire traction and the safety of an aircraft during takeoff and landing. For this reason, airports have a winter maintenance plan that includes, among other things, "a description of the arrangements for snow clearance"[13] and the order of priority for snow removal in the various areas of the airport, in accordance with Subpart 302 of the *Canadian Aviation Regulations* (CARs).

The operator of CYSK has a winter maintenance plan for the airport. It states that due to limited resources, it is generally not possible to clear the entire airport at once, and that in the event of winter storm conditions, the areas to be cleared are given an order of priority from 1 to 3, which must be respected.[14]

---

[12] NAV CANADA, *Canada Flight Supplement* (CFS) (effective 02 December 2021 to 27 January 2022).

[13] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subparagraph 302.411(i).

[14] Nunavut Department of Economic Development & Transportation, *Nunavut Airports: Winter Maintenance Plan* (November 2021), Section 2: Airside Winter Maintenance Priorities, p. 5.

On the day of the occurrence, the runway had been cleared of snow before the occurrence aircraft's arrival in accordance with this plan. The snow removal created snowbanks, mixed with gravel, varying in height up to 2 feet and extending about 25 feet from each side of the runway. The maximum snow accumulation permitted along and adjacent to runways and along taxiways can gradually increase from ½ foot (0.15 m) to 3.3 feet (1 m) laterally over a distance of 32.8 feet (10 m). It is possible that these snowbanks exceeded the gradual accumulation limit in some places. However, owing to the blowing snow at the airport, levelling these snowbanks was considered a Level 3 priority (the lowest), which meant they would be levelled as soon as conditions permitted.

1.10.2 Runway surface condition report

"Runways in Canada, […] are, on average, wet or contaminated one third of the time during the five coldest months of the year,"[15] and over a longer period of time in northern areas. Aerodrome operators publish a variety of data to inform pilots of the presence and type of contaminants on runways: runway surface condition (RSC) reports in NOTAMs, the Canadian Runway Friction Index (CRFI), and a code associated with the runway surface condition Global Reporting Format (GRF) determined using the runway condition assessment matrix.

However, the regulations do not require Canadian aerodrome operators to publish all of these data. For example, the publication of a runway condition code only applies to aerodromes with paved runway surfaces (asphalt and concrete) because the runway condition assessment matrix cannot be used if the runways are unpaved or partially paved.[16] In addition, for aerodromes with gravel runways, the CRFI is required only if the airport serves turbojet airplanes used in airline operations (Subpart 705 of the CARs).[17]

According to Transport Canada,

> [t]he reporting of surface conditions on a gravel runway is more difficult than it is for a paved runway. In the case of gravel runways, it is impossible to remove all the winter contaminants from the gravel surface. In many northern sites, the common practice is to prepare a solid snow-compacted base on top of the gravel whereby the compacted snow becomes the operational surface for winter operations. Thus, throughout most of the fall and winter, the operational base is not a normal gravel surface but is rather a frozen gravel, a compacted snow, or a compacted snow/gravel mix.[18]

When no CRFI is available, tables in the *Canada Flight Supplement* (Appendix B) can be used to estimate the CRFI based on the runway surface conditions. However, the CRFI data in

---

15 Aviation Publishers Co. Ltd., *From the Ground Up*, 30th Edition (2023), Runway Conditions Reports, p. 183.

16 Transport Canada, Advisory Circular (AC) 300-019: Global Reporting Format (GRF) for Runway Surface Conditions, Issue 02 (21 February 2021), paragraph 6.1(2).

17 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subsection 302.416(2).

18 Transport Canada, Advisory Circular (AC) 300-005: Changes to Runway Surface Condition Reporting, Issue 07 (21 January 2021), Section 7.0.

these tables are estimates for a hard surfaced runway; they do not provide data compiled from tests done on a gravel runway.

In this occurrence, the runway surface at CYSK had become a mix of gravel and compacted snow due to the winter season, and the operator did not publish any CRFIs. The last RSC NOTAM for CYSK was issued at 1709 on 16 December and indicated the presence of ½ inch of dry snow covering 100% of Runway 09/27. The only information available on the runway surface condition for the occurrence flight was that the runway had been completely cleared.

1.10.3 Unpaved runways

The surfaces of an unpaved runway can be unprepared natural surfaces, such as grass, or artificial surfaces, such as gravel.[19] In Canada, unlike airports serving the populated southern areas, most airports serving the less populated northern areas have gravel runways.

Gravel runways add a layer of complexity for operators and pilots when assessing whether a takeoff or landing can be conducted safely. The quality of the gravel surface can vary from one aerodrome to another, depending on factors such as the type of stone used, the equipment used for maintenance, the frequency of runway maintenance, and the outside temperature. In this occurrence, the flight crew did not consult the equivalent CRFI tables published in the *Canada Flight Supplement* mentioned above, because these tables are not adapted to gravel runways.

1.10.3.1 Operations on gravel runways in northern regions

Given the importance of air transportation in remote and northern communities, civil aviation infrastructure in the north was the subject of an audit by the Auditor General of Canada. For this audit, which covered the period from 01 April 2013 to 30 November 2016, the Auditor General of Canada consulted with air operators, among others, to find out what improvements they believed would "enhance […] safety, and improve accessibility and efficiency."[20] "Improvements to runways, such as paving gravel runways or extending runways"[21] and providing "more reliable and complete information on weather and runway conditions"[22] are 2 of the 4 improvements cited in the report. Stakeholders further stated that

---

19 Transport Canada, Advisory Circular (AC) 700-011: Operations on Runways with Unpaved Surfaces, Issue 01 (16 March 2012), paragraph 3.0(4).

20 Office of the Auditor General of Canada, Independent Audit Report*, Report 6 – Civil Aviation Infrastructure in the North – Transport Canada* (Spring 2017), paragraph 6.25.

21 Ibid., paragraph 6.28.

22 Ibid., paragraph 6.28.

> obtaining reliable local information in the north, such as information on weather and runway conditions was challenging. Pilots need reliable and complete information, or they may have to delay or cancel flights. […] We found that in 2015, 42 territorial airports were unable to report on current local conditions during parts of the day for an average of 25 days. This included 1 airport in Nunavut that was unable to report on local conditions during all or part of 96 different days over the year. As a result, unless other sources of information were available, such as automated weather information systems, pilots lacked key information on local conditions. This lack of information could have affected scheduled flights and medical emergency evacuation services in the communities. In addition, an air carrier that provided medical emergency evacuations to two of the territories stated that in one territory, it delayed or cancelled approximately 360 of 1,250 (29 percent) medical emergency evacuations annually due to the lack of reliable weather reporting.[23]

During this investigation, TSB investigators consulted 7 air operators, 6 of which provide air-taxi services (Subpart 703 of the CARs) and 1 of which exclusively provides airline services (Subpart 705 of the CARs) to northern communities, to ask them what they thought of the difference in traction between a gravel runway and an asphalt runway in winter. Two operators responded that a gravel runway provided better traction when it was well maintained, and 4 other operators indicated that a gravel runway provided very good traction, but that this varied by aerodrome. Only 1 of the air operators had the manufacturer's performance data for a gravel runway and used those data to prepare a reference document to be followed for its operations. Only 2 of the 7 air operators indicated that traction varied little with the outside temperature when it remained below freezing.

In the absence of accurate data on the surface conditions of gravel runways, operators indicated that they rely on the recent experience of their pilots at the aerodromes to determine whether they can land safely. According to these operators, the pilots' level of experience is a determining factor in the decision to allow the flight to "go and see," and this practice of taking off and "going to see" is reportedly common and yields good results.

In this occurrence, the PIC had landed at CYSK without difficulty controlling the aircraft on the evening of 15 December and had not noticed anything significant about the runway surface. He expected the traction to be good on landing on the day of the occurrence.

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.

However, it was equipped with a Garmin G1000 unit with a memory card, which provided data on the flight path, engine parameters, radio tuning, and navigation instruments. The aircraft was also equipped with a satellite flight-tracking system that recorded the following parameters: GPS (global positioning system) position, altitude ASL, date, time, ground speed, and direction of flight.

---

[23] Ibid., paragraph 6.38.

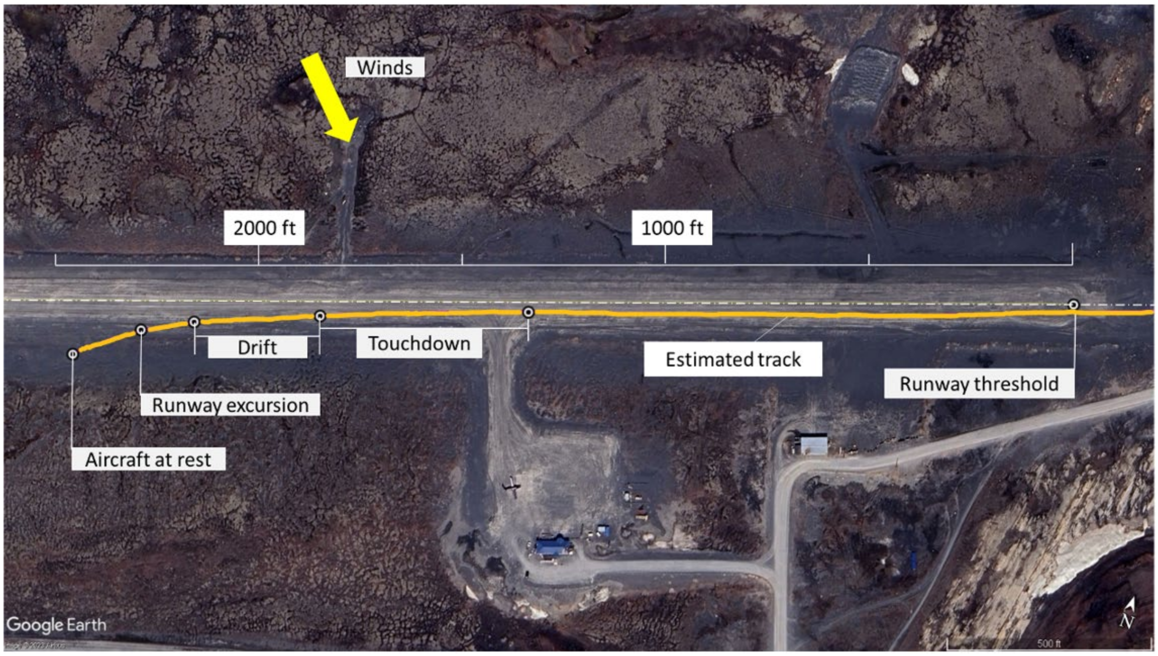
Figure 2 shows the estimated flight path on the aircraft's final approach to Runway 27. According to the data retrieved:

- The average indicated airspeed on approach was 125 knots with a stable approach slope of 3°.
- When the aircraft crossed the runway threshold, it had an indicated airspeed of 121 knots and was at 40 feet ASL (0632:34).
- The initial touchdown was approximately 30 feet left of the centre of the runway, between 1300 and 1800 feet beyond the runway threshold, when the indicated airspeed was 110 knots (between 0632:43 and 0632:46).
- Immediately after touchdown, the aircraft began to drift to the left while the heading remained aligned with the runway, and its indicated airspeed slowed to below 97 knots.
- At 2100 feet beyond the runway threshold, when the aircraft was travelling at 89 knots and decelerating, it began to yaw to the left (0632:49).
- During the yaw movement, an application of power was recorded.
- The aircraft exited the runway surface to the left at approximately 2250 feet beyond the runway threshold (0632:53).
- The aircraft came to rest, nose down, approximately 2400 feet beyond the runway threshold and 150 feet south of the centre of the runway.
- No braking was recorded, and no reverse thrust activation was performed.

According to the information gathered, the approach met the company's stabilized approach criteria.[24]

24 Keewatin Air LP, *Company Operations Manual* (15 March 2019), paragraph 7.3.8, p. 7-11.

Figure 2. Estimated track of the occurrence aircraft over Runway 27 at Sanikiluaq Airport, along with points where the aircraft touched down, drifted to the left, exited the runway, and came to rest (Source: Google Earth, with TSB annotations)



1.12 Wreckage and impact information

The aircraft came to rest, nose down (Figure 3). The left engine was torn from the firewall and folded completely under the wing between the nacelle and the fuselage. The propeller blades on the right engine were damaged and the nose landing gear strut failed. The nose of the aircraft sustained significant structural damage.

No runway lights were struck during the runway excursion.

Figure 3. The occurrence aircraft after the runway excursion, stopped with the nose down (Source: Keewatin)

1.13 Medical and pathological information

According to information obtained during the investigation, there was no indication that the flight crew's performance was affected by medical or physiological factors.

1.14 Fire

There was no indication of fire either before or after the occurrence.

1.15 Survival aspects

The occupants were all wearing their safety belt at the time of the impact. They were able to evacuate the aircraft, but had to walk approximately 1640 feet (500 m) to the terminal in difficult conditions (strong winds, temperature of −4 °C, reduced visibility due to darkness, as well as blowing snow and the snowy surface).

Airport staff did not see the runway excursion happen given the blowing snow, and only became aware of the accident when the occupants arrived at the terminal. The airport's emergency response plan was then activated and the occupants were taken care of.

1.15.1 Emergency locator transmitter

The aircraft was equipped with a 406 MHz Artex ELT (model Me406). The ELT activated upon impact, and the signal was received at 0633 by the Canadian Mission Control Centre in Trenton, Ontario, which then informed Keewatin.

1.16 Tests and research

1.16.1 TSB laboratory reports

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

- LP123/2022 – G1000 Flight Data

1.17 Organizational and management information

1.17.1 Keewatin Air LP

1.17.1.1 General

Keewatin began operations in 1971. The company holds an air operator certificate under CARs subparts 703 (Air Taxi Operations) and 704 (Commuter Operations). Over the years, it has developed expertise in the field of medical evacuations, which are offered 24 hours a day to remote communities in the Canadian Arctic. Its fleet includes King Air B200, Pilatus PC-12, and Cessna Citation 560 aircraft. Its main base is located at CYWG, and its secondary bases are located in Nunavut (Igloolik, Iqaluit, Rankin Inlet, and Cambridge Bay), Manitoba (Thompson, The Pas, and Churchill) and the Northwest Territories (Yellowknife).

1.17.1.2 Medical evacuation flights

For operations departing from CYWG, the operations manager, i.e., the director of flight operations or the chief pilot,[25] delegates the flight authorization to the person responsible for flight following.

The company operations manual (COM) states:

> d) Upon receipt of the request for contracted medevac services, the Flight Follower will contact the appropriate flight crew members and assign them to flight duty.
>
> e) Upon receipt of the call from the Flight Follower, the "on-call" medevac service flight crew members shall accept and authorize this duty assignment, in accordance with Keewatin Air LP's operational control system, to complete the contracted medevac service flight.[26]

Also according to the COM,

> When preparing the aircraft for medical transport, flight crews shall meet with the flight nurse and a verbal meeting shall take place to discuss any special patient considerations as they pertain to the operation of the aircraft.[27]

To mitigate the risk of patient condition influencing flight crew member decision making, the company has determined the following:

> 1. Flight followers, medical crew and management shall endeavor to limit to the maximum extent possible the amount of patient information that is provided to flight crew members in preparation for a flight […] and [make] every effort to avoid any discussion about the critical degree of the patient's condition with or in the presence of flight crew members.
> 2. Both flight crew members and medical crew shall not be rushed in any way which may adversely affect their ability to perform their duties or affect aviation safety. [They] shall not permit the condition of the patient to influence their decision making.[28]

In this occurrence, the patient's condition was not disclosed to the pilots and they were not under external pressure to conduct the flight in relation to the patient's condition.

1.17.1.2.1 Hazardous weather conditions

Before a flight is dispatched, the flight follower must gather information on weather and runway conditions. If weather stations do not issue reports at the requested aerodromes and weather conditions have been poor in the last few hours, the flight follower must request a weather report. When the weather conditions are hazardous, the flight follower must inform the on-call operations manager to avoid starting the flight crew's duty time too early. "The Chief Pilot, [Operations] Manager or the Captain is responsible for determining

---

25 Ibid., paragraph 4.2.1.1, p. 4-4.

26 Ibid., subparagraphs 4.2.2.1d) and 4.2.2.1e), p. 4-5.

27 Ibid., paragraph 4.3.2.1, p. 4-9.

28 Ibid., paragraph 5.7.1.5.2, p. 5-31.

whether the aircraft is able to access a community or not as it is NOT the Flight Coordinators [*sic*] job to interpret the weather."[29]

In this occurrence, the flight follower requested the weather conditions and then communicated them to the on-call operations manager.

The complexity and variability of operations in remote areas are such that complying with the regulations, such as meeting the weather minima for instrument flight rules flight, does not ensure the safety of flight operations. In its Safety Management System Policy, Keewatin states that the "primary goal is the proactive mitigation and elimination of hazardous conditions through effective risk management […]."[30] To mitigate the risks, the on-call operations manager took into consideration several factors such as the nature of the flight, the aircraft's capabilities, the airport environment, the weather conditions, the experience of the pilots, in addition to his own experience. He also relied on the pilots' judgment to decide whether a safe landing could be attempted once there, given that conditions often changed between the time a flight was authorized and the time of landing.

1.17.1.3 Training program

A training program provides pilots with the skills they need to perform their assigned duties and focuses not only on technical aspects, but also on human performance.

To do this, threat[31] and error[32] management (TEM) training helps pilots identify and analyze potential hazards, and implement appropriate strategies to handle threats while avoiding, identifying or mitigating errors before they lead to adverse consequences such as an undesired aircraft state. The PIC and the FO had completed the company's crew resource management (CRM) training, which included TEM training.

Standard operating procedures (SOPs) are strategies for managing threats that are developed by operators and tailored to their company's types and regions of operations. However, SOPs alone cannot cover all possible threats. In this occurrence, the primary threat identified by the flight crew for landing was the strength of the crosswind component, and the strategy chosen was a go-around at the slightest sign of an undesired aircraft state.

Keewatin's SOP manual states that a missed approach or balked landing should be conducted under the following circumstances:

---

29 Keewatin Air LP, *Keewatin Air Flight Coordinator Manual*, Policy B-8: Weather Challenges (18 August 2008, revised 14 July 2017).

30 Keewatin Air LP, *Safety Management System Manual*, Amendment 4 (02 December 2021), Section 1.1, p. 1-1.

31 A threat refers to any condition that increases the complexity of an operation and can decrease safety margins and lead to errors. (Source: Transport Canada, Advisory Circular (AC) 700-042: Crew Resource Management [CRM], Issue 02 [14 March 2020], Appendix E.)

32 An error refers to the mistake that is made when a threat is mismanaged. (Source: Ibid.)

a) Mechanical failure with aircraft or runway environment (i.e.) runway lights at night

b) Unstable approach

c) Obstruction of runway environment (i.e.) aircraft, vehicle, or animal in the runway environment

d) Weather[33]

The SOP manual does not mention a specific procedure for a balked landing, i.e. once the aircraft is on the ground.

1.18 Additional information

1.18.1 TSB accident statistics

The annual statistics presented by the TSB and available on its website[34] show general trends that can be presented by type of operation, aircraft, or phase of flight.

According to these statistics, from 2012 to 2022, 11 accidents were reported to the TSB for air ambulance operations (airplane) compared to 239 accidents reported for air transport operations (airplane).

1.18.2 Air transportation safety issue investigation report A15H0001

In 2019, the TSB released Air Transportation Safety Issue Investigation Report (SII) A15H0001, the purpose of which was to raise the bar on safety by reducing the risks associated with air-taxi operations in Canada.

Air-taxi operations are exposed to more and different hazards than other types of commercial aviation operations, and their operating context has an impact on what mitigations can be put in place to manage risks in flight, at the airport, and within the company.

1.18.2.1 Aerodromes and infrastructure

In remote and northern communities, air transportation is often the only reliable year-round mode of transportation. These communities rely on air services to supply fresh food, medicine, and other goods; deliver health-care services; provide emergency medical evacuations; support exploration and economic development work; and support tourism and travel outside of the community.

The north, in particular, presents inherent challenges and risks to air transportation. Its population is spread out in small communities over vast stretches of inhospitable terrain. Air operations are subject to extreme weather, including cold temperatures, and to extended periods of darkness. Low and sporadic passenger volumes, along with these harsh

---

33 Keewatin Air LP, *King Air 200 Standard Operating Procedures*, Revision 3 (01 November 2021), Section 6, paragraph 6.23.1, p. 6-16.

34 These statistics are available at www.tsb.gc.ca/eng/stats/aviation/stats.html (last accessed on 26 July 2024).

operating conditions, create a difficult and costly operating environment for the air-taxi industry.

Among the issues operators identified as posing a high risk to safety were aspects of remote, northern, and small aerodromes.

Many operators raised concerns about poor runway conditions and short runways. Their concerns included the absence of runway condition reports for some airports and the absence of information on aircraft performance limitations for taking off from and landing on soft fields, or short or gravel runways.

The TSB concluded that remote and northern communities of Canada require appropriate aerodrome facilities and infrastructure to ensure that air-taxi operators can provide safe air services for those communities.

1.18.2.2 Meteorological information

Canada's weather varies widely and can change rapidly because of the landscape: a diverse mix of mountainous areas, coastal rain forest, large inland lakes, vast prairie, boreal forest, Arctic regions, and the longest coastline in the world, bordering 3 oceans. This geography significantly influences weather conditions, both on the broader scale and in regional microclimates. These factors can make accurate weather forecasting difficult, posing problems for all sectors of aviation.

At the same time, effective flight planning requires current and accurate weather information, so that pilots can make sound decisions during takeoff and landing based on weather conditions, and avoid encountering poor weather en route. In the air-taxi sector, a large proportion of operations takes place in the most remote and challenging regions of Canada, where weather can be severe and unpredictable. Weather information therefore plays a crucial role in safety.

The TSB concluded that accurate weather information is a critical component of flight planning. It allows pilots to make sound decisions based on weather conditions.

1.18.2.3 Pilot decision making and crew resource management

The purpose of pilot decision making (PDM) training is to develop skills to make decisions that manage the flight-related risks effectively. Risks commonly encountered in air-taxi operations include aircraft loading, adverse weather conditions, unserviceable equipment, pressure to conduct and complete flights, and specific risks associated with medical evacuation and night flights.

Contemporary CRM training, which includes TEM principles, helps flight crews or single pilots develop the skills necessary to use all resources to manage the risks associated with air operations.

The diversity of operations in the air-taxi sector, combined with greater employee turnover than in other sectors, means that efforts to enhance PDM and CRM competencies have significant potential to improve safety. However, for the potential benefits of PDM and CRM training to be realized, pilots must be adequately supported in applying these skills on the job.

The TSB concluded that PDM and CRM are critical competencies that help flight crews manage the risks associated with air operations.

2.0 ANALYSIS

The flight crew members held the appropriate licences, ratings, and qualifications for the occurrence flight. There was no indication that the flight crew's performance was affected by fatigue or medical or physiological factors. No defects or malfunctions were reported during the occurrence flight and there was no indication that a component or system malfunction played a role in this occurrence.

Strong winds and snowfall were present at the destination at the time of the occurrence. The runway surface was a mix of gravel and compacted snow due to the winter season, and had been cleared before the flight's arrival.

Despite industry efforts to implement mitigation measures, the risks associated with air-taxi operations in northern regions are known. The persistence of certain factors, such as the lack of information on weather and runway surface conditions during flight planning, and the fact that air transportation is the only year-round means of transporting goods, food, and people influence the management of operations.

Therefore, this analysis will focus on flight authorization and planning, information available in flight, the decision to land, and the landing.

2.1 Flight authorization and planning

Following the request for the medical evacuation flight, the Keewatin Air LP (Keewatin) flight follower requested the latest weather conditions from the ground personnel at Sanikiluaq Airport (CYSK), Nunavut, and confirmed that the runway would be cleared of snow. Given the wind strength (30 knots) and the 28-knot crosswind component, the flight follower contacted the on-call operations manager to request authorization for the flight.

The on-call operations manager took into consideration the nature of the flight, the aircraft's capabilities, the airport environment, the weather conditions, the experience of the pilots, and his own experience to assess the risks to the safety of the flight and the chances of successfully completing the flight, while being aware of the community's expectations. Delaying the evacuation of someone who needs advanced medical attention can be a delicate matter if the community feels that the flight can be attempted.

The on-call operations manager was aware that the 28-knot crosswind component exceeded the maximum of 25 knots demonstrated by the aircraft manufacturer. However, this speed is not an aircraft limitation. The manufacturer had not published a theoretical crosswind component limitation for landings and takeoffs, nor was it required to do so. Based on his experience, the manager knew that landings had been successfully completed in the past when the crosswind component exceeded 25 knots. He relied on the pilots' judgment to decide whether a safe landing could be attempted based on the conditions at the time of landing.

Knowing that the pilot-in-command (PIC) had recent experience at CYSK and was a training pilot on the occurrence aircraft type, the manager authorized the flight to “go and see” if a landing was possible under these conditions.

The flight follower then briefed the flight crew on the flight. At the time of flight planning, the only information available on the runway surface condition was that the runway would be cleared of snow. The airport did not publish a Canadian Runway Friction Index (CRFI) and the flight crew did not consult the tables for equivalent CRFIs in the *Canada Flight Supplement* because they were not relevant to an unpaved runway. The PIC expected, however, that the traction would be good because he had landed without difficulty at CYSK on the evening of 15 December.

The PIC was concerned about the wind strength published in the 0200 weather report (320° true [T] at 29 knots, gusting to 36 knots) and the constant speed of the crosswind component of 27 knots. The flight follower informed the PIC that a discussion about the wind strength had taken place with the on-call operations manager who had authorized the flight to “go and see.” As a result, the PIC did not contact the on-call manager to discuss the matter. In addition, having experience flying in similar wind conditions and with no landing performance limitation for the aircraft, he knew that the standard practice was to “go and see.” He was also aware that conditions could change because the estimated time of arrival was several hours away, and that, if necessary, a go-around could be conducted. Therefore, the PIC agreed to conduct the flight, intending to make the final decision on whether or not to land based on the conditions at the destination.

Many factors (outside temperature, type of stone used for the runway surface, frequency of runway maintenance, equipment used for maintenance, etc.), which vary from one aerodrome to another, affect tire traction on a gravel runway. In the absence of more precise data on runway surface conditions, the 7 air operators consulted by the TSB that provide air transportation services in northern areas indicated that they rely on the recent experience of their pilots at the aerodromes to determine whether a safe landing can be conducted. The practice of taking off and “going to see” is reportedly common for northern operations and yields good results, i.e., with no reported adverse consequences.

Finding as to risk

If air operators have little information on runway conditions and associated aircraft performance, there is a risk that flights will be authorized to be conducted in conditions that exceed the aircraft’s landing performance capabilities.

2.2 Information available in flight and decision to conduct the approach

At approximately 0504, when the aircraft was halfway between Winnipeg/James Armstrong Richardson Airport (CYWG), Manitoba, and CYSK, the flight crew received the weather conditions recorded at 0500 at CYSK. Visibility had decreased to 1 statute mile in light snow and blowing snow. The winds were from 320°T at 35 knots, gusting to 46 knots. These winds resulted in a crosswind component with a speed of 33 knots, excluding gusts. No new information on runway surface conditions was available.

At approximately 0600, the flight crew conducted the approach briefing and began the descent to CYSK. The 0600 weather information showed little change: winds were from 310°T at 36 knots, gusting to 44 knots, and the crosswind component was 31 knots, excluding gusts. Updated runway surface conditions were still not available. The PIC was the pilot flying for the approach and landing because the first officer (FO) had limited experience on the King Air B200.

The flight crew determined that the main threats to the landing were the strength of the crosswind component and the possible presence of snowdrifts on the runway.

To manage the risks posed by these threats, the PIC and FO agreed that, before continuing with the landing, they would need to visually confirm that no snowdrifts were present, and agreed that they would conduct a go-around if they experienced difficulty controlling the aircraft's path and speed during the approach and landing.

Finding as to causes and contributing factors

In the absence of precise data on the aircraft's performance limitations, based on previous successful landings in similar wind conditions, and with an established plan to conduct a go-around if they had difficulty controlling the aircraft, the flight crew decided to conduct the approach with a crosswind component of 31 knots.

When the aircraft was approximately 4 nautical miles from CYSK at an altitude of about 1500 feet above sea level, the flight crew saw the runway edge lights. The approach remained stabilized on the normal approach path despite turbulence, and the aircraft's speed was kept at about 125 knots. The flight crew did not see any snowdrifts on the runway and continued the approach, because they had planned to carry out a go-around if they encountered difficulty controlling the aircraft.

As the aircraft crossed the runway threshold, the PIC had no difficulty controlling the aircraft and decided to land. The FO, who was monitoring the approach, did not notice any deviations or other signs that would lead him to make a go-around call.

The stability of the approach, the fact that control of the aircraft was maintained up to the runway threshold, and the possibility of a go-around after touchdown may have reinforced the impression that the landing attempt was still safe despite the strength of the crosswind component.

Finding as to causes and contributing factors

As the aircraft crossed the runway threshold, the FO, who was monitoring the approach, did not notice any deviations or other signs that would lead him to make a go-around call. With the PIC able to maintain a stable approach, the flight crew was certain that a go-around could be conducted at any time if control difficulties arose once on the ground, and decided to land.

2.3 Landing

The aircraft touched down on Runway 27 at 0632. According to the data collected, the initial touchdown occurred between 1300 and 1800 feet beyond the threshold of Runway 27 when the aircraft's indicated airspeed was 110 knots. The right wheel (windward side) touched down first, followed by the left wheel and finally the nose wheel. As soon as the aircraft landed, it began to drift to the left.

The PIC then attempted to keep the aircraft on a straight path down the runway, but was unsuccessful. Approximately 3 seconds after the aircraft started drifting to the left, when it was decelerating and its speed was 89 knots, the PIC initiated a go-around as planned and followed the manufacturer's balked landing procedure. The left landing gear struck a snowbank at the edge of the runway almost immediately thereafter.

The fact that the aircraft's path could not be maintained suggests that the strength of the crosswind was too high for the tires' ability to grip the runway surface. However, owing to the lack of precise data, the actual strength of the crosswind and tire traction limit at the time of landing could not be determined.

Finding as to causes and contributing factors

The combination of the strength of the crosswind and the degree of tire traction on the runway surface caused the aircraft to drift to the left. When the PIC realized that he was unable to control the drift after about 3 seconds, he conducted a go-around as planned, but the aircraft exited the runway surface immediately thereafter.

The PIC and FO's strategy was to initiate a go-around at the slightest sign of an undesired aircraft state. However, this strategy of conducting a go-around after landing did not work in this context, even though the pilot reacted very quickly.

Once an aircraft is on the ground, it is in a low-energy state. Any attempt to go around on approach or to reject the landing while the aircraft is in this state is very risky. It can take several seconds for the engines to accelerate to full throttle and gain the necessary speed to take off again. Once the aircraft has taken off again, it remains in this low-energy state for a period of time, that is, the time it takes to retract the landing gear and flaps and gain altitude. If, at this time, something unexpected happens, such as wind shear or control difficulties, the risk of loss of control and controlled flight into terrain increases. If the flight crew has any doubt about the safe execution of a landing, it is preferable that they initiate the go-around before the aircraft is in a low-energy state.

Finding as to risk

If an uncontrolled lateral drift of the aircraft occurs after landing and a go-around is initiated to reject the landing while the aircraft is in a low-energy state, there is a risk that if a runway excursion occurs, it will be exacerbated, or if the aircraft takes off in this state, that a loss of control or controlled flight into terrain will occur.

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. In the absence of precise data on the aircraft's performance limitations, based on previous successful landings in similar wind conditions, and with an established plan to conduct a go-around if they had difficulty controlling the aircraft, the flight crew decided to conduct the approach with a crosswind component of 31 knots.

2. As the aircraft crossed the runway threshold, the first officer, who was monitoring the approach, did not notice any deviations or other signs that would lead him to make a go-around call. With the pilot-in-command able to maintain a stable approach, the flight crew was certain that a go-around could be conducted at any time if control difficulties arose once on the ground, and decided to land.

3. The combination of the strength of the crosswind and the degree of tire traction on the runway surface caused the aircraft to drift to the left. When the pilot-in-command realized that he was unable to control the drift after about 3 seconds, he conducted a go-around as planned, but the aircraft exited the runway surface immediately thereafter.

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 air operators have little information on runway conditions and associated aircraft performance, there is a risk that flights will be authorized to be conducted in conditions that exceed the aircraft's landing performance capabilities.

2. If an uncontrolled lateral drift of the aircraft occurs after landing and a go-around is initiated to reject the landing while the aircraft is in a low-energy state, there is a risk that if a runway excursion occurs, it will be exacerbated, or if the aircraft takes off in this state, that a loss of control or controlled flight into terrain will occur.

4.0 SAFETY ACTION

4.1 Safety action taken

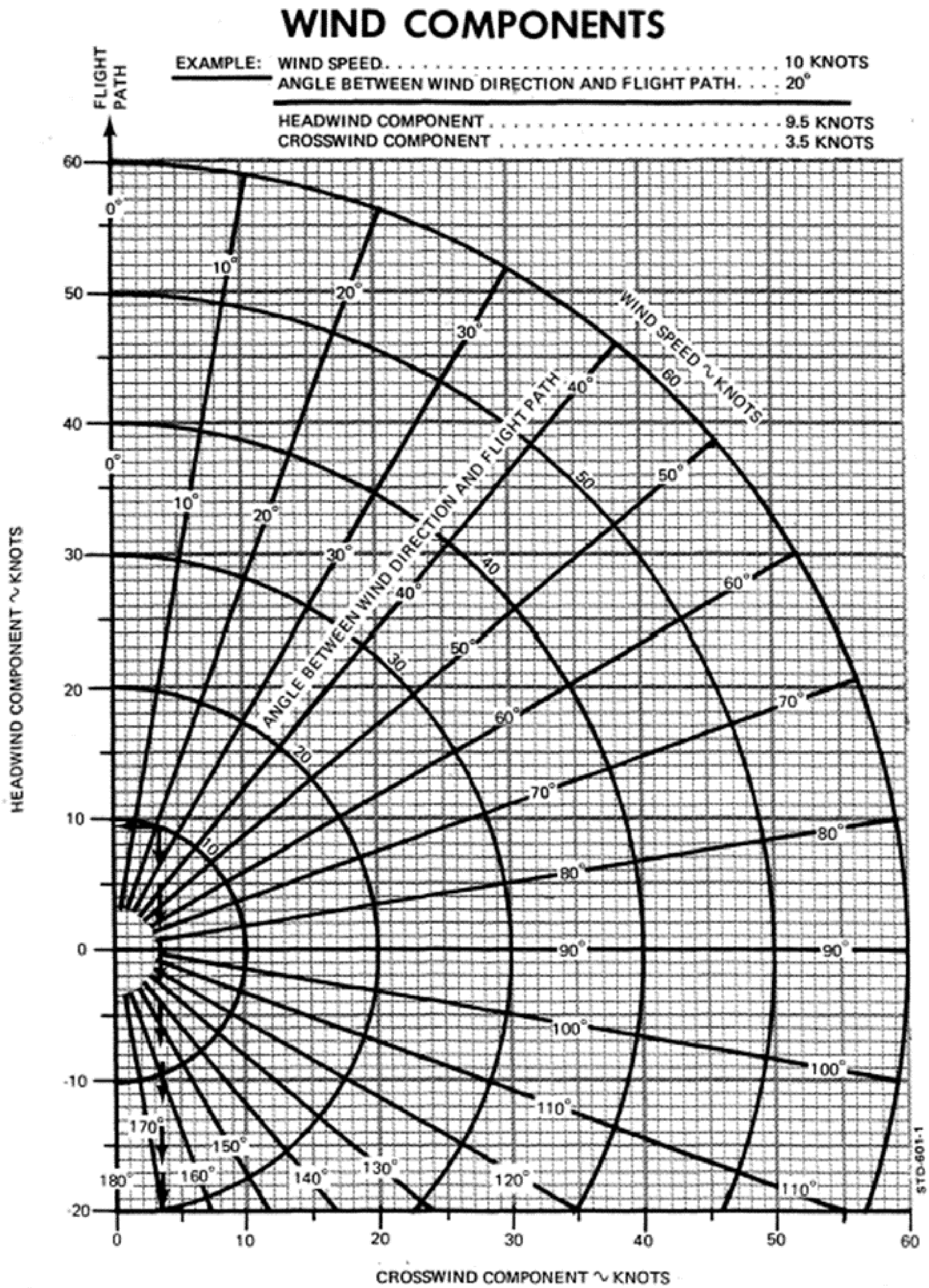
The Board is not aware of any safety action taken following this occurrence.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 26 June 2024. It was officially released on 22 August 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.

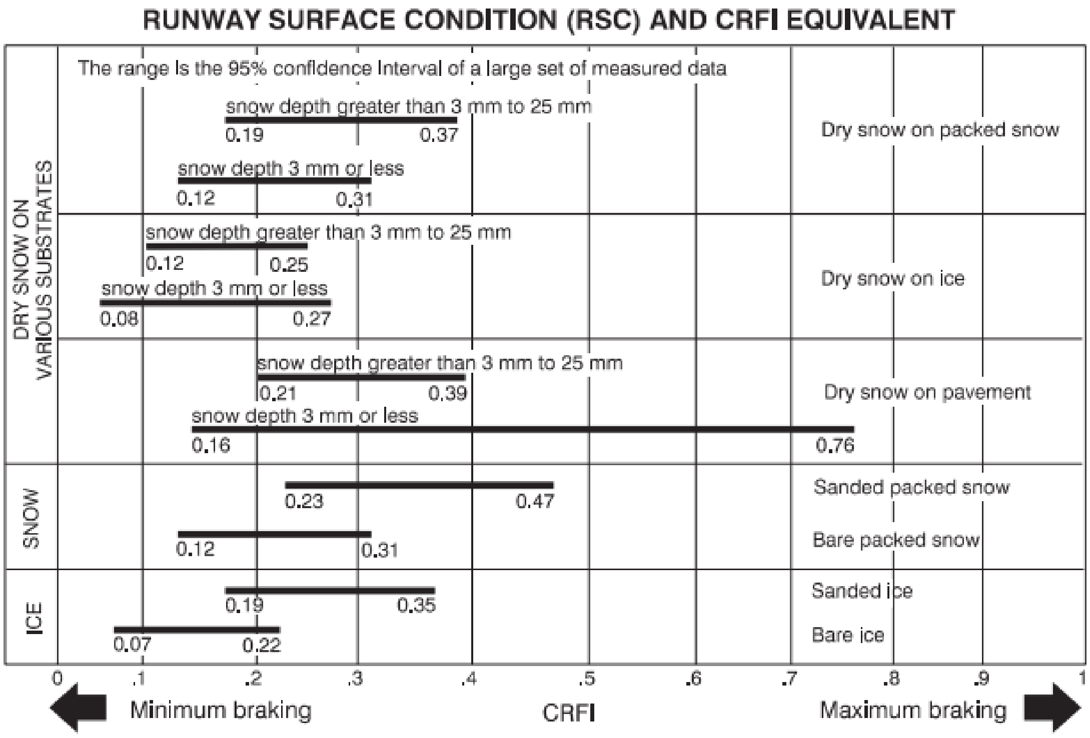
APPENDICES

Appendix A – Crosswind component calculation table



Source: Raytheon Aircraft Company, *Beechcraft Super King Air B200 and B200C Pilot's Operating Handbook and FAA Approved Airplane Flight Manual* (May 2000), Section V: Performance, p. 5-32.

Appendix B – Runway surface condition and Canadian Runway Friction Index (CRFI) equivalent table



MINIMUM AND MAXIMUM CRFIs FOR VARIOUS SURFACES

SURFACE	LOWER CRFI LIMIT	UPPER CRFI LIMIT
Bare Ice	No Limit	0.3
Bare Packed Snow	0.1	0.4
Sanded Ice	0.1	0.4
Sanded Packed Snow	0.1	0.5
Dry Snow on Ice (depth 3 mm or less)	No limit	0.4
Dry Snow on Ice (depth 3 mm to 25 mm)	No limit	0.4
Dry Snow on Packed Snow (depth 3 mm or less)	0.1	0.4
Dry Snow on Packed Snow (depth 3mm to 25 mm)	0.1	0.4
Dry Snow on Pavement (depth 3 mm or less)	0.1	Dry Pavement
Dry Snow on Pavement (depth 3 mm to 25 mm)	0.1	Dry Pavement

Source: NAV CANADA, *Canada Flight Supplement* (effective 02 December 2021 to 27 January 2022).