Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Robinson R44, registration VH-HRB

95 km west-north-west of Borroloola, Northern Territory on 7 August 2023

ATSB Transport Safety Report
Aviation Occurrence Investigation (Short)
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Addendum

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Executive summary

What happened

On 7 August 2023, a Robinson Helicopter Company R44, registered VH-HRB was departing the Lost City in the Limmen National Park, Northern Territory with 1 pilot and 3 passengers on board. During take-off, the helicopter rolled to the right and collided with terrain resulting in serious injuries to one passenger and minor injuries to the pilot and another passenger.

What the ATSB found

During take-off, the pilot was unaware that the helicopter's left skid was pressed against a tree root that was partially obscured by sand.

When the pilot applied flight control inputs to raise the helicopter into a hover, it began rolling to the left against the tree root. In response to that unexpected movement, the pilot applied right cyclic input then lowered the collective. However, the pilot was not aware that, while the right cyclic input freed the skid from the tree root, it also led to the helicopter drifting to the right. As such, when the pilot lowered the collective to settle the helicopter on its skids it dynamically rolled over to the right.

Safety message

This accident highlights the importance of smooth and controlled flight control inputs in the critical phases of flight. While a helicopter is in contact with the ground, it is subject to various influences which could result in a dynamic rollover. A thorough understanding of the principles of and contributing factors to dynamic rollover and the recovery methods are essential to conducting safe helicopter take-offs and landings, especially to unprepared areas.

Operators and pilots are also reminded to conduct a thorough visual inspection of landing sites to identify potential hazards prior to take-off. While uncertified aerodromes, bush landing sites and paddocks can be suitable landing areas, they are also prone to concealed hazards.

The investigation

Decisions regarding the scope of an investigation are based on many factors, including the level of safety benefit likely to be obtained from an investigation and the associated resources required. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On 7 August 2023, a Robinson Helicopter Company R44, registered VH-HRB and operated by Wellspring Rural Services Pty Ltd, was being used to conduct a series of sightseeing flights from Lorella Springs airstrip to the Lost City in the Limmen National Park, Northern Territory.

On the sixth flight of the day, at approximately 1150 local time, the pilot landed at the Lost City helicopter landing site (HLS) in a southerly direction. In accordance with the operating procedures, the pilot remained in the helicopter with the engine running while 2 passengers were off loaded, and 3 new passengers were loaded by a ground crew member for the return flight to Lorella Springs.

During the subsequent take-off with a prevailing east-south-easterly wind, the pilot applied slight left cyclic[1] to manoeuvre the helicopter into a hover. The pilot advised that the helicopter started rolling to the left, which the pilot thought was the onset of a dynamic rollover (see the section titled *Dynamic rollover).* In response, they applied right cyclic to counter the roll.

The helicopter subsequently started drifting right, which the pilot later advised they did not recognise, instead believing that the right skid was still on the ground. They lowered the collective[2] in an attempt to settle the helicopter resulting in the helicopter rolling onto its right side (Figure 1).

The ground crew member provided immediate assistance to evacuate those on board, however as they assisted the front left passenger by releasing their seatbelt, the passenger fell and sustained a minor injury. The pilot also sustained a minor injury. The passenger in the rear left seat was uninjured and the passenger seated in the rear right seat sustained a fractured rib.

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1 Cyclic: a primary helicopter flight control that is similar to an aircraft control column. Cyclic input tilts the main rotor disc, varying the attitude of the helicopter and hence the lateral direction.

2 Collective: a primary helicopter flight control that simultaneously affects the pitch of all blades of a lifting rotor. Collective input is the main control for vertical velocity.

Figure 1: VH-HRB post-accident

Source: Operator

Context

Pilot

The pilot held a valid commercial pilot license (helicopter) with a class 2 aviation medical certificate. They obtained their license in May 2023 and the theory of dynamic rollovers was taught during their training.

At the time of the accident, the pilot had accumulated 298 hours of aeronautical experience, with about half of that operating the R44. Since obtaining their license, they had completed around 100 landings at the Lost City HLS and all of those were in VH-HRB.

The pilot had been on duty for 4.5 hours at the time of the accident and stated they were feeling well rested and alert at the commencement of their flying duty that day.

Helicopter

The R44 is a 4-seat helicopter that is primarily all-metal construction with a 2-blade main and tail rotor system powered by a 6-cylinder Lycoming piston engine. VH-HRB was manufactured in the United States in 1994 and issued serial number 104.

The helicopter was maintained in accordance with the manufacturer's maintenance schedule, which required a periodic inspection every 100 hours or 12 months, whichever came first. The maintenance release indicated that VH-HRB had accumulated a total of 2,541 hours in service at the time of the occurrence. The helicopter had flown 31 hours since the last periodic inspection, and no outstanding defects were noted in the maintenance release.

The co-pilot controls had been removed and were stored under the pilot's seat for the flight, and the front doors had been removed. The helicopter was not fitted with an ELT, nor was it required to be.

The ATSB did not attend the accident scene. As such, a detailed examination of the airframe or engine was not performed.

Using information provided by the aircraft operator, the ATSB assessed that the helicopter was operated within the weight and balance requirements for the flight.

Meteorology

The pilot and operator stated east-south-easterly winds were prevailing at the time of the accident, which was typical for the location at that time of day. Two passengers recalled very gusty wind conditions prior to the flight.

Weather data was not available for the accident location; however, a review of weather data from the 3 nearest available locations (Borroloola Airport, Ngukurr Airport and McArthur River Mine Airport) indicated an east-south-easterly wind with a maximum of 15 kt at the time of the accident.

These conditions were within the helicopter's operating limits and it was reported that the pilot was experienced operating in these conditions. The pilot stated that there was always an option to swap duties with the ground crew member, who was also an experienced pilot, if they had any concerns that the conditions were beyond their personal limits. The pilot did not have any concerns about the wind conditions on the day and did not consider it was a factor in the accident.

Helicopter landing site

The helicopter landing site consisted of a clearing in the national park, approximately 100x30 m, with a sandy surface, scattered with tussocks of spinifex grass. The operator had utilised the landing site for 8 years, and a landing site plan was included in their exposition.

The operator's procedure for the landing site was to follow a curved departure to the south-east when easterly winds prevailed (Figure 2).

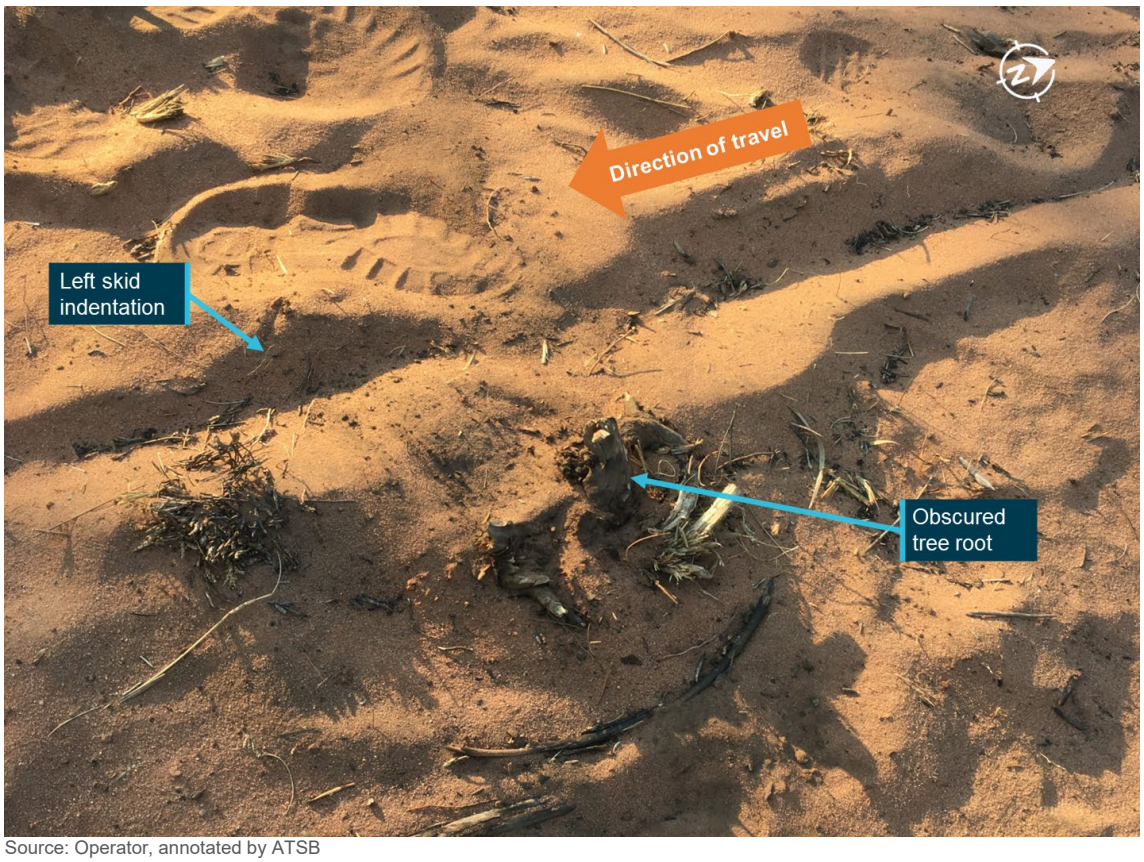
Figure 2: Intended direction of travel

Source: Google earth, annotated by ATSB

The operator inspected the landing site at the beginning of the tourist season (May) to ensure any hazards were removed or mitigated. While the operator had no specific procedure for regular inspection/maintenance of the landing site, a ground crew member drove to the landing site at the start of each day to wait for the first flight and continued loading and offloading passengers 6–8 times during the day. As such, the ground crew member visually scanned the landing site for hazards, multiple times daily.

Photographs provided by the operator post-accident (Figure 3) depicted a tree root protruding from the sand in close proximity, or pressed against, the helicopter's left skid.

Figure 3: Left skid indentation against tree root



Source: Operator, annotated by ATSB

Witness observations

The ground crew member was an experienced helicopter pilot and was approximately 50 m from the helicopter during the accident sequence. They later recalled that during the take-off they observed the helicopter pull sharply to the left and then sharply to the right, followed by the helicopter drifting to the right prior to rolling onto its right side.

Dynamic rollover

A rotors-running helicopter resting with one landing skid or wheel on the ground may, without appropriate pilot input, commence rolling around the skid. Under certain circumstances, this roll cannot be controlled and the helicopter will roll over. This condition is known as 'dynamic rollover' and is a function of the interaction between the:

- horizontal component of the total rotor thrust (or lift) acting about the point of ground contact
- weight of the helicopter, initially acting between the helicopter's skid landing gear or wheels, moving outside the helicopter's landing gear.

The Federal Aviation Administration Helicopter flying handbook Chapter 11 Helicopter emergencies and hazards stated that dynamic rollover begins when the helicopter starts to pivot laterally around its skid or wheel.

It further stated:

> 'This can occur for a variety of reasons, including... the skid or wheel contacts a fixed object while hovering sideward…'

Recovery from dynamic rollover involves smoothly lowering the collective while controlling any tendency to roll in the opposite direction with cyclic to re-establish the helicopter's weight evenly on the ground. In general, the application of smooth collective inputs is more effective in avoiding rollover issues than using the cyclic control.

Safety analysis

Prior to departing, the pilot was unaware that the helicopter's left skid was pressed against a tree root, which was not obvious as it was partially obscured by sand. During take-off with prevailing east-south-easterly winds, the pilot applied slight left cyclic to manoeuvre the helicopter into a hover. These inputs pushed the left skid into the tree root, which in turn resulted in the helicopter initially rolling around the left skid.

The pilot recognised this movement and attempted to recover by applying right cyclic then lowering the collective. However, it is likely that before they lowered the collective the helicopter had become light enough on the skids to commence drifting to the right due to the cyclic input. That lateral movement was not detected by the pilot, and when the pilot lowered the collective to settle the helicopter the right skid touched the ground, resulting in a dynamic rollover.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the collision with terrain involving Robinson helicopter R44, registration VH-HRB, 95 km north-west of Borroloola, Northern Territory on 7 August 2023.

Contributing factors

- The pilot was unaware that the helicopter's left skid was pushed against a tree root during the take-off, leading to an uncommanded left roll and subsequent dynamic rollover during the attempted recovery.

General details

Occurrence details

Date and time:	7 August 2023 - 1150 Central Standard Time	
Occurrence class:	Accident	
Occurrence categories:	Collision with terrain	
Location:	95 km west-north-west Borroloola, Northern Territory	
	Latitude: 15.8076° S	Longitude: 135.4565° E

Aircraft details

Manufacturer and model:	Robinson Helicopter Company R44	
Registration:	VH-HRB	
Operator:	Wellspring Rural Services Pty Ltd	
Serial number:	104	
Type of operation:	Part 133 Air transport operations - Rotorcraft	
Activity:	Commercial air transport – Non-scheduled – Joyflights/sightseeing charters	
Departure:	Lost City, Limmen National Park, Northern Territory	
Destination:	Lorella Springs airstrip, Northern Territory	
Persons on board:	Crew – 1	Passengers – 3
Injuries:	Crew – minor	Passengers – 1 serious, 1 minor, 1 uninjured
Aircraft damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- pilot of the accident flight
- operator and the chief pilot of Wellspring Rural Services Pty Ltd
- Bureau of Meteorology
- accident passengers

References

Federal Aviation Administration 2022, Helicopter Flying Handbook, Chapter 2 and 11, Aerodynamics of Flight'

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- pilot of the accident flight
- operator and the chief pilot of Wellspring Rural Services Pty Ltd
- Civil Aviation Safety Authority.

No comments to the draft report were received.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.