

**Aviation Safety Investigation Report
199904859**

**Kawasaki Heavy Industries
Kawasaki KH4**

15 October 1999

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Occurrence Number: 199904859 **Occurrence Type:** Accident
Location: Joondalup Lake
State: WA **Inv Category:** 4
Date: Friday 15 October 1999
Time: 1115 hours **Time Zone** WST
Highest Injury Level: Minor
Injuries:

	Fatal	Serious	Minor	None	Total
Crew	0	0	1	0	1
Ground	0	0	0	0	0
Passenger	0	0	1	0	1
Total	0	0	2	0	2

Aircraft Manufacturer: Kawasaki Heavy Industries
Aircraft Model: 47G3B-KH4
Aircraft Registration: VH-BFL **Serial Number:** G2-199
Type of Operation: Commercial Aerial Agriculture - Other
Damage to Aircraft: Destroyed
Departure Point: Joondalup Lake WA
Departure Time: 1105 WST
Destination: Joondalup Lake WA

Crew Details:

		Hours on	
Role	Class of Licence	Type	Hours Total
Pilot-In-Command	Commercial	665.0	724

Approved for Release: Monday, January 17, 2000

FACTUAL INFORMATION

History of Flight

The Kawasaki KH-4 helicopter was engaged in aerial work, spraying larvacide to control mosquitoes at Lake Joondalup in Perth's northern suburbs. The crew consisted of the pilot and an employee of the local city council who was directing the pilot on where to spray. The city council employee occupied the right passenger seat.



The spray runs were being conducted at an altitude of about 30 ft to prevent the pesticide from drifting excessively. The runs started at the east side of the lake, track crawling towards the west. The tracks of each run were orientated approximately north/south, aligned with the shoreline. The pilot reported that turbulence made the helicopter progressively more difficult to control in maintaining speed and height the closer the tracks came to the western side of the lake.

The helicopter had conducted three spray runs during the previous hour without incident. The fourth and final planned run was to cover the western shore area of the lake. While the helicopter was conducting a right procedure turn to track into north, it descended and hit the water. The helicopter came to rest in shallow water almost upright and slightly nose-up. It later rolled onto its right side. The pilot exited the helicopter unimpeded and the passenger released herself from her lap belt. She chose to stay in the helicopter until medical help arrived because she was concerned that she may have sustained a back injury.

Terrain

Lake Joondalup was oriented north-north-west and located in a small valley approximately 5.4 km east of the coast. High ground to the west of the accident site rose to a height of 70 m within 700 m. The ground to the east was more undulating, rising to a height of 100 m within 3 km. To the north-west of the lake were several small saddles. The high ground immediately to the west was a built-up area of residential housing and along the shore were trees to a height of about 6 to 10 m.

Weather

The weather at the time included 3 octas of cumulus cloud at 3,500 ft and 5 octas of strato-cumulus cloud at 4,500 ft. The temperature was 18 degrees Celcius. The wind at Perth airport, 25 km south-east of the accident site, was north-westerly at 14 kts gusting to 21 kts. The wind recording at Ocean Reef, the closest Bureau of Meteorology (BoM) facility to the accident site, was north-westerly at about 10 kts gusting to 13 kts. The Ocean Reef BoM facility was 6 km west of the accident site.

Witnesses at the site described the wind as being north-westerly and blustery with intermittent strong wind gusts.

An assessment of the terrain and wind conditions conducted by the BoM concluded that due to the trees and steep slope to the west of the lake, the wind flow over the area could have been disturbed and that, as a result, turbulence may have developed at the accident site. The BoM reported, however, that the degree of turbulence could not be determined due to the lack of recorded or observational data.

The investigation was on-site within 30 minutes of the accident. The wind was noted as being north-westerly at about 10 kts and gusting to an estimated 20 kts.

Personnel Information



The pilot had a total flying experience of about 724 hours, including 640 hours gained on the Bell 47/KH-4 helicopter types. Although the pilot had completed low-flying training and had acquired about 60 hours in low level operations including survey work, he had no experience in agricultural flying. He had completed a mosquito spraying operation without problems about 8 months prior to the accident. The operator reported that the pilot had conducted most of his low flying operations in relatively benign wind conditions. The pilot complied with the experience requirements under the exemption granted by the Civil Aviation Safety Authority (CASA) for the operator to conduct this particular type of work.

Helicopter Information

The helicopter was a Kawasaki KH-4 which at the time of the accident was within all-up-weight and centre-of-gravity limitations. The KH-4 cockpit/cabin was configured with a centre forward seat that was occupied by the pilot. Three passenger seats were located at the rear of the cabin, just aft of the pilot's seat. Two hoppers, one mounted on each side of the helicopter, were fitted for the disbursement of the dry granulated pesticide. The pilot reported that he was using a power setting of about 32 inches (Hg) Manifold Air Pressure (MAP) to maintain 30 kts groundspeed downwind during the wind gusts and about 25 inches to maintain a similar speed when flying into wind. The take-off (2 minutes) power limit was approximately 33 inches and maximum continuous power was about 28 inches. The maximum power permitted was 36 inches MAP. Flight manual data indicated that the helicopter should have been capable of achieving a rate of climb of nearly 1,000 ft per minute using take-off power at 39 kts.

Turbulence

As wind blows around and against obstacles such as trees, fences and buildings, the smooth flow breaks into a series of irregular, twisting, whirling eddies. These eddies are produced by mechanical turbulence and may rotate about axes in any direction. Mechanical turbulence tends to be lower over relatively smooth ground. The area upwind of the accident site was not smooth due to the trees.

Stronger winds usually produce more and larger eddies, and therefore more turbulence. Eddies could produce downdraughts that would cause a helicopter to lose height. In response, a pilot would need to increase the collective pitch to maintain the helicopter's height above the ground. Turbulence may also adversely affect the aerodynamic efficiency of the helicopter's main rotor blades, reducing the lift being produced by the main rotor system. As a consequence, flying in areas of turbulence usually requires more power to maintain a helicopter's height above the ground.

The adverse effect of turbulence may also be magnified if the helicopter is manoeuvring because the lift being generated by the main rotor system is being tilted away from the vertical. Therefore, only a percentage of the lift being produced by the main rotor is being used to counteract the effect of turbulence.

Flight profile



The pilot reported that he had completed a south-orientated track of the final run and had planned the right procedure turn to roll out heading approximately north. The procedure turn involved turning the helicopter to the left before commencing a right turn. This technique reduced the spacing between tracks. The pilot reported that while the helicopter was in the climbing banked turn to the left, he had flown it to a height of about 50 ft. Once he was sure of maintaining a suitable distance from the west bank of the lake, he commenced the right turn to align with the northerly track. He reported that during the turn to the right, he felt the helicopter begin to sink, so he lowered the nose to accelerate and continued the turn into wind. He also reported that at the time the wind was gusting. The pilot further reported that he felt the helicopter skidding in the turn as it descended below the tree height and he raised the collective and introduced power to arrest its rate of descent. However, the helicopter continued to sink and, realising that he would not be able to complete the turn into wind, he began rolling the helicopter to a wings-level attitude. The observer reported that she thought that the helicopter was "banked right over" and that during the turn, she could feel herself being pushed into her seat. She thought the bank angle was more than she had previously experienced during the morning. The pilot reported that he thought that the bank angle did not exceed 30 degrees.

The pilot reported that he continued raising the collective and introducing power. He reported that he did not over-pitch the main rotor and main rotor RPM remained within limits until the helicopter hit the water. When the helicopter skids hit the water, the helicopter spun through about 180 degrees and came to an abrupt stop. When all motion stopped, the pilot was still seated and restrained by his four-point harness. The observer reported that she thought that she had been pushed against the cabin roof during the impact although she was still firmly restrained by the lap harness after all motion had stopped.

Wreckage Information

The helicopter had come to rest approximately 50 m from the lake's western shore and about 550 m south-south-west of Lake Island. Damage to the main rotor system was consistent with the blades hitting the water under power. Witnesses reported hearing the engine operating immediately before the helicopter hit the water. No pre-existing mechanical fault in the helicopter was found.

The helicopter was being operated in accordance with operator's operations manual and the exemption granted by CASA. Although the pilot was qualified in accordance with requirements in the operations manual, he had no flying training in agricultural operations and was relatively inexperienced in low-level flying operations in adverse wind conditions. There appeared to be no pre-existing mechanical fault that contributed the accident.

During the three spray runs prior to the accident, the helicopter had been positioned towards the eastern side of the lake. The pilot had been conducting the runs approximately north/south and paralleling the shoreline, using the procedure-turn technique to reposition the helicopter for each run. The spray runs were being conducted at a height of about 30 ft with a climb to about 50 ft during the procedure turns. While the helicopter was experiencing some turbulence on the eastern side of the lake, the pilot noted that the turbulence was becoming more pronounced as he worked the helicopter westward. The lower level of turbulence experienced on the eastern side of the lake was consistent with mechanical turbulence dissipating over the smooth open water. In benign wind and turbulence conditions, the reported power margin would normally have been adequate for the task.

While the recorded wind conditions at the nearby Ocean Reef BoM station were quite benign, reports from the accident site indicated that the wind was blustery, and the strength of the gusts appeared to be significantly in excess of those being recorded at Ocean Reef. The lake's north-north-westerly orientation and high terrain to the west possibly increased the wind strength in the local area. The built-up area and vegetation along its western shore possibly induced wind eddies and considerably turbulent conditions near the lake's western shore.

The increasing level of turbulence being encountered by the pilot should have served to indicate that caution was required. Despite the increasing turbulence the pilot did not consider flying the helicopter higher above the water to provide a greater margin for regaining height should the helicopter be affected by the turbulent conditions. Rather, the pilot appeared focused on positioning the helicopter to ensure the spray coverage and to maintain a safe distance from the shoreline and trees. When the pilot banked the helicopter to the right, the evidence was consistent with it entering an area of strong turbulence, which caused the helicopter to unexpectedly descend towards the water. Although the reported power margin would normally have been adequate to effect a recovery in benign conditions, due to the lack of recorded information, the investigation could not determine if the power margin was adequate to overcome the conditions encountered by the helicopter at the time. Also, the pilot may not have used full power to recover from the descent. By the time the pilot realised that the helicopter was descending at an excessively high rate, there was insufficient height available for him to effect a recovery before the helicopter hit the water.

The helicopter's manoeuvring at a low height above the water, local weather conditions and the pilot's lack of experience in low-level operations in adverse wind conditions were probably all factors that contributed to the accident.

The helicopter's operator reported that the procedures and experience requirements for conducting low-level operations were being reviewed.

