SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigation Division** Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9064		
Aircraft Registration	**ZS-HCR**	**Date of Accident**	27 July 2012		**Time of Accident**	±0605Z	
Type of Aircraft	Garlick UH-1H (Helicopter)		**Type of Operation**		Private (Industrial Aid)		
Pilot-in-command Licence Type	Commercial Pilot		**Age**	32	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		775,3		Hours on Type	314,3	
Last point of departure	Amatole mountains near Hogsback, (Eastern Cape province)						
Next point of intended landing	Amatole mountains near Hogsback, (Eastern Cape province)						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Amatole mountains (GPS position; South 32°34.256' E ast 027°05.277' elevation 5 294 feet AMSL)							
Meteorological Information	Surface wind; 270°37 knots, Temperature; 13°C, Vis ibility; +10 km						
Number of people on board	1 + 0	**No. of people injured**	0	**No. of people killed**	1		

Synopsis

The pilot, being the sole occupant onboard the helicopter was engaged in a fire fighting operation in the Amatole mountain range located between Hogsback and Keiskammahoek in the Eastern Cape province. There were two helicopters that were participating in the fire fighting operation along with a 'spotter' aircraft and ground personnel. After uplifting approximately 1 000 litres of water into the bambi bucket from the nearby Cata dam the pilot proceeded to fly towards the fire line that was raging towards the north-west of Cata in the Amatole mountains. At the time of the operation strong wind conditions in the region of 70 km/h (38 knots) from the west were reported in the area. Evidence gathered at the crash site indicated that the bambi bucket, which was hanging approximately 10 m (33 feet) below the helicopter, collided with rising terrain. Following impact with terrain by the bambi bucket, which was still secured to the cargo hook mechanism, the helicopter impacted with the rising terrain along its intended flight path. The helicopter was destroyed by the post impact fire that erupted. The pilot was fatally injured in the accident.

Probable cause

During strong wind conditions the external load (bambi bucket) that was being slung below the helicopter collided with mountainous terrain as the pilot positioned the helicopter for the fire line, the pilot was unable to correct the helicopters sudden change in attitude (nose down), rendering ground impact inevitable.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner	**:** C J Rance (Pty) Ltd
Name of Operator	**:** Private (Industrial Aid)
Manufacturer	**:** Garlick Helicopter Corporation
Model	**:** UH-1H
Nationality	**:** South African
Registration Marks	**:** ZS-HCR
Place	**:** Amatole mountains (GPS position: S 32°34.256' E 027°05.277')
Date	**:** 27 July 2012
Time	**:** ±0605Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

Disclaimer:

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of flight

1.1.1 The pilot, being the sole occupant onboard the helicopter ZS-HCR was engaged in a fire fighting operation in the Amatole mountain range located between Hogsback and Keiskammahoek in the Eastern Cape Province. The aerial support consisted of two helicopters (both being UH-1H) as well as a 'spotter' aircraft, a Cessna 182.

1.1.2 After uplifting approximately 1 000 litres of water into the bambi bucket from the Cata dam the pilot proceeded to fly towards the fire line that was raging in the Amatole Mountain towards the north-west of Cata. At the time of the operation strong wind conditions in the region of 70 km/h (38 knots) was reported blowing from the west in the vicinity of the accident site (in the mountains).

1.1.3 The Google Earth map below provide the location of the accident site (indicated by the GPS position, yellow marker) as well as the Cata dam, which was located approximately 3,5 nautical miles from the accident site. The elevation difference between the accident site and the Cata dam was approximately 3 000 feet.

Figure 1. The Google earth map provides a general layout of the area they were operating in.

1.1.4 According to the pilot flying the second helicopter he was on his way to the fire line after he uplifted water from the Cata dam, when he experienced turbulence. He stated that he did not regard it to be so severe that he could not safely continue with the operation. After dropping his first load of water on the fire line he descended back to the dam to uplift his second load of water. On his way down he communicated with the pilot flying ZS-HCR, who had just picked-up his first load of water and was on his way up the mountain to the fire line. He mentioned the turbulence to him, not because he thought it was unsafe to proceed but to share all relevant information, which was standard practise during the initial assessment phase of the fire suppression operation. On his way up to the mountain, the pilot flying ZS-HCR replied *"I see what you mean".* After he uplifted his second load of water he called the pilot flying ZS-HCR again to let him know that he was lifting out of the dam and to ask his position. There was no acknowledgement of his radio call by the pilot flying ZS-HCR. He then called the 'spotter' pilot to ask if he had the other helicopter visual, he could not see him either and also called him on the radio without any response.

1.1.5 They then commenced a search for the helicopter ZS-HCR as there was no mayday, distress call, or any other indication from the pilot that there was a problem. The spotter pilot requested the helicopter pilot to fly a slightly different line to a spot fire that had started lower down the slope, from where the ground teams were and if he felt it necessary he could drop his load there. As the helicopter pilot got closer to the area he recognised the tail section of the helicopter ZS-HCR, which was red in colour. He informed the 'spotter' pilot immediately and requested him to activate a mayday for ZS-HCR.

1.1.6 The helicopter pilot then released his load of water in the bambi bucket in order to give him more manoeuvrability while he descended and approached the wreckage. As he got closer to the wreckage it became apparent that the turbulence was getting worse the lower he descended towards terrain. He landed on the nearest possible landing area in order to remove the bambi bucket from the cargo hook and then return to the accident site to see if there was anything he could do. The pilot indicated that he was unable to land close to the wreckage as the flat areas were still inside the fire area. He further noted that the turbulence was also deteriorating as the wind strength had picked up substantially. According to his assessment of the prevailing conditions it was highly unlikely that neither the medical rescue helicopter (Bell 206L) nor the police helicopter (AS 350B3) would have been able to land anywhere close to the accident site, which was indeed the case.

1.1.7 Ground personnel engaged in the fire fighting operation made their way up to the accident scene to render assistance. The helicopter was however, destroyed by the post-impact fire that erupted.

Figure 2. The Google earth map provides a closer view of the mountain cliffs facing towards the southwest.

1.1.8 Evidence gathered at the crash site indicated that the bambi bucket, which was hanging approximately 10 m (33 feet) below the helicopter, collided with rising (rocky) terrain. Following impact by the bambi bucket, which was still secured to the cargo hook mechanism, the helicopter collided with rising terrain in a nose down attitude along its flight path. The wreckage was consumed by the post-impact fire that erupted. The pilot was fatally injured in the accident.

1.1.9 The accident occurred during daylight conditions at a geographical position that was determined to be South 32°34.256' East 027°05.277' at an elevation of 5 294 feet above mean sea level (AMSL).

1.2 Injuries to persons

Injuries	Pilot	Crew	Pass	Other
Fatal	1	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	-	-	-	-

1.3 Damage to aircraft

1.3.1 The helicopter was destroyed by the post-impact fire that erupted.

Figure 3. A photo of the accident scene with the fire still raging in the mountains behind it.

1.4 Other damage

1.4.1 Apart from vegetation that was burnt down following the post-impact fire no other damage was caused.

1.5 Personnel information

Nationality	South African	Gender	Male	Age	32
Licence number	0271067233	Licence type	Commercial pilot		
Licence valid	Yes	Type endorsed	Yes		
Ratings	Undersling / winch rating				
Medical expiry date	31 August 2012				
Restrictions	None				
Previous accidents	None				

According to available information the pilot applied for a student pilot licence on 25 February 2005. On 13 April 2005 the authority received an application for his private pilot licence (helicopter).

On 14 May 2007 he submitted the required paperwork in order to obtain his UH-1H (Bell 205) type conversion rating. According to the form CA 61-13.02, which he submitted to the authority, he had flown 32 hours and 18 minutes dual on the helicopter type prior to submission of his application for his type conversion. The helicopter type was subsequently endorsed onto his pilot licence. At this stage of his career the pilot was still the holder of a private pilot licence. On 24 August 2007 he completed his initial practical flight test towards his commercial pilot licence with a designated flight examiner after he had written all the required commercial pilot exams.

On 6 March 2008 his undersling/winch rating was endorsed on his commercial pilot licence. According to the pilots logbook most of his flying was conducted on the Robinson R44 and UH-1H type helicopters. Also endorsed onto the pilot's licence were the Robinson R22 and the Alouette III (S316) type of helicopters. Available information (pilot flying logbook) indicates that he had not flown either of these two helicopter types during the 90-days preceding the accident flight.

Flying experience:

Total hours	775,3
Total past 90-days	23,6
Total on type past 90-days	12,3
Total on type	314,3

Breakdown of pilots flying hours according to helicopter types:

Total on type S-316	27,3
Total on type Robinson R22	55,1
Total on type Robinson R44	378,6
Total on type UH-1H	314,3
Total hours	**775,3**

The table below reflects the pilots flying hours during the 30-days preceding the accident flight.

Date	Helicopter type	Registration	Flying time
28 June 2012	UH-1H	ZS-HCR	1,6
29 June 2012	Robinson R44	ZS-RZC	1,1
30 June 2012	Robinson R44	ZS-RZC	0,6
5 July 2012	UH-1H	ZS-HCR	2,2
9 July 2012	UH-1H	ZS-HCR	1,0
20 July 2012	UH-1H	ZS-HCR	1,4
26 July 2012	UH-1H	ZS-HCR	1,3
Total hours flown			**9,2**

Weight and Balance

The pilot was the sole occupant onboard the helicopter and was flying the helicopter from the left-hand side. At the time of the accident flight it was slinging an external load (bambi bucket), which contained approximately 1000 litres of water. With the configuration it was in at the time it was being operated it was within its maximum weight limitations.

1.6 Aircraft information

Figure 4. A photo of a Garlick UH-1H type helicopter.

The UH-1H helicopter has a metal fuselage of semi-monocoque construction and tubular landing skids. It was powered by a single turboshaft engine (1000 kW or

1 400 shp) and was equipped with a two bladed main rotor and tail rotor system. It was developed in the 1950's to meet United States of America military requirements and the model 205 flew for the first time on 16 August 1961. The stronger engine was installed in 1966 to provide more power to the helicopter. Its maximum take-off weight was 9 500 pounds or 4 309 kg. Several of these helicopters were imported to South Africa and are extensively utilized in fire fighting operations all over the country as illustrated in the photo below.

Figure 5. A Garlick UH-1H helicopter engaged in a fire fighting operation slinging a bambi bucket.

Airframe:

Type	Garlick UH-1H	
Serial number	64-13623	
Manufacturer	Garlick Helicopter Corporation	
Year of manufacture	1964	
Total airframe hours (at time of accident)	6 281,2	
Last phase inspection (hours & date)	6 265,6	11 April 2012
Hours since last phase inspection	15,6 (Phase 5 inspection)	
C of A (issue date)	16 May 2011	
C of A (expiry date)	15 May 2013	
C of R (issue date) (present owner)	23 August 2010	
Operating categories	Restricted Part 127	

*NOTE: This helicopter was imported to South Africa from the United States of America in August 2008.

Engine:

Type	Lycoming T53-L-13B
Serial number	LE-23434-R
Hours since new	924,7
Hours since overhaul	618,7

According to the airframe and engine logbooks the following maintenance was performed during the last phase inspection prior to the accident flight, dated 11 April 2012.

(i) *"Phase 5 inspection carried out in accordance with TM 55-1520-210-PM, TM 55-1520-210-PMD and SACAA CATS CARS + GMRS.*

(ii) *Tail drive shaft couplings re-packed after tail rotor control cable was replaced.*

(iii) *Tail rotor pitch link rod end was replaced.*

(iv) *Elevator bell-crank was replaced.*

(v) *Tail rotor hangar bearings; Part No. 204-040-600-11, Serial No. A20-4255, A20-31151, A20-16904 and A20-15193 replaced A20-74541, A20-81356, 71090801 and 80594.*

(vi) *Cargo hook swivel bolt was replaced.*

(vii) *Tail navigation light bracket cracked, was replaced.*

(viii) *Compressor clean carried out and bleed band was repaired on engine.*

(ix) *Duplicate inspection was carried out on engine and airframe.*

(x) *Aircraft safe to carry out post maintenance check flight".*

1.7 Meteorological information

1.7.1 An official weather report was obtained from the South African Weather Services (SAWS).

Surface analysis

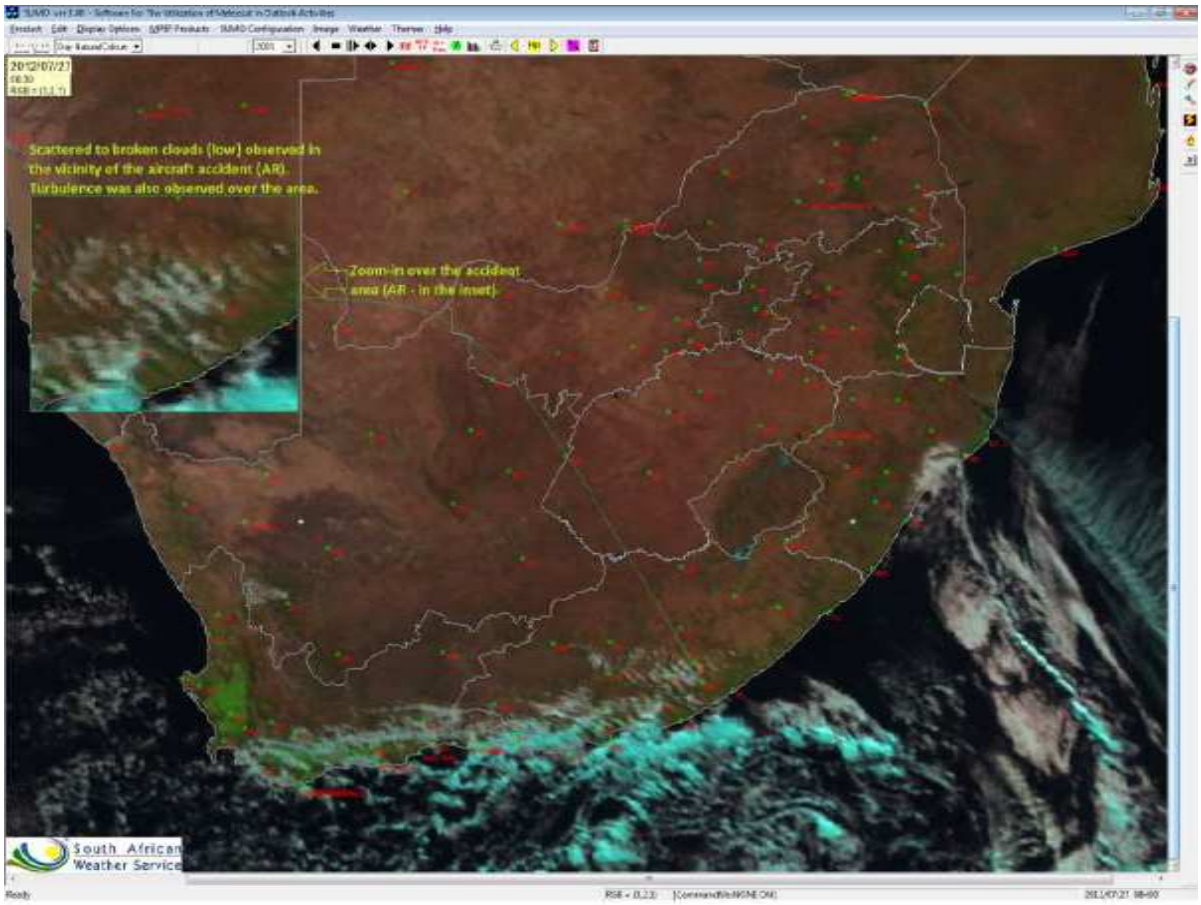
A cold front southeast of the country extended its tail to the north-eastern parts of KwaZulu-Natal. Together with the ridging Atlantic Ocean high pressure system in the west, the frontal system caused an onshore flow of cool and moist air along the south coast into the southern interior. The pressure gradient between the frontal system and the ridging high caused moderate to fresh south-westerly winds along the coastal areas.

Upper air analysis

The low pressure system off the south-east coast and the ridging Atlantic Ocean high pressure system to the west were also depicted as the 850 hPa. In the vertical, the frontal trough was overlaid by an upper air trough which leaned westward with height (baroclinic). Uplift occurs in areas from the upper air trough axes eastwards, and results in convective development in the presence of low-level moisture and maximum surface convection.

Satellite image

Scattered to broken clouds (cumulus and/or stratocumulus) were observed over the area of the aircraft accident. The clouds also indicated the presence of turbulence over the area. See the satellite image below.



Observed weather conditions in the vicinity of the incident/accident

The closest reporting weather office to the place of the accident was Bhisho. The meteorological routine reports (METARs) recorded strong gusty surface winds and cloud bases ranging between 2 500 ft and 3 000 ft above ground level (AGL). The satellite image also indicated the presence of turbulence over the area and this information was conveyed on the AIRMET bulletin.

Summary

Broken clouds with bases ranging from 2 500 – 3 000 feet and strong gusty winds were observed over the area of the aircraft accident. The satellite image also showed the presence of turbulence over the accident area.

The meteorological routine report (METAR) for Bhisho aerodrome (FABE) for 27 July 2012 at 0800Z was obtained. FABE was the closest reporting weather office to the accident site and was located approximately 24 nm to the south-east of the accident site.

FABE 270800Z 27030G37KT 9999 BKN030 13/02 Q1026

METAR decoded for 0800Z:

ICAO location indicator	-	FABE
Day of month	-	27 July 2012
Time	-	0800Z
Wind, True direction	-	270°, speed 30 knots gusti ng 37 knots
Visibility	-	10 km or more
Clouds	-	Broken (5 to 7 Octas) at 3 000 ft
Temperature	-	13℃
Dew point	-	2℃
QNH (sea-level pressure)	-	1026 hPa

It was noted from the 0900Z METAR for FABE that the wind strength had picked up to 35 knots gusting 40 knots. It remain to blowing for most of the day as the 1600Z METAR for FABE still indicated the wind strength to be 35 knots gusting 40 knots.

1.7.2 Additional weather information was obtained from an automatic weather station that was located at the Stutterheim office of the Fire Protection Association, which was located at a geographical position; South 32° 33’3 6.12” East 027° 26’7.94”, to the east of the town and was located approximately 18 nm from the accident site. The weather station recorded its data every 15 minutes.

Data for 27 July 2012 at 0600Z:

Wind	-	200°, speed vary between 3 to 15 knots
Temperature	-	10.9℃
Dew point	-	5.7℃
QNH (sea-level pressure)	-	1021 hPa

Data for 27 July 2012 at 0615Z:

Wind	-	225°, speed vary between 2 to 11 knots
Temperature	-	11.1℃
Dew point	-	5.6℃
QNH (sea-level pressure)	-	1021 hPa

1.7.3 Density altitude

Pressure altitude	5 294 ft
Temperature	*13℃
Density Altitude	± 6 500 feet

*NOTE: The temperature used for calculating the density altitude was obtained from the official SA Weather Services report and was the temperature for Bhisho aerodrome. No accurate temperature was available at the accident site.

1.7.4 Wreckage recovery

The wreckage was recovered some time after the accident occurred by utilizing a Bell 407 helicopter to sling the parts/components onto a truck that was parked near Cata. During the recovery process wind conditions picked up substantially at the accident site to such an extent that the recovery operation had to be halted until the next morning.

1.8 Aids to navigation

1.8.1 The helicopter was equipped with standard navigational aids as prescribed to be fitted to the helicopter by the regulating authority.

1.8.2 There were no pertinent navigational aids at the intended area of operation that the pilot was flying to.

1.9 Communications

1.9.1 The helicopter was equipped with a VHF radio that was serviceable prior to the flight.

According to the pilot that was flying the second helicopter, also a UH-1H, they were communicating on the VHF frequency 123.45 MHz a few minutes before the accident occurred. The ‘spotter’ aircraft pilot concurred that he was also in radio contact with the helicopter pilot several minutes before it crashed.

1.9.2 According to the pilot that was flying the second helicopter as well as the 'spotter' aircraft pilot; *"there was no mayday, distress call, or any other indication from the pilot flying ZS-HCR that there was a problem".*

1.10 Aerodrome information

1.10.1 The accident did not occur at or near an aerodrome.

1.11 Flight recorders

1.11.1 The helicopter was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required to be fitted to this type of helicopter according to the regulations.

1.12 Wreckage and impact information

1.12.1 The helicopter impacted with mountainous terrain sloping upwards in the direction of flight looking forward from in the helicopter on a heading of ± 240°M.

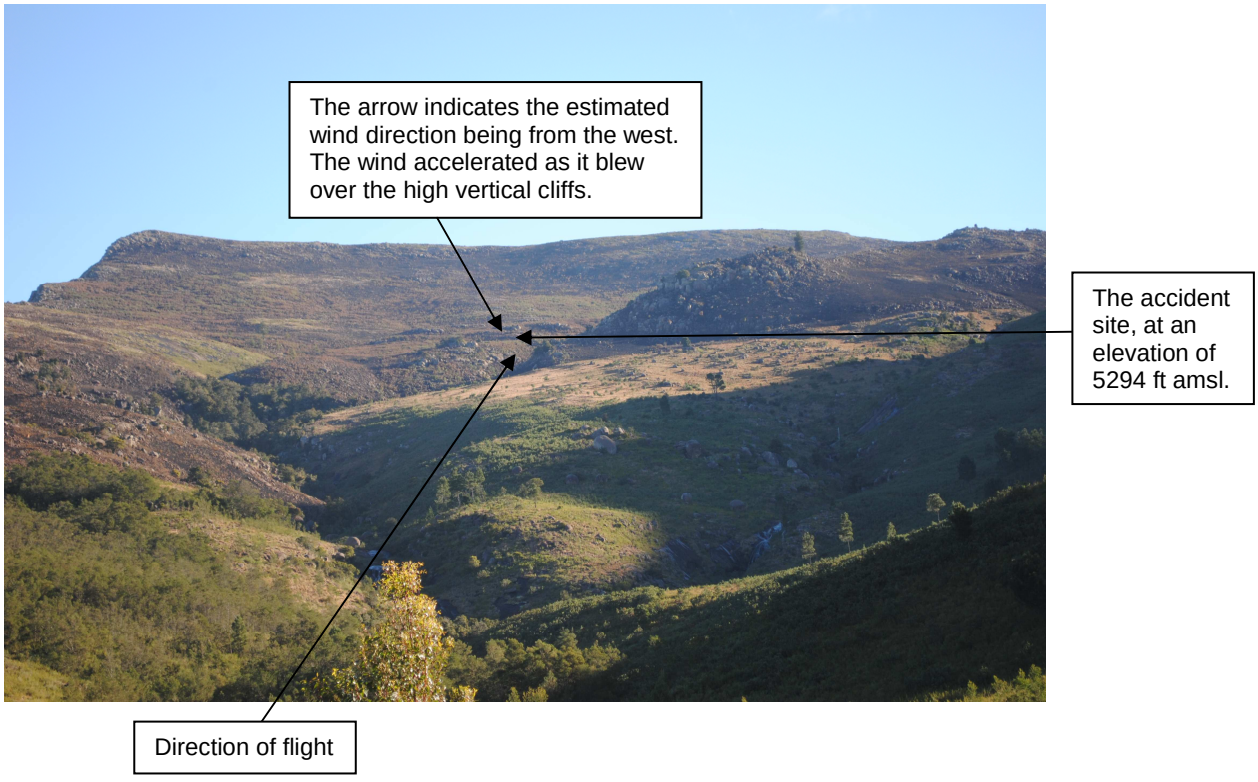


Figure 6. The photo was taken to illustrate the direction of flight as well as the prevailing wind direction.

Figure 7 below provides a view of the accident site. Looking at the photo the helicopter flight path was towards the high ground (towards the accident site).

Figure 7. A view of the accident site.

1.12.2 The first impact marking was observed to be caused by the bambi bucket that collided with rocky terrain as depicted in figure 8 (a) and (b) below.

(a) (b)

Figure 8. Impact markings on a large rock (a) a view towards the accident site from the rocks that was struck (b).

Along the impact line from thereon we found the two tail rotor blades still attached to the hub assembly, one of the blades suffered from extensive fire damage (was basically consumed to the root of the blade) and the other blade although distorted displayed minor fire damage. From there onwards we found the aft section of the tail boom (including both horizontal stabilisers and the pylon section), it was lying in

a near inverted attitude, indicative to a roll over to the right. The lower tail boom structure displayed evidence of impact with terrain. To the right of the aft tail boom section was the metal frame of the burnout bambi bucket (see figure 9a below) as well as the 5 m long cargo sling strop/cable and the cargo hook assembly. Both the cargo hook and the strop/cable where subjected to fire damage, with a section of the strop found to have melted. The cargo hook mechanism was found to be in the open/released position.

(a) (b)

Figure 9. Burnt out bambi bucket next to the tail boom pylon (a) and cargo sling cabling with bambi bucket hook (b).

1.12.3 Forward of the tail boom section was the engine, which was subjected to intense heat from the post impact fire. The photo in figure 10(b) below displays the engine after it was removed from below the burnt out sheet metal debris. The damage sustained by the engine was of such a nature that it could not be subjected to a teardown inspection.

(a) (b)

Figure 10. A view of the engine before (a) and after it was removed from the burnt out sheet metal structure (b).

1.12.4 The main rotor head with the two main rotor blades still attached was located approximately 15 m to the right of the main wreckage. The blades displayed substantial deformation but was not exposed to any fire damage. The main rotor drive shaft sheared at a 45° angle around the circu mference of the shaft which was indicative of an overload failure associated with impact. The main rotor drive shaft failure mode is visible in figure 11(b).

(a) (b)

Figure 11. A view of the main rotor head with the blades still attached (a) and a closer view of the main rotor head (b).

1.12.5 The main rotor gearbox and main drive shaft assembly was found to be projected in a straight line approximately 10 m ahead of the main wreckage. The main rotor drive was found to have failed in overload mode. Evidence of droop stop contact is visible on the side of the main rotor drive shaft associated with the impact sequence. The unit displayed evidence of minor scoring, caused by vegetation that burnt following the post impact fire.

(a) (b)

Figure 12. A view of the main rotor gearbox assembly (a) and a closer view of the main rotor drive shaft failure (b).

1.12.6 Evidence gathered at the crash site indicated that the bambi bucket, which was hanging approximately 10 m (33 feet) below the helicopter, collided with rising

(rocky) terrain. Following impact by the bambi bucket, which was still secured to the cargo hook mechanism, the helicopter collided with rising terrain ahead of its flight path. The wreckage was consumed by the post-impact fire that erupted.

1.13 Medical and pathological information

1.13.1 A post mortem examination was performed on the deceased on 30 July 2012 and the cause of death was determined to be: Multiple Injuries.

1.13.2 At the time this report was concluded no toxicology tests results were available as yet. Should any of the results once received indicate that it might have had a bearing on the pilot's performance, this will be considered as new evidence and the report will be accordingly revised.

1.14 Fire

1.14.1 The helicopter was destroyed by the post impact fire that erupted. Several components, some severely scared and some with minor fire damage were recovered from the scene following a sling operation by a helicopter. The components/parts include the following:

(i) The aft tail boom section, tail rotor gearbox and rotor assembly.
(ii) Main rotor gearbox, main rotor shaft and rotor head assembly.
(iii) Both main rotor blades, which were severely disrupted due to impact.
(iv) The engine, which sustained extensive fire damage.
(v) Bambi bucket frame (burned out), 5 m strop and cargo hook assembly.
(vi) Two seat frames.

1.15 Survival aspects

1.15.1 This accident was not considered survivable due to the intense post impact fire that followed impact.

1.16 Tests and research

1.16.1 The engine a Honeywell Lycoming T53-L-13B, serial No. LE-23434-R was found to have been exposed to the intense post-impact fire. The investigating team intended to perform a detailed teardown inspection of the engine in order to determine engine functionality however such an inspection was not viable following consultation with the engine manufacturer.

1.17 Organizational and management information

1.17.1 The helicopter was operated at the time of the accident in the industrial aid category, with the intension to render support in a fire fighting operation in the Amatole Mountains.

1.17.2 The aircraft maintenance organisation (AMO) that was maintaining the helicopter prior to the accident was in possession of a valid AMO Approval Certificate.

1.18 Additional information

1.18.1 The hazards associated with mountain flying under adverse wind conditions is something all helicopters pilots should be familiar with should he or she intend to fly within such terrain. In Annexure A attached to this report the hazards associated with such flying are being addressed.

1.19 Useful or effective investigation techniques

1.19.1 None.

2. ANALYSIS

2.1 Pilot (Man)

The pilot was the holder of a valid commercial pilot's licence (helicopter). He had accumulated 314,3 flying hours on the UH-1H type helicopter of which most of these flying hours was on the accident helicopter ZS-HCR. The primary utilization of the helicopter was in the role of fire fighting, with vast pine tree plantations that require protection against fires in the area where the helicopter was based.

The pilot was a local resident of the area and was therefore familiar with the associated flying related hazards/dangers during fire fighting operations especially in the mountainous areas where most of the pine tree plantation was located.

According to available information the pilot was in good health and well rested prior to the flight. The post mortem report indicated that the cause of death was due to multiple injuries.

2.2 Aircraft (Machine)

The helicopter was maintained in accordance with the approved maintenance schedule. Due to the intensity of the post impact fire very little structural evidence remained, which made it impossible to ascertain if control continuity was in any way jeopardised. The failure mode of some of the components that could be identified displayed evidence associated with normal operation (overload failure mode) at the time of impact. The entire cargo sling mechanism, 5 m strop and bambi bucket frame was located on the accident site. The cargo hook was found to be in the open/released position. The fact that the entire external load assembly was found on the accident site is an indication that the cargo hook mechanism most probably opened during the impact sequence, with the manual release cable being under tension, or the pilot might have pressed the release/jettison button on impact.

2.3 Environment

The operation was being flown in mountainous terrain. Strong westerly winds prevailed on the day with scattered to broken clouds over the area. The wind being from the west blew over a very high vertical cliff face, which most probably induced the onset of turbulence in the area of the accident site, which was some distance away from the actual fire line. It is believed that the effect of the wind was much more severe in the area of the accident site than anticipated or experienced by the pilot during his flight from the Cata dam towards the mountain. Even though the pilot flying the second helicopter mentioned the presence of turbulence and it was acknowledged, the turbulence most probably intensified along his flight path (towards the west) to such an extent that the pilot had to make a decision to release or jettison his external load.

2.4 Mission

The pilot was familiar with the type of operation and it was therefore nothing out of the norm for him. The accident occurred during his very first load, while still

on the positioning phase of the flight towards the fire line. It was not known if he first flew a reconnaissance flight over the area to familiarise himself with the possible hazards/dangers associated with the operation, including the prevailing wind conditions. It would appear that his approach path after he uplifted water from the Cata dam towards the fire line might have differed from the second helicopter pilot that participated in the operation as the second pilot had already dropped a load of water on the fire line. This observation was forthcoming from the information that was passed on from the 'spotter' pilot to the helicopter pilot that initiated a search for the helicopter ZS-HCR after the pilot did not respond to any radio communication from either of the pilots.

2.5 Conclusion

The approach path that was flown by the pilot of ZS-HCR placed him on the lee side of the mountain where strong wind conditions associated with turbulence prevailed. This evidence was forthcoming from the pilot that flew the second helicopter and located the wreckage following a brief search for ZS-HCR. He had to jettison his bambi bucket water load where after he landed at a secure location and unhooked the bambi bucket from the cargo sling mechanism. Further to that he was alone in the helicopter and indicated that the wind was strong with conditions deteriorating. This assessment of the prevailing wind conditions was further supported by the fact that neither the police helicopter (AS350B3), nor the emergency medical helicopter (Bell 206L) that was on standby, could land at, or in close vicinity to the accident site on the day.

The fact that the pilot did not communicate in any way over the radio by broadcasting a mayday or distress call could be an indication that what happened prior to impact occurred within a very short time frame. It is during this period that the pilot most probably attempted to fly the helicopter out of the situation, but being in close proximity to the ground was unable to recover from the sudden change in attitude (nose down) once the bambi bucket collided with terrain and ground impact followed.

The decision by the pilot not to have jettison the external load (bambi bucket) timeously could have been based on the fact that he; (i) did not want to jettison the bambi bucket as it would have damaged it to such an extent that it could not be repaired and thereby jeopardising their operational preparedness as well as incurring cost; (ii) or with the reference he had to the load via his external mirrors he thought the bucket might have cleared the rising terrain ahead on its flight path, resulting in a judgement error.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was the holder of a valid commercial pilot's licence and had the helicopter type endorsed in his licence.

3.1.2 The pilot was in possession of a valid aviation medical certificate that was issued by a CAA approved medical examiner.

3.1.3 The pilot was flying the helicopter from the left-hand side.

3.1.4 The pilot had logged 314,3 flying hours on the UH-1H type helicopter. He was familiar with the area and fire fighting operations as it was the primary application for which the helicopter was being utilized.

3.1.5 At the time of the accident, the helicopter was being utilized in an industrial aid operation in the Amatole Mountains.

3.1.6 The helicopter was maintained in accordance with an approved maintenance schedule.

3.1.7 The helicopter was in possession of a valid Certificate of Airworthiness.

3.1.8 The last maintenance inspection prior to the accident flight was certified on 11 April 2012 at 6 265,6 airframe hours.

3.1.9 According to available evidence 341 litres of Jet A1 fuel was uplifted into the helicopter prior to the flight.

3.1.10 The helicopter was being operated within its allowable weight limitations with the pilot being the sole occupant onboard and the external load (bambi bucket) being attached via the cargo hook mechanism.

3.1.11 The bambi bucket, strop and cargo sling hook mechanism was found at the accident site lying to the right of the main wreckage. It was subjected to fire damage.

3.1.12 The wind at the time of the accident was reported to be strong from the west with severe turbulence being reported in the area of the accident site. Neither the police helicopter nor the emergency medical helicopter was able to land at or near the accident site on the day.

3.1.13 The density altitude was calculated to be approximately 6 500 feet AMSL.

3.2 Probable cause/s

3.2.1 During strong wind conditions the external load (bambi bucket) that was being slung below the helicopter collided with mountainous terrain as the pilot positioned the helicopter for the fire line, the pilot was unable to correct the helicopters sudden change in attitude (nose down), rendering ground impact inevitable.

3.3 Contributory factor/s:

3.3.1 The helicopter encountered strong mountain winds associated with severe turbulence during the positioning phase of the flight prior to releasing the water from the bambi bucket onto the fire line.

3.3.2 The pilot's decision not to jettison the bambi bucket timeously should be regarded as a significant contributory factor to this accident.

4. SAFETY RECOMMENDATIONS

4.1 It is recommended to South Africa that private helicopter operators engaged in industrial aid operations (i.e., fire fighting, external sling load operations, etc.) should be in a possession of an Operations Manual approved by the regulating authority setting clear guidelines on operational limitations. This recommendation is issued in the interest of aviation safety.

5. APPENDICES

5.1 Annexure A (Mountain flying under adverse wind conditions)

ANNEXURE A

Mountain Flying:

Sources: Principles of Helicopter Flight, by W.J. Wagtendonk, Chapter 23

"The main hazards in mountain flying under adverse wind conditions are:

- *Updrafts and downdrafts that jeopardize control of the helicopter.*
- *Rapid changes to total thrust during the landing phase that may contribute to a hard touchdown or force the helicopter back onto the ground on lift-off.*
- *Rapid and unpredictable changes to translational lift values.*
- *The possibility of retreating blade stall in vertical gust or up drafts.*
- *Risk of mast bumping in severe updraft (negative g) situations.*

Ridgeline Flying:

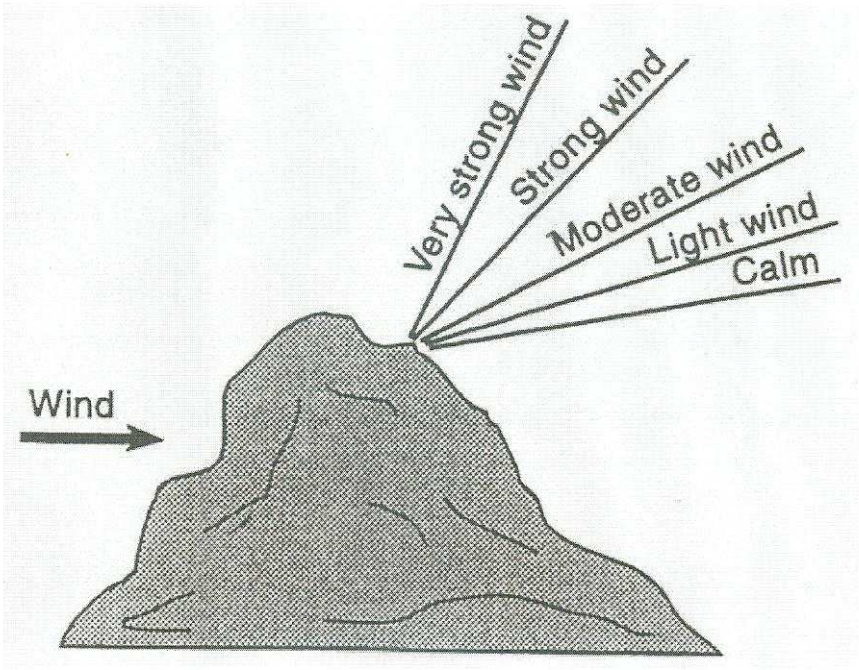
Flying on the windward side when flying parallel to the ridge if the wind is not in line with the ridge. If you must fly on the lee side, anticipate downdrafts and turbulence. The inevitable saddles and depressions in the ridge line often cause the wind to funnel, creating additional turbulence. When a series of close ridges are involved, the presence of downdrafts on the windward side of the ridge is possible. Cross ridge in moderate to strong winds at an angle other than 90°. The angled crossing leaves room for the helicopter to make a small turn away from the ridge if downdrafts are encountered.

The "Standard" Mountain Approach

The word "standard" is emphasized because there is no standard approach that always holds good in mountainous terrain operations. Standard is used to identify basic mountain approach considerations that influence the selection of an appropriate approach profile.

The standard approach, consist of an approach directly into the wind using the constant angle landing technique.

The landing is normally preceded by a hover, but zero-speed or run-on-landings are alternatives. Landings on mountain ridges into the wind may place the aircraft on a lee side of the ridge during the approach, in which case the steepness of the approach angle should be adjusted as shown in figure 11 on the next page.



Approach angle variations with different wind speeds.

If the wind or turbulence prevents the standard approach, the approach can be made along the ridge, angled or from the upwind side. In all cases a reconnaissance should be flown along the ridge at a slow but safe speed establish the best final approach direction and to check for obstacles. A helicopter approaching from the windward side risks drifting into the downdraft area after crossing the ridge itself when turning into the wind towards the landing site.

In all but light wind conditions (less than 10 knots), one need only approaching from the lee side of a ridge when landing on a saddle that has steep or high walls. In other situations, an approach at up to 90°to the w ind with a turn into wind at the site as preferable. The turn should not require additional tail rotor thrust, so the direction of the approach should be selected accordingly.
An approach to a pinnacle in strong wind conditions can be angled to avoid turbulence and downdrafts so that a steep approach is not essential. Alternatively, the approach can be made from the upwind side, as described for ridges.

There are some important points to constantly be alert for during pinnacle

approaches.

(i) An absence of peripheral clues both ahead and laterally deprives the pilot of information about the rate of the approach. Unless the site is familiar to a pilot, a short trail approach is advisable.

(ii) Turbulence is often pronounced on the lee side.

(iii) Ground effect is slow to come into play and approaches should not be protracted on the lee side of the pinnacle with resulting demands for high power.

(iv) The slope of the surface of a pinnacle is not as easy to assess as sites with adjacent ground features. Pilots should be prepared to abort landings where slopes exceed undercarriage and mast/hub limits.

Pilots must ascertain (through adequate reconnaissance) the best method in which the task can be completed and most importantly, to have a planned escape route. Do not hesitate to use the escape route if things don't work out the way they were planned. Some experienced pilots wish they had obeyed this golden rule".