ACCIDENT

Aircraft Type and Registration:	Gazelle HT.MK3, G-CBXT (XW898)
No & Type of Engines:	1 Turbomeca Astazou IIIN2 turboshaft engine
Year of Manufacture:	1974
Date & Time (UTC):	1 November 2008 at 0928 hrs
Location:	Winchcombe, Gloucestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Fatal) Passengers - 2 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence (Helicopter)
Commander's Age:	55 years old
Commander's Flying Experience:	305 hours (of which 122[1] were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was en-route from a private site near Tamworth, Staffordshire, to a maintenance facility near Royal Naval Air Station (RNAS) Yeovilton, Somerset. As it approached Langley Hill, near Winchcombe, Gloucestershire, it appears to have unintentionally entered IMC and subsequently impacted the hillside. All three occupants were fatally injured.

History of the flight

The helicopter was based at a private site at Baxterly, near Tamworth, Staffordshire, where one of its two owners lived. The other owner was the pilot of the accident flight. The co-owner who lived at Baxterly was not aware the pilot was intending to fly on 1 November 2008. However, prior to departure, from a window in his house, he witnessed the pilot strap a female passenger into the front left seat of G-CBXT.

The helicopter departed Baxterly at 0845 hrs and the pilot was planning to fly to a maintenance facility 3 nm north-north-east of RNAS Yeovilton, Somerset for a 25 hr inspection. En-route it landed and collected another passenger from a private site near Norton Lindsey, Warwickshire from where it departed at 0918 hrs.

Footnote

[1] The pilot's logbook was not recovered after the accident. All hours were obtained from the helicopter's technical log and data retrieved from its GPS.

Radio communications were established with ATC at Gloucestershire Airport at 0923 hrs as the helicopter approached Honeybourne[2]. The pilot informed ATC of his current position, routing and destination. They instructed him to report south-east abeam the airfield, which the pilot acknowledged. At 0938 hrs ATC attempted to contact G-CBXT as they had not received a position report; there was no reply. ATC continued to try to call the helicopter for the next 15 minutes and telephoned neighbouring airfields to see whether contact had made with them; it had not. At 0955 hrs ATC contacted the Distress and Diversion centre and overdue action was initiated.

The burned and smouldering wreckage of a helicopter was discovered by a horse rider at 1145 hrs on Langley Hill, 7 nm north-east of Gloucestershire Airport. This was later confirmed to be G-CBXT. All three occupants had been fatally injured.

Helicopter information

The Gazelle is an all-purpose, lightweight, military helicopter powered by a single gas turbine engine. It has three composite rotor blades and a fenestron (ducted fan) in place of a traditional tail rotor. It has an authorised maximum total weight of 1,900kg.

This helicopter was delivered to the Royal Air Force in 1973 and operated as XW898 until 1997, when it was put into controlled storage before being sold as surplus in 2001. The helicopter was then transferred to the civilian register as G-CBXT and after inspection and test, was awarded a Permit to Fly by the CAA in 2003. Conditions were placed on its operation which included the following limitation:

> *'5. Maximum number of occupants*
>
> *5.1 Maximum number of occupants authorised to be carried (including crew): Four (Two flight crew and two ground crew, i.e. engineering staff required for the maintenance of the aircraft away from base).'*

It was also to only be flown by day and in accordance with visual flight rules. An exemption allowed the helicopter to remain in its military livery and not display its civilian registration.

Maintenance History

Since its transfer to the civilian register, G-CBXT had been maintained in accordance with an approved maintenance schedule by a CAA approved maintenance organisation specialising in Gazelle helicopters. All lifed parts were controlled within operational limits and the next scheduled inspection, a 25 hr inspection, was due on the 5 November 2008. This is a relatively simple inspection to verify the helicopter's ongoing airworthiness. The Permit to Fly and Permit Maintenance release certificate were valid.

No details of any known defects were found. The maintenance organisation advised that had there been any, it was likely that the pilot would have contacted them to arrange rectification.

A radio altimeter was fitted to the helicopter, but had been disabled and placarded 'inoperative' since its transfer to the civilian register. The equipment is not approved for use in civilian machines.

The maintenance organisation was able to provide a duplicate Technical Log and copies of relevant certificates; the originals were destroyed in the accident.

Footnote

[2] Honeybourne is a disused airfield 16 nm north-east of Gloucestershire Airport that is commonly used as a visual reporting point.

Flights up to the end of September 2008 were available in these duplicate documents and details of subsequent flights were obtained from data recovered from the GPS equipment fitted to the helicopter.

The maintenance organisation stated that G-CBXT was coming to them for a 25 hr inspection. They added that they had sufficient personnel to manoeuvre the helicopter into the hangar to complete this.

Fuel

The pilot had positioned a 5,000 litre, purpose made, fuel bowser at an airfield close to his base. As far as could be determined, this was the main source of fuel for G-CBXT. The bowser had last been serviced on the 4 June 2008 and fuel samples taken at the time were satisfactory. It had been replenished with 4,500 litres of Jet A1 fuel on 7 June 2008. A copy of the release note was obtained from the fuel supplier. No contamination or water was present in samples taken from the bowser after the accident.

G-CBXT last visited the bowser location on 5 October 2008 and according to the airfield owner, the pilot was in the habit of not resetting the fuel totaliser until he next uplifted fuel. Assuming this information to be correct, the last uplift was 338 litres. The fuel capacity of G-CBXT was 457 litres, and since this visit it had flown for approximately one hour. Using a representative consumption rate, and assuming it had been refuelled to full, it is calculated that approximately 280 litres of fuel were on board at the time of the accident. It has not been possible to validate these assumptions accurately, but given the intense fire and smell of fuel present at the accident site, the estimate seems reasonable. The owner kept records of fuel uplift on a Personal Digital Assistant which was recovered in a poor condition and from which no data could be retrieved.

Examination of wreckage

Accident Site

The accident site and ground marks indicate that the helicopter was flying on a magnetic track of 020º and travelling forwards in a normal level flight attitude when it came into contact with the rising terrain at approximately 850 ft amsl. Using the ground witness marks made by the rotor blades, the ground speed was calculated to be 66 kt. The helicopter came to rest 18.5 m from the initial contact point and further up the hillside with the forward part of the main fuselage pointing back down the hill. There was a substantial fire which destroyed most of the main fuselage. The engine and gearbox fell to the right of the fuselage and the rotor blades remained attached; all three blades and their mountings sustained varying degrees of damage. Following this initial examination, the wreckage was recovered to the AAIB headquarters.

Controls

A detailed examination of the wreckage was conducted with the assistance of the French Bureau d'Enquetes et d'Analyses (BEA) and the airframe and engine manufacturers. No pre-existing defects or control disconnections were found but due to the fire damage, control runs could not be checked over their full length.

Engine and gearbox

An inspection of the engine, including an internal examination by borescope, confirmed that it was in a serviceable condition. Debris, consisting of mud and vegetation, was found as far into the engine as the turbine. The presence and nature of this debris indicated that the engine had been running at the time of the accident.

The coupling, connecting the engine to the gearbox, indicated that it had been under rotational load when it was pulled apart and damage to the coupling attaching the

bolt heads indicated that the engine was still turning after the disconnection. The engine and gearbox separated as the helicopter reached its final resting position.

Rotor head and blades

Examination of the rotor head, gearbox and drive to the rear fenestron found no pre-existing defects. Damage to the assembly indicated that power was present at the rotor blades upon ground contact; the blade mountings showed distinctive deformation indicating the order of the blade strikes. Each of the three rotor blades sustained damage consistent with the order in which they struck the ground and parts of the blades were found up to 50 m from the main wreckage.

Fenestron

The tail fenestron housing was distorted in the ground collision, causing the blades to contact the shroud. The nature of these contact marks and damage to the fenestron blades and their mountings indicated that the fenestron was producing thrust at the time the distortion occurred.

Instruments

The instrument panel remained clear of the fire and the GPS unit was recovered and later downloaded.

The helicopter was equipped with two artificial horizons, a primary and a standby. Both were removed from the helicopter and taken to an organisation specialising in their overhaul and testing. Following examination and testing it was determined that prior to the accident the instruments were in good condition and were most likely working normally and giving correct indications. Accident damage to bearings within both instruments suggests the aircraft was in a level attitude when it struck the ground.

The altimeter had the correct reference pressure set but post-accident was reading 550 ft, approximately 300 ft low. Further testing showed that there were no internal leaks and its response to changes in static pressure and reference pressure setting were normal. As part of pre-flight checks it is standard practice for a pilot to check the accuracy of the altimeter before each flight. It is therefore most likely that the altimeter was working normally until the point of impact and it was the impact forces that caused calibration error. Had the inaccuracy existed prior to the accident, the helicopter would be 300 ft higher than indicated by the altimeter affording the pilot a greater terrain clearance than expected.

Weather information

The horse rider who discovered the wreckage had been out around the farm, prior to her ride, from 0800 hrs to 0945 hrs. She stated that during that time there was "really dense fog" over the accident site and surrounding hills.

An aftercast of the routing and accident site was obtained from the Met office. It stated that in the immediate vicinity of the accident site, at the time of the accident, there was probably a range of likely cloud bases that would be generated by 'forced' ascent over high ground. It added that there was most likely broken (BKN) or near overcast cloud with patches of mist/haze likely to have reduced visibility to between 5,000 m and 10 km. Above 700 ft amsl, there was likely to have been cloud covering hills that would almost certainly have reduced visibility locally to less than 1,000 m, and quite likely to less than 200 m in places. Although patches of slight drizzle may also have been present, there is no direct evidence of precipitation. There was also strong evidence, from the High Resolution Visible satellite imagery, that skies were much clearer only a short distance north-west of the accident site. In the immediate vicinity of the accident site patches of

stratus were likely to have formed on high ground to give a scattered (SCT) or BKN stratus base of 700 ft to 980 ft amsl and tops at about 1,000 ft amsl. SCT or BKN stratocumulus with a base of approximately 3,000 ft to 4,000 ft, was likely to have been present above.

An estimation of the wind speed and direction is shown in the table below:

Height ft amsl	Wind Speed & Direction
Surface	010º 10 kt
500	020º 20-25 kt
1000	030º 25-30 kt
1500	040º 30-35 kt

It is likely that some areas to the lee of the hills were sheltered from the prevailing wind. There may have been local wind speeds of less than 10 kt with a rather variable direction.

The Gloucestershire Airport METAR for 0920 hrs stated that the visibility was 7 km and the cloud was SCT at 1,000 ft aal; this equates to 1,100 ft amsl.

Recorded information

Radar data from the Clee Hill radar head, which is 34.5 nm from the last GPS position, was available for G-CBXT during the accident flight, starting at 0918 hrs and ending ten minutes late. Each radar return was approximately eight seconds after the last. No altitude information was available. The aircraft was, however, equipped with a Bendix King Skymap IIIC GPS that recorded position, ground speed and ground track angle every 30 seconds, covering the same period.

The recorded track starts near the village of Norton Lindsey, Warwickshire, with G-CBXT 120 ft above the ground and finishes approximately 100 m away from the accident site. At this point, the aircraft was 150 ft above the ground, with a ground speed of 33 kt and heading in an easterly direction. The radar track (in red) and GPS points (in black) are illustrated in Figure 1.

The ground speed during the majority of flight was approximately 150 kt with G-CBXT climbing to just under 1,500 ft amsl after takeoff, and then gradually descending throughout the rest of the flight although there were several 100-200 ft climbs (see Figure 2).

A close-up of the end of the accident-flight track is given at Figure 3 and shows G-CBXT decelerating and descending as it flew towards and passed over the ridge extending westwards from Langley Hill (899 feet amsl) at approximately 160 feet agl.

The time, ground speed, altitude, height above ground level and track angle, for each of the last three GPS logged points, are given in Table 1.

Point	Time (UTC)	Ground Speed (knots)	Track (degrees true)	Altitude (feet amsl)	Height (feet agl)
A	09:26:57	140	221	1,077	805
B	09:27:27	120	239	1,060	437
C	09:27:57	33	90	993	150

Table 1

Logged GPS data (last three points) with calculated height above ground

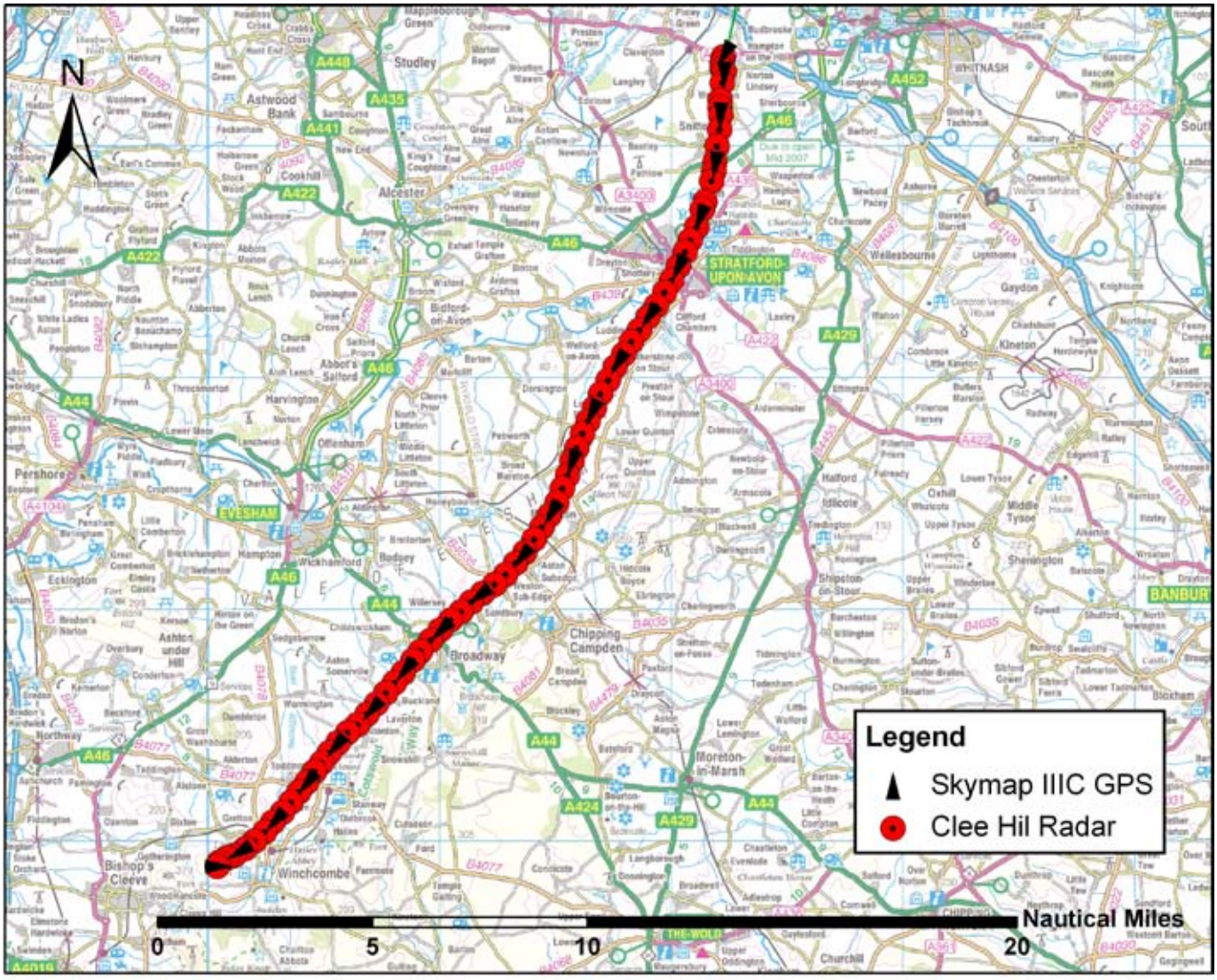

Figure 1

Radar and GPS tracks

Figure 4 show the relation of the last portion of the track with the crash site.

Occupant seating and harnesses

The helicopter was fitted with two individual front seats each with its own five-point harness attached to the seat. The metal end of each of the four other straps locks into a buckle on the crotch strap. To release the harness, a latch button needs to be depressed before turning the buckle head 90 degrees; this can be performed with one hand.

A rear bench seat capable of carrying three people was fitted. Due to the occupant restrictions of the Permit to Fly, only two car type (a lap belt with a single diagonal shoulder strap) harnesses were fitted. To unfasten the harness, a knob needs to be turned to release the buckle.

For all four seats, the buckle and metal strap ends remained intact but the strap material was consumed by the post-crash fire.

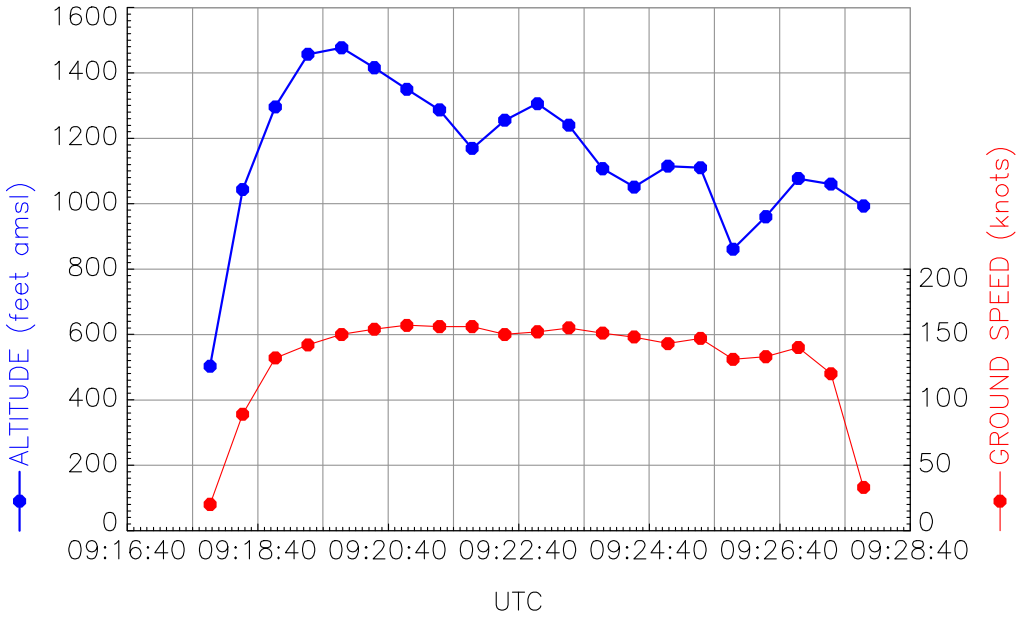

Figure 2

Accident track altitude and ground speed from GPS

The pilot was operating the helicopter from the front right seat but it could not be positively determined where the other two people were seated. It is likely that one would have been seated in the front left seat, probably the female passenger given that she was seen being strapped into that seat before the helicopter departed Baxterly, and the other on the rear bench seat.

The front right seat was detached from its mountings and the pilot remained secured to the seat by the harness; all four other straps were attached to the locked buckle of the harness. The front left seat was still attached to its mounting and its harness buckle was in the released position and did not have any of its other harness straps secured to it.

An unfastened front seat harness has the potential to restrict full aft movement of the cyclic control if the buckle falls down in front of the seat. This is a known issue and it is standard practice to fasten the harness whether or not the seat is occupied. The base of the cyclic control was inspected and as far as could be determined there was no evidence of contact with the harness buckle, but the inspection was not conclusive due to the severe damage caused by the accident. Other evidence shows that the helicopter was flying forwards in a level attitude and it is therefore unlikely that the cyclic control was affected by the harness buckle.

One of the rear seat harnesses was found in the secured position; it could not be determined to which seat this harness belonged.

Additional information

The pilot held a Private Pilot's Licence (Helicopter) with a Night qualification. This only allowed him to fly in VMC. During his skills test, prior to his licence being issued, he would have had to demonstrate to the examiner a rate one turn through 180º while flying on instruments. This is to show that he can safely turn the helicopter around to regain VMC in the event he accidently enters IMC.

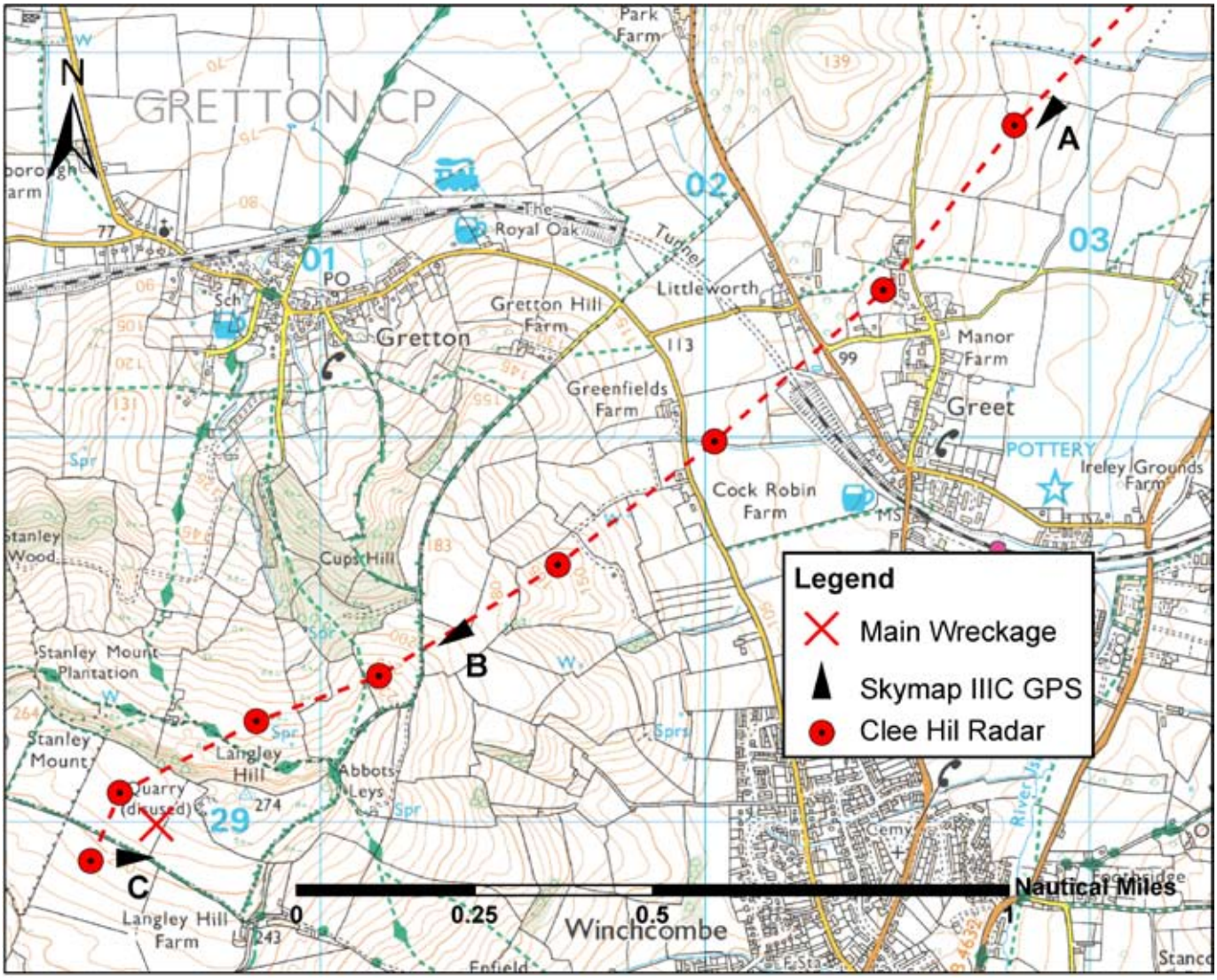

Figure 3

Close-up of the end of accident-flight track

The male passenger was a long standing friend of the pilot and had flown with him, according to the technical records, on numerous occasions before. The female passenger was believed to have been a recent business associate. Neither of them had any flying qualifications.

A homemade printed flight plan was recovered from the wreckage. It contained a list of waypoints from the en-route stop, near Norton Lindsey, to the destination, with their name, latitude and longitude, and bearing and distance information from the previous waypoint. The recorded flight path of G-CBXT remains within about 0.5 nm of the straight line track from abeam Honeybourne until about 2 nm north-east of the accident site where it gradually starts to converge onto the direct track line.

Medical information

Medical examination

A post-mortem of all three occupants was performed by a Home Office pathologist with a consultant aviation

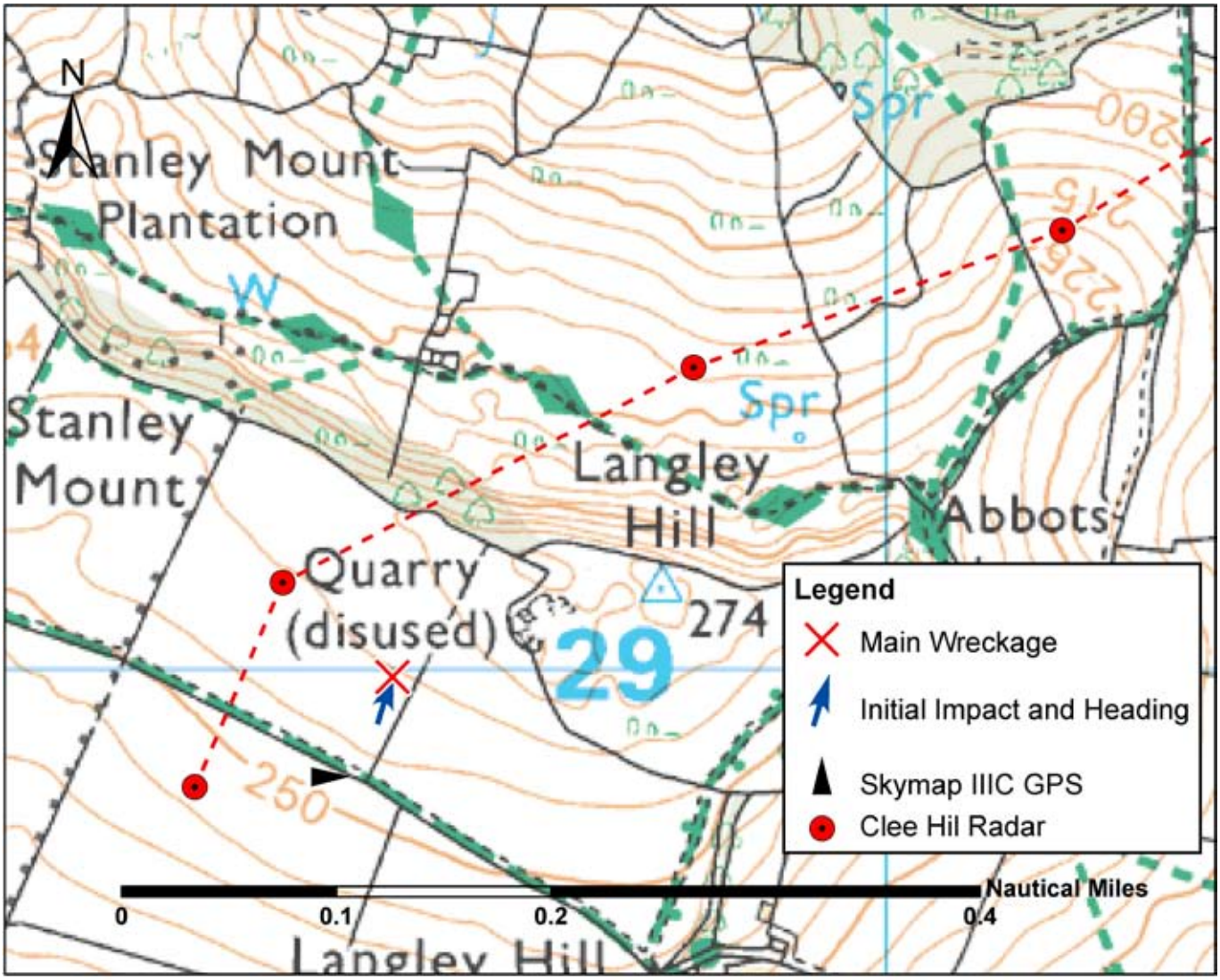

Figure 4

Crash site position with direction of ground marks

pathologist in attendance. It concluded that the two male occupants died of multiple injuries predominately due to deceleration at the time of impact.

The female occupant showed no evidence that she had been alive during the post-impact fire and that she was subjected to lesser decelerative forces with no injuries that could definitely account for her death. The report concluded that '*due to the limitations of the examination her cause of death was unascertained*'.

Only limited toxicology analysis could be performed on the pilot but no trace of drugs or drug metabolites were detected.

Medical records

The pilot held a current JAA Class 2 medical certificate. A report from his General Practitioner (GP) revealed that he had suffered from classical migraine for at least 10 years and that he had been prescribed assorted anti-migraine medication during that time.

He apparently suffered a migraine attack on average at least once a week at the time of the accident.

A review of his medical report forms, completed for the CAA for the renewal of his medical certificate in 1999, 2001, 2003, 2004, 2005, 2006 and 2007, confirmed that on each occasion he had not declared his history of migraine or medication to the CAA. The drug he was currently being prescribed would have been disqualifying for a Class 2 medical certificate and he would have been required to be headache free and off medication for a least two months prior to consideration of recertification.

The CAA medical department is required to operate under pan-European regulations which includes countries whose medical systems differ from those of the UK and as such, pilots' medical records are not examined. However, the NPPL style of self-declaration of fitness to fly requires a countersignature by the pilot's GP, who has access to the pilot's medical records.

Migraines

The symptoms of classical migraine include severe headaches and nausea and these can be preceded by visual disturbances, or other transient disturbances of brain function. The post-mortem could not determine whether a migraine attack contributed to the accident.

Analysis

Engineering

The helicopter was maintained to an approved schedule and the Permit to Fly and Permit Maintenance release certificate were valid. At the time of the accident, the engine was working normally, power was present at the rotor blades and the tail fenestron was working as expected. Of the control runs that could be checked, no pre-existing defects or control disconnections were found. Ground marks indicate that the helicopter was travelling forwards in a normal flight attitude, further suggesting that there were no control problems. Internal damage to both artificial horizon instruments reinforces the conclusion that the helicopter was in a level attitude at the time of the impact.

Medical

The pilot was being prescribed drugs for a medical condition which would have invalidated his medical certificate and as a result, his licence..

This accident highlights the ease with which a pilot, who has a disqualifying medical condition, may obtain a JAA medical certificate if they withhold information regarding their medical history and medication.

The CAA medical department is required to operate under pan-European regulations which includes countries whose medical systems differ from those of the UK. However, under present regulations there is a reliance on pilots to disclose potentially disqualifying conditions.

Conduct of the flight

The aftercast indicated that in the immediate vicinity of the accident site patches of stratus were likely to have formed on high ground to give SCT or BKN stratus with a base of 700 ft to 980 ft amsl and tops at about 1,000 ft amsl. As depicted in Figure 2, the helicopter's altitude gradually reduced as it tracked south-west from Norton Lindsey to Langley Hill. This is likely to indicate that the cloud base lowered and the helicopter descended to remain VMC below the cloud. The accident site was 850 ft amsl, and from the statement made by the horse rider, Langley Hill would have been in cloud at the time of the accident. Given the heights the helicopter was flying at before the accident, it was likely to have been in IMC from point A, shown in Figure 3, or shortly afterwards.

The final GPS recording placed G-CBXT at 993 ft amsl, with a ground speed of 33 kt. The ground marks indicated that it impacted the ground at 850 ft amsl (143 ft below the last recorded position), travelling forwards in a normal level flight attitude at about 66 kt ground speed. The impact point was approximately 100 m from the last GPS position. The wind at 1,000 ft amsl was from 030º at 25-30 kt, which meant the helicopter was likely to have had an IAS of 90-95 kt at impact.

The helicopter was tracking 239º at Point B in Figure 3. The accident site ground marks indicate that the helicopter was on a track of 020º at impact. This indicates that the pilot had turned through about 220º and may have been attempting to regain VMC from the direction the helicopter had originated, as he was taught in his PPL(H) training. However, the pilot was not qualified to fly in IMC, and would have lacked the practice to fly accurately on instruments.

While the likelihood of the pilot being incapacitated by a migraine attack cannot be discounted it is unlikely given that the helicopter appears to have impacted the hill in controlled flight.

The recorded data indicates that the helicopter was very close to the track that was probably active in the GPS. Flying 3 nm west of track in the River Severn valley over lower ground would have enabled the pilot to remain VMC below cloud.

Survivability

The female passenger was seen being strapped into the left seat of the helicopter before it departed its base. This seems to be confirmed by the positions of the bodies after the accident. Harnesses recovered from the wreckage indicate that the pilot's harness and one of the rear harnesses were secure, but the front left seat harness was undone. The post-mortem concluded that the female passenger showed no evidence of injuries which would necessarily have been immediately incapacitating. As a result she may have been able to release her harness following the impact.

Permit to Fly

This helicopter was allowed to fly subject to the conditions of its Permit to Fly with the limitation:

> *'Maximum number of occupants authorised to be carried (including crew): Four (Two flight crew and two ground crew, i.e. engineering staff required for the maintenance of the aircraft away from base).'*

The passengers had no flying qualifications and the helicopter was en-route to a maintenance facility where there were sufficient qualified engineering staff to assist with the handling of the helicopter. The passengers were thus not *required for the maintenance of the aircraft away from base* and should not therefore have been on board. They were also probably not aware of the conditions and limitations of the permit. In light of several accidents to ex-military helicopters, the CAA's Airworthiness team is working on a Permit Occupancy paper.

The following Safety Recommendation is therefore made:

Safety Recommendation 2009-089:

It is recommended that the Civil Aviation Authority review how the restrictions on occupancy of ex-military Permit to Fly Gazelle helicopters are notified.