ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior III, G-WAVS
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1998 (Serial no: 2842035)
Date & Time (UTC):	8 January 2018 at 1232 hrs
Location:	Bredon Hill, Overbury, Worcestershire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 2 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	52
Commander's Flying Experience:	5,700 hours[1] Last 90 days - 131 hours Last 28 days - 18 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft struck trees on isolated high ground in conditions of poor visibility and was destroyed. The pilot, a senior instructor, and the student pilot suffered fatal injuries. '*The Skyway Code*', published by the CAA, describes the hazards of flight in these circumstances and steps that can be taken at the planning stage to help avoid them.

History of the flight

The aircraft was being flown by an instructor of a flying school at Coventry Airport. He had conducted some local instructional flying earlier in the day and was then asked by the operations staff if he would deliver the aircraft to its maintenance base at Gloucester Airport. Such movements were a routine and regular aspect of the school's operation. The pilot was heard to express some concerns about the weather and appeared anxious to start the trip as soon as possible.

The plan was for two Coventry based aircraft, G-WAVS and G-USAA, both of which required engineering input, to fly to Gloucester at around the same time, each with two pilots aboard. All four pilots would then return to Coventry in another aircraft whose maintenance was concluded.

The instructor on the accident aircraft was accompanied by a student, who was approaching the navigation phase of his training, for whom this flight would provide some additional

Footnote

[1] Approximate total. The last logbook entry identified by the AAIB was made in December 2015.

exposure. The student prepared a route on a 1:500,000 scale aeronautical chart (Figure 1) following a standard route used by the school for such ferry flights. The highest terrain along or immediately adjacent to the route was shown as 1,048 ft amsl, and the maximum elevation figure was 1,400 ft amsl. Both crews conducted briefs and consulted the weather independently. There was no combined brief and no supervision by the flying school management (none was required). The crew of the accident aircraft did not use GPS navigation or flight planning software.

Figure 1

Part of aeronautical chart with track line

Prior to departure a pilot, believed to be the instructor of the accident aircraft, contacted Wellesbourne Airfield to check the weather conditions there. He was informed that an aircraft airborne in the vicinity had reported cloud overcast at 800 ft agl.

G-USAA departed Coventry Airport at 1206 hrs. G-WAVS, the accident aircraft, departed at 1208 hrs. Both turned south-west towards Stratford-upon-Avon and flew close to Wellesbourne Airfield, which they called by radio. They were aware of their relative proximity and the pilots transmitted air-to-air position checks to ensure their separation.

Southwest of Stratford, the two aircraft followed a very similar track, both maintaining an altitude of approximately 1,000 ft. The cloudbase in the area was approximately 1,000 ft amsl with freezing conditions forecast in cloud. The crew of G-USAA stated later that visibility reduced as the aircraft flew further south and west, and reported having to make frequent use of carburettor heating.

Close to Evesham the aircraft tracks diverged, with G-WAVS flying further to the north. At around 1230 hrs an aircraft believed to be G-WAVS was seen manoeuvring and flying very low in the Evesham area. Radar data indicated this occurred at altitudes between 700 and 1,000 ft amsl.

The aircraft was seen flying south-west toward Elmley Castle. Witnesses in that area described the weather as "quite foggy". They said they heard an aircraft flying "low" before appearing out of the cloud. One witness remarked that it seemed to be "pulling up". The witness lost sight of the aircraft as it continued southwest. Shortly afterwards the aircraft struck trees near the summit of Bredon Hill at an elevation of approximately 940 ft and came to rest in a field further south-west.

Following calls to the emergency services the air ambulance was launched at 1240 hrs from the helicopter emergency medical service (HEMS) base at Strensham Services on the M5. The helicopter pilot reported a cloud base of 500 ft agl and 3 km visibility. These were the minimum conditions for HEMS operations and the air ambulance launched in order to assist. It could not reach the accident site itself, which was significantly above the cloud base, and landed beside the nearby village of Overbury. Farm vehicles drove the medical personnel to the accident site.

Both occupants had suffered fatal injuries.

Accident site

The accident site was near the summit of Bredon Hill at an elevation of approximately 940 ft. There is a mast on the summit with an elevation of 1,046 ft, which is marked on the aeronautical chart. An aerial view of the site is at Figure 2.

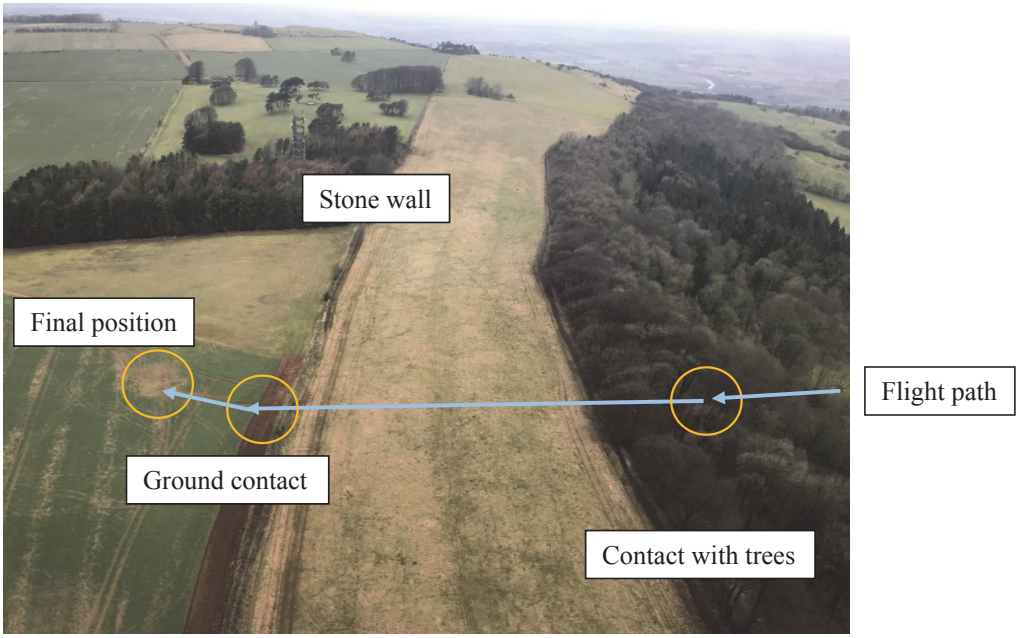


Figure 2

Accident site and Bredon Hill mast

Inspection of the accident site and wreckage indicated that the aircraft struck the top of trees near the summit of Bredon Hill on a heading of approximately 230°. This initial impact detached a portion of the outer left wing approximately 1.8 m in length, and part of the left aileron. The remainder of the aircraft then rolled to the left and descended to the ground approximately 170 m past the trees landing on its left side in a nose-down attitude causing further substantial damage. The aircraft contacted the surface close to and past a stone wall, which had not been contacted, and then quickly came to rest. This indicated that the final descent had been steep and at a slow forward speed.

Preliminary examination of the wreckage, and in particular damage to the propeller, indicated that the engine was producing power at the time of the impact. Both fuel tanks had been ruptured and no fuel remained but initial responders reported a strong smell of fuel which indicated fuel had been present. No pre-accident defects were identified.

Recorded information

Radar tracks were obtained for both G-WAVS and G-USAA. These covered both aircraft from initial climb from Coventry until G-USAA was on final approach to Gloucester, and for G-WAVS until the last radar return 200 m from the accident site. Figure 3 shows an overview of both tracks.

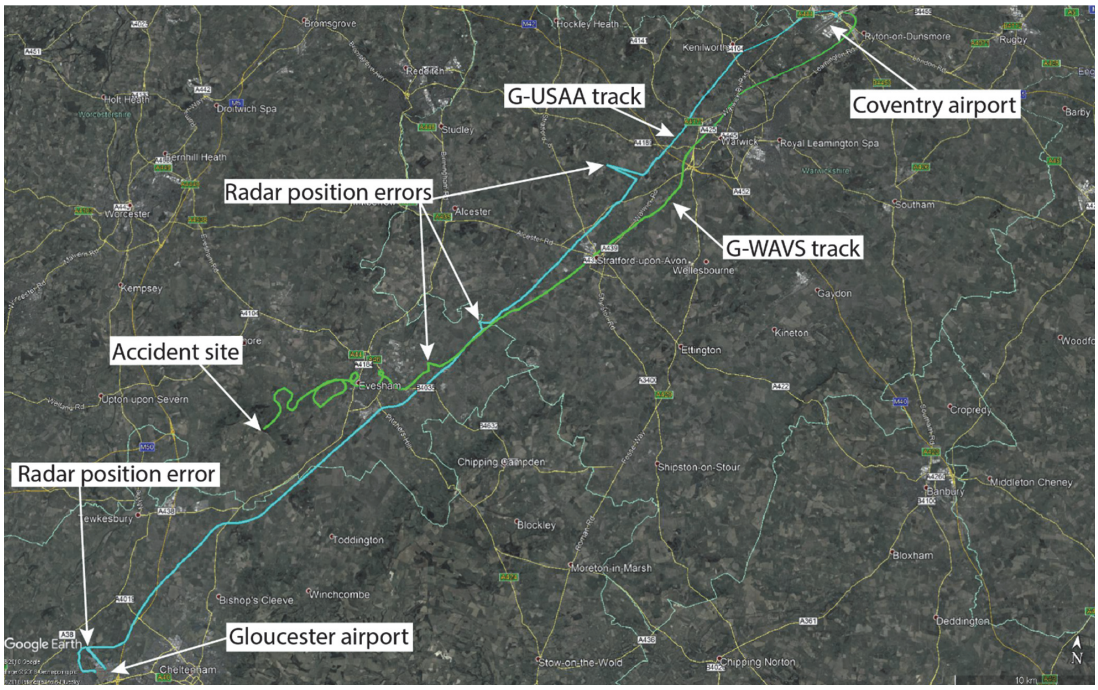


Figure 3

Radar tracks of G-WAVS & G-USAA

The radar data shows G-WAVS flew from Coventry towards Warwick and Stratford-upon-Avon, flying between approximately 800 ft and 900 ft amsl. G-USAA initially tracked to the north of G-WAVS, maintaining a separation of between 1 and 2 nm, but at a higher altitude of approximately 1,100 to 1,200 ft amsl. Both aircraft descended

approximately 300 ft when south of Stratford-upon-Avon, and their tracks converged. G-WAVS then turned towards the north-west, away from the track of G-USAA, and several low-level orbits were flown near Evesham before the aircraft flew towards Bredon Hill. Figure 4 shows the final track of G-WAVS and the altitude returns received from the aircraft's transponder, corrected to show altitude in feet amsl.

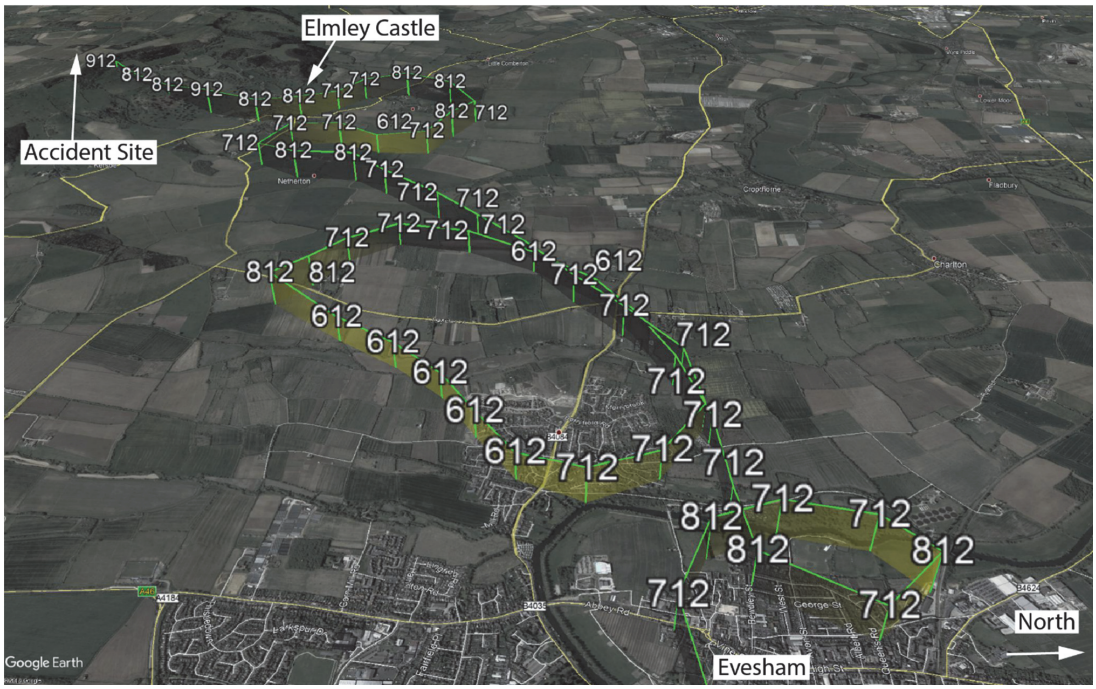


Figure 4

The final track and altitude returns from G-WAVS

The aircraft was equipped with a panel mounted GPS system. The unit was selected ON. No data was retrieved from this unit relating to the accident flight route, but it had stored its last known position, which was the accident site.

Radio contact between G-WAVS and Gloucester ATC was recorded. Both pilots' voices were audible on the recording and the content of the calls was routine. The last voice transmission was at 1225 hrs whilst the aircraft was manoeuvring near Evesham.

Aircraft information

The PA-28 is a low wing monoplane of conventional design, constructed primarily of aluminium and has four seats. It is powered by a carburetted, four-cylinder piston engine driving a fixed pitch propeller. A pilot-selectable carburettor heat system, using heat from the engine exhaust, is fitted to protect against carburettor icing. Fuel is carried in two integral wing tanks, one in each wing. The pilot can select either tank or OFF using a selector in the cockpit. The aircraft was equipped for flight in IFR conditions and was fitted with a GPS, VOR and ADF navigational equipment. The aircraft was not fitted with any de-icing equipment and therefore was not approved for flight in icing conditions.

The aircraft was maintained by the operator's own maintenance organisation and a review of the maintenance records showed that the aircraft had been maintained as required. The maintenance organisation had issued the aircraft with an extension, which allowed it to operate for a defined short period after the normal due date of a maintenance inspection. This extension expired on 9 January 2018. A review of other extensions issued by the maintenance organisation indicated that there had only been four other extensions issued between 1 January 2017 and the time of the accident, two of which were to move an aircraft's annual inspection date to coincide with its Airworthiness Review Certificate renewal date and the other two to allow the aircraft to complete a flight to the maintenance organisation. There had been over 360 maintenance inputs for scheduled maintenance in the same period.

Aircraft examination

The aircraft wreckage was recovered and taken to the AAIB facilities at Farnborough, Hampshire for further examination. This and examination of the aircraft log books did not reveal any pre-existing defects or anomalies with the aircraft or its instruments that may have contributed to the accident. The appropriate pressure setting,1022 hPa, had been set on the altimeter.

Meteorology

The forecast and actual weather reports for the Coventry area showed light winds from the north-east with a cloud base of approximately 1,000 ft. The Gloucester weather for the period of the accident also showed a light north-easterly wind with visibility reducing to 3,500 m in drizzle and mist and a cloud base of approximately 600 ft. The low-level forecast chart is at Figure 5. The crew of the accident aircraft are believed to have consulted this chart, a copy of which was found on the instructor's desk at Coventry Airport. The instructor is believed to have contacted Wellesbourne Airfield to check the en route weather. He was told that a pilot had reported a cloudbase of approximately 800 ft agl. Wellesbourne Airfield does not produce TAFS or METARS.

The Met Office analysed the conditions as follows:

> *'The chart shows that at 1200 UTC, the area of interest was covered by area C. The weather conditions in this area was* [sic] *associated with the warm front with general visibility around 20KM, but also widespread haze giving 7KM visibility. Isolated patches of light drizzle, or even snow grains were also possible which would reduce the visibility to 4000 M. It was a cloudy area with Broken or Overcast skies, bases of the cloud between 800-1300FT and tops 2500-4000FT. Any hills over 800FT would see foggy conditions.'*

Weather information for Birmingham and Gloucester airports was found after the accident on the pilot's desk at the airport.

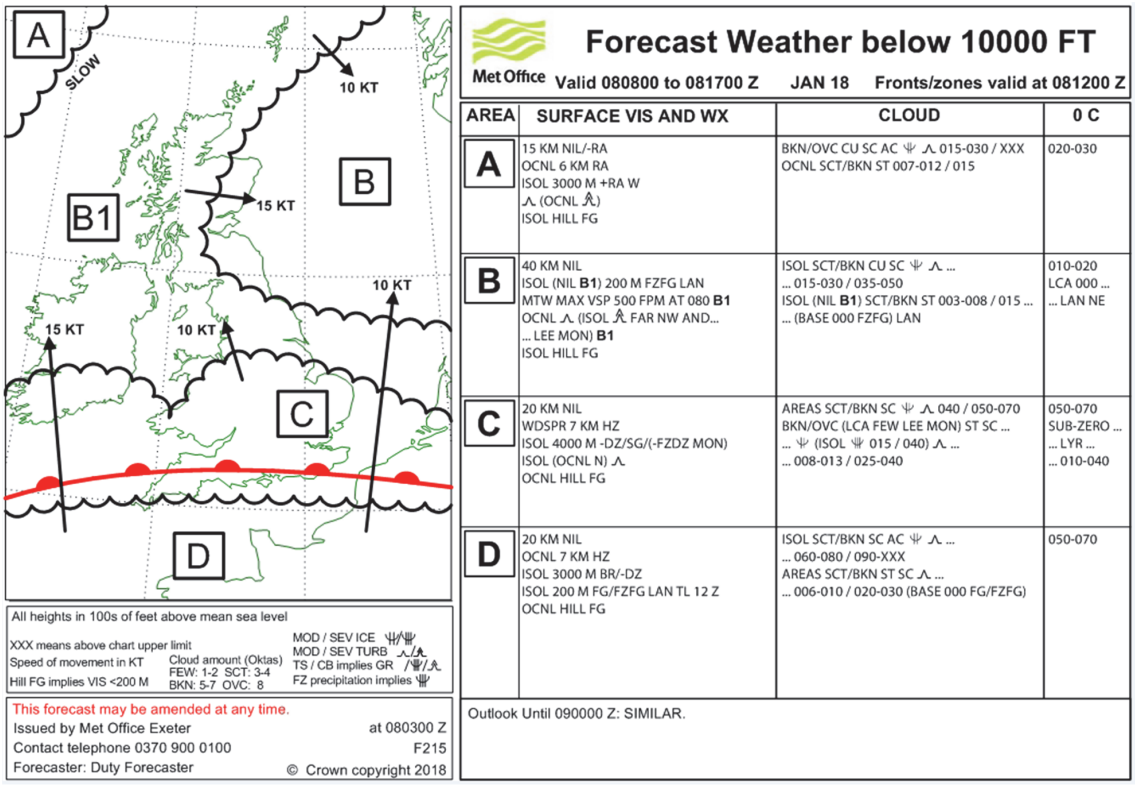


Figure 5

Forecast weather below 10,000 ft

Aids to navigation

The ADF equipment on the aircraft was tuned to the NDB at Gloucester, with its "ANT" selector button depressed. In this configuration the ADF could receive the NDB identification code but would not have indicated its location.

The VOR equipment was tuned to Daventry VOR and the course deviation indicator on the display was selected to the 258 radial. This did not align with the aircraft's course.

Several flight planning and mapping applications exist which can be used on mobile devices including tablets and mobile telephones. When suitably configured and provided with a GPS input these applications can improve a pilot's awareness of their position, especially in relation to nearby airspace and terrain, but may not meet the requirements for certification as a terrain awareness warning system.

A screenshot from one such application, which was used to simulate the approximate track of G-WAVS from Evesham towards Bredon Hill, is shown in Figure 6, below. The yellow aircraft symbol at top centre of the screenshot represents the simulated aircraft's position. In this image, the application's terrain warning feature is enabled and shows hazardous terrain in red. The white line with markers drawn ahead of the aircraft symbol represents the aircraft's predicted position at intervals in the future.

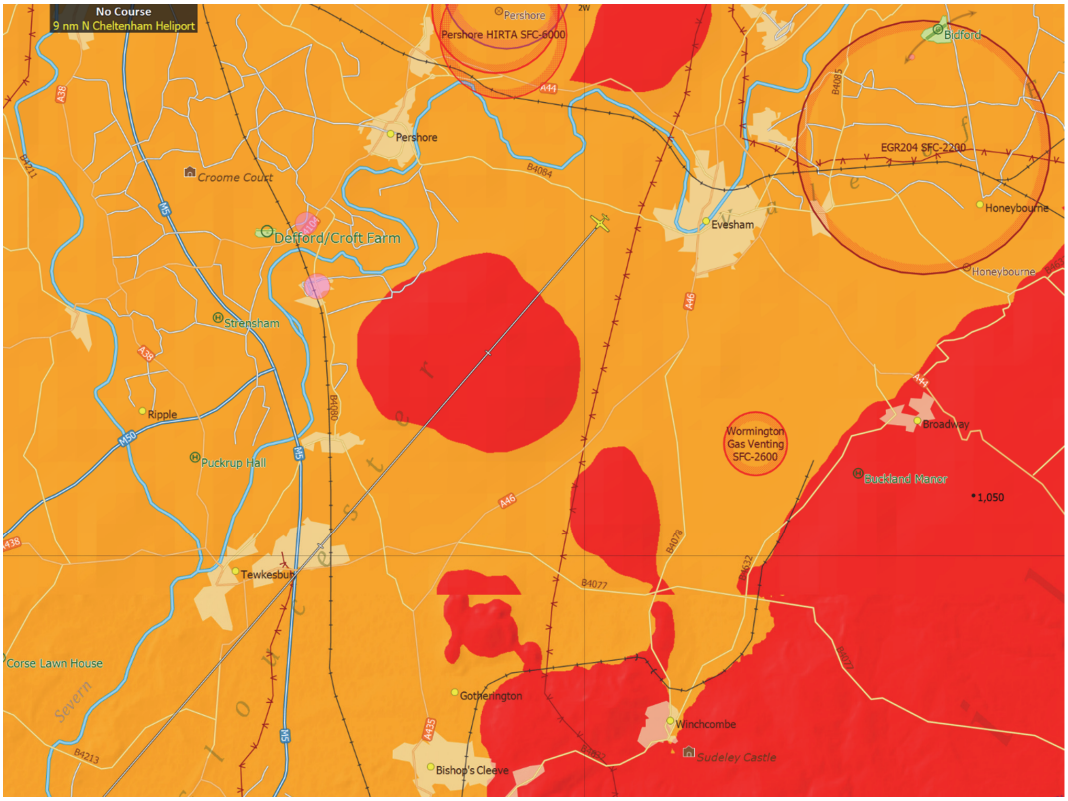


Figure 6

An example application showing the simulated track of G-WAVS towards Bredon Hill

The image shows the rising ground of Bredon Hill relative to the simulated aircraft flying at 900 ft amsl, and high ground to the right side of the Figure.

Civil Air Publication (CAP) 1535, '*The Skyway Code*', published by the CAA, states:

> *'Handheld and tablet based GPS systems have reduced the risk of CFIT[2], particularly if lost. However, they should not be used to fly in poorer weather than you otherwise would.'*

The instructor was not known to use GPS navigation or flight planning software and did not carry a tablet or smart phone that could employ such systems. There is no requirement to do so.

Witnesses from the school stated that they had been taught that when lost they should circle a recognisable feature and then contact the Distress and Diversion cell at NATS Swanwick (D&D) on 121.5 MHz.

Footnote

[2] Controlled flight into terrain.

Personnel information

Instructor

The experienced instructor was also an examiner and was the only salaried member of the Instructional Staff at Coventry. He held a CPL(A) and Instrument Rating (Restricted) (IRR), and had approximately 5,700 hours flying experience[3].

Aircraft from the school were regularly flown to Gloucester and witnesses stated that the instructor had flown the route often.

Witnesses reported that the instructor appeared concerned about the conditions for the flight to Gloucester. He gave them the impression that he was unhappy with the plan but there is no evidence that he raised any such concerns with the higher management of the flying school.

Student

The student's records indicated that he had completed approximately 19 hours of flying training, including some navigation training prior to the accident sortie, and that he had an understanding of the procedures to follow when lost. He had not previously flown the route from Coventry to Gloucester.

Pathology

Post-mortem examinations of the pilots revealed no evidence of incapacitation before the accident. Both had sustained injuries that were not survivable.

Organisational information

The instructor involved had been with the school for several years and was the nominated Senior Instructor at its Coventry location. He was the only salaried member of the flying instructional staff at Coventry. The school did not appoint a duty pilot, separate from the flying programme, to supervise day to day flying activity and routine management of flying operations was conducted by the operations desk personnel, who were mostly inexperienced pilots on courses at the school.

The school did not have a formal process for monitoring or recording instructor performance.

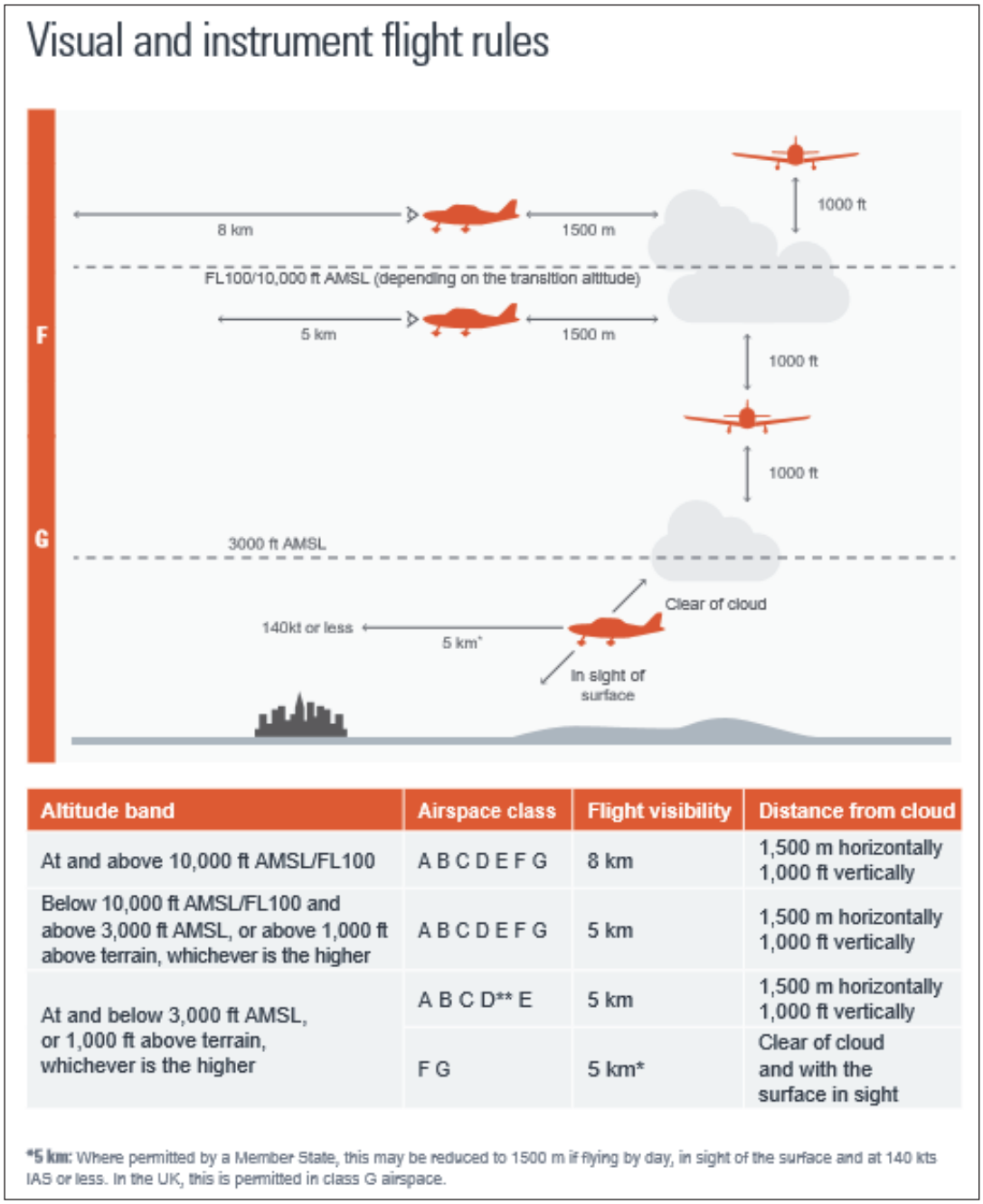
The flying school regularly made use of training flights to transfer aircraft from Coventry to its engineering base at Gloucester.

Flight in accordance with VFR

Regulations governing flight in accordance with VFR are contained in the Standard European Rules of the Air (SERA). The following extract from CAP 1535 provides a graphical representation (Figure 7).

Footnote

[3] It was not possible to determine the precise total because the last entry in his logbook was made in 2015.



Altitude band	Airspace class	Flight visibility	Distance from cloud
At and above 10,000 ft AMSL/FL100	A B C D E F G	8 km	1,500 m horizontally 1,000 ft vertically
Below 10,000 ft AMSL/FL100 and above 3,000 ft AMSL, or above 1,000 ft above terrain, whichever is the higher	A B C D E F G	5 km	1,500 m horizontally 1,000 ft vertically
At and below 3,000 ft AMSL, or 1,000 ft above terrain, whichever is the higher	A B C D** E	5 km	1,500 m horizontally 1,000 ft vertically
	F G	5 km*	Clear of cloud and with the surface in sight

***5 km:** Where permitted by a Member State, this may be reduced to 1500 m if flying by day, in sight of the surface and at 140 kts IAS or less. In the UK, this is permitted in class G airspace.

Figure 7

Graphical representation of flight rules

For flight below 3,000 ft or less than 1,000 ft above terrain, whichever is higher, and at speeds below 140 kt, the SERA require a visibility of 5 km. However, Member States may reduce this visibility requirement to 1,500 m. The UK has done so. CAP 1535 states:

> *'For operations in class G airspace the legal VFR minima allow flight in potentially very poor conditions. Clear of cloud and visibility of 1500 m is all that is required if below 3000 ft AMSL and flying at less than 140 kts. In reality, the limiting factor is usually cloud rather than in-flight visibility - in*

> *conditions approaching 1500 m visibility, the cloud ceiling would likely mean flying dangerously low. The legal minima are not a good reference point for decision making because safe VFR flight normally ceases to be possible long before the visibility is that poor. They are limits not targets.'*

The requirement to be in sight of the surface has been unintentionally omitted from this paragraph of the CAP 1535 but is reflected elsewhere in the document. The CAA stated that it intends to correct this omission in future publications.

CAP 1535 states that flight with a cloud ceiling of less than 1,500 ft agl or less warrants special attention to terrain and obstacles, and states:

> *'In practice, VFR flight when the surface visibility is being reported as less than 5 km is not recommended. You are unlikely to have a clear horizon to control the aircraft by and navigating visually will be difficult.'*

The weather forecast for the accident flight indicated the probability of areas of low cloud and poor visibility.

The school's operations manual contained the following information relating to weather minima for takeoff:

> *'Single-engine aircraft may take-off only when:*
>
> *VFR flights:*
>
> *i. The cloud base is not less than 800 feet AGL and the RVR is not less than 1800 metres and / or:*
>
> *ii. The weather conditions at the departure airfield are not below those for a circling approach, and:*
>
> *iii. The cloud base en-route is not less than 1000 feet AGL and the visibility en route is not less than 1800 metres, and:*
>
> *iv. The weather conditions at the destination and alternate aerodromes are forecast to be greater than operating minima for a visual join, for not less than 60 minutes after the estimated time of arrival.'*

Regarding VFR Navigation it stated:

> *'VFR Navigation*
>
> *Cloudbase /Flight Visibility*
>
> *Dual Generally 1000ft, but not less than 800ft at any point en-route*
>
> *Generally 5 km, but not less than 1800 m at any point enroute*

For cross country flights the Operations Manual stated:

> *'For all cross-country flights adequate planning must be incorporated to enable a diversion to be made to an alternate airport which is open and has forecast weather to be above the minima for a period not less than 60 minutes before and after the expected arrival at that alternate.'*

Flight in low visibility

Safety Sense Leaflet 13 published by the CAA, and European General Aviation Safety Team Leaflet GA 1, both regarding collision avoidance, discuss effective visual scans and outline the limitations of human performance in this regard. Both state that it takes approximately 23 seconds to complete one effective scan of the aircraft instruments and the outside environment, and a further 10 seconds for the pilot to react effectively to an external threat; or 33 seconds in total. An aircraft with a ground speed of 140 kt will travel 1,500 m in approximately 20 seconds.

Flight planning and safety altitudes

The school's operations manual defined minimum safe altitude as being 1,000 ft above the highest obstacle within 5 nm of the intended track. For the planned route at Figure 1 this would have given a safe altitude of 2,400 ft. However, on the day of the accident an altitude of 2,400 ft would have required penetrating icing conditions for which the aircraft was not equipped.

CAP 1535 states:

> *'Controlled flight into terrain and loss of control in IMC continue to be factors of many GA accidents. Attempting or continuing VFR flight in poor weather is a common cause of this.'*

It contains guidance on pre-flight planning as a means of mitigating the risks associated with such conditions.

Analysis

Engineering matters

A review of the maintenance documentation indicated the aircraft had been maintained to the required standard and the examination of the wreckage did not identify any anomalies or defects that could have contributed to the accident. Damage to the propeller indicated that the engine was producing power at the time of the accident.

Operational matters

It is likely that the aircraft encountered an area of low cloud and poor visibility during the flight to Gloucester. Such conditions were forecast, but the instructor decided to continue with the flight. The weather conditions forecast for the flight were better than those required for flight under VFR and by the school's operations manual. However, the poorer visibility likely to

have been encountered around Bredon Hill would have been significantly more challenging and the pilots of the other aircraft stated that the summit of Bredon Hill (940 ft amsl) was in cloud.

Although the instructor's IRR permitted him to do so, climbing into cloud was not a safe option because the aircraft was not equipped for flight in the icing conditions forecast to be present. Therefore, the crew had either to try to find more favourable conditions or continue operating in poor visibility at low altitude.

These circumstances would have increased workload and stress, potentially reducing the crew's performance. An aircraft with a ground speed of 140 kt will travel 1,500 m in approximately 20 seconds therefore the timeframe available to the crew to react effectively would have been very short. Consequently, in the conditions prevailing near Bredon Hill, it is likely the crew would have had insufficient time to avoid any obstacles they encountered.

Bredon Hill is on a direct track between the manoeuvring position near Evesham and Gloucester NDB, and if the instructor was uncertain of his position he may have chosen to use the NDB to indicate the location of the airfield. It was not possible to determine if the ADF unit's antennae button had been depressed in the accident sequence but in this configuration it would not have indicated the NDB's location.

The last radio contact with the aircraft occurred during its manoeuvres near Evesham. The apparently routine nature of that contact does not indicate any urgency at that stage of the flight.

The occupants of G-WAVS were not using a flight planning or mapping application. Although such applications may not meet the requirements for certification as a terrain awareness warning system, they can offer valuable situational awareness to a pilot of surrounding higher ground when used appropriately.

Students at the school were taught that when lost they should circle a recognisable feature and then contact D&D on 121.5 MHz. While the circling manoeuvres near Evesham are consistent with this practice, there were no radio calls received by D&D from the aircraft and it was not possible to determine whether these manoeuvres were a result of the pilot being lost or for some other purpose.

NATS states on its website[4] that *'pilots are actively encouraged to request training fixes and practice pans'* from D&D. As well as providing valuable training for controllers and pilots, making such a "practice" call might enable pilots to request assistance without alarming passengers or other crewmembers who may overhear their transmissions.

Given the student's lack of experience it is unlikely he could have offered significant assistance to the instructor.

Footnote

[4] https://nats.aero/blog/2014/08/distress-diversion/ [accessed October 2018].

The aircraft was approaching the end of its maintenance validity and the school decided to send the aircraft to its own facility at Gloucester where its regular maintenance was carried out. This organisation was also the aircraft's Continuing Airworthiness Management Organisation. An alternative maintenance facility was available at Coventry.

The instructor was described by the flying school as its Senior Instructor and it is likely he felt a duty towards the school and a wish to achieve the required tasking.

The minimum safe altitude for flight in instrument meteorological conditions was 2,400 ft, but the aircraft used for the flight was not equipped to fly in the icing conditions forecast to be present in cloud. The pilot was heard to express some concerns about the weather prior to the flight.

The routine management of flying operations was conducted by the operations desk personnel who mostly were inexperienced pilots on courses at the school. No person of adequate experience and authority was present to challenge the decision to conduct the flight in the conditions prevailing on the day of the accident.

The use of training flights for other purposes, such as positioning an aircraft for required maintenance, may provide useful experience for a student but has the potential to impose inappropriate pressures on the participants. The conduct of a training flight should not be influenced by unrelated operational necessities.

A more formal process of assessing performance and recording standardisation meetings may have assisted the organisation in sharing experience and good practice amongst its staff.

Conclusion

The aircraft struck trees near the summit of Bredon Hill following flight into conditions of deteriorating visibility. The aircraft was not equipped to operate in the icing conditions forecast in cloud and so could not climb to the minimum safe altitude.

In visibility close to the limits permitted under VFR there is very little time to avoid terrain and obstacles that may be encountered and, should conditions deteriorate, flight in these circumstances presents few options for a safe outcome.

CAP 1535, published by the CAA, advises pilots that flight in the minimum conditions of cloud and visibility permitted under VFR is not necessarily safe**,** and describes steps that can be taken when planning the flight to mitigating the risks of flight into terrain in poor weather.