ACCIDENT

Aircraft Type and Registration:	Socata TB10 Tobago, G-CFME
No & Type of Engines:	1 Lycoming O-360-A1AD piston engine
Year of Manufacture:	1996 (Serial No: 1795)
Date & Time (UTC):	30 September 2013 at 1051 hrs
Location:	11 nm south-east of Bristol International Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	332 hours (of which 34 were on type) Last 90 days - 9.5 hours Last 28 days - 3 hours
Information Source:	AAIB Field Investigation

Synopsis

The accident occurred during a flight from a private airstrip back to the aircraft's home base at Henlow. Poor weather conditions were forecast along the planned route, with low cloud and poor visibility. The pilot obtained only minimal meteorological information beforehand, which led him to believe that conditions were suitable for the proposed flight. When the aircraft encountered the poor weather, it started circling and descended to a very low level. It came within close proximity of a tower, forcing the pilot to carry out an avoiding manoeuvre. This placed the aircraft in an unusual attitude at low height and in very poor visibility, a situation the pilot had neither the training nor experience from which to recover.

Background to the flight

The accident occurred during a flight from a private farm airstrip near Taunton in Somerset to the aircraft's home base at Henlow Airfield, near Luton. The pilot made the outbound journey on Friday 27 September 2013 and planned to return to Henlow on the Sunday, having spent the weekend staying with his friends, the farm owner and his wife. However, the pilot's activities on the Sunday delayed his return to the farm, so he postponed his return flight until the following morning, Monday 30 September.

Outbound flight of 27 September 2013

Excellent flying conditions existed on 27 September for the outbound flight to the farm strip. The pilot had not previously flown there, although he had visited on several occasions

by road. Some time after taking off, the pilot made an unexpected return to Henlow. On entering the club house, he made comment to the effect that both his GPS units had stopped working (the pilot was referring to the tablet computers which he routinely used for this purpose but he mainly referred to the larger one). When others examined it, the tablet was still functioning but the GPS position was in error. This appeared to be resolved by turning the unit off and on again. According to the pilot's family, this was not the first occasion he had experienced technical problems with the tablet.

Radar data showed that, after taking off on the easterly runway, the aircraft turned left and established briefly on an appropriate south-westerly track, but then made a left turn on to a southerly track which took the aircraft into the Luton Airport control zone. It penetrated the zone by about 1 nm before turning right and returning eventually to Henlow.

Luton Airport ATC filed a safety report on the incident, which occurred at a time of high numbers of arriving aircraft and necessitated the Luton zone controller imposing a temporary restriction on departing flights. The pilot contacted Farnborough ATC (who provided a service outside controlled airspace in that area) and was given navigational assistance to avoid the control zone and return to Henlow.

Prior to his second departure, the pilot was advised by an acquaintance and part-time instructor to organise his departure such that he flew out to the east while ensuring the tablet's GPS was working correctly, before returning to overfly the airfield, so as to have a known starting point for navigation purposes. He also asked the pilot if he had a conventional chart with the route navigation information plotted on it in case of further problems, and the pilot said that he did. As described later it was subsequently established that, although the pilot carried an aviation chart, it had no more on it than an indistinct route line drawn between Henlow and the farm strip.

The accident flight

As Henlow Airfield was normally closed on Mondays, the pilot telephoned on the Sunday and arranged for a club member to be present on the airfield for his return the next day. It was agreed that he would return between 1100 hrs and 1300 hrs, with an ETA of 1130 hrs. The pilot also telephoned his wife. During their conversation, he mentioned that he was prepared to leave the aircraft at the airstrip if the weather was poor, and travel home by train. At the farm, the pilot mentioned that the weather for his return flight would be fine, but it was not known from where he may have obtained this information.

The pilot spent the evening before the flight relaxing with his friends and retired at about 2215 hrs. The following morning, at 0723 hrs, he telephoned an instructor (the same instructor that the pilot had spoken to prior to his outbound flight) to enquire about the weather conditions in the Henlow area. The instructor, who was at his normal place of work, asked the pilot to wait whilst he accessed an on-line weather report for Luton Airport (9 nm south of Henlow). He read this out to the pilot, who appeared content and did not ask for any further information (the content of the weather report is described later in this report, but conditions at Luton were generally favourable). Following this call, the pilot made a similar comment to the farm owner as he would later make to his wife, that conditions were clear for his return route.

The pilot was seen by the farm owner and his wife over the breakfast and early morning period. He appeared rested and in good spirits. He had with him two tablet computers, a larger one with a 250 mm screen and a smaller one. Although the pilot had used the larger one earlier in the weekend to show his friends details of the outbound flight, he was not seen carrying out any activity on either tablet during the morning period, although there were periods when he may have done so unobserved. He made no request to access the Wi-Fi facility at the farm or to use a separate computer there.

At about 1000 hrs on the day of the accident, the pilot was driven the short distance to his aircraft by the farm owner's wife. Although she was not directly concerned about the weather, she saw it was rather grey and asked the pilot if it was suitable for his flight. In replying, the pilot referred to the earlier phone call, and said that his route back to Henlow would be clear up to 6,000 ft. The pilot did not appear hurried or concerned, and took time during his pre-flight inspections to explain some of the aircraft features and related paperwork, although he mentioned that he needed to be back at Henlow by 1300 hrs. The farm owner's wife left the pilot to his preparations and saw the aircraft take off at 1023 hrs. She watched it make an orbit of the airfield before setting off eastwards.

Shortly after takeoff, the pilot attempted twice to make radio contact with ATC at Bristol Airport. The Bristol controller replied, but no further transmissions were received from the pilot. Other airfields and ATC units were contacted during the investigation, but there were no records of the pilot having contacted any of them during the accident flight.

Recorded radar data, together with GPS position information downloaded from the pilot's tablet computer, showed that the aircraft proceeded on an approximate track for Henlow, although with significant deviations as described later in this report. It passed over the low ground of the Somerset Levels, heading towards the Mendip Hills, where terrain rises to about 1,000 ft amsl. As it did so, the aircraft headed towards an area of poorer weather conditions, with low cloud, reduced visibility and rain.

Witnesses in the area of Stratton-on-the-Fosse, on the north-eastern side of the Mendip Hills, described the low cloud lying as mist or fog. Some heard an aircraft in the area some minutes before the accident, while others were not aware of it until very late. Those witnesses who heard the aircraft beforehand described varying engine sounds, as if the aircraft was manoeuvring or circling, although it remained hidden from view by the low cloud. Two witnesses closest to the eventual accident site described the aircraft passing over their property on more than one occasion and seemed to be getting lower, although they could not see it. The last time it passed over, the aircraft was extremely low and they were alarmed. The witnesses thought the aircraft may have been climbing from that point but, when the aircraft was at about the furthest point of its orbit from them, the engine noise reduced, suggesting to them that it may have been preparing to land. There was then a sudden increase in engine noise which continued until the sound of an impact a short while after.

A number of witnesses were working on the roof of Downside Abbey, a neo-Gothic structure with a tower reaching 166 ft agl. These witnesses described the aircraft appearing close by in a wings-level attitude but at very low height, immediately to the north of the Abbey and

on a track directly towards it. Almost as soon as they saw the aircraft, it began an avoiding manoeuvre in which it pitched nose-up and rolled to the right, accompanied by a change in engine note to what sounded like full power. The aircraft was reportedly well below the height of the tower, and witnesses believed it avoided the tower by about 30 m. A unanimous view was that the aircraft would have struck the tower had the pilot not taken avoiding action.

No-one saw the aircraft after the avoiding manoeuvre, either because it became lost from view behind the building or due to the poor visibility. However, many heard the sound of an impact soon afterwards.

The aircraft crashed in a partially wooded area within the grounds of the Abbey. Several people hurried to where the sound of the impact had come from. The first 999 call was made at 1052 hrs by the witnesses closest to the accident site, immediately on hearing the sound of impact. Several witnesses reported a strong smell of fuel at the site. An ambulance arrived on scene at 1109 hrs and it was established that the pilot had suffered fatal injuries. The elevation of the accident site was 630 ft amsl.

Engineering

Examination of the accident site indicated that the aircraft had impacted in a lightly wooded area, in such a way that only a single large tree and a small area of ground were affected. The wing structure was severely broken up as a result of a sequence of impacts with the boughs of the tree and aircraft debris was scattered over a limited distance from the ground impact point. It was concluded from the overall evidence that the aircraft had been descending at a very steep angle when impact occurred.

Examination also confirmed that the aircraft had been structurally complete at the impact.

The propeller was found to have separated as a result of a largely torsional failure of the forward end of the engine crankshaft. This failure, viewed in conjunction with the nature of the damage to the two blades, was consistent with the engine having been delivering power at impact. A detailed examination of the engine did not reveal any evidence of internal failure that was not associated with impact forces.

The flying control system was examined and found to be free from any evidence of pre-impact failure. Examination of the flap actuator confirmed that the flaps were fully retracted at the time of the impact. The vacuum pump, the power source for the primary gyro instruments, was found to be fully serviceable and correctly installed such that it would have been capable of creating the appropriate airflow velocity to enable the Attitude Indicator (AI) and the Horizontal Situation Indicator (HSI) to function correctly during engine operation.

The pilot initially planned to make a local flight on the Sunday, and to refuel at a local airfield. However, because of his other activities on the Sunday, this did not happen. A fuel consumption calculation showed that the aircraft would have landed at the farm with approximately 60-65% fuel remaining, after starting the day with full tanks. This would have been sufficient for about 90 minutes flying, including a suitable reserve. Assuming no more than light headwinds for the return flight, it would have been expected to take about 70 minutes.

Pathological and medical information

The pilot held a valid EASA Class 2 medical certificate. A post-mortem examination was carried out by an aviation pathologist. Toxicological tests revealed no evidence of drugs or alcohol, and no evidence of exposure to carbon monoxide. No natural disease was identified which could have contributed to the pilot's death or to the cause of the accident. It was established that the pilot had suffered multiple injuries which were all consistent with having been caused at the time of the accident, and that no additional or alternative personal safety equipment would have altered the fatal outcome.

Meteorological information

The Met Office provided a report on the meteorological situation that existed on the day of the accident flight.

General situation

Surface analysis charts indicated that the accident area was subject to a light to moderate east to south-easterly airflow, with a weakening warm front moving north-east across the area during the morning. Infra-red and visible satellite images showed thick frontal cloud over southern Wales and central southern England. Figure 1 shows a visible spectrum satellite image taken about the time of the accident.

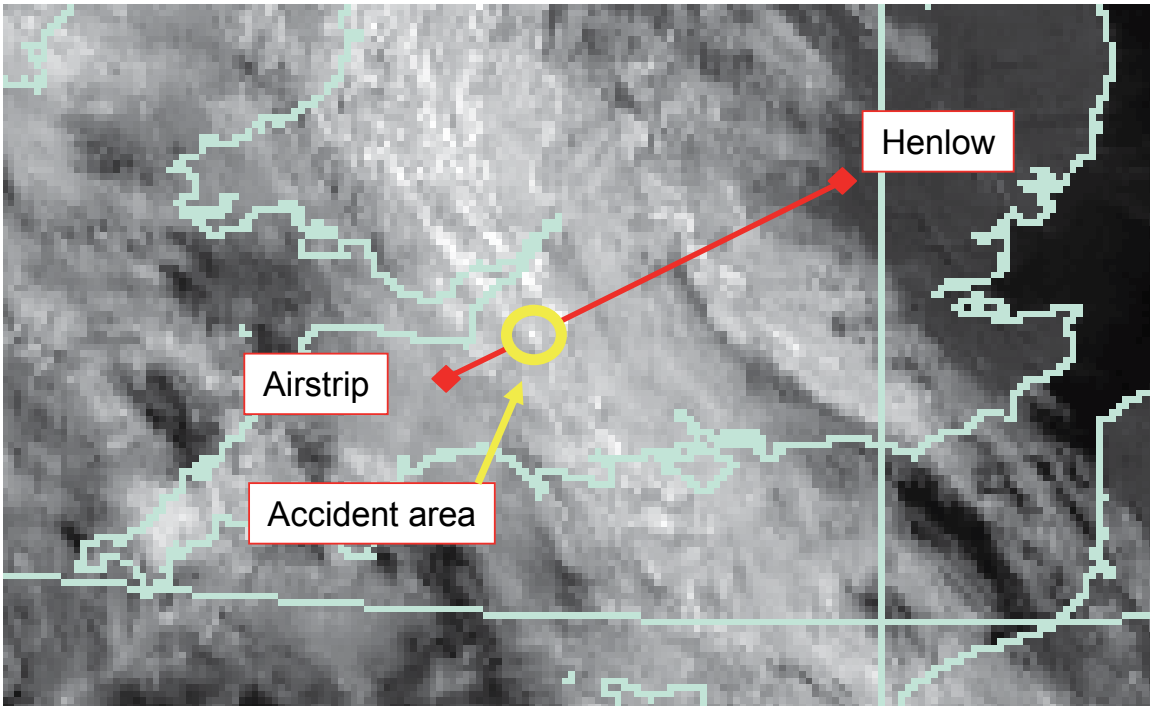

Figure 1

High Resolution Visible Spectrum Satellite Image
30 September 2013 at 1100 hrs UTC

Surface observations in the accident area for the hour before the accident showed visibilities reducing to between 1,300 m and 2,000 m generally, with some areas down to about 800 m. Similarly, cloud bases reduced to below 1,000 ft, and as low as 200 ft in places. There was also a slow moving band of moderate rain associated with the weather front, with lighter and patchier rain or drizzle elsewhere.

Further east, towards the planned destination, conditions were more favourable. Visibilities improved through the morning from around 8 km to around 20 km by midday, while cloud dissipated and cloud bases rose from around 1,000 ft to 2,500 ft.

Forecast information

Met Office Form 215 detailed weather conditions for flights below 10,000 ft over the UK and very near continent. The Form 215 issued at 0257 hrs on 30 September 2013 showed the forecast meteorological situation for 1200 hrs. This showed the slow moving weather front across the accident area with better conditions to the east. The text described isolated or occasional areas of reduced visibility in the accident area, with occasional hill fog (implying visibility of less than 200 m). Cloud bases immediately to the south-west of the front (the area the aircraft would be approaching from) were forecast to be down to between 500 ft and 1,000 ft on occasions, with cloud locally on the surface as fog.

The 0501 hrs forecast for Bristol Airport (30 nm north-east of the takeoff airstrip and 11 nm north-west of the accident site) included temporary reductions in visibility to 7,000 m in rain, and broken cloud at 1,200 ft. There was a 30% probability of 3,000 m visibility in rain and mist with broken cloud at 400 ft.

The 0805 hrs forecast for RNAS Yeovilton (23 nm east of the departure airstrip and about 16 nm south-west of the accident site) included temporary reductions in visibility to 5,000 m in light rain, and broken cloud at 800 ft. Later in the morning (from 1100 hrs on) temporary conditions were forecast to worsen to 3,500 m visibility in rain showers with scattered cloud at 600 ft and broken towering cumulus cloud at 1,500 ft.

The most recent forecast for Luton Airport before the pilot's phone call at 0723 hrs gave a light north-easterly wind and small amounts of cloud at 3,500 ft. Visibility was forecast to be in excess of 10 km, with a 30% chance of dropping to 6,000 m during the first part of the morning. Observations timed at 0650 hrs and 0720 hrs reported a visibility of 9,000 m and no significant cloud.

Airfield actual weather reports[1]

Bristol Airport reported increasing cloud amounts and reducing visibility through the morning, reaching 2,000 m visibility and overcast cloud at 400 ft by the 1020 hrs observation. By 1050 hrs (the time of the accident), visibility was 1,400 m in mist, with overcast cloud at 300 ft. Conditions worsened for a time afterwards, with visibility dropping to 700 m in fog.

Footnote

[1] All times are UTC (Greenwich Mean Time). The aircraft took off at 1030 hrs UTC.

RNAS Yeovilton reported light easterly or north-easterly winds through the morning. By 0850 hrs the station was reporting 7,000 m visibility in light drizzle, with scattered cloud at 900 ft and overcast cloud at 1,400 ft. By 0950 hrs, the conditions had deteriorated further, to 1,800 m visibility in light rain and drizzle with broken cloud at 400 ft and overcast cloud at 800 ft. By the time of the accident, Yeovilton was reporting a lowest cloud base of 200 ft.

Video footage

A member of the public provided footage from an in-car video system, reportedly showing conditions a short while before the accident. The footage was taken on a journey which terminated 400 m from the accident site. Assessments of visibility were made at several stages within 1 nm of the accident site, based on identifiable features. Conditions were misty with occasional light rain. Visibility was assessed to be 700 to 800 m.

Pilot's meteorological planning

The pilot's family described how he routinely used the home computer or his tablet computer to access weather information and to plan flights. He would, with a suitable internet connection, have been able to download meteorological and NOTAM[2] information using the flight planning application on his tablet. However, the meteorological information he would have been able to obtain this way would have been limited to actual and forecast airfield weather reports and wind conditions; synoptic charts or other graphical presentations that would show the presence of frontal systems and other meteorological features would not have been available. For this he would have needed to access an online aviation briefing service.

The pilot did have an online account with the Met Office's aviation briefing service, but last accessed this service on 30 June 2012. There was no record on the pilot's mobile telephone of a call to any other aviation weather briefing provider over the few days before the accident flight. It was found that the tablet had not downloaded meteorological data since 20 September 2013, which was the last occasion the pilot flew prior to the outbound flight of 27 September. Thus, the only confirmed source of meteorological information for the pilot was the phone call he made on the morning of the accident.

It was reported that the pilot had briefly discussed the weather for his planned trip on the previous Thursday, both with his son and with the co-owner of the aircraft. His son had observed that, although the weather was presently fine, poorer weather was due to arrive in the coming days. The pilot had responded by saying, as he did to his wife on the Sunday, that he was prepared to leave the aircraft at the farm strip if the conditions deteriorated. To the co-owner, the pilot said he would not make the trip if the weather was not going to be suitable. During the investigation, the pilot's family observed that he had no pending business engagements and should not have been under undue pressure to make the return flight.

Footnote

[2] Notices to Airmen.

Pilot's tablet computer

Data recovered from the tablet computer's memory consisted of files used by the flight planning and navigation application. These contained data related to meteorological reports, stored routes, the planned route at the time of the accident and recorded GPS data from the accident flight and earlier flights. As described earlier, the meteorological files contained no recent information.

Planned route

At the time of the accident, a route (termed here the 'planned route') was stored in the flight planning and navigation application, which would have provided the pilot with a graphical presentation on his tablet. This was the route that would have been displayed on the tablet at the time of the accident.

The planned route was from Henlow to the farm strip, ie applicable to the outbound flight. The application allowed the planned route to be reversed by the user, thus generating navigation data relevant to the return flight to Henlow. However, this had not been done (otherwise the route would have been modified to reflect the change). The route would still have been depicted on the tablet's display and could have been followed by the pilot, although associated navigation data (time and distance to destination) would have been inaccurate. The route contained an anomaly in that it did not go direct to the farm strip, but to a waypoint 1.7 nm south of it, over the town of Wellington. This manually-entered waypoint was labelled with the name of the farm, but its position appears to have been input incorrectly. Part of the planned route is shown in Figure 2.

GPS data – 27 September 2013

GPS data for both the outbound flight of 27 September 2013 and the accident flight were recorded in memory. The frequency with which the data points were logged by the GPS unit was dynamically controlled by algorithms in the unit's controlling software, based on rates of change of height, track, and ground speed.

The pilot's second departure from Henlow on 27 September followed an almost identical initial track to the earlier one that resulted in the infringement of Luton's control zone, except that it stabilised on a path appropriate to the planned route. About 5 nm of the last waypoint, the aircraft routed towards the farm strip for landing. GPS altitude for the majority of the route was approximately 2,000 ft.

GPS data – accident flight

The aircraft took off at 1023 hrs. Instead of converging on the planned route after takeoff as would be expected, the observed track continued to deviate northwards from it until the aircraft was about 8 nm from the farm strip (Figure 2). At range 10 nm, the aircraft turned right through about 150º before flying across the planned route and reversing course again to follow its direction, this time to the south of it. The aircraft then entered a 'figure of eight' manoeuvre before turning to establish on the planned route. There were further deviations from the route but, within 5 nm of the accident site, the position remained within 0.5 nm of it.

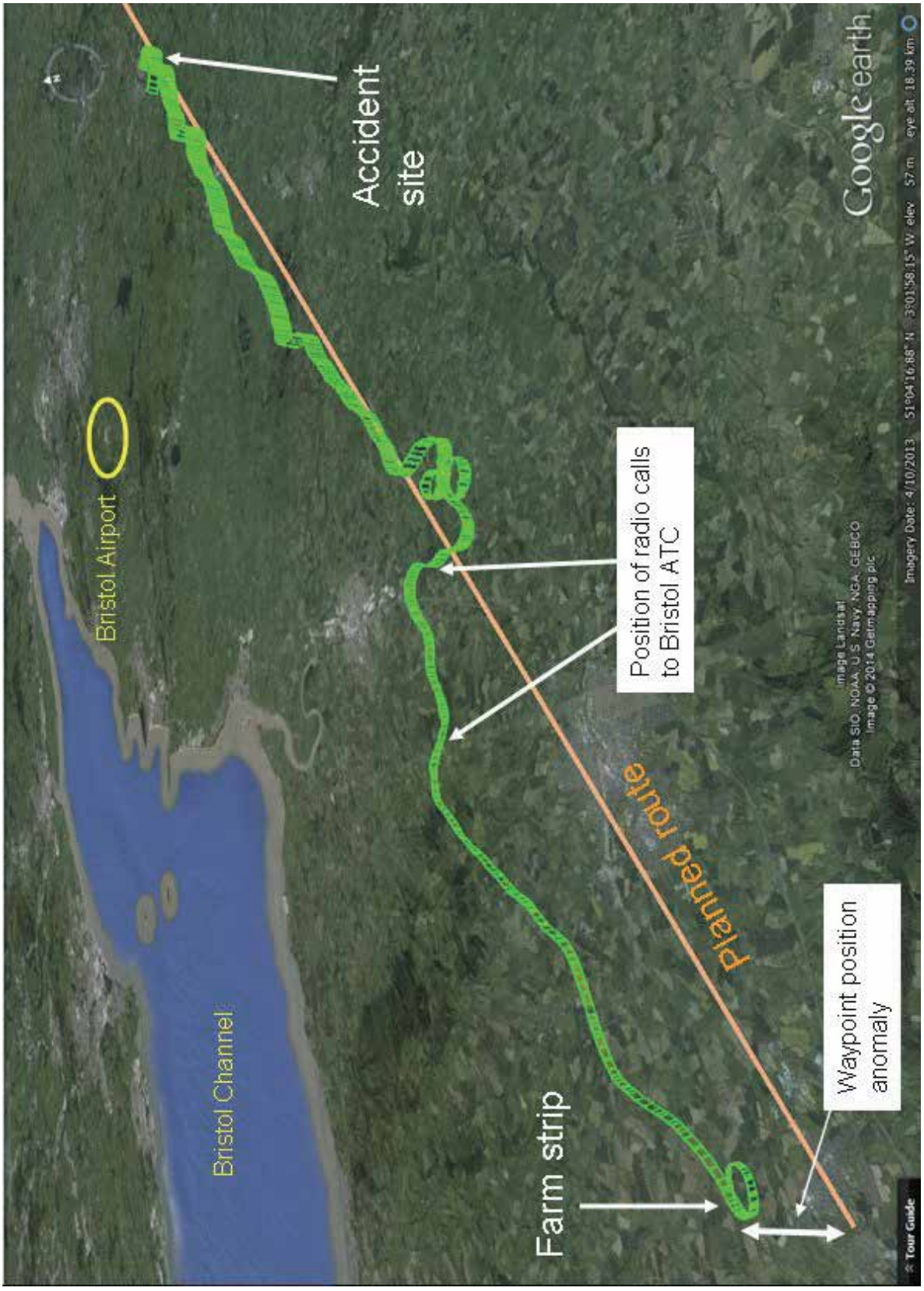

Figure 2

Planned route line and GPS track (oblique view)

GPS altitude data showed that the aircraft climbed to 1,000 ft (about 800 ft agl) over the farm strip before departing en-route. It maintained approximately this height until the point at which it turned across the planned route, when it climbed noticeably to between 1,300 ft and 1,400 ft. During the turn to the right at the start of its figure of eight manoeuvre, the GPS altitude reduced to about 700 ft agl. However, at this stage, the recorded positions suggest a degrading GPS function (possibly through signal blanking) so the associated altitude data may not be accurate. As the aircraft continued into a left hand orbit, the recorded GPS positions recovered and altitude values increased. As the aircraft turned towards its active route, it showed a sustained climb to about 1,800 ft altitude which continued until, as it passed over the city of Wells in Somerset, the GPS altitude indicated 3,100 ft (about 3,000 ft agl). After this point, altitude remained reasonably constant, while the ground beneath the aircraft steadily rose towards about 750 ft. Given the forecast winds, recorded groundspeeds were generally consistent with an IAS of 110 -120 kt.

Radar information

Recorded radar data was obtained from the long range radars at Clee Hill in Shropshire and Burrington in North Devon. The data from both heads commenced simultaneously as the aircraft climbed into radar coverage and showed a close correlation with the GPS data. No Mode C altitude data was received so the GPS altitude could not be verified. The aircraft's transponder controls were extensively damaged and it was not possible to establish whether Mode C had been selected by the pilot.

Final manoeuvres

Figure 3 shows a combination of the GPS position data and radar derived data. Also shown are the times of the last position points, the direction the aircraft was travelling before it took action to avoid the tower, and the accident site. The discrepancy between the tracks is due to the radar positional accuracy, recording rate and the low level coverage.

The aircraft started a right turn in the accident area, and started to descend. After about 270º of turn, it had descended to about 2,300 ft (about 1,700 ft agl). From this point, the GPS appears to have suffered from signal blanking again, as the recorded position began to deviate from the radar data and became unreasonable. Radar data shows the aircraft continued in its right turn, eventually turning through about 450º before radar returns ceased at 1050:31 hrs, 500 m from the aircraft's last observed position. The GPS data ends with 12 data points which occur at short intervals over a 12 second period, ending at 1050:51 hrs. The positions of these data points are unreliable, but all occur within 170 m of the last position reported by eyewitnesses.

Pilot information

Flying training

The pilot started flying training in 2004. He gained his PPL(A) in late 2011, by which time he had flown 287 hours, 267 of which were with an instructor. The extended training period was attributed in part to the pilot's business and other interests, which sometimes prevented the amount and quality of pre-flight preparation necessary for training flights. It was noted

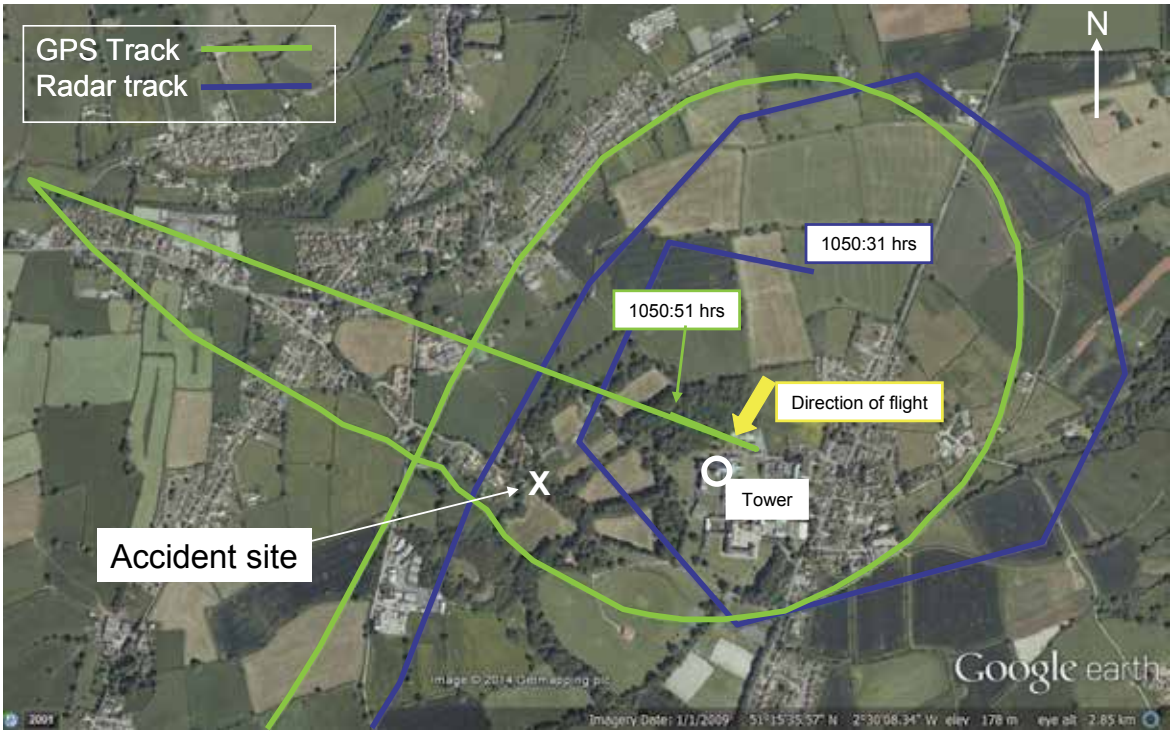

Figure 3

GPS and radar tracks for the final stages of the flight

that the pilot appeared content to fly dual for extended periods and did not regard gaining his pilot's licence as a goal in its own right.

A senior flying instructor, who had flown frequently with the pilot since 2008 (most recently, in May 2013), assisted the investigation with information concerning the pilot's strengths and weaknesses and general approach to flying. Although pre-flight readiness and preparation remained a weaker area, the pilot was described as being unlikely to embark on a flight which he knew might be beyond his experience or ability to deal with. While the pilot's handling skills were reported as generally good, it was felt that his airborne decision making ability could be degraded relatively easily if faced with demanding or unexpected situations. He had completed elementary instrument flying practice as part of his training but was not otherwise experienced in this skill[3]. It was considered unlikely that he would knowingly fly when bad weather was forecast, a view shared by the pilot's family.

With regard to contingencies occurring on navigation exercises such as poor weather or becoming lost, the pilot would have been trained in the correct contingency procedures and had demonstrated this knowledge during training.

Footnote

[3] Basic instrument flying techniques are taught during flying training as a contingency procedure in case of an inadvertent encounter with poor visual conditions. This training does not qualify a pilot to plan to fly by sole reference to the aircraft's instruments.

Experience in G-CFME

In early 2009 the pilot became joint owner of a Cessna 150, which he flew for most of the remainder of his flying training. He continued to fly the aircraft after gaining his PPL(A) until he became a joint owner of G-CFME in early 2012. From that time, all the pilot's recorded flying hours were in G-CFME. At the time of the accident, he had flown 34 hours in the aircraft.

Flight planning and navigation

During training, the pilot used conventional aviation charts and flight planning techniques to plan navigation exercises. According to his family, about six months before the accident he started using a flight planning application on his tablet computer for both flight planning and airborne navigation. The tablet used by the pilot used an internet connection (both Wi-Fi and mobile network connectivity) which provided the capability of carrying out planning functions, including displaying warnings to navigation and both current and forecast airfield weather conditions. It also had an in-built GPS receiver, enabling a continuous graphical presentation of current position. However, when used in an aircraft, such a unit is known to have particular limitations, such as signal blanking. The Civil Aviation Authority's Safety Sense Leaflet 25 states:

> *'Parts of the aircraft structure may get in the way, for example the outside wing in a turn. If this blanks the signal momentarily, the navigation capability may be degraded or lost, requiring several seconds of straight and level flight to re-establish navigation information. These problems are particularly prevalent in hand-held units with internal aerials.'*

A 1:500,000 scale aeronautical chart was recovered from the aircraft after the accident. The chart was marked only with an indistinct and broken route line between Henlow and the farm strip, applied with a chinagraph or grease pencil. There was no other navigational information marked on the chart. Advice by the Civil Aviation Authority is that stand-alone GPS equipment of the type used by the pilot was only ever to be used as an aid to other forms of navigation, typically correctly marked aviation charts and navigation logs.

'Landaway' experience[4]

A detailed analysis of the pilot's flying logbook and the aircraft's journey log was made, in order to establish the extent of the pilot's experience relative to the flights he planned for the weekend of the accident. Only flights made after the pilot gained his PPL were considered, as before that he would have been flying under the supervision of an instructor. It was found that all the pilot's experience of landing away at other airfields involved flights made there and back on the same day. The majority of airfields he visited were in his local flying area and none were further west or south-west than RAF Brize Norton in Oxfordshire.

Footnote

[4] 'Landaway' here refers to a flight from the pilot's home airfield to one or more other airfields where the aircraft lands before making a return flight.

With one exception, all the pilot's landaway flights were made in very good flying conditions. The single exception was when he flew with another pilot to a neighbouring airfield to collect G-CFME and then flew it back to Henlow, a distance of 14 nm. The outbound flight on 27 September was also made in excellent weather conditions.

Applicable regulations

Pre-flight duties of the aircraft commander

The Air Navigation Order 2009, which was applicable to the accident flight, listed in Article 86 the pre-flight duties of an aircraft commander. It included the following:

> *'A commander must, before taking off on a private flight, an aerial work flight or a public transport flight, take all reasonable steps so as to be satisfied (that) … the flight can safely be made, taking into account the latest information available as to the route and aerodrome to be used, the weather reports and forecasts available and any alternative course of action which can be adopted in case the flight cannot be completed as planned.'*

Visual Flight Rules (VFR)

The pilot was required to conduct his flight in accordance with the Visual Flight Rules (VFR). The rules applicable in any situation are dependant upon the aircraft's altitude, airspeed and airspace in which it is flying. In relation to the accident flight, when flying at or below 3,000 ft amsl, the pilot was required to remain clear of cloud with the surface of the ground in sight, and with a minimum visibility of 1,500 m. For flight above 3,000 ft amsl, the minimum visibility permissible is 5 km.

Analysis

The physical examination of the aircraft wreckage revealed no fault, malfunction or failure which may have contributed to the accident. The aircraft was assessed to be capable of normal flight and the engine was delivering power at the moment of impact. These conclusions were supported by eyewitness accounts that the aircraft made a sudden manoeuvre that appeared to be a deliberate action by the pilot to avoid the tower. Coincident with this was the sound of the engine going rapidly to what sounded like full power.

Recorded data showed the aircraft flying what appeared to be a continuous, controlled turn before the accident. This, along with the pathologist's report, the apparently deliberate avoiding manoeuvre flown by the pilot, and accounts of those who saw the pilot on the day of the accident, make pilot incapacitation an unlikely initiating factor in the accident.

From the recorded data and witness accounts, it is clear that the aircraft descended in a more or less continuous right hand turn to a very low height in poor weather. The pilot would have been aware of the considerable risk such a manoeuvre entailed, so it must have been for a reason which the pilot felt would have made any other course of action impossible or highly inadvisable. Considering the circumstances and the pilot's experience, the investigation considered that either navigation problems or the poor weather itself (or a combination of the two) were the most likely reasons.

Even though he had no experience of flight on the planned route, the pilot had no proper chart or navigation log prepared for the flight and was therefore dependant on his tablet computer. Even in fine weather, his ability to navigate without the computer and no chart as back-up was uncertain, as the airspace infringement incident of 27 September illustrated, so a failure in poor weather conditions in an unfamiliar area would have presented a major challenge. It is very unlikely that the pilot would have embarked on the flight or continued eastwards without continued position information, and the recovered data showed that the GPS was providing accurate position information for the great majority of the flight. It was therefore concluded that, although there was the capability for it to present a distraction in the final stages of the flight, a loss of GPS position data was not the reason that the pilot stopped following his intended route.

An obvious aspect of the accident was the extremely poor low level weather in the accident area, and the investigation considered this to be the probable reason that the pilot deviated from his intended route and descended. He would have encountered generally poor conditions soon after takeoff, which would have worsened as the aircraft approached the frontal system lying across the route. The GPS track from takeoff showed significant deviations and changes in altitude. These were not features of the outbound flight, which was flown in good conditions. Considering the weather and the need to get back to Henlow in reasonable time, it is unlikely that the pilot would have made these manoeuvres had he not deemed them necessary. Consequently, the manoeuvres were almost certainly weather-related. It is possible that the pilot was attempting to seek weather information from Bristol, but the responses were not acknowledged, and so presumably went unheard, by the pilot.

The investigation sought to explain why the pilot embarked on the flight when the poor weather conditions had been forecast. There was time available before the flight for the pilot to obtain the latest weather forecast and reports from airfields near his route, and he had the knowledge to be able to do so. He probably regarded his tablet computer as his main source of weather information, but he did not download any weather pertinent to the accident flight. The farm owner had a Wi-Fi system, but the pilot did not ask for access to it, nor to use the farm's own computer to access an online aviation weather briefing service. The apparent lack of other navigation planning is also notable, such as the planned route on the tablet computer, which remained unchanged since the outbound flight and still subject to the waypoint location error. In fact, there was no evidence to suggest that the pilot had carried out any pre-flight preparation at all, other than the telephone call to enquire about the Luton weather.

From the comments the pilot made to his friends at the farm strip, he clearly believed that the weather for the route was suitable. Had he been aware of any relevant weather information other than the Luton weather that he obtained by telephone (and there is no evidence that he did), then the pilot would have been unlikely to have held this view. Indeed, had the pilot been able to access weather information by other means, he would not have needed to make the call at all. It was concluded that the pilot based his assessment of the en-route weather conditions entirely on the conditions at the farm and the Luton reports, which would have led him to believe that weather conditions would improve the further east he flew. In fact, for the first part of the flight, the opposite was true.

As his return had been delayed, there would have been some pressure on the pilot to make the flight. However, the pilot had discussed a poor weather contingency with his family and it was felt he would have left the aircraft at the farm strip and travelled home by train if need by, as he had stated. The fact that he did not further supports the supposition that the pilot was not aware of the probable weather conditions affecting his planned flight.

Once airborne, the pilot was probably faced with critical decisions for which his experience to date and lack of pre-flight planning had not prepared him. The GPS track shows that the pilot was, at various stages, unable to make progress along his desired route, and he may even have started to turn back. However, his belief that conditions would improve the further east he flew may have been the reason he continued towards his destination. The aircraft climbed to around 3,000 ft altitude which, based on his outbound flight, was higher than the pilot probably intended to fly and is likely to have been above the lowest cloud. Whilst the in-flight conditions presumably improved with this change of altitude for a time, it is probable that the pilot had only intermittent ground contact and that this would have reduced as he flew towards the worst weather.

Eventually, the pilot appears to have been forced into an alternative course of action. The right turn may have been an attempt to turn back, but the aircraft continued to circle. It is possible that the weather conditions, which may have been steadily worsening for some time, made it impossible for him to identify a clear route out of the weather. With only basic instrument flying training and no recent practice, it is unlikely that the pilot would have been able to fly and navigate out of the situation using instruments alone. It is therefore probable that he started the descent with marginal ground references in an attempt to gain better conditions below the cloud, while probably being unaware at that time that the poor visibility extended to ground level.

From the description of witnesses, radar recordings and timings of recorded GPS positions, it is probable that the aircraft flew about a further 270º of turn from the point that the GPS position started to degrade. Although the actual track cannot be known, a reducing radius turn is indicated. While this could have been the result of pilot disorientation leading to an increasingly tight turn, the appearance of the aircraft when it became visible does not suggest this occurred. A more likely explanation is that the aircraft was reducing speed in the later stages, probably because of the poor visibility or even as a precursor to a possible landing. However, as the flaps were found to be fully retracted, an intention to land is considered to be less likely.

Final accident sequence

The apparent avoiding action described by witnesses would have been an instinctive reaction by the pilot when faced with a possible collision. It is therefore likely to have been quite a violent manoeuvre, causing the aircraft to enter a dynamic pitching and rolling manoeuvre with an upward vector. There would have been two significant consequences of this. In the poor conditions, it would have removed any ground references the pilot had, leaving him completely dependant upon his flight instruments for orientation. Furthermore, as the pilot was not prepared for the manoeuvre, it would have been disorientating and possibly even incapacitating in the short term. The pilot had neither the training nor experience to recover

from such a situation in the little height available. The proximity of the accident site to the tower and the nature of the accident site itself, suggests that the aircraft entered a climbing, rolling manoeuvre which resulted in the aircraft's nose dropping before it entered a steep final descent.