



# **Air Accident Investigation Unit Ireland**

**FORMAL REPORT**

**ACCIDENT**

**Cessna T182T, N247P  
Blackstairs Mt., Co. Carlow, Ireland**

**24 May 2015**



**An Roinn Iompair  
Turasóireachta agus Spóirt**

Department of Transport,  
Tourism and Sport

## FINAL REPORT

### Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13<sup>1</sup> of the International Civil Aviation Convention, Regulation (EU) No 996/2010<sup>2</sup> of the European Parliament and the Council, and Statutory Instrument No. 460 of 2009<sup>3</sup>, safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

Extracts from this Report may be published providing that the source is acknowledged, the material is accurately reproduced and that it is not used in a derogatory or misleading context.

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<sup>1</sup> **ICAO Annex 13:** International Civil Aviation Organization, Annex 13 to the Convention on International Civil Aviation, Air Accident and Incident Investigation.

<sup>2</sup> **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.

<sup>3</sup> **SI 460 of 2009:** Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.



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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents on 24 May 2015, appointed Mr Leo Murray as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report.

<b>Aircraft Type and Registration:</b>	Cessna T182T Turbo Skylane, N247P	
<b>No. and Type of Engines:</b>	1 x Textron Lycoming TIO-540-AK1A	
<b>Aircraft Serial Number:</b>	T18208280	
<b>Year of Manufacture:</b>	2004	
<b>Date and Time (UTC)<sup>4</sup>:</b>	24 May 2015 @ 09.30 hrs	
<b>Location:</b>	Blackstairs Mountain (Mt.), Co. Carlow, Ireland at N 52° 32.813' W 006° 48.582'	
<b>Type of Operation:</b>	General Aviation	
<b>Persons on Board:</b>	Crew - 1	Passengers - 1
<b>Injuries:</b>	Crew - 1 (Fatal)	Passengers - 1 (Fatal)
<b>Nature of Damage:</b>	Aircraft destroyed	
<b>Commander's Licence:</b>	European Union Flight Crew Licence, Private Pilot Licence (Aeroplanes), issued by the Civil Aviation Authority (CAA) in the United Kingdom	
<b>Commander's Details:</b>	Male, aged 57 years	
<b>Commander's Flying Experience:</b>	Estimated at 2,250 hours, of which approximately 300 were on type	
<b>Notification Source:</b>	Watch Manager, Dublin Air Traffic Control (ATC)	

<sup>4</sup> **UTC:** Coordinated Universal Time. Unless stated otherwise, all times in this Report are in UTC. Add 1 hour to obtain Irish Summer Time (IST), effective on the day of the accident.

## FINAL REPORT

### SYNOPSIS

The aircraft, with a Pilot, Passenger and two pet dogs on board, was en-route to the Irish Light Aviation Society airfield (ILAS Field) near Taghmon, Co. Wexford to attend a 'breakfast fly-in' that had been arranged for that day. It departed Athboy Airfield (EIMH), Co. Meath at 09.00 hrs and routed in a southerly direction at an altitude of approximately 1,500 ft towards Athy before turning to route directly towards the destination. Shortly after passing Carlow a shallow climb was initiated. The aircraft impacted high terrain at Blackstairs Mt. at 09.30 hrs, fatally injuring all on board. There was no fire.

### NOTIFICATION

A hillwalker came across the wreckage at approximately 13.40 hrs. He contacted the Emergency Services using his mobile phone and provided photographs which assisted the Emergency Services in identifying the aircraft. At 13.59 hrs, MRCC<sup>5</sup> Dublin received a telephone call from the Gardaí at Enniscorthy advising that a light aircraft with two occupants had crashed at Blackstairs Mt. The first responders to the accident site were members of the South East Mountain Rescue Association (SEMRA)<sup>6</sup>, who established that there were no survivors.

The Watch Manager, Dublin Air Traffic Control (ATC) notified the AAIU of the accident at 14.39 hrs. Four Inspectors of Air Accidents deployed by road to Killealy, Co. Wexford, the rendezvous point for the emergency response. An Irish Coast Guard helicopter transported the AAIU team together with Garda personnel and a further deployment of SEMRA from the rendezvous area to the accident site.

Upon notification of the accident, the following States appointed Accredited Representatives, Advisors and Experts to the Investigation: The National Transportation Safety Board (NTSB) and Federal Aviation Administration (FAA) of the United States, as State of Registration, State of Design and State of Manufacture and the Air Accidents Investigation Branch (AAIB) of the United Kingdom as a State which provided expertise.

## 1. FACTUAL INFORMATION

### 1.1 History of the Flight

The Investigation obtained a copy of CCTV recordings from EIMH for the morning of 24 May 2015 showing activities up to the departure of the aircraft. A CCTV camera situated on the front of the main hangar recorded a wide field of view that included the hangar where N247P was kept, the grass area in front of the hangar and the area where cars were normally parked, alongside a hedge a short distance from the main hangar. The CCTV recording showed that the Pilot arrived at the airfield in his car at 08.02 hrs accompanied by his two pet dogs.

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<sup>5</sup> MRCC: Marine Rescue Coordination Centre, Leeson Lane, Dublin.

<sup>6</sup> SEMRA: A voluntary, non-profit organisation affiliated to the Irish Mountain Rescue Association.



At 08.20 hrs the Pilot pulled N247P from the hangar without the use of a tow bar; he was then assisted by a second person to push the aircraft to a position in front of the hangar. Over the next 10 minutes, the Pilot and the second person pulled two other aircraft from the same hangar.

The Passenger arrived in his car at 08.41 hrs and shortly afterwards joined the Pilot at the aircraft. At 08.49 hrs the Pilot manually re-positioned the aircraft to the grass area in front of the hangar in preparation for engine start and taxi out. The owner of EIMH, who spoke with both the Pilot and Passenger prior to departure, told the Investigation that they both appeared to be in good spirits and looking forward to the trip.

The Pilot regularly brought his two dogs with him on the aircraft and both dogs accompanied him on this trip. A witness at the departure airfield saw the dogs being placed in their customary position behind the rear cabin seats. A relative of the Passenger, who flew in the aircraft many times stated that from their position the dogs could see the Pilot. Upon completion of pre-flight duties the Pilot boarded the aircraft through the left door and occupied the left seat. Shortly afterwards the Passenger boarded the aircraft through the right door and occupied the right seat. The engine was started at 08.54 hrs and taxi was commenced after a short warm-up period. Once the aircraft taxied away, it disappeared from the view of the CCTV. The owner of the airfield witnessed the aircraft taking off on Runway (RWY) 29 and making a left turn out towards the south.

Radar data, obtained later from Shannon ATCC<sup>7</sup>, showed the aircraft climbing through an indicated altitude of 900 ft on a southerly heading at 09.00 hrs. Radar returns for the flight displayed the general Visual Flight Rules (VFR) transponder conspicuity code '7000' indicating that the flight was to be operated under VFR. The aircraft climbed to an altitude of approximately 1,500 ft by 09.02 hrs and maintained a southerly direction which brought it to the east of Clonbullogue Airfield (EICL), where parachuting operations were in progress. The route flown was also clear of Danger Area<sup>8</sup> (EID5) at the Glen of Imaal, which was inactive at the time.

Just beyond Athy, Co Kildare, the aircraft turned left towards the destination with the track taking the aircraft to the south of Carlow Town and south of Mt. Leinster. Mt. Leinster has a peak terrain elevation of 2,602 ft AMSL<sup>9</sup> and a lighted obstacle (a communications mast), making it the most significant obstacle in the area at 2,960 ft. Radar returns were lost at 09.20:07 hrs, most likely due to terrain masking.<sup>10</sup> Data obtained from a portable Garmin 296 GPS unit recovered at the accident site, shows that during the period of terrain masking a shallow climb, at a rate of approximately 150 feet per minute (ft/min), was commenced. This data shows the climb was initiated at 09.25:07 hrs.

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<sup>7</sup> **ATCC:** Air Traffic Control Centre.

<sup>8</sup> **Danger Area:** Airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times.

<sup>9</sup> **AMSL:** Above mean sea level.

<sup>10</sup> **Terrain masking:** Radar returns are not received due to the presence of terrain between the target aircraft and the radar head.

## FINAL REPORT

At 09.28:26 hrs, the aircraft reappeared on radar on the same track towards ILAS Field passing an altitude of 2,000 ft. The return shows the transponder code of 7000 which was immediately replaced by the aircraft registration once the radar identified the aircraft. This track brought the aircraft towards rising terrain to the south of the summit of Blackstairs Mt. with a peak elevation 2,405 ft AMSL. The aircraft continued on a steady heading and shallow climb and impacted steeply rising terrain to the south of the summit at 09.30 hrs. Both persons on board the aircraft and the two dogs were fatally injured.

### 1.2 Injuries to Persons

The Pilot and Passenger were both fatally injured in the accident.

Injuries	Crew	Passengers	Others
Fatal	1	1	0
Serious	0	0	0
Minor /None	0	0	

### 1.3 Damage to Aircraft

The aircraft was destroyed.

### 1.4 Other Damage

The aircraft impacted on the western slope of Blackstairs Mt. A small area of disrupted rocks/soil indicated the point of initial impact.

### 1.5 Personnel Information

#### 1.5.1 Pilot

The Pilot began his flying training in 1987. The last entry in his personal logbook was dated 11 October 2014 and records a total of 2,217 hours flying time at that date. The logbook indicates that, in recent years, he flew on average about 80 hours per year. At the time of the accident his total flight experience would likely have been approximately 2,250 hrs. The Pilot was experienced in general aviation operations, having both owned and operated a variety of types of light aircraft over the years. He regularly made cross-water trips to the UK and between 11 and 15 July 2009, completed a trip to the United States, to deliver his Cessna 206 following its sale and to collect N247P following its purchase.

At the time of the accident, the Pilot held a European Union Flight Crew Licence, Private Pilot Licence (Aeroplanes) issued by the Civil Aviation Authority (CAA) of the United Kingdom. A Class 2 Medical Certificate pertaining to this Licence was revalidated by a UK AME<sup>11</sup> on 11 April 2015.

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<sup>11</sup> AME: Aeromedical Examiner.



The Pilot also held a Private Pilot Airman Certificate (Airplane) issued by the Federal Aviation Administration (FAA) on 30 April 2010 with Glider and Instrument Rating privileges. An FAA Class 2 Medical Certificate pertaining to this Airman Certificate was issued on 8 January 2015. On 15 June 2014, he completed a Flight Review in accordance with CFR<sup>12</sup> 14 Subpart A §61.56.

### **1.5.2 Passenger**

The Passenger who accompanied the Pilot on the accident flight was also a qualified pilot, commencing his flying training at Weston Aerodrome in October 1983. By October 1987 he had accumulated approximately 74 hours flight experience, at which time he decided to discontinue his training. Having taken up flying again several years later, he gained his FAA Private Pilot Certificate on 30 April 2010. His FAA Medical Certificate, Second Class, was valid to 1 August 2015. At the time of the accident he had approximately 208 hours of flight time recorded in his personal logbook. His logbook showed that in the previous year he flew a UK-registered Cessna 172 also based at EIMH; there was no reference to him having flown N247P. He also had a share in a Cessna 150 for a short period of time.

## **1.6 Aircraft Information**

### **1.6.1 General**

The Cessna Model T182T Turbo Skylane is an all-metal, four-seat, light cabin monoplane with a strut-braced high wing and fixed tricycle landing gear. It is powered by a Textron Lycoming TIO-540-AK1A turbocharged, fuel-injected, flat-six piston engine driving a three-blade, constant-speed McCauley metal propeller providing a rate of climb at sea-level of 1,040 ft/minute. Fuel is contained in two integral wing tanks with a combined capacity of 92.0 US Gallons (348 litres) with a total useable quantity of 87.0 US Gallons (329 litres).

### **1.6.2 N247P particulars**

N247P was built in 2004 and first registered to a private owner in the US. The aircraft was equipped to a high specification which included the Garmin G1000 (Integrated Flight Control and Navigation System). The G1000 system incorporated the Cessna Nav III avionics package, the highest avionics specification offered for the aircraft by the Manufacturer. N247P was also equipped with an oxygen supply permitting operation of the aircraft up to 20,000 ft without pressurisation.

### **1.6.3 Aircraft Ownership**

N247P was purchased by the Pilot in the US in July 2009 and was based at EIMH following its delivery by the Pilot. After its purchase, the Pilot retained the US registration mark on the aircraft. Although the aircraft was based in Ireland, maintenance of the aircraft was in accordance with US Federal Aviation Regulations (FARs) as it remained on the US register.

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<sup>12</sup> **CFR:** Code of Federal Regulations (United States).



## FINAL REPORT

To comply with FARs relating to the ownership and operation of US aircraft, the aircraft was registered in the name of a friend of the Pilot, (the registered owner) - a US citizen and commercial pilot who was also resident in Co. Meath. Such arrangements are not uncommon when non-US citizens purchase US-registered aircraft. Such aircraft can be registered in the name of a trustee by the beneficial owner. The beneficial owner of N247P was the Pilot.

### 1.6.4 Maintenance

The airframe, engine, propeller and avionics logbooks and additional documentation were made available to the Investigation. The last maintenance activity that took place in the US was an Inspection for the issue of a Special Flight Permit on 22 May 2009 in preparation for the aircraft's delivery flight to Ireland. Following its arrival in Ireland on 15 July 2009, the aircraft was maintained according to US FARs by an individual with an FAA Inspection Authorization. Inspection of the logbooks showed that all Annual Inspections were carried out including compression tests on the engine cylinders, together with maintenance actions arising from applicable Airworthiness Directives (ADs).

The most recent work performed on the avionics components was carried out in the US on 27 May 2009. This work involved compliance with Cessna Service Bulletin (SB) 08-34-03 regarding the updating of the FLTA<sup>13</sup> database. A reported GPS antenna fault was also rectified. Cessna SB 08-34-04A, concerning the GDC-74A Air Data Computer, was determined to be not applicable to N247P and was recorded as such.

### 1.6.5 Fuel

Avgas 100LL (Aviation gasoline) was available at EIMH. The airfield owner stated that the Pilot did not uplift fuel there for N247P. The last recorded fuel uplift for N247P was made at Enniskillen/St. Angelo Airport, Co. Fermanagh on 26 April 2015 when 182 Litres of Avgas 100LL was uplifted at 14.33 hrs.

### 1.6.6 Normal Procedures – Climb Speeds

Section 4, Normal Procedures, of the Pilot Operating Handbook (POH) states that normal 'en route' climbs should be performed with flaps up, at 90-100 kts indicated airspeed (IAS), 25 inches (manifold pressure), 16 US Gallons Per Hour (GPH) fuel flow and 2,400 RPM for the best combination of performance visibility and engine cooling. If it is necessary to climb more rapidly, for example to clear mountains or reach favourable winds at higher altitudes, the best rate-of-climb speed should be used with Maximum Continuous Power (MCP). This speed is 84 kts IAS at sea-level decreasing to 80 kts IAS at 20,000 ft'

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<sup>13</sup> FLTA: Forward Looking Terrain Avoidance.





If an obstruction dictates the use of a steep climb angle, the best 'angle-of-climb' speed should be used with flaps up and maximum power. This speed is 64 kts IAS at sea-level increasing to 68 kts IAS at 20,000 ft.

### 1.6.7 Autopilot

The aircraft was fitted with a Bendix/King KAP 140 two-axis autopilot incorporating an altitude preselect system. The autopilot provided the following modes of operation:

- Roll (ROL) mode which keeps the wings level.
- Vertical Speed (VS) mode which holds the climb or descent rate at the moment the autopilot is engaged or a manually-set climb or descent rate; controlled using the UP and DN buttons.
- Altitude hold (ALT) mode which holds a set altitude using combined engine power, pitch and trim control.
- Heading (HDG) mode which holds the magnetic heading set using the HDG bug on the G1000 PFD Horizontal Situation Indicator (HSI).
- Navigation (NAV) mode which locks on a course set using the Course knob when a valid VHF navigation source (NAV 1 or NAV 2) is shown on the G1000 HSI,
- Approach (APP) mode which is used to lock on to the final approach course to commence the final approach segment of the procedure.

The autopilot will climb or descend the aircraft at the set vertical speed and will return to level flight at the pre-selected altitude selection. The autopilot elevator trim system supplies automatic adjustment of elevator trim during autopilot operation and, when the autopilot is not engaged, gives the pilot a manual electric elevator trim function using the UP-DN switches on the control wheel. The elevator trim system is designed to fail to a safe condition (fail-safe) for any single trim system malfunction during flight.

### 1.6.8 Instrumentation and Navigation

The Garmin G1000 system presents flight instrumentation, position, navigation, communication and identification information to the pilot through large-format Garmin Display Unit (GDU) 1044B displays. The system consists of a number of Line Replaceable Units (LRUs) including a Primary Flight display (PFD), a Multi-Function Display (MFD), an Integrated Avionics Unit (IAU), an Air Data Computer (ADC) and an Attitude and Heading Reference System (AHRS). A GFC700 Automatic Flight Control System (AFCS) provides the Flight Director (FD) and Autopilot (AP) functions of the G1000 system which is fully integrated into the system avionics architecture.

The G1000 system includes two GDU 1044B units each with 10.4 inch Liquid Crystal Displays (LCD). The left display is configured as a PFD and the right display is configured as an MFD. Both GDUs link and display all functions of the G1000 system during flight. The displays communicate with each other through a High-Speed Data Bus (HSDB) Ethernet connection. The displays are also paired via an Ethernet connection with a GIA 63 Integrated Avionics Unit. An instrument panel similar to that in N247P is shown in **Photo No. 1**.

## FINAL REPORT



**Photo No. 1:** Cessna T182T Instrument panel (Avsim.com)

Each of the GDUs (PFD and MFD) incorporate a pair of SD cards located in slots at the upper right corner of the display bezels. The SD cards are used for storing the various databases and software updates. The top slot in each display is used for importing and exporting flight plans, flight data logging and loading navigation database updates. The lower slot of each display contains a Garmin Supplemental Data Card which is used for storing the various databases. Examination of the SD cards recovered at the accident site is discussed in **Section 1.16, Tests and Research**.

10

### 1.6.9 Multi-Function Display (MFD) – Map Pages

Information on the MFD is presented on screen ‘Pages’ which are grouped according to function. The Pages include, *inter alia*, a Navigation Page and a Terrain Proximity/Terrain-SVS<sup>14</sup>/TAWS-B<sup>15</sup> Page depending on the avionics package installed. N247P was equipped with the Nav III optional package which incorporated a TAWS Page. The Navigation Map displays aviation related data such as airports, navigation beacons and airways; geographic data such as towns, lakes, rivers and motorways; topographic data, where green to yellow colouring indicates elevation and hazard data such as other traffic, terrain and weather. The G1000 Pilot’s Guide states:

*‘An aircraft icon is placed on the Navigation Map at the location corresponding to the calculated present position. The aircraft position and the flight plan legs are accurately based on GPS calculations. The basemap upon which these are placed are from a source with less resolution, therefore the relative position of the aircraft to map features is not exact. The leg of the active flight plan currently being flown is shown as a magenta line on the navigation map. The other legs are shown in white’.*

<sup>14</sup> **Terrain SVS:** Terrain Synthetic Vision System.

<sup>15</sup> **TAWS-B:** Terrain Awareness and Warning System (Class B).



### 1.6.10 Hazard Avoidance Capability

Hazard avoidance features available for the G1000 are designed to aid situational awareness and provide advisory information with regard to potential hazards to flight safety associated with weather, terrain, and air traffic. Several avionics options are available for installation. The Cessna Nav III avionics package, as fitted to N247P, had TAWS-B capability. TAWS-B uses algorithms and stored terrain data to assess aircraft distance from terrain and obstacles and can provide visual annunciations and aural warnings to the Pilot. The TAWS-B system was certified to Federal Aviation Administration Technical Standard Order (TSO-C151b) dated 17 December 2002.

### 1.6.11 Terrain Awareness and Warning System - Class B<sup>16</sup> (TAWS - B)

TAWS-B is designed to increase situational awareness and aid in reducing incidents of Controlled Flight Into Terrain (CFIT). TAWS-B provides visual annunciations and aural warnings when terrain and obstacles are within the given altitude and distance threshold of the aircraft. The displayed alerts are advisory only. The TAWS-B alerts are predicated on the system not being manually inhibited.

The Garmin G1000 Pilot's Guide includes the following in regard to the TAWS-B system:

**WARNING:** Do not use TAWS information for primary terrain avoidance. TAWS is intended only to enhance situational awareness.

**NOTE:** Terrain data is not displayed if the aircraft is outside of the installed terrain database coverage area.

**NOTE:** The data contained in the TAWS databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.

Terrain Proximity requires a valid 3-D GPS position and a valid terrain/obstacle database 'to operate properly'. Terrain Proximity displays altitudes of terrain and obstructions relative to the aircraft position and altitude with reference to a database that may contain inaccuracies. Terrain and obstructions are shown only if they are in the database. Terrain and obstacle information should be used as an aid to situational awareness and is not designed to navigate or manoeuvre around terrain. The G1000 GPS receiver provides the aircraft's horizontal position and altitude. GPS altitude is derived from 'satellite position'. GPS altitude is then converted to the height above Geodetic Sea Level (GSL), which is the height above mean sea level calculated geometrically. GSL altitude is used to determine terrain and obstacle proximity.

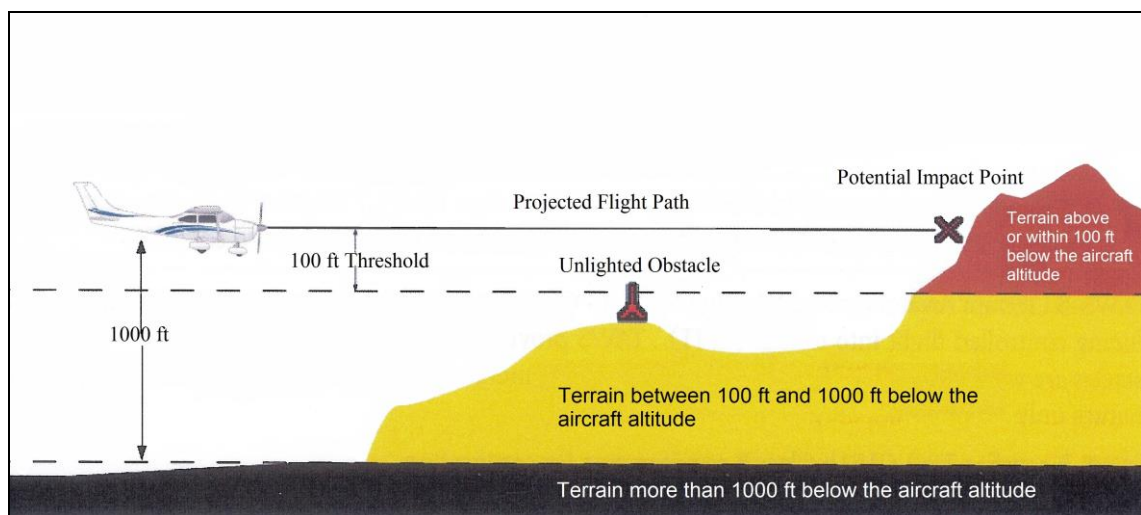
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<sup>16</sup> **Terrain Awareness and Warning System:** Equipment is classified as Class A or Class B according to the degree of sophistication of the system. Class A systems are required for all but the smallest commercial air transport aircraft; Class B systems are required for larger general aviation aircraft and recommended for smaller commercial or general aviation aircraft.

## FINAL REPORT

GSL altitude accuracy is affected by satellite coverage, but is not subject to variations in pressure and temperature that normally affect pressure altitude instruments and sensors. GSL altitude does not require local altimeter settings to determine altitude above mean sea level (MSL). Terrain and obstacle databases are referenced to MSL. Using the GPS position and altitude, the Terrain Proximity feature displays a 2-D picture on the MFD of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. GPS position and GSL altitude are used to calculate and predict the aircraft's flight path in relation to the surrounding terrain and obstacles.

The G1000 TAWS uses yellow (CAUTION) and red (WARNING) to depict terrain and obstacle (with heights greater than 200 feet AGL) alerts relative to aircraft altitude. Alert colours are adjusted automatically as the aircraft altitude changes. The colours and symbols are used to represent terrain, obstacles and potential impact points (**Figure No. 1**).



**Figure No. 1:** Terrain altitude/colour correlation for TAWS (Garmin)

Alerts are issued when flight conditions meet parameters that are set within TAWS software algorithms. When an alert is issued, visual annunciations are displayed and aural alerts are simultaneously generated. When an alert is issued, annunciations appear on the PFD and MFD. The TAWS alert annunciation is displayed to the upper left of the Altimeter on the PFD and below the terrain legend on the MFD. If the TAWS Page is not being displayed on the MFD at the time, a pop-up alert appears on the MFD.

The TAWS system conducts a self-test of its aural and visual annunciations during initial power-up. An aural message is issued at test completion. The system continually monitors several system-critical items such as database validity, hardware status and GPS status. If the terrain database is not available, the aural message "TAWS System Failure" is generated along with a 'TAWS Fail' alert annunciation. TAWS requires a 3-D GPS navigation solution along with specific vertical accuracy minimums. Should the navigation solution become degraded or if the aircraft is out of the database coverage area, the annunciation 'TAWS N/A' is generated in the annunciation window of the TAWS Page and the aural message "TAWS Not Available" is generated.

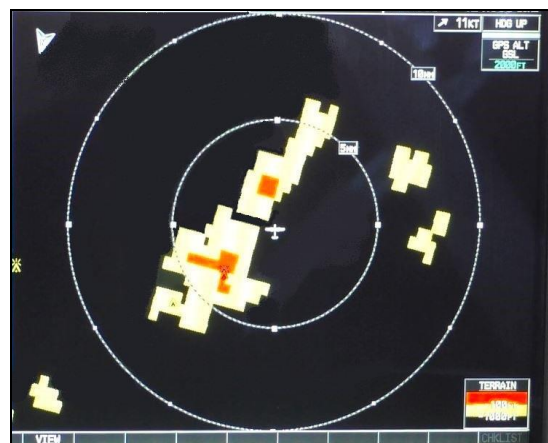




The Investigation carried out a flight in a Cessna 172 in the vicinity of the Blackstairs Mt. The aircraft was equipped with a Garmin G1000 similar to that installed in N247P. Screen shots were captured of the MFD Navigation and Terrain Proximity Pages for illustration purposes. **Photo No. 2** shows the MFD with the Navigation Page selected and **Photo No. 3** shows the MFD with the Terrain Proximity Page.



**Photo No. 2:** Navigation Page



**Photo No. 3:** Terrain Proximity/TAWS Page

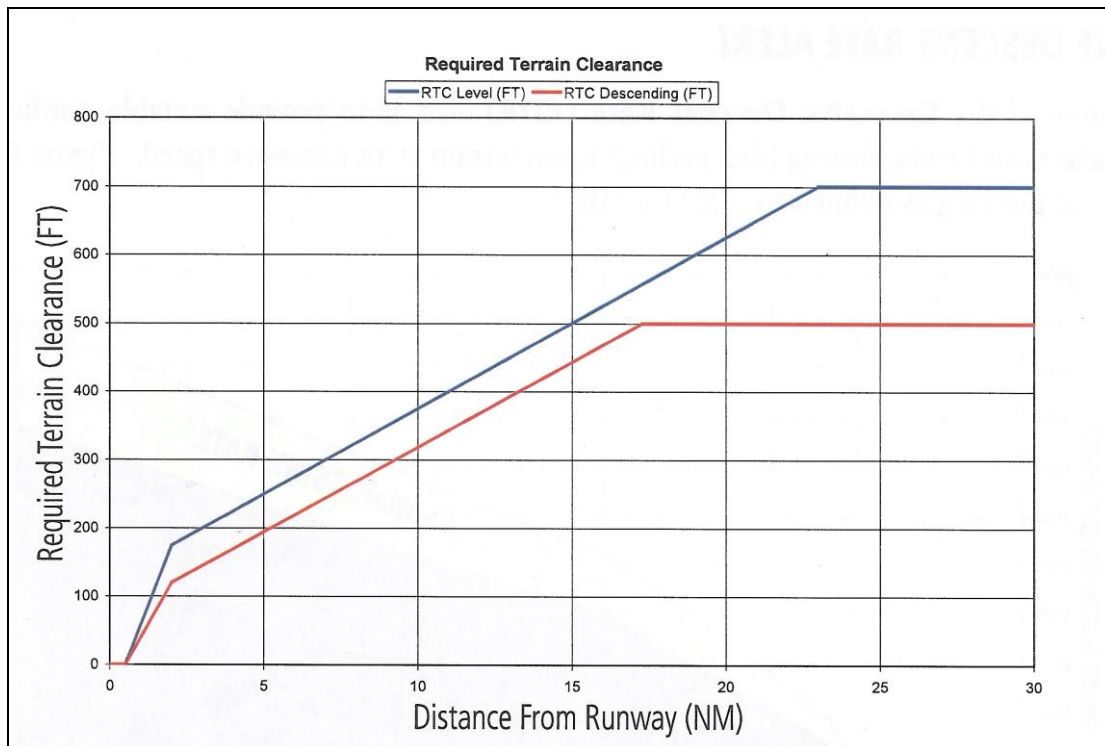
#### 1.6.12 Forward Looking Terrain Avoidance (FLTA)

The FLTA feature of TAWS compares the aircraft's projected flight path with known terrain and obstacles in their respective databases and issues a number of alerts as either a caution or a warning:

- Reduced Required Terrain Clearance (RTC)
- Reduced Required Obstacle Clearance (ROC)
- Imminent Terrain Impact (ITI)
- Imminent Obstacle Impact (IOI)

RTC and ROC alerts are issued, provided TAWS has not been inhibited, when the aircraft flight path is above terrain yet is projected to come within the FLTA alert minimum clearance values. When an RTC alert is issued, a potential impact point is displayed on the TAWS Page. ITI and IOI alerts are issued when the aircraft is below the elevation of a terrain or obstacle cell in the aircraft's projected path. The alert is annunciated when the projected vertical path is calculated to come within the FLTA alert minimum clearance values. The FLTA alert minimum terrain and obstacle clearance values with respect to the aircraft's distance to the runway is illustrated in **Figure No. 4**.

## FINAL REPORT



**Figure No. 4:** FLTA Alert – Minimum terrain and obstacle clearance values

14

Both RTC and ITI annunciations and aural messages have default settings; such message settings are configurable at installation and are installation dependent. A table showing how alerts (specifically due to terrain) are depicted to a pilot is presented in **Appendix A**. Alerts regarding obstacles are similar but reference '*obstacle*' instead of '*terrain*'.

#### 1.6.13 FLTA Inhibiting

FLTA alerts are automatically inhibited when the aircraft is less than 200 ft above the destination runway elevation while within 0.5 NM of the approach runway or the aircraft is between the runway ends. The FLTA aural and visual alert function of the TAWS may also be manually inhibited as follows:

- 1) Select the TAWS-B Page on the MFD
- 2) Press the INHIBIT Softkey to inhibit or enable TAWS (choice dependent on current state), OR
  - a) Press the MENU key
  - b) Select the 'Inhibit TAWS' or 'Enable TAWS' (choice dependent on current state) and press the ENT key.

The G1000 Pilot's Guide states that pilots should use discretion when inhibiting TAWS alerts and the system should be enabled when appropriate. When TAWS-B is inhibited, the alert annunciation **TAWS INH** is shown on the PFD and MFD. It was not possible to determine the operational state of the TAWS during the accident flight.



#### 1.6.14 N247P MFD Terrain Database

Maintenance records show that the Terrain Database in N247P was updated to cycle 08T2 in the US on 27 May 2009. Following the aircraft's arrival in Ireland, the Terrain databases were updated by means of SD cards<sup>17</sup> by the individual conducting the maintenance. The Pilot had an account with a navigation services provider through which he could obtain updates for the databases. Updating the databases involved removing the appropriate SD Card from the MFD bezel slot and inserting the Card into a suitable device with a connection to the service provider's website. The updated SD card is then fitted back into the MFD bezel slot and the new data is downloaded into the avionics system.

### 1.7 Meteorological Information

#### 1.7.1 General

*Met Éireann*, the Irish Meteorological service, provided the Investigation with the following aftercast for the Blackstairs area valid for 10.00 hrs on 24 May 2015:

<b>Meteorological Situation:</b>	The area was under the influence of a moderate north-northwest airflow with slight ridging from the Azores High.
<b>Wind (at surface):</b>	340 degrees at 10 kts
<b>Wind (at 2,000 ft)</b>	360 degrees at 28 kts
<b>Visibility:</b>	10+ km but risk of localised 100 m above 1,000 ft
<b>Weather:</b>	Nil but risk of Fog above 1,000 ft
<b>Cloud:</b>	Nil but risk 'Broken' (BKN) cloud 100 ft, above 1,000 ft
<b>Surface Temp/Dew Point:</b>	Temp 11/12 °C, Dew Point 7/8 °C
<b>Mean Sea Level Pressure:</b>	1022 hectoPascals (hPa)
<b>Freezing Level:</b>	8,500 ft

15

The aftercast also included the following comments:

'There were no general problems with cloud, visibility or weather. However, the atmosphere up to 925 hPa was absolutely unstable<sup>18</sup> with a lapse rate of approximately 3 °C per 1,000 ft. This would have led to a risk of poor visibility and cloud conditions above 1,000 ft due to condensation. Any convective activity would have occurred below 925 hPa because of the sharp inversion at that level caused by descending air in the ridge. There was a SIGMET<sup>19</sup> in operation for the area at the time indicating mountain wave activity with a maximum vertical speed of 700 feet per minute above 9,000 ft.'

<sup>17</sup> **SD cards:** Secure Digital non-volatile memory cards.

<sup>18</sup> **Unstable:** A warm or humid air mass at low level that rises and continues to rise.

<sup>19</sup> **SIGMET:** Significant Meteorological Report which provides concise information issued by a Meteorological Watch Office (MWO) concerning the occurrence or expected occurrence of specific en-route weather and other phenomena in the atmosphere that may affect the safety of aircraft operations.



## FINAL REPORT

The Automatic Weather Station (AWS) situated at Oakpark, Co. Carlow recorded the following cloud-base heights on 24 May 2015:

Time (UTC):	Height of cloud-base, metres (feet)
08.00 hrs	100-200 m (approx. 330-660 ft)
09.00 hrs	300-600 m (approx. 1,000-2,000 ft)
10.00 hrs	600-1,000 m (approx. 2,000-3,300 ft)

### 1.7.2 Operational and Other Weather Reports

A number of pilots attending the fly-in at ILAS Field were interviewed by the Investigation. They described the weather conditions in the vicinity of Blackstairs Mt. about the time of the accident, as ‘mist’ and ‘drizzle’ with the cloud ceiling between 800 and 1,000 ft AMSL. In one case a pilot approaching the Blackstairs from the north-west chose not to continue to ILAS Field and decided to divert to Kilkenny Airfield. His decision to divert was made about the time of the accident to N247P.

A number of persons living or walking in the area of the Blackstairs Mt. contacted the AAIU and made reports regarding the weather on the morning of the accident. These reports indicated that the mountain was obscured by what was variously described as ‘drizzle’, ‘rain’ and ‘low cloud’.

### 1.8 Aids to Navigation

#### 1.8.1 General

Neither the departure nor the destination airfields were equipped with navigation aids and no instrument let-down procedure<sup>20</sup> was available at ILAS Field. The only civil aerodrome close to the route equipped with radio navigation aids was Waterford Airport (EIWF). This aerodrome is equipped with a Non-Directional Beacon (NDB) suitable for en route navigation and an Instrument Landing System (ILS) to facilitate instrument approaches to RWY 26.

The Garmin G1000 Pilot’s Guide warns:

*‘During flight operations, carefully compare indications from the G1000 to all available navigation sources, including the information from other NAVAIDs, visual sightings, charts, etc.’*

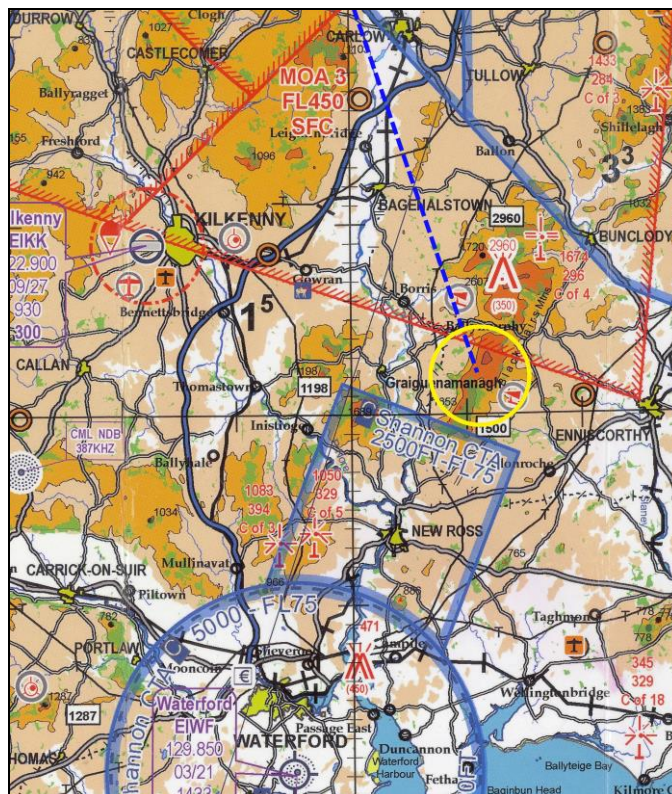
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<sup>20</sup> **Let-down procedure:** A flight procedure conducted on aircraft instruments to place the aircraft at a safe height and position to complete a landing.



## 1.8.2 Charts

A number of Aeronautical Charts for VFR navigation covering both Ireland and the UK were found at the accident site. The chart found that would be applicable to the route was ICAO 1:500,000 IRELAND (2172 ABCD) Edition 05, with aeronautical and topographical information on the chart dated 30 October 2011. The current chart at the time of the accident was Edition 06, dated 31 May 2013. There were no markings or notes made on the chart recovered. The flight path (blue dotted line) and Blackstairs Mt. (circled in yellow) are indicated on the Edition 05 chart in **Figure No. 5**.



**Figure No. 5:** IRELAND (2172) Edition 05, flight path and position of impact. The destination, ILAS Field is situated at the bottom of the illustration near Taghmon.

While the elevation of the lighted obstacle (a communications mast) on Mt. Leinster is depicted as 2,960 ft AMSL on the IRELAND 2172 chart; no elevation data is depicted for the peak at Blackstairs Mt. The only method of assessing the elevation of Blackstairs Mt. on this, or the current chart, is by comparing the contour colour (hypsometric tint) with the legend on the chart.

The IRELAND 2172 Chart shows Maximum Elevation Figures (MEFs) in each quadrangle bounded by graticule lines for every half degree of latitude and longitude. MEFs are represented in thousands and hundreds of feet AMSL. Each MEF is based on information available concerning the highest known feature in each quadrangle, including terrain and obstacles rounded up to the next 100 ft with another 300 ft added. The chart states that the MEF 'is not a safety altitude'. The MEF with reference to the Blackstairs area is 3,300 ft AMSL, represented by the figures '3<sup>3</sup>' in the top right of **Figure No. 5**.

## FINAL REPORT

### 1.9 Communications

The flight took place entirely in Class G<sup>21</sup> airspace within the Shannon Flight Information Region<sup>22</sup> (FIR); a flight plan was not filed nor was one required. The flight took place outside controlled airspace but within an FIR. A flight information service could have been provided by Shannon Air Traffic Service (ATS), if requested.

The Pilot did not make radio contact with Shannon ATS during the flight and consequently did not avail of the flight information service or the flight alerting service which would have been available. Following departure from EIMH there is no evidence that the flight had radio contact with any other station (airfield or aircraft) en route.

### 1.10 Aerodrome Information

Not applicable.

### 1.11 Flight Recorders

Flight recorders were not carried nor were they required to be carried.

### 1.12 Wreckage and Impact Information

#### 1.12.1 General

The accident site was located on a steep rocky slope on the western side of a ridge extending south-west from the summit of Blackstairs Mt., peak elevation 2,412 ft AMSL. The surface of the debris field consisted of areas of deep gorse interspersed with rocky outcrops and crevasses.

The aircraft impacted at an elevation of approximately 2,150 ft in steeply rising terrain. Ground scars at the initial impact point indicate that the aircraft attitude was approximately wings level and slightly nose-up. From the initial impact point, the Investigation found numerous items of scattered wreckage comprising of components such as engine bearer pieces, engine accessories, propeller blades, cabin contents and furnishings, doors, acrylic fragments, and undercarriage components. A diagram showing the layout of the wreckage is reproduced in **Appendix B**.

The only documents located were a number of charts, an airfield guide and a collection of loose pages from the Pilot Operating Handbook for the aircraft type. The Investigation was informed that the Pilot carried a flight bag in the aircraft. However, the Pilot's flight bag was not located, despite several searches over a number of days. The direction and point of initial impact and the final position of the main wreckage is illustrated in **Photo No. 6**.

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<sup>21</sup> **Class G:** Airspace within which aircraft are not under the control of ATC.

<sup>22</sup> **Flight Information Region (FIR):** Airspace of defined dimensions designated by the appropriate ATS authority within which flight information service and alerting service are provided.



**Photo No. 6:** Initial impact point and location of main wreckage

At impact the engine separated from the engine bearers. Parts of the engine bearer structure were found scattered at the initial impact point. The engine was located 120 m downhill from the impact point on the western slope of Blackstairs ridge. A field inspection of the engine was carried out prior to lifting the engine from the site. The fuel manifold was opened and was found to contain fuel. The spark plugs were removed and inspected; all were found to be in a good condition.

The empennage, wings and remains of the cabin structure came to rest in close proximity to each other 112 m from the initial impact point on a heading of approximately 170 °M. The cabin structure forward of the empennage disintegrated during the impact sequence

The three propeller blades separated from the hub which was found fractured. Two of the three propeller blades were found beyond the position of the main wreckage. All blades showed indent marks to their leading edges and distortion consistent with impact with rocks. The variable pitch (VP) piston from the propeller was located approximately 220 m from the initial impact point, on the opposite side of the ridge.

The level and nature of the damage suffered by the turbocharger impeller vanes was consistent with high rotational speed at the time of impact. The final position of the empennage and wings is illustrated in **Photo No. 7**.



## FINAL REPORT



**Photo No. 7:** Main wreckage with both wings in the background

#### 1.12.2 Detailed Inspection of Wreckage

20

Following initial examination at the accident site, the aircraft wreckage was recovered by helicopter with the assistance of the Irish Air Corps and subsequently transported by road to the AAIU wreckage examination facility at Gormanston, Co. Meath for more detailed inspection.

The forward engine cylinders showed evidence of impact on their undersides together with peripheral damage as the engine travelled a considerable distance once detached. Most engine ancillary components were detached and remained within the general debris field.

The propeller blades each exhibited damage consistent with rotational impact with rock. The propeller hub was fractured and was found in two separate pieces.

Each wing was fractured at the root and showed compression consistent with terrain impact. Witness marks at the initial impact point confirm the aircraft impacted in a wings level and slightly nose-up attitude.

All flight control surfaces were accounted for. No pre-accident defects were identified with the linkages or controls.

The cabin disintegrated during the impact sequence. The seats were still attached to their mounting rails and the rails had separated from the floor structure. The front harness straps were intact but disrupted. The oxygen cylinder was found in the rear fuselage close to its installed position. The mounting brackets had fractured.



The Instrument panel was severely damaged. The PFD screen was broken and separated from the panel. Its internal components were scattered. The MFD screen was broken but retained within the instrument panel. Its internal components were disrupted. Two SD cards were recovered from the MFD bezel, a third was found loose within the debris. The three analogue-type instruments, the Airspeed Indicator, Attitude Indicator and Altimeter were still in-situ in the lower instrument panel. The glass face of each instrument was intact. The only useful information was obtained from the Altimeter. The Altimeter sub-scale was set to 1021 hPa, 1 hPa lower than that indicated by the aftercast.

The engine controls consisting of the throttle, propeller and mixture were of the Push-pull type. The throttle control was found almost full open; the propeller control was coarsened by approximately 1 cm. The mixture control was towards the lean setting but due to the severe disruption of the instrument panel no definitive conclusions can be drawn regarding the mixture control position.

The Alternate Static control was in the normal (OFF) position and both Cabin Heat and Cabin Air controls were positioned OFF. The Flap Position selector was in the UP position. The panel-mounted hour-meter showed a total of 1,202.8 hours of engine operation.

## 1.13 Medical and Pathological Information

### 1.13.1 Pilot Medical Information

The Pilots aviation medical records showed that he suffered a myocardial infarction<sup>23</sup> which was treated with proximal LAD stenting<sup>24</sup> in July 2007. Following recovery, he underwent certificatory investigations and secondary preventative treatment. He regained his Class 2 Medical Certificate and flight crew licence in 2008. Under the auspices of his AME, the Pilot was subject to annual cardiology reviews and tests in addition to the standard medical requirements for his flight crew licence renewal.

In 2014, a year prior to the accident, the Pilot's fitness was again considered satisfactory, with the Pilots ECG<sup>25</sup> being over-read by a second AME. In 2015, approximately 6 weeks prior to the accident, the Pilot was required by the AME to undergo an additional cardiology review and exercise test. This was carried out by a Consultant in Dublin on 24 March 2015 and the report was satisfactory.

As per EASA<sup>26</sup> requirements, a resting ECG was not required on this occasion and a Class 2 Medical certificate was issued following his aeromedical examination on 11 April 2015.

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<sup>23</sup> **Myocardial infarction:** Death of a segment of heart muscle which follows interruption of its blood supply.

<sup>24</sup> **Proximal LAD Stenting:** A medical procedure relating to the left anterior descending coronary artery.

<sup>25</sup> **ECG:** Electrocardiogram, a diagnostic tool used to assess the electrical and muscular functions of the heart.

<sup>26</sup> **EASA:** European Aviation Safety Agency.

## FINAL REPORT

## 1.13.2 Inquest

An Inquest into the deaths of both occupants was held by the Coroner for Co. Carlow at Carlow Courthouse on 29 September 2015. The verdict returned by the Jury in each case was that *'death was due to blunt force trauma secondary to a plane crash'*.

## 1.13.3 Pathological Information

Post-mortem reports for each of the deceased persons were made available to the Investigation by the Coroner for Co. Carlow.

Report No. AP000225T/15 relating to the Pilot, states *inter alia*:

*'Cardiovascular system. ...There was a 3 cm area fibrosis involving the lateral / free wall of the left ventricle. This area fibrosis extending from the mid chamber to the apex and was consistent with a previously healed myocardial infarction. There were two areas of fibrosis involving the posterior wall of the left ventricle each measuring 1 cm in diameter. There was a thrombus occluding a stent in the right mid coronary artery. The proximal right coronary artery showed mild atheroma<sup>27</sup>. The left circumflex coronary artery was patent<sup>28</sup> and showed only mild atheroma. The left anterior descending coronary artery contained a stent which was patent and showed no evidence of thrombosis. The major systemic arteries showed moderate atheroma....no pulmonary embolism was seen.'*

*'Comment: The deceased was involved in a plane crash. At post-mortem there was no evidence of bite marks from a dog. The deceased had evidence of blunt force trauma with severe crush injuries to the chest and abdomen and severe head injuries consistent with a plane crash. The deceased also had evidence of severe heart disease with myocardial fibrosis and thrombosis occluding a stent. .... The deceased may have had a cardiac event which impaired his ability to fly the plane.'*

A Toxicology Test Report, relating to the Pilot, stated that neither drugs nor Ethanol were detected. Carbon Monoxide saturation<sup>29</sup> was *'less than 10%'*, a level not consistent with Carbon Monoxide poisoning.

Report No. AP000228J/15 relating to the Passenger, states that the cause of death was due to *'multifocal blunt force trauma consistent with a plane crash'*. A Toxicology Test Report, relating to the Passenger, stated that neither drugs nor Ethanol were detected. Carbon Monoxide saturation was *'less than 10%'*, a level not consistent with Carbon Monoxide poisoning.

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<sup>27</sup> **Atheroma:** Degeneration of the walls of the arteries due to the formation of fatty plaques and scar tissue.

<sup>28</sup> **Patent:** Open and unobstructed.

<sup>29</sup> **Carbon Monoxide saturation:** Specifically, Carboxyhaemoglobin (COHb) saturation. A COHb saturation of 25% is sufficient to cause headache, confusion, dizziness, some visual disturbance and possibly fainting. A saturation of 45% is sufficient to produce vomiting and unconsciousness and 60% is sufficient to cause death.





The post-mortem reports state that neither person showed evidence of marks from a dog bite. The post-mortem reports were presented as evidence at an Inquest held into the deaths of the occupants on 29 September 2015. The Investigator-In Charge appeared at the Inquest and read a statement outlining the factual information known at that time.

#### 1.13.4 Forensic Pathologist Opinion Report

As the Pathologist's report for the Pilot said that *"The deceased may have had a cardiac event which impaired his ability to fly the plane"*, the Investigation sought independent expert opinion from a Forensic Pathologist regarding the Pilot's medical history and pathological findings.

A suitably qualified<sup>30</sup> and independent UK-based Forensic Pathologist, who has previously assisted the UK AAIB, was contacted by the Investigation. In its letter of instruction, the Investigation forwarded specific background information to the expert including specific questions to be addressed, a brief medical history, a copy of the post-mortem report relating to the Pilot, a copy of the AAIU Preliminary Report, a copy of the Inquest Statement made by the Investigator-in-Charge and a log of activities obtained from CCTV recording of the preparations for the flight on which the accident occurred. The Investigation posed the following questions:

1. Could the stent thrombosis have caused any form of incapacitation either sudden or subtle?

*'Acute thrombosis of a coronary artery can result in the development of an arrhythmia (abnormal heart beat), which can cause sudden collapse and death with little or no warning. In contrast, coronary thrombosis can also be completely asymptomatic. Between these two extremes lies a spectrum of symptoms ranging from overt physical manifestations that might be interpreted even by non-medical persons as a 'heart attack' (such as chest pain, shortness of breath, sweating etc.) to far less obvious sensations such as nausea, light-headedness, tiredness or anxiety, the significance of which could potentially be overlooked by the individual or an observer. It is not possible to determine how a specific coronary thrombus would have affected a particular individual at a given time. However, as this blood vessel had previously been treated with a stent device, and the area of heart muscle supplied by this vessel contained scarring from previous damage, it is possible that any symptoms experienced as a result of acute thrombosis might have been interpreted as cardiac in origin based on recollection of previous experience of myocardial infarction.'*

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<sup>30</sup> **Suitably qualified:** The Forensic Pathologist held the following qualifications: Bachelor of Medicine and Bachelor of Surgery (MBChB), a member of the Royal College of Surgeons of England by examination (MRCS), a Fellow of the Royal College of Pathologists by examination (FRCPath), a member of the Forensic and Legal Medicine of the Royal College of Physicians (MFFLM) and a member of the British Association in Forensic Medicine. The individual is also a fully registered medical practitioner with a licence to practice medicine in the United Kingdom.

## FINAL REPORT

2. Could the effects of the thrombosis have impaired the Pilot's ability to carry out the normal functions during flight?

*'As mentioned above, the range of symptoms possible as a result of acute coronary thrombosis varies widely.*

*It is certainly possible that an individual experiencing cardiac symptoms may have been sufficiently impaired to have had a detrimental effect on control inputs and other physical tasks normally required in order to fly the aircraft.'*

3. Could the effects of the thrombosis have impaired the Pilot's ability to make appropriate decisions regarding the flight path of the aircraft?

*'As with the previous point, it would be possible for cardiac symptoms to be sufficiently distracting for an individual to result in interference with decision-making and other mental processes required whilst flying an aircraft.'*

4. Is it possible to determine, with reasonable certainty, if the thrombosis occurred prior to impact?

*'The post-mortem report describes a full-thickness laceration (tear) affecting the right side of the heart, as well as a disrupted pericardium and other internal chest injuries. The presence of such trauma in close proximity to the coronary blood vessel introduces the potential for an element of artefact<sup>31</sup>. After death, blood can and does form 'clots', and it is possible for solid or semi-solid blood to be found within blood vessels (including stented coronary arteries) at the time of post-mortem examination even though no genuine thrombosis occurred prior to death. The presence of a stent also introduces technical difficulties that can further hinder interpretation of coronary findings. There is therefore a possibility that the reported 'thrombus' may have been an artefactual post-mortem phenomenon. However, assuming that the thrombus observed during the post-mortem examination represents genuine ante-mortem thrombosis within a coronary stent, it is not possible to be certain about how long it had been present. General comments may be made with reference to microscopic changes that occur after days, weeks or months, but even histological (microscopic) examination cannot specify precisely when a thrombus occurred. The post-mortem report indicates that some samples of tissue were retained in case future microscopic examination became necessary. If the thrombus (or part of it) has been preserved, then microscopic examination at this stage may yield additional information. For the reasons stated above, such examination is not guaranteed to provide evidence that the thrombus occurred prior to impact, and would not provide evidence of symptom production.'*

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<sup>31</sup> **Artefact:** An anomaly observed that is not normally present but occurs as a result of the preparative or investigative procedure.



## Other observations

*'It is not my suggestion that the thrombus observed at post-mortem was not genuine, but a comprehensive consideration cannot ignore this as a potential possibility. Histological examination of the thrombus and myocardium (heart muscle) may be possible at this stage if these samples were included in the retained histological specimens.*

*However, even if such an examination were to be carried out it would not be guaranteed to provide conclusive evidence of medical incapacitation.*

*As a complicating factor, individuals with coronary artery disease and fibrosis (scarring) from previous myocardial infarction are at risk of arrhythmias and sudden death at any time. There is no need for a thrombus to have been present for a significant acute cardiac event to have occurred. Fatal cardiac events can occur at rest, but may be precipitated by cardiovascular stress whether it is physical or emotional (or a combination of both). The CCTV footage log details a period of physical exertion during the preparation of the aircraft for flight. This may have been a factor in triggering a cardiac event, but this is not something that can be proved or excluded based on pathological examination.*

*The pathological findings should not be interpreted in isolation, and the detection of a significant lesion (i.e. coronary thrombosis) should be considered along with other evidence for correlation with the circumstances of the crash. Loss of control due to in-flight incapacitation of the pilot may produce a markedly different appearance to a scenario of controlled flight into terrain, for example, and therefore the medical evidence should be considered within the wider context of the incident to avoid misinterpretation.*

*It is noted that the Passenger was also a qualified pilot with experience in flying light aircraft, and might therefore have been in a position to continue flying if the pilot had become unwell. This would require recognition of incapacitation, and it is possible for cardiac (and other medical) events to occur without being immediately apparent to observers.*

## Summary

*The observed coronary thrombosis, if genuine<sup>32</sup>, could have resulted in a spectrum of outcomes ranging from sudden collapse and death to being entirely asymptomatic (unnoticed). Familiarity with cardiac symptoms based on previous experience of myocardial infarction could have alerted the individual to the cardiac origin of any symptoms that might have occurred, but equally any symptoms may have been sufficiently vague to have been overlooked.*

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<sup>32</sup> **'if genuine'**: A thrombosis that has occurred *ante-mortem* (prior to death).

## FINAL REPORT

*Subtle symptoms may still have been sufficiently distracting to have impeded performance, either physical or mental, whilst flying. It is possible for a cardiac (or other medical) event to take place without being immediately apparent to observers.'*

The above Opinion Report (No. FP0693Y) was dated 9 November 2015 and although it was not a requirement for this report to be subjected to a Critical Conclusions Check as required by the Code of Practice for Forensic Pathologists held by the Forensic Science Regulator in the UK, the opinion report has been peer reviewed in a manner analogous to that process. The peer review stated that *'the conclusions reached in this report are reasonable based on the information adduced'*.

### 1.13.5 Communication with Pathologist

Following receipt of the above Opinion Report, the Investigation communicated with the Pathologist regarding the possibility and potential usefulness of testing on retained tissue samples. The Pathologist made the following comment:

*'I can confirm that small pieces of tissue were retained at postmortem for histology .... However, it was not possible to retrieve the thrombus noted in the stent so this material is not available for analysis. I agree with [the Forensic Pathologist Opinion Report] comment that it is not possible to exclude the possibility that the thrombus was an artefact induced by the severe trauma inflicted to the heart or the post-mortem process. I feel that this finding should not be used to infer that a coronary artery thrombus caused the accident. The deceased was also found to have myocardial fibrosis (scarring of the heart) which can lead to sudden death or loss of consciousness. However, I was informed at inquest that his heart disease was stable and that he was well on the day of the flight. ...In summary, I don't feel that it is possible to conclude from the evidence that a sudden cardiac event caused the plane crash'.*

### 1.13.6 Pathologist Supplementary Report

On 14 July 2016, the Pathologist who carried out the post-mortem, submitted a Supplementary Report to the Coroner in relation to the Pilot with the following comment:

*'This case was discussed at Inquest. It appears that the deceased had a known history of stable ischaemic<sup>33</sup> heart disease and had appeared to be well on the day of the fatal flight. The pilots did not give any distress signal during the flight indicating that either of them was unwell. Given the degree of trauma to the heart inflicted by the plane crash it is quite possible that the thrombus noted in the stent at post-mortem was an artefact – this finding does not provide conclusive evidence that a coronary artery thrombus caused symptoms leading to a crash.*

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<sup>33</sup> **Ishaemic:** (adj. of Ischaemia) an inadequate flow of blood to a part of a body caused by constriction or blockage of the blood vessels supplying it.



*Myocardial fibrosis (Scarring) can be associated with sudden death/sudden loss of consciousness but the history of stable heart disease, the lack of symptoms and the lack of any distress call from the plane make this less likely. In summary, this man was involved in a plane crash and had underlying stable heart disease. It was not possible to conclude with certainty from the post-mortem findings that an acute cardiac event caused the plane crash.'*

#### 1.14 Fire

There was no fire.

#### 1.15 Survival Aspects

The accident was not survivable.

#### 1.16 Tests and Research

##### 1.16.1 Navigation SD Cards N247P

Three SD cards were recovered at the accident site. One SD card was found loose in the debris field, and contained a file but no data. The other two cards were recovered still mounted in their respective bezel mounting slots which had detached from its respective GDU. The cards were removed from the slots and externally examined. The upper slot receptacle was noted to have some impact damage. The card slots and bezel were identified as being from the MFD (**Photo No. 8**).



**Photo No. 8:** SD Cards as recovered from the MFD bezel. The upper slot and card are on the right-hand side of the photo

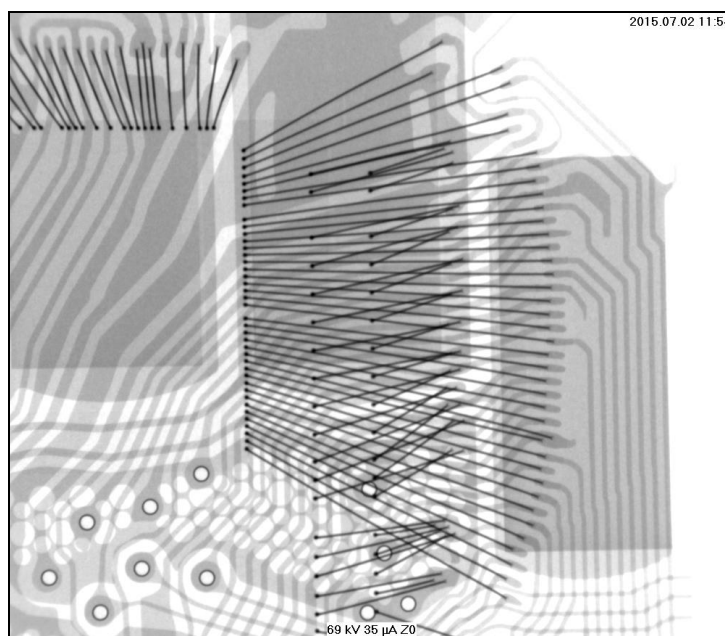
Both cards recovered from the MFD were identical and labelled 'Garmin GDU10XX SUPPL DATA 010-00330-42'. The card in the upper slot was found to be annotated 'M' on the face and 'MFD' on the back.



## FINAL REPORT

This card was inserted in test equipment and while the card itself was readable it contained no data. The second card, which was located in the lower SD slot, was found to be annotated 'P' on the face and 'PFD' on the back. The position of this card in the lower slot of the MFD identified this as likely to be the flight data logging card. This card was also inserted in test equipment however the card could not be read.

The Investigation sought technical assistance from the *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile* (BEA), the French Safety Investigation Authority, to attempt to recover the data from the second (flight logging) card. The BEA first conducted an external examination of the card followed by examination by means of X-ray. The X-ray images revealed no mechanical damage to the cards internal circuitry and that the internal printed circuits appeared intact. One of the X-ray images is reproduced in **Photo No. 9**. The card was then connected to appropriate test equipment, however, the card remained unreadable.



**Photo No. 9:** A sample X-ray image of the SD card from the lower slot on the MFD showing no visible damage to the internal circuitry

The AAIU also sought the expertise of the National Transportation Safety Board (NTSB) regarding recovery of the SD card data. The NTSB stated that they tried a variety of methods to read the SD card but that these proved unsuccessful.

The SD Card was also sent to a Dublin based company which specialises in critical data recovery. They stated that unlike earlier flash drives with separate components, this type of device utilises a 'monolithic chip' for memory storage with all components integrated into the chip itself. Unfortunately, the internal memory of the chip could not be detected either through conventional or diagnostic interfaces. The specialist report stated that monolithic drives may fail for a number of reasons. They are typically sensitive to bending and pressure and they are also susceptible to the same faults as traditional flash drives such as sudden power loss and damage due to wear.



## 1.17 Organisational and Management Information

Not applicable.

## 1.18 Additional Information

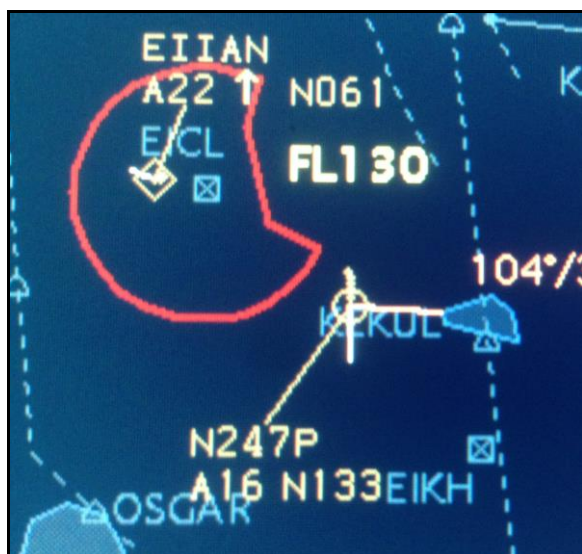
### 1.18.1 Garmin 296

A portable Garmin 296 GPS unit was recovered in a damaged state at the accident site. The Investigation later established that it belonged to the Passenger. Due to its damaged state, the device was taken to the facilities of the UK AAIB where data was successfully downloaded. The recorded data points show that, following a turn at Athy, a direct track was followed towards the destination. The data indicates that when the aircraft was 8 Nautical Miles (NM) south of Carlow Town at 09.25:42 hrs, the aircraft commenced a shallow climb at approximately 150 feet per minute. The last track data point was recorded at 09.30:05 hrs; the groundspeed was calculated at 135 knots (kts).

### 1.18.2 Radar Data

The Investigation reviewed a replay of the radar data obtained from Shannon ATCC. The aircraft first appeared on ATC radar at 09.00 hrs passing an indicated altitude of 900 ft in a climb. The radar replay shows that the aircraft levelled at an altitude of approximately 1,500 ft and tracked in a southerly direction routing abeam EICL where parachuting activity was taking place. The parachuting zone is represented by a red boundary line (**Photo No. 10**).

Approaching Athy, the aircraft turned left in the direction of ILAS Field and proceeded south of Carlow Town. Radar contact with the aircraft was lost, due to terrain masking at 09.20:06 hrs at a position 43 NM north of Waterford Airport. **Photo No. 11** shows the last radar return just prior to radar masking.



**Photo No. 10:** Radar image of N247P routing south abeam parachuting zone



**Photo No. 11:** Radar image at 09.20:06 hrs prior to terrain masking



## FINAL REPORT

During the period of terrain masking, data from the portable Garmin 296 shows a shallow climb was commenced at 09.25:07 hrs. At 09.28:26 hrs, the aircraft reappeared on radar on the same track towards ILAS Field passing an altitude of 2,000 ft in a shallow climb at a groundspeed of 149 kts (**Photo No. 12**). The return shows the transponder code of 7000 which was immediately replaced by the aircraft registration once the Mode S radar head identified the aircraft. The final radar returns showed the aircraft at an altitude of 2,300 ft, 'A23' in **Photo No. 13**.



**Photo No. 12:** Radar image at 09.28:26 hrs when the radar return was re-established



**Photo No. 13:** Last radar image with altitude data at 09.30:05 hrs

The ATC radar display is generated using ARTAS<sup>34</sup> data. The ARTAS system corrects the data from the various radar heads for temperature and pressure, resulting in an indicated altitude presented to the controllers radar display. The last actual ARTAS data shows the aircraft at 2,025 ft. Due to corrections with the data, this was displayed as 'A23' on the ATC radar screen.

### 1.18.3 Standardised European Rules of the Air (SERA)

#### 1.18.3.1 General

Regulation (EU) No 923/2012 sets out the common rules of the air and operational provisions regarding services and procedures in air navigation. The provisions of the Regulation were applied by Ireland from 4 December 2014.

#### 1.18.3.2 Flight Information Service

In Class G airspace both VFR and IFR flights are permitted and a flight information and alerting service is available from ATS if requested. Separation with other traffic is not provided and no clearance is required from the ATS. All IFR flights shall be capable of establishing air-ground voice communications with the appropriate ATS unit. In the Shannon FIR, a flight information service was available on 127.500 MHz below Flight Level 75 in Class G airspace.

<sup>34</sup> ARTAS: ATM surveillance tracker and server.



### 1.18.3.3 VFR Operational Minima

The minima for visibility and distance from cloud for VFR operations are set out in SERA.5001. **Table No. 1** shows the applicable VFR minima for operation in Class G airspace:

Altitude Band:	Flight Visibility:	Distance from Cloud:
At and below 900 m (3,000 ft) AMSL or 300 m (1,000 ft) above terrain, whichever is higher.	5 km (when so prescribed by competent authority, a flight visibility of not less than 1,500 m for flights at speeds of 140 kts IAS or less).	Clear of cloud and with the surface in sight.

**Table No. 1:** VFR Minima for operation in Class G airspace

### 1.18.4 Safety Sense Leaflets

The Irish Aviation Authority (IAA) website provides a link to the 'Safety Sense' series of Leaflets. These Leaflets, published by the UK Civil Aviation Authority (CAA) provide practical guidance for general aviation pilots. Of note in 'Leaflet No. 1, Airmanship' is the following:

*'EN-ROUTE*

- a) Log all important information, including heading changes with the time you make them.*
- b) Keep looking well ahead and around for indications of possible weather problems, such as cloud between you and the horizon making it appear lower. If you encounter deteriorating weather, turn back or divert early – well before you are caught in cloud. Do not attempt to fly between lowering cloud and rising ground. Many pilots have come to grief because a lowering cloud base has forced them lower and lower into the hills. You MUST avoid 'scud running'.*
- c) if forced into or above cloud, do not fly below your planned Safety Altitude. ...'*

31

### 1.18.5 Controlled Flight Into Terrain

Controlled Flight Into Terrain (CFIT) is used to describe events whereby an airworthy aircraft under the complete control of the pilot is inadvertently flown into terrain, water, or an obstacle. The pilots are generally unaware of the danger until it is too late.

Since 1968, there have been 12 fatal general-aviation/military accidents in Ireland involving impact with elevated terrain. These accidents resulted in a total of 35 fatalities and all occurred in poor weather conditions. A table listing the above accidents is presented in **Appendix C**. While the particular circumstances that led to each accident may be different, the list provides some insight as to the prevalence of such accidents and the fact that they continue to occur.

### 1.19 Useful or Effective Investigation Techniques

Not applicable.

## FINAL REPORT

## 2. ANALYSIS

### 2.1 General

The safety of a flight is dependent on many factors including, but not limited to, the airworthiness of the aircraft, the extent of the flight planning carried out, the experience of the pilot, the weather conditions experienced and the decisions made by the pilot during the flight itself. To determine the likely contributory causes the Investigation examined each stage of the flight to see if any precursors to the accident were present.

The Pilot was experienced in the operation of general aviation aircraft. He had owned and operated a number of aircraft over the years, including a Cessna 172 similar in configuration to the Cessna 182 involved in the accident. He regularly flew trips to the UK. Considering the experience of the Pilot, undertaking the planned flight in the prevailing conditions on the day should have been within his capabilities and experience. Following its purchase by the Pilot in 2009, the aircraft retained its US registration and was registered to a friend of the Pilot, a US citizen resident in Ireland. By retaining the aircraft on the US register its maintenance was continued under FAA FAR requirements. This ownership arrangement had no bearing on the accident.

### 2.2 Flight Preparation

32

The Pilot arrived at EIMH with adequate time to prepare the aircraft for the flight. He was joined by the Passenger approximately 20 minutes prior to departure. The flight preparation as evidenced by CCTV recording appeared to be unhurried and a witness who spoke with the Pilot and Passenger said both were in good spirits and looking forward to the trip.

The flight was undertaken under VFR. No flight plan was filed, nor was one required as the entire flight was undertaken in Class G airspace in the Shannon FIR. By choosing not to file a flight plan, the flight would not be known or monitored by Shannon ATC. Flight information would have been available had the Pilot made radio contact with Shannon on 127.500 MHz<sup>35</sup>. As no flight plan was filed, ATC were unaware that the flight was overdue at its destination and no overdue procedure was activated as the flight was not monitored. Fellow pilots at the destination airfield became aware that the aircraft was overdue and after enquiries were made, the alarm was raised.

The accident occurred at 09.30 hrs after 30 minutes of flight. The wreckage was only discovered by chance by a hillwalker at 13.40 hrs, some four hours after the accident. On this occasion the accident was not survivable but this will not always be the case. Depending on the severity and nature of an aircraft accident, it is possible to survive the accident itself and succumb to injuries and/or environmental conditions if first responders do not arrive in a timely manner. The importance of ensuring that details of a planned flight and in particular the estimated time of arrival are made known to a third party cannot be overstated.

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<sup>35</sup> MHz: MegaHertz.



## 2.3 Medical Considerations

### 2.3.1 Aeromedical

The Investigation sought to determine if the thrombus that was identified during the post-mortem examination, or if the Pilot's existing medical condition could have had a bearing on the accident. Aviation medical records obtained by the Investigation showed that the Pilot suffered from a 'myocardial infarction' in 2007. Following his recovery, he was subject to additional medical tests alongside the normal tests and examinations required to renew his pilot licence. In May 2015, and the previous year, the Pilot elected to complete his medical examination with an AME in the United Kingdom, as he then held an EASA PPL issued in the UK. His medical history had been properly declared to the AME prior to each of his licence medical examinations.

For each of those aeromedical examinations, the AME who carried out the Pilot's medical examination was satisfied that the Pilot was fit and re-issued his Medical Certificate. On both occasions, the Pilot's ECG was over-read by a second medical examiner.

Although the Pilot had a known medical condition, evidence shows that additional scrutiny and consideration was given by the AME prior to assessing the Pilot as fit for re-issue of his Class 2 Medical Certificate. Notwithstanding this assessment, the Investigation nevertheless considered whether the Pilot's previous medical condition was likely to have contributed to the accident.

### 2.3.2 Consideration of Pilot Incapacitation

Considering the medical history of the Pilot and the findings of the Inquest, the possibility that the Pilot may have suffered from subtle or sudden incapacitation was examined. The Investigation considered the report of the Pathologist who carried out the post-mortem examination and in addition sought the opinion of a Forensic Pathologist.

The post-mortem report identified '*a thrombus occluding a stent in the right mid coronary artery. The proximal right coronary artery showed mild atheroma*' and the comment: '*The deceased also had evidence of severe heart disease with myocardial fibrosis and thrombosis occluding a stent. .... The deceased may have had a cardiac event which impaired his ability to fly the plane.*'

CCTV footage obtained by the Investigation shows the Pilot involved in pulling N247P from its hangar and with assistance, moving two other aircraft, before repositioning N247P prior to starting. In the opinion of the Forensic Pathologist while this activity '*may have been a factor in triggering a cardiac event, but this is not something that can be proved or excluded based on pathological examination*'.

In answer to questions posed by the Investigation, the Forensic Pathologist was of the opinion that the thrombus observed during the post-mortem examination could also have been '*artefactual in nature*', in other words the possibility that the thrombosis may have occurred post mortem could not be excluded.

## FINAL REPORT

If the thrombus observed at post-mortem examination was in fact ante-mortem, the Investigation considered if the condition could have caused sudden or subtle incapacitation of the Pilot. The Forensic Pathologist concluded that:

*'The observed coronary thrombosis, if genuine, could have resulted in a spectrum of outcomes ranging from sudden collapse and death to being entirely asymptomatic (unnoticed). Familiarity with cardiac symptoms based on previous experience of myocardial infarction could have alerted the individual [the Pilot] to the cardiac origin of any symptoms that might have occurred, but equally any symptoms may have been sufficiently vague to have been overlooked. Subtle symptoms may still have been sufficiently distracting to have impeded performance, either physical or mental, whilst flying.'*

The Pathologist who performed the post-mortem commented, subsequent to the Inquest, that:

*'...it is not possible to exclude the possibility that the thrombus was an artefact induced by the severe trauma inflicted to the heart or the post-mortem process. I feel that this finding should not be used to infer that a coronary artery thrombus caused the accident. .... In summary, I don't feel that it is possible to conclude from the evidence that a sudden cardiac event caused the plane crash'.*

In a Supplementary Report, he stated that *'...[the Pilot] had underlying stable heart disease. It was not possible to conclude with certainty from the post-mortem findings that an acute cardiac event caused the plane crash'.*

34

The Passenger held an FAA Private Airman Certificate but did not hold an Instrument Rating. Examination of his personal logbook shows that he had not flown the accident aircraft, or the accident type – a Cessna 182. However, he had a significant amount of flying experience and had a share in a Cessna 150 for a short period of time. Despite the fact that the aircraft he was familiar with had analogue instruments, the Investigation is of the opinion that the Passenger would likely have been capable of taking control of the aircraft had an obvious need arisen. In such a case, it would be reasonable to assume that a call would be made by radio but there was no evidence that any radio transmissions were made by N247P following its departure from EIMH. The aircraft was likely being flown on autopilot and flight path changes would have required minimal intervention.

In view of the foregoing, it was not possible to conclude with certainty, from the post-mortem findings, that an acute cardiac event was a factor in this accident.

### 2.4 Flight Path

The flight path was reconstructed from data contained in the portable Garmin 296 recovered at the accident site and was consistent with the ATC radar records made available to the Investigation. The route taken brought the aircraft southwards at approximately 1,500 ft, remaining outside controlled and restricted airspace and also remaining clear of parachuting operations taking place at EICL.





The route flown was also clear of Danger Area (EID5) at the Glen of Imaal. After passing Athy, a turn was made to the left, which brought the aircraft to the south of Mt. Leinster, the highest terrain in the area and a well-known peak. Plotting the recovered position points from the portable GPS showed that the track followed would have extended direct to the destination at ILAS Field. However, the track also brought the aircraft directly over the southern ridge of Blackstairs Mt. The Pilot may not have appreciated the extent and elevation of the southern ridge of Blackstairs Mt.

While the elevation of the obstacle (a communications mast) at Mt. Leinster is included on VFR charts, the height of Blackstairs Mt. is not. An estimate of the height of Blackstairs Mt. can only be made by reference to the colour coding of elevation contours.

Following the turn after Athy towards the destination, the route took the aircraft to the south of Carlow Town. Data recovered from the portable GPS shows that the aircraft commenced a shallow climb at 09.25 hrs, when the aircraft was approximately 10 NM from the southern ridge of Blackstairs Mt. The rate of climb was calculated to be in the order of 150 ft per min as the aircraft closed with the terrain. Such a rate of climb is below the performance capability of the aircraft and is consistent with an 'en route' climb but at a higher than recommended indicated airspeed. Considering the elevation of the terrain ahead, this shallow climb meant that the aircraft was on an unsafe flight path.

Witness reports and meteorological data for the time of the accident show that the mountain and ridge at Blackstairs Mt. were enveloped in low cloud and were in all probability not visible to the Pilot and Passenger. The aircraft would have entered this cloud as it neared Blackstairs Mt. The aircraft track and the shallow climb rate were maintained until impact.

To safely follow the route selected from the turn at Athy, in the cloud conditions prevailing, it would have been prudent to climb to at least the MEF of 3,300 ft AMSL as separation from terrain could not be assured visually. Such a course of action would have required the Pilot to contact Shannon ATCC and advise of the changed status of the flight from VFR to IFR, in effect opening a flight plan. The aircraft was IFR-equipped and the Pilot held an appropriate rating on his licence. However, with no instrument let-down at ILAS Field and numerous items of VFR traffic in the vicinity of the destination such action would not have been practical. The safest and simplest course of action was to deviate around the high terrain and maintain VMC.

## 2.5 Pilot Experience

A family member witnessed the Pilot spending time the night before with charts planning his route for the following day. An important part of the flight planning would have been to assess the proposed route and to take account of the forecast weather both along the route and at the destination. It could not be determined what weather forecast or information the Pilot may have considered prior to the flight. The Pilot's flight bag was not located and this bag may have contained weather information obtained relevant to the flight.

## FINAL REPORT

At the departure and destination airfields, the weather conditions were good. In the vicinity of Blackstairs Mt., local weather conditions were such that low cloud and drizzle existed at the time of the accident. Whether the Pilot was aware of the locally poor conditions could not be established. Other pilots en route to ILAS Field encountered the same conditions and either deviated around the Blackstairs ridge or diverted to an alternate airfield.

### 2.6 Aircraft Records

The aircraft logbooks were made available to the Investigation. All evidence shows that the aircraft was properly maintained in accordance with (US) FARs. The Investigation identified no pre-accident defects with the aircraft.

### 2.7 Engine Considerations

Inspection of the fuel manifold at the accident site showed that it contained fuel. The performance of the aircraft (speed and rate of climb) determined from the portable Garmin GPS unit, the condition of the propeller blades and the condition of the turbocharger impeller provide evidence that the engine was developing significant power at the time of impact. In addition, the GPS data shows that the aircraft impacted in a shallow climb at a groundspeed in the order of 130 kts. Furthermore, had a problem occurred with the engine during the latter part of the flight, it is unlikely that the aircraft would have continued towards its destination.

36

### 2.8 Automatic Flight and Navigation

Flight path data from the portable GPS showed none of the variations typically seen during hand-flying. This indicates that automatic flight modes were likely engaged during the initial climb and remained engaged until impact with terrain. It appears that with the auto flight capability engaged, the aircraft was placed on a direct track to the destination following the en route turn. Subsequently, the aircraft commenced a shallow climb likely using an automatic pitch mode.

#### 2.8.1 TAWS

The aircraft was equipped with TAWS-B. The TAWS is designed to provide situational awareness regarding terrain and to provide cautions and warnings when the aircraft's calculated flight path is in a conflict situation with terrain or an obstacle. The TAWS system is certified to FAA standard TSO-C151b. To comply with this standard, the TAWS system performs an automatic self-test during initial power-up of the aircraft to ensure serviceability of the system. The system continually monitors several critical parameters such as database validity, hardware status and GPS status. As the Investigation could not determine if the TAWS had been manually inhibited it is not possible to know whether it generated visual and aural cautions and warnings as the aircraft closed with the terrain.





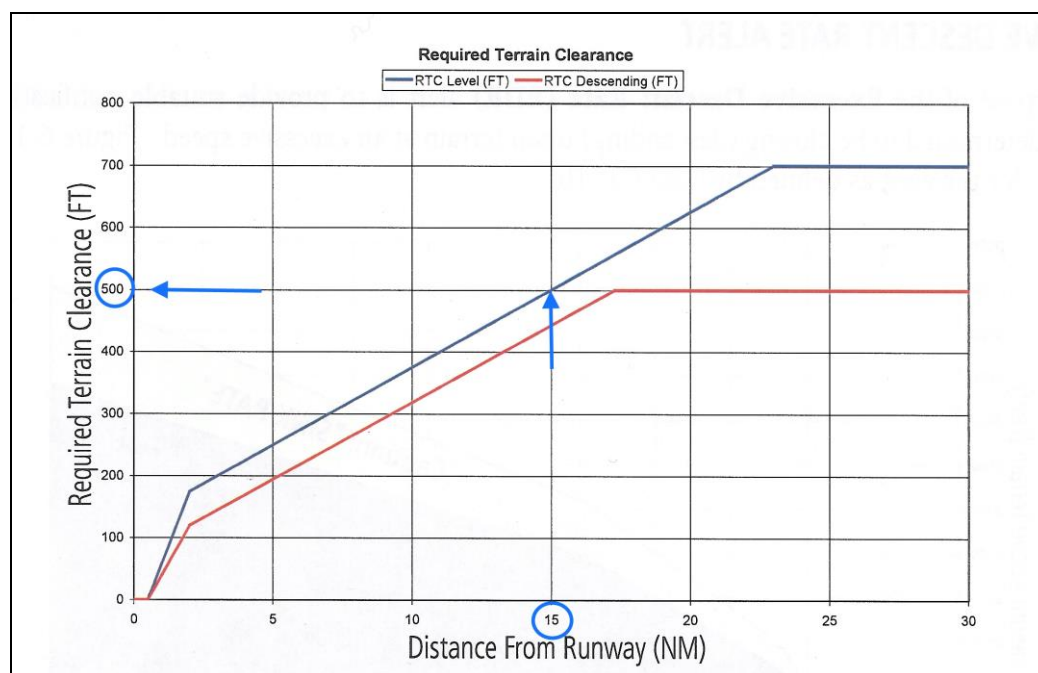
## 2.8.2 Terrain Database

The G1000 Pilot's Guide specifically warns: *'Do not use TAWS information for primary terrain avoidance. TAWS is intended only to enhance situational awareness'*. Safe terrain separation must be determined and ensured by the Pilot. While the aircraft position and the flight plan legs are accurately based on GPS calculations, the base maps upon which these are placed were from a source with less resolution. Therefore the relative position of the aircraft to map features may not be exact. Considering these limitations, safety altitudes for each leg of a proposed flight should be determined by a pilot when flight planning to ensure that adequate safe terrain separation is provided for. The Terrain database could be updated by the Pilot through an account he had with a service provider in the US.

## 2.8.3 FLTA Alert

FLTA alerts may be manually inhibited. The G1000 Pilot's Guide states that pilots should use discretion when inhibiting FLTA alerts. It is not possible to determine if the FLTA function of the TAWS had been manually inhibited at the time of the accident.

Acknowledging that the system should not be used for primary terrain avoidance, the Investigation considered, for completeness, how the minimum terrain clearance threshold varies with the distance to destination. At the point of impact, the aircraft was approximately 15 NM from its destination at ILAS Field. With ILAS Field entered as the destination runway, the FLTA Alert minimum terrain clearance value reduces (with the aircraft in level flight) from 700 ft to 500 ft as referenced by the dark blue line in **Figure No. 5**.



**Figure No. 5:** Reduced FLTA Alert, Minimum Terrain and Obstacle Clearance Values with aircraft 15 NM from destination runway)

## FINAL REPORT

If this was the case, the reduced minimum terrain clearance value would have had the effect of giving a caution or warning slightly later than would be the case if the aircraft was more than 23 NM from the destination runway. Notwithstanding the minimum terrain clearance threshold variations, the Investigation notes that there was no indication that the aircraft altered its flight path prior to impact.

Data shows the aircraft in a shallow climb, the level flight case is used for the purposes of this calculation.

### 2.9 Summary

The maintenance records presented to the Investigation indicated that the aircraft was well maintained and did not reveal any pre-accident defects. Wreckage examination did not reveal any pre-existing defects. All evidence indicated that the aircraft was airworthy at the time of the accident. The Investigation is satisfied that the aircraft performance was consistent with the engine developing high power at the time of the impact.

As the Investigation could not determine if the TAWS had been manually inhibited it is consequently not possible to know whether it generated visual and aural cautions and warnings as the aircraft closed with the terrain.

The flight was conducted under VFR. Conditions were encountered en-route that required a lateral deviation around rising terrain if VMC was to be maintained. With the aircraft 10 NM from Blackstairs Mt., a shallow climb consistent with an 'en route climb' was commenced at an indicated speed that was in excess of a best rate-of-climb speed as given in the POH. The rate of climb selected was not sufficient to provide safe terrain clearance and all evidence indicates that the aircraft impacted terrain in controlled flight and under normal control and that there was no attempt to alter the aircraft's flight path prior to impact.

The Pathologist who carried out the post-mortem, determined in a Supplementary Report that the Pilot had underlying stable heart disease. It was not possible to conclude with certainty from the post-mortem findings that an acute cardiac event caused the accident.



### 3. Conclusions

#### (a) Findings

1. The aircraft was properly maintained in accordance with (US) FARs.
2. No pre-accident defects were identified with the aircraft.
3. The aircraft performance was consistent with the engine developing high power at the time of the impact.
4. The aircraft was placed on a direct track to the destination following the en route turn near Athy.
5. Automatic flight modes were likely engaged at the time of impact.
6. The flight was undertaken as a Visual Flight Rules flight in Class G airspace in Visual Meteorological Conditions.
7. Local weather conditions in the vicinity of Blackstairs Mt. were such that continued flight in Visual Meteorological Conditions, on the selected track, was not possible. It is likely that the aircraft entered cloud and Instrument Meteorological Conditions as it closed with rising terrain at Blackstairs Mt.
8. The aircraft was equipped for flight in Instrument Meteorological Conditions and the Pilot held an Instrument Rating on his licence.
9. The Pilot entered Instrument Meteorological Conditions without ensuring adequate terrain clearance. The aircraft impacted terrain at 2,150 ft AMSL; the Maximum Elevation Figure for the area of Blackstairs Mt. was 3,300 ft AMSL.
10. The Pilot may not have appreciated the extent and elevation of the southern ridge of Blackstairs Mt.
11. The Pilot suffered a myocardial infarction in July 2007. Following recovery, he underwent certificatory investigations and secondary preventative treatment. The Pilot was subject to annual cardiology reviews and tests in addition to the standard medical requirements for his flight crew licence renewal.
12. Additional scrutiny and consideration was given by the Aeromedical Examiner prior to assessing the Pilot as fit for re-issue of his Class 2 Medical Certificate 6 weeks prior to the accident.

## FINAL REPORT

13. It was determined that the Pilot had underlying stable heart disease. It was not possible to conclude with certainty from the post-mortem findings that an acute cardiac event caused the accident.
14. The Passenger held an FAA Private Airman Certificate and would likely have been capable of taking control of the aircraft had an obvious need arisen.
15. There is no evidence that any radio transmissions were made by N247P following departure from EIMH up to the time of impact, a time of approximately 30 minutes.
16. It was not possible to determine if the FLTA Alert was inhibited at the time of the accident.
17. The aircraft was equipped with TAWS, a system which generates cautions and warnings when the calculated flight path will conflict with terrain. As the Investigation could not determine if the TAWS had been manually inhibited it was not possible to ascertain if the TAWS generated cautions or warnings as the aircraft closed with the terrain.
18. Data extracted from the recovered portable Garmin 296 GPS was consistent with the use of the auto flight capability of the aircraft.
19. All evidence indicates that the aircraft impacted terrain in controlled flight and under normal control and that there was no attempt to alter the aircraft's flight path prior to impact.

40

### **(b) Probable Cause**

Inadequate terrain clearance while operating in Instrument Meteorological Conditions.

### **(c) Contributory Cause**

Continued flight towards rising terrain when Visual Meteorological Conditions could not be maintained.

## **4. SAFETY RECOMMENDATIONS**

This Investigation does not sustain any Safety Recommendations.



## Appendix A

### Extract of TAWS Alerts specific to terrain only

Alert Type:	PFD/MFD ** Alert annunciation	MFD pop-up alert (except TAWS Page)	Aural Message
Reduced Required Terrain Clearance Warning (RTC)	PULL UP	TERRAIN – PULL UP * or TERRAIN AHEAD – PULL UP	"Terrain, Terrain; Pull Up, Pull Up"* or "Terrain Ahead, Pull Up, Terrain Ahead, Pull Up"
Imminent Terrain Impact Warning (ITI)	PULL UP	TERRAIN – PULL UP or TERRAIN AHEAD – PULL UP *	"Terrain, Terrain; Pull Up, Pull Up" or "Terrain Ahead, Pull Up, Terrain Ahead, Pull Up"*
Reduced Required Terrain Clearance Caution (RTC)	TERRAIN	CAUTION-TERRAIN or TERRAIN AHEAD *	"Caution; Terrain, Caution, Terrain"* or "Terrain Ahead Terrain Ahead"
Imminent Terrain Impact Warning (ITI)	TERRAIN	CAUTION-TERRAIN or TERRAIN AHEAD *	"Caution; Terrain, Caution, Terrain" or "Terrain Ahead Terrain Ahead" *

\* Default configuration of messages are indicated. Optional messages are indicated and are only configurable at installation.

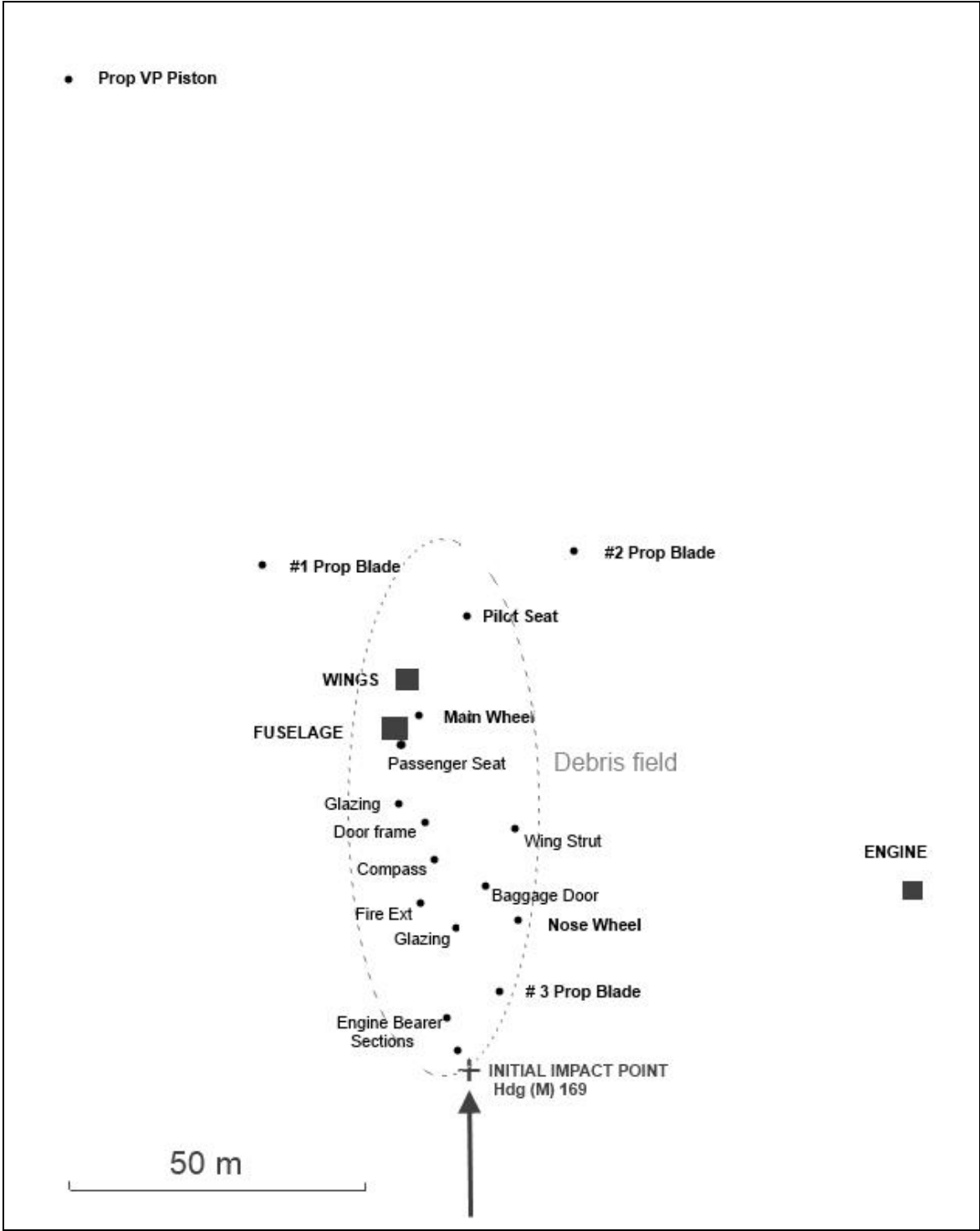
\*\* Annunciation is displayed on the MFD when terrain is enabled.



FINAL REPORT

Appendix B

Wreckage Plot – major items





## Appendix C

### List of fatal general aviation/military accidents involving impact with elevated terrain in Ireland since 1968

Date:	Reg/Serial:	Type:	Location:	Fatalities:
19.11.68	5Y-AIN	Cessna 182M	Slieve Felim, Co. Limerick	1
20.09.76	EI-BBP	SOCATA MS893E	Galtee Mt., Co. Limerick	3
01.10.79	G-AWPV	Cessna F.172H	Cuilcagh Mts., Co. Fermanagh	4
07.09.83	G-BKGY	Cessna F.182Q	Blackstairs Mt., Co. Wexford	4
18.07.87	OO-LVS	Mooney M.20J	Knockmealdown, Co. Waterford	4
12.12.87	EI-BOY	Murphy Sprite	Cloon, Co. Wicklow	4
02.02.92	EI-BUV	Cessna 172RG	Glenmalure, Co. Wicklow	2
12.12.96	G-HAUG	Sikorsky S.76B	Carlingford Mt., Co. Louth	2
01.07.99	248	AS365F Dauphin	Tramore, Co. Waterford	4
28.08.02	EI-ONE	Bell 206B	Slieve Mish, Co. Kerry	1
25.10.08	G-BGTJ	Piper PA 28-180	Corriebracks, Co. Wicklow	4
12.10.09	265	Pilatus PC-9M	Cornamona, Co. Galway	2
			<b>Total:</b>	35

- END -

**In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.**

**A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.**

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