DEPARTMENT OF TRANSPORT

IRELAND

ACCIDENT

TO

AGUSTA BELL 206B 111

REGISTRATION EI-BMP

near

HEADFORD, CO. GALWAY

on

JULY 29, 1982.

REPORT OF THE INVESTIGATION MADE UNDER
THE AIR NAVIGATION (INVESTIGATION OF ACCIDENTS)
REGULATIONS 1957, (S.I. No. 19 of 1957).

Contents

Aircraft Accident Report

Aircraft:	Type: Agusta Bell 206B 111 Helicopter.
	Registration: EI-BMP
Operator:	Irish Helicopters Ltd.
Place of Accident:	Near Headford, Co Galway.
Date and approximate Time:	July 29, 1982. 06.00 hours.

All times in this report are GMT.

Synopsis:

The accident occured during an early morning charter flight from Ballynahinch Castle to Shannon Airport. The pilot and the four passengers were killed instantly when the helicopter struck the ground some distance North of the direct overland route. Radiation fog was widespread in the area.

When the accident occured the helicopter was being manoeuvred at low altitude in conditions of varying and restricted visibility. No pre-crash defects were found in the helicopter and the accident probably occured when the pilot lost adequate visual references and permitted the helicopter to strike the ground because of induced false sensations arising from spatial disorientation.

The probable cause of the accident was the pilot's attempt to continue flight in deteriorating visibility. Reasons or contributory factors were not determined. There may have been some anxiety to complete the flight. Also important were the changing visual conditions actually experienced by the pilot.

1. FACTUAL INFORMATION

1.1 History of the Flight:

On July 29, 1982 the helicopter, registration EI-BMP, crashed at a location two miles East of Headford, Co Galway. The accident occured during an early morning charter flight from Ballynahinch Castle to Shannon Airport. The pilot and the four passengers were killed instantly.

EI-BMP was refuelled at Shannon Airport on the day before the accident and departed from there at 15.30 hours to position at Ballynahinch Castle. The pilot stayed overnight in a local hotel. The helicopter was not equipped with emergency flotation gear and an inland route was selected for the accident flight, reference Appendix 1. The pilot did not file a flight plan nor did he contact the Meteorological Service before commencing the flight. He obviously intended to contact Air Traffic Control enroute before entering the Shannon Control Zone, but had not done so before the accident.

In an attempt to reconstruct details of the flight, a number of persons who had seen or heard the helicopter were interviewed. The locations are identified in Appendix 2 and the results are summarised in the following paragraphs.

The pilot stayed at location 1. He retired to his room at 21.10 and was collected at 05.00 and driven to the helicopter at location 2. According to the driver they arrived at the helicopter at 05.10 and the pilot performed a pre-flight inspection. At 05.40 the four passengers arrived on foot. Three of them were carrying document cases and a set of golf clubs was put into the baggage compartment. The helicopter

lifted off at 05.45 and headed East towards the village of Recess. The weather between location 1 and 2 was described as clear, initially there were patches of ground fog about 6 feet deep around the Castle but these disappeared quickly.

The person at location 3 reported being awakened at 05.55 by the noise of the helicopter. The weather was clear but about 06.30 fog formed and visibility was reduced to about 50 yards. According to the person at location 4 the helicopter flew over Oughterard at 06.00 in a North-Westerly direction. A few minutes later it returned and was observed heading East over Lough Corrib.
Visibility was good at the time.

Fog was widespread to the East of Lough Corrib. The helicopter was seen flying overhead at locations 7 and 8 and a moving flashing light was seen near location 6. At locations 5 and 9 to 20 inclusive the helicopter was heard in flight but not seen. It was reported as having hovered near location 9 for 5 or 6 seconds.

An approximate flight path was constructed from the evidence and is shown in Appendix 2. The persons interviewed judged the helicopter to be flying at a low height. Considerable variation in times were reported but a consensus placed the time of the accident between 06.00 and 06.05.

Some persons in the vicinity of the accident site heard the noise stop suddenly, others heard a bang but because of the restricted visibility due to fog the accident site was not located until 12.25.

1.2 Injuries to Persons.

Injuries	Crew	Passengers	Others
Fatal	1	4	-
Serious	-	-	-
Minor	-	-	-

1.3 Damage to Aircraft.

The helicopter was destroyed.

1.4 Other damage.

Damage was caused to pasturage and associated boundary walls and hedges.

1.5 Personnel Information.

Pilot: Male, age 31.

Licence: Irish Commercial Pilot's Licence No. 612/H valid until 10-11-82.

Ratings: Part 1 (Pilot-in-command)

Bell 47 Soloy

Bell 206B

Medical Certificate: Valid until 10-11-82.

Experience: Single engine land planes 214 hours

Single engine single rotor helicopters

778 hours which includes 474 hours on the type

The pilot joined Irish Helicopters Limited on 13-8-81. From then until 16.12.81 he flew the Bell 47 Soloy. During Nov/Dec '81 he completed a Bell 206B conversion course. He was successful in passing the Department of Transport technical examination and had his licence endorsed for the Bell 206B on 9.12.81. Since 18.12.81 until the time of the accident, the pilot flew only the Bell 206B.

During the Bell 206 Conversion Course, the training captain assessed the pilot's performance as good and commented that he had a steady attitude towards flying and was of a high average standard. Base checks were satisfactorily completed on 7.12.81 and 20.5.82.

The pilot was principally employed to operate power line inspection, but had been operating since April 1982 in the general charter market under the supervision of Pilot-in-Charge (Dublin). He was not cleared for night or instrument operations.

1.6 Aircraft information.

1.6.1 General.

Registration:	EI-BMP
Type:	Agusta Bell 206B 111 Helicopter.
Manufacturer:	Costruzioni Aeronautiche Giovanni Agusta - Italy.
Serial Number:	8564.
Date of Manufacture	October 1978.
Engine:	Allison 250-C20B
Certificate of Airworthiness:	Transport Category (Passenger)
	Issued: 30 April 1982.
	Valid to: 29 April 1983.
Total Flying Hours:	615

EI-BMP was a single engine five place helicopter certified for land operation under Visual Flight Rules (VFR). It was not equipped with Emergency Flotation Gear.

1.6.2 Instruments, Avionics and Lights.

The flight instruments fitted were: an altimeter,

an airspeed indicator, an artificial horizon, a rate of climb indicator, a turn and slip indicator and an eight day mechanical clock. The compasses consisted of a standard magnetic type and a King KC55A gyro system.

The avionics included a Collins ANS351 Area Navigation System and Collins Microline Equipment comprising communications and navigation transceivers, ADF, DME and a transponder.

The external lights consisted of: two adjustable landing lights on the nose, navigation lights at the ends of the tailboom and horizontal stabilizer and a red flashing anti-collision beacon light on top of the fin. A light baffle consisting of a strip of metal 3" high and ¾" wide was fitted to the anti-collision light at the forward point.

An operating limitation in the aircraft flight manual states "Turn anti-collision light OFF during flight in or near visible moisture to prevent uncommon reflections and possible pilot vertigo".

1.6.3 Maintenance.

Inspection of the maintenance records indicated that the helicopter had been maintained in accordance with the regulations. There were no "carried forward" defects in the Technical Log.

1.6.4 Weight and Balance.

The estimated fuel on board at the time of the accident was 408 lb of jet A-1.

Estimated weight at the time of the accident:	3122 lb.
Maximum allowable weight:	3200 lb.
Estimated centre of gravity at the time of the accident:	108.2 inches.
Allowable centre of gravity range at the accident weight:	106 to 111.7 inches.

1.7 Meteorological information

1.7.1 General situation.

For several days prior to the accident, Ireland had been under the influence of anticyclonic conditions. At 12.00 on July 28 the anticyclone was centered over Northern Scotland with central pressure 1026 mb. By 24.00 on July 28 the position and intensity of the anticyclone had not changed significantly and a ridge of high pressure extended over Ireland. These conditions persisted throughout the night and during the morning of July 29.

1.7.2 The onset of radiation fog and visibilities.

Radiation fog is a land fog whose development depends on the cooling of the ground at night. Certain conditions favour the formation of radiation fog. These include: cloudless sky with effective net radiation, light wind, high relative humidity.

It was clear on the evening of July 28 that such conditions would be present and that fog and/or low cloud would be fairly widespread over the country on the morning of July 29. The actual reports from proximate meteorological stations are tabulated in Appendix 3.

1.7.3 Conditions in the accident area.

The terrain in the accident area is low lying with no steep gradients and would have favoured the formation of fog.

Estimated range of visibilities at time of accident less than 100 to 600 metres.

Estimated range of cloud ceilings at time of accident less than 100 to 400 ft.

Conditions were better to the North as indicated by the Claremorris reports where at no time during the period did the visibilities reach fog limits.

According to the persons interviewed at the locations shown in Appendix 2 the weather was clear on the Western side of Lough Corrib but fog was widespread on the Eastern side. The person at location 8 stated that the helicopter was clearly visible, there was fog at the time but it was not dense. The persons at other locations in the accident area reported the presence of dense fog.

1.7.4 Weather briefing of pilot.

There is no evidence of a briefing for the flight having been requested of or given by the Meteorological Service.

1.8 Aids to Navigation.

Not relevant. The flight was being operated in accordance with Visual Flight Rules.

1.9 Communications.

The helicopter was equipped for VHF communications. The Pilot did not contact Air Traffic Control before or during the flight. There was no requirement for him to do so until entering the Shannon Control Zone.

1.10 Aerodrome information.

Not relevant.

1.11 Flight recorders.

Flight recorders were neither required nor fitted.

1.12 Wreckage and impact information.

1.12.1 Accident Site.

The main wreckage trail extended over three fields covering a distance of 165 metres on a heading of 340°. Disruption occurred at initial impact, the fuel tank burst, the cabin structure was fragmented and the rotor blades struck the ground to the left of the initial impact point.

The disintegrating helicopter continued moving forward and ploughed through a stone wall into the second field. Wreckage was distributed across the second field and the engine was embedded in the wall between the second and third fields. The rotor head assembly including portions of both blades was found in the third field 142 metres from the point of initial impact. A piece of the outer leading edge of one rotor blade was eventually found 375 metres East and to the South of the impact area

There was no sign of fire in field No. 1 but there were a number of small localised fires in field No. 2 where oil spillages had occurred.

The wreckage distribution and damage was consistent with the helicopter striking the ground intact with a high velocity of descent and considerable forward speed. The attitude was nose down with a moderate left bank.

1.12.2 Examination of Wreckage.

The tailboom including the vertical fin and horizontal stabilisers and the rear portion of the fuselage structure were contained in three large pieces. The four cabin doors and the baggage compartment door were torn away at the hinges and latches. The distortion and damage was consistent with all being attached and secured at impact. The cabin area was broken into numerous pieces and the skids, steps and cross tubes were torn away. The engine, transmission, main rotor, systems and controls were dislodged and extensively damaged.

Examination of the wreckage revealed no evidence of pre-impact failure or malfunction. All of the evidence indicates that the helicopter was intact at impact with the engine in a "Power-On" condition and the systems functioning normally.

The flight instruments were extensively damaged. The altimeter sub-scale setting was 1022 mb. The airspeed indicator needle was missing but impact marks on the dial indicated a needle position of 123 m.p.h. The front of the turn and slip indicator was distorted with the needle indicating a left turn of about 250°/minute. The clock face was intact with the hands showing a time of 33 secs. after 07.00. The magnetic compass was damaged and toppled at a heading of 320°.

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The engine instruments were also extensively damaged. The face of the gas producer RPM was distorted, the large needle was intact and positioned at 96%. Marks on the face of the torque indicator at the 80% position may have been caused by needle slap at impact. The face of the rotor and power turbine RPM was found with the needles attached. The rotor needle was in the normal operating range but the N_2 turbine needle indicated a slightly greater RPM.

The navigation and communication avionic equipment was destroyed and no useful information could be obtained.

It was established by examination of the light bulb filaments that the anti-collision beacon light on top of the fin was lit at impact and that the navigation lights were unlit. The landing lights were destroyed and no useful information was obtained from them.

1.13 Medical and pathological information.

Post mortem examination of the occupants showed that, in all cases, death was instantaneous and was due to multiple injuries sustained on impact. Toxicological findings were negative and there was no medical or pathological evidence that may have had a bearing on the accident.

1.14 Fire.

Fire damage was not extensive. There were a number of small localised fires where oil spillages were ignited during the break-up sequence. There were no signs of fire at the initial impact point or any evidence indicating pre-impact fire.

1.15 Survival.

The passengers were expected at Shannon Airport at 06.45 to join a flight to Paris. As take-off time approached enquiries were commenced at Shannon. When it was established that the helicopter was missing en-route, an alert was declared and search and rescue commenced. The accident occured some distance North of the expected route. Because of this and the restricted visibility due to fog the accident site was not located until 12.25.

The accident was not survivable. The occupants were thrown from the helicopter during impact. The three rear seat belts were fastened and had been torn away at the end fixings. The front seat belts and shoulder harnesses were in numerous pieces and disconnected at the rotary buckles. The seat belts had been torn away at the end fixings suggesting that they had been fastened at impact. No determination could be made on the shoulder harnesses.

1.16 Tests and Research

A number of flight tests were conducted in a similar helicopter loaded to simulate the accident weight and centre of gravity. Flight was stabilised at a selection of speeds in a 250^0 left hand turn using 80% torque. A nose down attitude was induced and the forward speed and rate of descent allowed to increase. When the speed reached 123 m.p.h. the elapsed time, height loss and rate of descent were noted. Because of the imprecise nature of the tests the results, which are summarised in the table, should be used for guidance only.

Speed m.p.h.		Elapsed time seconds	Height loss feet	Rate of Descent feet/minute
Start	Finish			
40	123	17	300	1500
50	123	10	300	2000
60	123	11	300	2000
70	123	9	250	2000

1.17 Additional Information.

During VFR flight orientation is maintained by the sense of sight in observing the attitude of the helicopter in relation to the earth's surface. While flying by reference to the natural horizon the attitude of the aircraft can be readily detected at all times.

When the natural horizon is no longer clearly visible there is a definite susceptibility to spatial disorientation and visual illusions. The associated physiological factors are clearly detailed in the USA, Department of Transportation, Federal Aviation Administration publication AC 61-27- Instrument Flying Handbook.

General rules for flight in accordance with Visual Flight Rules require a helicopter to be flown in a flight visibility of not less than 800 metres and in such case to be manoeuvred at a speed which would give the pilot adequate opportunity to observe other traffic or any obstruction in good time to avoid collision.

2. ANALYSIS

2.1 Wreckage examination.

Examination of the wreckage revealed no evidence of any pre-impact malfunction or failure of the helicopter or its controls.

The wreckage distribution and damage was consistent with the helicopter striking the ground with a high velocity of descent and considerable forward speed. The attitude was nose down with a moderate left bank. This was confirmed by information from the flight instruments which suggested a forward speed of 123 m.p.h. and a left turn of 250°/minute at impact.

The nature and extent of damage to the engine was indicative of a "power-on" condition. The torque indicator was marked at the 80% position and the other engine instruments were consistent with a considerable amount of power having been developed at the moment of ground impact.

2.2 Weather.

Around the time of the accident fog was reported at Galway Meteorological Station with a visibility of 100 metres and a cloud ceiling of 100 feet. Shannon, Birr and Claremorris were clear of fog.

The persons who had heard or seen the helicopter on the Eastern side of Lough Corrib reported the presence of fog at the time. The person at location 8 in Appendix 2 stated that the helicopter was clearly visible; there was fog at the time but it was not dense. The persons at locations near the accident site all reported the presence of dense fog. The route on the Western side of Lough Corrib was unaffected by fog until after the accident had occurred.

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It was concluded from the evidence that fog was encountered after crossing Lough Corrib. It was patchy initially but was described as dense by observers in the general location of the accident site.

2.3 Flight reconstruction.

An approximate flight path constructed from witness evidence is shown in Appendix 2. The helicopter left Ballynahinch Castle at 05.45 and the accident occurred between 06.00 and 06.05. The distance travelled was about 36 miles.

The pilot had not filed a flight plan. He obviously intended to contact Air Traffic Control en-route before entering the Shannon Control Zone but had not done so before the accident.

A weather briefing for the flight had not been obtained from the Meteorological Service. The pilot may have judged it unnecessary in view of the good visibility in the departure area and the existing stable anti-cyclonic conditions. Consideration given to the possibility of encountering radiation fog is unknown.

The helicopter was well equipped with flight instruments and navigation aids but was certified only for land operation under Visual Flight Rules. A condition of the Pilot's Licence was that he should not fly out of sight of the ground or by sole reference to instruments. For the safe conduct of the flight therefore, surface references were crucial.

According to the person at location 4 in Appendix 2 the helicopter flew over Oughterard in a North-Westerly direction, returned, and then headed East over Lough Corrib. The diversion was most likely to enable the pilot to assess visibility conditions. In any event he decided to fly East instead of following a more direct Southerly route.

According to witness evidence, the helicopter turned onto a Northerly heading before striking the ground. This is confirmed by the wreckage trail heading of 340°.

2.4 General.

As viewed by a pilot in flight dense radiation fog may obliterate the entire surface; a less dense, shallow or patchy fog may permit his observation of part of the surface. The fog encountered after crossing Lough Corrib was patchy initially but was described as dense by observers in the general location of the accident site. During the latter portion of the flight, therefore, the helicopter was being manoeuvred at a low altitude in conditions of varying and restricted visibility. The turn onto a Northerly heading before ground impact suggests an attempt to fly clear of the fog as visibility decreased.

Consideration of the evidence indicates that the accident probably occurred when the pilot lost adequate visual references and permitted the helicopter to strike the ground because of induced false sensations arising from spatial disorientation. The disorientation may have been intensified by the use of the anti-collision beacon light in the prevailing meteorological conditions.

The results of the flight tests reported in section 1.16 indicate that the estimated impact conditions can be readily achieved from the range of lower initial speeds with a height loss of about 300 feet.

The reasons why the pilot allowed himself to lose visual references before landing or turning back sooner must remain a matter for conjecture. There may have been some anxiety to complete the flight. Also important were the changing visual conditions actually experienced.

3. CONCLUSIONS.

3.1 Findings.

(i) The flight was being operated overland and in accordance with Visual Flight Rules.

(ii) The pilot was properly licensed and medically fit.

(iii) The pilot did not hold an instrument rating.

(iv) The helicopter had a valid certificate of airworthiness and had been properly maintained.

(v) The helicopter was certified only for land operation under Visual Flight Rules.

(vi) The loading and centre of gravity were within the prescribed limits.

(vii) No pre-crash defects were found on the helicopter, the engine or the controls.

(viii) The anti-collision beacon light was lit during the flight.

(ix) There is no evidence of a briefing for the flight having been requested of or given by the Meteorological Service.

(x) Because of visibility conditions observed from Oughterard the pilot flew East across Lough Corrib instead of following a more direct Southerly route.

(xi) Fog was encountered after crossing Lough Corrib. It was patchy initially but was described as dense by observers in the general location of the accident site.

(xii) The turn towards the North prior to striking the ground was an attempt to fly clear of the low visibility conditions encountered.

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(xiii) The accident probably occurred when the pilot lost adequate visual references and permitted the helicopter to strike the ground because of induced false sensations arising from spatial disorientation.

(xiv) The disorientation may have been intensified by the use of the anti-collision beacon light.

(xv) The helicopter struck the ground with a high velocity of descent and an estimated speed of 123 m.p.h. The attitude was nose down with a moderate left bank.

(xvi) The impact conditions can be readily achieved from a range of lower initial speeds with a height loss of around 300 feet.

3.2 Probable Cause.

The probable cause of the accident was the pilot's attempt to continue flight in deteriorating visibility. Reasons or contributory factors were not determined. There may have been some anxiety to complete the flight. Also important were the changing visual conditions actually experienced by the pilot.

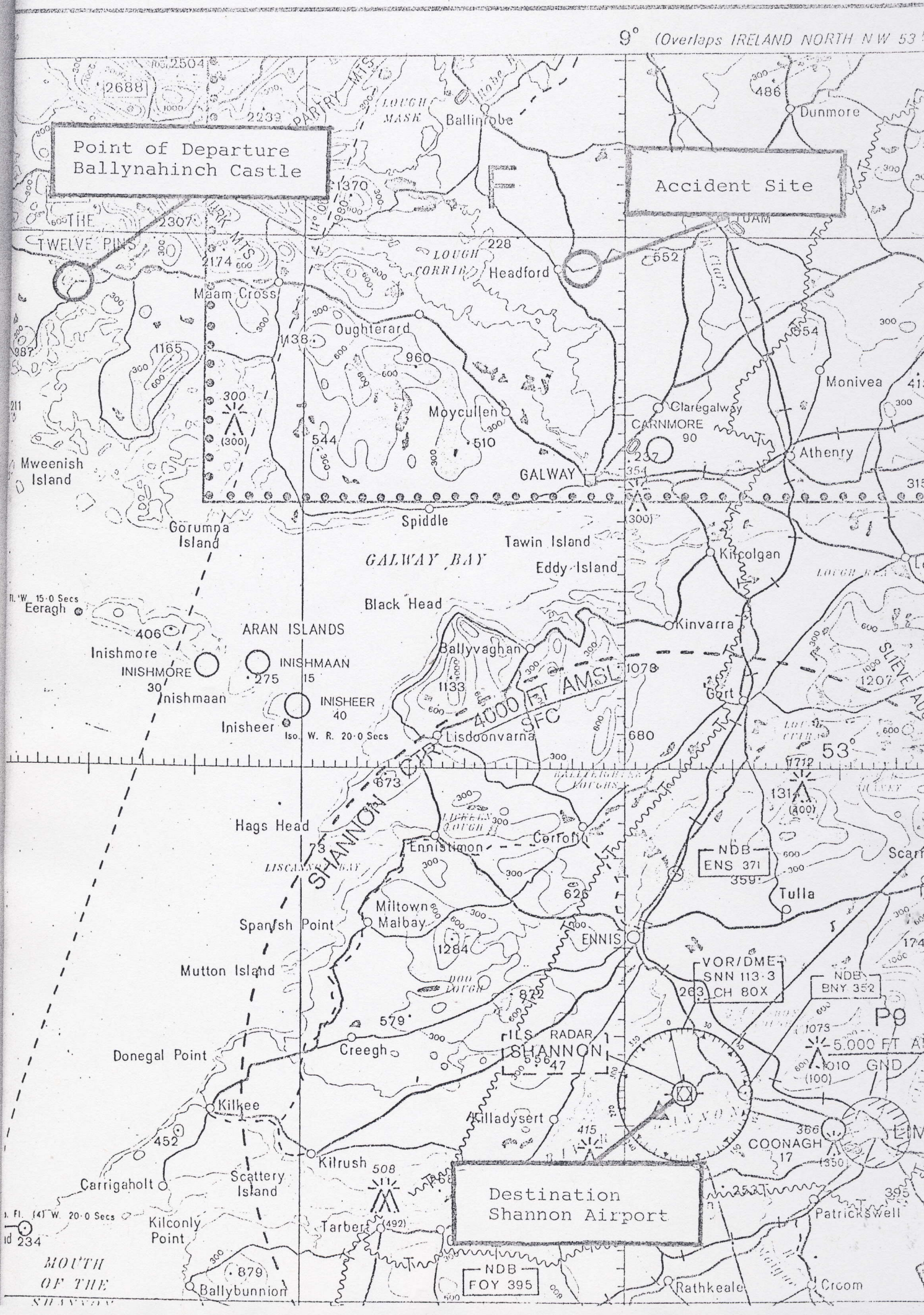
J McStay

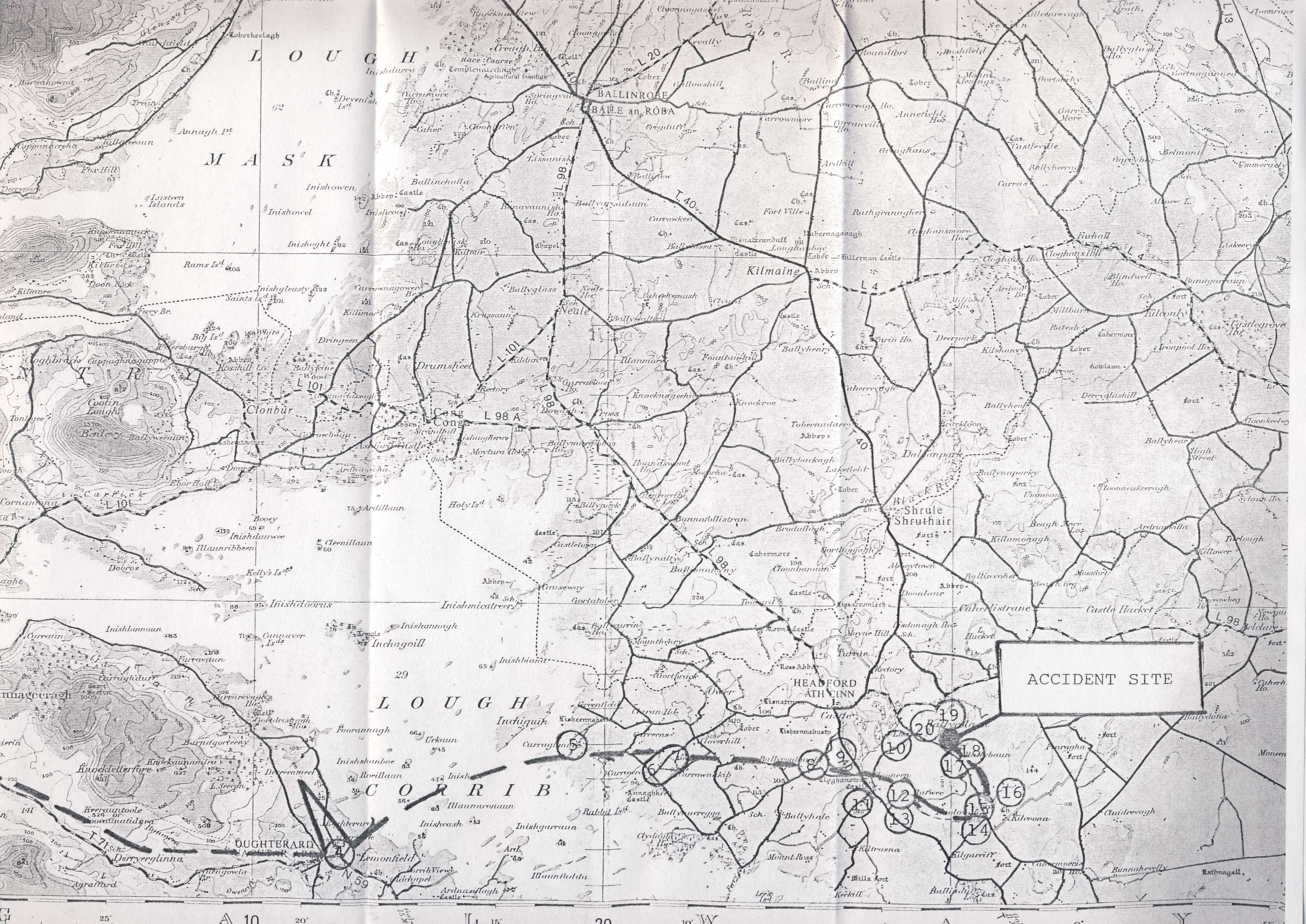
INSPECTOR OF ACCIDENTS

25th January 1983.

AERONAUTICAL CHART

ELEV IN FEET

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ACTUAL REPORTS FROM METEOROLOGICAL STATIONS JULY 29, 1982.

TIME	STATION	WIND	WEATHER	VISIBILITY	CLOUD	NOTES
0500	Galway	Calm	Fog	200 m	Vertical Visibility 200 ft.	Fog began 0445
	Shannon	190/03	Mist	3km	8 Okta. 500 ft.	QNH 1023 mb
	Birr	180/01	Mist	1.6 km	8 Okta. 1200 ft.	
	Claremorris	090/02	Mist	6km	Clear	
0600	Galway	090/02	Fog	100 m	Vertical Visibility 100 ft.	
	Shannon	Calm	Mist	3km	3 Okta. 400 ft. 7 Okta. 700 ft.	QNH 1023 mb
	Birr	160/01	Mist	1.6 km	8 Okta. 1200 ft.	
	Claremorris	Calm	Mist	6 km	Clear	
0700	Galway	Calm	Fog	600 m	Vertical Visibility 200 ft.	Fog ended 0845
	Shannon	Calm	Mist	3 km	8 Okta. 500 ft.	QNH 1023 mb
	Birr	Calm	Mist	2 km	8 Okta. 1200 ft.	
	Claremorris	090/01	Mist	6 km	Clear	