FINAL REPORT

AAIU Report No: 2010-019
State File No: IRL00908075
Published: 08/12/2010

Operator:	Private
Manufacturer:	Sikorsky
Model:	S-76B
Nationality:	United States of America
Registration:	N399BH
Location:	Bettystown, Co. Meath, Ireland N53º 42', W006º 15'
Date/Time (UTC):	18/09/2008 @ 15.41 hrs

SYNOPSIS

The helicopter had landed and shutdown earlier that afternoon on Bettystown beach where its passengers alighted. The Pilot then repositioned the helicopter to a nearby unsuitable small car park in the centre of the village of Bettystown. While attempting to land, the main rotor of the helicopter struck a steel lamppost. The helicopter yawed, then rolled and the main rotor disintegrated on hitting the ground. The Pilot evacuated the helicopter, which was destroyed by an extensive post-crash fire. Collateral damage resulted from helicopter debris hitting nearby properties and cars. The Pilot and two bystanders suffered minor injuries. The Emergency Services responded in a timely manner and extinguished the fire.

NOTIFICATION

The Station Manager, Dublin Air Traffic Control (ATC) notified the AAIU of the accident following which a team of investigators was dispatched to the site.

In accordance with the provisions of Statutory Instrument S.I. 205 of 1997, the Chief Inspector of Air Accidents, on 18 September 2008, appointed Mr. Paddy Judge as the Investigator-in-Charge (IIC) to carry out a Formal Investigation into this Accident. The sole purpose of this Investigation is the prevention of aviation accidents and incidents. It is not the purpose of the Investigation to apportion blame or liability.

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1. FACTUAL INFORMATION

1.1 History of the Flight

The Visual Flight Rules (VFR) flight originated near Naas, Co. Kildare, and proceeded to the nearby Kilrush Airfield, where it refuelled. The Pilot and the beneficial Owner[1] of the helicopter, were on board when it flew onwards to Dundalk, Co. Louth. It landed there in a hotel car park and a passenger boarded (in this Report that person is referred to as the Passenger). The helicopter then flew from Dundalk to a Hotel[2] in the seaside village of Bettystown, Co. Meath. Initially the beach was suggested as a landing site, but a decision was then made to land in the Hotel car park. However, the helicopter did not land there due to a car entering the car park and causing an obstruction. The helicopter subsequently landed close by on the public beach, where the passengers met the Hotel Owner. At that point the Pilot was requested to fly to Dublin City, through Dublin ATC control zone, but declined as he had not filed a flight plan that was required in order to fly through that area. He then shut down the engines and his 2 passengers alighted. He said that an increasing number of sightseers, people and cars approached the helicopter and, for safety reasons, he decided to reposition the helicopter to the Hotel car park, which was 100 metres away, where he had been given permission to land. He did not physically inspect the car park but understood that it would be kept clear.

The Pilot started the helicopter's engines and lifted off. He circled the village and made an approach from the east into the car park. The helicopter then descended vertically into the car park. Video evidence showed that the landing gear was in the extended position during this approach. During the descent to land, the left rear portion of the main rotor disk struck a 5 metre high lamppost, initially dislodging a light fitting on top. Seconds later, the main rotor blades made a more substantial contact with the steel lamppost. The helicopter then violently rotated clockwise and rolled to the left. Its main rotor disintegrated on ground contact and the tail rotor hit a low wall. The helicopter was destroyed by an intense post-crash fire that broke out immediately after ground impact. The Pilot had minor injuries but successfully managed to exit the helicopter unaided. Two bystanders also suffered minor injuries. All three were taken to hospital for examination and were released a short time later.

Considerable collateral damage occurred when flying debris from the helicopters main and tail rotors hit nearby properties and cars. The Emergency Fire Services, from counties Louth and Meath, attended and extinguished the remains of the fire.

The nature of the accident and severity of the post-crash fire resulted in the complete destruction of the cockpit area including, warning lights, instrumentation, controls and helicopter documentation. Therefore, little could be learned by the Investigation from those sources. However, the witnesses who observed the accident, the Cockpit Voice Recorder (CVR), security cameras and a video of the accident on a mobile phone provided information that was useful to the Investigation.

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[1] **Beneficial Owner:** See **Section 1.17**

[2] The car park is part of a hotel complex that had been part converted to apartments and was in part used as a school. This Report refers to this complex as the Hotel.

1.1.1 Interviews

The Investigation interviewed a number of people in relation to this accident.

1.1.2 Pilot

The Pilot stated that he had taken off originally from Carragh, near Naas with a passenger who was the Owner of the helicopter. They routed initially to Kilrush Airfield to uplift fuel. They thereafter departed to Dundalk, with an endurance of one hour thirty minutes, where they landed in a hotel car park 22 minutes later. Here they picked up a second passenger, who had previously obtained permission for them to land at Dundalk. The Pilot was then asked to fly south to another hotel car park at Bettystown where they were to meet another person, the Hotel Owner. He landed on an empty beach, adjacent to the Hotel. At that time he had about 55 minutes fuel endurance and understood that the Passenger had arranged permission for him to land at either the car park or the beach in Bettystown. The Hotel Owner who had approached the helicopter after landing then asked him to fly over Dublin City but the Pilot declined this request, as he had not filed a flight plan to do so. His two passengers then disembarked. He stated that a large crowd of people and cars were approaching the helicopter and for safety reasons he decided to reposition the helicopter to the Hotel car park where he had been given permission to land. He understood that a person from the Hotel would ensure it was kept clear.

The Pilot said that after lift-off he completed a wide orbit to give the person from the Hotel time to clear the cars from the car park. He flew at a height of at 800 ft and saw that the area was clear except for a silver SUV[3], which caused him some concern. There were no unusual engine indications and the helicopter was operating normally. He descended south of the Hotel, into wind (270º/8 kts) and remembered calling LDP[4]at 200 ft and 45 kts. He said that as he got nearer he felt the car park was too tight and he decided to initiate a go-around at about 170 ft. Approximately one second later he said that a No. 1 Fire Caption and T-handle Fire Warning occurred. As he was past LDP he was committed to land and proceeded with the emergency procedure, cancelled the warning and then confirmed that No. 1 engine was operating in the green range. He continued the approach and noticed a lady and child standing beside the SUV on his right hand side watching the helicopter land. He slowed the helicopter almost to a hover. After they both disappeared down a ramp behind the SUV he continued to land. He felt the helicopter jerk. He immediately lowered the collective and felt another jerk and the helicopter yawed. He pulled both the T-handles and fired one if not two fire bottles after ground contact as the helicopter rolled over.

He stated that the helicopter had no technical defects and it did not have a history of false fire warnings. His intention had been to complete the fire drill after the helicopter had landed. He had tried to land at the car park site because he knew that he had permission to land there.

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[3] **SUV**: Sports Utility Vehicle

[4] **Landing Decision Point**: The point used in determining landing performance from which, a power unit failure having been recognised at this point, the landing may be safely continued or a baulked landing (go-around) initiated.

The Pilot said that the following factors may have contributed to the accident. He believed remaining on the beach was not an option (due to the large crowd gathering) while he had permission to land at another secure local site. On being told that the car park was clear he did not expect to encounter people in the car park, who may have diverted his attention. He had not expected to travel to Bettystown and was only informed of this prior to landing in Dundalk. He believed that after LDP he followed the emergency procedure as the No. 1 Fire warning and T-handle were illuminated.

During his interview by the Investigation, the Pilot at his request was accompanied by the director/secretary of an aviation services supply company (herinafter called the Supplier). The Supplier was also a pilot who had flown N399BH. The Supplier, during this interview and in the Pilot's presence, told the Investigation that he employed the Pilot and paid him a salary and that his company had flown the helicopter for the Owner of the helicopter on a freelance basis, charging by the day. In addition, the Supplier had, in December 2007, paid for an experienced S-76B type-rated pilot, who was not an instructor, to provide the Pilot with familiarisation training on the helicopter.

The Pilot said that part of this training involved vertical operations.

1.1.3 Helicopter Owner

The Owner stated that they flew to Dundalk and picked up the Passenger, a business associate. He and this Passenger intended to meet the Hotel Owner in Bettystown to discuss a site. He said that the Passenger phoned the Hotel Owner who said he would be standing on the beach, the position where they should land. They landed and the Pilot shut down the engines. The Hotel Owner enquired if they were going to look at the site in Dublin, but there had been no plans to do so and this had never been discussed with the Pilot. They got out of the helicopter and it was decided that, as there were a lot of people moving around on the beach, they would have to move the helicopter. The Hotel Owner said that there was plenty of room in his car park.

The Owner stated that he had employed the Supplier to look after his helicopter and to provide both a pilot and organise the ongoing maintenance of the helicopter, as he was not experienced in these areas. He said that he had told the Pilot where they were going before they started and that he knew that they were going to the Hotel from the time they left Dundalk. He did not know who gave the Pilot permission to land on the beach but understood there was permission to land. His intention had been to return to Dundalk and then back to his base.

The Owner bought the helicopter because of the time it saved him by travelling directly to his business destinations in Ireland and the U.K. Regarding the USA registry of the helicopter, the Owner had been advised by his UK brokers to leave it on the USA register as the helicopter had previously been registered by that authority. He understood that the transition and legal documention required to place it on the Irish Register would be onerous.

1.1.4 Passenger

The Passenger described himself as a PR consultant who was facilitating a meeting between the helicopter Owner and the Hotel Owner. The flight was organised on the previous day and he had arranged permission for the helicopter to land at Dundalk. He boarded the helicopter in a large car park in Dundalk and understood that they were to pick up the Hotel Owner at Bettystown and then go to visit a site. On arrival at Bettystown the Pilot said that he did not have a flight plan, so they disembarked and went to an apartment for a meeting. When they arrived there he heard the noise of the crash and subsequently saw the helicopter in flames. Black smoke was coming into the apartment, which they evacuated.

1.1.5 Hotel Owner

This witness stated that the helicopter landed on the beach and he understood that the plan was to go and see a site in Dublin and so got onboard. However, he understood there was a problem with a flight plan so they decided to have a meeting in his apartment at the Hotel instead. He had given the Pilot permission to land in the car park, which was empty, and the Pilot said that he would go up and land there. He stated that, after the crash, windows were smashed and parts of the helicopter had entered the building.

1.1.6 Eye Witnesses

1.1.6.1 Witnesses on Beach

Witnesses stated that the helicopter initially landed on the beach and the engines shortly afterwards shut down. Two passengers left the helicopter. The engines then started and it lifted. After circling the area it approached from the east, the seaward side, and continued hovering low over gardens with the houses on its left side and the Hotel to the right. As the helicopter descended to land the left side of its main rotor clipped and "*shattered the top of a light standard*". This "*seemed to send everything into a spin and debris went flying in all directions"*. Witnesses reported seeing thick black smoke afterwards.

1.1.6.2 Drivers of Cars

The SUV Driver had just parked when she saw the helicopter landing on the beach, so she went to the front of the Hotel. Her husband, the Hotel Owner, went down to the helicopter. He came back with two others, one of whom was the Owner of the helicopter who told her that the Pilot was thinking of landing in the car park. As there were children playing in the car park she asked them to leave. A red car then entered the car park and she asked the driver to move the car as a helicopter was about to land. The driver became irate. She then felt the wind from the helicopter and moved with her child to the protection of a ramp going down under the hotel. She saw the helicopter falling and crouched down.

The driver of the red car, who suffered minor injuries, said that she drove into the car park and parked. A lady with a child told her not to park there, as a helicopter was about to land. She said that she did get back into the car with the intention of moving it but could not see the helicopter, which was coming down behind her. She was in the car when she sustained her injuries.

1.1.6.3 Apartment Occupants

Witnesses in different apartments overlooking the accident site saw the helicopter attempting to land. One witness was a former pilot and heard the noise of the helicopter hovering about the Hotel opposite his apartment. It landed on the beach and took off again, did a circuit about Bettystown and attempted to land in the car park. The helicopter had approached over the gap between the buildings. During the attempted landing the main rotor hit a lamp standard. The helicopter had been descending very slowly and hit the glass first. The helicopter rose and then fell and the main rotor collapsed. The helicopter then toppled over on its side and burst into flames within a couple of seconds with a lot of smoke.

Another witness stated that the fire broke out initially on the bottom of the helicopter. He saw the Pilot then get out and after he had gone a short distance, an explosion occurred. He said that there were at least three explosions. A third witness opened his balcony door overlooking the accident site and saw the helicopter hitting the top of the light stand. He started to run as parts of the helicopter came through the window of his apartment.

1.2 Injuries to Persons

The following injuries were reported to the Investigation

Injuries	Crew	Passengers	Total in aircraft	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	1	0	1	2
None	0	0	0	Not applicable
Total	**1**	**0**	**1**	**3**

1.3 Damage to Aircraft

The aircraft was destroyed. As the main blades made contact with the lamppost, the helicopter started to rotate violently and descended onto the top of a low wall. This wall tore out the bottom of the fuselage and ruptured the fuel tanks, which were located in the forward under-floor area of the fuselage. The escaping fuel fed the subsequent fire.

1.4 Other Damage

A broken steel lamppost, originally measuring approximately 5 metres in length, was found beside the southern low wall. Its base was located alongside the wall 14 metres from the Main Street boundary wall. The wall itself suffered impact and fire damage as did the asphalt surface on either side of the wall.

A steel security fence was mounted on the western low wall (total height 1.7 metres) and separated the car park from the main street. Bars on this fence were damaged and bore marks of being hit by high-speed projectiles. A number of windows in nearby buildings were broken and a section of the main rotor was recovered from a nearby indoor swimming pool. This section had penetrated both the roof of the building and its ceiling. Parts of both main and tail rotor blades were found embedded in concrete walls and nearby buildings. The red car in the car park was damaged, as were some cars in the nearby street.

1.5 Personnel Information

1.5.1 (Commander)

The Pilot's logbook showed the following flying experience:

Personal Details:	Male, aged 33 years
Licence:	FAA, Private Pilot Licence Rotorcraft-Helicopter
	JAA, Commercial Pilot Licence, Type Rating A109
Medical Certificate:	11 December 2007

Flying Experience:

Total all types:	5,356.0	hours
Total all types P1[5]:	See Note	hours
Total on type:	78.1	hours
Total on type P1:	See Note	hours
Last 90 days:	115.0	hours
Last 28 days:	33.0	hours
Last 24 hours:	2.5	hours

Note: The Pilot's logbook showed his flight hours as single engine or multi-engine entries but not by type or operating capacity.

The Pilot held a valid Federal Aviation Administration (FAA) issued Private Pilot, Rotorcraft-Helicopter: Instrument Helicopter Licence. His First Class medical certificate, issued by an FAA approved Aero Medical Examiner (AME) was valid. He stated that he had previously completed training with a pilot who was experienced on the S-76B. The FAA informed the Investigation that, as the Pilot was already rated as a Private Pilot Rotorcraft, he did not need a checkout under Federal Aviation Regulations in order to fly the S-76B. Therefore, such informal training was appropriate. The FAA advised the Investigation that a pilot licensed as a Private Pilot may not act as pilot-in-command of an aircraft for compensation (Federal Aviation Regulation (FAR) 61, Section 113, **Appendix A**) and that if he was employed to fly a helicopter that it could not be done under the privileges of a Private Pilot Licence.

The Pilot also possessed a valid Irish Aviation Authority issued Joint Aviation Authorities (JAA) Helicopter Commercial Pilot Licence (CPL) with Instrument Rating. This licence had a multi-engine type rating for Agusta 109 types but not for the S-76B. His First Class medical certificate, issued by a JAA approved AME, was valid.

At the time of the accident, the flight was being operated in the General Aviation – Private flight category.

[5] **P1:** also known as the handling Pilot

1.6 Aircraft Information

1.6.1 General

The helicopter was originally registered in 1985 as N92AE and later N89WC. A fire in a maintenance facility in Galway in 2006 destroyed some of its maintenance records. These were subsequently reconstructed in accordance with FAA Document AC43-9C. Following this, the aircraft was re-registered by the FAA as N399BH on 14 July 2007.

As the helicopter was registered by the United States, its airworthiness was maintained in accordance with Federal Aviation Authority Regulation standards. The Investigation, through the assistance of the Air Accident Investigation Branch (AAIB) UK, obtained copies of all the maintenance documentation from the FAR 145 facility that maintained the helicopter. The post accident fire in Bettystown destroyed all documentation onboard the helicopter. Although documentation was incomplete, the evidence found indicated that the helicopter was being maintained to the required standard.

No evidence of a registration number was found on the burnt wreckage nor was the helicopter data plate found, as most of the helicopter had been completely destroyed. A data plate found on the tail cone was stamped Part No. 7600-04000-041, Serial No. A172-00311. The original manufacturing records showed that this serial number was installed on S-76B Serial No. 760311 on the 30 October 1985, the date of manufacture of this helicopter, indicating that the wreckage is that of N399BH.

1.6.2 Leading Particulars

Aircraft type:	Sikorsky
Manufacturer:	S-76B
Constructor's number:	760311
Year of manufacture:	1985
Certificate of registration:	14 July 2007
Certificate of airworthiness:	Issued by the FAA, 28 August 2008
Length Overall:	16 metres
Rotor Diameter:	13.41 metres
Total airframe hours:	Not determined
Total cycles:	Not determined
Engines:	2 x PT6B-36A
Maximum authorised take-off weight:	5,307 kg
Weight (empty):	3,731 kg
Estimated Final Take off weight:	4,220 kg
Estimated weight at time of accident:	4,176 kg
Centre of gravity at time of accident:	Estimated within Limits

1.6.3 General Information

The Sikorsky S-76B is a twin engine, single main rotor helicopter capable of carrying up to 13 passengers and a pilot. The minimum main rotor clearance, at 107% Nr[6] and a flat pitch, is nominally 2.4 metres at the front. The main rotor rotates anti-clockwise when viewed from above. The structure of the helicopter contains significant amounts of composite material with two side-by-side fuel tanks mounted in the belly, ahead of the main landing gear. The engine fuel used was Jet A1, also known as kerosene.

1.6.4 S-76B Fire Detector System

Of relevance to this occurrence is Part 2, Section I of the Flight Manual that describes the engine fire detector system:

> *Two flame detectors are located in each engine fire zone, one above and behind the exhaust port and one below the combustion chamber. Sensing a flame, the detector transmits a signal to an amplifier unit to light the appropriate ENG FIRE PRESS – TONE OFF warning light on the master warning panels. The amplifier also transmits a continuous tone to the pilot's and copilot's headset, and lights the appropriate engine quadrant T-handle warning light marked NO. 1 or NO. 2 FIRE. The warning lights will remain on until the fire is out…*

Part I, Section III contains the emergency procedures that cover Engine Compartment Fire (page 3-38A):

> *Symptom:*
> *# 1 or # 2 FIRE warning light and respective T-handle light on with continuous tone heard.*
>
> *Confirming:*
> *Smoke, burning odour, or abnormal engine indications.*
>
> *Actions:*
> *Reset tone by pressing a FIRE warning light.*
>
> *With fire confirmed, establish safe single engine flight while fully retarding illuminated T-handle of affected engine.*
>
> *Place fire extinguisher switch to MAIN. An extinguishing of the appropriate FIRE warning light and T-handle light is supportive information that the fire has been arrested. If fire persists, place fire extinguisher to RESERVE.*
>
> *If any sign of fire persists, land immediately, otherwise land as soon as possible.*
>
> *Shut down and leave helicopter immediately.*

[6] **Nr**: Main Rotor RPM.

1.6.5 S-76B Audible Warnings

The Manufacturer has informed the Investigation that three audible warnings are provided by the same tone generator: Engine Fire, ENG Out and Landing Gear UP. The Landing Gear UP is an intermittent tone, activated when the helicopter is below 60 knots and the landing gear is up, while the Engine Fire warning is a continuous tone; thus they are quite distinct.

Each tone can be cancelled by depressing the Master Caution warning light positioned in front of each crew member. However, the warning light stays on.

1.7 Meteorological Information

The Pilot sourced his weather information from AVBRIEF.com. The conditions as reported were:

	Forecast Conditions	**Actual Conditions**
Visibility:	10+ km	10+ km
Wind:	270/05 kts	250/08 kts
Cloud:	None below 5,000 ft	None
Temperature:	15ºC	15ºC

1.8 Aids to Navigation

None applicable

1.9 Communications

As the area was not under ATC control there were no relevant ATC records

1.10 Accident Site Information

The accident site, which is located in the centre of the village, was inspected and measured by the Investigation shortly after the accident. The Emergency Services were in attendance at the time. The smouldering wreckage of the helicopter was resting on the southern low wall **(Photo No. 1**). There were three cars in the car park at the time of landing.

The site is a small car park, the total area measuring 32 by 24 metres. It is a ground level site just above sea level. A low wall with lampposts on the western and southern perimeters, and buildings on the northern and eastern sides, enclose the car park.

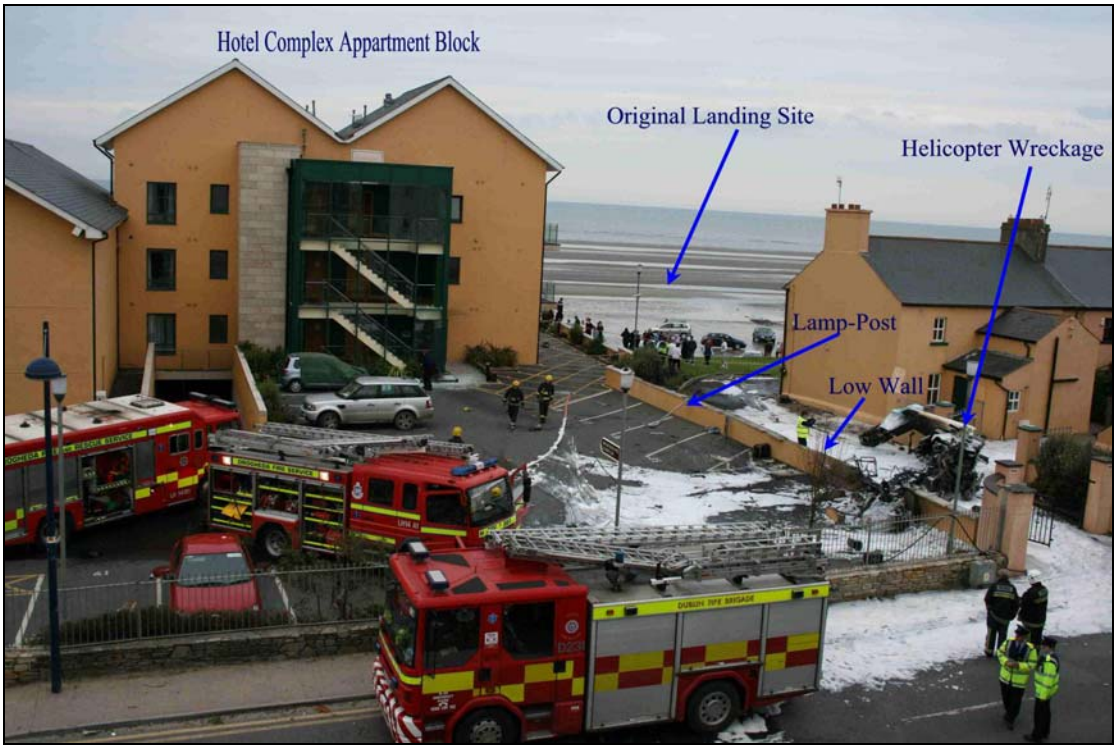


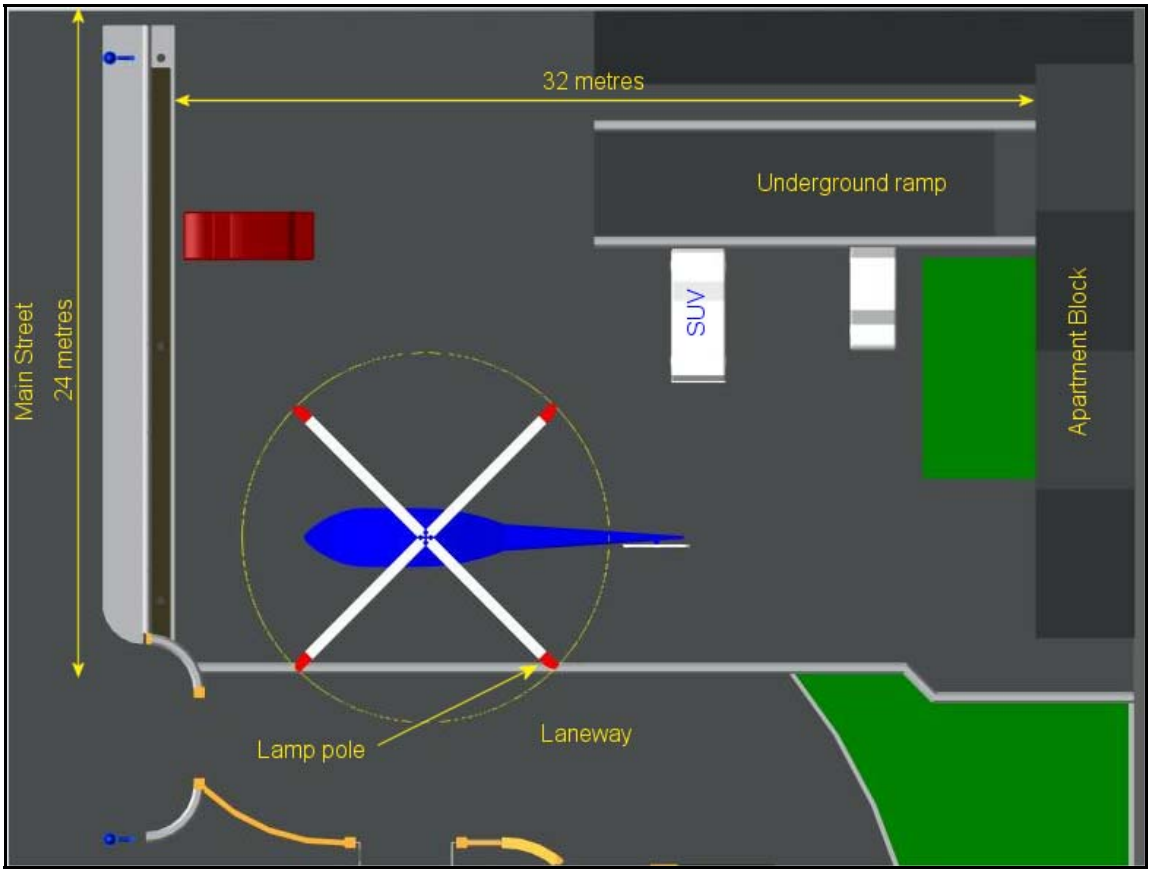
Photo No. 1: Accident site looking east
(View from the apartment of a witness in **Section 1.1.6.3)**

The apartment block (to the east) contained within the Hotel complex was 14.3 metres (47 ft) high, while the apartment building on the main street (to the west and from where this photograph was taken) was 10.2 metres (33 ft) high. The gap between the apartment block and the house on the far side of the laneway **(Photo No. 1)** was measured at 12.5 metres (41 ft).

The car park is bounded by a secondary school to the north, an apartment block that forms part of the Hotel complex to the east, a laneway that gives access to the beach to the south and the main street of Bettystown village to the west.

The Irish Air Corps assisted the Investigation by recovering the wreckage from the site and debris from the adjacent streets, buildings and roofs. Subsequently the wreckage and debris were removed to the AAIU facility at Gormanston for a technical examination.

Graphic 1 details the relevant measurements. The clear useful area in which the Pilot was attempting to land was approximately 15 by 15 metres.



Graphic 1: Helicopter in estimated landing position
(Sketch-map orientation north up)

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder (CVR)

The CVR fitted to the helicopter recorded four audio channels for 30 minutes, following which it overwrote the previous recording and recommenced. Although extensively burned and damaged in the post accident fire, the unit was brought by the IIC to the download facility of the AAIB at Farnborough, and successfully downloaded. No. 4 channel recorded pilot audio. (The times noted on the CVR transcripts are relative to the beginning of the recording and use the format mins:secs).

The CVR recording commenced during the flight from Kilrush to Dundalk and timings (in minutes and seconds) begin from that moment. It recorded that when the Pilot landed in Dundalk the Owner asked him to fly to Bettystown. The Pilot queried this and he was told to land beside the Hotel on the beach.

The helicopter took off from Dundalk and the Pilot reported to ATC 6 minutes later that he was en-route for Bettystown at 1,000 ft. On arrival overhead Bettystown the Pilot told the Owner "*I best not land in the sand, it will blow a lot of stuff into the engines*" and the Owner told him to land in the car park.

An attempt was made to do this but a car parked and opened its door as the helicopter was about to land and the Pilot stated that he would "*go-around and come back in again*". A number of options were discussed including the Owner suggesting a *"green area there at the apartment block"* which was decided against.

The Owner then suggested landing on the beach, which the Pilot proceeded to do commenting, "*you don't want to stick around too long, there's a lot of people*". The Owner subsequently indicated a dry spot on the beach where the helicopter should land.

After landing, the Pilot shut down the engines. He was then asked to go to Inchicore in Dublin City to which the Pilot replied, "*I've no plans to get into Dublin, - I didn't even know we were going to Dublin*". (The plans referred to were an ATC flight plan). The Pilot apologised and then repeated this. After a short interval during which background conversation occurred the Pilot said to the Owner that he had "*better move out of here, there's too many people*" and that he would go up to the car park where the car had been parked in the way. The Owner asked him was he sure, which the Pilot confirmed.

The CVR at 28:35 records the engines restarting and shortly afterwards the Pilot made a "*Go back*" comment (probably regarding somebody coming too close to the helicopter). One minute later a double warning tone sounded. At 31:45 the Pilot passed a comment "*Tight on fuel again*" and called "*LDP*" at 32:24. The CVR records the initial contact with the light on lamppost at 33:03.92. The trace spectrum (**Appendix B**) indicates that three blades struck it. The Pilot exclaimed almost immediately *"Oh .... Hit something"* and 3 seconds later wonders "*What did I hit?*" The recording ends three seconds later.

The normal breathing of the Pilot is registered by the CVR at 3-5 second intervals from 28:50. There is a marked change in the sound of his breathing after the initial contact at 33:04.

There were two warning tones on the recording; an oscillating tone during engine start (28:08) and a later double tone, at 29:58. The oscillation tone was identified as electromagnetic interference created by the high-tension ignition system during engine start.

The double tone was identified as a landing gear warning tone generated by the aircraft (see **Section 1.6.5)**. Sound analysis determined the spectral signature of this tone plus its harmonics. A search of the four CVR recorded channels by the AAIB, using spectral analysis software, did not detect any evidence of that spectral signature after LDP or during the later stages of the approach.

The Pilot assisted the Investigation by listening to the CVR recording but was unable to identify any evidence of a fire warning tone.

1.11.2 Flight Data Recorder (FDR)

An FDR was not fitted nor was it required to be.

1.12 Wreckage and Impact Information

The nature of the accident and severity of the post crash fire resulted in the complete destruction of the cockpit area including, warning lights, instrumentation, controls and helicopter documentation. The entire cabin section and centre section of the helicopter were destroyed, having suffered severe fire damage that caused most of the structure to melt or reduce to ash. Part of the tail cone had remained intact and the tail rotor gearbox had separated but remained in the car park. The helicopter data plate was not found. Much of the metal had melted and pooled. While the core of both engines had survived relatively intact, the engine accessories had largely melted. The lower casing of the main gearbox had melted. The main rotor head largely survived and showed damage consistent with heavy blade contact.

Considerable collateral damage occurred as flying debris from the helicopter hit nearby properties and cars. The car park surface and adjacent boundary wall suffered fire damage.

1.13 Medical Information

The Pilot and two bystanders suffered minor injuries. All three were taken to hospital for examination and were released a short time later.

1.14 Fire

The helicopter was destroyed by an intense post-crash fire, which broke out immediately after ground impact. The Pilot reported that smoke filled the cabin after 2-3 seconds. A security camera (See **Section 1.18.2**) recorded flames within 2 seconds of the helicopter fuselage rotation ceasing. The Emergency Fire Services, from counties Louth and Meath, arrived 13 minutes later and extinguished the remains of the fire.

1.15 Survival Aspects

The Pilot had minor injuries but successfully managed to exit the helicopter unaided. He reported that he could not open the cockpit door but succeeded in forcing out the pilot door window and exited the helicopter by that means. A man came over to assist him but he was out of the helicopter by that time.

1.16 Tests and Research

None applicable.

1.17 Organizational and Management Information

Under American law, only USA citizens are normally permitted to own a USA registered general aviation aircraft[7]. To comply with this requirement, and yet still facilitate a non-US citizen owning such an aircraft, there is a widespread practice whereby the aircraft is registered with the FAA in the name of a *Trustee*. The non-US citizen, or *beneficial owner*, (known as the Trustor) then enters an agreement with the Trustee.

[7] A non-USA citizen can own such an aircraft if at least 60% of its flying time is within the USA.

In this case, the FAA Certificate of Registration shows that a Corporation registered the helicopter with the registered owner named as Barrack Aviation INC, Trustee, with an address in Delaware in the United States. Although the helicopter's FAA registry showed that a Trustee based in the United States owned N399BH, the Beneficial Owner was Irish.

1.18 Additional Information

1.18.1 Video

An eyewitness, who was located south of the accident site, took a video recording by mobile phone. This showed the helicopter initially circling the car park and then landing on the beach. Later it showed the descent into the car park. The video confirmed that, during the attempted landing in the car park, the main rotor initially contacted and broke a lamp on top of a lamppost. (**Photo No. 2**, captured from the video, shows the helicopter in a hover with the shattered lamp falling).

The helicopter then rose slightly and stabilised. Approximately 4 seconds later the helicopter descended, and the main rotor blade contacted the steel lamppost. The helicopter then yawed rapidly to the right while rolling to the left. Rotor debris is then seen flying and the helicopter rolled over within 3 seconds of the second lamppost contact. The video later showed a large number of onlookers very close to the fire.

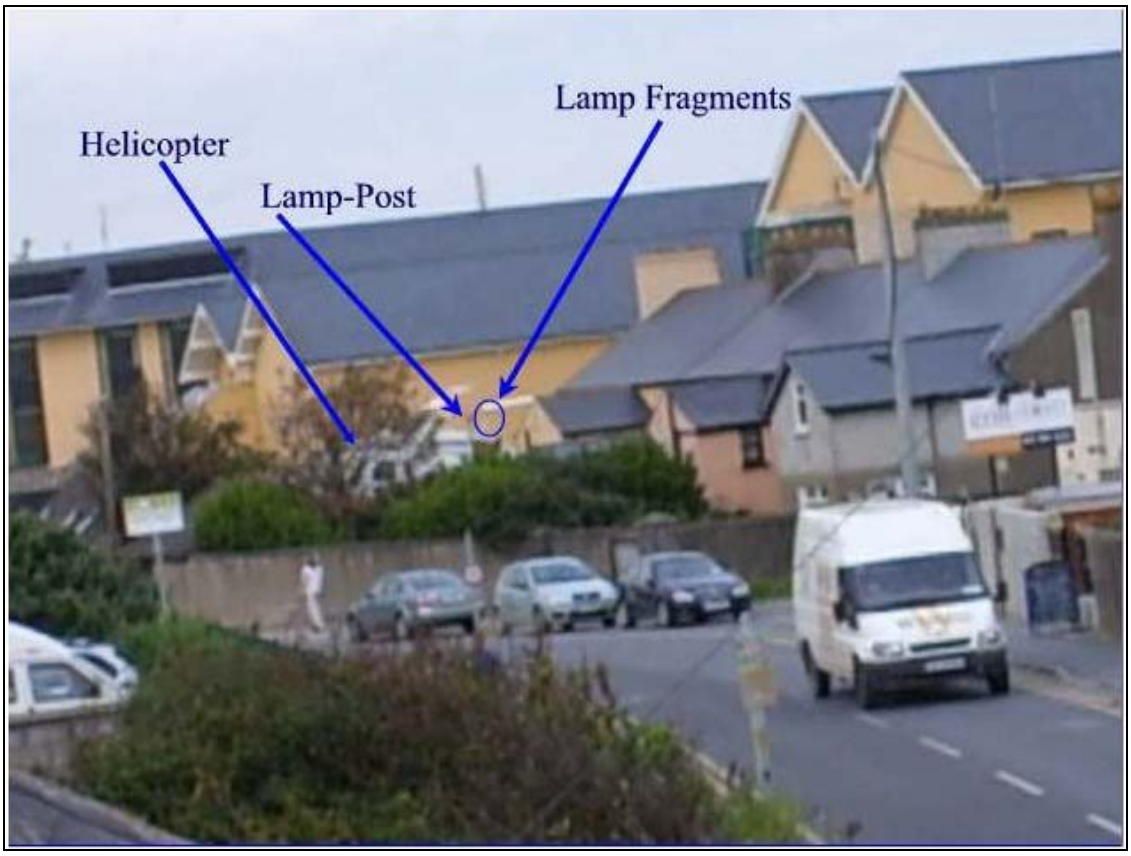


Photo No. 2: Initial contact with lamppost

Note: The falling lamp fragments appear as a lighter coloured (encircled) spot under the rotor blade. The darker coloured spot beside it is the lamppost.

1.18.2 Security Camera (CCTV)

A Closed Circuit Television (CCTV) security camera was mounted on the outside of the local supermarket facing south along the village street. The security system, which stored images at 4 frames per second, recorded the accident sequence. **Table 1** is a summary of the relevant recordings

Time	
15.40:34	Wheels of helicopter first appear in frame with the helicopter in forward motion and descending
15.40:42	Helicopter forward flight ceased
15.40:44	Vertical descent commenced
15.41:00	Vertical descent stops Helicopter then rises approximately one metre
15.41:02	Vertical ascent stops
15.41:05	Helicopter yaws to the left and commences descent
15.41:06.50	Helicopter rises slightly, commences rolling left with a rapid yaw to the right
15.41:07.50	Helicopter yaws through 90º and begins descent
15.41:08.25	Helicopter has yawed a further 90º and rolled to approximately 60º left
15.41:08.50	Main rotorblades strike the ground
15.41:08.75	Impact. From this point on the accident site is generally obscured by a grey cloud
15.41:09.50	Flying debris recorded by camera
15.41:10.75	Rotation of the helicopter ceases
15.41:11.00	Pedestrians run for cover
15.41:12.75	First flames recorded
15.41:14	Flying debris ends
15.41:37	Dense black smoke commences
15.41:46	Group emerge from hotel
15.41:56	Group leave car park
15.42:43	From this point on significant crowds of bystanders gather
15.49.22	Garda presence
15.54.16	Fire services arrive
15.55.17	Ambulance arrives
15.57:09	Garda car arrives

Table 1

The recording showed that the elapsed time from when the helicopter came into camera coverage and commenced its vertical descent until its initial hover was 16 seconds.

Photo No. 3: CCTV image recorded at time 15.41:08.25

Photo No. 3 was taken from an image recorded by the CCTV camera at 15.41:08.25 hrs and shows the main rotor contacting the ground. The aircraft is on its side facing east, at right angles to the camera having yawed 180°, with an approximate 60º left bank angle.

1.18.3 Permission to Land

The Investigation was informed that the helicopter was granted permission by the owners to land in both hotel car parks i.e. Dundalk and Bettystown. The situation regarding permission to land on the beach is complicated by the fact the beach is divided into two different zones; the higher beach above the high water mark and a foreshore that extends from the high to the low water mark. The foreshore is controlled by the Department of Agriculture, whereas, the higher beach is controlled by Meath County Council. As parts of the beach were wet, the helicopter landed on a dry patch. High water on the day occurred approximately 2¼ hours earlier and, as the tidal range on the day was 4.14 metres, it is estimated that the tide had ebbed approximately 1.4 metres by the time the helicopter landed.

The Foreshore Section of the Department of Agriculture, under whose control the foreshore falls, informed the Investigation that they hold no record of receiving a request for a helicopter to land on Bettystown beach on the day in question. Meath County Council also informed the Investigation that it had not received a request for a helicopter to land on Bettystown beach that day and accordingly did not grant permission.

1.18.4 Helicopter Performance

1.18.4.1 General

The International Civil Aviation Organisation (ICAO) describes the ability of a helicopter to climb and clear obstacles using the term "Performance Class". This helicopter was certified for Performance Class 1 operations or operations where the performance of the helicopter is such that in the event of an engine failure the helicopter is able to land within the distance available or to safely continue the flight to an appropriate landing area, depending on when the failure occurs.

However, the manufacturer and the FAA describe approach and landing profiles using the term Category 'A', Alternate Category 'A' and Category 'B'. The Flight Manual Supplement No. 9, Part 1, prescribes and describes Category 'A' vertical operations from ground level heliports.

It should be noted that Performance Class operations (as used within the EU and Ireland) are more conservative than Category operations. Thus, in the USA Category B vertical operations out of confined sites are regarded as having an acceptable level of risk exposure, whereas, such operations are not permitted under Irish Air Law except in the case of Search and Rescue or military operations.

Therefore, Air Law regarding such operations is very different in the USA and Ireland.

1.18.4.2 S-76B Approach and Landing

In general, the landing technique of a helicopter requires, as in fixed wing aircraft, a stable and constant angle approach and descent to a landing site. The S-76B Flight Manual describes a number of take-off, approach and landing techniques. Specifically regarding approach and landing, the Flight Manual (Part I, Section II, Normal Procedures – Approach and Landing) describes two Category 'A' and one Catgory 'B' Approach and Landing profiles. Category 'A' Approach and Landing procedure is intended for visual approaches to a minimum available field length. The Alternative Category 'A' Approach and Landing procedure provides a more shallow profile for transition from instrument approaches or where available landing space is not critically short. In general terms, Category 'A' provides assurances that approach and landing can be either terminated or continued following loss of a critical power unit, depending on where the failure occurs. Category 'B' does not meet Category 'A' standards. This means it cannot guarantee that it will be able to continue the flight in case of an engine failure, and the possibility of a forced landing has to be taken into account. Category 'B' therefore requires greater landing distances at the landing site, in order to reflect one-engine inoperative landings to a hard-surfaced runway.

The helicopter is required to establish an approach to pass through a point, the LDP, above the touchdown elevation at a specific speed and a specific rate of descent. Deceleration is initiated passing a specific height and speed and the approach continues with a deceleration to a running touchdown or hover.

	Category 'A' Landing	Alternate Category 'A' Landing	Category 'B' Landing
LDP	250 ft	75 ft	250 ft
Speed KIAS	40 kts	60 kts	45 kts
Descent rate not greater than	600 ft/min	300 ft/min	600 ft/min
Deceleration height	50 ft	50 ft	50 ft
Deceleration speed	40 kts	30 kts	45 kts

Table 2

Landing distance required for each category of approach is calculated from graphs in the S-76B Flight Manual, Part 1, Section IV Performance Information. In general, landing distances reflect the landing distance required from a height of 50 ft to a stop landing on a hard-surfaced runway with one-engine inoperative (**Table 2**).

Assuming a landing weight of approximately 4,176 kg, a temperature of 15ºC and a wind of 8 kts, the landing distance required (**Table 3**) for the three categories are:

Category 'A'	Alternate Category 'A'	Category 'B'
550 ft/166 m	1,000 ft/300 m The landing distance is 1,000 ft for all weights, altitude, temp and calm wind.	720 ft/218 m Wind Calm

Table 3

1.18.4.3 S-76B Vertical Approach and Landings

S-76B Supplement No. 9 – Category "A" Transport Vertical Operations from Ground Level Heliports, identifies the requirements for vertical operations of the S-76B helicopter for both steep and shallow approaches. It states that a minimum flight crew complement of 2 pilots is required. It requires that pilots must have completed a training programme on the use of these procedures prior to using the supplement and further states that vertical operations are limited to ground level heliports measuring 70 x 70 ft (21.34 x 21.34 metres) or larger.

In general terms, the landing space required from a 50 ft height to ground level for a shallow approach is 1,050 ft/318 m and for a steep approach 275 ft/83 m.

1.18.4.4 Height/Velocity Diagram

As the energy level available to a helicopter's rotor is a combination of engine power, height and speed, information is provided for the pilot to allow him to safely operate the helicopter at low heights and speeds while landing or taking-off. This information is contained in the S-76B Flight Manual Height/Velocity Diagram (see **Appendix C**) and is only published for maximum allowable take-off gross weight.

The Pilot reported that he had approximately 760 lbs (345 kg) of fuel onboard at the time he had landed on the beach. As the Pilot was the only occupant, the helicopter weight at the time of impact is estimated at 4,176 kg, or 1,131 kg below the Maximum All Up Weight (MAUW) of 5,307 kg.

It should be noted that there is a change in aerodynamic reaction close to the ground as the height is increased. A helicopter In Ground Effect (IGE) needs less power to hover very close to the ground and this effect extends up to approximately 0.75 times the main rotor disk diameter from the ground at which point it diminishes rapidly to end at about 1.5 times main rotor diameter. Above that height, the hover is Out of Ground Effect (OGE) and more power is required.

1.18.5 Helicopter Operation - Legislation

1.18.5.1 General

As the helicopter was registered in the United States its maintenance and airworthiness standards were required to comply with the USA Federal Aviation Administration Regulations.

However, a USA helicopter operating in a foreign state is required to comply at least with the international standards contained in Annex 6 to the Chicago Convention - Operation of Aircraft Part III, International Operations - Helicopters. These are transferred into local law and, since this accident occurred in Ireland, Irish regulation is applicable.

In addition, Ireland is a member of the European Union and EU law takes the form of either Directives or Regulations. Whereas EC Regulations are directly applicable, EC Directives must be incorporated into Irish law through either Primary or Secondary legislation, namely Acts and Statutory Instruments (S.I.s). Regulation (EC) No 216/2008 (as amended) on common rules in the field of civil aviation establishes the European Aviation Safety Agency (EASA), which regulates various aviation activities within the EC. This Regulation is also known as the Basic Regulation.

It should be noted that the competence of EASA in aviation is expanding and AR.GEN 305 (Monitoring of activities) contains oversight requirements for national competent authorities. As part of this process EASA has published two Notices of Proposed Amendments (NPA) regarding the safe operation of aircraft in EC states (see **1.18.5.4 EASA Notices of Proposed Amendment**). Before the end of 2010, EASA intends to publish its proposal for regulating third country operators. Therefore, in the future, the type of operation conducted by the accident aircraft will be subject to European rules.

Previously, the JAA represented the civil aviation regulatory authorities of a number of European States, including Ireland, who had agreed to co-operate in developing and implementing common safety regulatory standards and procedures. The EC later established EASA to centrally regulate various aviation activities within the EC. This process is now implemented by the EC "Basic Regulation", No 216/2008 (as amended) on common rules in the field of civil aviation. Provisions relating to EASA are supported in Irish law by the EC (European Aviation Safety Agency) Regulations, 2003 to 2008. (S.I. Nos. 469/2003 and 95/2008) and the Irish Aviation Authority (IAA) is designated as the 'competent authority' in this State for EASA Regulation.

Whereas the competence of EASA in aviation is expanding within the EC, the provisions of Irish aviation legislation are still applicable regarding this accident and the following definitions are relevant:

Commercial air transport operation. An aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire. (ICAO Annex 6)

General aviation operation. An aircraft operation other than a commercial air transport operation or an aerial work operation. (ICAO Annex 6)

General Aviation (GA) *as defined means all Non-commercial activities of aircraft other than complex motor powered aircraft. (Irish Aviation Authority)*

Complex Motor-powered Aircraft *means: A Helicopter with a maximum certificated take-off mass exceeding 3,175kg or; with a maximum approved passenger seating configuration of more than 5 or Certificated for operation with a minimum crew of at least two pilots or a Tilt Rotor aircraft*. (EC Regulation 216/2008)

1.18.5.2 Irish Operational Regulations

Under the provisions of The Irish Aviation Authority Act, 1993, the IAA is empowered to make Orders for the purpose of giving effect to the Annexes to the Chicago Convention listed in the Schedule to the Act (which includes Annex 6). Civil helicopter operations are primarily regulated by the Irish Aviation Authority (Operations) Order, 2006 (S.I. No. 61 of 2006) and the Irish Aviation Authority (Rules of the Air) Order, 2004 (S.I. No. 72 of 2004) (as amended). Heliport operations are regulated by the Irish Aviation Authority (Aerodromes Standards) Order, 2006 (S.I. No. 26 of 2000) and the Irish Aviation Authority (Aerodromes and Visual Ground Aids) Order, 2000 (S.I. No. 334 of 2000), as amended by S.I. No. 216 of 2005.

1.18.5.3 Rules of the Air

The Definitions in S.I. No. 72 of 2004 (Rules of the Air) state:

"congested area" means in relation to a city, town or settlement, an area substantially used for residential, commercial or recreational purposes without adequate safe forced landing areas;

"heliport" means an area of land, water or structure used or intended to be used for the takeoff and landing of helicopters;

"Performance Class 1" are those operations such that, in the case of critical power unit failure, it is able to land on the rejected take-off area or safely continue the flight to an appropriate landing area, depending on when the failure occurs;

"Performance Class 2" are those operations such that in the event of critical power unit failure, performance is available to enable the helicopter to safely continue flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which cases a forced landing may be required.

"Performance Class 3" are those operations such that, in the event of a power unit failure at any time during the flight, a forced landing may be required in a multi-engine helicopter but will be required in a single engine helicopter.

"safe forced landing" means an unavoidable landing or ditching with a reasonable expectancy of no injuries to persons in the aircraft or on the surface or of no significant damage to property;

The Regulation (S.I. No. 72 of 2004) further states, inter alia:

13. The pilot-in-command shall have final authority as to the disposition of the aircraft.

17. Nothing in this order shall be construed as preventing a departure from a provision of this Order, including the Rules in the Schedule to this Order to such extent as may be necessary to avoid immediate danger.

S.I. No. 355 of 2008 (Aerodromes and Visual Ground Aids) Order, 2008 states:

5. (1) An aircraft shall not take-off from or land at any place in the State save at:

(d) in case of a rotorcraft or balloon, not being used for public transport, any place where the aircraft may take-off or land without undue hazard to persons or property and in respect of which the owner or occupier of that place shall have given permission for such use, except that, in the case of a rotorcraft, where that place is of an elevated construction, located on the roof of a building or structure, it shall also be licensed by the Authority under this Order for such use by that rotorcraft;

1.18.5.4 Operations Advisory Memorandum (OAM) No. 08/00

The IAA has published guidelines for Heliport sites in OAM No. 08/00, which is available on the IAA website. Although this guidance applies primarily to commercial operations, it is also practical guidance for helicopter operators and heliport owners in what is a specialised and complex area.

The OAM advises the reader/user of these guidelines to refer to the current and appropriate IAA Regulations. Particular attention should also focus on ICAO Annex 14, Volume 2 (Heliports); Heliport Manual Document 9261-AN/903; JAR[8]-OPS 3, ICAO Annex 6 Part 3 (International Operations) – Helicopters; JAR-OPS 3 (Helicopter); and to relevant AICs[9], Aeronautical Notices and OAMs, as appropriate. Where clarification is required, it states that the IAA should be contacted.

Although Section 1.3 of the OAM states that the operator should inform local Gardaí of the intended operation, this is not mandatory. Section 3.7 states:

A heliport site, suitable for Performance Class 1 operations, must be of sufficient dimensions to accommodate twice the overall length of the largest helicopter intending to use the heliport (see Appendices 2 of this OAM).

The heliport surface should be firm, substantially level and free from debris/dust/sand etc., which could endanger the helicopter, property, persons, vehicles or animals in the vicinity of the helicopter downwash 'footprint'. Helicopter downwash is proportional to the weight and size of the helicopter type producing it.

[8] **JAR**: Joint Aviation Authority Regulations agreed by European aviation regulatory authorities.
[9] **AIC**: Aeronautical Information Circular

For example, a hovering SK6IN can displace a volume of downwash equivalent to its weight of, circa, 9 tonnes. The effect of such downwash can be considerable and debris/litter such as loose papers, plastic bags, leaves, dust, sand or gravel, can become airborne endangering the helicopter itself, nearby persons, animals, structures, parked vehicles, etc. In particular, vulnerable persons can be easily blown over and/or injured by flying debris. The area downwind of a helicopter is worst affected. It is also recommended that no moveable/unmoveable object be permitted closer than 1.5 x Helicopter Main Rotor Diameter or 30 metres to the centreline of a helicopter, whichever is the greater, whilst a helicopter is manoeuvring slowly in close proximity to the surface.

An example of guidance (referred to in Appendices 2 of the OAM above) for a helipad layout and minimum dimensions for a Bell 222 helicopter is contained in **Appendix D**. When calculated for an S-76B type helicopter, the Final Approach and Take-off Area (FATO) + Safety Area (SA) equates to approximately 30 metres, in addition to a minimum permitted distance from buildings of 20 metres. The guidance for the Bell 222 is therefore similar to the S-76B type.

1.18.5.5 EASA Notices of Proposed Amendment (NPA)

Regarding the oversight of national authorities proposed by EASA in AR.GEN 305 (Monitoring of activities), EASA has published two NPAs, with a view to introducing binding, uniform rules regarding the safe operation of aircraft in EC states, namely NPA 2008-022 and NPA 2009-002. Such operation includes the type of helicopter operation conducted by this aircraft.

NPA 2008-022 consists of six NPAs of which NPA 2008-022b proposes the oversight of national authorities in implementing and enforcing the Basic Regulation and the oversight of persons and organisations undertaking aviation activities in the territory of the Member State. Section: *AR.GEN.305 Monitoring of activities* , proposes:

(a) The competent authority shall establish and maintain an oversight programme to monitor persons and organisations exercising activities on the territory of the Member State or certified by the competent authority that is proportionate to the complexity of the activities and the risks involved. The programme shall be developed taking into account the size of the organisation, local knowledge, possible certification according to industry standards and past surveillance activities.

(b) The oversight programme shall include:

(1) sample inspections, including unannounced inspections;

(2) for each organisation, at least once every 24 months:

(i) regular audits at intervals determined by the results of past surveillance activities;

(ii) meetings convened with the accountable manager to ensure they remain informed of significant issues arising during audits.

(c) The oversight shall focus on a number of key risk elements and identify any finding.

(d) The competent authority shall keep and update the continuing oversight programme, including a list of the approved organisations under its supervision, the dates when audit visits are due and when such visits were carried out.

NPA 2009-002 proposes including, inter alia, non-commercial operations by complex motor-powered aircraft and its conclusions state:

- *Regarding non-commercial operations by complex motor-powered aircraft select option 3C - declaration signed by the organisation managing the aircraft and endorsed by the owner, based on general operating and flight rules and organisation requirements – as explained in paragraph 2.8.8. The MCA[10] shows that this is the preferred option due to the positive impacts in safety, economic and regulatory harmonisation terms.*

- *Regarding non commercial air operations with other than complex motor-powered aircraft select option 4A - apply all ICAO standards and recommended practices even to operations outside the scope of ICAO Annex 6 (e.g. private domestic general aviation) – as explained in paragraph 2.9.8. The MCA shows that this is the preferred option due to the positive impacts in safety, social and regulatory harmonisation terms.*

The Investigation was informed by EASA that this declaration, signed by the organisation managing the complex motor-powered aircraft and endorsed by the owner, is an additional requirement to the Basic Regulation, which requires all ICAO standards and recommended practices, even for operations outside the scope of ICAO Annex 6.

1.18.6 Further information supplied by Owner

A Draft Report was issued on this accident in November 2009. In order to resolve conflicting information received by comment from interested parties the Investigation contacted the Owner. The Owner informed the Investigation in writing, on 22 April 2010, that his company had "*outsourced to*" the Supplier "*all aspects of the operation and management of the maintenance of the aircraft N399BH, for which the company was invoiced by*" the Supplier "*and payments were made against these invoices*". The Owner supplied copies of invoices that his company had paid to the Supplier. The invoices showed that the Supplier had invoiced for the travel, hotel and daily rate of an instructor for dates 2 and 3 of December 2007. These also showed that he had invoiced the Owner for a "Pilot Services Daily Rate" (pilot flying) on 4 and 5 December 2007 and the 6, 7, 9, 10, 11, 19, 20, 26 and 30 of June 2008. The Investigation was informed that the Owner made no payments to the Supplier after the helicopter accident and that the maintenance facility had billed the Owner directly for the costs of its work on the helicopter.

1.18.7 Further information supplied by Pilot

The Investigation understood from the Pilot's original interview that he was employed by the Supplier to fly N399BH and the Draft Report on this accident reflected that. Subsequently the Pilot submitted on 19 December 2009, as a comment on the Draft Report, that he was not employed by the Supplier to fly this helicopter and that he flew it, without payment or compensation from anybody, to build flying hours and experience on this particular helicopter type. He submitted that he made any arrangement to fly it directly with the Owner and that flying this helicopter was not part of his employment duties with the Supplier.

[10] **MCA**: Multi-Criteria Analysis: Evaluation by identifying, selecting, weighting and scoring criteria.

As a result, the Pilot was requested to attend for a second interview, which was later held in May 2010 when the Pilot returned from abroad. During this interview, the Pilot stated that he had not been paid for the flight, which was a private flight for the Owner who had arranged the flight by calling him directly and, as he was free, he agreed to do the flight. The Pilot indicated that he had no knowledge of charges or invoicing by the Supplier. He provided a sworn declaration to the Investigation stating that he had no contract or job description with the Supplier but was employed by the Supplier from about May 2006 to October 2008 to fly A109 type helicopters and flew the S-76B during his time off without payment to gain experience. He later supplied the Investigation with copies of his logbook that recorded him flying N399BH on 2, 3, 4 and 5 December 2007 and on the 6, 7, 9, 10, 11, 19, 20, 26 and 30 of June 2008 and on a number of flights subsequent to that date. A number of these flights in June were to the UK. The Pilot recorded himself as PIC for all S-76B flights in his logbook, although some flights on other types are recorded with his name and another.

1.18.8 Information supplied by the Supplier

The Investigation made repeated attempts to contact the Supplier, in order to clarify aspects of the relationship between the Supplier, the Pilot and the Owner. A significant delay ensued as the Supplier did not reply to these communications. However, following contact from his solicitor, an interview was held on 16 July 2010, with both the Supplier and his solicitor attending. There the Supplier stated that there was no contract or terms of employment between his company and the Pilot, but that the Pilot was an employee of the company and that income tax and PRSI was paid. He said that the employment duties of the Pilot did not include flying N399BH who, if he did, was not paid for so doing and did so during his time off. He was unable to provide details of the Pilot's leave or days off as he claimed there was no record. He said that he personally was flying the aircraft with an FAA Commercial licence on the days that the Owner had been invoiced, and that he would provide the Investigation with certain original documentation, including his pilot's logbook. He provided a sworn declaration that stated, inter alia, that he had never requested the Pilot to fly N399BH at his request or as his agent/employee and that he had no involvement whatsoever with the Owner or his company after June 2008. Subsequently, he provided copies of his logbook that showed that he flew N399BH as PIC on the 2 and 3 December 2007 and on 6, 7, 9, 10, 11, 19, 20, 26 and 30 June 2008. The copies showed no record of flights on N399BH after that date. However, he did not provide the original of his flying logbook to the Investigation as he had agreed.

The Investigation notes that the Owner received invoices from the Supplier for "Pilot Services" for the 4 and 5 December 2007 when the Supplier was not the pilot of the helicopter, according to his logbook, and the Pilot's logbook recorded that he flew the aircraft.

1.19 Useful or Effective Investigation Techniques

Not applicable.

2. ANALYSIS

2.1 Helicopter Landing Sites

2.1.1 General

A helicopter, by design, does not have to use conventional aerodrome sites and thus offers a significant advantage over the use of a fixed wing aircraft, whereby it can be operated into and out of temporary or permanent heliports.

Landing sites outside of aerodrome/airfield sites generally come in three different forms:

- Large open sites, such as parks, football pitches, golf courses, etc
- Elevated sites, such as a rooftop helipad, rig or lighthouse.
- Confined sites, where the flight of the helicopter is limited in some direction by terrain or the presence of obstructions, natural or manmade, e.g. a clearing in the woods, or a car park within or near to a building.

These landing sites may be within or outside a "Congested Area". The most challenging helicopter landing site is that where a confined and/or elevated site is contained within a congested area.

The intended landing site was a small car park located in the centre of a village, a congested area by definition of the Rules of the Air (**Section 1.18.5.2**).

2.1.2 Technical Considerations

When planning an operation to a landing site/heliport located within a congested area, a helicopter operator/pilot must ensure, in the event of an engine failure during any stage of the landing and take-off segments, that the helicopter used will retain Performance Class 1 capability, i.e., that in the case of a critical power unit failure, it is able to land on the rejected take-off area or safely continue the flight to an appropriate landing area, depending on when the failure occurs.

For helicopters operated in Performance Class 2 and 3, landing site/heliport take-off and landing distances and the obstruction environment are such as to permit a safe forced landing to be carried out should an engine fail during the landing or take-off segments and that there are also sufficient open spaces in the immediate vicinity of the landing site to ensure a safe forced landing should an engine failure occur during the approach and continued take-off segments. Such helicopters cannot be used for a landing in a congested site.

This helicopter was certified for Performance Class 1, and was thus capable of operating to and from suitable landing sites that are contained within congested areas.

2.1.3 Operational Considerations

In addition to the technical considerations, the suitability of the landing site/heliport must also be viewed from an operational standpoint. Factors such as, wind direction, available power reserve, surface condition/slope, proximity to obstructions, wires, livestock, public access/activity and security must be taken into account.

Accordingly, it is clear that careful consideration must always be given to the selection of a landing site/heliport by heliport site owners/occupiers, helicopter operators and pilots. This can be done by visiting the proposed site in person, viewing maps/documentation relating to the site, telephoning owners/occupiers to acquire a description of the site or flying a Recce[11] flight. Owners, who are considering allowing a helicopter to land on their property, should consider seeking expert advice from the authority or otherwise before granting permission to land since the requirements for these operations are quite complex.

However, ultimately the pilot-in-command (PIC) has the final authority as to the disposition of the helicopter, in particular, with regard to the suitability of any intended landing site.

2.2 The Landing Site

2.2.1 General

The overall general dimensions of the car park were approximately 32 x 24 metres. However, the existence of an underground ramp access, the boundary walls/fences, the lampposts and the presence of three parked vehicles reduced the available clear area down to approximately 15 by 15 metres. In addition, as high buildings, fences and lampposts surrounded the landing site, the site was a "confined area". The landing site was therefore a confined and congested area.

The helicopter made its final approach from the direction of the beach and, as reported by the Pilot, over the gap between the hotel apartment complex and the house beside the lane to the beach. This gap was measured at 12.5 metres. As the main rotor diameter of the S-76B is 13.41 metres, it is clear that the helicopter would not have fitted through the gap and it had to remain above the highest obstacle, which in this case was the hotel apartment complex (47 ft/14.3 m). An adequate clearance margin was required, therefore it is likely that the Pilot flew a constant angle approach, to an Out of Ground Effect (OGE) hover height of approximately 65 – 70 ft.

Thereafter, both CCTV and video evidence clearly show that the helicopter made a vertical descent without forward airspeed from that height down to a hover just above the lamppost (16.5 ft/5 m), which was located alongside the wall of the car park. The Investigation is therefore satisfied that the Pilot performed a vertical operation into this confined area. However, there was inadequate landing space for that manoeuvre since the area required by the Flight Manual was 21.34 x 21.34 metres (see **Section 1.18.4.2**) and that available was only 15 by 15 metres.

In addition, the S-76B Flight Manual Supplement No. 9 Vertical Operations, require that two pilots, with specific training, are onboard during vertical operations. These requirements were not satisfied when this accident occurred.

[11] **Recce**: A reconnaissance flight over the proposed landing area. This term is frequently used in association with helicopter operations.

2.2.2 Performance

As identified under **Section 1.18.4.1 S-76B Approach and Landing**, the Flight Manual prescribes and describes a number of approach and landing profiles, including Category 'A', Alternate Category 'A' and Category 'B', Supplement No. 9, Part I, prescribes and describes Category 'A' vertical operations from ground level heliports. All the above approach and landing profiles require a specific and calculated landing distance/space within the approach/departure area of the landing point. The Investigation is satisfied that insufficient distance was available at the Hotel car park for any of these Approach Categories.

When considering the helipad layout and minimum dimensions (OAM No. 08/00) for an S-76B type helicopter, the FATO and SA are approximately 30 metres, and the safe distance from an obstruction/building approximately 20 metres. However, the Investigation notes that this OAM is guidance material and is therefore not a regulation that must be complied with. It is therefore discretionary, unlike the S-76B Flight Manual which is obligatory. The view of the Investigation is that the provisions of OAM No. 08/00 should be obligatory when operating complex helicopters into confined and congested sites and accordingly a Safety Recommendation is issued.

Furthermore, whether on take-off or landing, a helicopter must be operated so as to have sufficient energy levels to enable it to continue to fly or to land safely at a low height and speed. The Investigation is satisfied, from examining the CCTV recording of the vertical descent into the car park, that the heights and speeds recorded during the vertical descent were significantly within the avoid area of the Height/Velocity of the Flight Manual, as depicted in **Appendix C.** This avoid area is based on the helicopter being at MAUW, which was not the case. However, no information is provided in the Flight Manual for operations at a lower weight and therefore a safe landing is not assured in the event that an engine suddenly becomes inoperative during that vertical descent.

2.2.3 Suitability of the Landing Site

The available clear area at the time of the attempted landing was approximately 15 square metres. The Flight Manual requirements (whether vertical operations or otherwise) and OAM guidelines require significantly in excess of that which was available. These requirements/guidelines however, assume a worst-case scenario in that they assume that a critical power plant is lost and that the approach can be discontinued or continued (depending on where the failure occurs) to the landing point. As a result, they provide vital protection to those onboard the helicopter and in relatively close proximity to the landing site. In addition, the requirements/guidelines provide a general "margin of safety or area of safety", in the event that a pilot has to cope with any emergency during the approach, landing or take-off phase.

The close proximity to the main street, which contained members of the public, buildings and vehicles, the general confinement of the landing area, the obstacle intense environment, and the requirement to enter the area in a vertical descent all contributed to the selected landing site being quite unsuitable.

Although there is a school beside the car park, it was closed at the time of the accident. Had it been at an earlier time when pupils were leaving the school a landing could not have been attempted since the Investigation subsequently found that the car park was usually full at that time due to parents waiting to collect pupils.

2.3 Loss of Control

Witnesses to this accident consistently reported that the main rotor blades struck a lamppost with a consequent loss of control of the helicopter, which then impacted heavily and caught fire. All recorded evidence, such as, video; CCTV and CVR support the statements of the witnesses.

The video taken by one witness shows the helicopter slowly descending vertically into the car park. The left rear area of the main rotor blade disc struck and dislodged the lamp on top of the lamppost. The helicopter then ascended slightly and re-established a hover. Approximately 3 seconds later the helicopter descended again and the main rotor blades disintegrated following contact with the steel lamppost and subsequently the ground. This video correlates with the images captured on the CCTV.

When viewing the final sequence of events, it is clear that the presence of the red car in the car park and the activity around it became the focus of the Pilot's attention, as the available space had now become even more restrictive than in his previous attempt to land. While in a steady hover, the Pilot likely prioritised in ensuring that he had adequate clearance from the parked car with its individual who was reported to be reluctant to move. While seated in the right hand seat, the Pilot would have been unable to ensure clearance of the rear left side of the helicopter and the confinement of the site was such that a clearing turn would not have been possible. This alignment, in a hover position to the left and away from the parked car, brought about the first contact with the lamp. While the Pilot commented that he had hit something the initial impact itself was relatively slight, as was shown by the CVR trace in **Appendix B**. The camera video confirmed that at that point only the lamp on top of the lamppost had been shattered (**Photo 2**). The re-establishment of a hover allowed the Pilot time to confirm the controllability of the helicopter. However, the Pilot did not further explore the cause of the initial contact and continued to descend from the same hover position, this time the main rotor making more substantial contact with the steel lamppost.

The Investigation is satisfied that striking an obstruction, which was contained within a confined landing site in a congested area, caused loss of control with a consequent ground impact.

2.4 Reported No. 1 Engine Fire Warning

The Pilot reported that the No. 1 Fire Caption and T-handle illuminated after he passed LDP and thus was committed to a landing. Following the fire warning, he proceeded with the drill, cancelling the warning and then confirmed that No. 1 engine was operating in the green range.

In the case of a fire warning with no sign of fire or abnormal engine indications, a pilot is not required by Flight Manual procedures to *land immediately.* The Flight Manual in this case contains the requirement to accomplish the fire drill and then to *land as soon as possible* (**Section 1.6.4**), thus a diversion can be made to a more suitable landing site if necessary.

As there was no Flight Recorder available (or required) and as the post impact fire resulted in the total destruction of the cockpit area, including melting of the engine accessories, there was no physical evidence to confirm whether or not a fire warning occurred prior to impact.

It is noted that the helicopter took off from the beach to re-position to the car park and shortly afterwards a warning tone sounded twice. The Investigation is satisfied that this warning was associated with the early retraction of the landing gear before the airspeed had reached 60 kts **(Section 1.6.4)**.

As the tone was only heard twice, it indicates that the Pilot either silenced the warning or the helicopter had accelerated above the warning threshold of 60 kts, neither of which is an unusual occurrence. The audible warning for both the undercarriage and the fire warning system is provided by the same tone generator. Therefore, the fact that the undercarriage warning sounded verifies that the warning system was functioning. Consequently, had an engine fire warning been later detected during the latter stages of the approach, a continuous tone would be expected to be heard on the CVR. All 4 audio channels of the CVR were searched, but no fire warning tone was found. The Pilot also listened to the CVR and he too was unable to identify any evidence of a fire warning.

In addition, the breathing pattern of the Pilot was regular and normal up to the initial contact with the lamp and does not reveal signs of abnormal stress. The sound of his breathing alters in the 6 seconds from the initial contact to the end of the recording. One would expect that if the Pilot was presented with an emergency during the latter stages of the approach then his breathing and stress levels would have changed.

None of the video or CCTV footage taken showed any evidence of fire prior to impact. No witnesses reported a fire before impact.

Therefore, the combination of both factors; the lack of a fire warning tone on the CVR and the recorded unchanged breathing of the Pilot prior to the initial contact leads the Investigation to the opinion that an engine fire warning was unlikely to have occurred before the initial strike. This is reinforced by the fact that, although the CVR records the Pilot frequently commenting aloud on matters associated with the operation of the helicopter, he passed no comment after he called “LDP” until he exclaimed that he had hit something.

However, it is possible that the fire warning system detected a fire immediately after the main impact, as fire is seen on the CCTV record within 2 seconds of the helicopter coming to rest. It is not unusual for witnesses to confuse the sequence of events especially when they have been involved in traumatic, compressed time events, such as this accident.

2.5 Human Factors

The recovered CVR provided the Investigation with a good account of the sequence of events leading up to the accident. The Pilot was under the impression that he was to fly from Naas to Dundalk and back to Naas. On landing at Dundalk the Owner asked the Pilot, if he would, *'land us at Bettystown'*. The Owner continues to describe the location, *'beside the hotel, the* [named] *hotel on the beach'*. The Pilot responded, *'no problem'* and they flew to Bettystown. The initial intention was to land on the beach, but the Pilot suggested that, due to the risk of sand ingestion into the engines, they would land in the car park. The Owner agreed to this but, as the helicopter made its first approach, a car entered the car park and the Pilot aborted the landing. The Owner then engaged in providing a number of options and suggestions of landing sites to the Pilot, including a green area beside the apartment block, and finally directed the Pilot to a clear dry area on the beach. Following landing and engine shutdown, a further request was made to fly to Inchicore in Dublin. It is clear that the Pilot was also unaware of this requirement and was apologetic in advising that he had *"no plans to get to Dublin"* and was thus unable to do the flight. It is noted however, that the passengers accepted this decision without question. The arrival of a number of bystanders coming towards the helicopter, provided safety concerns for the Pilot and he elected to start up the helicopter and re-position it into the hotel car park.

This account of events also gives an insight into the general operational environment with which the Pilot was confronted with that day. While unaware of a requirement to land at Bettystown, the Pilot undertook the mission, even though he was unaware of the exact location and suitability of the landing site. In attempting to find a suitable landing site, the Owner became heavily involved in the decision-making process and the Pilot attempted to respond to these requests. The situation was compounded further as the Pilot had to decline an additional new request to go to Dublin. The arrival of sightseers towards the helicopter, the fact that the helicopter was parked on a public beach and the concern of the Pilot to fulfil the wishes of the Owner, all combined to put additional pressure on the Pilot and thus created a need for him to respond and recover the situation as soon as possible. The fact that the Pilot did not have the opportunity to conduct a pre-recce of the Bettystown area, meant that he had no further landing options available to him other than to either leave the area or land in the car park which he had previously attempted to land in. A decision to leave the area would have complicated the situation further. Therefore, it is probable that the Pilot felt pressurised into attempting to land at a landing site, which he himself most likely considered less than suitable.

Private owners who invest in a helicopter for private corporate type operations, such as this case, do so because it provides efficiency by travelling directly to private or business destinations thus saving time. Similarly, owners hire pilots to ensure their objectives and requirements are accomplished. As the helicopter is sold with stated performance requirements and capabilities, owners tend to expect such performance and capabilities to be achievable at all times, regardless of when or by whom the helicopter is been flown. In cases where a pilot is not directly employed by an owner but by a company providing an owner with a range of services, there can be a certain lack of goal congruency between pilot and owner. In general, owners of helicopters are not familiar with performance requirements or operational and legal limitations and employ a pilot to look after these considerations.

However, while the helicopter has the unique capability to land vertically, not all landing sites are suitable, and the final decision to use a landing site rests with the pilot. Therefore, particular helicopter pilots can be faced with the challenge of responding to the corporate type demands of private owners, while still ensuring safety within the Rules of the Air. A dilemma therefore can exist whereby a pilot in ensuring the safety of the operation, does not meet the needs of the owner concerned, and thus possibly jeopardises his employment. It is clear therefore that there can be significant pressures on a pilot to maintain a positive "can do" profile and reputation regarding an owner's wishes and demands.

2.6. Legal Considerations

The Investigation is satisfied that the Owner was not charging for the use of his aircraft and that therefore the flight was not a Commercial Air Transport operation as defined (see **Section 1.18.5**). The Owner informed the Investigation that he had engaged a company to provide a pilot and organise the ongoing maintenance of this large helicopter. In business terms, such an arrangement is regarded as a corporate or commercial transaction.

That this anomaly can arise is due to the fact that in international aviation there are only two agreed types of operation: Commercial Air Transport and General Aviation. Although corporate aviation is referred to in the legislation of the USA and has been recently addressed by EASA, in Ireland it is still part of General Aviation and is therefore regulated as such.

2.6.1 Aircraft Registration

The helicopter was registered in the USA and had not been placed on the Irish register. The Owner informed the Investigation that he had been advised that this process would be onerous. The Investigation is satisfied that this was, in part, due to the initial certification costs of placing a first S-76B on the Irish registry and also due to the fact that the original documentation for the aircraft had been destroyed in a previous fire.

However, had this large helicopter been on the Irish Register it would have been categorised as a Complex Motor-Powered Aircraft and consequently would have required an Air Operator's Certificate (AOC) and two pilots to operate it. Had this been the case this accident would not have occurred since an AOC would require a landing site to be surveyed in advance and the car park would have been rejected as unsuitable.

Whereas the international standards and recommended practices of Annex 6 Operation of Aircraft Part III, International Operations - Helicopters should apply to helicopter operations worldwide, there are significant variations in the regulatory environment in various states regarding how those standards are achieved.

Relative to Ireland the operational philosophy in the United States is quite different and less regulated. The Rules of the Air in Ireland (**Section 1.18.5.2**) requires that the more conservative Performance Class rules be used to calculate safe landing distances. Whereas in the USA a Category B vertical operation out of confined sites is regarded as having an acceptable level of risk exposure, this is not allowed in Ireland.

The Investigation notes that there is a fundamental dichotomy between the system in operation in the USA and that in Ireland, both in operation and licensing. Since the Pilot was already rated as a Private Pilot Rotorcraft, he did not need a checkout under Federal Aviation Regulations in order to fly the S-76B. However, the training that the Pilot received would be considered wholly inadequate for a pilot to commence flying an S-76B type helicopter under either Irish or European regulation.

Additionally, the maintenance scheduling and requirements are more intensive under Irish registration. Therefore, due to the increased ongoing operational and maintenance costs a helicopter based and registered in Ireland is at a significant cost disadvantage relative to those registered in the USA.

The Investigation notes that NPA 2008-022 proposes the future oversight of competent authorities in member states of the EU to ensure that they will establish and maintain an oversight programme to monitor persons and organisations exercising activities on the territory of the Member State. In addition, NPA 2009-002 proposes future requirements for operation of complex, motor powered aircraft. These NPAs will include the oversight of aircraft, such as this helicopter, to ensure that they are being operated in accordance with relevant legislation. In view of these proposals, the Investigation is of the opinion that a Safety Recommendation is not therefore required.

2.6.2 Pilot's Licence

The Owner of the helicopter informed the Investigation that he employed the Supplier to provide a pilot and organise maintenance services. The Supplier informed the Investigation, during the Pilot's initial interview that he employed the Pilot and had paid for his S76 training. The Pilot had two valid licences; a FAA PPL and a JAA CPL. Whereas the Pilot could fly the helicopter under the privileges of his FAA issued PPL, the FAA advised the Investigation that, if the Pilot was paid for this, it could not be done under the privileges of a Private Pilot Licence. Although the Pilot also had a JAA CPL, he did not have an S-76B helicopter rating on that licence and therefore could not fly the helicopter under the privileges of that licence. Due to the Pilot's interview and that of the Owner, the Investigation understood that the Pilot was employed to fly the N399BH and a Draft Report was produced to that effect.

The Pilot, in a later submission, informed the Investigation that he was not employed by the Supplier to fly this particular helicopter (N399BH) and that he flew it on his own time without payment in order to build hours on type. However, this conflicted with the original information given to the Investigation. The Owner was then contacted, and he reaffirmed that he had outsourced flying of the helicopter and provided the Investigation with invoices showing that he had paid for the training costs of both the Supplier and the Pilot and that the Supplier had invoiced him for pilot flying. In trying to resolve this issue, the Investigation subsequently interviewed both the Pilot and the Supplier and requested their logbooks.

The Investigation notes the Owner paid for pilot flying on the dates recorded by the Pilot in his logbook up to the 30 June 2008. The Pilot's logbook copies record this flying as P1 and does not record another pilot either flying or assisting him in flying the aircraft on those dates, although it does so on other dates. The Supplier subsequently said that he too was flying the aircraft on those days as PIC. Had the Supplier been acting as PIC on these flights then the Pilot should not have been

recording his time as P1 when pilot flying was being charged for, as this was not within the privileges of his PPL licence.

The Investigation notes that the Supplier invoiced the Owner for a "Pilot Services Daily Rate" for the 4 and 5 December 2007 when the Pilot's logbook recorded that he flew the helicopter and the Supplier's logbook showed that he did not fly N399BH on those dates. Thus, the Supplier invoiced the Owner for a Pilot Services Daily Rate when N399BH was flown by the Pilot. At that time, the Pilot was in the employment of the Supplier as a helicopter pilot.

It is clear that the Owner understood that he had outsourced pilot flying of his helicopter and that he was paying a commercial rate for a pilot to fly his helicopter. It is also clear that the Owner did not pay for Pilot Services on the day the helicopter crashed. Furthermore, the Pilot also stated that no payment was made to him for this flight. Accordingly, in view of the conflicting information, the Investigation was unable to satisfy itself as to the validity of the Pilot's licence to conduct this flight.

2.6.3 Permission to Land

A pilot must ensure that he has permission to land at a particular landing site before he commences a flight. In this case, it would have been difficult since the CVR reveals that the Pilot was only informed that they were travelling to Bettystown after landing in Dundalk. He was asked to land beside the Hotel on the beach. It is unclear whether this request was to land beside the Hotel or land on the beach but, in any case, the Pilot agreed. There is no record on the CVR of landing permission being discussed since the Pilot probably presumed that an adequate landing site existed in the Hotel car park where the Hotel Owner had given permission to land. Such was not the case and instead he landed on the beach where he did not have permission to land from either authority that controlled it.

2.7 Survivability

The accident happened in the middle of a village at a time when, fortunately, the local school, located in the Hotel complex, had closed for the day and there were few bystanders. Following main rotor blade contact with the lamppost, the helicopter lost control and entered a violent rotation, impacted and caught fire. The helicopter wreckage came to rest on the far side of a low boundary wall adjacent to the car park. It is considered likely that the robust steel security fencing between the car park and the street protected those people on the footpaths and passing traffic at the time of the accident. However, significant projectile damage was inflicted on a number of buildings within the general area of the car park. Had the helicopter wreckage entered the main street it is likely that significantly more injury to persons and damage to property would have occurred. As it was, it is considered remarkable that no serious injuries occurred to any members of the public during the impact sequence.

Despite the fact that the helicopter was engulfed by fire in two seconds, the Pilot successfully managed to extricate himself safely by kicking out the door window and the accident itself was therefore survivable.

The view of the CCTV camera of the accident, at 15.41:08.75, was obscured by a thick grey cloud. As the car park surface was clean and intact post accident this was

unlikely to be dirt and was probably the result of fuel dispersion from ruptured fuel tanks. This rupture was caused by the helicopter impacting the low wall while still rotating. A witness reported the initial fire at the bottom of the helicopter (where the fuel tanks were located) and the thick black smoke that is the normal result of burning large quantities of fuel.

The Investigation noted the presence of a crowd of bystanders watching the post impact fire, one person from metres away. The heat of the flames eventually drove these bystanders back. In addition, three minor explosions were reported. The public should be aware that aviation accidents such as this one, while extremely rare, frequently involve a large quantity of fuel and are higly dangerous areas. This, combined with hot engine parts, can cause explosions of considerable violence, especially if a petrol engine helicopter is involved and the fuel tanks are intact. In this case the fuel was kerosene, a less volatile fuel that is used in turbine engines.

In addition, modern helicopters are constructed of considerable quantities of composite materials. Such materials, when burnt, can be injurious to the health of those nearby who are not equipped with suitable breathing equipment. Therefore, the general public should keep such accident sites at a safe distance. Self preservation alone would suggest this.

The Emergency Services were recorded by the CCTV arriving 13 minutes after the accident, which is considered by the Investigation to be a satisfactory response time.

3. CONCLUSIONS

(a) Findings

1. The Helicopter had a valid FAA Certificate of Airworthiness.

2. The Pilot inspected the car park from the air on arrival over Bettystown but, due to a car entering the car park, landed on the beach instead.

3. Permission had not been obtained to land on the beach.

4. The Pilot had safety concerns regarding the number of people gathering about the helicopter on the beach and decided to re-position the helicopter to the car park where he had permission to land.

5. The Pilot did not avail of the opportunity to inspect the car park on foot prior to re-positioning from the beach.

6. The Pilot reported that an engine fire warning activated on No. 1 Engine after LDP. However, the Investigation did not find any evidence to support this.

7. During an attempted vertical landing, the main rotor of the helicopter contacted a lamppost, following which control was lost and the helicopter yawed to the right and rolled rapidly to the left.

8. The main rotor impacted the ground and the helicopter was destroyed in the post impact fire.

9. A vertical landing was attempted without the required crew complement.

10. The approach profile used did not comply with the requirements of the Flight Manual.

11. The car park did not conform to Flight Manual heliport size specifications and was too small.

12. The selected landing site in the centre of a village was inappropriate.

13. The Investigation was unable to satisfy itself regarding the validity of the Pilot's licence to conduct this flight.

14. Bystanders approached the flaming wreckage oblivious to the threat to their own safety.

15. The Investigation considers it remarkable that no serious injuries resulted from this accident, considering the confined and congested location.

(b) Probable Cause

During a vertical descent into a confined and unsuitable landing site, the main rotor of the helicopter contacted a lamppost causing loss of control.

(c) Contributory Causes

1. The car park did not conform to Flight Manual specifications for a landing site.

2. A vertical landing was attempted without the required crew complement or competency.

4. SAFETY RECOMMENDATIONS

It is recommended that:

1. The Irish Aviation Authority should incorporate the provisions of OAM No. 08/00 into Irish Air Law Regulation. **(IRLD2010023)**

Appendix A

Code of Federal Regulations (USA) Sec. 61.113

FAR Part 61 CERTIFICATION: PILOTS, FLIGHT INSTRUCTORS, AND GROUND INSTRUCTORS

Subpart E--Private Pilots

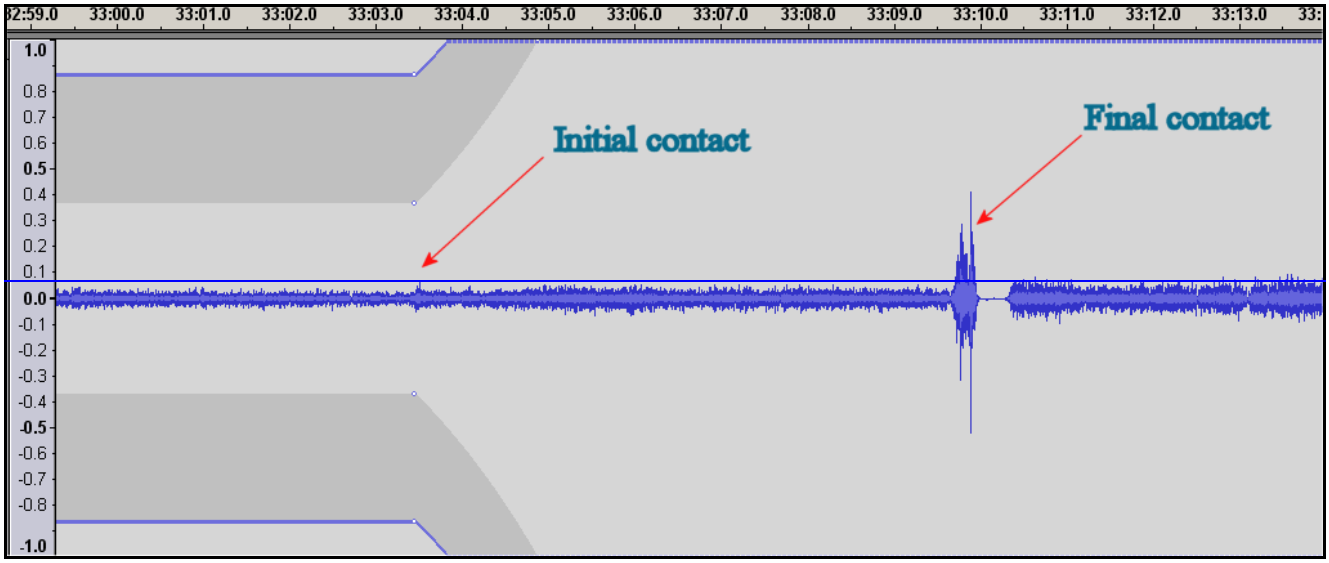
Private pilot privileges and limitations: Pilot in command.

(a) Except as provided in paragraphs (b) through (g) of this section, no person who holds a private pilot certificate may act as pilot in command of an aircraft that is carrying passengers or property for compensation or hire; nor may that person, for compensation or hire, act as pilot in command of an aircraft.
(b) A private pilot may, for compensation or hire, act as pilot in command of an aircraft in connection with any business or employment if:
(1) The flight is only incidental to that business or employment; and
(2) The aircraft does not carry passengers or property for compensation or hire.
(c) A private pilot may not pay less than the pro rata share of the operating expenses of a flight with passengers, provided the expenses involve only fuel, oil, airport expenditures, or rental fees.
(d) A private pilot may act as pilot in command of a charitable, nonprofit, or community event flight described in Sec. 91.146, if the sponsor and pilot comply with the requirements of Sec. 91.146.
(1) The sponsor of the airlift notifies the FAA Flight Standards District Office with jurisdiction over the area concerned at least 7 days before the event and furnishes--
(i) A signed letter from the sponsor that shows the name of the sponsor, the purpose of the charitable event, the date and time of the event, and the location of the event; and
(ii) A photocopy of each pilot in command's pilot certificate, medical certificate, and logbook entries that show the pilot is current in accordance with Secs. 61.56 and 61.57 of this part and has logged at least 200 hours of flight time.
(2) The flight is conducted from a public airport that is adequate for the aircraft to be used, or from another airport that has been approved by the FAA for the operation.
(3) No aerobatic or formation flights are conducted.
(4) Each aircraft used for the charitable event holds a standard airworthiness certificate.
(5) Each aircraft used for the charitable event is airworthy and complies with the applicable requirements of subpart E of part 91 of this chapter.
(6) Each flight for the charitable event is made during day VFR conditions.
(7) The charitable organization is an organization identified as such by the U.S. Department of Treasury.
(e) A private pilot may be reimbursed for aircraft operating expenses that are directly related to search and location operations, provided the expenses involve only fuel, oil, airport expenditures, or rental fees, and the operation is sanctioned and under the direction and control of:
(1) A local, State, or Federal agency; or
(2) An organization that conducts search and location operations.
(f) A private pilot who is an aircraft salesman and who has at least 200 hours of logged flight time may demonstrate an aircraft in flight to a prospective buyer.
(g) A private pilot who meets the requirements of Sec. 61.69 may act as pilot in command of an aircraft towing a glider or unpowered ultralight vehicle.

Appendix B

CVR Sound Spectrum

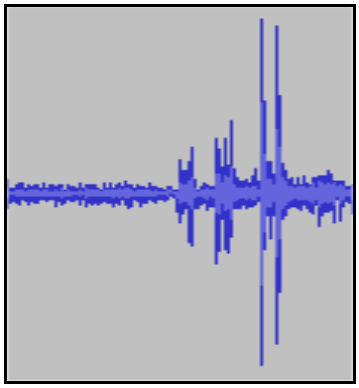
The following extract of the CVR Channel No. 4 sound spectrum shows the CVR recording from 32.59.25 to Final contact.



Graphic 3 - CVR Channel No. 4, final segment of CVR recording

Note: The blank trace recorded after the Final Contact is due to the CVR erase head having erased the earlier 30-minute recording, the beginning of which follows the erased section.

Channel No. 4 frequency graph shows 3 initial strikes of increasing amplitude. The initial contact above is amplified in **Graphic 4**:



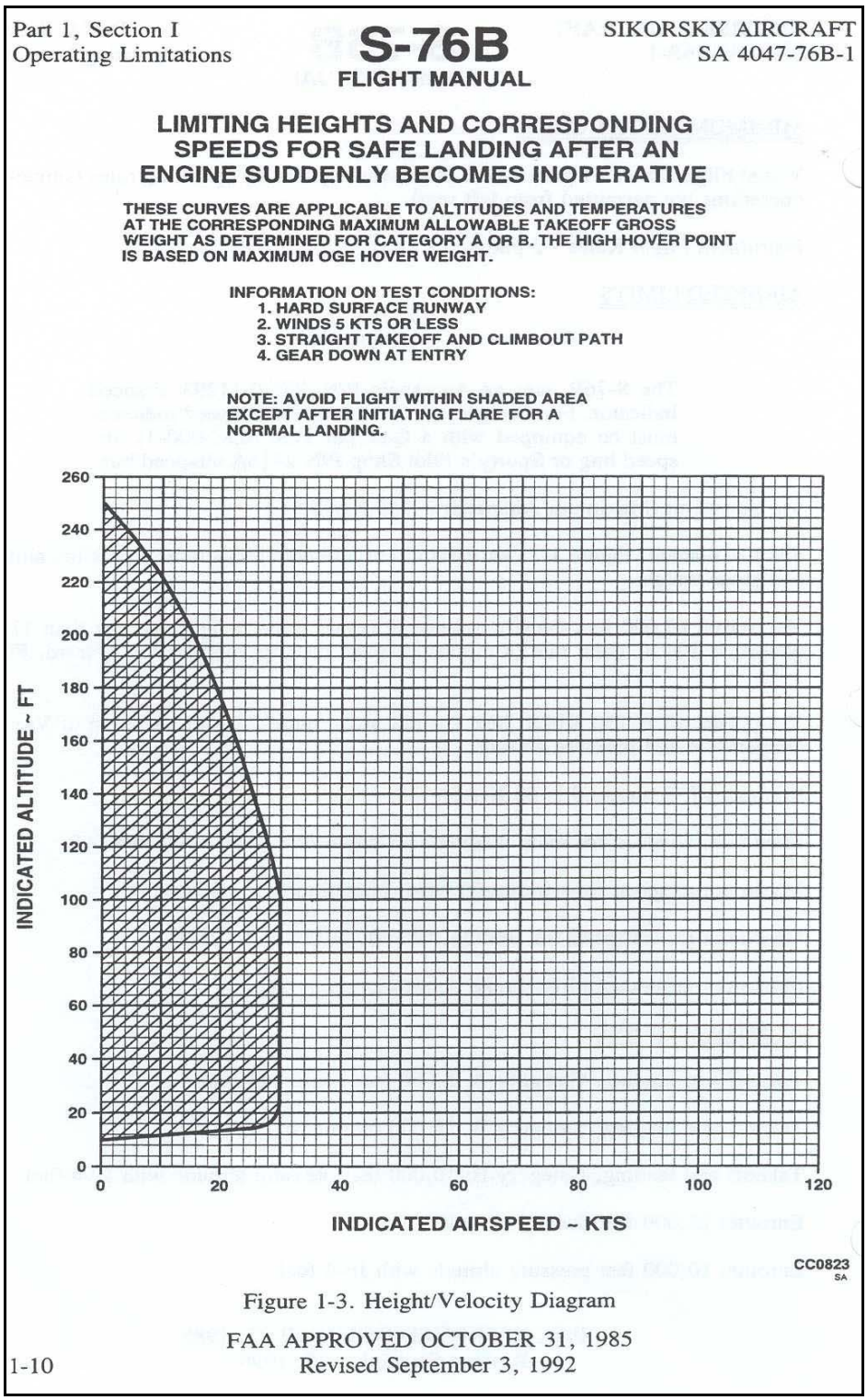
Graphic 4 – Initial contact

The elapsed time from Initial Contact to then end of Final Contact is 6.08 seconds.

FINAL REPORT

Appendix C

S-76B Height/Velocity Diagram

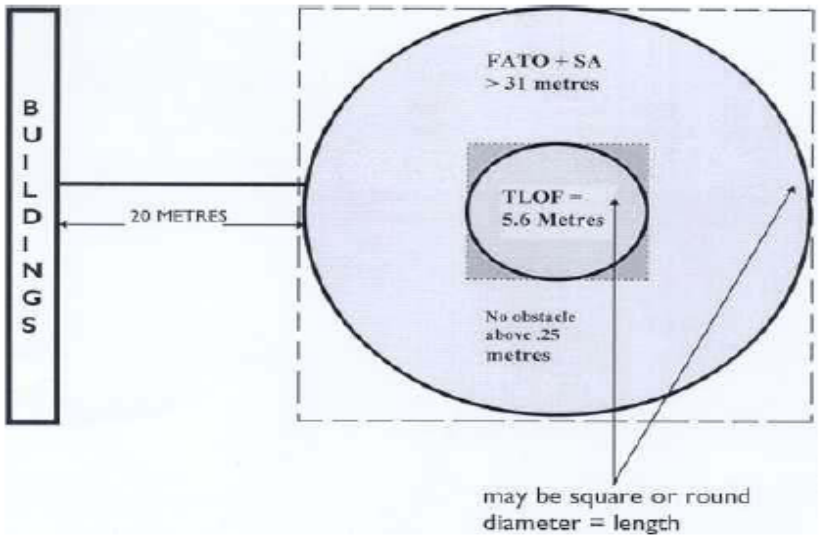


Appendix D

OAM No. 08/00, 4.3

This guidance is typical of that provided for the information of heliport or potential heliport owners e.g. landowners considering allowing a helicopter to land or take-off from their property.

4.3 HELIPAD LAYOUT AND MINIMUM DIMENSIONS FOR BELL 222



Notes:
Touchdown and Lift-off area = 1.5 x largest undercarriage dimension
= 1.5 x 3.72
= 5.58 m (say 5.6 m)
FATO + SA = 2 x Overall length of B222
= 2 x 15.33 m
= 30.66 m (say 31 m) but
Flight Manual helipad profile requires minimum area of 2.5 x 11.92 (RD)
= 29.8 m (say 30m)

TLOF surface to be firm, flat and load bearing to 2.5 MTW A = 10 Tonnes
Recommended concrete/ paved surface for access by hospital utilities in all weather conditions.

Minimum permitted distance from buildings = 1.5 x RD
= 1.5 x RD
= 1.5 x 12.8m
= 19.2m (say 20 m)

It is strongly recommended that the TLOF be located 30 metres or more away from buildings to avoid downwash effects on the building and noise disturbance/annoyance to persons in the building.

OAM 08/00 *20*

OAM No. 08/00, 4.3 Helipad layout guidance for a Bell 222 Helicopter

Appendix E

Glossary

AAIB	Air Accident Investigation Branch, UK
AAIU	Air Accident Investigation Unit - Ireland
AIC	Aeronautical Information Circular
AME	Aero Medical Examiner
AMSL	Above Mean Sea Level
AOC	Air Operator's Certificate
ATC	Air Traffic Control
CCTV	Closed Circuit Television security camera system.
CPL	Commercial Pilot Licence
CVR	Cockpit Voice Recorder
EASA	European Aviation Safety Agency - EU
EC	European Community
EIDW	Dublin Airport
EU	European Union
FAA	Federal Aviation Administration - USA
FAR	Federal Aviation Regulations - USA
FATO	Final Approach and Take-off Area
FDR	Flight Data Recorder
GA	General Aviation
IAA	Irish Aviation Authority
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IGE	In Ground Effect
IIC	Investigator-in-Charge
JAA	Joint Aviation Authority
JAR(s)	Joint Aviation Authority Requirement(s)
LDP	Landing Decision Point
MAUW	Maximum All Up Weight
METAR	Meteorological Actual Report
Navaid	A ground based RF transmitter
NOTAM	Notice to Airmen
Nr	Main Rotor RPM.
OAM	Operations Advisory Memorandum
OGE	Out of Ground Effect
PIC	Pilot-in-command
PPR	Prior Permission Required
PPL	Private Pilot Licence
QNH	An altimeter barometric setting that displays altitude above sea level
RPM	Revolutions Per Minute
RWY	Runway
SA	Safety Area
S.I.	Statutory Instrument (Irish Legislation)
SR	Safety Recommendation
SUV	Sports Utility Vehicle
UTC	Universal Time Coordinated (the standard time for aviation)
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

- END -