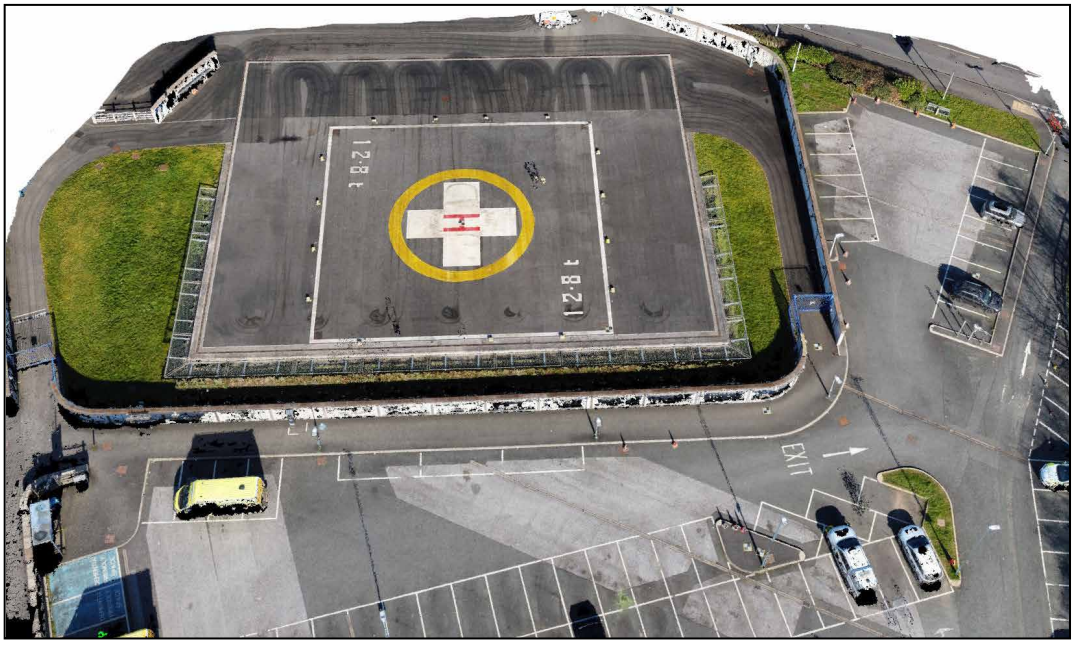
AIRCRAFT ACCIDENT REPORT 2/2023

AAIB
Air Accidents Investigation Branch

Report on the accident to
Sikorsky S-92A, G-MCGY
at Derriford Hospital, Plymouth, Devon
on 4 March 2022



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Contents

Appendices

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AAIB	Air Accidents Investigation Branch
ACANS	Aviation Command & Aircraft Navigation System
AEO	All Engine Operating
agl	above ground level
AI	Aeronautical Information
AIDU	Aeronautical Information Documents Unit
ANO	Air Navigation Order
AOC	Air Operator's Certificate
ARCC	Aeronautical Rescue Coordination Centre
ATC	Air Traffic Control
ATMIST	Age, Time of incident, Mechanism, Injuries sustained, Treatment and needs (paramedic handover report)
ATSB	Australian Transportation Safety Board
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CCTV	Closed circuit television
CLSD	Company Landing Site Directory
DfT	Department for Transport
DH	Derriford Hospital
DHSC	Department of Health and Social Care
DRA	Dynamic risk assessment
EASA	European Union Aviation Safety Agency
ED	Emergency Department
ETA	Estimated Time of Arrival
FATO	Final Approach and Takeoff Area
FOD	Foreign Object Damage/Debris
FODUO	Foreign object damage, Obstacles, Downwash hazards, Undershoot clearance and obstacles, Overshoot clearance and obstacles (mnemonic)
FSI	Flying Staff Instruction
ft	feet
GA	Go-around
HART	Hazardous Area Response Team
HBN	Health Building Note
HCA	Helideck Certification Agency
HEMS	Helicopter Emergency Medical Service
HHLS	Hospital Helicopter Landing Site
HLL	Helideck Limitations List
HLS	Helicopter Landing Site
hrs	hours (clock time as in 1200 hrs)
HRT	Helicopter Response Team
HSE	Health and Safety Executive
ICAO	International Civil Aviation Organisation
KIAS	knots indicated airspeed
kg	kilogram(s)
kt	knot(s)
lb	pound(s)
m	metre(s)
m/s	metres per second
MCA	Maritime and Coastguard Agency
MOD	Ministry of Defence
MPFR	Multi-Purpose Flight Recorder
MTC	Major Trauma Centre
MTOW	Maximum Takeoff Weight
NAA	National Aviation Authorities
NHS	National Health Service
NTSB	National Transportation Safety Board
OEI	One Engine Inoperative
OM	Operations Manual
OnSLG	Onshore Safety Leadership Group
PC	Performance Class
PF	Pilot Flying
PHNT	Plymouth Hospitals NHS Trust
PPE	Personal protective equipment
PT	Public Transport

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

QEH	Queen Elizabeth Hospital
RAF	Royal Air Force
RFFS	Rescue and Fire Fighting Services
RN	Royal Navy
RTOD	Restricted Takeoff Distance
SAR	Search and Rescue
SOP	Standard Operating Procedure
SRR	Search and Rescue Region
SWASFT	South Western Ambulance Service NHS Foundation Trust
SWAST	South Western Ambulance Service Trust
UHF	Ultra-high Frequency
UK	United Kingdom
VHF	Very High Frequency

Air Accidents Investigation Branch

Aircraft Accident Report No: 2/2023 (AAIB-28045)

Registered Owner and Operator:	Bristow Helicopters Ltd
Aircraft Type:	Sikorsky S-92A
Nationality:	British
Registration:	G-MCGY
Place of Accident:	Derriford Hospital, Plymouth, Devon
Date and Time:	4 March 2022 at 1055 hrs All times in this report are UTC

Introduction

The Air Accidents Investigation Branch (AAIB) were notified of this accident on 4 March 2022, the day that it occurred. In exercise of his powers, the Chief Inspector of Air Accidents ordered an investigation to be carried out in accordance with the provisions of retained Regulation (EU) 996/2010 (as amended) and the UK Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2018.

The sole objective of the investigation of an accident or serious incident under these regulations is the prevention of accidents and serious incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

In accordance with established international arrangements, the National Transportation Safety Board (NTSB) in the USA, representing the State of Design and Manufacture of the helicopter, appointed an Accredited Representative to the investigation. The helicopter operator, the hospital Helicopter Landing Site (HLS[1]) Site Keeper[2], and the UK Civil Aviation Authority (CAA) also assisted with the investigation.

Summary

The helicopter, G-MCGY, was engaged on a Search and Rescue mission to extract a casualty near Tintagel, Cornwall and fly them to hospital for emergency treatment. The helicopter flew to Derriford Hospital (DH), Plymouth which has a Helicopter Landing Site (HLS) located in a secured area within one of its public car parks. During the approach

1 Hospital Helicopter Landing Sites are also referred to as HHLS in some documents.
2 The HLS Site Keeper is the owner of the HLS, as identified in CAA publication CAP 768, 'Safeguarding Aerodromes'.

and landing, several members of the public in the car park were subjected to high levels of downwash from the landing helicopter. One person suffered fatal injuries, and another was seriously injured.

The investigation identified the following causal factors:

1. The persons that suffered fatal and serious injuries were blown over by high levels of downwash from a landing helicopter when in publicly accessible locations near the DH HLS.

2. Whilst helicopters were landing or taking off, uninvolved persons were not prevented from being present in the area around the DH HLS that was subject to high levels of downwash.

The investigation identified the following contributory factors:

1. The HLS at DH was designed and built to comply with the guidance available at that time, but that guidance did not adequately address the issue of helicopter downwash.

2. The hazard of helicopter downwash in the car parks adjacent to the HLS was not identified, and the risk of possible injury to uninvolved persons was not properly assessed.

3. A number of helicopter downwash complaints and incidents at DH were recorded and investigated. Action was taken in each case to address the causes identified, but the investigations did not identify the need to manage the downwash hazard in Car Park B, so the actions taken were not effective in preventing future occurrences.

4. Prior to this accident, nobody at DH that the AAIB spoke to was aware of the existence of Civil Aviation Publication (CAP) 1264, which includes additional guidance on downwash and was published after the HLS at DH was constructed. The document was not retrospectively applicable to existing HLS.

5. The operator of G-MCGY was not fully aware of the DH HLS Response Team staff's roles, responsibilities, and standard operating procedures.

6. The commander of G-MCGY believed that the car park surrounding the DH HLS would be secured by the hospital's HLS Response Team staff, but the co-pilot believed these staff were only responsible for securing the HLS.

7. The DH staff responsible for the management of the HLS only considered the risk of downwash causing harm to members of the public within the boundary of the HLS and all the mitigations focused on limiting access to this space.

8. The DH staff responsible for the management of the HLS had insufficient knowledge about helicopter operations to safely manage the downwash risk around the site.

9. The HLS safety management processes at DH did not result in effective interventions to address the downwash hazard to people immediately outside the HLS.

10. HLS safety management processes at DH did not identify that the mitigations for the downwash hazard were not working well enough to provide adequate control of the risk from downwash.

11. Communication between helicopter operators and DH was ineffective in ensuring that all the risks at the DH HLS were identified and appropriately managed.

12. Safety at hospital HLS throughout the UK requires effective information sharing and collaboration between HLS Site Keepers and helicopter operators but, at the time of the accident, there was no convenient mechanism for information sharing between them.

Following this accident, Safety Action was taken by the helicopter operator, Derriford Hospital and NHS England Estates to control and mitigate the risk. The specific action taken is detailed in paragraph 4.2.1 of this report. Additional action by Derriford Hospital and NHS England Estates to improve safety, as described in paragraph 4.2.2 of this report, is either planned or in progress.

Helicopters used for Search and Rescue and Helicopter Emergency Medical Services (HEMS) perform a vital role in the UK and, although the operators of these are regulated by the UK Civil Aviation Authority, the many helicopter landing sites provided by hospitals are not. It is essential that the risks associated with helicopter operations into areas accessible by members of the public are fully understood by the HLS Site Keepers, and that effective communication between all the stakeholders involved is established and maintained. Therefore, nine Safety Recommendations have been made to address these issues, and these are listed in paragraph 4.1 of this report.

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1. Factual Information

1.1 History of the flight

1.1.1 Background

The helicopter was operating from its base, at Newquay Cornwall Airport, on behalf of the Maritime and Coastguard Agency[1] (MCA) on a Search and Rescue (SAR) operational flight[2]. The operator had been flying out of Newquay with Sikorsky S-92A helicopters (S92) in the SAR role since 1 January 2016. Prior to this, SAR flights around the UK were operated by the military.

The operator has its UK headquarters in Aberdeen and operates from 10 bases around the UK in the SAR role. Five operate the S92 and five operate the Agusta Westland AW189 (AW189). There are two helicopters at each base.

1.1.2 The flight

The helicopter was tasked by the Aeronautical Rescue Coordination Centre (ARCC)[3] to assist with extracting a hypothermic casualty that was in a river, at the bottom of a valley, near Tintagel, Cornwall. Already in attendance were ambulances, the coastguard, local authority Rescue and Fire Fighting Services (RFFS) and a Hazardous Area Response Team (HART).

The crew anticipated that they would winch the casualty into the helicopter and then land in a nearby field, where they would hand over the casualty to an ambulance for onward transportation to hospital by road.

The helicopter took off from Newquay Cornwall Airport at 1004 hrs and arrived on scene about 10 minutes later. Onboard were the commander (in the right seat), the co-pilot (in the left seat), a winch operator[4] and a winchman (in the cabin). The co-pilot was Pilot Flying (PF) for the departure and transit to the scene. The commander was PF for the task.

Upon arrival at the scene the crew over flew it, during which they noticed about 15 people in attendance, along with a large number of loose items belonging to them. Noting the wind was coming from the north, down the valley, the commander commented that, due to the likelihood that these items would be

1 MCA is an Executive Agency, sponsored by the Department for Transport, who provide a 24-hour maritime and coastal SAR emergency coordination and response service for the UK.
2 A SAR operational flight is defined in CAP 999, 'UK Helicopter Search and Rescue (SAR) National Approval Guidance' (published March 2021) as '*a flight by a helicopter operating under a SAR Approval when tasked by the SAR Tasking Agency*'.
3 The ARCC is responsible for coordinating all MCA SAR helicopters and fixed wing aircraft.
4 The winch operator and winchman are defined in CAP 999 as *SAR Technical Crew Member.* See Appendix A for more details.

affected by the helicopter's downwash, they would need to be secured before the winchman was lowered. Following the commander's request, the winch operator instructed those on the ground (via VHF radio) to secure all the loose items.

While this was being completed the crew did a dynamic risk assessment (DRA), carried out the pre-winching checks, and briefed for the task.

The winchman was then lowered to the scene, and released, after which the helicopter flew away to hold, while the winchman assessed the casualty in discussion with those in attendance. Given the nature of the terrain and the location of the ambulances it became apparent that, if the casualty was to be transported to hospital by road, it would take about one hour for the ambulance paramedics to retrieve their equipment and walk back up the valley to their vehicles. Given the state of the casualty, the winchman decided that they needed to get her to hospital as soon as possible.

The crew consulted the helicopter's flight management system to find the location of the closest hospital. While Treliske Hospital, Cornwall, had a similar flight time, the casualty would have needed a road ambulance transfer to the Emergency Department (ED), whereas at Derriford Hospital (DH), Plymouth, the casualty could be transferred the short distance from the hospital's HLS to the ED on a trolley. Thus, it was decided that they would take the casualty to DH. Both flight crew had operated into this HLS several times previously.

While the casualty was being prepared for recovery to the helicopter, this intention was passed by radio to the ARCC, along with an approximate flight time of 10 to 12 minutes. The casualty and the winchman were then recovered into the helicopter, and it departed for DH. Soon after departing, the winch operator informed the ARCC of an ETA of 1055 hrs. The co-pilot was PF for the transit to DH.

During the transit to DH the crew discussed the approach direction to the HLS at DH. To benefit from a small headwind, it was decided to approach on a westerly heading. The crew discussed the fact that, with the light northwesterly wind, the downwash would be blown towards the car park that bordered the south and east side of the HLS[5]. They also discussed that as the approach involved a lateral change of line from over the public road to slide forward and left to the HLS, only the co-pilot would be visual with the car parks in the later stages. As such the copilot was the PF for the approach and landing.

5 See paragraph 1.10 for more details on the HLS at DH.

A 'dynamic approach[6]', as opposed to a vertical approach, was flown by the copilot using a Performance Class (PC) 2[7] profile. A vertical approach is normally avoided by SAR crews, if possible, as there are other hazards associated with this type of approach, including vortex ring. A vertical approach would also give more time for the downwash and associated effects to build.

At about 1,100 ft agl the commander commented that "OUR DOWNWASH WILL BE GOING OVER THE CAR PARK TO THE LEFT." He added that if anything or anyone was seen that would be affected by the downwash, they would go around and consider their options as he believed that the casualty was not critical. However, the winchman informed him that the casualty was in need of some "FAIRLY URGENT" medical attention, which the commander acknowledged.

Soon thereafter, the landing checks were completed. At about 500 ft agl, the winch operator informed the co-pilot that, due to the approach angle, it would predominately be the co-pilot's lookout from the left seat for cars in the car park, and that he, the winch operator, would be looking out the door on the right side of the helicopter; the co-pilot was content with this. The commander, in the right seat, had restricted visibility to the left of the helicopter. However, both pilots' attention would have been predominately focused on the HLS as they got closer to it.

Once below 80 kt, the right door was opened by the winch operator and the HLS was noted to be clear.

At about 200 ft agl, the winch operator was looking out the right door and told the copilot to be aware of a person in the undershoot, in the car park by some cars, that he could see (Figure 1). The co-pilot reported that he was also visual with that person. The co-pilot thought it was a man, who he believed was in the latter stages of getting into the car but assessed him as not a factor because he believed the car door would be shut before they landed. The co-pilot also believed he saw two people (one of whom he noted "had long hair"), at the south-western end of the HLS wall, walking in an easterly direction along the footpath. During this time the aircraft had about 45% twin-torque and flew with about 10° nose-up pitch attitude. This reduced to about 5° noseup as the helicopter came over the HLS.

At about this time, two other people were also walking together on the footpath that is alongside the wall on the southern side of the HLS. From CCTV footage, both appeared to have shoulder-length hair. As they got to the end of the wall, by the access gate on the south-eastern corner of the HLS, they noticed a

6 See paragraph 1.17.4.4.2, *UKSAR Flight Operations Manual Part A,* for more details of a dynamic approach.

7 See Appendix B, *Operations Manual Part B Supplement SAR S-92A* for more details on aircraft performance.

helicopter flying low and stopped to watch it. 12 seconds later they were both blown over with one of them sustaining a serious head injury. At this point, the long-haired lady seen by the copilot was about 10 m from the southwestern corner of the HLS. Having seen the two people being blown over, she initially ran to offer them assistance, as did two other by-standers one of which was an off-duty nurse, before she ran to some ambulances, that were parked in the western side of Car Park B, to request assistance from paramedics.

At around the same time, another person who had just exited a car to the east of the HLS was also blown over and sustained a serious injury.

The helicopter landed 17 seconds later. The landing weight was 23,080 lb/10,468 kg.

After the helicopter landed, the co-pilot saw the long-haired lady he had seen during the approach, running from his 8 o'clock position towards the ambulances. As he thought she may have been running to seek assistance, he became concerned that someone unseen may have been blown over by the helicopter's downwash. Once the casualty in the helicopter had been transferred on a trolley to the ED staff, the commander asked the winch operator to investigate. Given the amount of activity in the car park was increasing, the commander then elected to leave the helicopter and investigate too, while the co-pilot remained with the helicopter and monitored the radios.

When the commander arrived at the south-eastern corner of the HLS, he met up with the winch operator and was told that two people had been blown over by downwash. They were both injured and were being treated by paramedics. One of those was by the south-eastern corner of the HLS (Position '2' in Figure 1) and the other was in the car park about 21 m east of the wall of the HLS (Position '1' in Figure 1). He then returned to the helicopter to inform the co-pilot of what he had found and stated that they would shut down the helicopter's engines. The commander briefly asked the co-pilot if he saw anyone during the approach, to which he said he only saw the man in the undershoot, by the cars, that the winch operator also saw. The commander then left the helicopter and returned to the scene with the winchman's 'response bag'.

Once the commander was sure that both casualties were receiving treatment, he informed the ARCC and the helicopter operator, who responded by removing the approval for its S92s and AW189s to operate into the HLS at DH until further notice.

The person with the head injury was taken to the ED by paramedics about 14 minutes after the helicopter landed. The seriously injured casualty arrived at the ED about 33 minutes later. The person with the head injury subsequently

died later that day.

Once the casualties had left the scene the crew returned to the helicopter and prepared to depart back to Newquay. Just as the helicopter was about to depart, the crew noticed a few people standing by the gate (which is next to the grass to the west of the HLS) to watch the takeoff. Upon the commander's request, the winch operator temporarily exited and asked the bystanders to move back. The helicopter then departed and returned to Newquay without further incident.

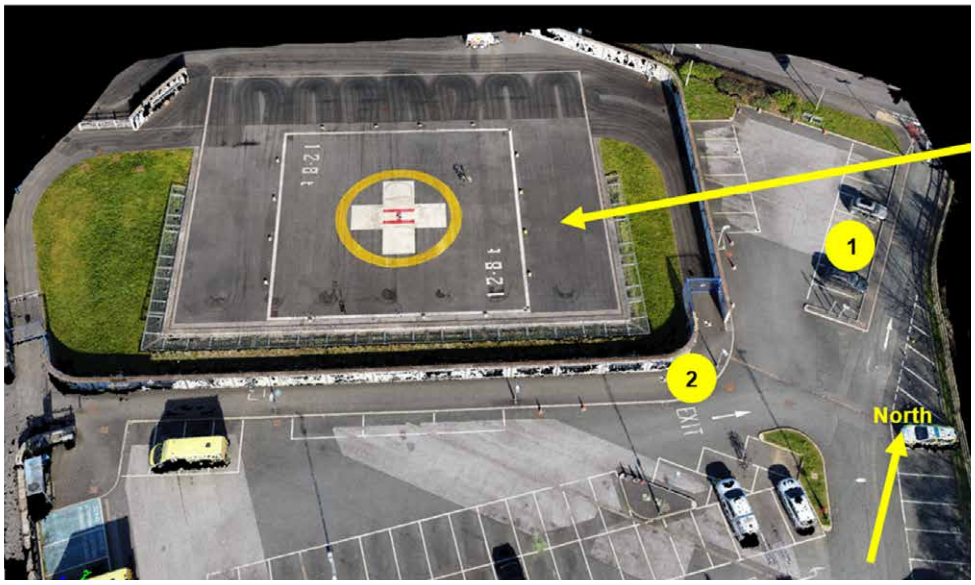


Figure 1

Approximate locations of the injured persons and the direction of approach of the helicopter

Following the accident, DH advised all operators that helicopters >5,000 kg Maximum Takeoff Weight (MTOW) were not permitted to operate into the HLS at DH until further notice; a Notice To Airmen was issued to publicise this. DH further advised that; Car Park B would be closed to all vehicles other than ambulances until further notice, all pedestrian movements in Car Park B would be controlled during future helicopter landings and takeoffs and, as far as practicable, all pedestrian movements on the public highway pavement, to the north of the HLS, along Derriford Road, would be controlled during helicopter movements.

1.2 Injuries to persons

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

Table 1
Injuries to persons

1.3 Damage to the helicopter

None.

1.4 Other damage

None.

1.5 Personnel Information

1.5.1 Commander

Age:	55 years	
Licence:	Airline Transport Pilot's Licence	
Licence expiry date:	31 January 2023	
Ratings:	Sikorsky 92 / Sikorsky 61	
Operator Proficiency Check expiry:	31 July 2022	
Licence Proficiency Check expiry:	31 July 2022	
Line check expiry:	28 February 2023	
Medical certificate expiry:	5 December 2022	
Flying Experience:	Total hours	7,239 hours
	Total on type	2,797 hours
	Total PIC	6,201 hours
	Last 90 days	44 hours
	Last 28 days	15 hours
	Last 24 hrs	2 hours
Previous rest period:	>24 hours	
Emergency and safety equipment:	15 July 2021	
Crew Resource Management training:	31 May 2021	

The commander was a qualified SAR Commander and a current Line Training Captain. He was previously a Type Rating Instructor and Examiner on the S92. He had been flying the S92 in the SAR role since 2008.

Prior to joining the operator, he was in the Royal Navy (RN) for 17 years where he flew the Sikorsky SK61 'Sea King' and was also a Qualified Helicopter Instructor.

1.5.1.1 Commander's comments

The commander commented that crews are always aware that downwash from a S92 is "massive", and this is always in their minds. On a SAR task it is mitigated by hovering as high as possible, as was the case at Tintagel. When operating into and out of unprepared landing sites like fields, a pre-landing '5S' recce'[8] is carried out. During this they check the surrounds of the HLS using the mnemonic 'FODUO'[9] to assess it. While this was not explicitly discussed going into DH, downwash was discussed when they were about five minutes from landing when it was stated that the helicopter's downwash was likely to be taken towards the car park due to the wind direction.

He had no knowledge of what third party risk mitigations were in place at DH's HLS and was not aware of what risk assessments DH may have carried out.

He was aware that DH's HLS Response Team staff attended the HLS when helicopters landed. He assumed they were responsible for ensuring that the HLS and the surrounding area were prepared, and that third party people were informed of the helicopter's arrival and controlled as necessary. This included those in Car Park B.

He added that if a crew observes something that might be a safety issue at an HLS, they would carry out a DRA, although they might not term it that. They would discuss the issue and the condition of the casualty in the helicopter and if there was any urgency to get them into the ED.

The commander commented that he had flown go-arounds at other HLS before, due to concerns for those on the ground. One was due to a pedestrian walking alongside the wire fence next to the HLS. On another occasion, during the approach to an HLS, two parked single decker buses were observed to be loading passengers next to the HLS. As a result, they orbited in the vicinity and only landed once the buses were moved.

8 See paragraph 1.17.4.4.2, *UKSAR Flight Operations Manual Part A Supplement 1 – SAR Techniques*, for more details of the '5S' recce.

9 FODUO stands for, FOD-Obstacles / Obstructions-Downwash Hazards – Under-shoot / Overshoot. See paragraph 1.17.4.4.2, *UKSAR Flight Operations Manual Part A Supplement 1 – SAR Techniques* for more details.

1.5.2 Co-Pilot

Age:	53 years	
Licence:	Airline Transport Pilot's Licence	
Licence expiry date:	31 October 2022	
Ratings:	Sikorsky 92 / Airbus Helicopters AS355	
Operator Proficiency Check expiry:	31 May 2022	
Licence Proficiency Check expiry:	31 October 2022	
Line check expiry:	31 January 2023	
Medical certificate expiry:	16 April 2022	
Flying Experience:	Total hours	5,217 hours
	Total on type	1,801 hours
	Total PIC	3,812 hours
	Last 90 days	41 hours
	Last 28 days	20 hours
	Last 24 hrs	3 hours
Previous rest period:	24 hours	
Emergency and safety equipment:	7 October 2020	
Crew Resource Management training:	31 May 2021	

The co-pilot was a qualified SAR Commander and had been flying the S92 for the operator, in the SAR role, since 2013. Prior to joining the operator, he was in the RN for 25 years, where he flew the Sikorsky SK61 'Sea King'. He was also the commanding officer of a RN SAR squadron and was a qualified helicopter instructor.

1.5.2.1 Co-pilot's comments

The co-pilot commented that a UK SAR crew can theoretically be tasked to land at any hospital HLS in the UK and, if tasked to an unfamiliar HLS, would first check in the operator's '*Compatibility of UK Hospital Sites with UKSAR Aircraft Types'* Flying Staff Instruction[10] (FSI) that states what helicopter types are authorised to land at a specific HLS. Crews would then look in the HLS directory for a brief description. These were the only two documents that crews had in the helicopter. If a crew were not familiar with an HLS and, depending on the severity of the casualty on board, they may elect to conduct an 'overfly recce', a 'hover recce' or a 'recce on the final approach'.

10 See paragraph 1.17.4.4.4 for more details of '*Compatibility of UK Hospital Sites with UKSAR Aircraft Types'* Flying Staff Instructions.

He added that he had an expectation that every hospital had undertaken a risk assessment of their HLS and would have identified the appropriate third party mitigations. He further advised that 'we do not have the capacity or time in the cockpit to read through each NHS overview note to scrutinise any thirdparty mitigations'.

He believed that the DH HLS Response Team staff only opened the gates for the ED staff and the helicopter crews to access the HLS. He was not aware if they had any other responsibility.

He advised that as DH is a prepared HLS, and that the crew were familiar with it, many of its characteristics would not have changed from previous visits and therefore would not be discussed as part of the '5S' recce. However, the variables would be and were discussed on the approach.

Operating crews have also been required to watch a video highlighting the effects of downwash. The same video is specifically referred to in CAP 1264 - *Standards for helicopter landing areas at hospitals*[11].

1.5.3 Winch operator

The winch operator was a qualified SAR winch operator, winchman paramedic and a winchman instructor. Prior to joining the operator in 2013 he had been a SAR winchman since 1998 in the RN.

He had about 5,700 flying hours.

1.5.4 Winchman

The winchman was a qualified SAR winchman and a qualified paramedic. Prior to joining the operator in 2015 he was in the Royal Air Force (RAF) where he had been a helicopter crewman and a SAR winchman since 2009.

He had about 5,100 flying hours.

1.5.5 Injured parties

1.5.5.1 Fatally injured person and her relative

The fatally injured person and her relative were walking unaided back to their car in Car Park B after an outpatient's appointment. The car was located just around the corner from the end of the footpath on the southern edge of the HLS. As they approached the end of the footpath, they heard a helicopter and saw it descending. Not realising there was an HLS there, the relative thought

11 See paragraph 1.17.2.5 for more details on CAP 1264 and a link to the video.

it was going to turn away and fly somewhere else. However, as it continued to descend, they stopped and looked up at it believing it was landing on the 'building' that they were walking around.

At this point the relative saw the fatally injured person being lifted off the ground by the downwash, before landing on the ground. The relative was also blown over onto her back but did not leave the ground. Once the relative was able to assist the fatally injured person, it was apparent she was unconscious and had suffered a serious injury to the rear of her head. The relative then shouted for help and an off-duty nurse and her daughter responded. While the nurse tended to the fatally injured lady, the daughter went to find paramedics at some of the nearby ambulances, who came to assist.

The relative sustained some minor injuries to her hand, ankle and, subsequently, suffered from some back pain.

The relative had made many previous visits to DH, but had never been so close to a landing helicopter, and was unaware that the landing site was so close to Car Park B.

The relative was aware of the yellow signs[12] on the wall by the footpath that state '*Danger of downdraft* [downwash] *and flying debris*.' However, she did not feel they reflected the severity of the danger. Her understanding was that any downdraft might blow someone's hat off, but not physically lift people off their feet.

1.5.5.2 Seriously injured person

The person that sustained serious injuries was accompanying a friend who had an outpatient's appointment. While the friend went to get a parking ticket, she got out of the car and waited for her to return. While she waited, she saw a helicopter fly "very low" over her head. The downwash lifted her off her feet and she landed on the ground between the two cars sustaining serious injuries which resulted in her being unable to stand. When her friend returned, she was not visible but was attracted to her by her shouts for help.

The seriously injured person had visited DH before on several occasions. However, this was the first time she had parked in Car Park B, as previously she was dropped off at the hospital entrance. She did not notice any warning signs and she was not aware there was an HLS at DH.

12 See paragraph 1.10.7, *Pedestrian environment around the helipad*, for more details of the signage at the HLS.

1.5.6 DH Head of Estate Site Management

The DH Head of Estate Site Management had been working at DH for 23 years in various facilities roles at the time of the accident. His previous roles covered car park management, environment management, sustainability, and waste. He was manager of the HLS until 2020. His role at the time of the accident was Head of Estate Site Management with overall responsibility for all the hospital's buildings and site services including the HLS. This included corporate safety and compliance aspects.

He was in an estates post when the design and planning for the HLS was initiated in 2012 and had minor involvement throughout its development until taking responsibility for the operation of the HLS when it was completed. He did not have any formal training or previous experience in managing an HLS.

1.5.7 Hospital risk assessor

The signatory to the most recent risk assessment for the HLS had worked for the hospital for 16 years. Initially she was employed in secretarial and personal assistant roles and was then trained as a security specialist in 2015. Her role as a security specialist included security of the HLS from members of the public. In 2020, she became responsible for overseeing all aspects of the HLS, including risk assessment and maintenance. She had no knowledge of helicopter operations prior to this and did not complete any specific training for it. She received no formal risk assessment training but did have experience of undertaking other risk assessments at the hospital.

1.5.8 Helicopter adviser

A helicopter adviser was employed by the hospital Trust to conduct a feasibility study for building a new HLS at DH. The adviser had been a helicopter pilot in the RN for approximately 30 years. After retiring from the military, he worked for the CAA as a flight operations and aerodrome inspector. He specialised in providing advice and inspection of helicopter facilities for special events. He first provided advice for a hospital HLS facility in 1990. After retiring from the CAA, he continued to provide advice to hospitals, in a private capacity, and was involved in over 60 such projects in the UK and Ireland. The helicopter adviser contributed to the development of Health Building Note (HBN) 15-03[13] and CAP 1264. He retired completely in 2015.

13 See paragraph 1.17.2.4 for more details on HBN 15-03.

1.5.9 Designers

The designers of the HLS were civil engineers employed by a global infrastructure consulting business. In this business there was a wide range of experience including aviation projects. The individuals involved in the DH project had some previous experience with a helicopter site but were not aviation specialists. The designers' role was to develop the detailed design drawings, based on the requirements outlined in the feasibility report, which made recommendations about suitability for helicopters up to and including the size of a S92. The designers also took the project through the planning process, overseeing the construction contract.

1.6 Helicopter information

1.6.1 General

Manufacturer:	Sikorsky
Type:	S-92A
Helicopter Serial No:	920257
Year of manufacture:	2015
Number and type of engines:	2 General Electric Co CT7-8A turboshaft engines
Total airframe hours:	2,541 hours
Total airframe landings:	3,880
Airworthiness Review Certificate:	Valid to 05 October 2022

1.6.2 Helicopter description

G-MCGY was a Sikorsky S92 helicopter operating in a SAR configuration. Table 2 is a comparison of parameters that are relevant to this report between a S92 helicopter and a typical Helicopter Emergency Medical Service (HEMS) type helicopter eg Airbus Helicopters EC135.

Parameter	S92	Typical HEMS
Maximum Takeoff Mass (kg)	12,020	< 5,000
Main rotor diameter (m)	17.17	10
D-value[14] (m)	20.88	13

Table 2

Weight and rotor parameter comparison

14 D-value is the largest dimension of the helicopter when the rotors are turning. This will normally be measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane, or the most rearwards extension of the fuselage in the case of a Fenestron or NOTAR (NO TAil Rotor) tail.

1.6.3 Helicopter downwash and sidewash

For an aircraft to remain airborne, the total lift must equal its weight. In the case of a helicopter, the lift is generated by the main rotor blades, which displace air as they rotate at a constant speed. The displaced air is called the downwash, and when the helicopter is at altitude, this disperses into the surrounding air with little, or no effect at ground level.

As a helicopter slows, the downwash disperses less effectively, and it becomes more concentrated into a vertical column of descending air. As a helicopter descends, the downwash will eventually impinge on the ground and dissipate outwards in all directions. This horizontal movement of the air is sometimes referred to as sidewash[15]. The resultant wind speed at ground level, and how the downwash dissipates depends on many factors including local climatic conditions, helicopter speed, weight, height above the ground, and airflow interaction with objects such as buildings, trees and cars etc.

1.6.4 S92 downwash

The helicopter operator's Operations Manual (OM) contained a section that described downwash and its hazards. It stated that the maximum downwash velocity for the S92 is about 51 kt (26 m/s). The manual indicated that this occurs approximately 100 ft (two rotor diameters) below the helicopter (Figure 2). GMCGY passed through 100 ft agl about 25 seconds before landing. At this time, it had about 68% twin-torque power applied.

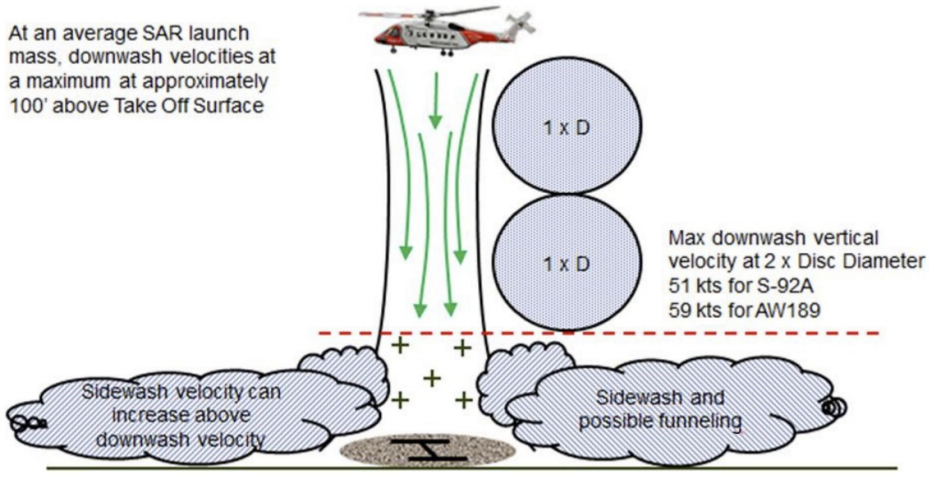


Figure 2

Diagram of maximum downwash from operator's OM

15 In this report, 'downwash' will be used as an all-encompassing term.

1.6.5 All engine operating (AEO) go-around

For an AEO go-around (GA) no power target is specified in the operator's OM or the manufacturer's *Rotary Flight Manual*. However, the PF would need to apply enough power to overcome the inertia of the descent during the approach. This would be judged by the PF at the time, but it is believed that an additional 15 to 20% twin-torque would be required, up to a maximum of 100% torque (maximum continuous power when less than 100 KIAS).

1.7 Meteorological information

An aftercast produced by the Met Office summarised the weather conditions at DH as generally fine with a light to moderate north-westerly wind and with some shower activity to the north.

Reports from Plymouth Mountbatten Automatic Weather Station, situated about 4 nm south of DH, indicated that the wind was northerly at 2 or 3 kt until 1000 hrs, backing more north-westerly (310° to 330°) and increasing to 8 to 11 kt thereafter, gusting up to 14 kt.

CCTV of the HLS windsock at DH indicated that the wind was light from the north-west. A still image taken from the recording shortly prior to the helicopter landing is shown in Figure 3.

Figure 3

Picture of the windsock at DH HLS shortly before the helicopter landed

1.8 Aids to navigation

Not applicable.

1.9 Communications

The pilots were in contact with ATC by VHF radio.

While in the helicopter, the flight crew and rear crew, communicated amongst themselves via the helicopter's intercom. There was also a 'medical loop', which allows the winch paramedic to plug into and communicate discretely with the casualty on a talking headset. Should any of the other crew members need to communicate with the winch paramedic they can connect to the medical loop.

When the winch paramedic was disconnected from the helicopter's intercom system he was in contact with the helicopter's crew via a 'Polycon' SAR radio. This is a short-range UHF radio which allows the winch paramedic to hear the crew speaking on the intercom, through his helmet, as the intercom is permanently transmitted on Polycon when it is turned on. The paramedic can also talk to the crew via a 'press to transmit' button, which the crew hear though the helicopter's intercom. The paramedic cannot hear the Polycon if they take their helmet off while on scene. In this situation, they use a handheld VHF FM radio and can communicate with the helicopter on the UK SAR maritime frequency, 'Channel 0' (156.00 MHz).

Communications between the helicopter and the on-scene coastguard, and the Maritime Rescue Coordination Centre operations room were via VHF radio on Channel 0.

The helicopter was also equipped with Airwave. Airwave is the communications network used as the primary system for voice and data communications by the emergency services in the UK. The Airwave radios on board allowed the crew to communicate with the ARCC, and, if required, any other SAR helicopter on the UK SAR 'Talkgroup'. They can also talk to all other on-scene emergency services if their 'number' is known.

1.10 Aerodrome information

1.10.1 General

In April 2012, DH was designated as the Major Trauma Centre (MTC) for the Devon and Cornwall peninsula. It is a specialist hospital responsible for the care of the most severely injured patients involved in major trauma and provides 24/7 emergency access to consultant-delivered care for a wide range of specialist clinical services and expertise.

1.10.2 Original HLS

Prior to 2015, the hospital did not have a purpose-built HLS. It used an area of grass, adjacent to Car Park B, and near the entrance to the ED. This was only available for daylight operations. It was big enough for HEMS type helicopters, but larger SAR or military helicopters had to land at Plymouth Airport, which required a transfer to the hospital by road ambulance. The airport closed in December 2011 and larger helicopters were displaced to playing fields at the nearby University of St Mark and St John ('Marjons'). This also required a transfer by road ambulance.

1.10.3 DH HLS

After the hospital was designated as an MTC, the hospital Trust decided to construct a purpose-built HLS to meet the current and expected demand. The hospital Trust's full business case from April 2014 stated that '*the recommendation of the MTC evaluation panel to deliver 'an on-site helipad that does not necessitate ambulance transfer', essentially leaves the Trust with no option but to upgrade or replace the existing helipad*'.

In June 2015 a new purpose-built HLS opened in the north-west corner of Car Park B. The HLS had been operating for seven years before the fatal injury and records indicated there had been over 2,500 landings, of which at least 140 were SAR type helicopters. Some of these SAR flights involved casualties that were taken to a hyperbaric chamber in the Diving Diseases Research Centre, which is in an adjacent science park.

The HLS is a partially raised structure (on a mound) that was specified to be able to accept helicopters with a maximum weight of 12,800 kg or a maximum Dvalue of 21 m. This is sufficient for HEMS and SAR type helicopters including the S92 and AW189. The HLS is separated from the car park by a perimeter wall and access for hospital staff is through one of two lockable gates in the southwest and southeast corners of this wall. If required, road vehicles can access the HLS through a lockable gate in the west side of the wall. Figure 4 shows plan and elevation views of the HLS.

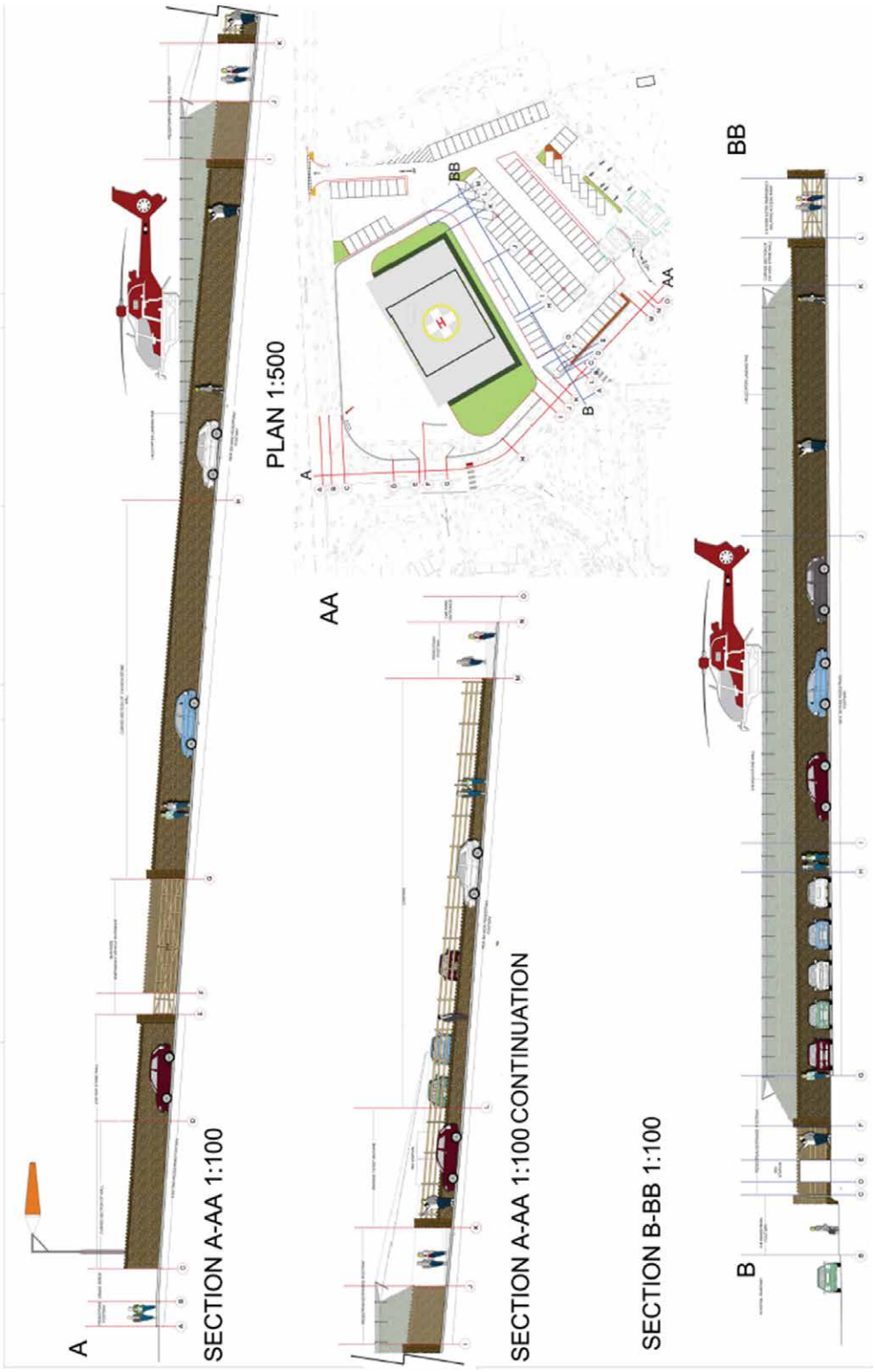


Figure 4

Plan and side elevations showing the adjacent footpath in Car Park B and the locations of the HLS access gates. (Used with permission)

1.10.4 Designated helicopter approach and departure flight paths

International guidance[16] indicated that elevated heliports should have at least two approach and departure flight paths separated by no less than 150°. The designated flight paths for the DH HLS have tracks of about 090° and 240° and are shown in Figure 5. They both pass over hospital car parks.

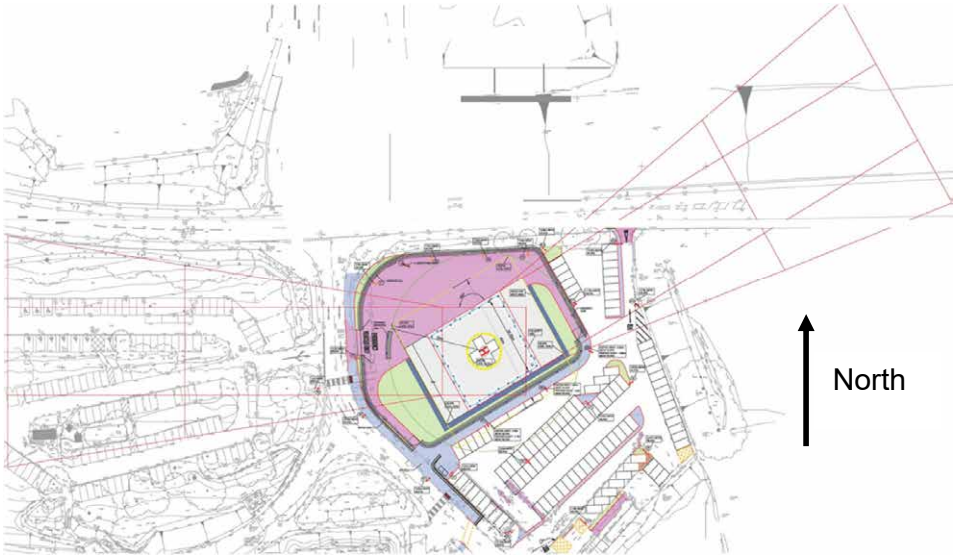


Figure 5

Approach and departure flight paths designated by DH in its guidance to operators

On 9 September 2015 DH issued, via email, *Helicopter Operators Using the Helicopter Landing Site, Derriford Hospital, Plymouth*'[17] to numerous helicopter operators, including the operator of G-MCGY, local HEMS and police operators and local military units. It stated in Section 11, *AIRCREW – Responsibilites*, '*Approach and depart from the HLS using the designated flight paths – see …* [Figure 5 above].' The operator took these flight paths as advisory as performance and/or meteorological issues could dictate that an approach outside these paths may be required. However, they did not advise DH of this possibility. This document stated that it provided a summary of the aspects relating to helicopter operations from DH's *On-site Operational Procedure and Response to an Emergency Incident*[18] *(Version 1 issued 4 June 2015)*.

The *On-site Operational Procedure and Response to an Emergency Incident* document did contain the roles and responsibilites for the HLS Response Team staff in Section 6.4. These duties did not include management of people outside the HLS boundary except for making sure that they remained behind the '*safety*

16 ICAO Doc 9261, see paragraph 1.17.2.3 of this report.
17 A copy is at Appendix C.
18 An extract covering the roles and responsibilities of the HLS Response Team is at Appendix D.

wall' and advising them not to take photographs or smoke. The operator of G-MCGY was sent a copy of this in July 2017 but they could not find it at their headquarters or their Newquay base. Other operators that use the HLS at DH had not seen this document.

Another helicopter operator that uses DH HLS was not aware of the *Helicopter Operations Using the HLS, Derriford Hospital, Plymouth* document, despite them being on the distribution list of the email. This was thought to be due to a change of personnel and may have been missed during the handover. However, they did have a copy of DH's risk assessment. Additionally, their own flight path chart for DH had a 79° approach cone centred on a track of 282°, ie mostly outside that shown in Figure 5 above. They commented that this was due to performance requirements for the helicopter they operated. They added that they believed the DH designated flight paths were only recommended and could not confirm whether their flight paths had been shared with DH.

In 2023 another helicopter operator declared to DH that they had developed a new PC 1 flight path outside of the ones that DH had previously published. After discussions with the operator and an aviation consultant, DH acknowledged this. A new version of the document containing the designated flight paths had not been published at the time this report was published.

1.10.5 No 1 Aeronautical Information Documents Unit (AIDU) Publication

The No 1 AIDU is an RAF unit that produces aeronautical information products and services to UK Defence Aviation worldwide. They are also available for purchase by civilian operators.

One of the AIDU's publications is a landing site directory titled the '*Helicopter Landing Sites - Hospitals United Kingdom*'. This is a flight information publication that had charts for about 173 HLS both at hospitals and remote sites close to hospitals and is published every 28 days. The information it provides is predominantly of use to military helicopters as there is no '*3dimensional*' data that would be required by an operator of a civilian helicopter, to assist them in terms of assessing a helicopter's performance considerations. The entry for DH at the time of the accident is shown in Figure 6.

Among the hazards listed in the entry for DH were; '*Downwash protection wall (8ft) 30m West. Roads 40m North and West. Car park 20m SE'.*

While it stated, '*Best approach heading 090*', there was no reference to the south-westerly flight path as shown on Figure 5.

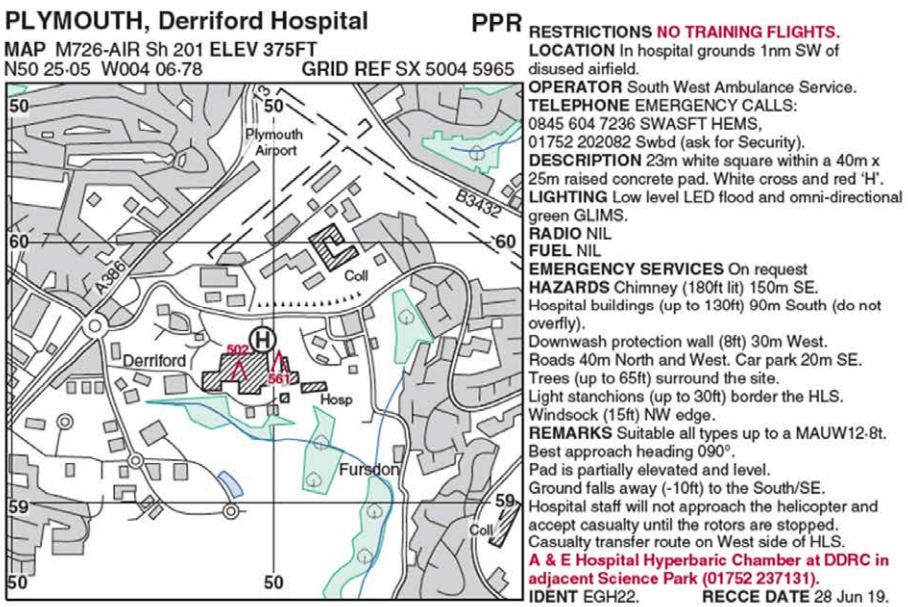


Figure 6

No 1 AIDU *Helicopter Landing Sites - Hospitals United Kingdom* entry for DH

In August 2022 the No 1 AIDU updated the entry for DH by adding 'TEMPORARILY CLOSED', in red, diagonally across the whole page. This was because they chose not to revalidate the information while the AAIB investigation was ongoing.

DH were unaware that there was an entry for its HLS in the AIDU directory, until they were shown it by the AAIB, and they had no records of any correspondence with the No 1 AIDU. Upon reviewing it, DH commented that it contained several discrepancies[19].

1.10.6 Hospital operational procedures at the DH HLS

At the time of the accident, the hospital employed a contractor that provided staff who, in addition to other security duties, fulfilled the role of the HLS Response Team. The Trust's standard operating procedures (Trust SOP) for the HLS were defined in the hospital Trust's *Helicopter Landing Site: Operational Procedure and Emergency Response (Version 2, issued October 2020)* and in the contractor's *Assignment Instructions (issued November 2021)* documents. The Trust SOP listed responsibilities of the operator, aircrew, ED staff and the HLS response team. It stated it should be read by ED staff, the emergency planning and liaison officer, the contract manager, helicopter operators and aircrew. The operator of G-MCGY did not have a copy of the Trust SOP, but one other helicopter operator to the HLS was sent a copy of the 2020 version as

19 Descriptions of the operator, the layout and the best approach heading were amongst the discrepancies noted.

the amendments made applied only to that specific operator. The Assignment Instructions document was for use by the contractor's staff and provided more detailed descriptions of the required tasks.

The HLS Response Team's duties for the arrival of a helicopter included: obtaining and wearing the correct personal protective equipment (PPE); unlocking the access gate; visual inspection for damage and debris within the HLS boundaries; reporting the operational status of the HLS to the ED; ensuring members of the public remain behind the safety wall and traffic management duties in support of the patient transfer. Daily checks by the contractor's staff were also required to ensure the HLS and all associated equipment were in good order. All car parks were patrolled by the contractor's security staff daily. The contractor also employed groundskeepers who were responsible for removing loose articles from the car parks.

The Trust SOP for the HLS did not specify any required actions during a helicopter arrival with respect to pedestrians or vehicles in any hospital car park or on the road outside the HLS boundary.

Evidence from witness interviews and activity logs showed that daily checks and pre-arrival checks were not always completed. The contractor's HLS Response Team staff had other security duties in the hospital, such as dealing with violent patients, which meant that they were not always able to attend the HLS in time. However, CCTV showed that during the arrival of the helicopter on 4 March 2022, except for not wearing PPE, the HLS Response Team performed their duties as specified. These staff advised the AAIB that they were not always informed of a helicopter arrival in time to collect the PPE which was stored remotely in another part of the hospital.

The Trust SOP, issued in 2020, referred to HBN 15-03 and Regulatory Article 3532 and did not refer to CAP 1264.

After the accident, the Trust updated the SOP to include additional duties for the HLS Response Team to inform people in the surrounding areas outside the helipad wall when a helicopter was arriving or departing, and to introduce a 'safe system of work' for staff authorised to work on the HLS or in the surrounding areas. The Trust have advised that the new procedure has been implemented at DH.

1.10.7 Pedestrian environment around the HLS

The HLS is flanked on two sides by Car Park B and is close to the entrance to the ED. This car park has pedestrian access at the north-eastern corner (where vehicles exit) and offers a cut-through pedestrian route for people

approaching the hospital from the east along the public road (Miller Way) which is on the north side of the HLS (Figure 7). There is also a pedestrian route passing to the north of the HLS along this public road.

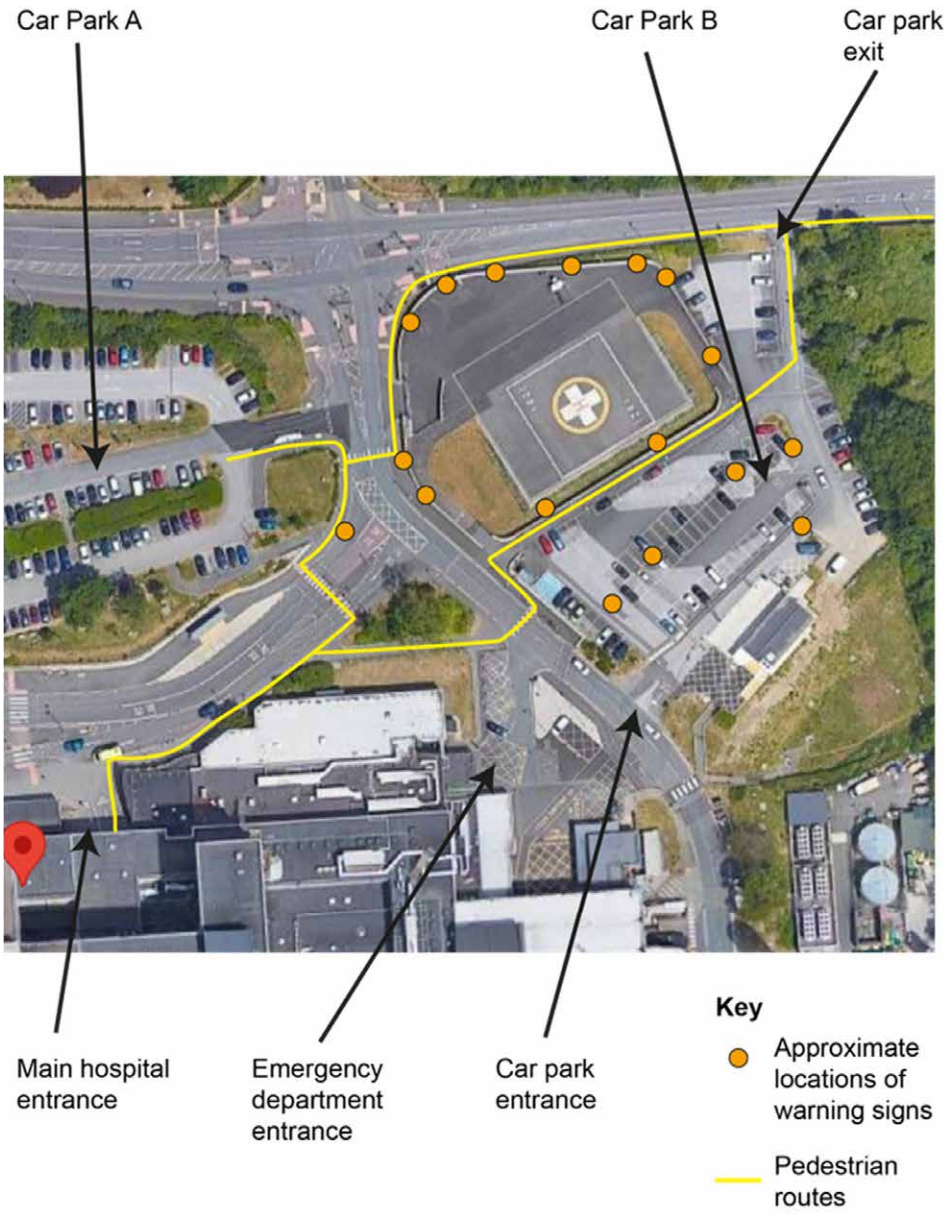


Figure 7

Overview of the HLS pedestrian environment
© 2023 Google, Image © Landsat / Copernicus

Warning signs stating '*Helicopter Landing Danger of downdraft and flying debris*' were attached to the outside perimeter of the HLS at regular intervals (Figure 8). The same sign was also mounted on lighting posts and bollards at other locations throughout the car park and on the road (Figure 9).

Figure 8

Warning sign on the perimeter of the HLS

Figure 9

Warning sign repeated in Car Park B

These safety signs were not installed when the helipad opened. DH reported they were installed at a later date as part of the action taken in response to downwash complaints and incidents. The timeline and decision process were not documented in the risk assessment or post-incident investigation documentation that were provided to the AAIB.

The HLS gates were marked with a specific instruction to '*KEEP OUT*' (Figure 10).

Figure 10

Sign attached to the HLS gates

1.11 Recorded information

1.11.1 Flight recorders

G-MCGY was fitted with a solid-state Multi-Purpose Flight Recorder (MPFR) that recorded several hundred hours of flight data. It also recorded cockpit images, four times a second for approximately the last three and a half hours, including a limited view of the pilots' controls and instruments, as well as an external view. In addition, the MPFR recorded for the last 30 hours; the ambient sounds in the cockpit and, on three other separate channels, conversations between all the crew members. It also recorded audio transmitted and received by the crew via either the VHF, 'Polycon' or Airwaves systems.

For the incident flight, Figure 11 shows G-MCGY's flight path during the approach to the HLS (circled in red) and Figure 12 shows the flight data against time, as G-MCGY descended below 150 ft above the ground. The data shows that there were no sudden applications of power during the final approach to land that would have exacerbated the helicopter's downwash, nor were any sudden variations made to the helicopter's flightpath. Each engine was developing between 70% to 75% torque as the helicopter passed the pedestrians.

The flight data for this period showed that, as the helicopter passed over Pedestrian 1 (Figure 1), G-MCGY was approximately 50 ft agl with a groundspeed of 10 kt. G-MCGY subsequently passed abeam Pedestrian 2 at approximately 45 ft agl, with a groundspeed of 9 kt.

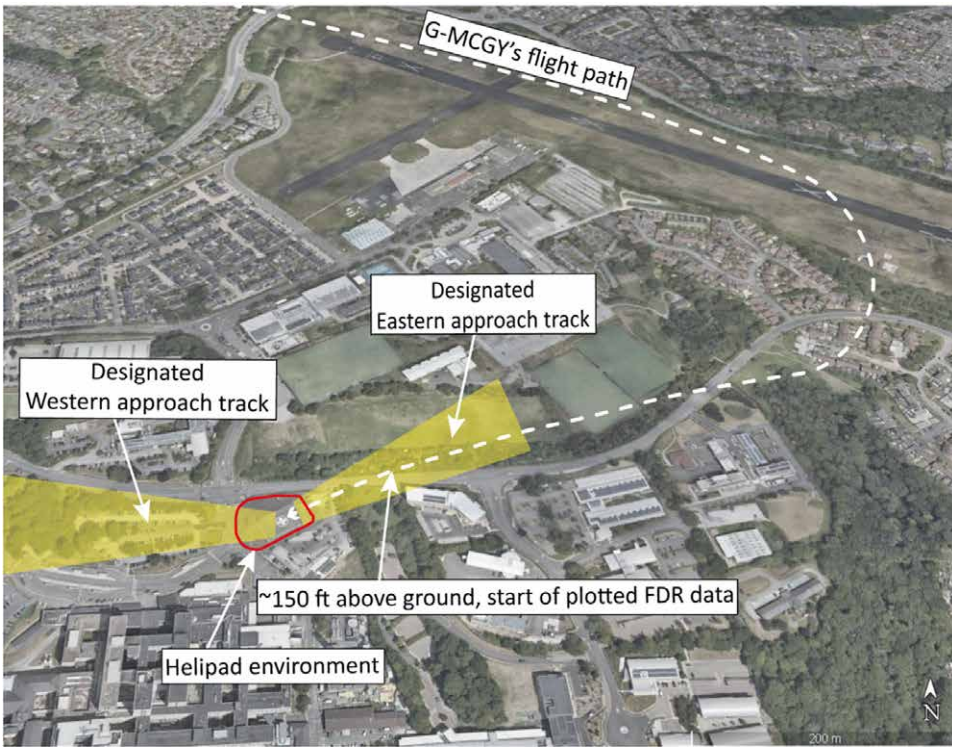


Figure 11

G-MCGY's flight path during the approach to DH
© 2022 Google

1.11.2 CCTV

1.11.2.1 CCTV around the time the helicopter landed

Table 3 details the relevant observations taken from the CCTV recording, which shows the HLS and Car Park B. The time recorded on the CCTV imagery is approximately sixteen seconds behind the time used by the MPFR, plotted in Figure 12.

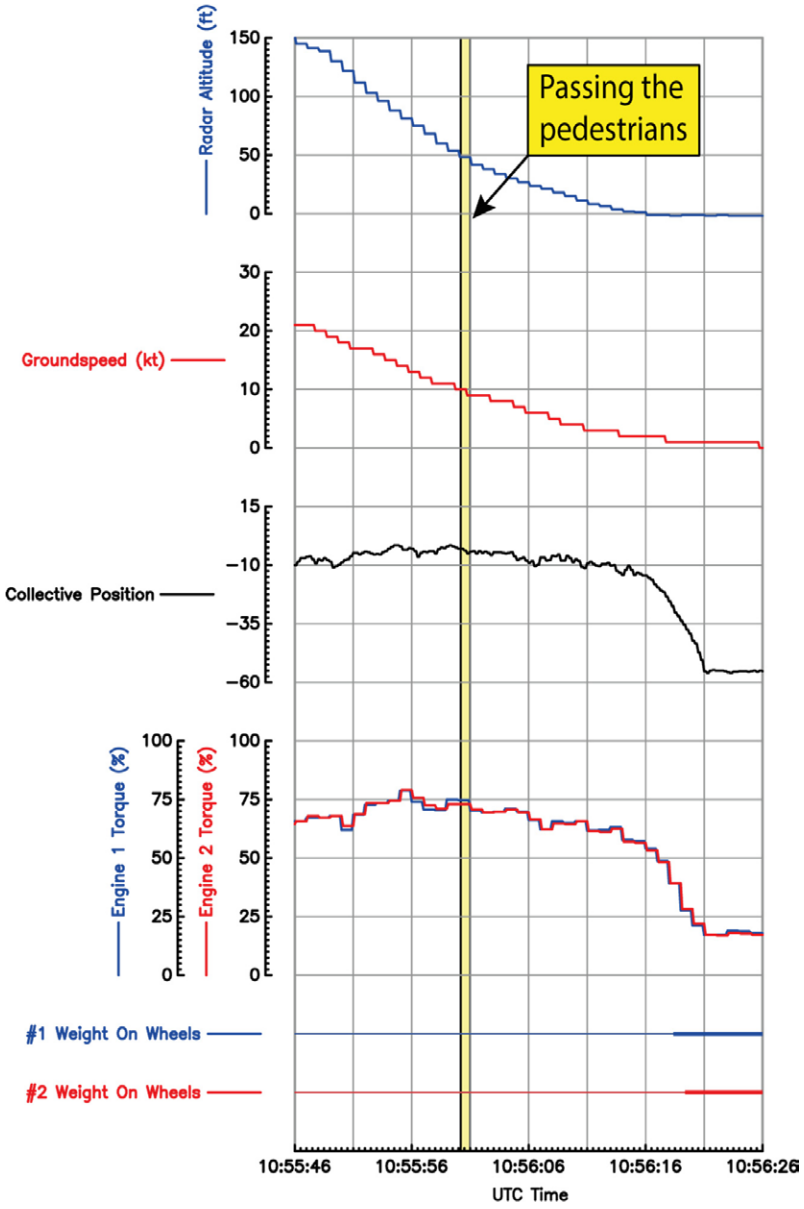


Figure 12

Flight data for G-MCGY's final approach and landing

In a five-minute sample of CCTV containing the accident arrival, 27 people were observed walking in Car Park B. In this sample, several people stopped and watched the helicopter. A long-haired lady, walking on the footpath on the south side of the HLS, appeared to take shelter from the wind near the wall before running to assist those who had been blown over. Litter and a barrier in the car park were disturbed. Figure 13 shows the positions of people in Car Park B a few seconds before the injured people were blown over.

CCTV Time (HHMM:SS)	CCTV observations
1053:05	Security staff entered the HLS, via the gate at the southwest corner of the HLS.
1054:35	The two people that were subsequently blown over walked past the southwest HLS gate.
1055:21	A man in a red coat opened the door to a car in the undershoot of the HLS and got into it.
1055:33	The two people stopped by the southeast HLS gate.
1055:36	A long-haired lady, who was on her own, started to walk from the southwestern corner of the HLS in an easterly direction.
1055:44	The two people by the south-east gate were blown over.
1055:57	The long-haired lady started to run to assist.
1056:03	The helicopter landed.
1056:12	The long-haired lady and two others reached those that were blown over.
1056:16	The long-haired lady started to run back towards the ambulances in the western side of Car Park B.
1057:05	Paramedics reached the south-east HLS gate and started to attend to those blown over.

Table 3

Relevant observations from the CCTV

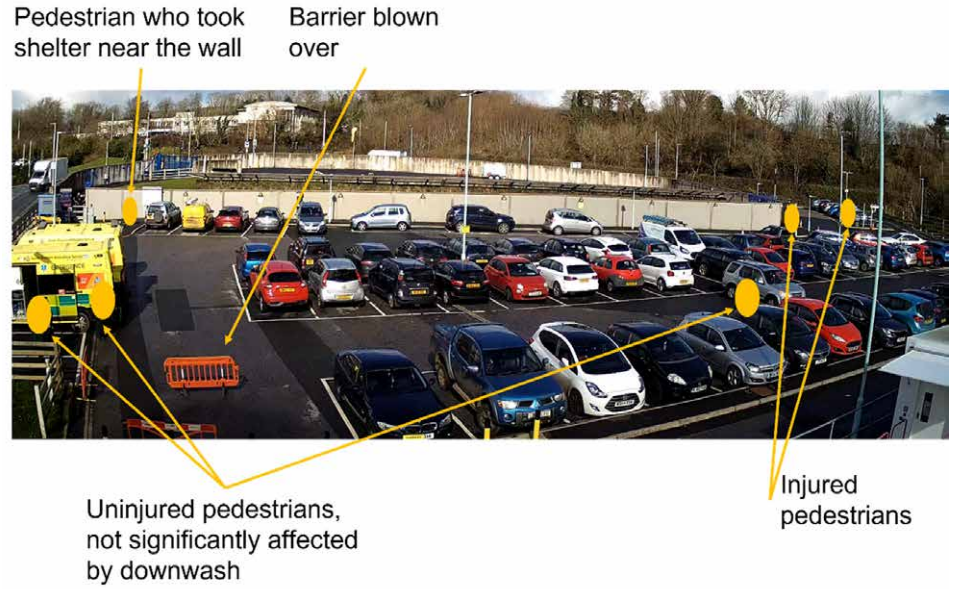


Figure 13

CCTV image showing positions of people in Car Park B a few seconds before the helicopter landed (looking north)

1.11.2.2 General CCTV observations

CCTV for previous helicopter arrivals and departures, prior to the accident day, was used to observe normal pedestrian movement and behaviour around the HLS. 12 five-minute samples of CCTV that included an air ambulance arrival or departure were examined in detail covering weekdays and weekends and different times of day. No CCTV of an S92 arrival or departure prior to that on the day of the accident was available as CCTV recordings are only retained for 28 days, and there had been no other S92 landings during that period.

In 8 out of the 12 samples Car Park B was full. In the least busy sample, it was approximately half full. The number of people observed walking within Car Park B ranged from 5 to 26 within a 5-minute period and the average was 16. People of all ages used the car park and a proportion had mobility aids such as walking sticks and walking frames. Most of the movements were between cars and the car park paths leading to the hospital ED and main entrance.

The arrival and departure of air ambulances did not appear to affect pedestrian behaviour significantly. The most common reaction was to look at the helicopter and carry on in the direction they were walking before. Only one person was observed to shelter near to the HLS wall and no one appeared to change path to avoid the HLS. One person was observed to lift their child on to the roof of their car to watch a helicopter. The downwash from the air ambulance helicopters in the samples did not appear to move items in the car park or affect the movement of pedestrians to any great degree.

1.11.3 Other data sources

Radar data was available for some of the flight, but coverage stopped to the north of Plymouth and so did not assist the investigation.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

The fatally injured person was of slight build and the cause of death in the post-mortem examination report was recorded as '*head injury.*'

The seriously injured person was also of a slight build. The main injury sustained was a broken neck of femur (hip).

1.14 Fire

Not applicable.

1.15 Crashworthiness

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

1.17.1 General

NHS England Estates and Facilities are responsible for national oversight of the NHS Estate. They lead the operational and policy development for the estate including areas of staff and patient safety, efficiency, effectiveness and quality. NHS England liaise with their counterpart organisations, NHS Scotland, NHS Wales and NHS Northern Ireland, on matters of mutual interest.

NHS England Estates considers that the design and ongoing maintenance of HLS falls within its national Estates assurance remit. They advised that they worked with the Department of Health and Social Care to shape the guidance in CAP 1264, but this investigation did not determine the extent of that involvement.

In late 2019 NHS England Estates were part of an HLS Meeting which latterly became known as the NHS Hospital HLS Working Group[20], formed of a variety of stakeholders, including the CAA, Department for Transport (DfT), MCA and some operators, to raise any immediate issues, which required their attention.

Many organisations were involved in the development and operation of the HLS at DH. In summary, their roles and responsibilities with respect to the HLS are shown in Table 4.

20 See paragraph 1.18.6.4 for more details of what work the NHS hospital HLS Working Group has instigated.

Organisation	Role
SAR operator	Transport of injured persons to an HLS.
HEMS operators	Transport of injured persons to an HLS.
Hospital Trust	HLS Site Keeper, responsible for the safe ground operation of the HLS including patient transfer, security, fuel facility, weather facilities and maintenance. Responsible for the safe operation of Car Park B.
Design agency	Responsible for the detailed design and production of design drawings for the HLS. Oversight of the construction phase.
Local authority planning department	Responsible for assessing the HLS building plans and issuing planning consent.
Helicopter adviser	Author of the feasibility study for the new HLS. Post construction inspection to confirm compliance with ICAO Heliport Manual issue 3.
CAA	Responsible for the regulation of SAR and HEMS operators. Originator of the published guidance for new HLS (post-2016).
Construction company	Responsible for the HLS construction only. Not discussed further in this report as no relevant factors were found.

Table 4

Organisations involved in the DH HLS

1.17.2 HLS guidance

1.17.2.1 General

Hospital HLS in the UK are unlicensed and, therefore, not regulated by the CAA. There are no mandatory requirements for their design or operation, but there are guidance documents based on international Standards and Recommended Practices. The evolution of a number of the documents referred to in this report is shown in Appendix E and each document is discussed here.

1.17.2.2 ICAO Annex 14

ICAO Annex 14 defines the international Standards and Recommended Practices for heliport planning, design and operation. The document was at its Third Edition when the Derriford HLS was designed and built. It did not contain any information about the possible effects of rotor downwash on personnel.

1.17.2.3 ICAO Heliport Manual, Doc 9261

The ICAO Heliport Manual provides international guidance for helicopter landing sites. Edition 3, which was current when the Derriford HLS was designed and built, contained no information about the possible effects of rotor downwash on personnel. It suggested that heliports should have two approach surfaces (paths) separated by at least 150°.

In 2021, Edition 5 introduced additional guidance including the consideration of third parties. Paragraph 2.1.4.3 covered downwash and said that '*non-essential people should not be allowed within 3 rotor diameters of helicopter operation'*.

The document does not provide guidance on how a downwash zone should be managed, or how public areas adjacent to a helicopter landing site should be risk assessed.

1.17.2.4 HBN 15-03: Hospital helipads

In 2008, the Estates Division of the Department of Health published document HBN 15-03: Hospital helipads. The document described '*the requirements and options for new hospital helipads compliant with regulatory requirements, and provided guidance on their operation and management.*' It stated that other documents provided principal guidance and legislation including Annex 14[21] and the associated Heliport Manual[22].

HBN 15-03 was used as guidance when the Derriford HLS was developed. It described three types of HLS:

- Ground-level HLS
- Elevated (rooftop) HLS
- HLS on raised structures and mounds

Chapter 2 addressed planning considerations. It included a section about public safety that stated:

> *'All helicopters in flight create a downward flow of air known as downwash. The severity depends on the weight of the helicopter, the dissipating effect of wind, and disruption by screening in the form of buildings, trees, hedges and walls. The downwash in a small area underneath large SAR and military helicopters can be intense, displacing loose hoardings and blowing grit and debris at people,*

21 ICAO Annex 14 Volume II, Heliports, 2004.
22 ICAO Doc 9261 AN/903 Heliport manual, 1995.

cars and buildings in the immediate vicinity. The loose objects can then be a risk to the helicopter if they are carried into the rotor blades or engines by re-circulating airflows. Old and infirm people are particularly susceptible to the wind strength of downwash. For small, light ambulance helicopters, the effect is greatly reduced but should still be considered; a 30 m downwash zone around the helipad should be kept clear of people, parked cars and buildings. However, the most effective mitigation is to raise the helipad above areas used by the public and NHS employees. Raised sites reduce the downwash effects considerably, and high elevated or rooftop sites remove the risk.'

The chapter about ground-level HLS said:

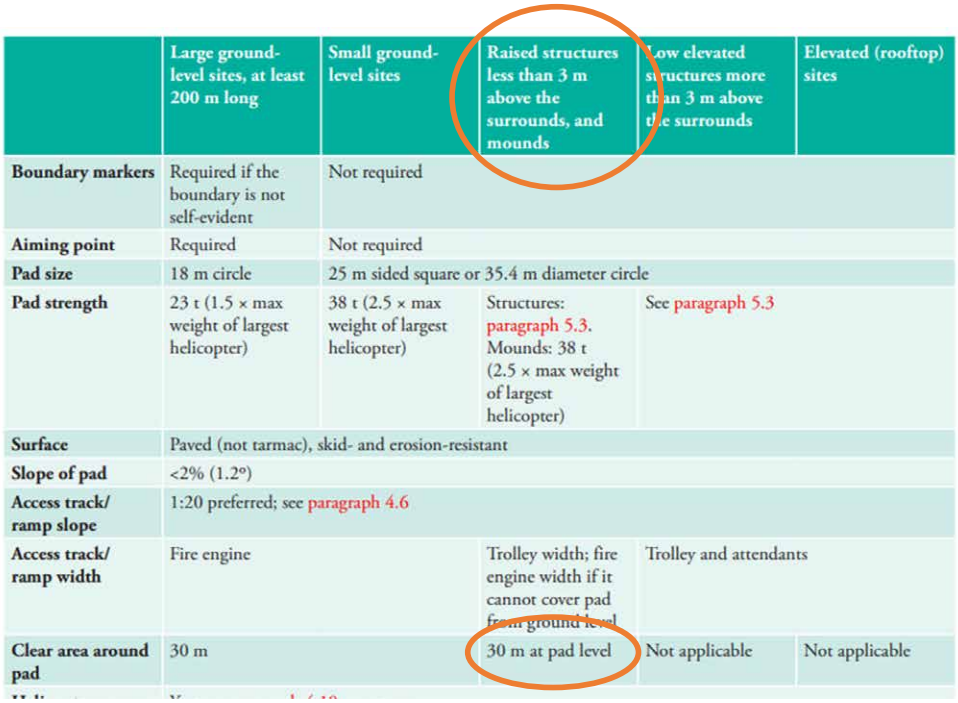
'…an area of 30 m around the pad should be kept clear of people, structures and hard obstacles to avoid injuries and damage from debris blown by the downwash. Large helicopters require a larger downwash zone than ambulance helicopters.'

HBN 15-03 did not quantify how much larger the downwash zone should be for a larger helicopter, or if it should be a circle, centred on the HLS, or a 30 m zone extending from the HLS boundary in all directions. The chapter about ground-level HLS also said:

'…the 30 m downwash zone should be marked by fencing where it does not constitute an obstacle to the helicopter, and by signs elsewhere, to stop people encroaching. It may be necessary to stop traffic on roads which cross the zone, and the hospital risk assessment might require one or more members of staff to be present to police all movements.'

This was the only guidance in the document relating to signs.

The chapter about HLSs on raised structures and mounds did not mention a downwash zone. A summary table in the document (Figure 14) stated that this type of HLS needed a clear area of '*30 m at pad level.*' The term '*clear area*' was not defined.



	Large ground-level sites, at least 200 m long	Small ground-level sites	Raised structures less than 3 m above the surrounds, and mounds	Low elevated structures more than 3 m above the surrounds	Elevated (rooftop) sites
Boundary markers	Required if the boundary is not self-evident	Not required			
Aiming point	Required	Not required			
Pad size	18 m circle	25 m sided square or 35.4 m diameter circle			
Pad strength	23 t (1.5 × max weight of largest helicopter)	38 t (2.5 × max weight of largest helicopter)	Structures: paragraph 5.3. Mounds: 38 t (2.5 × max weight of largest helicopter)	See paragraph 5.3	
Surface	Paved (not tarmac), skid- and erosion-resistant				
Slope of pad	<2% (1.2°)				
Access track/ ramp slope	1:20 preferred; see paragraph 4.6				
Access track/ ramp width	Fire engine		Trolley width; fire engine width if it cannot cover pad from ground level	Trolley and attendants	
Clear area around pad	30 m		30 m at pad level	Not applicable	Not applicable

Figure 14

Extract of the summary table showing the clear area requirements around each type of HLS

1.17.2.5 CAP 1264 - Standards for helicopter landing areas at hospitals

In 2016 the CAA published CAP 1264, which superseded HBN 15-03. The Department of Health and Social Care (DHSC) was involved in its development to some degree. The document provides guidance for new HLS and those undergoing refurbishment. It is not retrospectively applicable to existing HLS.

The document contains a section about planning and safeguarding, which states:

> *'For a surface level heliport operating exclusively light air ambulance helicopters it is recommended that a minimum 30 m downwash zone be established around the heliport which is kept clear of people, property or parked vehicles (typically 2 to 3 rotor diameters of the helicopter). The downwash zone, to account for the approach to land and take-off manoeuvres, may need to be extended in the portion below the helicopter flight path to account for operating techniques which promote local disturbances, such as when a helicopter pilot applies full power during the rearward portion of the take-off. If heavy or extra heavy helicopters are to be utilised at surface level, the downwash zone established around*

the heliport should be considerably larger; typically between 50 m and 65 m for the largest helicopters.'

This section contains a link to a video[23] that gives some guidance on downwash effects. In the video it states, "Wind speeds in excess of 50 kt can be experienced up to 85 ft from the aircraft which…can equate to the equivalent of a category one hurricane."

A section of the document that considered the options available for an HLS included the following text about HLS on raised mounds less than 3 m tall:

'By raising an HLS by one storey this may have some limited beneficial impact on harmful environmental issues (such as noise nuisance, rotor downwash effect etc) created by the helicopter operation; benefits are confined to the case of smaller air ambulance helicopters. However, it is unlikely that raising the HLS by just a single storey will provide any benefit for larger helicopter operations. In particular the severe downwash effects created by larger types can make operations to heliports on raised structures challenging; due to the risks posed to third parties who may be moving around under final approach areas and due to the possibility of damage to nearby vehicles and/or property e.g. a raised HLS directly above, and/or surrounded by a public car park. Where operations by very large helicopters are to be facilitated, often the only way to reduce the detrimental environmental impact is to locate the HLS above a tall building (preferably the tallest on the estate).'

Chapter 7 outlines the recommendations for HLS on raised structures that are less than 3 m above the surrounding terrain. It advised that:

'It is strongly recommended to establish a downwash zone around the touchdown and lift-off area which during helicopter operations is kept clear of people and loose articles (e.g. light and insecure objects) to avoid injuries and damage from any debris that might be disturbed as a result of downwash or blade tip vortices. For small to medium air ambulance helicopters a 30 m downwash zone is recommended. For large helicopters such as are operated in the SAR role, and for military helicopters, an extended downwash zone should be provided which is typically 50 m – 65 m beyond the centre of the touchdown and lift-off area.'

CAP 1264 refers to CAP 738 for guidance about safeguarding an HLS.

23 The downwash effects guidance video can be accessed here: https://www.youtube.com/watch?app=desktop&v=09bvuYRKwwc [accessed 22 February 2023].

1.17.2.6 CAP 738 – Safeguarding Aerodromes

CAP 738 offers guidance to those responsible for the safe operation of aerodromes to help them assess what impact a proposed development or construction might have on that operation. CAP 738 is intended to provide advice and guidance to all those involved in the process of aerodrome safeguarding and states '*primarily these are certificated and licensed aerodromes, heliports and hospital helicopter landing sites (HHLS)*' but that '*non-licensed aerodromes, heliports and HHLS may find the information of assistance.*' Typical examples of things to be considered would be new buildings and temporary cranes.

Edition 3 of the document was published in 2020 to incorporate changes that included guidance material for heliports. The document contained a sample aviation safeguarding procedure for HLS, which outlined the responsibilities of the HLS Site Keeper. The document said that the example procedure did not have to be followed verbatim, but it was included to provide an indication of the aspects that needed to be considered. This included the creation and management of a safeguarding arrangement with the local planning authority, which could include a 'safeguarding map' to show the boundary of the agreed safeguarding area. The document also contained a section entitled '*Other Safeguarding Considerations*' that included the following text:

> *'…integral to safeguarding is the potential for damage caused by the downward flow of air from the rotor system in flight, known as 'rotor downwash' which, for large and very large helicopters, and even for small helicopters at high power setting, can be intense, displacing loose hoardings and blowing grit and debris at persons, property and vehicles in the vicinity. As part of safe management practices, Xxxxxxxx Hospital commits to ensure that, as far as reasonably practicable, a minimum downwash safety zone, agreed between the helicopter operator and the Site Keeper, around the HHLS will be established and to the extent necessary kept free of persons, property or parked vehicles beneath the approach path, back-up area, take-off/climb surfaces. The following safety checks will be completed daily:*
>
> *a) Identify a person responsible for monitoring helipad 'downwash safety zone'.*
>
> *b) The responsible person to ensure to the extent necessary that this zone is kept free from persons, property, parked vehicles…'*

1.17.3 Planning for the new HLS

1.17.3.1 General

A team of people who worked for the hospital Trust were assigned to deliver the new helicopter landing site. The objective was to have a landing site that was compliant with the relevant guidance at the time (HBN 15-03 and the ICAO Heliport Manual, Doc 9261 edition 3) and offered 24-hour facilities to ambulance and SAR helicopters. None of the people employed by the Trust had any qualifications, training, or experience in helicopter operation. A user group was established to provide operator input during the design, build and operation of the new landing site. The Trust employees who worked on the project reported that they relied on the expertise of the helicopter adviser and the user group.

The new landing site was considered a safety and operational improvement compared to the previous grass landing site. The atmosphere within the project team was reported to be positive and the new HLS was considered a success.

There was no evidence of any pressure to compromise safety during the build project or subsequently. The COVID-19 pandemic was not reported to have affected the operation or management of the helicopter landing site.

1.17.3.2 HLS feasibility report

The hospital Trust contracted an independent helicopter adviser to help them to select the most suitable HLS type and location. He completed a feasibility report in February 2012, recommending a partially raised HLS suitable for helicopters up to, and including, the size of a S92. The report said that the most suitable location was Car Park B because this would minimise patient transfer time after landing. It would also ensure that there could be two helicopter approach/departure flight paths, which would comply with ICAO guidance.

1.17.3.2.1 Consideration of downwash

The feasibility report referred to work conducted by the New Zealand Forest Research Institute to measure wind velocity on the ground for helicopters flying at different heights and forward speeds. This was done using helicopters that weighed between 4,000 kg and 5,000 kg, which is the typical weight of an air ambulance helicopter. The report acknowledged that larger helicopters such as the S92 will generate larger downwash velocities.

The report contained annotated scans of two graphs showing downwash velocities for helicopters weighing up to approximately 5,000 kg. One of these, Figure 15, was used to predict that a 4,000 kg helicopter hovering just above

the ground would create downwash with a peak velocity of 55 kt (28.3 m/s) at a distance of 40 ft (12.2 m) from the centre of the main rotor. The report stated that this would reduce to 15 kt (7.7 m/s) if the helicopter hovered approximately 8 ft (2.4 m) above the ground. The report did not mention that the same graph indicated that at this height, the peak wind speed would be greater (approximately 13 m/s) at a distance of 90 ft (27.4 m) from the centre of the rotor.

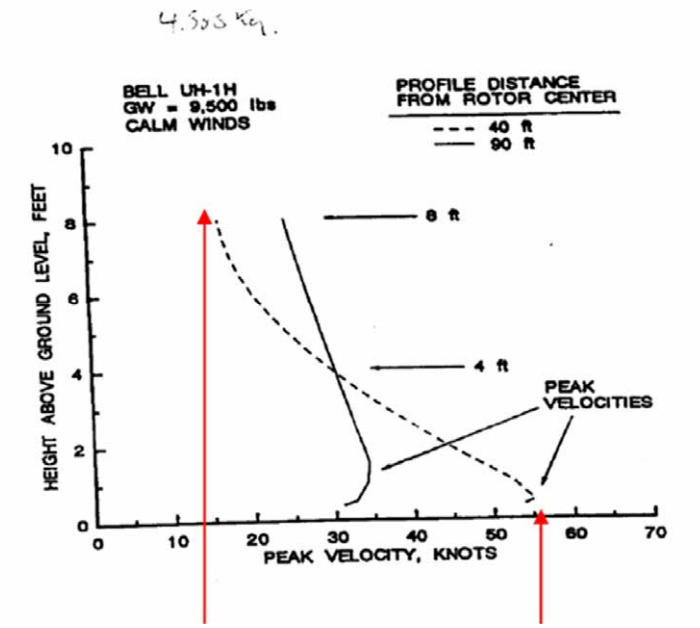


Figure 15

Extract from the feasibility report
(red arrows highlighted specific wind velocities in the report)

The report stated that military and coastguard type helicopters up to 12,800 kg would generate larger downwash velocities and another scanned and annotated graph (Figure 16) indicated that the S92 could cause wind speeds of 42.8 kt (22 m/s) which is equivalent to gale force 8 to 9 on the Beaufort wind force scale.

The report concluded that the effects of downwash '*on persons or property underneath the flight path will be little more than the effects normally experienced on a gusty, very windy day*.' It stated that approach and departure profiles are designed so that the helicopter can land on the HLS in the event of an engine failure, which entails a steeper than usual approach or a vertical takeoff to a decision point between 120 ft and 200 ft above the HLS. It also stated that '*the most significant effects of down wash will be confined to the helipad itself.*'

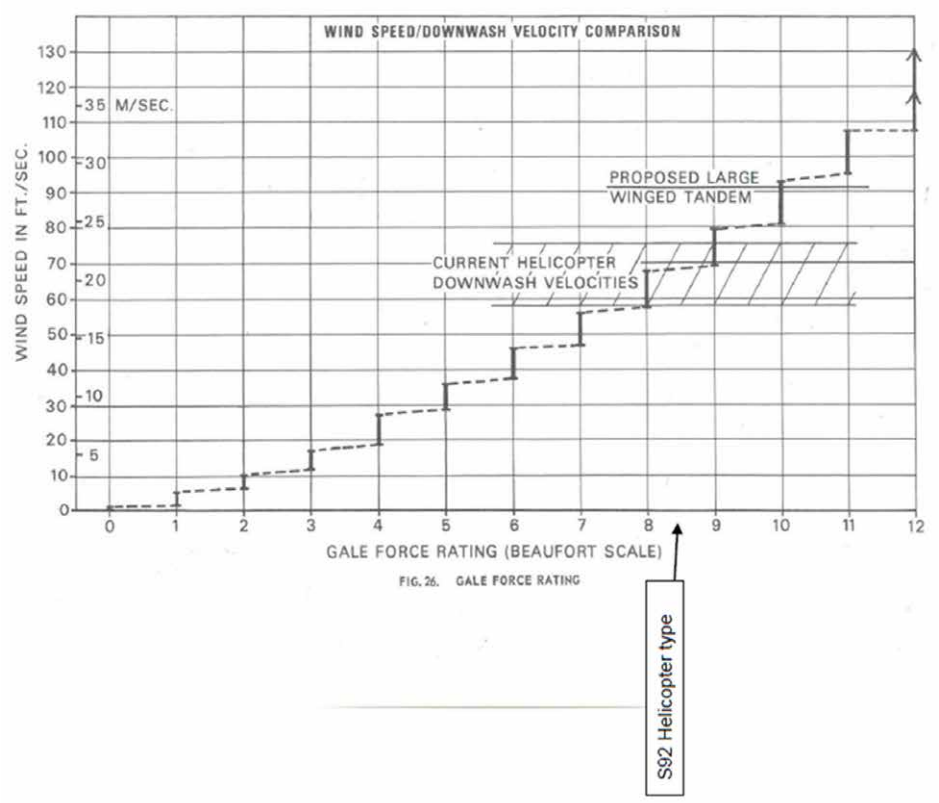


Figure 16

Extract from the feasibility report highlighting S92 downwash

Paragraph 2.19 referred to military helicopters and the MCA, specifically Sea King and S92 helicopters. It stated that the noise and downwash from these helicopters would normally be considered unacceptable close to hospital facilities. However, it stated that the proposed location at Derriford should be far enough away from sensitive areas that operations should be acceptable considering the likely infrequency. The report stated that by providing a larger than minimum size HLS surface, '*the majority of the down wash effects will be confined to the helipad surface itself and should not affect vehicles parked either under the helipad or close to it. When these larger types* [S92 and Sea King] *are expected the hospital staff should ensure that any vulnerable persons or objects are removed to a safe place well before the aircraft arrives*.' This latter comment regarding moving people to a safe place prior to the arrival of larger helicopters was not mentioned in the '*Conclusions and Recommendations'* section of the report.

1.17.3.2.2 Recommendations in the feasibility report

The feasibility report contained a section entitled '*Conclusions and Recommendations*.' Relevant recommendations included:

- The HLS should be designed to accommodate helicopter types up to and including the size and weight of the S92.
- The early designation of an HLS manager who should be encouraged to acquire the skills to manage and operate the HLS and associated activities as the project developed.

Other relevant recommendations in the main body of the report, but not repeated in the Conclusions and Recommendations section included:

- The writing of an HLS Operating Manual (by the HLS manager).
- Provision of signage to warn people about helicopter operations in the area. Traffic lights or barriers were not considered necessary provided staff were trained and capable of '*securing*' the area around the HLS.
- Periodic audits (at least annually) of the HLS to ensure continuation of good maintenance, operating procedures and best practice. The report said these audits should be carried out by a specialist external auditor or an independent auditor from the hospital Trust's quality management organisation.

1.17.3.2.3 Involvement of the helicopter adviser after the feasibility report

The helicopter adviser said that he was not involved in the detailed design or construction of the HLS. He did, however, visit the HLS after it was constructed, and he provided a 'certificate' to verify that the installation met the requirements of ICAO Annex 14. The certificate did not refer to HBN 15-03 and the adviser used his own design because there was no template or requirement for such a certificate.

1.17.3.3 The design agency

The organisation that designed the HLS used the feasibility report and HBN 15-03 to inform their decisions. The contract tendering process included a requirement for the feasibility report to be verified and, in October 2012, the design agency sent an email to the Hospital Trust project manager asking for clarification. The email said '*Verification could be a cursory read or a complete validation by an independent aviation specialist with helicopter experience.*

Maybe a pragmatic approach would be to check the geometry of the safe take off and landing profiles in the report to ensure that the helipad is sited correctly.' The project manager replied that the pragmatic approach was acceptable. The HLS was eventually built in a different location in the car park, where obstacle clearance would be better.

Based on the feasibility report, the design organisation believed that helicopters would take off and land vertically, and that downwash would be contained within the HLS. They designed boundary walls with the primary intention of preventing unauthorised access, but a secondary function was to help contain downwash, especially at the northern boundary, which is adjacent to a main road. Where appropriate, the walls were placed to create a 30 m safety area at the level of the HLS, as required by HBN 15-03. Downwash was not considered to be a hazard in the car park.

Liaison with the helicopter adviser was reported to be informal; there was no contractual relationship between the two parties.

1.17.3.4 Local authority planning department

The helicopter landing site required planning permission to be built. Public safety was part of the scope of the planning application assessment. The planners had no aviation knowledge, training, or experience. They relied on the consultation process to highlight any objections or concerns on safety grounds. The planning officers consulted the CAA who they expected to provide any relevant comments relating to safety. They received a standard response saying that the CAA were not required to be consulted. The highway authority and the 'public protection' department of the council were also consulted but did not offer any safety concerns. The planning officers were not aware of the guidance documents available at the time.

1.17.3.5 Helicopter operators' involvement

The helicopter user group included representatives from the Devon and Cornwall HEMS operators and the military, who were operating SAR aircraft at the time. The suitability of the site for S92 aircraft was discussed on at least two occasions prior to the landing site opening. In each case the conclusion recorded was that the site was designed to the current requirements.

While the operator commenced the workup phase at Newquay in October 2015, they did not start delivering SAR cover until 1 January 2016. As such they did not participate in any of the design and consultation stages of the HLS.

1.17.3.6 Opening and operation of the HLS

The Head of Estate Site Management acknowledged that the HLS and the car park is owned by the hospital Trust, and responsibility for the safe operation of the HLS is with the Trust.

When the HLS was completed and handed over to the Estates Department for operation, they were given an information pack that contained some maintenance instructions but there was nothing concerning operational procedures for a helicopter landing. Some modifications, including the installation of more secure gates to control public access, had to be made before it could be opened.

A video[24] of the first landing on the new HLS shows people standing close to the place where the fatal injury occurred who were affected by the downwash to the extent that they had to hold on to each other for support (Figure 17). This first landing was a Sea King helicopter, which is lighter than G-MCGY was on the day of the accident.[25]

Figure 17

Still from internet video showing people affected by downwash on the opening day of the HLS

The Head of Estate Site Management recalled that he was told by the project team that there was a 30 m safety zone that they needed to worry about irrespective of the helicopter type and his understanding was that it was okay for the 30 m zone to extend over Car Park B because it was only required at "pad level and not ground level" and as such the safety zone went above the car park. He formed an understanding that helicopters would initially hover at height above the HLS and then descend to land. This led him to believe

24 https://www.youtube.com/watch?v=_fdauGP7E3k [accessed on 28/03/2023].

25 The maximum takeoff weight of a Sea King is 9,525 kg. G-MCGY was 10,468 kg at landing on the day of the accident.

that the walls surrounding the HLS would thus stop the downwash from going outside the HLS.

There were risk assessments for the HLS and the car parks which were regularly reviewed and are discussed in more detail in paragraph 1.18.2 of this report. Nobody within the hospital Trust that the AAIB asked was aware that CAP 1264 had superseded HBN 15-03 until after the accident.

1.17.4 The helicopter operator's perspective

1.17.4.1 General requirements

There are two types of operations that regularly fly into the HLS at DH; SAR missions and HEMS missions. While both operations are operated under an Air Operators Certificate and are deemed to some extent to be commercial air transport operations, SAR missions have additional guidance in the form of ICAO Annex 12 and CAP 999.

1.17.4.2 ICAO Annex 12 – Search and Rescue

ICAO Annex 12 states that contracting States shall arrange for the establishment and prompt provision of SAR services within their territories to ensure that assistance is rendered to persons in distress. Such services shall be provided on a 24-hour basis.

It is under this requirement that SAR resources are provided in the UK.

1.17.4.3 CAP 999 – UK Helicopter Search and Rescue (SAR) National Approval Guidance

CAP 999 is used to assist operators intending to conduct civil maritime SAR helicopter operations in the UK in accordance with national requirements and recommended practices. It provides an expected means of compliance together with guidance in determining operational procedures and OM development.

The Third Edition, published in January 2021, was extant at the time of the accident. It stated in Chapter 2:

> ***'Helicopter SAR operations***
>
> *2.1 Search and Rescue is a State activity regulated by National Aviation Authorities (NAAs). In the UK, operation of civil helicopters for SAR is considered to be for the purposes of Public Transport (PT) and therefore subject to Article 101 of the ANO requiring a national Air Operator's Certificate (AOC).*

…

2.5 The operator remains fully responsible for the control and oversight of its operations under any SAR tasking.'

Chapter 3, *Operating requirements,* states in paragraph 3.7, that an operator is to '*produce or obtain'* a directory of HHLS. While the operator did not have its own HLS directory, they used the No 1 AIDU's, *Helicopter Landing Sites – Hospitals United Kingdom*, and entries in their OM Part C for each site it operates to. This was approved by the CAA.

See Appendix A for additional details of *Performance requirements* from the Third Edition of CAP 999.

1.17.4.4 The helicopter operator's OM

An operator is to have a set of manuals that contain all instructions and information necessary for operational personnel to perform their duties. Pertinent extracts from these are included in the following paragraphs.

1.17.4.4.1 UKSAR Flight OM Part A

The operator's OM Part A predominantly includes all the operational information relating to the whole operation and is not specific to any helicopter type.

Section 8.3.10 - Wake Turbulence and Downwash, discusses downwash and the dangers associated with it in helicopter operations. It also advises crews how to optimise and fly an approach. It stated that '*the airstream under a high-density disc aircraft* [like a S92] *may approach that of a Category 1 Hurricane (64 knots sustained).*' See Appendix F for more details of the contents of Section 8.3.10.

1.17.4.4.2 UKSAR Flight Operations Manual Part A Supplement 1 – *SAR Techniques*

Supplement 1 to OM Part A, *SAR Techniques,* contains information on both 'search' and 'rescue' techniques for both onshore and offshore SAR mission. Most of the information is not specific to any helicopter type.

It states the following in Chapter 2, '*ONSHORE OPERATIONS'**:***

'2.1 Confined Area Operations / Unprepared Sites

2.1.1 Recce

The 5S Recce is a standard brief that is used to cover the elements likely to affect the aircraft approach and landing.'

The elements of the 5Ss stand for; size, shape, surrounds, surface and slope.

For the approach to DH, as the pilots had operated into it several times previously, the '*Surrounds'* was the principal 'S' that they considered, as the others would not have changed since their last visit. Under *'Surrounds', Section 2.1.1* it states:

> *'Surrounds:*
>
> *Note surrounding area, check for and brief (always mindful of downwash & sidewash velocities):*
>
> *F FOD Foreign Object Damage – susceptibility & object dislodgement;*
>
> *O Obstacles / Obstructions – wires, masts or overhanging branches. Alternative Sites?;*
>
> *D Downwash Hazards – object 'pick-up', funnelling areas;*
>
> *U Undershoot Clearance and obstacles;*
>
> *O Overshoot Clearance and obstacles.'*

1.17.4.4.3 OM Part C – *Route Guide*

OM Part C, *Route guide*, details instructions and information relating to communications, navigation and aerodromes for each aerodrome/operating site planned to be used by the operator's helicopters. It should be read in conjunction with OM Part A.

Section 12, Special Operating Site Limitations – Performance, Limitations and Operating Procedures, states the following:

> ***'12.2 Onshore Helicopter Hospital Landing Sites (HHLSs)***
>
> *There is currently no comprehensive National Database of Hospital Helicopter Landing Sites.*
>
> *While it is anticipated that this will be forthcoming, to date, crews are to make use of the Military, Number 1 AIDU Hospital Landing Sites Directory and the equivalent Helicopter Landing Sites, documents for planning purposes. These documents are available from the ACANS App[26] or the Bristow Library on SAR Crew iPads.*
>
> *…Each site will have its unique characteristics and will have been surveyed to a varying degree.*

26 ACANS (Aviation Command & Aircraft Navigation System) is a form of electronic flight bag application on the pilots' portable electronic device which can be used as a navigation tool.

It is anticipated that all major HHLSs within the UK will be certified to demonstrate compliance with National guidelines for such facilities. This certification will be based on a 'Design Helicopter' and include an Aviation Protocol Document that establishes due diligence in the control and supervision of the HHLS.

By their nature, HHLSs are located in areas that attract a lot of third party activity in obstacle rich environments. To minimise the risk of third party injury or damage following an emergency or due to rotor downwash etc., it is important that SAR crews conduct a dynamic risk assessment prior to landing to confirm performance and establish whether anything has changed since the last inspection of the HLS.'

1.17.4.4.4 Operator's HLS FSI

The operator publishes the *Compatibility of UK Hospital Sites with UKSAR Aircraft Types* FSI. This is an internal document which it provides to all its crews. It details a comprehensive list of the HLS in the UK that are currently available to the operator's SAR helicopters, along with those that have been removed until further notice. The HLS listed are approved (or not) for operations by its S92 and/or AW189 based on local knowledge and engagement, along with evidence from their SMS.

In its '*Introduction'* it states, '*All crews are reminded of the need to carry out Dynamic Risk Assessments during every landing and takeoff and are to follow the guidance and direction that is detailed in the operations manuals.*'

It is a 'live' document that was reviewed every six months where any feedback from operational crews, wider industry, and Base HLS Representatives are considered before amendments are made. Since the accident they are now reviewed monthly and additional information has been added for each site as to whether an HLS has facilities for it to be secured and by whom, ie coastguard rescue team, police and/or hospital staff.

Immediately after it was notified of this accident, the operator amended the FSI to withdraw the approval for its S92 and AW189 helicopters to operate into DH.

1.17.4.4.5 Operator's Risk Assessment

The operator had a generic risk assessment covering all HLS in a '*hostile and congested environment'*[27].

27 The Air Navigation Order 2016 defines a 'Hostile environment' as an environment in which a safe forced landing cannot be accomplished because the surface is inadequate; or the helicopter occupants cannot be adequately protected from the elements; or search and rescue response and capability is not provided consistent with anticipated exposure; or there is an unacceptable risk of endangering persons or property on the ground. It also defines a 'Congested area' as being in relation to a city, town or settlement, and means any area which is substantially used for residential, industrial, commercial or recreational purposes.

The extant version, which was assessed on 15 December 2021, listed '*Downwash causing 3rd Party Damage/Injury*' as a risk. This was mitigated with the following control measures. The items in brackets are the documents where more details can be found on each measure:

'1. Site Recce (5S, FODUO)//EO devices (Ops Manual)

2. Crew Training and Competency Checks and Training (Ops Manual A and D)

3. Control of access during operations (Stakeholder Engagement)

4. Look out (Operation Manual)

…'

It categorised the risk as '*High Risk – Acceptable with Mitigation for limited period of operation*' before control measures were applied.

The risk assessment has been reviewed since the accident but there has been no change to the control measures. However, an assessment, after the control measures have been applied, of '*Acceptable with Mitigation*' has been added.

1.17.4.4.6 Operator's downwash training procedures for the mitigation of downwash

Downwash is routinely discussed and considered on all operational flights and all training flights in accordance with the previously mentioned guidance in the operator's manuals. A pilot's competence with regards to the guidance is assessed during an annual Line Check, which is conducted in a helicopter.

Downwash is also considered and discussed in the simulator as part of the training of various profiles including approach and landings at HLS. There is also a requirement that downwash is discussed during a pilot's six-monthly Operator's Proficiency Check.

Pilots are also required to maintain their competency in certain skills. Among these is landing in confined areas, where one such landing is required to be conducted at least every 45 days. Part of the planning and execution of the skills includes downwash awareness.

The video mentioned in CAP 1264 was shown to all crews in 2018. It is also included in the SAR Line Training package for all new joiners.

1.17.4.4.7 Operator's comments

The operator commented that they did not engage with DH during the design of the HLS as the HLS was opened before the operator started operating from Newquay and subsequently into DH.

They added they were not aware of having completed their own site survey of the HLS at DH prior to operating into there in January 2016. They used the information in the No 1 AIDU's '*Helicopter Landing Sites Hospitals United Kingdom*' directory. However, the operator's representative stated that a third party conducted a survey with an unmanned aircraft, on behalf of the operator, about a month after the HLS opened. This was to establish the obstacle environment around the HLS for performance considerations for helicopter operations.

The operator had been given a copy of a document titled '*Helicopter operators using the helicopter landing site, Derriford hospital, Plymouth.'* It covered characteristics of the HLS, aircrew responsibilities and the flight paths but not the duties of the Helicopter Response Team. The operator stated that they deem that the published flight paths to the HLS at DH are advisory as there may be an operational need to fly outside these areas and it would depend on the outcome of the dynamic risk assessment as to whether it would be appropriate to fly outside them.

The helicopter operator commented that its base at Newquay did not have a copy of the Trust's SOP '*Helicopter Landing Site: Operational Procedure and Emergency Response (Version 2, issued October 2020)' or the 'On-Site Operational Procedure and Response to an Emergency Incident*' which detailed the duties of the HLS Response Team. The operator was unable to locate a copy of the *On-Site Operational Procedure and Response to an Emergency Incident*, at its headquarters, despite it being sent to its representative in July 2017. However, they did have a copy of the '*Helicopter operators using the helicopter landing site, Derriford Hospital, Plymouth'* document (Appendix C) that DH had sent to all helicopter operators. This document did not detail the duties of the HLS Response Team. Before the accident they would have expected these staff at DH to ensure the landing site was secure and that the surrounding car park was free from members of the public. They were not aware that the HLS Response Team were only responsible for the area within the walls of the landing site, and that their duties did not include management of people outside the HLS boundary except for making sure that they remained behind the '*safety wall*' and advising against taking photographs or smoking.

The operator added that at some of its other bases, they have been given limited information by other hospital Trusts for sites into which it might operate.

However, the information provided by these Trusts was not standardised, with an SOP for one Trust not mentioning the HLS Response Team and their responsibilities.

If a site had not been secured by the hospital's staff for whatever reason, then ideally crews would hold off until it had been completed. However, the operator advised that, if there was a rapidly deteriorating casualty, crews would probably continue to land, subject to a dynamic risk assessment. In terms of trying to mitigate any type of inherent danger, including that to uninvolved third parties, for an operating crew it is about balancing the risk against the medical needs of the casualty.

The operator advised that, although it was not very proactive in engaging with hospital Trusts, it would not hesitate to liaise with them if an issue was raised by one of the crews, for example if there was no security or coastguard present to help secure a site. It is planned to have a representative from the operator that would liaise directly with each HLS, but there are some issues still to be resolved before these posts are established.

1.18 Additional information

Hospital HLS fulfil a vital role by allowing people to be transferred rapidly to a hospital for medical care. In May 2022, a UK charity announced that over 20,000 landings had been made on UK hospital HLS that they had partially funded. Records examined as part of this safety investigation indicated that over 2,500 landings occurred at the DH HLS since it opened in 2015. Most of these involved HEMS type helicopters, but at least 140 were larger SAR type helicopters.

1.18.1 Other incidents at the DH HLS

1.18.1.1 Complaints received in 2015

Meeting minutes from the hospital's project board meeting in July 2015 referred to '*minor*' complaints about downwash during landings. The meeting minutes and some interview evidence indicated that the hospital Trust discussed putting a warden in place to tell members of the public that a helicopter was landing. The DH Head of Estate Site Management stated that the intention was only to prevent people entering the HLS, and not to inform people within the car park because downwash was not considered a risk outside the helipad walls, and it would not be practical for one person to cover Car Park B and the public road at the same time.

1.18.1.2 Downwash incidents prior to March 2022

The hospital Trust provided details of known downwash incidents that occurred before March 2022. These are summarised at Table 5.

Date	Description	Response / Action taken
21/04/2021	Hospital porter was holding a mattress onto a bed when a helicopter landed. Bed folded and hit him in the face. No injuries.	Staff reminded to comply with operating procedures. Bed should be kept at the bottom of the access ramp until the helicopter has landed. Two porters should be used, one at each end of the bed.
30/05/2019	Debris blown onto road by helicopter downwash. No damage or injuries.	Contractors did not comply with operating procedures. Daily HLS inspection extended to include car park and perimeter.
22/06/2017	A helicopter taking off disrupted people sitting at picnic benches in Car Park A. Minor injury sustained by a member of the public who was hit by an access door that was blown off an electrical control box.	Medical team attended to the injured person. Control box door was replaced with a more secure type. Picnic benches had been placed in the wrong area and were removed. Additional signage was installed.
16/06/2016	Pedestrian blown over by downwash in Car Park B. Pain to elbow and left foot.	Pedestrian treated for injuries and discharged. CCTV showed helicopter did not follow the expected flight paths. Reminder sent to all operators about the designated flight paths and landing procedure.

Table 5

Helicopter downwash incidents that were recorded by the hospital Trust

1.18.1.3 Pedestrian injury in 2016

On 16 June 2016, a pedestrian in Car Park B sustained minor injuries when they were blown over by the downwash of a S92 just before it landed. Representatives from the hospital Trust reviewed the CCTV footage and concluded that the pedestrian was blown over because the helicopter approached from the south, directly over the car park, instead of using one of the two designated flight paths.

The DH Head of Estate Site Management sent an email to helicopter operators that typically landed at Derriford reminding them that they should approach the HLS using the designated flight paths. The email also said:

> *'The design of the pad and in particular the blast walls is that a helicopter should position itself over the H at a height of approximately 20 m before landing vertically. This way the downdraft is cushioned by the blast walls. On this occasion because he was lower the downdraft hit the car park…we spent a bit of time with the Marines and their Merlin to prepare for authorised emergency landings and by ensuring the pilot was 20 m or more above the H before trying to land we kept the downdraft within the pad with no effect on any of the pedestrians who had crowded in the car park to watch it land.'*

The SAR operator sent a reply that acknowledged the designated flight paths but said that on the day the pedestrian was injured, the pilot elected to approach the HLS as he did because of the wind conditions and local building work. The operator's Newquay base Chief Pilot sent an internal e-mail, to the Newquay pilots, to record that he had spoken with the Head of Estate Site Management to explain that the 'Helicopter operators using the helicopter landing site, Derriford Hospital, Plymouth' (Appendix C of this report) did not include a requirement to hover at 20 m. His email said that the Head of Estate Site Management had accepted this and would amend and re-issue the document. An amended document had not been provided at the time this report was published.

The Head of Estate Site Management wrote to the pedestrian in July 2016 to explain the outcome of their internal investigation. The letter said there had been approximately 400 landings at the HLS in its first year of operation and they were only aware of two other incidents. It said that helicopters were supposed to hover at 20 m before descending vertically onto the HLS, but this requirement had not been complied with on the day of the incident. The AAIB asked the Head of Estate Site Management for additional information about the other two incidents, and the requirement to hover at 20 m before descending vertically, but he could not recall where the 20 m requirement came from or provide any additional information.

The hospital management believed that the unusual flight path of the helicopter was the explanation for the incident and the event did not prompt the hospital Trust to reconsider the safety of the HLS. The operator agreed that the helicopter appeared to not comply with the recommended flight path but added that the northerly wind at the time may have blown the downwash in the direction of the pedestrian. In response to this, the Head of Estate Site Management understood and accepted that '*the pilot has the ultimate say based on conditions and I would never try to challenge that…*'

1.18.1.4 Unreported incident in July 2021

Four days after the fatal injury, a local news agency reported online that a member of the public had said that his wife had been blown over in the hospital car park in October 2021. The AAIB established that the date was incorrect, and the occurrence happened during the morning of 16 July 2021. The car parks were busy when the couple arrived at the hospital, but they found a space in the north-east corner of Car Park B, close to the HLS. The man's wife stood outside the car while he reversed into the parking space. He heard a helicopter approaching from the east (behind his car) and, after it landed, he could no longer see his wife. He got out of his car and found her lying on the ground between two parked vehicles. She was uninjured so they decided not to tell the hospital what had happened. As such, DH were unaware and so unable to record it or investigate.

The AAIB asked the SAR operator to check their records and they advised that none of their helicopters landed at Derriford on 16 July 2021. Records from the South Western Ambulance Service Trust indicated that four air ambulances landed at DH on that day, so the inference is that the pedestrian was blown over by a helicopter in a lower weight category (between 3,000 kg and 4,000 kg) than the S92.

1.18.2 Hospital Trust risk assessment and risk management

1.18.2.1 Requirements and guidance relating to risk assessment

The *Management of Health and Safety at Work Regulations 1999*[28] require employers to put in place arrangements to control health and safety risks. As part of this, all employers are required to make a suitable and sufficient assessment of the health and safety risks to their employees and other people arising in connection with the work being undertaken.

The Health and Safety Executive (HSE) guidance document *HSG65 Managing for Health and Safety, Third Edition, 2013*[29] provides further detail on the scope and method of a suitable and sufficient risk assessment. It also refers to other guidance including the *Health and Safety toolbox – How to control risks*[30] which is relevant to risk assessment. The various guidance documents do not follow a consistent format but taken together, they make the following general recommendations for what a risk assessment process should include:

28 *The Management of Health and Safety at Work Regulations 1999, UK Statutory Instrument No. 3242*, https://www.legislation.gov.uk/uksi/1999/3242/contents/made [accessed on 20 January 2023].

29 Health and Safety Executive (2013), *HSG65 Managing for Health and Safety, Third Edition*, https://www.hse.gov.uk/pubns/priced/hsg65.pdf [accessed on 20 January 2023].

30 Health and Safety Executive, *The health and safety toolbox, How to control risks at work*. https://www.hse.gov.uk/toolbox/managing/managingtherisks.htm [accessed on 20 January 2023].

- Identification of hazards and consideration of who might be harmed – All foreseeable significant risks should be identified. The scope should include things that happen very infrequently but with catastrophic effects, to things that happen much more frequently but with lesser consequences. The assessment should take account of possible harm to employees, contractors, members of the public, those using products and services and anyone else affected by the activity, such as neighbours. The assessment should consider how a risk could affect different groups eg the elderly.

- Evaluation of the risks – Consideration of the likelihood that harm will occur given the controls in place and what additional control measures can be implemented that are reasonably practicable.

- Check that risks are being adequately managed – Monitoring the effectiveness of controls and learning from experience.

- Recording the findings – Keeping a simple record that documents the hazards, how people might be harmed by them and what you have in place to control the risks.

- Competence - The guidance suggests that risk assessment should be done by someone with knowledge of the activity, process or material that is being assessed.

These criteria have been used below as a framework to document the relevant parts of the hospital Trust's risk management policy and practice in relation to the HLS.

1.18.2.2 The Trust's Risk Management Policy & Procedure

DH were required to follow the risk management policy provided by the Trust. The Trust's *Risk Management Policy and Procedure* that was in place at the time of the accident (Version 15, issued November 2021) was reviewed in relation to the HSE guidance. This was a general policy designed to apply to all risks. It did not include any content specific to hospital HLS.

On 10 May 2023, the HSE wrote to all NHS Trust and Board Chief Executives with a '*reminder of legal health and safety duty and how it should be discharged to effectively manage risk associated with hospital helipad use.*'

1.18.2.2.1 Identification of hazards and consideration of who might be harmed

The policy introduction mentioned the need to create a safe environment for patients, staff, and the general public. However, the focus in the risk identification section of the policy and the risk management framework was on risks to the quality of patient care, the safety and wellbeing risks to staff in the work environment, and risks to the Trust in terms of meeting its objectives and maintaining reputation. The risk assessment template (Figure 18) required the assessor to consider who might be harmed and to complete an impact score for patients, staff, business and '*risk of harm.*'

1.18.2.2.2 Evaluation and recording of the risks

The policy stated that each risk should be assessed on the likelihood of it happening and the impact should the risk occur. It also stated the assessment should consider the adequacy and effectiveness of the controls, and all this should be recorded on the template. A process for review, approval and escalation was detailed. The policy provided instructions on how the assessment should be recorded using a structured template (Figure 18) and, for unresolved risks, an electronic risk register system called Datix. The Datix system captured the same information as the template and included some additional fields to support action planning for the unresolved risks.

1.18.2.2.3 Check that risks are being adequately managed

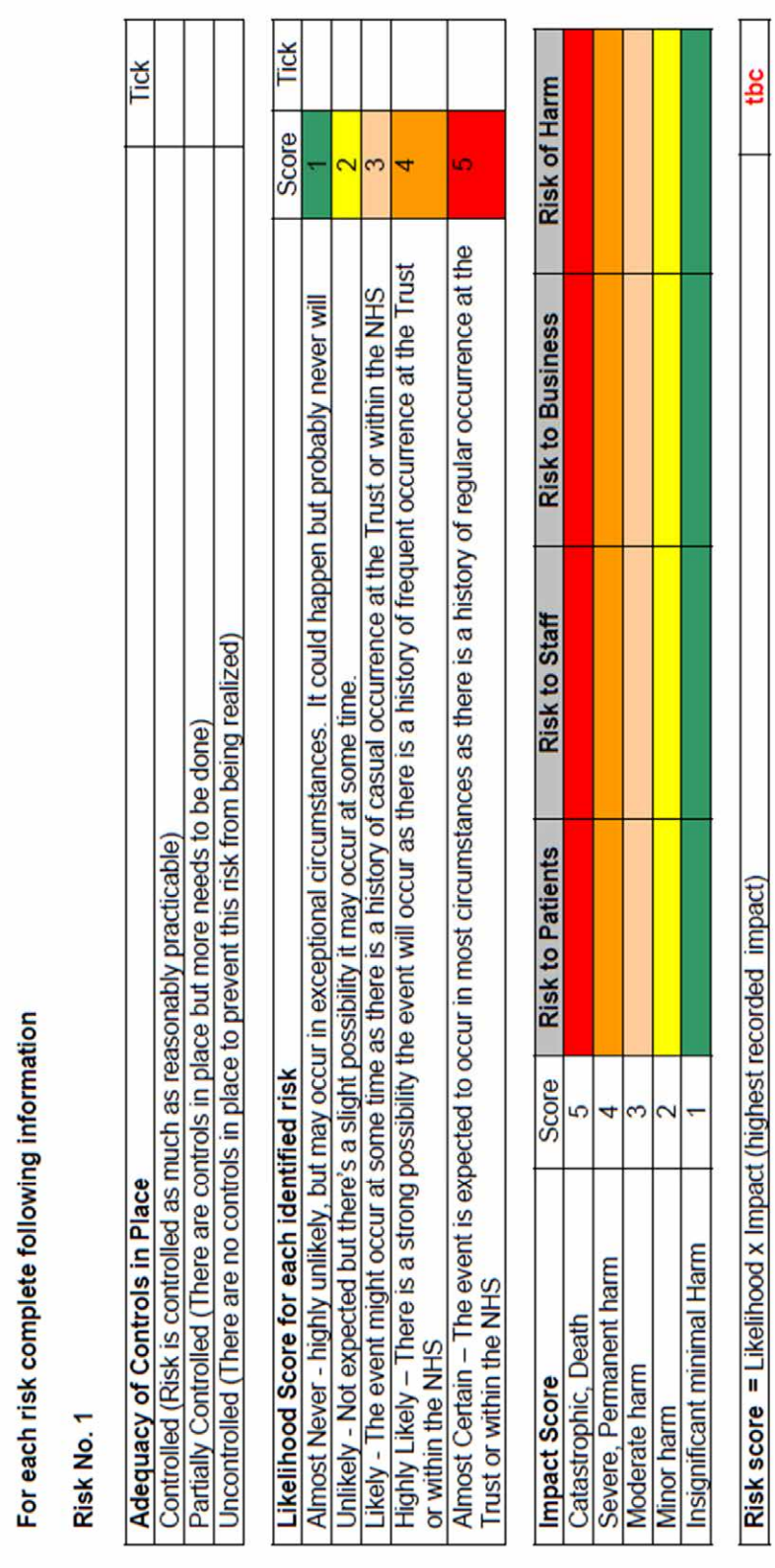
The policy specified a review timescale for risks according to their seriousness, ranging from monthly for serious risks to annually for accepted risks. A risk management framework was included, and it specified that incidents and feedback or complaints should be part of the scope of risk identification if they were not adequately addressed. The policy did not require monitoring or analysis of patterns or trends of incident occurrence or complaints. Compliance with the policy was intended to be monitored on a regular basis.

1.18.2.2.4 Competence

The Trust policy specified that risk management training should be provided to any '*identified staff member who has been nominated to support the risk assessment process within their department.*' The individual that risk assessed Car Park B and the HLS told the AAIB that she had not received any risk assessment training. She had been on a waiting list to attend a course about ten years ago, but the training had never taken place.

1.18.2.3 The Trust's risk assessment of the HLS

Risks associated with the new HLS were assessed at the design stage and documented in the hospital Trust's full business case. One identified risk was



For each risk complete following information

Risk No. 1

Adequacy of Controls in Place	Tick
Controlled (Risk is controlled as much as reasonably practicable)	
Partially Controlled (There are controls in place but more needs to be done)	
Uncontrolled (There are no controls in place to prevent this risk from being realized)	

Likelihood Score for each identified risk	Score	Tick
Almost Never - highly unlikely, but may occur in exceptional circumstances. It could happen but probably never will	1	
Unlikely - Not expected but there's a slight possibility it may occur at some time.	2	
Likely - The event might occur at some time as there is a history of casual occurrence at the Trust or within the NHS	3	
Highly Likely – There is a strong possibility the event will occur as there is a history of frequent occurrence at the Trust or within the NHS	4	
Almost Certain – The event is expected to occur in most circumstances as there is a history of regular occurrence at the Trust or within the NHS	5	

Impact Score	Score	**Risk to Patients**	**Risk to Staff**	**Risk to Business**	**Risk of Harm**
Catastrophic, Death	5				
Severe, Permanent harm	4				
Moderate harm	3				
Minor harm	2				
Insignificant minimal Harm	1				

Risk score = Likelihood x Impact (highest recorded impact)	tbc

Figure 18

Extract from The Trust's *Risk Management Policy & Procedure for Managing Risks (Version 15, November 2021)*

'*Restrictions to vehicle and pedestrian movements during take-off and landing down wash periods to ensure public and staff safety.*' The identified mitigation was '*A full design study has been undertaken to take into account downwash area and is incorporated into the design.*' The risk was given a green 'low' rating.

The AAIB reviewed the Trust's HLS risk assessment version issued in 2020 and interviewed witnesses involved in this risk assessment. The hospital Trust stated an initial risk assessment was undertaken in 2015 but was unable to locate this previous version, so the AAIB was not able to compare it with that issued in 2020.

The focus of the AAIB's review was the assessment of the hazard of downwash to members of the public, and the observations are noted in the following paragraphs.

1.18.2.3.1 Identification of hazards and consideration of who might be harmed

Ten hazards were identified including '*Damage to persons, vehicles or property from downdraft*.' Three risks were identified including '*Persons, vehicles or property are at risk of damage from downdraft from aircraft rota* [sic] *blades.*' Hospital representatives advised that they believed that the risk from downdraft only applied inside the HLS walls although this is not stated in the risk assessment record. They believed that the risk was mitigated because their standard operating procedures prevented members of the public from entering the HLS. Another identified risk was '*Members of the public may be vulnerable if they have accessed the helicopter landing site.*'

1.18.2.3.2 Evaluation and recording of the risks

Nine control measures were identified. The record of the assessment did not specify which controls related to which hazard or risk. Of the controls, '*Helicopter landing pad meets requirements laid down in Regulatory Article 3532*', '*SOP in place*', '*Access control and CCTV in place*' and '*Daily checks for damage and detritus*' may have related to downdraft. Regulatory Article 3532 was a military regulatory document that was not applicable to civilian HLS. The 2020 risk assessment did not refer to HBN 15-03 (the superseded guidance that was current when the HLS was built) or CAP 1264 (the guidance that was current at the time of the most recent risk assessment review but was not retrospectively applicable).

Each of the three risks was not separately evaluated. A single rating of the adequacy of controls was given: '*Controlled (Risk is controlled as much as reasonably practicable)*'. A single rating of likelihood was given: '*Almost never – highly unlikely, but may occur in exceptional circumstances. It could happen*

but probably never will.' A single impact score for risk of harm was given: '*Catastrophic, Death.*' The assessment was recorded on the template specified in the Trust's policy.

1.18.2.3.3 Check that risks are being adequately managed

AAIB were informed that the risk assessment was reviewed every five years or earlier if there was a specific requirement to do so following an incident or accident. Previous versions were not available, but the risk assessor stated that no changes were made during the 2020 review.

The risk assessor involved a representative from the operator as part of the review. The hospital Trust had records of some past downwash events including the 2016 pedestrian incident. The risk assessor knew about this incident and assumed that any changes that might be needed had already been incorporated. As the event in 2021 was not reported to DH, the risk assessor was unaware of it.

1.18.2.3.4 Competence

The 2020 review of the HLS risk assessment was not conducted by someone with knowledge of the activity being assessed. However, the risk assessor did involve a subject matter expert from the operator to assist with an understanding of the key issues and risks associated with helipads (paragraph 1.18.2.5 provides further detail).

1.18.2.4 The Trust's risk assessment of the car parks

The AAIB examined the Trust's risk register entries for the car parks dated between 2005 and the accident date, and the observations are noted in the following paragraphs.

1.18.2.4.1 Identification of hazards and consideration of who might be harmed

Harm to members of the public and staff from slips, trips and falls was considered but not in relation to helicopter downwash. The focus of the risk register after the opening of the helicopter landing site was on the loss of parking spaces in Car Park B.

Following this accident, the risk assessment for Car Park B was amended to assess the risk to pedestrians from helicopter downwash.

1.18.2.4.2 Evaluation and recording of the risks

Likelihood and impact were rated in line with the Trust's policy. Findings were recorded on the electronic risk register, Datix.

1.18.2.4.3 Check that risks are being adequately managed

Each risk had an identified risk owner. There was evidence of regular inspection of the car park and identification of new hazards and a process for checking if mitigations had been implemented.

1.18.2.4.4 Competence

The car park risk assessments were conducted by a number of different people and their knowledge and experience was not examined in detail.

1.18.2.5 Liaison between the helicopter operator and the hospital Trust regarding downwash

During a 2020 meeting with the DH HLS risk assessor, the operator's representative recalled delivering a presentation that included one slide that highlighted the control of third parties around the HLS as an issue (Figure 19). The slide pack for this presentation included more than 50 slides and covered multiple aspects including regulation, safety management and helicopter performance. He reported delivering the same presentation to the DH Head of Estate Site Management in 2019. The hospital risk assessor recalled that the material presented was "really technical" and "didn't register."

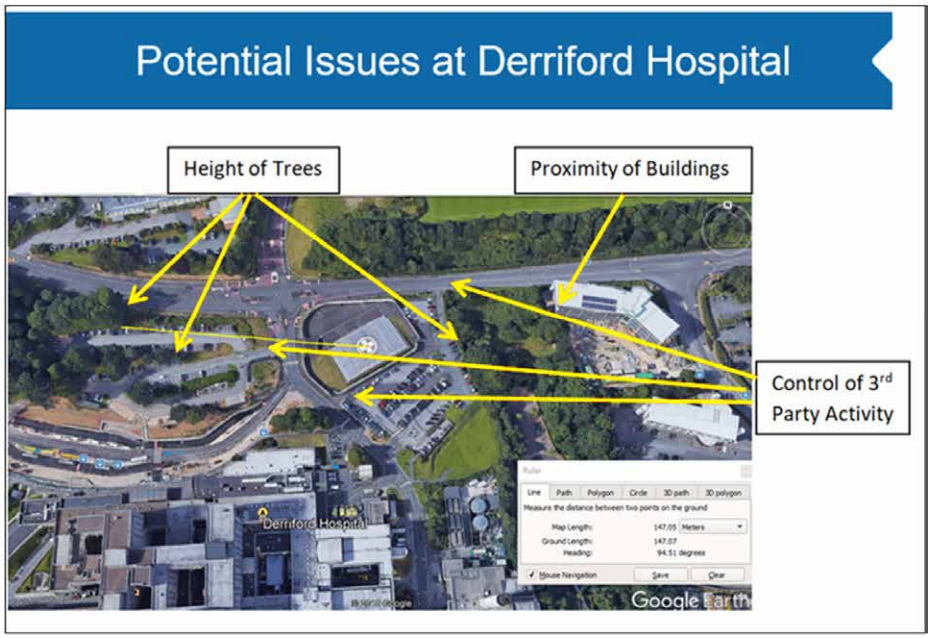


Figure 19

Based on slide from the helicopter operator's presentation to the hospital Trust in 2019 and 2020
(arrow colours changed to improve accessibility)

A representative from the helicopter operator met with the Trust in January 2019 and November 2020[31] and discussed a proposed extension to the ED[32]. During the meetings and subsequent email exchanges, the operator raised several concerns and highlighted the fact that downwash is unpredictable and can be destructive. They added that it also has the potential to have a great impact on third party infrastructure and personnel.

They advised that the ED extension would not be acceptable to continue operations into DH and, before considering giving approval to do so, they would reassess the areas surrounding the HLS to confirm that safeguarding would be assured once the extension was complete.

This extension has now been approved by the local planning authority. Work is due to commence in August 2023 and its anticipated completion will be around September/October 2026.

1.18.2.6 Wind speeds in the car park due to downwash

After the accident, the hospital Trust commissioned an independent study to investigate the local wind conditions around the HLS during HEMS helicopter operations. Six flights were monitored and the wind due to the downwash varied. The maximum wind speed measured in Car Park B was reported to be 12.5 m/s when a helicopter hovered over the HLS after approaching from the east. The maximum wind speed that was measured outside the car park was 13.0 m/s. This was to the west of the helipad, next to the main entrance road to the ED, and was recorded when a helicopter took off and reversed to the west before departing to the east.

1.18.3 Incidents at other hospital HLS

1.18.3.1 Australian Transportation Safety Board (ATSB) Investigation

In January 2022, the ATSB published an Aviation Occurrence Brief[33] following an accident where a pedestrian was seriously injured after being blown over by a helicopter as it approached a hospital HLS. The pedestrian was reported to have been walking about 50 m from the HLS, which was on an elevated platform approximately 8 m above the road. The helicopter was an Agusta Westland AW139, which has a maximum takeoff mass of 6,800 kg and a main rotor diameter of approximately 14 m.

31 He subsequently stopped working for the operator in March 2021.
32 Planning reference 21/02000/FUL10. Details of the application can be accessed here: https://planning.plymouth.gov.uk/online-applications/applicationDetails.do?keyVal=R221Y5MMG0S00&activeTab=summary [accessed 28 March 2023].
33 Rotor wash event, AgustaWestland AW139 The Alfred hospital, Victoria, on 28 October 2021 (atsb.gov.au) [accessed 28 March 2023].

The ATSB said that they had received five reports involving 'rotor wash' (downwash) events at hospital HLSs since 2016, and three of them had occurred at the same hospital. Before re-commencing operations at the HLS, the operator and hospital took the following actions:

- They reduced the maximum number of helicopters allowed on the HLS from two to one.
- They implemented pedestrian marshalling procedures for all helicopter movements, so that operations only occur when no pedestrians are within 30 m of the HLS.

The hospital engaged a consultant to review the design of the HLS, and the ATSB publicised the following safety message in their report:

> *'Helicopters produce significant main rotor downwash, especially during hover taxi, take-off and while approaching to land. It is important that the risk of downwash related injuries, either by direct exposure or by being struck by loose items, be assessed prior to using a helicopter landing site (HLS).*
>
> *As pilots have limited ability to reduce rotor downwash during these phases of flight, securing loose items in the vicinity of the HLS and keeping people a safe distance away are the most effective ways of preventing injury.'*

1.18.3.2 G-RESU serious incident on 23 March 2023

On 23 March 2023, at about 1215 hrs, a HEMS H145 helicopter (MTOW 3,726 kg) departed the HLS at the Queen Elizabeth Hospital (QEH), King's Lynn, Norfolk. At the time, the wind at RAF Marham, 7 nm southeast of the HLS, was from 220° at 20 to 25 kt.

The QEH HLS is situated within a grassed level area in the south-east corner of the hospital grounds (Figure 20). The grassed area has a hospital car park 36 m to the west of the centre of the HLS. To the south, 48 m from the centre of the HLS, runs a major road and, 49 m from the centre of the HLS to the north, is an access road to another hospital car park.

When the helicopter departed, the crew flew a PC 1, rearward takeoff departure profile. This required the helicopter to lift from the HLS and climb to 170 ft while flying backwards to a position approximately over the car park's access road, before transitioning to forward flight and departing on a heading of about 220°. This was the normal type of departure for a HEMS helicopter from the HLS.

During this time, four vehicles, which were parked in the car park to the north-east of the HLS, were damaged by some loose gravel from the car park's surface, that was disturbed by the helicopter's downwash. There were no injuries reported. Given the strong southwesterly wind it is believed the helicopter's downwash was blown further into the car park than would have been expected in a lighter wind.

The crew of the helicopter were unaware of this incident when they departed. The helicopter's operator was notified by QEH after the vehicle owners made the hospital's Emergency Planning Officer aware of the damage.

As a result of this incident the hospital has established a monthly road sweeping programme.

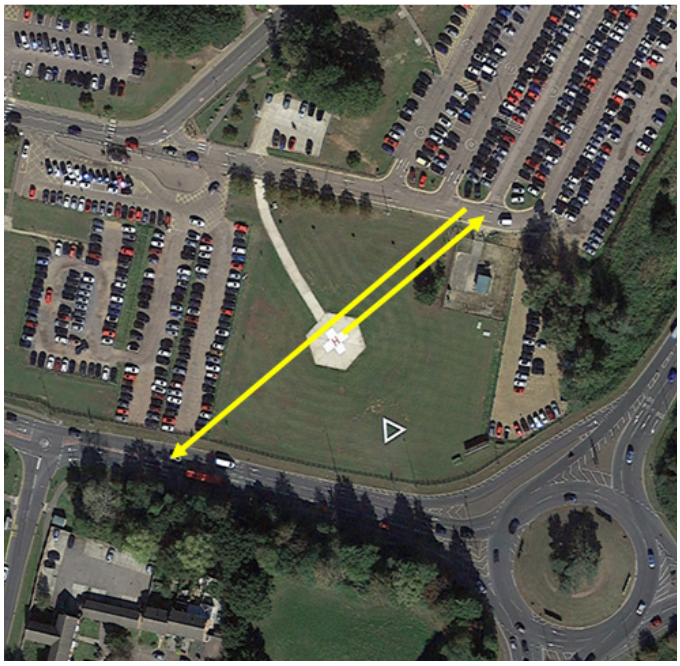


Figure 20

The HLS at QEH, King's Lynn showing the rearward takeoff departure track
© 2022 Google

1.18.3.3. G-TAAS serious incident on 12 August 2022

On 12 August 2022, an AW109SP landed at the University Hospital Wales (Cardiff) without landing site preparation or fire cover. The AAIB investigation found this was because the message reporting the helicopter's departure was sent too late and used an unreliable communication method. In addition, '*the pilot did not confirm the site was prepared during the approach and the requirement to do so was not emphasised in site-specific procedures*.' The investigation also found that the hospital did not have a relationship with other

operators outside Wales who might use the HLS and was not aware how hospital procedures could be disseminated to all potential operators.

The event showed the importance of effective collaboration between hospital Trusts and helicopter operators to ensure that the specific safety requirements and procedures for each hospital landing site are clearly communicated to pilots. The AAIB report[34] identified that '*there is currently no convenient mechanism for this, and it requires each operator to engage with the owner of each potential landing site and each landing site owner to identify and engage with each potential operator.'*

1.18.4 Wind exposure limits for civilians

In 2014 the United States Army published a report that considered the operational impacts of 'rotor wash' (downwash) and winds produced by jets or ducts[35]. The document considered personnel hazards and it contained an appendix that addressed human performance limitations. It said that the wind engineering community has previously studied the effects of wind exposure on unprotected civilians but acknowledged that this was not directly related to rotor wash applications. Irrespective of this, the report concluded that the research provided excellent guidelines, especially for the young and elderly. Factors such as weight, size, age, health, protective clothing and task, eg holding an umbrella or pushing a pushchair all affect wind velocity threshold limits.

The research concluded that for civilians aged over 50, gusty winds above 8.5 m/s (approximately 16.5 kt) had a quantifiable effect on a person's stability. 50% of civilian test subjects were reported to be displaced by a sudden gust of 11 to 12 m/s (approximately 22.4 kt), and 100% were displaced by a sudden gust of 15 m/s (approximately 29.2 kt).

1.18.5 Requirements and guidance relating to warning signs

HBN 15-03 suggested that the 30 m downwash zone should be fenced or signed for ground-level landing sites '*to stop people encroaching*' but there was no equivalent suggestion for raised landing sites. The DH HLS feasibility study recommended for signage to be provided.

The Health and Safety (Safety Signs and Signals) Regulations 1996[36] specify signage that must be provided for employees if there is a residual health and safety risk that has not been removed or controlled by other means and where

34 AW109SP_G-TAAS_05-23.pdf (publishing.service.gov.uk) [accessed 23 May 2023].
35 US Army Technical Report RFMR-AF-14-02, *Rotorwash Operational Footprint Modelling*, July 2014 ADA607614.pdf (dtic.mil) [accessed 28 March 2023].
36 Health and Safety Executive (2015). *Safety signs and signals: The Health and Safety (Safety Signs and Signals) Regulations 1996. Third edition.* https://www.hse.gov.uk/pubns/priced/l64.pdf [Accessed 28 March 2023].

signs can reduce that risk. The regulations do not apply to safety signs for other people, such as visitors to a workplace and members of the public. This is covered in the Health and Safety at Work Act (1974) and employers must ensure, so far as is reasonably practicable, the health and safety of others who may be affected by their work activity. Safety signs may be part of the measures to protect others and the safety signs regulations offer principles of good design practice for warning signs which are applicable to any type of warning sign. Other freely accessible HSE documents also contain generic guidance[37] regarding sign design. The following collated guidelines are relevant to the warning signs at the Derriford HLS:

- In determining when and where to use safety signs, employers should consider the results of the risk assessment which should identify hazards, the risks associated with those hazards, and the control measures to be taken.
- If the hearing or sight of any person is impaired, additional measures should be taken to ensure that people can see or hear the warning sign or signal.
- More than one type of safety sign may be necessary, for example, the combination of a visual warning sign with an acoustic warning.

Warning signs (Figure 21) may incorporate a triangular black pictogram on a yellow background with black edging (the yellow part to take up at least 50% of the area of the sign).

Figure 21

Example of a warning pictogram

Prohibitory signs (Figure 22) should have a round black pictogram on white background with red edging and diagonal line (the red part to take up at least 35% of the area of the sign).

37 https://www.hse.gov.uk/comah/sragtech/techmeassigns.htm [Accessed 28 March 2023].

Figure 22

Example prohibitory sign

Signs require adequate illumination and size should be appropriate for intended viewing distance.

It may sometimes be useful to supplement a safety sign with text to aid understanding.

If too many signs are placed together there is a danger of confusion or of important information being overlooked.

1.18.6 Other industry developments

1.18.6.1 CAP 1864 – *Onshore Helicopter Review Report*[38]

In 2013 the CAA instigated a review into offshore operations which culminated in a comprehensive report published as CAP 1145 - *Safety review of UK offshore public transport helicopter operations in support of the exploitation of oil and gas*. CAP 1145 raised many actions and recommendations to improve the safety of offshore commercial helicopter operations. Subsequently, the CAA determined that a similar approach should be undertaken with regards to the onshore sector of helicopter operations. The result was CAP 1864, which was published in 2019.

Chapter 22 of CAP 1864, *Flight Operations: Helicopter Emergency Medical Service (HEMS) operations* states the following:

> *'22.5 Hospital landing sites*
>
> *…By their nature, hospital sites tend to be quite organic and the overall site often develops with time. This building development can affect the approach/departure paths since their inception, or the growth of surrounding trees etc. that limit the availability of these*

38 First published November 2019 and can be accessed at: CAP1864: Onshore Helicopter Review Report (caa.co.uk) [accessed 28 March 2023].

sites to some or all aircraft. There are new hospital landing sites being introduced around the country which should be designed in accordance with CAP1264 (Standards for helicopter landing areas at hospitals), but there is no mechanism for the site owner to promulgate the site information to all potential operators or use the guidance CAP. Rotor downwash continues to challenge operators and sites must be managed appropriately so that 3rd party risk is minimised. It is recognised that the newer generation HEMS types are heavier directly resulting in increased downwash. The SAR fleet have particular challenges in this area given the size of aircraft operated. Each HEMS operator is required to keep, monitor and update their own landing site guide specific to their helicopter type for the hospitals they use in their areas of operation.'

As a result, the following action (Action 23) was proposed:

***'A23:** The CAA will establish a work group with key stakeholders and operators to review the provision of Hospital Landing Site information with the aim of adopting a unified controlled source similar to that used for offshore helidecks.'*

On the subject of awareness of CAP 1264 by the Department for Health and local planning authorities, the Onshore Helicopter Review Report noted the following:

'CAP 1264 "Standards for helicopter landing areas at hospitals" was produced to replace 'Department of Health, Health Building Note 15- Hospital Helipads' leaflet. The CAP ensures any hospital heliport fulfils the international standards in ICAO Annex 14, Volume 11. The OSR [onshore review] *discovered this document is not well known by both the Department of Health and Local planning authorities.*

This was evidenced by planning authorities authorising new build at or near a HHLS resulting in the site not being able to accept the latest SAR helicopter models. (Norfolk and Norwich/Aberdeen Royal infirmary are examples).'

With regards to a centralised directory or database containing information on hospital helicopter landing sites, the report stated:

'There is no centralised UK wide product that provides hospital landing site information to all operators. There are commercial products available for all other recognised aerodromes and helipads,

but it remains the operators responsibility to ensure it conducts its operation adapted to the aircraft types it operates. To that end, operators must provide crews with appropriate information on its established operating sites with Performance and overall operating safety in mind.

i. Military Flight Information Publications (Mil Flips)

The No.1 Aeronautical Information Documents Unit [AIDU] *whose overriding responsibility is to deliver Aeronautical Information (AI) products and services to UK Defence Aviation worldwide continues to produce the Helicopter Landing Site Hospital (HELI HOSP) biannually which are available for purchase by Civil UK operators. However, this document does not take into account the full operating requirements for a civil SAR operation. It does however provide some rich information on all known hospital sites.*

The OSR [onshore review] *has identified that SAR operators are using a mix of locally produced landing site material and the RAF HLS publication. Whereas, HEMS operators are using self-produced directories as the norm and the 'HELI HOSP' as back up for out of area tasking.*

Operators should review the provision of Hospital Landing Site information and be encouraged to adopt a unified controlled source such as that used for offshore helidecks.'

In the report's conclusion, it stated the following as one of the 'next steps' being actioned and proposed:

'A number of strategies are already underway including the formation of the Onshore Safety Leadership Group [OnSLG]*…This Group will publish its progress in these matters in the form of an annual update as well as minutes of meetings held.'*

1.18.6.2 OnSLG activities

Following the publication of CAP 1864 in November 2019, the OnSLG was established in July 2020, with the first meeting occurring a month later. After a break due to the COVID pandemic, three meetings were held in 2022 and one in 2023. Members include representatives from helicopter operators (including the operator of G-MCGY), the CAA and the DfT. Since this accident, landing sites and approach safeguarding have been some of the lead topics that have been discussed.

At a meeting held in June 2022, where governance of hospital HLS was discussed, it was agreed that this should rest with DfT/HSE. Work was also ongoing by the members to determine what information would be preferred in any potential national Helicopter Landing Site database that would be used by multiple operators.

The OnSLG has proposed that they would be willing to take the lead on aspects such as hospital HLS. However, this is yet to be decided with other stakeholders.

NHS Estates England are not currently members of the OnSLG. However, it is planned to invite them to participate. The HSE were also not members but began participating in May 2023.

There seems to be a consensus that, as most operators already use ACANS as their primary navigation tool on their helicopter, this could be an effective system to promulgate landing site details to all other operators. Additionally, the data on the landing sites can be updated in real time by the HLS Site Keepers (hospitals) or the helicopter operators.

The OnSLG are planning to hold a 'HHLS Summit' with representation from all those involved including representatives from NHS Scotland and NHS Wales. It is likely this will occur once this report has been published in case it contains actions which will need to be discussed.

1.18.6.3 Other work streams

The CAA worked with the DfT and the State Safety Board in 2020, to highlight the need for a unified approach in providing an HLS database for all users. They also engaged with the DHSC and the Ministry of Defence (MOD) to ensure this database included safeguarding arrangements in terms of helicopter performance considerations and to protect and maintain the airspace around their aviation assets. This resulted in the establishment of the NHS Hospital Helicopter Landing Site Working Group.

1.18.6.4 NHS Hospital HLS Working Group

The NHS Hospital HLS Working Group is chaired by NHS England Estates and includes members from CAA, DfT, MCA, the operator of G-MCGY, HEMS operators, and other stakeholders, and had been meeting since October 2019. In the minutes of the first meeting, DfT were asked to explore whether they may be able to gain approval from Government Ministers for a national HLS database. No response to this action could be found in any successive minutes.

It was noted in the minutes of its May 2021 meeting that there had not been much improvement to HLS over the preceding two years due to a lack of access to funding and appropriate training, and no one principal stakeholder was taking the lead. Like the OnSLG, they too had been discussing an HLS database.

It had several work strands which are ongoing at the time of publication. Some are:

1. Conduct online events, hosted by NHS England Estates, for stakeholders at NHS hospitals to draw attention to the guidance in CAP 1264 on the safe and compliant design and management of HLS sites amongst the industry and local planning authorities. 'Webinars' were held in March and August 2022, and more are planned.

2. Work with other hospital HLS towards a common database for all operators. The OnSLG have taken responsibility for this and are looking to move forward with their favoured option, '*Airbox ACANS'* application which is currently used by the operator and others.

3. Instigated a national data collection with all NHS hospital Chief Executives in England. This seeks assurance on levels of compliance with the standards in CAP 1264 and to identify any staff training requirements. The results of this had not been made available at the time of publication of this report, but they are intended to inform NHS England Estates of any additional next steps that may be required.

4. NHS England Estates, working with the CAA, is considering introducing a package to develop training in ground operations and oversight of hospital HLS facilities. The objective is to roll out such a training programme to the Accountable Managers of all the hospital HLS in England, Wales, and Scotland.

1.18.6.5 Offshore helicopter landing areas

Offshore installations are, like hospital HLS, regarded by the CAA as unlicensed operating sites. As such helicopter operators are required to '*satisfy themselves that each helideck to which they operate is fit for purpose'*, and they discharge their duty of care through an inspection programme undertaken on their behalf by the Helideck Certification Agency (HCA).

The HCA is a contracted organisation that was initially established by UK offshore helicopter operators to conduct independent inspections of helidecks on their behalf. However, they also inspect HLS at various onshore locations, including hotels, hospitals, sporting venues and private sites, both in the UK and globally.

The HCA uses CAP 437 '*Standards for offshore helicopter landing areas*[39]*'.* CAP 437 presents the criteria required by the CAA in assessing the standards of offshore helicopter landing areas for worldwide use by helicopters registered in the UK. They have also surveyed hospital HLS.

All HCA certificated helidecks are promulgated in a document called the Helideck Limitations List (HLL) on the HCA's website[40], which is publicly available. Part D of the HLL lists each individual helideck, by region, and records any non-compliance against CAP 437.

39 CAP 437: Standards for offshore helicopter landing areas (caa.co.uk) [accessed 28 March 2023].
40 HCA HLL is available at: https://www.helidecks.org/information/helideck-landing-limitations/ [accessed 28 March 2023].

2 Analysis

2.1 Introduction

The investigation found that the accident happened because uninvolved members of the public were blown over by helicopter downwash in the car park adjacent to the hospital HLS.

The discussion that follows considers the following themes:

- Conduct of the flight including SAR operations and the landing.
- Regulatory framework and guidance relating to hospital HLS.
- Design and management of the DH HLS, including other downwash related events.
- Industry working groups.

2.2 The accident

CCTV footage showed that three pedestrians in Car Park B were blown over by the downwash from G-MCGY as it made its final approach to the HLS. One person was seriously injured, and another person subsequently died because of the injuries they sustained.

2.2.1 Conduct of the flight

Upon arrival at the scene of the hypothermic casualty near Tintagel, and prior to them being recovered into the helicopter, the crew were acutely aware of the effect the helicopter's downwash could have had on those members of the emergency services present and their equipment. This led the crew to take some positive action to reduce the risk to those on the ground by instructing them to secure their equipment, prior to the winchman being lowered down to the casualty.

As the helicopter approached DH the crew conducted a dynamic risk assessment, in the form of an abbreviated version of the 5S Recce, as stated in the operator's OM. This seems appropriate as DH was an HLS that they landed on regularly and as such the 'Size', 'Shape', 'Surface' and 'Slope' would have been known to them. The 'Surrounds' was the one item that they needed to complete with 'Downwash' being one specific item in the 'FODUO' acronym. While all items were not necessarily verbalised, as most of the items covered by FODUO would not have changed since their last landing, they were aware of the fact that, with the light northwesterly wind, the helicopter's downwash

would be blown over Car Park B. This was reiterated by the commander at about 1,100 ft agl on the approach to the HLS. As such, it would appear that the helicopter's downwash was in their minds throughout the flight.

During the final approach, the crew continued to conduct a dynamic risk assessment by looking for persons that may have been at risk due to the helicopter's downwash, and the commander briefed the crew that should they see anything or anyone that would be affected by the downwash they would execute a GA. Those observed were one person in the undershoot and two people, one that was noted to have long hair, to the left of the HLS's wall, but the crew believed they were not at risk.

The co-pilot saw a man in the car park who he believed was in the latter stages of entering a car but assessed him as not at risk from the effects of downwash because he believed the man would be in the car, with the door shut, before they landed. The co-pilot also saw what he believed were two people (one who he noted had long hair) by the HLS wall moving in an easterly direction at the time. Shortly after the helicopter landed, the co-pilot recognised the long-haired lady again as she ran past the helicopter to request assistance for those injured. However, the CCTV showed that the long-haired lady was on her own as she left the south-western corner of the HLS and not with another person. The CCTV does show two people, both of whom had shoulder-length hair, walking together by the HLS wall and these were the two who were later blown over after they stopped at the south-eastern corner of the HLS, by the gate, to observe the helicopter land. The investigation was unable to reconcile the difference between the co-pilot's recollection of the long-haired lady being with another person and the CCTV evidence showing that she was on her own, but the positive identification after the helicopter had landed reinforces the view that it was the long-haired lady that was observed by the co-pilot during the approach and that he did not see the two who were subsequently blown over.

The area around the south-eastern HLS gate was close to the core of the downwash zone and thus these two people were at greater danger from the downwash. The seriously injured person, who was between two cars, was also similarly in the core of the downwash zone. These two specific locations could also have aggravated the strength of the downwash due to that fact that it probably accelerated though the gate aperture in the wall of the HLS, and also through the gap between the cars.

During the last stages of the approach, it is possible the co-pilot and commander were not able to see those blown over as they may have been out of their line of sight. Also, as the helicopter flew over the car park in the undershoot, their attention would have been focused on the HLS. As the two people by the 2 m HLS wall were to the left of the helicopter, they were probably outside the

field of view of the commander who would have been focused on monitoring the helicopter during the final approach and, being seated on the right of the helicopter, his field of view to the helicopter's left was additionally restricted by the co-pilot in the left seat.

Had any of the crew felt that any of those seen during the final approach were at risk of being seriously affected by the helicopter's downwash, a GA would have been an option for which the commander had briefed the crew during the approach. However, given that a GA would require a large increase in the helicopter's power, and thus its downwash, it could have potentially led to other persons at a greater distance from the HLS being affected and increasing the risk of injury.

Whatever the situation, there is always the chance that there will be people that are out of sight that may be at risk and so, when flight crews conduct a dynamic risk assessment during an approach to any site, careful judgment is needed to weigh up the risks of continuing against the medical urgency of any casualty onboard.

People unseen by a flight crew may be visible to those personnel present on the ground to secure an HLS and its surrounding area prior to a helicopter's arrival. While they may not be equipped to communicate verbally with the helicopter, they may have the time and means to warn those people on the ground to take appropriate action, ie remove themselves from the downwash safety zone.

2.2.2 Helipad preparation

2.2.2.1 HLS response team

The arrangements in terms of staffing the HLS did not allow the SOP to be fully completed for every helicopter movement. However, on the day of the accident the HLS Response Team personnel attended the HLS in time and, apart from not wearing the required PPE, conducted the pre-landing inspection and security duties as specified in the hospital's HLS SOPs. The HLS Response Team were not required to protect people outside the HLS boundary from downwash and their performance and behaviour did not contribute to the accident.

2.2.2.2 Pedestrian environment and behaviour around the HLS

The HLS is situated in a very busy area for pedestrian movements. Most of the movements occur between the hospital and parked vehicles in Car Park B and there are also movements through the car park between facilities in the hospital and between the hospital and residential areas nearby.

In general, people in the area were not aware that they were close to an HLS until they observed a helicopter. Arrivals and departures of helicopters had little effect on the behaviour of most people. It was common for people to look at the helicopter and perhaps pause to do so. Generally, people were not observed to take precautions such as moving away from the HLS when a helicopter was operating. The behaviour of the people who were injured on the day of the accident was typical of people within that environment and situation.

2.3 Oversight and conduct of helicopter SAR missions

2.3.1 General

As stated in CAP 999, SAR is a State activity regulated by the CAA. The CAA seemed to conduct their regulatory duties in a similar way to the way they regulate PT/AOC operations, with additional guidance in the form of CAP 999. This included approving the AIDU directory, as a company directory. However, there seemed to be no real support, from an aviation perspective, from the UK departments of State for those hospitals that have an HLS.

2.3.2 The helicopter operator

The operator of G-MCGY took the hazards associated with downwash seriously, and this is evident in the way the crew flew the task to recover the casualty from Tintagel and also during the approach to DH. In addition to its risk assessment for operations to an HLS in a hostile and congested environment, its OM discussed the effects of downwash, and possible mitigations, in multiple areas. The 5S recce includes 'FODUO' as a supplementary mnemonic to 'Surround' to include a discussion about downwash. In addition to the requirement for downwash to be discussed routinely on all flights, there were several initial and recurrent training requirements that crews were required to complete both in a simulator and in a helicopter. Additionally, since 2018, personnel have been required to watch the video specifically referred to in CAP 1264 that highlights the effects of downwash.

2.4 Design and management of helipads

2.4.1 UK guidance prior to 2016 – downwash considerations

When the HLS was designed and built, HBN 15-03 provided guidance to NHS Trusts. A general section about public safety stated there should be a 30 m downwash zone that should be kept clear of people, parked cars and buildings. This was repeated in the section about ground-level HLSs, which also said that larger helicopters needed a larger downwash zone. The HBN did not indicate how much larger the downwash zone should be, but it said that the zone should be marked by fencing and signs. It also advised that it might be necessary to

stop traffic on roads and that a hospital's risk assessment might conclude that one or more members of staff would be needed to police movements.

The section about HLS on raised mounds did not mention a downwash zone, but a summary table stated that there should be a 30 m clear area at the HLS landing level, rather than at ground level. The term 'clear area' was not defined, and the AAIB believe the intent was to minimise the chance of a helicopter colliding with an obstacle. The Derriford HLS design appears to conform to this.

The advice in HBN 15-03 for downwash zones was inconsistent between the different types of HLS and could potentially lead to an interpretation that downwash was not a factor for an HLS on a mound.

2.4.2 Guidance after 2016 – downwash considerations

CAP 1264 superseded HBN 15-03 shortly after the Derriford HLS opened. This document was published by the CAA, but NHS England Estates advised that the DHSC had been involved to some degree during its development. It contained more comprehensive guidance about downwash and stated that a downwash zone for large helicopters should extend 50 m to 65 m from the centre of the HLS. It noted that downwash from larger helicopters could make operations into an HLS on a raised mound more challenging by posing a risk to people under the final approach, and it also referred to adjacent public car parks. CAP 1264 was only applicable to new build facilities or those undergoing refurbishment. It was not retrospectively applicable to the Derriford HLS, and the hospital Trust did not know that HBN 15-03 had been superseded with the enhanced guidance contained in CAP 1264.

ICAO Annex 14 and the associated Heliport Manual were amended after CAP 1264 was published. The changes included a section about the protection of third parties and a recommendation that non-essential people should be kept between two and three rotor diameters from an operating helicopter. For a S92, this equates to approximately 52 m, which aligns with the downwash protection guidance in CAP 1264.

CAP 1264 contains references to CAP 738. The CAP 738 introductory text indicates that the guidance is applicable to certificated and licensed aerodromes, but it also states that non-licensed aerodromes, heliports and HLS may find the information of assistance. The focus of CAP 738 is to ensure the continued safety of aircraft operating at the location. It states that a downwash zone should be agreed with helicopter operators, and that someone should be responsible for monitoring this zone to ensure it is kept free of persons, property, and parked vehicles as necessary. CAP 738 is available on the CAA's website

but, like CAP 1264, it is unlikely that many hospital Trusts will be aware of its existence or that its contents could be relevant to the routine operations of their own HLS. It would be of benefit to hospital Trusts, or any other organisation that manages an HLS, to be able to find all the applicable downwash guidance in one document without the need to cross refer. Therefore:

Safety Recommendation 2023-028

It is recommended that the UK Civil Aviation Authority includes the appropriate downwash guidance relevant to hospital helicopter landing sites in one published document.

2.4.3 The DH HLS

The previous areas available for helicopters to land at (or near) DH had safety issues and operational limitations. The new HLS was seen as a big improvement to operations and safety, and a positive step for the hospital capability to care for trauma patients.

The hospital project team responsible for the delivery of the new HLS facility had little aviation knowledge. The hospital specified that the new landing site should be compliant with the standards and recommended practices in effect at that time. They commissioned an expert to produce a feasibility report because they wanted the recommendations of an independent consultant.

The feasibility report recommendations were consistent with HBN 15-03, ICAO Annex 14 version 3 and ICAO heliports manual version 3, which were the best available official guidance documents at the time. The report considered the effects of downwash but downplayed the potential effects and concluded that most of the downwash would be confined to the HLS surface. The hospital Trust appeared to rely on these conclusions from the feasibility report from this point forward and, as documented in the business case, considered the downwash hazard to be adequately controlled by the design of the HLS. There were no other checks within the design or planning approval process likely to highlight any residual risk to the public from downwash.

2.4.4 DH HLS safety management

2.4.4.1 General

Despite in some places downplaying the downwash hazard, the feasibility report did make recommendations about managing the site and downwash hazard that were over and above the available guidance at the time but were not acted upon. Some of these were in the main section of the report instead of the conclusions and recommendations section. Specifically, the hospital

did not put in place procedures to manage the public areas outside of the HLS during an S92 landing and did not audit the operation of the HLS on an annual basis.

The Trust's ongoing safety management of the operational landing site could have provided a mechanism for its continuing safety to be assured. The system in place did not work effectively to identify that the mitigations for the downwash hazard were not working well enough to provide adequate control of the risk.

The Trust's risk management policy was consistent with the Health and Safety Regulations and HSE guidance. The primary focuses were risks to the quality of patient care, safety and wellbeing risks to staff, and risks to the reputation and delivery of the Trust. Harm to members of the public was not a prime focus but was clearly in scope and there were specific sections on the standard risk assessment template that appeared to be intended to capture it.

The Trust's risk assessments for the HLS and the car parks were largely consistent with the Trust's policy and HSE guidance in terms of methodology but there were areas of weakness in the implementation. In the landing site risk assessment, the risk of downwash causing harm to members of the public was identified, but the area considered was limited to the landing site itself, so all the mitigations focused on limiting access to this space.

The assumption that downwash risk was confined within the boundary of the landing site appears to have originated from the feasibility report, the guidance in HBN 15-03 and a false understanding that the HLS boundary wall was built to contain downwash.

The risk from downwash was not recognised or recorded for Car Park B and no mitigations for it were identified or implemented in the car park, except for safety signs which were present but not documented as a mitigation in any material provided to the AAIB.

2.4.4.2 Safety signs for members of the public

There were no specific regulations that required safety signs at the HLS and HBN 15-03 did not provide any detailed guidance on signage. However, the feasibility report recommended them to be provided. Warning signs were not present when the site was opened but were installed at some point before the accident in response to some of the past complaints and incidents. This installation of the signs suggests that there was some recognition within DH of the downwash hazard outside of the HLS boundary.

To have any safety benefit, the signs need to have some effect on people's behaviour. To influence behaviour, the signs need to be noticeable, meaningful and persuasive. Conforming to standard conventions and good practice for the design of signs, such as that set out by the HSE, could assist with that, as would using a risk assessment as the basis for the positioning of them.

There was no evidence that there was a relationship between the assessment of risk and the design decisions made regarding the signs. They were not listed as a mitigation in the risk assessment.

The text of the warning signs did identify a hazard, '*Danger of downdraft and flying debris*', but did not provide people with a clear understanding of the severity of the hazard or give them instructions what to do.

The signs were well maintained, and clearly legible as well as being repeated throughout the car park. They displayed the appropriate yellow colour for a warning but were not enhanced with pictograms or any features to assist people with limited vision or English literacy.

The signs were permanently displayed with no active features to distinguish when the hazard was and wasn't present.

In some locations the signs were closely located with other signs that would probably be more attention grabbing such as the hospital map. The signs were not highly conspicuous when viewed from across the car park or when viewed side on.

The person who was seriously injured reported that they were not aware that they were near to an HLS which shows that they had not noticed or understood the significance of the signs.

Analysis of the CCTV showed no changes in behaviour when a helicopter was approaching that were consistent with people taking action to protect themselves, such as moving further away from the HLS.

The use of signs within the car park did not achieve the aim of helping members of the public to protect themselves from downwash and this may have been partly due to their design. Signs and warnings will always have a limited ability to influence people and some people will not change their behaviour in response to any sign. Improved signage and warnings at the HLS could have some benefit, but it will always be preferable to exclude people from an area of danger, or remove the danger itself through design, rather than warn them once they have entered a hazardous area.

2.4.4.3 Risk assessment effectiveness

There was a process in place to review the HLS and Car Park B risk assessments and there was evidence that reviews were undertaken as planned. However, the reviews did not identify that the downwash hazard in Car Park B was not adequately controlled, and they did not identify the latest CAA guidance about hospital helicopter landing sites. There was a history of downwash incidents and complaints that the hospital was aware of. They believed this to be adequately addressed because each event was responded to individually at the time it occurred. In this respect, DH's risk assessment was consistent with the Trust guidance which did not require patterns or trends to be considered. However, the general pattern of events due to downwash in Car Park B was not recognised and used to update the likelihood score for the downwash risk. Such an update might have triggered more attention to it from the Trust.

The weaknesses in the risk assessments in relation to the downwash risk were probably partly the result of the hospital's HLS management team having insufficient knowledge about helicopter operations. In addition, the risk assessor for the most recent update to the landing site risk assessment had received insufficient training in risk assessment and risk management. The risk assessment review process was also weak in that it did not proactively identify the latest guidance and consider its potential significance.

There was some collaboration between the helicopter operator and the Trust managers of the HLS which, if it had been effective, could have helped overcome some of these weaknesses. However, in this case it did not result in a coherent approach to the management of the downwash risk at the site. The oversight and assurance activity by the DH management did not detect that the people and processes in place were not adequately identifying and mitigating the risks associated with the HLS.

For the HLS Site Keepers, performing adequate risk assessments is a task requiring specialist knowledge that is not readily available within the health service. Hospital HLS managers would benefit from enhanced guidance on how to risk assess their sites and the range of potential mitigations that might be used to reduce the risk of uninvolved persons being exposed to the hazards associated with HLS.

Therefore:

Safety Recommendation 2023-029

It is recommended that the UK Civil Aviation Authority, in conjunction with the Onshore Safety Leadership Group and the relevant NHS organisations in the UK, develop and promulgate enhanced risk management guidance for hospital helicopter landing sites, and provide information on the range and use of potential mitigations for the protection of uninvolved persons from helicopter downwash.

Both the helicopter operator and DH were clearly willing to work with each other and were communicating on a semi-regular basis between 2015 and 2020. However, as evidenced by the differing views of compliance with designated flight paths and the duties of the HLS Response Team staff outside of the immediate area of the HLS, it is apparent that there was a lack of mutual understanding of each other's needs.

Although some useful information was passed between them, neither party ensured that the other had sufficient understanding of it in order to make effective decisions, and part of this can be attributed to the hospital staff's lack of knowledge and understanding of helicopter operations. In the case in 2016, where someone was blown over, this led to the conclusion by the hospital that the helicopter's approach outside of the designated flight paths was the causal factor for the incident. As a consequence, this was an opportunity missed to identify that the downwash risk, especially in Car Park B, was not adequately controlled.

The operator had a meeting with DH in January 2019 where they highlighted the potential for third party risk in Car Park B but there was no evidence that this resulted in any changes made in the way that the DH HLS was operated.

Similarly in 2020, when the DH risk assessor requested a briefing from the helicopter operator, in addition to again highlighting areas around the HLS where the control of third party individuals was a potential issue, the presentation covered regulation and helicopter performance, and the risk assessor did not understand the material presented. As a consequence, another opportunity to identify and address the downwash risk was missed by the hospital and the operator.

There are currently no minimum competency requirements for those personnel who are responsible for managing hospital HLS. To manage the risks effectively, these personnel need to have the knowledge to understand the risks and to

also have effective systems in place for the communication and management of safety risks that may be highlighted by other organisations. Therefore:

Safety Recommendation 2023-030

It is recommended that NHS England Estates, in conjunction with the Onshore Safety Leadership Group and the UK Civil Aviation Authority, develop competency requirements, and introduce training, for all hospital helicopter landing site managers that includes, as a minimum, a basic introduction to helicopter operations and safety management practices appropriate for such facilities.

NHS England Estates should seek participation from the healthcare organisations in Scotland, Wales, and Northern Ireland to develop these competency requirements.

2.4.5 The effects of downwash

Wind speeds due to downwash depend on many factors including the helicopter weight, speed, height and environmental conditions such as temperature and prevailing wind conditions at the time. Air can be recirculated by the helicopter rotor blades, and it can accelerate in the gaps between obstacles such as the gated entrances to the helipad and between parked cars.

The ATSB published a report in 2022 after a pedestrian was blown over and seriously injured when a helicopter was landing at a hospital HLS. The pedestrian was approximately 50 m from the helicopter and safety actions were taken to introduce a downwash protection area.

2.4.5.1 Downwash in the DH car parks

The DH HLS feasibility report stated that the effects of downwash on people under the helicopter flight path would be little more than a gusty, very windy day. It stated an S92 could generate a downwash velocity of 42.8 kt (22.0 m/s) immediately below the main rotor. The Derriford feasibility report contained information from the New Zealand Forest Research Institute and the AAIB used this to estimate that a 5,000 kg helicopter with a 16 m rotor could generate a windspeed around 16.1 kt (8.3 m/s) when flying at a height of 15 m and a groundspeed of 8.1 kt. In comparison, when the pedestrians were blown over, G-MCGY was at an altitude of about 14 m with a groundspeed of about 9.2 kt. G-MCGY weighed around 10,500 kg so the downwash beneath it probably exceeded 8.3 m/s.

Due to the large number of variables involved, the AAIB considered it was impractical to recreate the conditions that existed when the accident happened.

However, after the accident, the hospital Trust commissioned an independent study to investigate local wind conditions in Car Park B and adjacent areas. Six HEMS flights were monitored, and the maximum wind speed that was measured in the car park was reported to be 12.5 m/s. The maximum speed that was measured outside the car park was reported to be 13.0 m/s. A US Army report said that 50% of civilian test subjects were displaced by a sudden gust of 11 to 12 m/s, so the evidence indicates that, even for HEMS helicopters (which are usually lighter than SAR helicopters), wind speeds in Car Park B can be sufficient to displace people.

In 2016 a pedestrian was injured when she was blown over in Car Park B as a S92 helicopter was landing. Another was blown over in 2021 when a HEMS type helicopter was landing. These occurrences also indicate that the risk from downwash applies to all helicopter types and, whilst most landings at Derriford are uneventful, it is possible that other occurrences and near misses have not been reported.

Figure 23 shows an aerial view of the Derriford HLS. It shows the approximate positions of all the pedestrians that are known to have been blown over and the three circles show the extent of downwash zones with radii of 30, 50 and 65 m. Most of Car Park B is inside the downwash zone for a large helicopter, as described in CAP 1264. All the pedestrians were inside this zone when they were blown over.

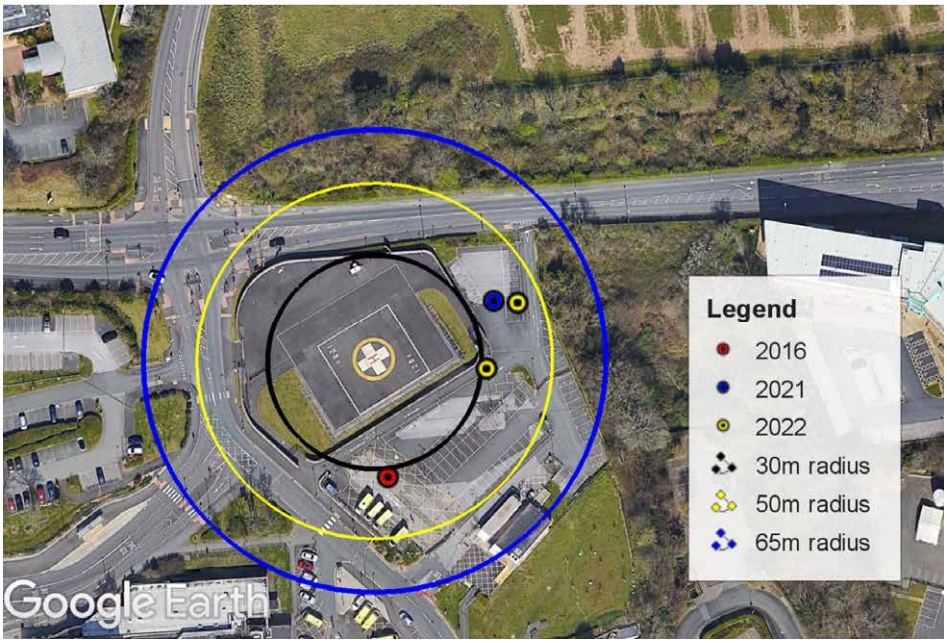


Figure 23

Approximate pedestrian positions and downwash zones defined in CAP 1264
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2.5 Other hospital HLS

There are approaching 200 hospital HLS in the UK, many of which were built prior to the publication of CAP 1264. The AAIB safety investigation into the accident at DH did not conduct a survey of these other sites, and so is unable to judge any degree of compliance with the guidance that is provided in CAP 1264, CAP 738 and current ICAO documents. DH only became aware of CAP 1264 after this accident and this is likely to have been the case for many other hospitals with HLS in the UK. In the absence of knowledge of the guidance provided in CAP 1264, it is possible that a number of these other sites do not have adequate downwash zones, nor effective measures in place to manage public movements in such hazardous areas.

If downwash zones were implemented to the guidance in CAP 1264 and ICAO documents at all hospital HLS in the UK, the risk of injuries to uninvolved persons would be reduced. Therefore:

Safety Recommendation 2023-031

It is recommended that NHS England Estates review all existing hospital helicopter landing sites for which it has responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-032

It is recommended that NHS Wales Health Boards and Trusts review all existing hospital helicopter landing sites for which they have responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-033

It is recommended that NHS Scotland Assure review all existing hospital helicopter landing sites for which it has responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-034

It is recommended that the Northern Ireland Health and Social Care Trusts review all existing hospital helicopter landing sites for which they have responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Offshore helicopter operators have established the HCA to conduct independent inspections of helidecks on their behalf, and all the UK healthcare organisations may wish to consider involving the HCA in order to conduct the reviews recommended above.

2.6 Industry working groups

2.6.1 OnSLG

The Onshore Helicopter Review Report was published in 2019. It highlighted that new HLS were being introduced which should be designed in accordance with CAP 1264, but there was no mechanism for the HLS Site Keeper to promulgate the site information to all potential operators.

As a result of Action 23 in the report, the OnSLG was established with representatives from helicopter operators, the CAA and DfT. It is of note that NHS England Estates were not participants in the OnSLG, but the intention is that they will become so, together with representation from the healthcare organisations in Scotland, Wales, and Northern Ireland. The OnSLG has recently advised its intention to support, where appropriate, all the UK healthcare organisations.

Prior to this accident, progress had been slow with regular meetings not starting until mid-2022 and with a focus on a national database. A national database would avoid some duplication of work by operators and be highly beneficial for the industry to have a centralised database of HLS that is able to be updated quickly in an operational environment by helicopter operators and HLS Site Keepers. In the case of G-RESU, had the hospital staff had access to a national database, they could have used it to notify all helicopter operators that there was loose material on the car park that could cause a hazard if disturbed by a helicopter's downwash.

An HLS database could, provided that everyone is able to openly share information, lead to better cooperation and communication between the HLS Site Keepers and the helicopter operators using them. Therefore:

Safety Recommendation 2023-035

It is recommended that the Onshore Safety Leadership Group (OnSLG), in conjunction with the UK Department for Transport, facilitate and support the development and introduction of a dedicated national hospital helicopter landing sites (HLS) database that can be updated in an operational environment by helicopter operators and hospital HLS Site Keepers.

In addition to helicopter operators and other stakeholders, the OnSLG should seek participation from the healthcare organisations in England, Scotland, Wales, and Northern Ireland.

2.6.2 NHS England Estates

In late 2019, before this accident, a working group on HLS was established. Although there was participation by the DfT, CAA, MCA, helicopter operators and other stakeholders, it noted that no one principal stakeholder was taking the lead in addressing the issues they were discussing. However, in common with the OnSLG, they were also proposing a national HLS database.

Since this accident, several workstreams have been initiated, that appear to be addressing some of the issues raised during this investigation. However, the results of some of these were not known at the time this report was published.

2.7 State-level safety leadership for hospital HLS

At an individual hospital HLS, the aircraft operator is responsible for the safe flight of the helicopter and the HLS Site Keeper (often the hospital Trust) is responsible for providing a safe landing site. The safety of people in the vicinity of a hospital HLS is an area of joint responsibility because in a hospital environment, neither party can ensure safety without the cooperation of the other.

Because this responsibility is joint, safety relies on effective sharing of information between the HLS Site Keeper and each operator so that the characteristics of the HLS, the procedures and the roles of each party at each site are understood. This is currently a laborious process that requires each individual operator and HLS Site Keeper pair to collaborate. Operators use multiple hospital HLS, and each site can have multiple operators. This aspect was one of the AAIB's investigation findings for the G-TAAS report mentioned earlier.

The evidence from this investigation suggests that, despite willingness and efforts from both the hospital Trust and the operator over a period of years, the communication between them did not achieve sufficient protection for people using Car Park B even though this issue was specifically discussed. Evidence

also suggests that the problem is not confined to this particular hospital, Trust or helicopter operator. As well as there being no convenient mechanism to support communication, there is limited aviation competence, resource and centralised support for the task of managing an HLS within the NHS. Therefore, these HLS Site Keepers have a responsibility for which they do not have the capability to properly fulfil.

Pre-dating the accident, there were several relevant national initiatives that sought to improve safety at hospital HLS such as the Onshore Helicopter Review and two national working groups run by the onshore helicopter industry and NHS Estates. These initiatives have identified some actions that could facilitate communication between hospitals and multiple operators, such as a national HLS database with the capability to be updated in real time. However, the progress of action from these groups has been slow and there has been duplication of effort with separate groups trying to progress similar actions.

Although there have been some steps towards addressing the issues raised in this report, progress could be accelerated if there was centralised leadership from an organisation in a position to secure resources and drive the improvements in safety required. There are a diverse range of stakeholders involved in the decisions around hospital HLS; business needs, local planning, design, risk assessment and ongoing risk management responsibilities are distributed over a number of government departments and current improvement efforts appear to be somewhat fragmented. Healthcare, emergency services and transport are all State functions in the UK, so it would be appropriate for a State organisation with the necessary expertise and channels of communication between other government departments to provide the necessary leadership. The DfT has such expertise and remit for aviation safety policy and therefore:

Safety Recommendation 2023-036

It is recommended that the UK Department for Transport, in conjunction with the Onshore Safety Leadership Group, establish and lead a national initiative to improve the protection of uninvolved persons from helicopter operations at hospital helicopter landing sites (HLS).

This initiative should have sufficient authority, representation, resources, and expertise to ensure that coordination between the various risk owners and stakeholders is effective.

The various stakeholder roles and responsibilities (in particular those of HLS Site Keepers and helicopter operators) should be clear to all those involved, and the planning, design, and ongoing risk management of hospital HLS should be considered appropriately.

3 Conclusion

3.1 Findings

3.1.1 The accident flight

1. The crew were properly licensed and qualified to conduct the flight and were well rested. They all had extensive experience of flying SAR missions in both RN and civilian operations.

2. The operator had procedures and training in place to help crews to mitigate the effects of downwash.

3. The crew were aware of possible downwash issues during the task to pick up the casualty and during the approach to Derriford Hospital.

4. Whilst the crew had two potential hospitals with similar flight times to transport the casualty to the Emergency Department, they chose Derriford because it would be the most expeditious for their hypothermic casualty.

5. To benefit from a small headwind component, the crew elected to make the approach on the DH designated westerly flight path for the approach.

6. The helicopter's landing weight was 23,080 lb/10,468 kg, which was within the weight limit for the HLS.

7. The co-pilot was the PF for the landing as he had the better field of view to perform the approach and landing onto the HLS.

8. The crew conducted a dynamic risk assessment while inbound to Derriford, as required by the operator's Operations Manual.

9. The crew were aware that the helicopter's downwash would be blown over the car park.

10. The crew had briefed to conduct a go-around should they see anything that they considered could be affected by the helicopter's downwash.

11. Shortly before landing, the winchman informed the crew that the casualty needed urgent medical attention.

12. At about 200 ft agl, the winch operator saw a person in the undershoot in the car park and advised the co-pilot. The co-pilot, who could also see them, did not consider their presence to be an issue.

13. The co-pilot believed he saw two people (one who he noted had long hair) to the left of the HLS wall, by the southwestern corner, and a man entering his car in the undershoot who he assessed would not be affected.

14. CCTV evidence shows that a person with long hair was on her own at the south-west corner of the HLS and was the one who was later observed by the co-pilot running to the south-eastern corner of the HLS to assist the injured persons.

15. Three people in Car Park B were blown over by rotor downwash from the landing helicopter.

16. It is unlikely that the flight crew saw the people who were blown over.

17. If a late go-around had been performed, the greater downwash would have increased the risk of incurring damage or injury over a larger area around the HLS.

18. The downwash from the landing S92 affected most of Car Park B to varying degrees with several objects observed to have been affected.

19. Paramedics from an ambulance waiting in Car Park B were alerted by a member of the public and tended to those who had been injured without delay.

20. One pedestrian, who was in Car Park B, was blown over and subsequently died of her injuries; the relative accompanying her was also blown over and suffered minor injuries.

21. Another pedestrian, also in Car Park B, was blown over and suffered serious injuries.

22. Safety signs for pedestrians were provided that were well maintained, legible and repeated throughout Car Park B. However, they were ineffective in changing pedestrian behaviour during helicopter takeoffs and landings.

23. The relative of the fatally injured person was aware of the signs on the wall of the HLS but felt they did not reflect the level of danger they warned against.

24. The seriously injured pedestrian did not notice the warning signs.

25. The behaviour of the injured people on the day of the accident was typical of people within that environment and situation.

3.1.2 DH HLS site findings

26. The DH HLS had been operating for seven years and records indicated there had been over 2,500 landings, of which around 140 were SAR type helicopters.

27. The DH HLS was built in accordance with the guidance material available at the time.

28. The advice provided in the guidance at the time was inconsistent between the different types of HLS and could lead to an interpretation that downwash was not a factor for an HLS on a mound, such as the DH HLS.

29. The DH HLS is intentionally situated close to the ED so that casualties can be transferred quickly. This is a busy area for pedestrian and vehicular movements.

30. An independent helicopter adviser was used during the feasibility stage of the helipad design.

31. The feasibility report recommendations were consistent with HBN 15-03, ICAO Annex 14 version 3 and ICAO heliports manual version 3.

32. The feasibility report considered the effects of downwash but downplayed the potential effects and concluded that most of the downwash would be confined to the DH HLS surface.

33. Involvement of the helicopter adviser by the designers was informal.

34. The hospital Trust believed the downwash hazard was adequately controlled by the design of the DH HLS.

35. The feasibility report made recommendations about managing the DH HLS site and downwash hazard that were over and above the available guidance at the time.

36. The hospital Trust did not implement the recommendation in the feasibility report to manage the public areas outside the DH HLS.

37. The hospital Trust's '*Standard Operating Procedure'* and the '*On-site Operational Procedure and Response to an Emergency Incident'* for the HLS did not include any operational procedures for managing the areas outside the HLS boundary.

38. The hospital Trust was not aware of the additional guidance published in CAP 1264 until after this accident.

39. DH issued the document *Helicopter Operations Using the Hospital Landing Site, Derriford Hospital, Plymouth* (which included the designated flight paths) to numerous helicopter operators including that of G-MCGY.

40. The operator of G-MCGY interpreted the designated flight paths as advisory.

41. One helicopter operator was sent, but could not locate, a copy of this document containing the designated flight paths; this was thought to be due to a change of personnel and may have been missed during the handover.

42. This other operator developed their own flight path which was outside one of the designated flight paths, and this was not communicated to DH.

43. In 2023, another helicopter operator advised DH that they had developed a new flight path outside of those that DH had previously published, and this has been acknowledged by DH.

44. DH was unaware of the significance that helicopter operators using the DH HLS considered the designated flight paths to be advisory only.

45. The operator of G-MCGY used the No 1 AIDU's, *Helicopter Landing Sites - Hospitals United Kingdom* as an HLS directory, and internal document *Compatibility of UK Hospital Sites with UKSAR Aircraft Types* which lists what HLS are approved, and not approved, for its helicopters to operate into.

46. The No 1 AIDU entry for DH states, '*Best approach heading 090*', but there is no reference to the south-westerly designated flight path. The entry for DH also contained other discrepancies including the layout.

47. About a month after the HLS opened, a third party, on behalf of the operator of G-MCGY, conducted an aerial survey to establish the obstacle environment around the DH HLS for performance considerations for helicopter operations.

48. The operator of G-MCGY did not carry out a specific risk assessment of the HLS at DH after a site visit in July 2015.

49. The operator of G-MCGY was sent a copy of the *On-site Operational Procedure and Response to an Emergency Incident* but their headquarters could not locate it. The operator's Newquay base did not have a copy of it and neither did any other operators that used the HLS at DH.

50. None of the helicopter operators that used the HLS at DH had a copy of the hospital Trust's '*Standard Operating Procedure'* for the HLS Response Team staff at DH.

51. The helicopter operator of G-MCGY did not have a copy of any of the standard operating procedures used by HLS Response Teams at any other hospital HLS within the operating area of its Newquay base.

52. The helicopter operator and the commander believed that the hospital's HLS Response Team staff were responsible for ensuring the HLS and its surrounding areas were secured before an arrival. The co-pilot believed that these staff only opened the gates for ED staff and helicopter crews to access the HLS.

53. Although, prior to the helicopter's arrival, the hospital's HLS Response Team had secured the HLS, they did not secure the surrounding areas, nor were they required to do so.

54. On the day of the accident, the HLS Response Team followed the standard operating procedure as specified except for wearing the correct PPE.

55. Security personnel at the hospital were not always able to fulfil the duties specified in the standard operating procedure prior to the arrival of a helicopter because, at times, they may be dealing with other incidents at DH.

3.1.3 DH HLS safety management findings

56. The Trust's risk management policy was consistent with the Health and Safety Regulations and HSE guidance.

57. There were no competency requirements for personnel responsible for managing the DH HLS.

58. DH's HLS management team had insufficient knowledge of helicopter operations to make effective risk assessments for uninvolved persons being exposed to hazards associated with the HLS.

59. The DH HLS risk assessor had not received sufficient training in risk assessment and risk management.

60. A lack of mutual understanding resulted in ineffective communications between the HLS Site Keeper and the helicopter operators who used the HLS.

61. A number of helicopter downwash complaints and incidents at DH were recorded and investigated. The hospital Trust were aware of two previous downwash related events that had resulted in minor injury. Although action was taken on each occasion to prevent a reoccurrence, this did not result in changes being made to the management of Car Park B during helicopter takeoffs and landings.

62. Although reviews of the risk assessments for the HLS and Car Park B were conducted, the reviews did not identify that the downwash hazard in Car Park B was not adequately controlled.

63. The pedestrians that were injured were within 50 m of the centre of the HLS, and in the area that should be designated as a downwash zone for heavy helicopters for HLS built after 2016 (in line with CAP 1264). HBN15-03, which was in place in 2015, did not require a 50 m downwash zone for any type of HLS.

64. Even for smaller HEMS helicopters, downwash in Car Park B can be sufficient to blow people over.

65. The oversight and assurance activity by the DH management did not detect that the people and processes in place were inadequate to identify and mitigate the risks associated with the DH HLS.

3.1.4 General HLS findings

66. Hospital HLS in the UK are unlicensed. Local planning permission is required but there are no aviation regulatory requirements controlling their construction or operation.

67. There is limited aviation competence, resource and centralised support within the NHS for managing hospital HLS.

68. There were no competency requirements for personnel responsible for managing hospital HLS in any guidance documents in place at the time of the accident.

69. Hospital HLS managers would benefit from enhanced guidance on how to risk assess their sites and the range of potential mitigations that might be used to reduce the risk of uninvolved persons being exposed to hazards associated with the HLS.

70. Updated HLS design guidance was published by the CAA as CAP 1264 after the Derriford HLS was completed. CAP 1264 specifies a larger safety zone of up to 65 m for heavy helicopters like the S92.

71. CAP 1264 is not retrospectively applicable to existing HLS.

72. CAP 738 contains useful guidance on downwash zones but this is not included in CAP 1264.

73. In the absence of a centralised database, there is no convenient mechanism for HLS Site Keepers to promulgate site information to all the helicopter operators that might use it.

74. It would be beneficial to the industry to have access to a centralised database that can by updated rapidly in an operational environment by HLS Site Keepers and helicopter operators.

75. CAP 1864, Onshore Helicopter Review Report, published in 2019, issued Action 23, which was to work towards a '*unified*' hospital HLS database. The OnSLG was established with one of its tasks being to work on this.

76. The progress of relevant national safety initiatives has been slow with a lack of State-level leadership to support and coordinate the efforts of the parties involved.

3.2 Causal factors

The investigation identified the following causal factors:

1. The persons that suffered fatal and serious injuries were blown over by high levels of downwash from a landing helicopter when in publicly accessible locations near the DH HLS.

2. Whilst helicopters were landing or taking off, uninvolved persons were not prevented from being present in the area around the DH HLS that was subject to high levels of downwash.

3.3 Contributory factors

The investigation identified the following contributory factors:

1. The HLS at DH was designed and built to comply with the guidance available at that time, but that guidance did not adequately address the issue of helicopter downwash.

2. The hazard of helicopter downwash in the car parks adjacent to the HLS was not identified, and the risk of possible injury to uninvolved persons was not properly assessed.

3. A number of helicopter downwash complaints and incidents at DH were recorded and investigated. Action was taken in each case to address the causes identified, but the investigations did not identify the need to manage the downwash hazard in Car Park B, so the actions taken were not effective in preventing future occurrences.

4. Prior to this accident, nobody at DH that the AAIB spoke to was aware of the existence of Civil Aviation Publication (CAP) 1264, which includes additional guidance on downwash and was published after the HLS at DH was constructed. The document was not retrospectively applicable to existing HLS.

5. The operator of G-MCGY was not fully aware of the DH HLS Response Team staff's roles, responsibilities, and standard operating procedures.

6. The commander of G-MCGY believed that the car park surrounding the DH HLS would be secured by the hospital's HLS Response Team staff, but the co-pilot believed these staff were only responsible for securing the HLS.

7. The DH staff responsible for the management of the HLS only considered the risk of downwash causing harm to members of the public within the boundary of the HLS and all the mitigations focused on limiting access to this space.

8. The DH staff responsible for the management of the HLS had insufficient knowledge about helicopter operations to safely manage the downwash risk around the site.

9. The HLS safety management processes at DH did not result in effective interventions to address the downwash hazard to people immediately outside the HLS.

10. The HLS safety management processes at DH did not identify that the mitigations for the downwash hazard were not working well enough to provide adequate control of the risk from downwash.

11. Communication between helicopter operators and DH was ineffective in ensuring that all the risks at the DH HLS were identified and appropriately managed.

12. Safety at hospital HLS throughout the UK requires effective information sharing and collaboration between HLS Site Keepers and helicopter operators but, at the time of the accident, there was no convenient mechanism for information sharing between them.

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4 Safety Recommendations and Action

4.1 Safety Recommendations

The following Safety Recommendations have been made:

Safety Recommendation 2023-028

It is recommended that the UK Civil Aviation Authority includes the appropriate downwash guidance relevant to hospital helicopter landing sites in one published document.

Safety Recommendation 2023-029

It is recommended that the UK Civil Aviation Authority, in conjunction with the Onshore Safety Leadership Group and the relevant NHS organisations in the UK, develop and promulgate enhanced risk management guidance for hospital helicopter landing sites, and provide information on the range and use of potential mitigations for the protection of uninvolved persons from helicopter downwash.

Safety Recommendation 2023-030

It is recommended that NHS England Estates, in conjunction with the Onshore Safety Leadership Group and the UK Civil Aviation Authority, develop competency requirements, and introduce training, for all hospital helicopter landing site managers that includes, as a minimum, a basic introduction to helicopter operations and safety management practices appropriate for such facilities.

NHS England Estates should seek participation from the healthcare organisations in Scotland, Wales, and Northern Ireland to develop these competency requirements.

Safety Recommendation 2023-031

It is recommended that NHS England Estates review all existing hospital helicopter landing sites for which it has responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-032

It is recommended that NHS Wales Health Boards and Trusts review all existing hospital helicopter landing sites for which they have responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-033

It is recommended that NHS Scotland Assure review all existing hospital helicopter landing sites for which it has responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-034

It is recommended that the Northern Ireland Health and Social Care Trusts review all existing hospital helicopter landing sites for which they have responsibility against the latest guidance and instigate appropriate actions to minimise the risk of injury from downwash to uninvolved persons.

Safety Recommendation 2023-035

It is recommended that the Onshore Safety Leadership Group (OnSLG), in conjunction with the UK Department for Transport, facilitate and support the development and introduction of a dedicated national hospital helicopter landing sites (HLS) database that can be updated in an operational environment by helicopter operators and hospital HLS Site Keepers.

In addition to helicopter operators and other stakeholders, the OnSLG should seek participation from the healthcare organisations in England, Scotland, Wales, and Northern Ireland.

Safety Recommendation 2023-036

It is recommended that the UK Department for Transport, in conjunction with the Onshore Safety Leadership Group, establish and lead a national initiative to improve the protection of uninvolved persons from helicopter operations at hospital helicopter landing sites (HLS).

This initiative should have sufficient authority, representation, resources, and expertise to ensure that coordination between the various risk owners and stakeholders is effective.

The various stakeholder roles and responsibilities (in particular those of HLS Site Keepers and helicopter operators) should be clear to all those involved, and the planning, design, and ongoing risk management of hospital HLS should be considered appropriately.

4.2 Safety Actions

4.2.1 Action taken

As a result of this accident, Safety Action was taken by various organisations as set out below.

4.2.1.1 Action taken by the operator of G-MCGY

The approval for its S92 and AW189 helicopters to operate into the HLS at DH was removed from its FSI until further notice.

Since the accident, more frequent reviews of the FSI are being conducted and additional information has been added for each site as to whether it has facilities for it to be secured and by whom, ie coastguard rescue team, police and/or hospital staff.

4.2.1.2 Action taken by the DH HLS Site Keeper

No helicopters >5,000 kg MTOW were permitted to land on the HLS at DH until further notice. A Notice To Airmen was issued to publicise.

Car Park B was closed to all vehicles other than ambulances until further notice.

All pedestrian movements in Car Park B would be controlled during all future helicopter landings and takeoffs.

All pedestrian movements on the public highway pavement along Derriford Road would be controlled as far as reasonably practical during helicopter operations, but DH has no legal authority to prevent pedestrian movements on the public highway.

The risk assessment for Car Park B was amended to include an assessment of the risk to pedestrians from helicopter downwash.

Additional visual and audible signs around the landing pad on the main pedestrians' routes around the location have been installed.

Yellow hatched floor markings have been installed outside each of the gated entrances to the pad, warning pedestrians not to stand in that location to view helicopters landing or taking off.

Audible message points around the external walls of the landing pad, activated by the security team once they reach the pad, have been installed. The audible message will warn pedestrians of helicopter movements, the risks of downwash and asking them to move to a different location quickly.

4.2.1.3 Action taken by the QEH HLS Site Keeper

As a result of the incident involving G-RESU, the hospital has established a monthly road sweeping programme.

4.2.1.4 Action taken by NHS England Estates

They have hosted online events for stakeholders at NHS hospitals to draw attention to the guidance in CAP 1264 on the safe and compliant design and management of HLS sites amongst the industry and local planning authorities.

4.2.1.5 Action taken by the HSE

On 10 May 2023, the HSE wrote to all NHS Trust and Board Chief Executives with a '*reminder of legal health and safety duty and how it should be discharged to effectively manage risk associated with hospital helipad use.*

4.2.2 Action planned or in progress

As a result of this accident, the following Safety Action is planned or in progress.

4.2.2.1 Action planned or in progress by the DH HLS Site Keeper

- Designs to secure and control access to Car Park B have been finalised and works are currently being tendered.

- The procedures for the security staff were reviewed with additional responsibilities added. These procedures were issued to security staff and are being trialled in conjunction with advice from an aviation consultant appointed by DH. They had not been approved for wider circulation at the time of publication of this report.

4.2.2.2 Action planned or in progress by NHS England Estates

- They have instigated a national data collection with all NHS hospital Chief Executives in England to seek assurance on levels of compliance with the standards in CAP 1264 and to identify any staff training requirements. The results of this had not been made available at the time of publication of this report, but they are intended to inform NHS England Estates of any additional next steps that may be required.

- NHS England Estates, working with the CAA, is considering introducing a package to develop training in ground operations and oversight of hospital HLS facilities. The objective is to roll out such a training programme to the Accountable Managers of all the hospital HLS in England, Wales, and Scotland.

- They are working with other hospital HLS towards a common database for all operators.

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Appendix A

Extracts from Third Edition of CAP 999 - *UK Helicopter Search and Rescue (SAR) National Approval Guidance*

Definitions for use in CAP 999

SAR Crew *- The members of crew required to operate a helicopter on a SAR flight, i.e. flight crew (commander / co-pilot), SAR technical crew members (winch operator / winchman), or that combination stated in the company operations manual.*

SAR Operational Flight *– A flight by a helicopter operating under a SAR Approval when tasked by the SAR Tasking Agency.*

SAR Technical Crew Member *– A member of the SAR crew (e.g. winch operator, winchman) other than flight crew who is assigned to a helicopter SAR flight for the purpose of operating specific aircraft and role equipment, assisting the flight crew during the mission and attending to any person in need of medical assistance.*

...

Chapter 3 Operating requirements

Performance requirements

3.4 SAR operational flights should operate to the highest possible performance standard.

- *Helicopters conducting operations to/from a FATO* [Final approach and takeoff area] *at a hospital that is located in a congested hostile environment are to be operated in accordance with Performance Class 1*[1]*.*

- *Helicopters conducting operations to/from a SAR operating site located in a hostile environment are, as far as possible, to be operated in accordance with Performance Class 2. The commander is to make every reasonable effort to minimise the period during which there would be danger to helicopter occupants and persons on the surface in the event of failure of a power unit.*

…

3.7 The operator is to produce or obtain a relevant Hospital Helicopter Landing Site (HHLS) Directory of UK Major trauma centres and any UK Hospital, including with an elevated HHLS, where it is likely a SAR helicopter could be operated in order for performance criteria to be established.

1 The S92 is unable to operate in accordance with Performance Class (PC) 1 into hospitals in a hostile congested environment at the operational role weights and fuel loads. The operator subsequently obtained an exemption from the CAA to operate to PC 2 with exposure.
An amendment to CAP 999 to reflect this option was published in Fourth Edition, in March 2023. It can be accessed here: https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=4092

Appendix B

Extracts from the operator's OM Part B Supplement SAR S-92A

4 Performance

4.1 Helicopter Performance Classes

For performance purposes, helicopters are grouped into the following classes:

Performance class 1:

Operations with performance such that, in the event of failure of the critical power unit, the helicopter is able to land within the RTOD [Restricted Takeoff Distance] available or safely continue the flight to an appropriate landing area, depending on when the failure occurs.

Performance class 2:

Operations with performance such that, in the event of critical power failure, the helicopter is able to safely continue the flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which case a forced landing may be required.

Performance class 3:

Operations with performance such that, in the event of critical power failure at any time during flight, a forced landing may be required in a multi-engine helicopter.

…

4.4 Performance Class 2 (PC2) Operations – Detailed Description

4.4.1 Introduction

The S-92A has been certified in Category A.

This means that they can operate in both Performance Class 1 (PC1) and PC2.

PC1 operations are usually flown to and from paved runways; while there is an EASA approved PC1 onshore helipad profile for the S-92A, it requires a helipad of at least 102sq-ft for departure, and the landing distance from 50ft is 528ft.

Neither of these figures makes the PC1 onshore helipad profile suitable for many landing sites where SAR operations are undertaken.

…

Appendix B cont

Congested area:

In relation to a city, town or settlement, any area which is substantially used for residential, commercial or recreational purposes (See also definitions of hostile and non-hostile environment).

…

Hostile Environment:

1. An environment in which:

a. A safe forced landing cannot be accomplished because the surface is inadequate; or

b. The helicopter occupants cannot be adequately protected from the elements; or

c Search and rescue response/capability is not provided consistent with anticipated exposure; or

d. There is an unacceptable risk of endangering persons or property on the ground;

2. In any case, the following areas shall be considered hostile:

a. For overwater operations, the open sea areas North of 45N and South of 45S designated by the Authority of the State concerned; and

b. Those parts of a congested area without adequate safe forced landing areas.

…

4.4.5 So what does operating to PC2 profiles achieve?

Apart from the fact that PC1 operations require either a runway (for horizontal operations) or a very large, clear area (for vertical operations), PC2 has one large advantage over PC1 which makes it viable for SAR training and operations. It is this; Performance Class 2 can be considered as Performance Class 3 take-off or landing, and Performance Class 1 climb, cruise and descent. It comprises an All Engines Operating (AEO) obstacle clearance regime for the take-off or landing phases, and only reduces to a One Engine Inoperative (OEI) obstacle clearance regime for the climb, cruise, descent, approach and missed approach phases.

Appendix C

Instructions for the DH HLS sent by DH to numerous operators in September 2015

Plymouth Hospitals NHS
NHS Trust

HELICOPTER OPERATORS USING THE HELICOPTER LANDING SITE, DERRIFORD HOSPITAL, PLYMOUTH

1 The On-site Operational Procedure and Response to an Emergency Incident Framework has been developed is support of the Helicopter Landing Site (HLS) opened at Derriford Hospital, Plymouth in June 2015 and this document provides a summary of aspects relating to Helicopter Operators.

2 Plymouth Hospitals NHS Trust (PHNT) provides acute and tertiary services with facilities for reception and transfer of critically ill and injured patients. PHNT is also a designated Major Trauma Centre (MTC) for the Peninsula Trauma Network, covering Devon and Cornwall.

3 The HLS shall only be used by the by the air ambulance and other emergency aircraft associated with the transfer of patients to and from Derriford Hospital or the Diving Diseases Research Centre.

4 The helicopter landing site (HLS) is operational 24/7 and has the capability to accommodate one helicopter, for day and night time landings and is designed for medical transfers use for hospital purposes only. It has been built in accordance with Hospital Building Note 15-03 (Hospital HLS's) and conforms to ICAO Annex 14 Volume II (Heliports) standards.

5 The helicopter landing site provides access for air ambulances, the Police, HM Coast Guard, Search and Rescue, Royal Navy and Royal Air Force with helicopters of 12.8t gross weight or less and a 'D' value of 21m or less. Larger aircraft (Merlin or Chinook) will land at the secondary landing site at Royal Marine Barracks, Bickleigh.

6 Helicopter Operators will be expected to undertake their own risk assessments and develop plans/arrangements in support of using this HLS facility. This should include maintaining their own landing site cards for routine landings, as part of their Landing Site Directory.

Appendix C cont

7 Following approval with their CAA Flight Operations Inspector, Operators may provide an operational instruction to PHNT, for consideration and advance agreement on how more than 1 air ambulance helicopter could be accommodated in exceptional circumstances eg an aircraft grounded by major unserviceability when the same operator may need to fly another helicopter for life saving reasons.

8 Authorisation to land at the Derriford Hospital HLS will only be granted as part of the ATMIST process into the Emergency Department for emergency patient transfers or via the Helicopter Manager for planned attendances eg training exercises.

CHARACTERISTICS

9

Location	north of car park B, Derriford Hospital, Plymouth, PL6 8DH
Lat (50.417685)	Long (-4.112722)
Elevation	160m
Dimensions	42m x 26m

10 The helicopter landing site has the following characteristics:

- ‘Raised’ level HLS of soil and Tensar construction, less than 3m high
- Designed and calculated for helicopters with a maximum take-off weight of 12.8 ton (metric)
- Perimeter safety netting of 1.5m wide surrounds the HLS
- Markings – centred white cross containing a red H, circled in yellow and denoting 12.8t weight limit. The remaining flat surface is grey in colour.
- Lighting is controlled via Emergency Department staff located at the desk in the ‘majors’ corridor and will be turned on upon receipt of ATMIST report. Lighting consists of:
  - low level green blister landing lights
  - low level floodlights
  - emergency exit lights located at the 2 exit points
  - group A low intensity steady red obstruction lights – 3 at the top and 3 half way up the boiler house chimney – as chimney exceed 45m in height
  - no red obstruction lights will be on any structures around the site, other than the chimney as they are lit during hours of darkness to an adequate level
- Access/egress:
  - Emergency access through gate to north west of HLS
  - Patient Transfer Team access via gate to south west of the HLS
- Automatic de-icing – the HLS has an ice resistant, non, slip surface

Appendix C cont

- Wind sleeve located to the north west of HLS
- Weather station located on roof of Derriford Hospital
- Fire hydrant is located near the wind sleeve to the north west of the HLS
- Anchor points – not provided
- No refuelling capability on site but able to accommodate mobile tanker deployed to facility by aircraft support organisation
- VHF communications between the aircraft and hospital are not available

11 **AIR CREW – Responsibilities**

- Notify ED via red phone and provide ATMIST report.
- Notify SWASFT Ambulance Control HEMS Dispatcher that they are bringing a patient to the HLS at Derriford Hospital, Plymouth (to enable conflicting flights to be managed).
- For onward transfers to the Diving Disease Research Centre, crews are requested to remind SWAST HEMS Dispatcher that SWAST are required to notify ED of the planned arrival at the Derriford HLS, even though the patient is not for ED. This will enable the Helicopter Response Team to undertake the required checks, ensure the lights are switched on and facilitate any problems with access through the emergency access gate for the road ambulance.
- Monitor weather at Derriford Hospital utilising on-site weather station. Operators should not ask hospital staff for weather details.
- Confirm estimated time of arrival from pilot and communicate to ED staff, in order that hospital staff can co-ordinate arrangements to receive casualties.
- Note safe to land illumination and make final decision on whether to land at HLS. If the HLS is not operational for any reason a sign will be placed completely covering the 'H' denoting the HLS is not in use.
- Approach and depart from the HLS using designated flight paths – see Appendix A.
- Signal to the Helicopter Response Team when it is safe to approach the aircraft. If the HRT are not visible from landing area, air crew to go to edge of HLS until HRT in clear line of sight. Hospital staff will not approach the aircraft until blades have stopped turning. The only exception to this is for Search and Rescue aircraft, with the pilot's permission, helicopter crew will guide and escort hospital staff, whilst rota blades may be still turning. This procedure is considered safe as the rota blades are over 15' above ground.
- In exceptional circumstances (not involving Search and Rescue aircraft) the patient may need to be 'hot' unloaded from an Air Ambulance helicopter, prior to the engine being shut down. The Helicopter Response Team may move

Appendix C cont

forward to the top of the ramp but will not move towards the aircraft until the rotor blades have stopped turning.

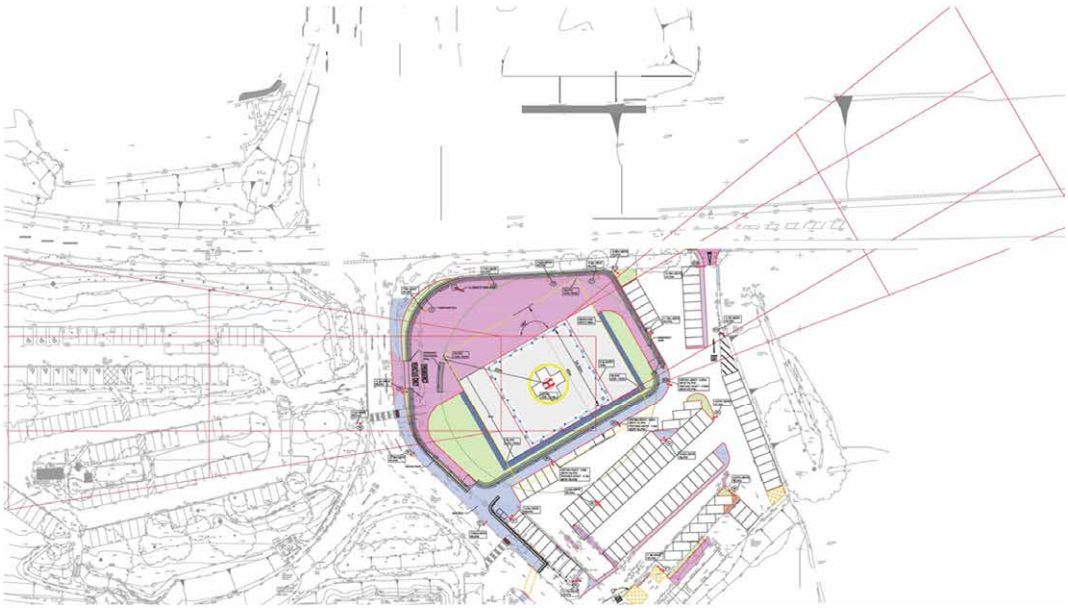
- Aircrew are responsible for off-loading the patient from the aircraft, with Emergency Dept staff responsible for the safe transfer into the hospital.
- Aircrew will accompany the patient, maintaining clinical responsibility for the patient until handed over to staff within the Emergency Department.
- During the transfer from HLS to the Emergency Department, the patient will be monitored using helicopter clinical equipment.
- Securing equipment and responsible for safety of their own aircraft – as no 'tie down' points have been included in the HLS surface.

12 CONTACTS

Helicopter Manager **Emergency Planner**

Ref: MCS/HLS Overview for Operators – Revised 1st September 2015

FLIGHT PATHS (Appendix A)



Appendix D

Extract from the Derriford Hospital helicopter landing site '*On-site operational procedure & response to an emergency incident*' document detailing HLS Response Team roles and responsibilities

Plymouth Hospitals NHS
NHS Trust

DERRIFORD HOSPITAL HELICOPTER LANDING SITE

ON-SITE OPERATIONAL PROCEDURE & RESPONSE TO AN EMERGENCY INCIDENT

Appendix D cont

6 ROLES AND RESPONSIBLITIES

….

HLS Response Team

6.4 Security

Helicopter Arrival:

- Obtain and don PPE from Security Office and proceed to Helicopter Landing Site
- Proceed to pad, unlock access lower access gate
- Undertake visual inspection for damage, obstacles and other loose debris – both on the HLS surface and within the HLS boundaries - remove or report to ED Nurse in Charge. Identify and remove anything, however small (eg twigs) that could present a danger to staff, public or the aircraft when blown around by downwash onto the car park or pavements below
- Report the operational status ('Operational' or 'Closed') of the HLS to the Nurse in Charge of ED
- One Security Guard to wait at crossing gates. When HRT team start to move from the Emergency Department to HLS, close gates to stop traffic and re-open when they have safely crossed the road
- Remain at HLS until the helicopter crew give a 'thumbs up' from the aircrew – once the aircraft has fully shut down and the rotor blades have stopped turning
- Ensure any visitors interested in viewing the helicopter remain behind the safety wall, do not use camera/phone to take photos (as flashes can temporarily blind the pilot) and are reminded not to smoke.
- Undertake traffic management duties including process to close/open gates across road, in support of patient transfer
- Ensure access gate to HLS is locked

Helicopter Departure:

- Once helicopter is ready to leave, ensure that no-one enters the HLS area and no items can blow onto the HLS
- Maintain security arrangements during take-off until aircraft is well clear of site
- Check helicopter is clear of site and inform ED Nurse in Charge that lights can be switched off
- Return PPE to Security office

If [company name redacted] Security staff not available, [company name redacted] Parking staff are to undertake this role

Appendix E

Year	ICAO Annex 14 Vol II[1]	ICAO Doc 9261	CAA CAP 738	CAA CAP 1264	Other	DH HLS
1995	2nd Edition	3rd Edition				
1996						
1997	Amdt 2					
1998-2002						
2003			1st Edition			
2004	Amdt 3					
2005						
2006			2nd Edition			
2007						
2008					HBN 15-03 published[2]	
2009	3rd Edition					
2010-11						
2012	4th Edition					Feasibility report
2013						
2014	Amdt 6					Business case
2015						HLS opened
2016	Amdt 7 & 8			1st Edition[3]	HBN 15-03 withdrawn	
2017-18						
2019				Amdt 1	CAP 1864 published[4]	
2020	5th Edition	4th Edition	3rd Edition[5]			
2021		5th Edition[6]				

Table 5
Evolution of HLS related documents

1 Downwash zones are not addressed in Annex 14 Vol II.
2 30 m downwash zone for light helicopters with a larger zone, albeit unspecified, for larger helicopters in HBN 15-03.
3 Recommended 30 m downwash zone for light helicopters and 50 m to 65 m for the largest helicopters to be kept clear of people, property or parked vehicles.
4 Downwash is mentioned in CAP 1864 but not quantified.
5 Downwash is first addressed in 3rd Edition of CAP 738 but does not quantify a downwash zone.
6 A downwash area extending to 2 to 3 rotor diameters is first addressed in 5th Edition of Doc 9261.

Appendix F

Extracts from the operator's UKSAR Flight OM Part A

8.1.2 Criteria and Responsibilities for Determining the Adequacy of Aerodromes to be Used Whilst Conducting SAR Flights

8.1.2.1 Use of Aerodromes, Heliports and SAR Operating Sites

Company SAR Helicopters are required to operate throughout the SRR conducting SAR Operational Flights or SAR Training Flights. In practical terms this means that they can be tasked from their SAR Operating Base to Aerodromes or Heliports as detailed in the UK AIP or to SAR Operating Sites such as remote sites or hospitals as listed in the Company Landing Site Directory in the OM Part C – Route Guide...

The suitability of the above SAR Operating Sites for a SAR Flight to depart from or approach to is based on a number of factors namely:

- *The nature or urgency of the flight being conducted i.e. a SAR Operational Flight or SAR Training Flight;*
- *The Aerodrome or Heliport that the SAR Flight takes place from or to;*
- *The requirement of an SAR Operating Site to have been surveyed in order to comply with helicopter performance conditions i.e. when operating to a hostile congested hospital landing site; The SAR Operating Site (on scene) is a remote site and should therefore be dynamically risk assessed by the SAR Crew as suitable for a landing and take-off;*

…

Company SAR Helicopters may routinely operate to Aerodromes or Heliports as listed in the UK AIP. SAR Helicopters may also routinely operate to a Heliport or Landing Site which has previously been surveyed and is listed in the Company Landing Site Directory (CLSD) as listed in the OM Part C – Route Guide. However, SAR Crews should appreciate that the grant of a licence to a Heliport or Landing Site does not necessarily guarantee its suitability for all types of aircraft and operation and a dynamic risk assessment should be conducted in accordance SAR practices such as the 5-S Recce before a take-off or landing is conducted.

…

Appendix F cont

8.3.10 Wake Turbulence and Downwash

8.3.10.1 General

The physical characteristics of all aircraft are such that their passage leaves an area of disturbed air in their wake. This "wake turbulence" tends to increase with the size and power of the aircraft…

As described in Section 8.3.10.2, downwash is a form of wake turbulence produced by helicopters flying at low speed…

Downwash…can lift even quite heavy objects into the air instantly…

Generally speaking, the larger the helicopter, the greater the potential downwash danger. Still air conditions permit the resulting vortices to persist and travel considerable distances.

8.3.10.2 Downwash Hazards & Operations in Recirculation

Downwash is a hazard for a SAR Operations as landings are often conducted in un-surveyed or un-managed sites where the security of the surrounding structures or surfaces cannot be fully established until the aircraft is in close proximity to the site itself.

The S-92A and the AW189 both have a high-density rotor disc. This is a factor of the aircraft's mass compared to the size of rotor disc that is used to provide thrust.

Both the S-92A and the AW189 also have cambered blade aerofoils and swept anhedral tips in order to generate greater thrust with a smaller disc area.

High density disc helicopters present 3 significant issues:

- *Downwash effects may be felt and observed up to 500' below the helicopter in a still wind condition;*
- *The point of maximum airstream velocity in the downwash is at 2 x Disc diameter (2D) and has an approximate value of 51 Knots for an S-92A and 59 knots for an AW189 at SAR take off mass. This 2D figure is at a height above ground of 95' for an AW189 and 110' for an S-92A;*
- *SAR Crews often fly approaches that results in the helicopter maintaining at or slightly above 95' for the final approach phase to reduce noise and maintain good visual references: this is in the optimum bracket for maximum downwash effect.*

Appendix F cont

The further effects of downwash occur when objects funnel the downwash (as shown below) once it has hit the ground: this effect is known as sidewash and may see the 2D value of the air increase velocity again, possibly by up to 10 knots.

In summary, the airstream under a high-density disc aircraft may approach that of a Category 1 Hurricane (64 knots sustained).

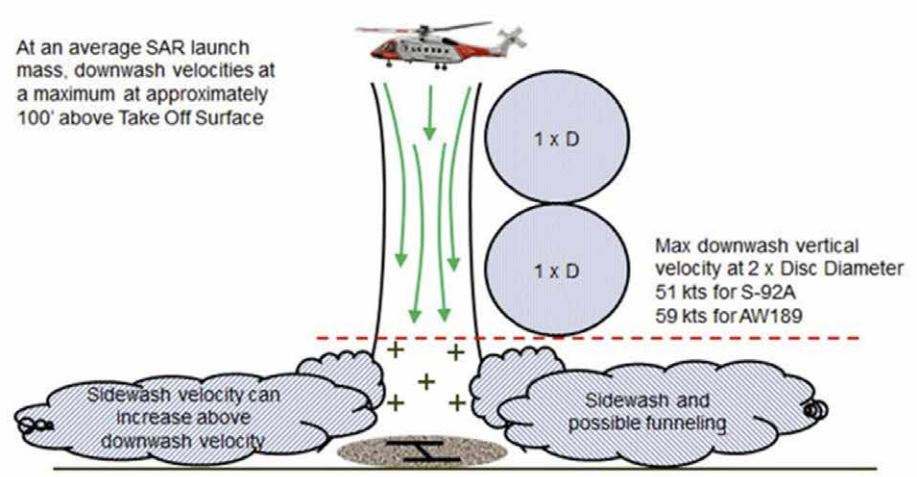


Figure 8-10 Downwash and Sidewash

8.3.10.3 Optimising the Approach

Planning the approach should be carried out in accordance with the 5'S' recce procedure. During the recce, any structures that might present a FOD or downwash hazard should be identified with care taken to look at possible effects caused by downwash and then again with effects caused by sidewash. In particular, any areas that might funnel the airstream should be marked out and accounted for.

Therefore, the path of the aircraft during approach, hover and go around / departure should be considered holistically for downwash hazards.

If the recce determines that the site presents too high a FOD / Downwash hazard to the aircraft or personnel / structures on the ground, then alternative sites should be identified.

Appendices

8.3.10.4 Flying the Approach

A steeper than normal dynamic manoeuvre, if available as an option, will be the best way to reduce the time that downwash has to build during the approach and affect the site below: in other words, delaying the point at which the downwash 'touches down.' This may be PC 2 rather than PC 1 and is shown below:

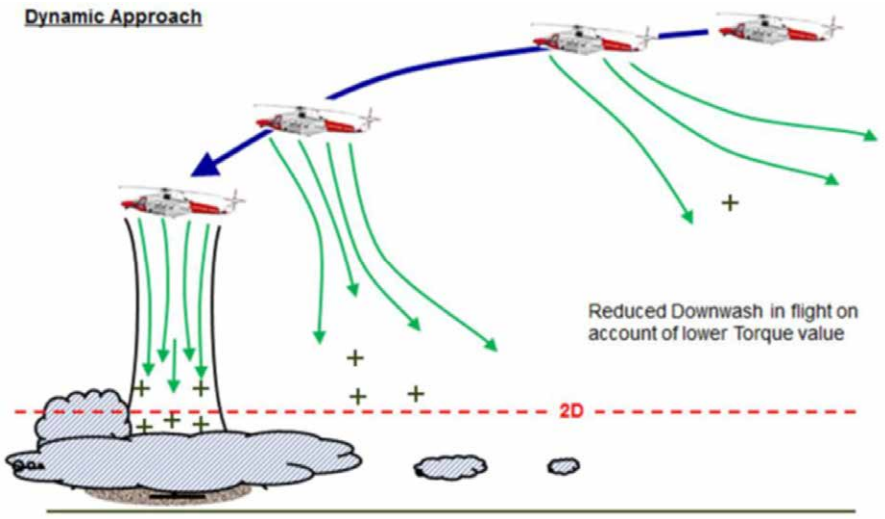


Figure 8-11 Dynamic Approach

Unless otherwise indicated, recommendations in this report are addressed to the appropriate regulatory authorities having responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken. In the United Kingdom the responsible authority is the Civil Aviation Authority, Aviation House, Beehive Ringroad, Crawley, West Sussex, RH6 0YR.

Aircraft Accident Report 2/2023

Report on the accident to
Sikorsky S-92A, G-MCGY
at Derriford Hospital, Plymouth, Devon
on 4 March 2022