APPENDIX C

Helicopter Report

Please note this report is provided as information and is to be revised

Schematic Design Report
Helicopter Landing Site
Wagga Wagga Base Hospital Redevelopment Project

Prepared for: Rice Daubney

By: Heli-Consultants Pty Limited

February, 2009

Revised July, 2011

For: Capital Insight

Executive Summary

Heli-Consultants were briefed by Rice Daubney in 2009 to assist in concept design development and to prepare this report addressing various design issues relevant to providing helicopter accessibility at the Wagga Wagga Base Hospital -- soon to be redeveloped.

We were provided with concept design drawings, we attended a preliminary design development meeting, and we were later provided with concept design development drawings for Wagga Wagga Base Hospital. Since that time, changes have been made to the concept design and the scale and shape of the main clinical services block have changed. We have now been asked by Capital Insight to revise this report in light of the latest design.

While rooftop helipads provide some initial design challenges, we believe that elevated landing sites at hospitals have significant advantages over surface-level sites, including:-

- Fewer security issues;
- Lower long-term human resource demands;
- Greater safety – particularly to non-participants;
- Lesser environmental impact – both noise and rotor wash; and,
- A smoother and quicker transfer of patients from the aeronautical environment to the hospital environment.

Numerous studies have validated the advantages of helicopters in trauma and retrieval medicine. Their ability to transit point-to-point – transcending surface congestion and natural obstacles – produces time-savings both in the delivery of definitive care to the scene or referring hospital, and in bringing the patient to the referral centre of excellence.

Helicopters are now a well-established part of the public health system in NSW and the ACT – and have been regularly used to transport patients to and from Wagga Wagga Base Hospitals for years.

The SouthCare helicopter is based in Canberra, ACT; other NSW Ambulance helicopters are based at Orange, Sydney and Wollongong; and Child Flight/NETS provide a state-wide newborn and paediatric retrieval service from their combined base at Children's Hospital, Westmead.

These helicopter services have been operating to and from a concrete helipad at the Duke of Kent Oval in Wagga Wagga – several hundred metres from the Base Hospital. An ambulance is utilized to provide transport between the hospital and the helipad – necessitating double-handling of all patients.

There are no licences, certifications, registrations or other site-specific approvals required from CASA for the proposed HLS at the new hospital site. At one time the aviation authorities discouraged the use of elevated helipads in Australia. That is no longer the case. Most of the major trauma hospitals in Sydney as well as Gosford, Newcastle, Wollongong, Bathurst and Canberra Hospitals, now use elevated or roof-top HLS.

At the time this report was originally submitted, it was considered that *Civil Aviation Advisory Publication (CAAP) 92-2[1]* and NSW Health *Policy Directive PD2005_128* (formerly known as *Health Circular 98/61*) contained the most useful and relevant material for the hospital HLS design process in NSW. In late 2010 a new draft Policy Directive "Guidelines for Hospital Helicopter Landing Sites in NSW" was cited by the NSW Ambulance Service Medical Retrieval Unit as the basis for commissioning a new hospital helipad at Liverpool Hospital in southwest Sydney.

That new draft policy is not yet promulgated on the NSW Health website (PD2005_128 is still shown to be the current policy) however it is believed to be the current *de facto* guideline. The new guideline draws from two other heliport standards – the ICAO Technical Annex 14, Volume 2 (in respect of load-bearing capacity) and US FAA Heliport Design Advisory Circular Chapter 4 – Hospital Heliports (in respect of clear groundspace and airspace, lighting, marking and ancillary safety features). The draft guidelines contains more detailed design information than its predecessors, yet it remains the case that there is no single standard or published specification which addressed all matters that needed to be considered in the design and development of an elevated HLS.

There are site-specific issues that may require non-standard solutions to achieve optimal safety and operability. The "advisory" publications acknowledge that there may be alternative ways of achieving equivalent safety – and they should not be viewed as inflexible "standards".

In designing hospital HLS which are intended to be used regularly by a cross-section of pilots, designers should select criteria going beyond "minimum specification" to reduce the number of mission rejections that occur in respect of that site. Our recommendations borrow from a number of Australian and overseas design standards and are intended to provide a facility that can be used reliably, safely and conveniently.

In defining the project for a new HLS, a number of preliminary design questions should be addressed in order to avoid premature obsolescence of the design:-

- We considered **whether the HLS should be constructed to cater for the new civil tiltrotor (CTR) aircraft** about to enter service. We believe that such aircraft will eventually be used in air medical transport – but the timetable remains uncertain and the design criteria for vertiports are at this stage "underdone". **We recommend that the possibility of designing for modular expansion in future be examined.**
- We examined **whether the HLS should be designed to accommodate those special flight procedures used by modern multi-engine helicopters (known as "Cat-A" or "Performance Class-One") that guarantee either a safe landing back on the heliport or a safe diversion to another suitable landing area – in the event one engine fails at any stage in the flight**. We found that **most (not quite all) of the helicopter types** likely to be used at Wagga Wagga Base Hospitals **could be used under those performance conditions with a 27m x 27m load-bearing structural HLS.** Therefore **we are confident that the design parameters proposed will not result in the facility becoming obsolete by virtue of a rule-change** mandating those procedures.
- We considered **whether the facility could be designed as an "IFR heliport"** under international rules. We found **that the airspace and lighting array requirements are so onerous that they could not be met**. We note that **"point-in-space" instrument approaches can still be used** to operate to and from hospital HLS in bad weather –

however the operating minima are less advantageous than if precision approaches could be carried out.

- We addressed **whether the proposed HLS should be built to accommodate Australian Defence Force (ADF) helicopters** inasmuch as those helicopters appear to **be integral to NSW counter-disaster and counter-terrorist planning.** We found that **most of the medium-sized ADF helicopters likely to be available in NSW, the ACT or Victoria could take-off and land at a 27m x 27m elevated facility with only minor enhancement to the load-bearing capability** – however we qualify these conclusions by saying that the ADF's operating rules in this regard are not clearly promulgated (or, if promulgated, are not readily available to the public) and the information we had available comprised the personal opinions of various ADF personnel contacted.

- We considered **whether we should recommend the inclusion of a "parking position"** adjacent to the proposed HLS so that a second helicopter could arrive notwithstanding one helicopter already on the helipad. We have no data at this stage upon which to project utilisation of the revamped facilities – hence no basis for estimating conflicts. We note that the Duke of Kent Oval could be used to take any "overflow".

- We have reviewed state planning and environmental legislation and we advise that – **provided the facility is used exclusively for medical flights** – the proposed development is **neither "designated development"** under the planning laws **or "scheduled premises"** under the pollution control laws. We believe that hospital helipads are an "incidental or ancillary-use" to any major public hospital in NSW so that any zoning in which such a hospital is permitted -- should be construed as impliedly permitting an hospital HLS.

- We note that an assessment of noise and pollution has been conducted by Wilkinson Murray in accordance with the *Environmental Planning and Assessment Act, 1979* – and that no significant environmental impact emanating from the proposed helicopter operations is anticipated. We believe that the flight path alignment as indicated in Figure 10 is the most favourable both operationally and environmentally.

- **We believe the revised plan supplied to us by Capital Insight (depicted at Figures 11 and 12) incorporating the rooftop HLS at Level 7 will provide a viable layout for a functional HLS that complies with the relevant legislation and official guidelines. Flight path modelling within the campus and near vicinity (Figures 13-16) illustrate compliance with the requisite obstacle-free flight path gradients for visual flight operations.**

Introduction

Consultants' initial brief in 2009 was to assist Rice Daubney with the establishment of design criteria, identification of air safety requirements and advisory material; and consideration of the planning, environmental, fire and safety issues pertinent to developing an HLS (helicopter landing site) at Wagga Wagga Base. We have since been commissioned by Capital Insight to consider a revised concept plan for the facility and comment on the location and functionality of the HLS proposed therein.

1. The Hospital/Air Medical Transport Interface

We do not purport to expand in detail upon the role played by Wagga Wagga Base Hospital in the state's health plan. Suffice to note that Wagga Wagga is a major regional centre in south central and south western NSW and as such its base hospital is both an "exporter" and an "importer" of a significant number of patients annually.

Neither do we propose to review in detail the working of those air medical services contracted to the NSW Ambulance Service – other than to note that a network of medical/rescue helicopters covers the more populated portions of the state, and that medically-staffed helicopters are used for both primary (scene) flights and secondary (inter-facility retrieval) flights.

We also observe that – unlike air medical services in some parts of the world – medical/rescue helicopters in NSW are not specifically aligned with any particular care facility – but are used as health resource multipliers to optimise care within the entire public hospital system within NSW.

Other than their unique capabilities as rescue platforms, the most obvious advantage of helicopters in the transport of the critically ill is their point-to-point speed, transcending surface congestion and obstacles. Probably the most significant factor in reducing morbidity and mortality among the critically ill and injured is the timely delivery of medical teams capable of definitive intervention at the scene. Early stabilization by retrieval specialists – whether at the accident site or inside local and regional health care facilities – is equally if not more important than the actual transport of the patient(s) to a referral centre.

Nonetheless, rapid transport of patients can be vital to their ultimate outcome. Some patients cannot be sufficiently stabilized *in situ* – and require urgent intervention that is only available within secondary or tertiary facilities. The total amount of time spent reaching the critical care units within those public hospitals will impact patient outcome in those cases.

The genuine point-to-point transportation capabilities of rotary-winged vehicles are neutralised if secondary or extensive intra-mural transport is required. The effectiveness of helicopters in air medical transport is directly related to the availability of helicopter landing sites with immediate access to the relevant critical care units. Helicopter Landing Sites (HLS) at hospitals are the air/medical interface in air medical operations.

Proximity and convenience of hospital HLS are only one side of the coin when it comes to site selection and design. Safety and reliability under a wide range of operating conditions is equally important.

As air medical transport comes to be perceived as routine, as the air medical services evolve into 24-hour, all-weather operations, as larger, transport-category helicopters become the norm in air medical service, and as public expectation of a zero-accident rate in air medical operations becomes entrenched, the minimum standards for hospital HLS increase. Basic or minimal HLS are no longer acceptable for facilities used regularly by helicopters worth up to $15 million each.

This is frequently not appreciated by those who, having seen (in person or in the news) helicopters performing feats of rescue -- often from unprepared locations – believe helicopters can operate safely without an elaborate landing facility. It must be understood that not all the manoeuvres a helicopter is capable of – carry the same risk.

Vertical landings, winch operations, night operations, and landings in tightly confined areas all carry significant risks that are only justified in critical situations. Helicopter services conducting these operations have a significantly higher accident rate than those conducting more mundane flights – albeit a rate that is probably justified by the high success rate. Good risk management practice dictates that any risks which can be mitigated – must be -- in order to reduce the overall organizational risk to acceptable levels.

Nothing can be done to address the suitability of an area surrounding a random accident site – the flight crew must either accept the risks, divert to a less convenient location, or refuse the flight. But where it is known, in the case of both referral centres and receiving centres, that dozens of flight movements per year will operate to and from that venue, sound risk management practice dictates that the HLS should be located and designed with the safety of air crew, patients, and members of the public paramount. The terms “routine” and “time-critical” are not mutually exclusive in this context.

In designing hospital HLS which are intended to be used regularly by a cross-section of pilots, designers should therefore select criteria going beyond “minimum specification” to reduce the number of mission rejections that occur in respect of that site. Our recommendations borrow from a number of Australian and overseas design standards and are intended to provide a facility that can be used safely in a wide range of conditions i.e. – the use of which does not add to the risks inherent in helicopter emergency service operations.

Before the final design of the proposed facility is implemented, we recommend that the key design features be presented to the Aeromedical and Medical Retrieval Service of the NSW Ambulance Service -- and their endorsement of the design be sought. (This consultation is recommended in the Draft NSW Hospital Heliport Guidelines discussed later in this report.)

1.1 Review of Existing HLS at Duke of Kent Oval, Wagga Wagga

At one time helicopter landings were conducted within the grounds of the Wagga Wagga Base Hospital – however several factors evolved that resulted in air medical helicopter movements being diverted to the Duke of Kent Park located approximately 400 metres north west of the hospital on the other side of Edward Street (Sturt Highway), including *inter alia*:-

- NSW medical authorities mandated higher standards of safety and on-board patient care for helicopter retrieval services that could only be achieved using larger, transport-category helicopters.
- The NSW Ambulance Service required providers of air medical transport to have "instrument flight rules" (IFR) capability – which is available only on multi-engine helicopters.
- Occupational Health and Safety Legislation dictated provision of a "safe system of work" for all NSW employees – which led to insistence upon the use of larger, transport-category helicopters by the respective employers of air medical attendants (most of whom are employed by agencies other than the helicopter operator).
- The air safety authorities required air operators to adopt aviation risk management procedures as the centrepiece of their safety programs – resulting in decisions being taken to discontinue operations by larger, transport-category helicopters within the inadequate confines of the old Wagga Wagga Base Hospital surface-level landing area.

As will be seen from the subsequent discussion, the physical dimensions of clear ground space and airspace -- and the requisite separation distance from non-participants -- all increase with any increase in the size and mass of the helicopters using a particular landing site. The helicopters used in air medical transport in NSW thus have simply "out-grown" many of the hospital helipads used previously. The same is essentially true for Victorian air medical services.

1.2 Designation of Airspace and Air Traffic Control

1.2.1 Rules and Responsibilities

Designation of particular airspace and development of the rules for operation within specific classes of airspace is a function of the Civil Aviation Safety Authority. Airservices Australia operates an Air Traffic Control (ATC) system and provides air traffic services in civil airspace across Australia and in the adjacent oceanic air routes. Airservices also operate and maintain the radio navigation aids required for the air route structure. The Australian Defence Forces (ADF) provide air traffic control services for civil and military aircraft operating in military control zones and military restricted areas.

1.2.2 Particular Air Traffic Issues at Wagga Wagga Hospitals.

The airspace superjacent to Wagga Wagga Hospital is designated Class "G" from ground level up to 8500 feet above mean sea level – which means that air movements (including take off's and landings from the Hospital HLS) are "un-controlled" and do not require an ATC clearance. Pilots operating in Class "G" airspace are required to fly in accordance with the international "rules of the road" and to keep a look-out for other traffic – however avoidance of a collision is solely the responsibility of the respective pilots in Class "G" airspace.

A "common traffic advisory frequency" (CTAF) is designated for operations in the vicinity of Wagga Wagga Airport so that pilots may broadcast their position and alert other aircraft to their intentions.

From 8500 feet above mean sea level (AMSL) upward to 12,500 feet the super-incumbent airspace is designated Class "E" – meaning that it is controlled airspace requiring a clearance for IFR (instrument) operations – with ATC facilitating separation from other traffic using radar – but uncontrolled for VFR (visual) operations.

From 12,500 to 18,000 feet AMSL the airspace is designated Class "C". Above 18,000 feet the airspace is designated Class "A". In both "C" and "A" airspace all VFR and IFR operations are controlled by ATC in order to provide safe separation from other traffic.

There is no instrument approach procedure published for the existing Wagga Wagga helipad – however there are published instrument approaches (both non-precision and precision) serving the Wagga Wagga airport.

In summary, there are no specific clearances required for helicopter operations at the proposed Wagga Wagga Hospital HLS. Figure 1 below is an excerpt from the Sydney Visual Navigation Chart (VNC) showing the airspace classification in the Wagga Wagga area.

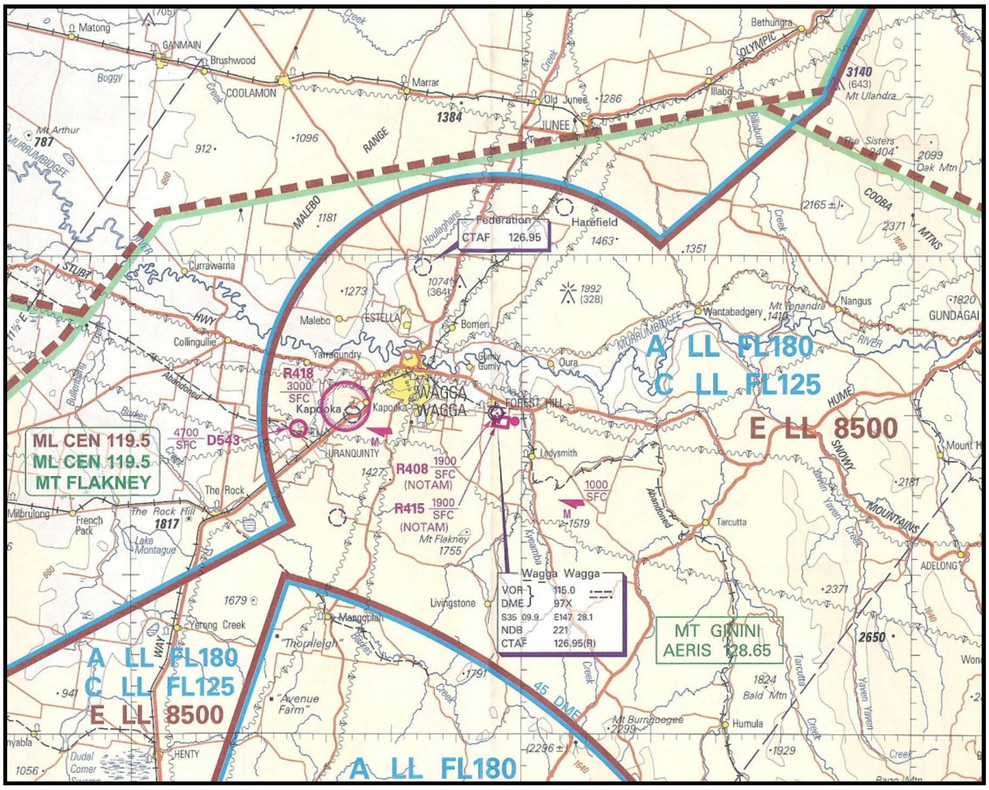


Figure 1 - Wagga Wagga Airspace from Sydney VNC

2. Air Legislation and Other Sources of Design Criteria for Helicopter Landing Sites (HLS)

2.1 Civil Aviation Regulations 1988 and Civil Aviation Safety Regulations 1998

Except in the case of heliports used by high-capacity (30+ seats) scheduled air services, there are no requirements for licensing or site-specific approval of HLS by the Civil Aviation Safety Authority (CASA) in Australia. To the best of our knowledge, there are no mandatory HLS standards from any authority applicable in New South Wales or elsewhere in Australia.

Civil Aviation Regulation (CAR) 92 provides for take-off's and landings at places which are, in all the circumstances, safe and suitable for such operations. Safety and suitability of hospital landing sites are (legally) matters for pilots-in-command to determine prior to each operation.

The Civil Aviation Act, 1988 (Cth) provides inter alia:- "s. 20A. (1) No person may operate an aircraft in a careless or reckless manner so as to endanger the life of another person. (2) No person may operate an aircraft in a careless or reckless manner so as to endanger the person or property of another person." This criminal provision reinforces the duty of the pilot in command to select helicopter landing sites carefully. It also highlights the difficult choices pilots may have to make where there is inadequate separation or security at a landing site and curious onlookers gather to observe take off's and landings.

CASR Part 139 – Aerodromes establishes a regime for certification or registration of some aerodromes in Australia. Helicopter Landing Sites fall within the definition of "aerodrome". However, except in the case of aerodromes used by high-capacity transport operations (30+ passenger seats), there is no requirement to certify helicopter landing sites.

2.2 Civil Aviation Advisory Material

2.2.1 CAAP 92-2[1] -- Guidelines for the establishment and use of helicopter landing sites (HLS)

CASA provides non-mandatory design guidance for helicopter landing sites (HLS) in CAAP 92-2. The ". . . guidelines set out factors that may be used to determine the suitability of a place for the landing and taking-off of helicopters. Experience has shown that, in most cases, application of these guidelines will enable a take-off or landing to be completed safely, provided that the pilot in command:-

- has sound piloting skills; and
- displays sound airmanship."

Substantial compliance with CAAP 92-2 standard HLS criteria is recommended for the proposed Hospital HLS (except as specifically indicated below). However CAAP 92-2 is vague in many respects and completely silent on a number of design issues – most notably the structural characteristics of elevated HLS.

2.2.2 *CASR Part 139 – Aerodrome – Manual of Standards*

Section 8.11 of the Aerodrome Manual of Standards contains information on marking of helicopter areas on aerodromes – however that material is not specifically relevant to off-airport HLS such as the proposed Hospital HLS.

2.3 Federal Controls on Elevated or Rooftop HLS

Prior to 1990 the air navigation regulations required site-specific approval for HLS in most circumstances. The Department of Civil Aviation (DCA) and its successors in name, as a matter of policy, did not approve roof-top sites for use by single-engine helicopters or by twin-engine helicopters that did not have one-engine-inoperative "fly away" capability. Effectively, this policy amounted to a *de facto* ban on roof-top helipads in Australia for many years. Some health planners may not be aware that this policy has changed.

Since 1990 – rooftop facilities have not been officially discouraged and a number of rooftop hospital HLS have been built.

2.4 Future Position under Federal Legislation

Because both domestic air safety legislation and international standards are currently under review, planning to avoid premature obsolescence of helicopter landing facilities (due to rule changes) is a significant challenge.

We have considered the content of draft Civil Aviation Safety Regulations (CASR) Part 133 – Commercial Rotorcraft Operations – which has the status of a "Notice of Proposed Rulemaking" (NPRM)". We have recently learned that CASA have decided to create a new Part 138 of the CASR's for Aerial Work operations – including ambulance operations. A first draft of Part 138 is not yet completed, however we believe that the draft standards previously incorporated in CASR Part 133 for air medical operations – will probably re-appear in draft Part 138.

We have also been monitoring the progress of ICAO working groups set up to recommend changes to ICAO Technical Annex 14 (Volume 2) – Heliports. As a signatory to the Chicago Convention on International Civil Aviation, Australia will is obliged to adopt – to the greatest extent practical, ICAO standards and recommended practices. The most recent iteration of Annex 14 (Volume 2) was released in July, 2009, and became effective in November of that year. However work on changes to the lighting and marking standards and recommended practices continues.

It is interesting to note that – whereas the Civil Aviation Safety Authority previously referred to CAAP 92-2[1] as its design criteria for helicopter landing sites – nowadays the official CASA position[1] appears to be that they do not have design

[1] The "differences" with ICAO Standards and Recommended Practices that have been filed by the Australian government [most recently promulgated in *AIP SUPPLEMENT (SUP) H12/11* dated 5 MAY 11] include the following:- Australia does not regulate the design and operation of heliports in Australia. If the owner/ operator of a heliport intends to develop and operate a heliport for the purpose of regular public transport or charter operations, they are referred to the ICAO Standards and Recommended Practices set out in Annex 14 Volume II.

criteria for helicopter landing sites – and that ICAO Annex 14, Volume 2 should be referred to for the design of heliports used for charter or regular public transport purposes. CAAP 92-2[1] is being referred to as merely a guideline to pilots to assist them in evaluating the safety and suitability of a particular site for helicopter operations. That provides little assistance to those who are trying to establish the appropriate design standard for heliports used in aerial work operations such as air ambulance.

2.5 NSW Health Department and Air Medical Helicopter Operator's Policy

2.5.1 NSW Health Department Circular 93/107

A set of practical guidelines for the establishment of hospital HLS in NSW based upon the Standard HLS criteria from CAAP 92-2 were originally prepared by air medical helicopter operators; endorsed by both the Perinatal Emergency Transport Co-ordinating Committee and the Medical Retrieval Committee of the NSW Ambulance Service; and then promulgated as NSW Health Department Circular 93/107: Guidelines for Medical Helipads dated 15 December, 1993.

2.5.2 NSW Health Circular 98/61 – later called *NSW Health Policy Directive PD2005_2008.*

A few years later, the NSW Health Department "Medical Retrieval Unit" (MRU) convened an *ad hoc* committee of air medical chief pilots to review Circular 93/107. Their revised guidelines were endorsed by CASA and promulgated as NSW Health Department Circular 98/61 dated 13 July, 1998. Those guidelines were later re-designated as *NSW Health Policy Directive PD2005_128*. They re-iterated most of the key elements of *CAAP 92-2* and were considered to be the most relevant design criteria for any new Hospital HLS until very recently.

2.5.3 Revision 03 -- DRAFT POLICY DIRECTIVE -- NSW HEALTH DEPARTMENT -- GUIDELINES FOR HOSPITAL HELICOPTER LANDING SITES IN NSW (late 2010)

When commissioning the new landing site at Liverpool Hospital in late 2010, we became aware of the existence of a new draft policy directive apparently intended to replace *PD 2005_128*. At the time of writing, a final version of the latest document has not been promulgated on the NSW Health website – and *PD2005_128* remains there as the current guideline. Nonetheless the NSW Ambulance Service Medical Retrieval Unit (coordination point for air medical helicopter operations in NSW) appears to regard the new draft guidelines as the *de facto* standard for NSW Hospital Helicopter Landing Sites.

The newest Health guideline for hospital landing sites departs significantly from the previous version and is based upon International Civil Aviation Organization (ICAO) Technical Annex 14, Volume 2 (Heliports) in respect of load-bearing capacity; and upon *Chapter 4 – Hospital Heliports* – of the US *Federal Aviation Administration Advisory Circular AC 150/5390-2B* (known as the FAA Heliport Design AC – described in more detail below) in respect of clear groundspace, airspace, lighting, markings and ancillary safety features. This is in line with the recent tendency to regard CAAP 92-2[1] as no more than a pilot's guide to assessing landing sites – but is in contrast to the Victorian and Queensland health authorities who have adopted hospital heliport design criteria based upon *ICAO Annex 14, Volume 2* (described below in more detail) in respect of clear airspace and groundspace and minimum size requirements as well as load-bearing capacity.

2.5.4 Operator policy.

The Chief Pilots of the helicopter services most likely to use the HLS set the safety standards for their respective operations, answer to CASA for those standards, and provide guidance to their line pilots in the exercise of those pilots' ultimate command responsibility under Regulation 92. If a particular site is deficient in respect of the design criteria recommended by those Chief Pilots, then it is unlikely that individual line pilots will be prepared to take off and land at that site.

2.6 Other Relevant Design Criteria

We have considered the following additional reference material in providing our preliminary design advice:-

2.6.1 Building Code of Australia

The Building Code of Australia (BCA) does not have any specific design criteria for structural HLS. Indeed, some provisions of the BCA may be at odds with safe heliport design features (eg. BCA purports to require safety railings, etc. around elevated structures which would, on an elevated HLS, impinge the obstacle-free surfaces required for safe manoeuvring).

2.6.2 Victorian Department of Human Services (Capital Management Branch), Capital Development Guidelines:- 6.7 Air Ambulance Helipads

The Victorian air ambulance helipad guidelines concentrate on measures to protect the airspace around hospital helipads. Structural issues, fire protection and marking issues are dealt with very generally. The Victorian guidelines purport to be based upon ICAO Annex 14, Volume 2 – Heliports.

2.6.3 **US Federal Aviation Administration (FAA)** ***Heliport Design Advisory Circular 150/5390-2B*** **dated 30 September, 2004.**

The FAA Design Guide is more comprehensive than the Australian CAAP 92-2(1). Of particular interest is Chapter 4, "Hospital Heliports". The FAA AC (like CAAP 92-2) does not have the force of federal law; however it is widely incorporated by reference into state heliport licensing laws across the US; and thus has a significant impact on heliport design. As mentioned above, Chapter 4 of the FAA Heliport Design AC is cited as the appropriate design standard in the NSW Health Department's Draft Policy Directive for hospital HLS.

Just over a month ago, the US FAA released a more recent draft Heliport Design Advisory Circular 150/5390-2**C** for comment. If the final form of that new iteration follows the current draft, then there will be significant changes to Chapter 4. It is not clear whether the NSW Health Department Policy Directive will be ultimately referenced to the Hospital Heliport Chapter of the FAA Heliport Design Advisory Circular as amended from time-to-time – or if the particular criteria from iteration -2B will remain crystallized until the NSW Health Policy Directive is eventually reviewed again.

2.6.4 Helicopter Association International Heliport Design Guide (1999 edition).

"Section 1 – Needs Assessment" provides a useful and comprehensive outline of considerations in planning an HLS. Because of the widespread use of Defense and National Guard helicopters in disaster relief operations in the USA, the HAI Heliport Design Guide recommends that the Army UH-60 Blackhawk should be the design helicopter for hospital heliports in that country.

2.6.5 Structural Design Guidelines for Heliports (Report Number AD-A1498967 – also referred to as Report Number DOT/FAA/PM-84-23); Schwartz, Witczak & Leahy (Department of Civil Engineering, University of Maryland), October, 1984.

Sponsored by the US FAA, referred to in Chapter 4 of the FAA Heliport Design Guide, and formerly incorporated into the Helicopter Association International's Heliport Design Guide, this paper analysed loads on heliport structures caused by hard landings, rotor downwash and helicopter vibrations; and proposed a model for structural design. It is now significantly dated – but it remains a most comprehensive reference on the subject.

2.6.6 Louisiana Department of Transportation and Development, Louisiana Hospital Heliport Study; Volume 1: Development Guide (April, 1982) and Volume 2: Hospital Facilities Study (May, 1984)

Formerly incorporated into the Helicopter Association International's Heliport Design Guide, this comprehensive document addressing hospital heliport issues refers extensively to now obsolete editions of the FAA Heliport Design Advisory Circular and NFPA Standard 418.

2.6.7 FAA Vertiport Design Advisory Circular 150/5390-3 dated 31 May, 1991

In anticipation of the development of "civil tilt-rotor" (CTR) aircraft, the FAA produced a preliminary Vertiport Design Advisory Circular to provide guidance in the planning of facilities which would be used by both helicopters and CTR aircraft. The Circular offers the only guidance currently available on the design of ground facilities for these new aircraft. However, the Civil Tiltrotor Development Advisory Committee Report to Congress, Volume 2 - Technical Supplement (December 1995) noted that an increased understanding of CTR capabilities since 1991 indicates the need to update this design advisory circular. A heliport/vertiport working group has been formed to revise both advisory circulars – and the matter is also under consideration by an ICAO working group.

2.6.8 International Civil Aviation Organisation (ICAO) Technical Annex 14, Volume II - Heliports

"Technical Annexes" to the Chicago Convention, 1944 contain the ICAO "Standards" and "Recommend Practices". As a signatory to the Chicago Convention and a member state of ICAO, Australia has a treaty obligation to implement ICAO "Standards" to the greatest extent practicable; and to notify ICAO of any differences between its regulations and ICAO "standards". The most recent iteration of this document came into effect in November 2009. Issues relating to heliport lighting and marking are still being resolved and it is anticipated that a further revision to the technical annex will be released before long.

Australian *AIP SUPPLEMENT (SUP) H12/11 dated May 11 - DIFFERENCES FROM ICAO STANDARDS, RECOMMENDED PRACTICES AND PROCEDURES* – includes the following statement in relation to Technical Annex 14, Volume 2 (2d edition, A/L 4):-

> "Australia does not regulate the design and operation of heliports in Australia. If the owner/ operator of a heliport intends to develop and operate a heliport for the purpose of **regular public transport or charter operations**, (emphasis ours) they are referred to the ICAO Standards and Recommended Practices set out in Annex 14 Volume II."

2.6.9 ICAO Heliport Manual (3rd Ed, 1995)

The Heliport Manual is an advisory publication explaining and expanding upon ICAO Technical Annex 14. It contains considerably more detail than CAAP 92-2(1) and includes structural design guidance for elevated heliports and helipads, but does not have a separate chapter devoted to hospital heliports. (This document will be re-written to reflect the changes incorporated in Technical Annex 14 – Volume II – when finalized.)

2.6.10 US National Fire Protection Association (NFPA) Standard 418 – 2006:- Standard for Heliports

This document contains fire protection standards for heliports including roof top heliports. NFPA standards are widely adopted throughout the USA and in many overseas jurisdictions. In some respects the NFPA fire code differs from the fire protection recommendations contained in the ICAO Heliport Manual.

2.6.11 International Building Code 2003; International Code Council

Section 1611A.10 of this code includes a structural standard for rooftop heliports based upon the recommendations of the US FAA.

2.6.12 CAP 437 Offshore Helicopter Landing Areas - Guidance on Standards; UK CAA

This reference details the assumptions involved in calculating "heavy landing loads" and "emergency landing loads".

2.6.13 OFFSHORE TECHNOLOGY REPORT 2001/072: - Helipad structural requirements; PAFA Consulting Engineers for the Health and Safety Executive; UKOOA

This reference contains a useful literature review regarding the assessment of structural loads for elevated heliports.

2.7 Facility Design Summary

There are no licences, certifications, registrations or other site-specific approvals required from CASA for the proposed HLS.

Revision 03 - DRAFT POLICY DIRECTIVE - NSW HEALTH DEPARTMENT - GUIDELINES FOR HOSPITAL HELICOPTER LANDING SITES IN NSW (prepared late 2010) contains useful and relevant material for the hospital HLS design process in NSW – and draws from both ICAO Annex 14, Volume 2 and

Chapter 4 of the FAA Heliport Design AC. There is no single standard or published specification which addresses all matters that need to be considered in the design and development of an elevated HLS.

Standards, Guidelines and Advisory Publications notwithstanding, it is consistent with the widely-accepted concept of "evidence-based" design as applied to hospitals, that hospital helipads should also be designed with a cognisance of the safety data available.

Several years ago the US Federal Aviation Administration commissioned a series of studies into accidents on heliports over a 30-year period comprising hundreds of incidents.

They were hoping to identify the extent to which heliport design features contributed to helicopter accidents on the particular facility. The results of these studies were published in 1991-2 under the respective titles:- "Analysis of Helicopter Mishaps at Heliports, Airports and Unimproved Sites" (DOT/FAA/RD-90/8) and "Composite Profiles of Helicopter Mishaps at Heliports and Airports" (DOT/FAA/RD-91/1).

The upshot of these reports is that collision with obstacles has been and remains the most common type of helicopter accident occurring on a heliport. As a result of these findings the FAA changed their criteria controlling the height of light fixtures and similar items of essential equipment installed on any particular heliport.

We strongly recommend that no significant obstacles be permitted within the manoeuvring area and urge careful planning in the location of lighting, exit signs, fire extinguishers, water hydrants, etc. to ensure those necessary features are positioned so as not to contribute to the risk of an obstacle-strike.

In a separate study during the 1990's, the FAA determined that the shape of the helipad, its markings and its lighting array affected the accuracy with which pilots flew their approaches. **It was clearly established in that study that helipads and lighting arrays with straight sides and sharp angles provided better visual cues to pilots compared with circular or elliptical helipads.** Prior to that study, the FAA depicted heliports as circular in shape; since that study heliports have been depicted as square or rectangular in American design advisory materials. **<u>We strongly urge that hospital helipads in NSW should be square or rectangular in shape.</u>**

3. Preliminary Design Issues

Not all hospital heliports are created equal. Before advancing the proposed HLS design, it is necessary to consider a range of preliminary issues that will define the project. To decrease the risk of premature obsolescence, both future technology and evolution of operating rules must be considered in the project definition. The fundamental aim is to make the hospital directly-accessible to air medical service providers under the widest range of operating conditions – and for as long as possible.

3.1 Heliport or Vertiport?

Whether the new facilities should make provision now to accommodate a future category of aircraft likely to be used in air medical operations—the "Civil Tilt Rotor" (CTR) -- or whether to retain the capacity to upgrade the site for that purpose in future, should be seriously considered.

3.1.1 CTR -- Background

A new type of vertical take-off and landing (VTOL) aircraft—the tilt-rotor—is under development. Tilt-rotor aircraft can take off and land like a helicopter and then transition to aeroplane mode for high altitude, high speed cruise en route. Landing sites that are able to accommodate CTR's as well as helicopters are called "vertiports". (See Figure 2 below.)

Tilt-rotor research started in the 1950's. By the late 1980's, the concept had matured to the point where the US Marine Corps contracted with Bell and Boeing for the development and manufacture of a such an aircraft to be called the V-22 "Osprey". That aircraft was developed and delivered to the USMC for operational deployment in the late 1990's.

Following a fatal accident in December, 2000, the Marine Corps grounded its fleet of Osprey's for 18 months pending a design re-evaluation. Modifications were made to the aircraft design, and test flying commenced in late May, 2002. Eventually the Osprey re-entered service and has now been fully operational for over a year.

In 1991 the US FAA produced a "Vertiport Design Advisory Circular" to assist planners in the development of ground facilities for existing VTOL aircraft (eg. helicopters and tilt-rotor aircraft) as well as for future VTOL aircraft (eg. tilt-wing and fan-in-wing aircraft). That design guide is currently being revised in light of actual flight experience with military tilt-rotor aircraft.

In November, 1996, Bell Helicopter Textron and the Boeing Co. announced a commercial joint venture to produce a "Civil Tilt-Rotor" (CTR) aircraft to be called the BB-609. The announcement stated that the aircraft would be a six- to nine passenger CTR and would be designed primarily for executive transport, natural resource exploration, emergency medical evacuation, governmental support roles and disaster relief.

For a time, Italian helicopter manufacturer Agusta Aerospace took over Boeing's interest in the project and the aircraft was known as the BA-609. About 3 or 4 years ago, Agusta withdrew from the project and the aircraft is now being developed by Bell alone.

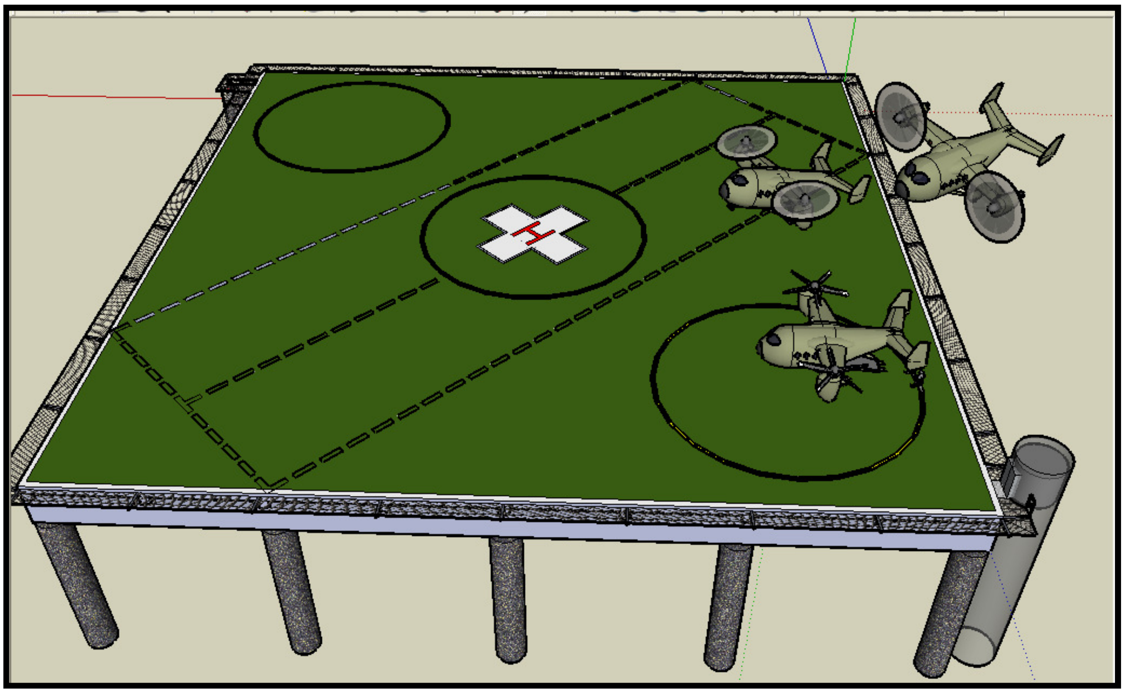


Figure 2 -- Tiltrotor aircraft operating from a vertiport

CTR -- Discussion

The B-609 in air medical operations is expected to provide hospital-to-hospital capability at fixed-wing air ambulance speeds between the most distant hospitals in NSW without re-fuelling. However, type-certification criteria for tilt-rotor aircraft have not yet been settled and it is not clear how the vertiport criteria may change.

The 1991 version of the US vertiport design guide recommends a minimum-size Final Approach and Take Off Area (FATO) of 75 metres square. The guide recommends, for elevated public-use facilities, a full-size load-bearing FATO. For private-use vertiports or vertistops, the guide suggests that portions of the FATO may extend into unobstructed airspace beyond the edge of the building or platform.

Any revised vertiport design guide may call for an even larger FATO than the 1991 edition recommended. It seems likely that the CTR will require more space to operate than existing helicopters require.

Despite the great promise which this very capable aircraft offers, it is consultants' opinion that the CTR will not completely replace air medical helicopters—particularly over stage lengths less than 100 nm. If anything, consultants believe the CTR is more likely to replace conventional fixed-wing air ambulances in retrieval work over distances between 100 nm and 400 nm.

It is obviously important for regional hospitals to be able to transport patients in or out by all transport modes serving that region. The status of the CTR and vertiport design criteria should therefore be monitored and reconsidered at any time in future where proposed development might impinge approach paths or restrict expansion of the proposed hospital HLS. However, there remains a degree of uncertainty about the prospects for introduction of the CTR into air medical service in NSW in the near term.

3.1.2 CTR -- Recommendation

At this point in time, consultants do not believe sufficient information is available to be able to design the proposed hospital HLS as a vertiport specifically to accommodate CTR's or other future vertical flight aircraft.

If possible, the any proposed facility should be designed with a view to future modular expansion of the helipad – should CTR's be introduced into the air medical transport role in NSW.

Development in the neighbourhood should be monitored, and any necessary steps should be taken to protect flight paths from encroachment.

3.2 Performance Class One, Two or Three?

Under the heading "5.3 Performance" the draft NSW Health HLS Guidelines say:-

"The current HEMS helicopters under contract in the Sydney Basin area, the Agusta AW139 and the Eurocopter EC145, are capable of operating to Performance Class 1. Whenever operationally possible HEMS helicopters are to meet Performance Class 1 requirements.

HEMS helicopters under contract outside of the Sydney Basin do not currently meet Performance Class 1 requirements, however it is anticipated that future HEMS rotorcraft contracts in NSW will align with the Sydney Basin requirements.

Future CASA regulatory requirements are anticipated to require the use of Performance Class 1 helicopters in particular urban environments and roof tops."

Additionally, CAAP 92-2, at Pp. 3-4 under the heading "Factors that should be considered prior to using an HLS", provides:

"The pilot of a helicopter operating to, from or at an HLS should ensure that:

. . . where a helicopter may be required to be operated with a rejected take off or landing capability, and the performance requirements of the particular flight manual detail greater or additional requirements concerning the FATO, GEA, LLA or the approach and departure paths than those set out in these guidelines, then the greater and/or additional requirements should be met."

Thus, an important preliminary design consideration for a new hospital HLS is whether to accommodate Performance Class One (PC1) or Two (PC2) operations by existing and future air medical helicopters.

3.2.1 PC1 & 2 – Background

Currently, air ambulance operations in Australia are conducted in the "aerial work" category. Under existing rules, single- or multi-engine helicopters which are not operated with a rejected take off or landing capability can be used (i.e. PC1, 2 or 3 permitted). However, the existing rules are being re-written.

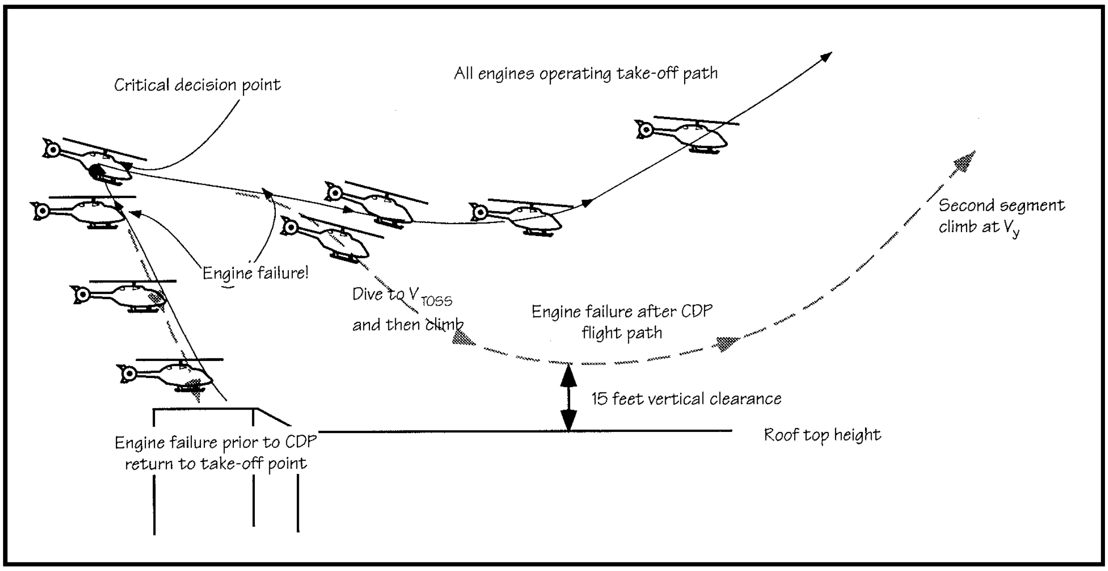
Some jurisdictions are moving in the direction of full, one-engine inoperative "accountability" in all air transport operations. That is to say, multi-engine aircraft are required which have the capability—in the event of an engine failure at any point in the flight—of continuing to a safe landing at a suitable prepared site using the remaining engine(s). That is called Performance Class One (PC1).

Other jurisdictions are moving in the direction of one-engine inoperative accountability except for a short "window" during the takeoff where it can be shown the chances of a failure within the "window" are statistically-remote. That is called PC2. It appears PC2 will be the performance standard required for future Australian air medical operations.

Technically, Category A and Category B refers to the helicopter certification; and PC1, 2 and 3 refer to helicopter performance standards. PC1 and 2 require a helicopter certified under "Category A" (Cat-A). PC3 operations may be conducted with helicopters certified under Cat-A or B. Sometimes the terminology is used loosely.

In achieving their performance objective, helicopter manufacturers employ a variety of strategies, to include prescribed flight profiles (See Figure 3 below for an example), and (in some cases) setting minimum heliport dimensions for Cat-A/PC1&2 operations which may exceed the dimensional requirements for other (i.e. Cat-B/PC3) operations.

Figure 3 – Illustration of PC1 or Category A departure from elevated helipad.



Draft CASR Part 133 (as it now stands) says:-

> *"133.TC – EMERGENCY and MEDICAL SERVICES . . . . .*
>
> *TC.2 Performance requirements*
>
> *A. Rotorcraft conducting EMS operations shall as far as possible be operated in accordance with performance class 2 procedures. The pilot shall make every reasonable effort to minimise the period during which there would be danger to rotorcraft occupants and persons on the surface in the event of failure of a power unit. . . . ."*

3.2.2 Cat-A/PC1& 2 – Discussion

The language above suggests on its face that helicopters utilising the proposed hospital HLS will not be required to operate under Cat-A (PC1) in the near term. PC2 will probably be required, however final rule-making is still a little way off.

When the regulatory reform program first kicked off – it was mooted that inter-hospital flights should be treated as public transport flights. If that philosophy is enacted into law, it would follow that at least some air medical operations would be required to meet PC1 requirements at hospital helipads.

In Europe, most jurisdictions treat "HEMS" ("helicopter emergency medical services" -- meaning scene flights) differently to "Air Ambulance" (meaning inter-hospital transport of the critically-ill). In those jurisdictions HEMS operations are regulated similar to "aerial work" in Australia; while Air Ambulance flights are regulated as "public transport".

Hospital helipads in Australia must necessarily accommodate both HEMS and Air Ambulance operations. We cannot foresee exactly how the rules will be re-written. We can only advise that – if new hospital HLS are designed without regard to Cat-A/PC1 requirements – then there is a risk of that facility being made prematurely obsolete by an adverse rule change. If they are designed to accommodate Cat-A/PC1 – then by necessary implication they will accommodate PC2 and 3 operations.

The following table includes existing and future helicopter types:-

- that have been or will be certified to Cat-A/PC1; and
- are now being used, or are considered likely in the future to be used, in air medical operations in NSW and Victoria.

Where it is available, we have shown the minimum flight manual HLS dimensions for Category A/PC1 (vertical) operations:-

<table>
<tr><th colspan="2"><u>Helicopter Type</u></th><th><u>Operated by:</u></th><th><u>HLS size for Cat-A/PC1</u></th></tr>
<tr><td colspan="2">Eurocopter BK-117B2</td><td>Sydney Lifesaver and Hunter Westpac Rescue</td><td>20m x 20m</td></tr>
<tr><td colspan="2">Eurocopter AS365N2</td><td>Child Flight; VicPol</td><td>25m x 25m</td></tr>
<tr><td colspan="2">Agusta A109E</td><td>CareFlight</td><td>Elevated – 15m x 15m
Ground level – 20m x 20m</td></tr>
<tr><td colspan="2">Agusta AW139</td><td>CHC Bankstown & Wollongong</td><td>15m x 15m</td></tr>
<tr><td rowspan="4">Bell BH412</td><td>"Classic"</td><td>Southcare</td><td>Not certified for Cat-A heliport procedures – requires a runway</td></tr>
<tr><td>SP&HP (B-series engines)</td><td>Hunter Westpac Rescue (current)</td><td>46m x 22m – 2 pilots</td></tr>
<tr><td rowspan="2">HP&EP (D-series engines)</td><td rowspan="2">Child Flight; Hunter Westpac Rescue (future)</td><td>Elevated 18.3m x 18.3m – 2 pilots*</td></tr>
<tr><td>Ground-level 25.9m x 22.9m – 1 pilot**</td></tr>
<tr><td colspan="2">Eurocopter EC 135</td><td>NSW Police</td><td>20m x 20m</td></tr>
<tr><td colspan="2">Eurocopter EC 145/BK117C2</td><td>CHC Bankstown & Orange</td><td>20m x 20m or 20m Diameter</td></tr>
</table>

Eurocopter EC 155		None currently in air medical use in Australia – becoming common in other countries. (May be operated by CHC at Orange soon.)	Ground-level 21.6m Diameter
Sikorsky S76	B, C & C+	Future use possible.	Tentatively – 24m Diameter

Notes: * This procedure requires 2 pilots and is designed for elevated oil platforms where there is a "drop-down" capability. It is unlikely this procedure could be used at an elevated hospital HLS. In any event, most existing air medical operators are single-pilot operations.

** This procedure was originally certified for surface-level, single-pilot (1P) operations – however we understand the "surface-level" restriction has been removed and that BH412EP's will be able to operate 1P to a 25.9m x 22.9m elevated HLS under Cat-A/PC1.

It will be seen from the table that a load-bearing helipad with minimum 27m x 27m dimensions will be suitable for Cat-A/PC1 operations by all of the civil helicopters for which Cat-A heliport procedures are published – EXCEPT the older-model Bell 412 HP models (B-series engines only).

Designing for Cat-A/PC1 by the Bell 412HP would require extending the load-bearing helipad to 46 metres along the axis of the approach and departure path.

3.2.3 Cat-A/PC1 Summary and Conclusions

The possibility of a rule-change mandating Cat-A/PC1 procedures at hospital HLS exists – although we cannot say that it is more likely than not. Even if not mandated by air safety regulations, some operators may choose to operate to Cat-A/PC1 standards to enhance safety. PC2 is likely to be required.

If the load-bearing helipad is at least 27m x 27m, then most of those helicopters of the existing and future air medical fleet certified for Cat-A/PC1 and 2 will be able to operate to that standard at the proposed facility – except the Bell 412HP with B-series engines.

If such a rule change comes into effect, all single-engine helicopters, all multi-engine helicopters not certified for Cat-A heliport (or vertical) procedures (e.g. Sikorsky S-76A and Bell 412 "Classic & SP-models), and the standard Bell 412HP will be excluded from operating from a 27m x 27m load-bearing helipad.

Accommodating Cat-A/PC1 by the Bell 412HP (B-series engines) requires more than a 75% increase in deck area over that required for Bell 412EP and upgraded HP models (fitted with D-series engines) and is not supported.

Since a significant number of air medical helicopter types would still be able to operate to a 27m x 27m load-bearing helipad even if PC1 were mandated for air ambulance operations, we are satisfied that such a facility would not become obsolete for that reason. Air medical transport to and from the new Wagga Wagga Hospital would be affected – but not entirely frustrated. It is likely that the Southcare Bell 412 "Classic" operating in Canberra and southern NSW would be upgraded to a Bell 412EP if the rule change occurred.

3.3 VFR, IFR (non-precision) or IFR (precision) Heliport?

3.3.1 VFR/IFR Background

The Standard HLS criteria in CAAP 92-2 is expressed to be applicable only to Day and Night Visual Flight Rules (VFR) operations. There are no guidelines currently published in Australia for HLS to be used under the Instrument Flight Rules (IFR). However, both the US FAA Heliport Design Advisory Circular and the ICAO Heliport Manual contain airspace, lighting and marking requirements for IFR heliports—with different criteria applicable to precision and non-precision approaches.

Precision approaches require both horizontal track guidance and vertical flight path guidance – and are generally aligned with a runway. Where only track guidance is available, "non-precision" approaches can be flown. The weather minima (ceiling and visibility) are inevitably higher for a non-precision approach.

Recently, "Global Positioning Systems" (GPS) that determine position by reference to satellites in geostationary orbit have come into widespread use. GPS navigation systems do not require signals from ground-based navaids, and have been approved for use in "non-precision" instrument approaches – such as at Westmead Hospital, Lithgow Hospital, Wollongong Hospital, and Gosford Hospital. Eventually, precision approaches using "augmented" GPS signals will be approved in Australia – but this may be several years away.

One of the fundamental choices to be made in project definition, bearing in mind the need to maximise availability irrespective of weather, is whether the proposed new HLS should be designed in accordance with ICAO's lighting, marking and airspace requirements for an instrument heliport.

However, the current ICAO standards for non-precision instrument heliports require an approach lighting array 210 metres long. There simply is not sufficient space for such an approach lighting array on either of the campuses.

The obstacle-free surfaces required for an instrument heliport are onerous.

The relevant ICAO lighting and marking standards are currently under review, and may be amended shortly to provide for alternate, self-contained approach lighting systems on elevated HLS. Developments on this front should be monitored. In the meantime, designing an instrument heliport at Wagga Wagga Base Hospital is impractical.

Instrument approach procedures can still be conducted on the basis of instrument flight to a point-in-space followed by visual flight from that point-in-space to a landing at the hospital HLS – albeit with higher cloud ceilings and greater visibility.

3.3.2 VFR/IFR Recommendations

On the assumption that future ICAO guidelines for instrument heliports may be more achievable, we recommend that a mechanism be established so that future development within the Wagga Wagga Base Hospital campus will be assessed to determine whether it may limit existing or future instrument operations at the HLS.

We recommend that a mechanism be established to monitor development proposed within the vicinity of the hospital and subjacent to the flight paths (including "missed-approach" tracks) so that representations may be made to prevent any development that might adversely impact the use of IFR procedures at those hospital HLS.

3.4 Should the HLS be designed to accommodate Australian Defence Force (ADF) Helicopters (major disaster scenario)?

The HAI Heliport Development Guide (at Section 1 – in relation to hospital heliport design in the USA) states:- ". . . The additional cost to allow for the growth possibilities in the original site selection, design and construction is very small as compared to total replacement. A helicopter such as the **Sikorsky S-70 (military UH-60)** is often times a design aircraft for hospitals, as it is often used by the U.S. Army and National Guard during emergencies. **Thus, where practical, hospital heliports should be designed for this helicopter. . .**" (Emphasis ours.)

3.4.1 ADF Helicopters -- Background

During the Sydney Olympics, and again during the 2003 Rugby World Cup, Australian Army UH-60L (S-70A-9) Blackhawks were despatched to Sydney for counter-terrorist and counter-disaster activities. It was found that none of the elevated HLS at Sydney tertiary hospitals were capable of receiving S-70-class helicopters such as the Army Blackhawks and Navy (S-70B-2) Seahawks – despite the ADF resources being integral to the NSW counter-disaster plan.

3.4.2 ADF Helicopters -- Discussion

At the present time, the closest ADF helicopter base to Wagga Wagga is HMAS Albatross, the RAN air station near Nowra. A regiment of Army Blackhawks is also based at Holsworthy near Sydney. A similar-sized helicopter, the MRH-90, is has been ordered for the Australian Army and a small number have been delivered for developmental flying in Nowra and Townsville. Any of these ADF helicopter types could become involved in patient transport as part of its counter-disaster role.

The table below summarises key dimensions for ADF aircraft that might be called upon during counter-terrorist or counter-disaster operations:-

<table>
<tr><th colspan="2" rowspan="2">ADF Aircraft Type</th><th rowspan="2">Nearest Base</th><th colspan="6">Key Dimensions</th></tr>
<tr><th>Rotor Dia. (m)</th><th>Overall Length (m)</th><th>Wheel Base (m)</th><th>Tread (m)</th><th>Max. weight (kg)</th><th>Max. Fuel Capacity (l)</th></tr>
<tr><td rowspan="4">Army</td><td>UH-60L (S-70A-9) Blackhawk</td><td>Oakey & Holsworthy</td><td>16.36</td><td>19.76</td><td>9.14</td><td>2.97</td><td>9980</td><td>1375</td></tr>
<tr><td>MRH-90</td><td>Nowra</td><td>16.3</td><td>19.56</td><td>6.3</td><td>3.63</td><td>10,600</td><td></td></tr>
<tr><td>CH-47D Chinook</td><td>Townsville</td><td>15.83 (30.14*)</td><td>30.14</td><td>7.86</td><td>3.63</td><td>22,679</td><td>3891</td></tr>
<tr><td>(AS-350BA) Squirrel</td><td>HMAS Albatross NAS Nowra</td><td>10.69</td><td>12.99</td><td>1.43</td><td>2.1</td><td>2100</td><td>532</td></tr>
<tr><td rowspan="2">R.A.N.</td><td>(S-70B-2) Seahawk</td><td rowspan="2">Nowra</td><td>16.36</td><td>19.76</td><td>4.82</td><td>2.7</td><td>9927</td><td>2115</td></tr>
<tr><td>SK50 Sea King</td><td>18.9</td><td>22.15</td><td>7.16</td><td>3.97</td><td>9525</td><td>2994</td></tr>
</table>

Because Chinooks are based so far away from NSW, we consider it is highly unlikely those helicopters would be involved in any counter-disaster operations that would involve hospitals in the South West of NSW. Sea Kings are being phased out of the RAN inventory. Therefore we disregard the dimensions, weight and capacity associated with those types. The remaining helicopter types may be used in counter-disaster operations that would require a landing at Wagga Wagga Hospital. Such operations would not be "routine" air medical operations and would be infrequent.

Although ADF aircraft are subject to ATC clearances and the "rules of the road", most of the civil air safety regulations do not apply to their operation. Cat-A/PC1 issues discussed above are not relevant to ADF helicopter operations.

Details of precise ADF operating guidelines are not available to us. We are, however, assured by ADF officials that the obstacle-free and load-bearing areas they require for Blackhawk, Seahawk, and MRH-90 helicopters (and all smaller ADF helicopters) when operated during a civil emergency -- are no greater than those required for the Bell 412EP or AW139 designed to civil guidelines.

Application of critical dimensions, weights and capacities from the design helicopter to the heliport design will be detailed below. It will be shown that three of the four ADF helicopter types mentioned above are larger and heavier than the largest civil helicopter likely to use the site. Nonetheless it will not be necessary to apply all of the civil design parameters to these helicopter types.

The obstacle-free and load-bearing areas that we will recommend with respect to the "civil" design helicopter will provide sufficient area for emergency-use by ADF helicopters, i.e. no increase in space will be required to accommodate ADF landings in civil emergencies. On the other hand, accommodation for those ADF types may require an increase in the structural load-bearing capacity of the helipad.

We can provide the raw data and performance objectives – but we are not capable of making structural calculations. As will be detailed below, a number of helipad loading scenarios must be calculated in order to determine the critical design load. For civil purposes, this includes both a "hard landing load" and an "emergency landing load" by the largest (heaviest) helicopter likely to use the site.

Because of the infrequency of likely use, we will recommend that only the "hard landing load" be considered in respect of the ADF helicopters. We do not know at this stage whether the allowance for "hard landings" by the larger ADF helicopters will exceed the structural provisions required to accommodate "emergency-landings" by civil helicopters – but we expect the load-bearing values to be very similar.

3.4.3 ADF Helicopters – Summary of Recommendations

The new Wagga Wagga Base Hospital HLS should be designed to accommodate ADF helicopters that are likely to have a counter-disaster role. This includes Army Blackhawks and MRH-90's and Navy Seahawks as well as smaller ADF helicopters based at Holsworthy or Nowra.

Planning to accommodate ADF helicopter types should proceed on the basis of their being used in emergency circumstances. Under that operating scenario, use of ADF helicopters will not increase the obstacle-free areas required by civil helicopters during routine air medical operations -- and are not expect to increase the load-bearing requirement significantly, if at all.

In calculating the critical load for structural design purposes, the "emergency landing load" need not be applied to the ADF helicopters.

3.5 Should the HLS incorporate a "parking position" to allow simultaneous use by two helicopters?

3.5.1 Parking Position -- Background

With medically-staffed helicopters, patients brought into or sent out of a health-care facility are normally "handed-over" inside the hospital – either in the emergency department (ED), intensive care unit (ICU) or at some dedicated point near the HLS where monitoring equipment, etc. belonging to the transport team can be installed or removed, where there are sufficient patient-handling attendants to transfer from the helicopter stretcher to a hospital bed or vice versa, and where patient details, history, etc. can be related to the succeeding medical team.

Although, given adequate training for hospital staff, it may be possible to "hot load" or "hot unload", normally the helicopter shuts down and stops the rotors prior to the patient being removed from or loaded onto the helicopter. The helicopter remains on the HLS during handover.

This process typically takes between 25 and 50 minutes. If the helipad at the receiving facility does not have a load-bearing area adjacent to the movement area for "parking" – then the HLS is effectively closed to any inbound flights until the first helicopter vacates the HLS – to the obvious detriment of the second patient(s).

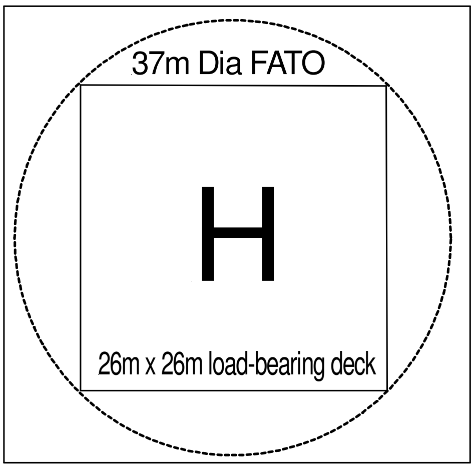
Alternatively, all inbound helicopters could "hot unload" immediately upon arrival, and then depart again as soon as the patient is off-loaded – either circling or re-positioning to some other HLS or airport nearby to shut-down.

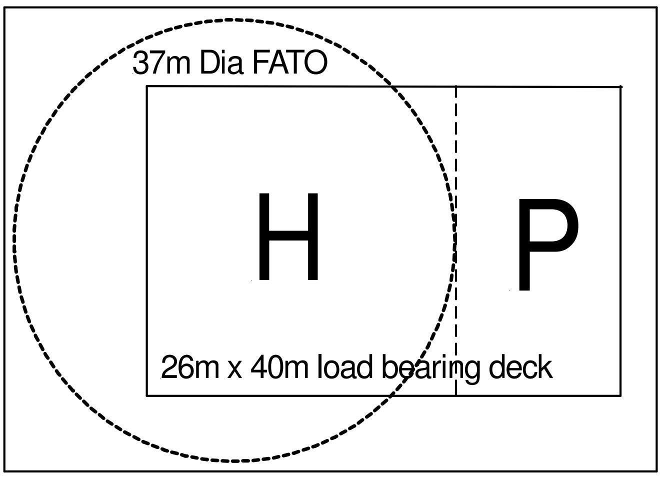
Another alternative is for helicopters to shut down for patient unloading and then start up immediately and either circle, or re-position, as above. In either case, the helicopter could then return to the HLS when the retrieval team is ready for pick-up – or the retrieval team could make their way by ground transport to some other HLS. The following factors must be considered in balancing cost and convenience:-

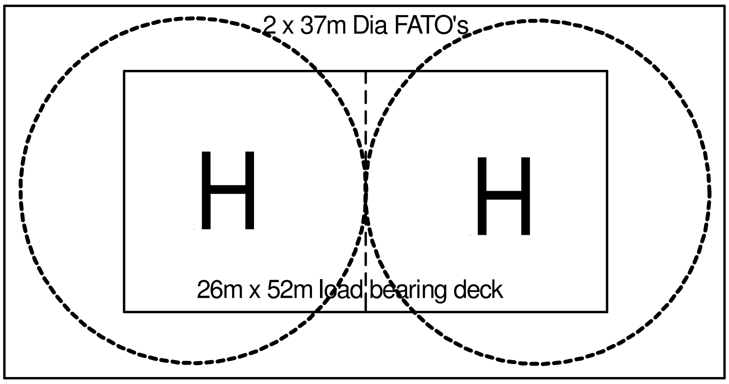
- "Hot" loading and unloading involves working in close proximity to high-RPM (hence nearly invisible) rotor blades in a high-noise environment necessitating communications by hand signals. It requires extensive training for all staff members who might possibly be called upon to assist at any time – and even then it is inherently risky compared to loading and unloading with rotors stopped.
- "Double movements" impose at least twice the environmental cost (noise impact) for the same community benefit (patient transfer).
- "Double-movements" are costly in terms of extra hours flown and in terms of associated maintenance costs for helicopter operators. Many helicopter engine components have a retirement life based upon either operating hours or start cycles – whichever limit is reached first. If frequent short flights are required, the cycle limit will be reached first and the components will have to be retired with relatively few hours accrued. In the short term this may be the operator's problem – but in the long term the cost will be borne by the public health system.

3.5.2 Parking Position -- Discussion

Provision of a "parking position" for a second helicopter does not require a doubling of the size of the load-bearing area unless it is intended that both helicopters will be operating with rotors turning simultaneously. A 14-metre load-bearing extension (i.e. 27m x 40m rather than 27m x 27m) to the helipad would be sufficient – provided the opposite side of the HLS is clear of obstacles. See illustrations below.







3.5.3 Parking Position -- Recommendation

Extension of the load-bearing surface to incorporate a "parking position" at Wagga Wagga Hospital that is clear of the Final Approach and Take-Off Area of the HLS may not be justified for regional facilities. However, any changes in projected utilisation of the sites should be considered before reaching a final decision.

If possible (as with the issue of future civil tiltrotor aircraft) the proposed facility should be designed with a view to future modular expansion of the load-bearing helipad – should a parking place (or additional parking places) be needed.

4. Recommended Design Features For Wagga Wagga Base Hospital HLS

4.1 Determining the "Design Helicopter" and Critical HLS Dimensions

4.1.1 Design Helicopter – CAAP 92-2 and Health PD 2005_128 Discussion

CAAP 92-2 describes a "Standard HLS" as comprising, at least:-

- Final Approach and Take-Off Area (FATO) = 2 x Overall Length (rotors turning)
- Ground Effect Area (GEA) = Main Rotor Diameter
- Landing and Lift-Off Area (LLA) = Undercarriage dimensions plus 1 metre on all sides
- Approach and Departure Paths = FATO width widening at 10^{o} splay to 4 x rotor diameter with 7.5^{o} obstacle-free gradient

Each feature of a Standard HLS (described in more detail below) is a function of particular helicopter dimensions. Where more than one type of helicopter will use a site, the "design helicopter" will be a composite of the critical dimensions of all types using the site.

The authors of Health Circular 98/61 (PD2005_128) - having regard to a composite design helicopter reflecting the critical dimensions of all civil helicopters in air medical use in NSW - recommended minimum dimensions for each element of an "hospital helipad" – consistent with CAAP 92-2 Standard HLS dimensions – as follows:-

FATO	–	37 m. Diameter
GEA	–	18.5 m. Diameter
LLA	–	9 m x 9 m
Flight Paths	–	37 m widening at 10^{o} splay

Note: Where Cat-A/PC1 procedures are required, the minimum helipad size specified in the rotorcraft flight manual (RFM) apply. Refer also to our earlier comments regarding accommodation for larger ADF helicopters.

Nothing in that document (or in CAAP 92-2) made it clear what should be the physical size of an elevated helipad – other than referring to the minimum heliport size for Cat A operations in the respective flight manuals. However it is generally assumed that for structural helipads – there should be a combined, load-bearing LLA/GEA.

4.1.2 Design Helicopter -- DRAFT POLICY DIRECTIVE -- NSW HEALTH DEPARTMENT -- GUIDELINES FOR HOSPITAL HELICOPTER LANDING SITES IN NSW Discussion

The latest iteration of the NSW Health guidelines suggests minimum values for all the components of a hospital HLS – but changes the terminology to reflect the American usage.

Under American and ICAO usage, the FATO must be 1.5 times the overall length but must be surrounded by a "safety area" of at least 0.3 times the rotor diameter. Instead of a GEA and LLA – American and ICAO usage refers to a "TLOF" (take-off and landing area). Those international concepts are adopted in the draft Health Policy Document intended to replace PD 2005_128.

Under that document, the AW139-type is recommended as the "design helicopter". The document recommends a 25m x 25m FATO, a 14m x 14m and a 4m "safety area".

Because of the different definitions or descriptions for identical terms -- great care must be exercised in discussing design standards from differing jurisdictions. For the most part – the physical characteristics of a FATO (or a combined FATO and safety area) are similar for a given design helicopter – irrespective of which design rules are chosen for a particular project. Similarly, a TLOF under the new Health policy document has the same dimensions as a GEA/LLA under PD 2005_128.

Despite the potential for great confusion with the myriad of different guidelines and the different terminology used therein – the final product should look very similar irrespective of which design regime is embraced for the design phase – provided the various components aren't "mixed-and-matched" for convenience.

4.1.3 Design Helicopter and Critical HLS Dimensions -- Summary

The AW139 – though the heaviest of all the civil helicopters used in air medical work – is not the largest in terms of rotor diameter and over-all length. The Bell 412 is slightly larger. There remain a number of Bell 412's in air medical service and they are likely to continue for some time. For that reason we recommend that the "design helicopter" be a composite of the AW139 (all-up-weight) and BH412 (overall length and rotor diameter).

We also believe that an elevated helipad requires greater than the minimum-sized TLOF (or combined load-bearing GEA/LLA) – especially since that size is inadequate to allow Category A/PC1 operations by many of the helicopters that might use it.

We consider that a minimum helipad (ie. TLOF or GEA/LLA) size of 27 m x 27 m is desirable for air medical operations to allow manoeuvring of trolleys around helicopters for patient loading and unloading; and for the attendance by medical personnel at the helipad upon the arrival of critical or unstable patients – as well as to allow Cat-A/PC1 operations by (nearly) all of the existing air medical helicopters (except the earlier Bell 412-variants).

Those HLS dimensions will, we have been advised, be adequate for ADF helicopters likely to be used in civil counter-disaster operations.

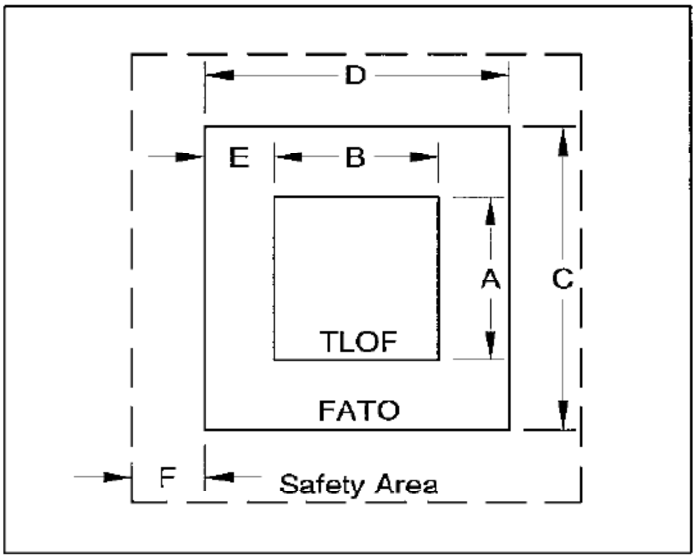
If a "parking position" is desired, then a rectangular helipad at least 27 m x 40 m is recommended. **However, we do not believe a parking position is essential – due to the availability of Duke of Kent Reserve to take "overflow" movements.**

4.2 HLS components under competing design criteria

4.2.1 Final Approach and Take Off Area (FATO) and Safety Area

Although the resulting obstacle-free manoeuvring area is similar under both formulae – the ICAO/FAA formulae are more prescriptive in relation to the height of essential equipment within the safety area – compared to CAAP 92-2 and Health PD 2005_128.

Specifically (under the FAA guidelines embraced by the draft NSW Health guidelines) there should be no obstacles within the FATO and obstacles within the safety area should be no higher than 20-25 cm at the edge of the FATO nor penetrate an incline from that height upward at a 5% slope.



Note: HLS may be square or round. Length and Width dimensions also relate to diameter if round.

Design Helicopter: Agusta AW139

RD: Rotor diameter of the design helicopter
OL: Overall length of the design helicopter

A – Min GEA/TLOF Width: 1.0 x RD (14 m.) (if round, diameter is 14 m.)
B – Min GEA/TLOF Length: 1.0 x RD (14 m.)
C – Min FATO Width: 1.5 x OL (25 m.)
D – Min FATO Length: 1.5x OL (25 m.)
E – Min separation between perimeters of the GEA/TLOF and FATO: 0.5(1.5 x OL – 1.0 x RD) (5.5 m.)
F – Min Safety Area Width: 0.3 x RD (4 m.)

Figure 3- Depiction reproduced from draft Health Policy Document -- Guidelines for Hospital HLS

4.2.2 Ground Effect Area (GEA) and Landing and Lift-Off Area (LLA) or Take-Off and Landing Area (TLOF)

Health Policy Document 2005_128 recommends an 18.5 metre diameter GEA and says:- "If on a building, the entire GEA should also be capable of accepting the static and dynamic loads involved." The draft NSW guideline rounds the AW139 rotor diameter down to a whole number and recommends a 14m x 14m TLOF. That dimension is insufficient, in our view, to accommodate the manoeuvring of trolleys around the helicopter for loading and unloading of patients – and is also insufficient to permit Cat-A/PC1 operations by several helicopters types. We have recommended a 27m x 27m TLOF.

If the surface of the TLOF will be concrete and it is necessary to seal the surface with membrane to make it waterproof, then we recommend that the surface be poured with a 9 m x 9 m x 10 cm recess located at the "aiming point" in the centre of the TLOF.

After the surface has been sealed then the recess should be filled level with concrete – creating an LLA for skid-equipped helicopters to touch down without damaging the sealing membrane.

Note: Some elevated HLS have "tie-down" provisions built into the helipad. This is probably a carry-over from practice on off-shore and marine helipads -- and we do not believe they are necessary for hospital HLS.

4.2.3 Flight Paths

CAAP 92-2 requires at least one flight path for all HLS which should start at the edge of the FATO and extend upward at a 8:1 gradient. The flight path is the same width as the FATO but expands at a 10^{o} splay to a width of four rotor diameters and to a height of 500 feet above HLS level. For the design helicopter, the final width is at least 58.8 metres.

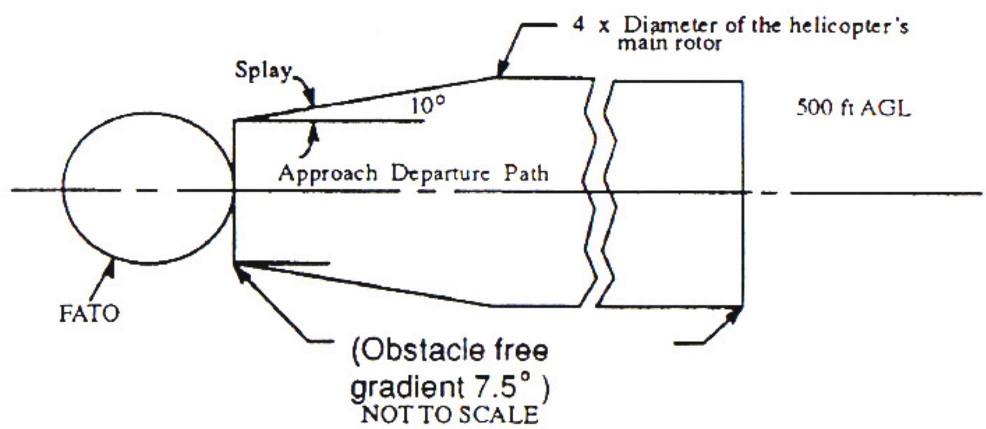
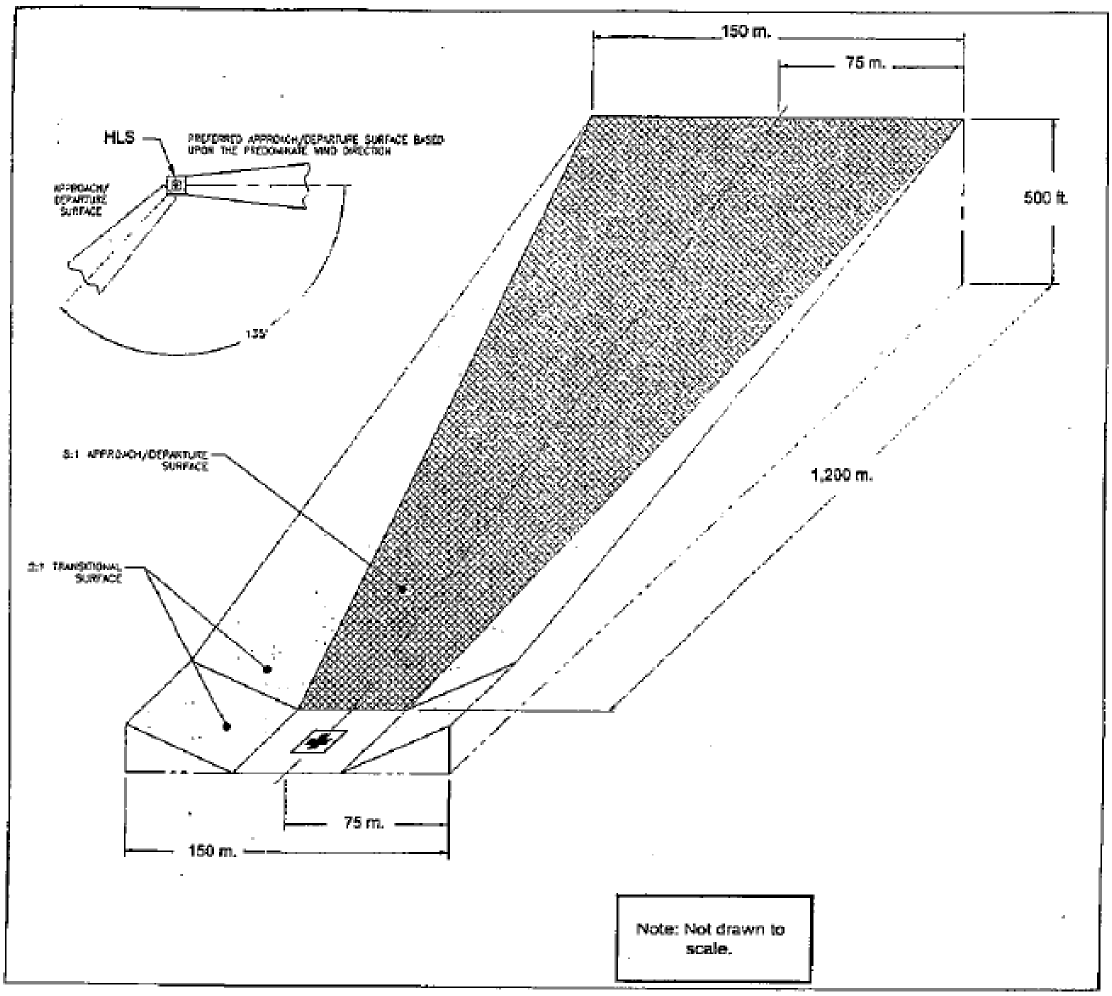


Figure 4 -- Previous criteria for flight paths under Health PD 2005_128.

The draft NSW Hospital HLS guidelines specify flight paths in accordance with the US FAA formulae – being a 1:8 slope (approx. 7.2^{o}) starting at the edge of the FATO and widening uniformly to a width of 150 metres coinciding with a height of 500 feet above the helipad level at a distance of 1200 metres horizontally. Additionally, transitional surfaces are required (in most cases) sloping upward from the FATO and/or the edge of the flight paths with a 1:2 slope as indicated in the diagram below.

"The approach/departure surface should be free of penetrations. Any penetration of the transitional surface should be considered a hazard."



Note:

1. Rotor diameter and weight limitation markings not shown for simplicity.

Figure 5 -- Flight Paths as depicted in draft Health Policy Document -- Guidelines for Hospital HLS

"The transitional surfaces need not be considered if the size of the approach/departure surface is increased for a distance of ~600 m. as shown in Figure [6]. The lateral extensions on each side of the 8:1 approach/departure surface starts at the width of the FATO and is increased so that at a distance of ~600 m. from the FATO, it is 30 m. wide. Penetrations of area A or area B, but not both, shown on Figure [6] by obstacles may be allowed providing the penetrations are marked or lit and not considered a hazard."

"When the standard surface is incompatible with the airspace available at the HLS site, no operations may be conducted unless helicopter performance data supports a capability to safely operate using an alternate approach departure surface."

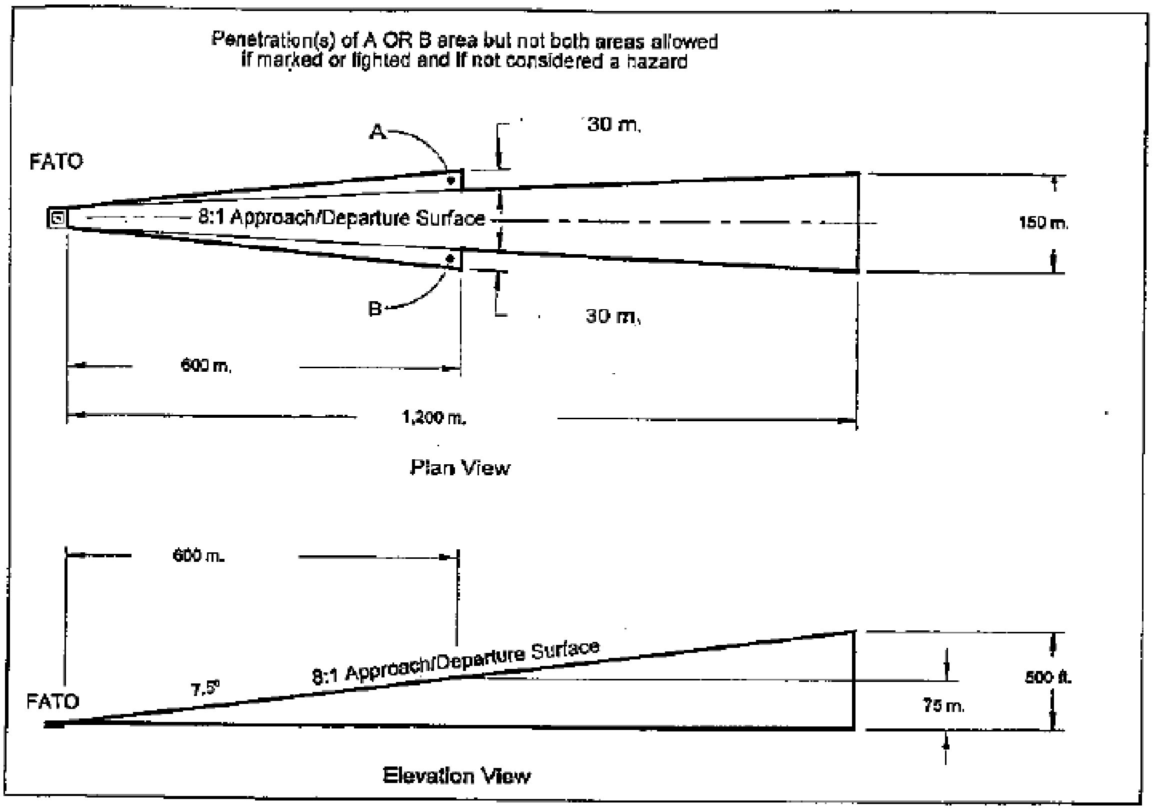


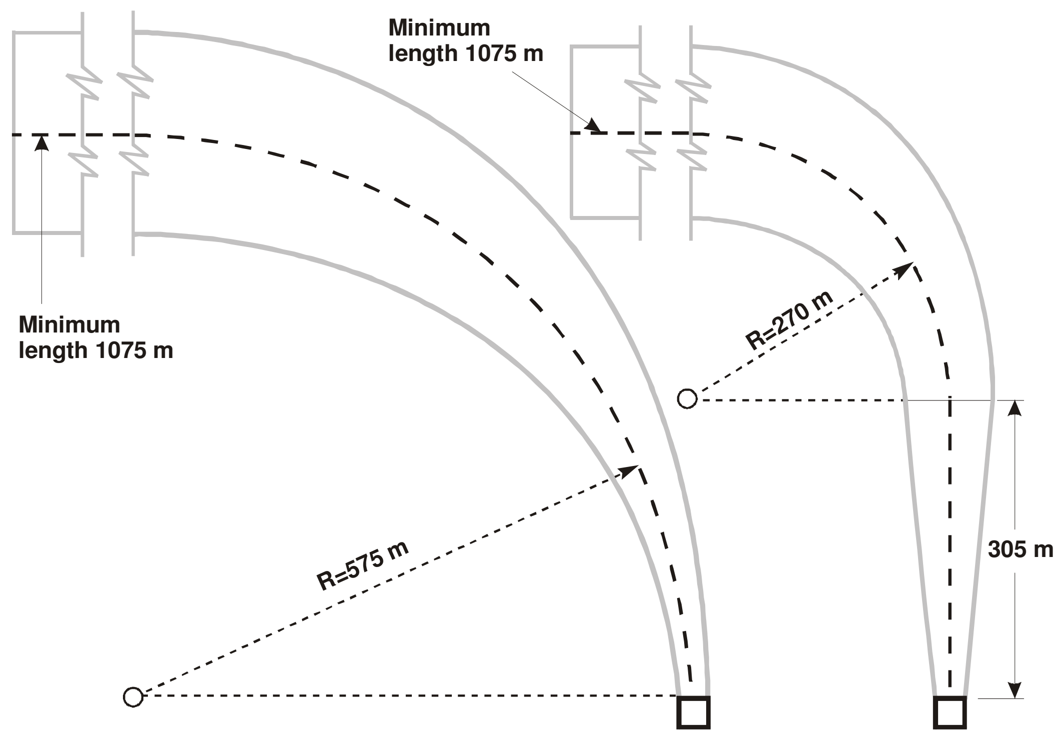
Figure 6 -- Alternate (wider) Flight Path where Transitional Surfaces Not Available – Extract from Draft NSW Health Policy Document Hospital HLS Guidelines

CAAP 92-2 says the flight paths can curve to avoid obstacles but does not specify the minimum radius of curvature or any minimum final approach path that must be straight. Existing Health Policy Document 2005_128 recommends two flight paths for approach and departure not less than 150^{o} apart to facilitate operations in all wind conditions – and notes that the rate of curvature should be the subject of expert input. This is in line with the ICAO Heliport Manual.

The draft Health Policy Document says, in respect to flight path curvature:- "VFR Approach/Departure paths may curve in order to avoid objects or noise sensitive areas. More than one curve in the path is not recommended. Changes in direction by day below 300 feet should be avoided, and there should be no change in direction below 500 feet at night."

Transport Canada Heliport Standards (expanding upon ICAO guidelines) set out the following formula to describe the flight path and minimum turn radius:-

> S + Cr ≥575 m and Cr ≥270 m – where S is the length of the straight portion of the flight path and Cr is the radius of the turn. Maximum direction change is 90^{o}.



Note 1: *Any combination of curve and straight portion may be established using the following formula: S+Cr ≥ 575 m and Cr ≥270 m, where S is the length of the straight portion and Cr is the radius of turn.*

Note 2: *The minimum length of the centre line of the curve and straight portion is 1075 m*

Figure 4-2. Curved approach and take-off climb surface for non-instrument FATO

Figure 7 -- Depiction of ICAO and future US flight path curvature criteria as depicted in Canadian Heliport Guidelines.

Although FAA Heliport Design Advisory Circular 150/5390-2B was silent on the degree of curvature allowed in a flight path, the new draft -2C iteration of that document has adopted the same formula to regulate the degree of curvature in a flight path.

We recommend that restriction on flight path curvature should be applied to NSW Hospital helipads.

Overflight of any ventilator or compressor discharges in the vicinity of the HLS should be avoided. Future development on site should be controlled to ensure that gas discharges are not constructed beneath the flight paths. Furthermore, any air intakes should be positioned as far as possible from the helipad to avoid intake of fumes into the hospital air supplies. We are aware of cases where this has happened with air intakes located more than 25 metres from the centre of the HLS -- about 11 metres from the edge of the helipad.

4.3 HLS Structural Design Parameters

4.3.1 Load Bearing Capability -- Background

CAAP 92-2 says the LLA should be capable of bearing twice the gross weight of the helicopter; or, if on a building, the LLA should be capable of accepting the static and dynamic loads involved. There is no further explanation of how such loads should be calculated.

Dating back over several editions, the US heliport design advisory circular has recommended for elevated helipads a load-bearing capacity of 1.5 times the maximum weight of the largest helicopter proposed to use the site applied through two contact points. The US vertiport design guide and the International Building Code recommend the same load factor.

In 1984, the US FAA commissioned the Civil Engineering Department at the University of Maryland to analyse the loads likely to be applied to structural helipads and to develop Structural Design Guidelines for Heliports. Their report dated October, 1984, is incorporated by reference into the current US heliport design advisory circular.

The study team conducted a literature review to ascertain the range of existing guidelines for helipad structural loading. They found that the existing ICAO, American Petroleum Institute, Louisiana Department of Transport, US FAA and US Coast Guard guidelines all recommended provision for hard landing loads equal to 1.5 times the maximum gross weight (MGW) of the helicopter.

The UK Civil Aviation Authority (CAA) recommendations were considerably more severe, requiring a hard landing impact load of 2.5 times the MGW increased by a structural response factor of 1.3 yielding a total impact load factor of 3.25. (As will be discussed later, the most recent ICAO heliport manual has now adopted the UK CAA standard.)

The study concluded that loads caused by hard landings are usually the critical structural loading condition for structural helipads and are often expressed as a multiplicative factor applied to the MGW of the design helicopter.

The study developed a “reliability-based approach to hard landing loads” based upon a “probability density function” for hard landing gear loads. After analysis, it was determined that for all practical purposes, the reliability-based load factor thus developed is smaller than the FAA recommended load factor of 1.5 MGW (or 0.75 MGW through each main gear).

The study considered the effect of local “punching” shear forces directly under the landing gear. The study concluded that with normal construction materials used on helipads, resistance to “punching” shear forces would be expected to be less critical than overall load-bearing capacity.

The study also considered whether vertical or horizontal downwash pressures could become critical design loads, and concluded after analysis that such pressures would invariably be less than the wind loading criteria specified in the Uniform Building Code (UBC).

The report considered the effects of structural vibrations induced by contact between the undercarriage of an idling helicopter and the helipad. After analysis, it was concluded that no special design consideration was necessary to account for such structural vibrations which are of a small magnitude. **The report, acknowledged, however, that even a small excitation force could cause problems if the excitation period was resonant with the natural frequency of the structure—which is a function of its stiffness and mass.**

The report suggested that the occurrence of resonance could be predicted by noting the frequency of the vertical “bounce”[2] of the helicopter and relating it to the response period of the structure. The report went on to suggest that, for structures which are sensitive to vibrations, a vibration isolation system (eg. a “floating slab”) could be utilised.

The study also analysed other structural loading combinations such as snow loading and live loading to determine that the hard landing loads were the critical design loads, and in concluding that the then existing guidelines for such loads were adequate for heavily utilised helipads and conservative for lightly utilised helipads.

4.3.2 Load Bearing Capability -- Discussion

Notwithstanding the findings of the University of Maryland as report above, the latest edition of the ICAO heliport manual contains structural design advice based upon the UK CAA helipad standards. That design advice has been adopted as the appropriate load-bearing criteria in the draft NSW Health Policy Document for hospital helipads; and can be summarised as requiring consideration of the following load combinations:-

CASE A—Helicopter on Landing

a) Dynamic load due to impact on touchdown
b) Sympathetic response on the FATO
c) Over-all superimposed load on the FATO
d) Lateral load on the platform supports
e) Dead load of structural members
f) Wind loading
g) Punching shear

CASE B—Helicopter at Rest

a) Dead load of helicopter
b) Overall superimposed load
c) Dead load on structural members and wind loading.

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[2] Vertical vibrations in a helicopter occur as a function of main rotor shaft speed multiplied by the number of main rotor blades. The steady state operating conditions of an helicopter running on an helipad are called “flight idle” and “ground idle”. The predominant aerodynamic vibration in any helicopter occurs with each blade-passage past a given point in main rotor rotation. The main types of helicopter likely to use the proposed hospital HLS all use 4-bladed main rotor systems.

The Bell 412 has a main rotor speed of 324 rpm at flight idle (100% N_R) and 260 rpm at ground idle (80% N_R). Thus, the “4-per-rev” vibration of a Bell 412 has a frequency of 21.6 Hz at flight idle and 17.28 Hz at ground idle.

The BK-117 has a main rotor speed of 383 rpm at flight idle (100% N_R) and 257 rpm at ground idle (67% N_R). Thus, the “4-per-rev” vibration of a BK-117 has a frequency of 25.53 Hz at flight idle and 17.11 Hz at ground idle.

Depending upon the structural response factor, application of the ICAO design criteria will result in a load-bearing capability up to 3.25 times the MAUW of the largest helicopter to use the site. In the case of the AW139, this yields (approximately):- 3.25 x 6400 kilograms = 20,800 kilograms.

The fundamental difference between the US FAA approach and the UK CAA approach lies in the contingencies being planned for. The worst case contingency planned for in the US codes (as we understand them) is the heavy landing load – equal to a descent at 2.4 metres/second (1.5 g's) applied over two contact points (e.g. in a tricycle helicopter – through 2 of the 3 wheels).

The UK code considers the heavy landing scenario and also the "emergency landing" or "crash landing" scenario which is assumed to be the failure-point for the helicopter undercarriage. We understand that this scenario is equivalent to 2.5 g's over the load-bearing surface.

We have earlier recommended that the emergency landing scenario should not apply to a structural assessment of landings by ADF helicopters. We acknowledge that the process is more complex than we have depicted, however we note that (1.5g) x (10,600 Kg) ≈ (2.5g) x (6400 Kg).

Therefore, we believe that the accommodation of ADF helicopters in emergencies may not require significantly (or any) greater load-bearing capacity than that required to accommodate the largest civil helicopter likely to use the site on a more routine basis.

We do not have the expertise to further quantify the structural design criteria for an elevated HLS, but we will gladly supply copies of whatever information we have available to structural engineers to complete such a design.

4.3.3 Load Bearing Capability -- Recommendation

We recommend that any elevated should be constructed to accept the dynamic and static loads imposed by helicopters up to the size of the AW139 (6400 kilograms MAUW) – as calculated in accordance with the ICAO and UK procedures (and as recommended in the draft NSW Health Guidelines for HLS) for structural helipads – to include an emergency landing load calculation.

We further recommend that the load-bearing capacity of the HLS should be adequate to accept the dynamic and static loads imposed by ADF helicopters up to the MRH-90 (10,600 Kg) – including the hard-landing scenario -- but excluding the emergency landing scenario. We believe the facility should be accessible by ADF helicopters – but that the frequency of use by those larger helicopters does not justify planning for the crash-landing contingency.

For the purposes of calculating live loads, the weight of medical attendants, flight crew and patients is included in the MAUW of the helicopter. Additional live load on the helipad could include up to seven persons comprising porters, medical staff or security officers; and up to two hospital trolleys.

Advice on marking the helipad will be provided separately, in light of the final solution for load-bearing capacity.

4.3.4 Surface, Slope and Drainage

For an elevated or rooftop HLS, the surface construction of HLS should be non-flammable and impervious to fuel and oil. It should also be non-slip or skid-resistant. Construction materials for elevated HLS are discussed below.

CAAP 92-2 specifies a maximum over-all slope across the GEA of 1:8 – however elevated helipads are normally designed near-level with only enough slope to facilitate drainage of rainwater and also of fuel in the event of a mishap resulting in spillage.

The draft Health Policy Document for hospital helipads recommends a maximum of 3.0% slope with 2.0% recommended.

The US FAA heliport design guide recommends gradients between 0.5% and 2.0%. Ideally, the deck can be designed so that the surface slopes down away from a centrally-located touchdown point and on either side of a slight ridge extending from the touchdown point toward each egress. The ridge comprises the approach route to the helicopter and the escape route from the helicopter in the event of a fire.

The helipad should have a rounded, raised lip of approximately 3 - 5 centimetres (1 ½ - 2 inches) around the perimeter. This lip should also extend across the entrance to any ramps, staircases or other openings to ensure that spilled fuel does not enter other parts of the structure.

Drains should be positioned at the low points of the sumps thus created by the slope and raised lip. Drains should be of sufficient capacity to accommodate heavy rainfall in accordance with the BCA and should be covered with course screen. Because re-fuelling is not proposed, there is unlikely to be any significant oily residue in the run-off from the helipad, hence no need to process run-off through a fuel-water separator for environmental reasons. Processing helipad run-off from a fire safety perspective is discussed below.

4.3.5 Material

The materials used for helipads should be flame resistant and impervious to fuel spills. The most common materials used in the construction of elevated helipads are aluminium, steel and reinforced concrete.

The advantages of reinforced concrete are its relatively low initial cost and low maintenance costs. The main disadvantage of reinforced concrete for an elevated helipad is its weight. In general, reinforced concrete is the best option for helipads which are designed integral to a new structure, where allowance for the weight can be made in the underlying structure.

Steel helipads are generally lighter but more expensive than concrete. Their main disadvantage is significant ongoing maintenance costs, because of problems with oxidation.

Aluminium helipads are generally the lightest but most expensive of the helipad materials. Aluminium is most advantageous for retrofit installations where the underlying structure may be incapable, without reinforcement, of supporting concrete or steel. Aluminium is less susceptible to corrosion and exhibits better strength to weight ratios than steel.

4.3.6 Attendant Waiting Areas

CAAP 92-2(1) provides that a ". . . pilot of a helicopter operation to, from or at an HLS should ensure that: . . . the HLS is clear of all: . . .persons, other than persons essential to the helicopter operation; and . . . no person outside the helicopter, other than a person essential to the operation is within 30 metres of the helicopter. . . ." Health PD 2005_128 clarified this by specifying no person within 45 metres of the centre of the helipad.

The "safety buffer" (not to be confused with the 0.3 x rotor diameter "safety area") is considered to apply on the plane of the landing and lift-off area, i.e. it is a horizontal buffer. On rooftops there is seldom sufficient space to achieve that horizontal buffer. Persons on subjacent levels are not subject to the same horizontal separation.

There should be a solid structure available to shield porters and medical attendants awaiting helicopter arrivals from rotor wash and the effects of any mishap. The lift structure may serve that purpose – provided there is an area "behind" that structure for personnel to stand during take-off's and landings.

While security staff would be considered to be "essential to the operation" and thus "exempt" from the separation requirements as far as air legislation is concerned, the potential for employer's liability under "Occupational Health and Safety" legislation requires that the HLS should be designed so that they can provide security for the site without themselves being subjected to unnecessary danger.

Large windows (unless solidly screened) facing the HLS within that safety buffer zone are discouraged as they may create the impression of a "viewing area" overlooking the movement area – attracting non-participants who would be at risk.

4.4 Safety Fence and other Safety Features

4.4.1 Safety Fence or Shelf?

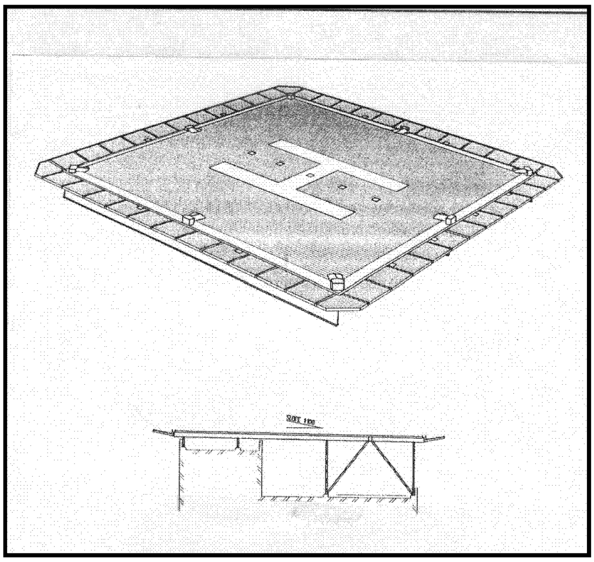
For elevated helipads, a safety fence or shelf is required around the edge of the deck. The US FAA heliport design guide recommends a fence or shelf 1.5 metres wide with a load carrying capability of 122 kilograms per square metre which should not project more than 5 centimetres above the level of the deck.

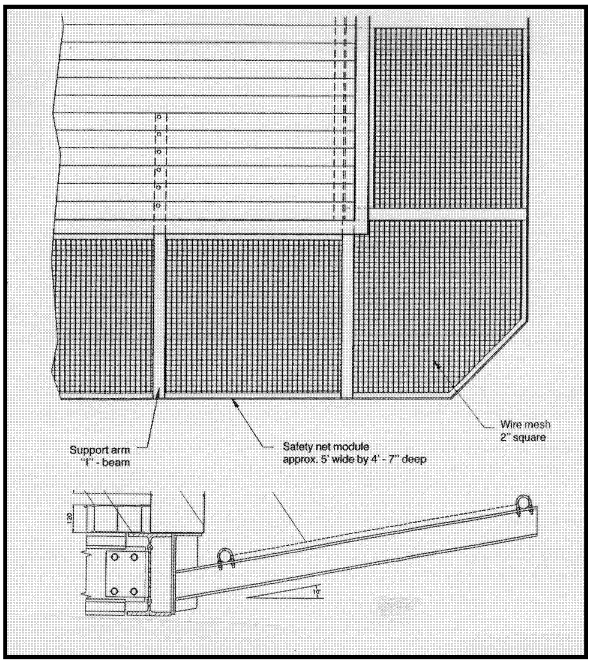
The ICAO heliport manual recommends a 1.5 metre safety fence capable of withstanding, without damage, a 75 kg mass being dropped from a height of one metre which should be manufactured to provide "a hammock effect for a person falling into it rather than the trampoline effect produced by some rigid materials".

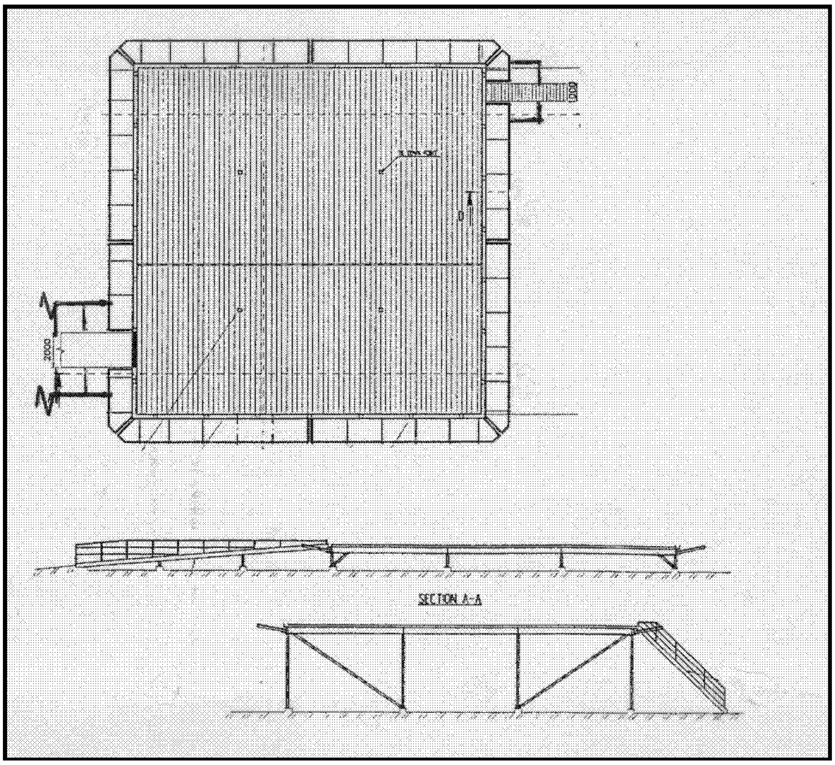
The support arms should be attached to the edge of the structure approximately 12 cm below the level the helipad and should extend upward at an angle of approximately 10^{o} so that the outer edge of the fence is approximately level with the helipad.

Note:- Where turbulence may be an issue (see discussion below) then a solid safety <u>shelf</u> is preferred to a porous safety fence.

The safety fence should extend around any ramps or staircases so that it is not necessary to have safety rails protruding more than 25 cm above the level of the helipad.







4.4.2 Egress

There must be two separate means of egress from elevated helipads. One means of egress must accommodate patient movement. This can be either a lift capable of carrying a patient trolley plus up to four attendants at a time; or a ramp. Access and egress to and from the helipad should be lockable on the landside, for security, but should be incapable of being locked on the airside, to guarantee unimpeded egress in the event of a landing mishap.

Ramps should have incline, turn radii and safety rails complying with building standards for such structures except that safety rails leading onto the helipad shall not extend more than 25 cm above the level of the helipad.

The maximum incline of the ramp should be such that a patient trolley can be manoeuvred safely by one attendant—normally about 1:16 unless a mechanical device is used to brake and/or propel the trolley.

The second (emergency) egress from the helipad can be a fire stair and need not be attended during helicopter operations—provided it is locked on the landside-only.

4.4.3 Protecting Obstacle-free Planes

The FATO must be free of obstacles likely to interfere with the manoeuvring of the helicopter. All light fixtures and tie downs (not recommended in this particular instance) located within the FATO should be flush or nearly flush with the surface.

If not entirely flush, any protrusion should be rounded to minimise the chance for “dynamic rollover” in the event it is struck by the skid of a manoeuvring helicopter.

Fixtures immediately around the helipad such as safety rails or fire extinguisher mounts should not extend more than 25 cm above the level of the FATO. The obstacle-free approach/departure gradients begin at the edge of the FATO and at the same level as the helipad so no fixtures should protrude into that airspace.

Ideally, any fire protection equipment (fire extinguishers, hose reels, etc.) associated with the HLS can be mounted on a stairwell “landing” below the helipad level.

Any covered “walkway” leading from the lift to the helipad should not protrude into the FATO. No vertical safety railings may impinge the FATO – horizontal (or nearly horizontal) safety fences must be used within the FATO and flight paths.

4.5 Fire Protection

4.5.1 Protection Standards

We are unaware of any specific provisions in BCA relating to fire protection on helipads. CAAP 92-2 (and the Health Department Circular) specify that an HLS on a building should have two carbon dioxide fire extinguishers of at least 4.5 kilograms capacity each; with one positioned at each access/egress route.

The US FAA heliport design guide does not contain detailed requirements for fire fighting equipment, but refers to National Fire Protection Association (NFPA) 418 -- Standard for Heliports – 2006. “Chapter 6, Rescue and Fire Fighting” in the ICAO heliport manual contains fire fighting specifications for both surface-level and elevated helipads. In some ways the ICAO criteria appear to parallel the NFPA standard except that it uses metric dimensions, etc. However the two “standards” appear to have differences which go beyond metrication.

We are not technically qualified to comment on the respective merits of NFPA 418 versus the ICAO heliport manual. We note that re-fuelling is not proposed for either hospital HLS.

The availability of automatic helipad fire-fighting systems is noted. Such systems comprise foam nozzles which are activated by sensors monitoring the helipad. We are unaware of any empirical data in support of their effectiveness. However, we have heard anecdotes about false activations by automatic monitors resulting in foam being sprayed onto the windscreens of hovering helicopters – thus causing accidents involving otherwise perfectly serviceable aircraft.

We believe fire protection engineers should review the aviation standards for heliport fire protection and provide advice on compliance. We specifically discourage installation of automatic foam monitors around the HLS.

4.5.2 Drainage, Fuel-Water Separators and Catchment

We note that earlier editions of NFPA 418 contained a requirement that rooftop heliports have either a fuel-water separator with sufficient storage to take the full fuel capacity of the largest helicopter to use the site (AW139 -- 1270 l.) or drainage from the helipad routed external to the building. The processing rate of any separator must exceed the flow rate of the combined hose reels – if installed.

Those requirements were removed in the 1990 edition of the standard. Not all jurisdictions have adopted NFPA 418-1990 or its subsequent iterations, with some choosing to retain the more stringent fire protection requirements of NFPA 418-1978.

We note that the decision to remove the NFPA requirement for drainage isolation or fuel-water separation was based upon an extensive survey of some 27 million helicopter landings which did not disclose a single instance in which a fuel-water separator would have provided any benefit. Nonetheless we believe that conservative fire protection measures are important if the hospital HLS is located on a clinical building where it would be expected patients may not have the ability to self-evacuate in the event of a fire.

We also note that the suggested individual fatality risk criteria for various land uses as set out in the NSW Department of Urban Affairs and Planning Hazardous Industry Planning Advisory Paper No. 4 reflect a philosophy that hospitals, schools, child-care facilities, and old-age housing require the most stringent protection from external threat of all land uses considered.

We believe that either all drainage from the helipad should be isolated and routed independently of the structure; or all drainage from the helipad should be routed through a fuel-water separator capable of processing run-off at a greater rate than the combined discharge capacity of all hose reels on the helipad.

The new draft Health Policy Document on hospital helipads recommends a fuel water separator capacity of 2700 litres – comprising static holding capacity of 1500 litres and integral storage of 1200 litres separated jet fuel.

4.5.3 Fire Fighting and Rescue Equipment

In addition to the fire protection referred to above, we recommend that rescue equipment should be provided in a cabinet adjacent to the helipad (either outside the FATO or below the level of the helipad) as enumerated in the ICAO heliport manual. The equipment should be accessible both from the helipad and from the land-side.

In making this recommendation, consultants assume that at least some of the hospital personnel ultimately tasked to attend helicopter arrivals will be trained to use the equipment and, in the event of a mishap on the helipad, could be expected to 1) raise the alarm with the NSW Fire Brigade; and 2) take early steps to contain the fire and rescue any helicopter occupants.

It is possible that following a mishap, some crew members from the helicopter might be able to assist other occupants and to fight any fire. However, it is more likely that any effective fire fighting and rescue efforts would be conducted by ground staff attending the helicopter movement—pending the arrival of the NSW Fire Brigade.

If it is unlikely that hospital staff would be committed to such a role, then provision of the rescue equipment is of little value.

4.6 Lighting

The HLS lighting recommendations of the draft Health Policy Document comprise the main lighting criteria for the site and are reproduced *verbatim* below:- "For night operations, the GEA/TLOF (for elevated helipads) or the FATO (for surface-level helipads, approach/departure direction, and the windsock must be illuminated. Due to Night Vision Goggles (NVG) operations, appropriate research is required to ensure that LED type lights will operate within the required spectrum."

4.6.1 Perimeter Lighting

"The GEA/TLOF perimeter is to be lit with green lights. Flush mounted lights are to be used, and they should be located within 30 cm. of the outside edge of the GEA/TLOF perimeter. Lighting on the outside edge provides better visual cues to pilots when at a distance from the HLS, since they outline a larger area."

4.6.2 Landing and Take-Off Direction Lights

"Landing and Take-Off direction lights are a preferable feature for both surface and elevated HLSs. On elevated HLSs, they should be installed on the deck to provide landing and take off directional guidance at night. Landing direction lights are ideally a configuration of five yellow, flush mounted omni-directional lights on the centreline of a yellow two headed arrow with black borders painted on the deck, and showing the preferred approach/departure path/s. These lights are normally spaced at 5 m. intervals beginning at a point not less than 6 m. and not more than 8 m from the GEA/TLOF perimeter and extending outward in the direction of the preferred approach/departure path. If however the area does not allow for such a size, the arrow/s may be proportionally reduced in size and less lights may be used."

4.6.3 Windsock Lighting

"The windsock is to be illuminated by four closely mounted white lights to ensure that it may be seen clearly from all directions. A red obstruction light is also to be positioned on the top of the mast."

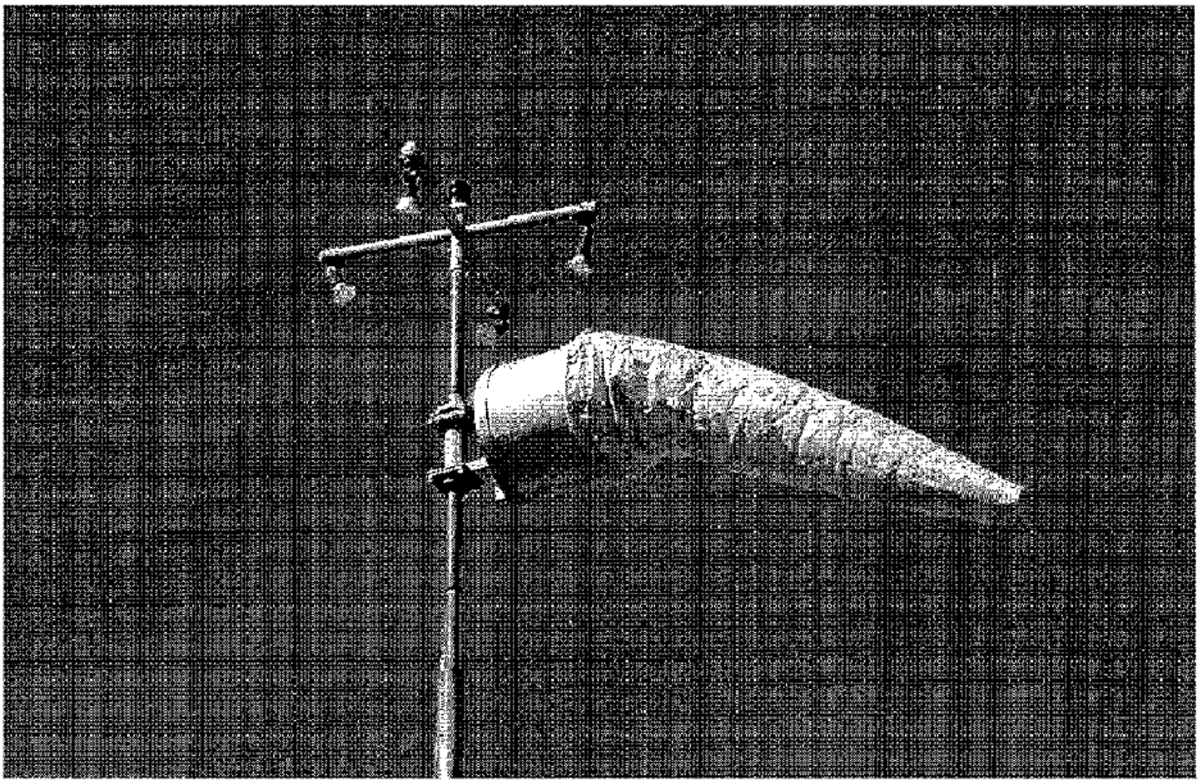


Figure 8 - Example of windsock lighting arrangement

4.6.4 Flood Lights

"Flood lights may be positioned to illuminate the GEA/TLOF and the FATO **for the purposes of aiding in helicopter loading and unloading**. To eliminate the need for tall poles, these flood lights may be mounted on a co-located building wall if it is high enough. The flood lights are to be clear of the GEA/TLOF, the FATO, the Safety Area, and the approach/departure surfaces and any required transitional surfaces.

Care should be taken to ensure that flood lights and their associated hardware do not constitute an obstruction hazard. Flood lights should be aimed down and provide a minimum of 3-foot candles (32 lux) of illumination on the HLS surface. **Flood lights can interfere with pilot vision during takeoff and landings and are therefore to be capable of being independently manually turned off. They are to be on a separate circuit to that of all other lights.**"

4.6.5 HLS Identification Beacon

"A HLS identification beacon is recommended equipment. The beacon is to be located as close as is practical to the HLS, and on the highest point of the hospital reasonably available. The AC recommends a beacon capable of flashing white/green/yellow at the rate of 30 to 45 flashes per minute. Such a beacon may be activated via a PAL system, which is also recommended."

4.6.6 Lighting Activation

"All HLS lighting must be capable of manual activation and deactivation. Flood lighting should be on a separate circuit to that of the FATO, GEA/TLOF, approach/departure directional lighting, windsock, local obstruction lighting and any visual glideslope indicator installed. These latter lights may be on a common circuit."

All but flood lighting may also be activated via a Pilot Activated Lighting (PAL) system. This utilises a hospital based VHF radio and timed switching device. The pilot is able when within range (~20 nm.), to activate via a VHF radio transmission from the aircraft, on a pre set frequency. The PAL system allows for 30 minutes duration. Lights may be manually turned on and may be manually turned off within the 30 minutes, or they automatically turn off at 30 minutes prior to a flashing warning. The installation of PAL equipment is recommended.

The manual activation switching must be readily accessible to the HLS attendant staff.

All perimeter light fixtures should have a maximum height of 25 centimetres. Ideally, perimeter lights can be mounted on the safety fence arms outside the helipad and recess slightly below the helipad. Only the lense of the fixture should protrude above the helipad level."

4.7 Marking

The HLS marking recommendations of the draft Health Policy Document comprise the main marking criteria for the site and are reproduced *verbatim* below:-

4.7.1 HLS Surface Covering and Marking

"Where possible, all paint used on a HLS surface is to be hard wearing (road type), fuel resistant, non slip and UV resistant. Elevated HLS decks should be painted light grey, out to at least the perimeter of the FATO. Surface markings should identify the facility as a HLS. Lines/markings for the FATO and GEA/TLOF are to be 30 cm. wide and of a contrasting colour (white) to enhance conspicuity. The following markers and markings are to be used."

4.7.2 GEA/TLOF and FATO Perimeter Marking

"The perimeter of the GEA/TLOF and the FATO is to be defined with markers and/or lines.

a) GEA/TLOF. The perimeter of the GEA/TLOF is to be defined with a continuous white line 30 cm. wide." (Refer to Figure 9.)

"b) FATO. The perimeter of the FATO is to be defined with a 30 cm. wide dashed white line. The corners of a square FATO should be defined, and the perimeter marking segments are to be 30 cm. in width, approximately 1.5 m. in length, and with end-to-end spacing of approximately 1.5 m." (Refer to Figure 9.)

4.7.3 Hospital HLS Identification Marking

"The identification marking is intended to identify the location as a hospital HLS, mark the GEA/TLOF, and provide visual cues to the pilot.

Standard marking is a red "H" in a white cross (which may be on a red background), defined by the GEA/TLOF continuous white line. The "H" is to be oriented to magnetic north. Arrows and landing direction lights . . . are also be used to indicate one or more preferred approach/departure directions." (Figure 9 illustrates the requirements of the standard hospital marking.)

4.7.1 Hospital Identifier

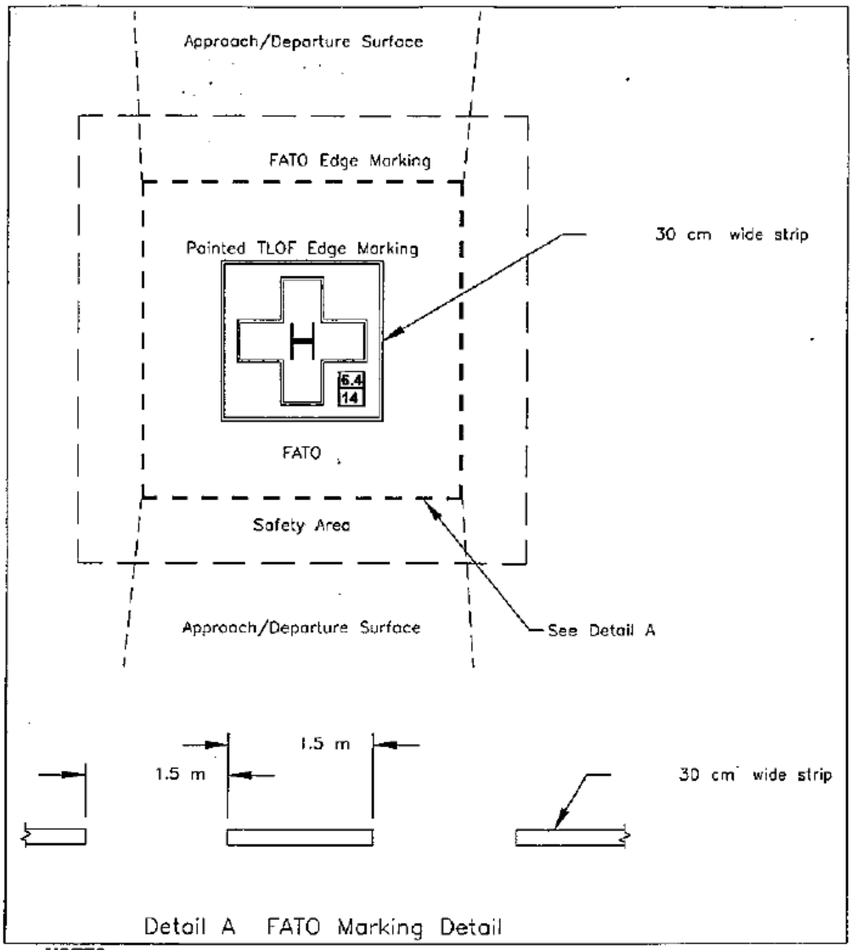
"The name of the hospital and its identifier should be painted on the HLS surface on the northern side and beyond the FATO perimeter markings, or if there is insufficient space, between the FATO and GEA/TLOF lines. The letters should be 1 m. high, in white and be marked as per the example for Royal North Shore Hospital following: 'RNSH (YXNS)'." (Note: The four-letter identifier starting "YX**" is an aviation identifier issued by Airservices Australia and should be established after the project has been finalized but before commissioning.)

4.7.2 Weight and Rotor Diameter Size Limitation Markings

"The GEA/TLOF on roof top/elevated HLSs is to have the Maximum Take Off Weight limit marking in metric units, i.e. a marking of '6.4' equating to the Design Helicopter limit of 6,400 kg. This marking is to be located in the centre of the upper section of a GEA/TLOF weight/size limitation 'box'.

The GEA/TLOF is also to be marked to indicate the rotor diameter of the Design Helicopter. This marking is to be in metres, i.e. in this case a figure of "14", and be centred in the lower section of a GEA/TLOF size/weight limitation 'box'.

When viewed from the preferred approach direction, these markings should be located on the GEA/TLOF in the lower right-hand corner or the lower right-hand quadrant of a circular GEA/TLOF. The numbers should be 0.9 m. high and black with a white background and in a box of dimensions indicated in Figure 9."



Note:

1. The "H" should be orientated to Magnetic North.
2. The perimeter of the GEA/TLOF should be defined with a continuous, 30 cm. wide white line.
3. The perimeter of the FATO should be defined with a 30 cm. dashed white line approximately 1.5 m. in length, and with end-to-end spacing of approximately 1.5 m.
4. The corners of the FATO should be defined.
5. The positions/directions of the Approach/Departure Surfaces are examples only.

Figure 9 -- Markings as depicted in draft NSW HLS Guidelines

4.7.3 HLS Deck Walkways

"Painted walkway markings are to be positioned on the decks of elevated HLSs. They are to be direct from the primary deck access point entry doors to the edge of the TLOF/GEA. Walkways should be at least 1.8 m. wide and be painted in UV resistant yellow and black diagonal lines.

The pavement should be designed so that spilled fuel or lubricants do not drain onto passenger walkways or toward a parked helicopter."

4.7.4 Surface Level Walkways and Paths

"Surface level walkways and paths should be sealed, not exceed a slope of 1:12, have no steps, and be where possible not less than 1.8 m. wide. If possible they should be covered to within 20 m. of the HLS Safety Area boundary."

4.7.5 Magnetic North Orientation

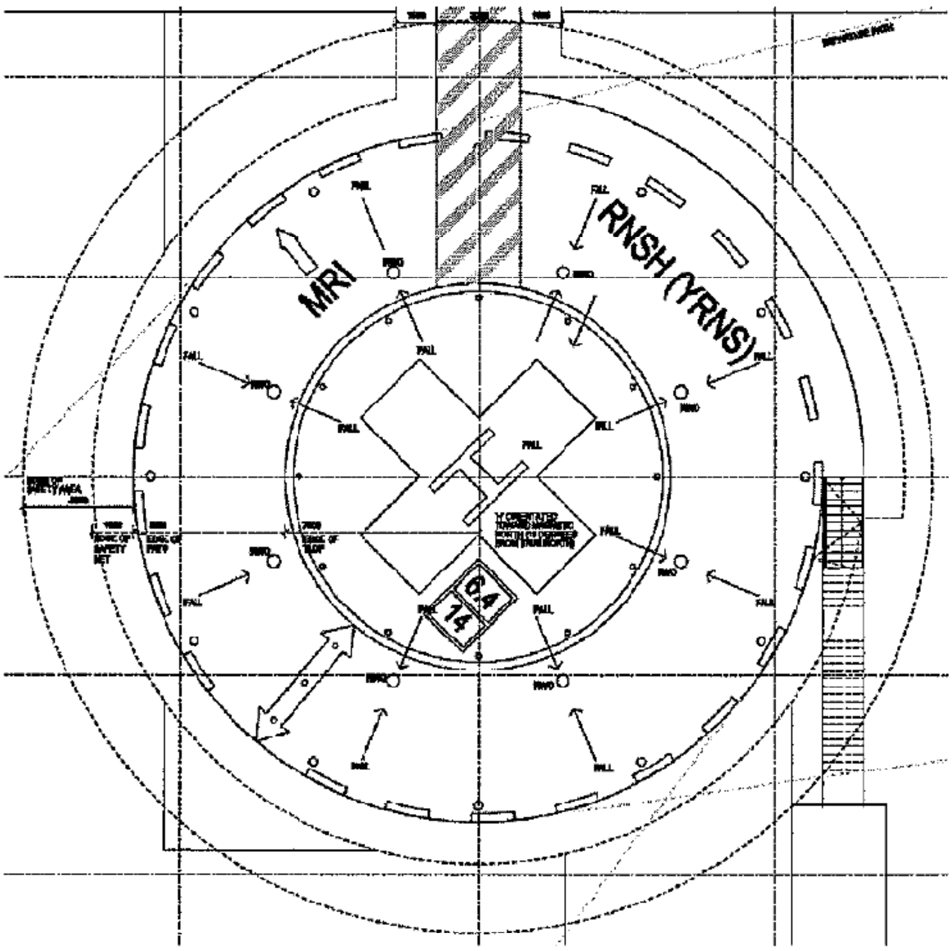
The "H" marker and thus its white cross background is to be orientated towards Magnetic North.

4.7.6 Example Roof Top HLS Layout

The following diagram at Figure 10 extracted from the Draft NSW Health Policy Document on Hospital HLS provides an example of a roof top HLS layout incorporating:

- GEA/TLOF perimeter markings and lighting,
- safety net and safety area,
- maximum weight and rotor size limitation markings,
- HLS deck walkway,
- hospital identifier,
- hospital HLS identification marking with magnetic north orientation,
- MRI direction,
- preferred approach and departure direction, and
- secondary HLS deck emergency exit.

Our note:- Notwithstanding the author of the draft Guidelines stating that circular helipads are acceptable (and depicting the markings using a circular shape) – we do not believe that a circular helipad is appropriate for the rooftop of a clinical building. Helipads and markings with straight edges and sharp corners provide better visual cues and thus help reduce the risk of a rooftop accident to the risk-management ALARP standard:- as low as reasonably practical. The markings illustrated below can be applied to a square or rectangular helipad.



Note:

1. HLS deck in light grey.
2. The perimeter of the FATO is defined with a dashed white line at 25 m. diameter, and with flush mounted green lights.
3. The perimeter of the GEA/TLOF is defined with a continuous, 30 cm. wide white line at 14 m. diameter, and with flush mounted green lights.
4. The direction arrow is yellow, with flush mounted yellow lights.
5. HLS identification marking is a red "H" on a white cross orientated to magnetic north.
6. Walkway is in yellow and black stripes.

Figure 10 -- Example of Hospital Rooftop HLS Layout and Markings – as depicted in draft NSW Health Guidelines

4.8 Other Features

Hangars and re-fuelling facilities are located at Wagga Wagga Airport and are not recommended for the proposed facility. Tie downs are not required.

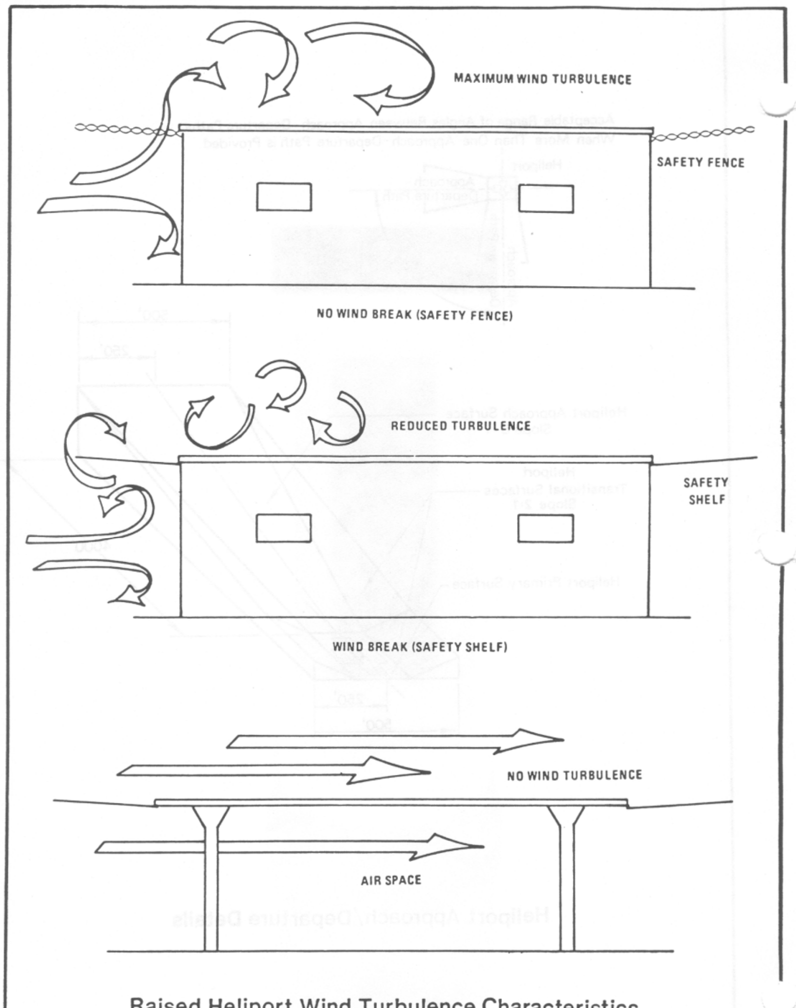
4.8.1 Patient Access

Trolley paths should be at least 1.2 metres wide and have a maximum slope of 1:12 (1:16 desirable) with no camber.

4.8.2 Communications

In addition to communications via security officers' portable radio, a telephone extension should be located in the "waiting area" adjacent to the HLS to allow pilots to "cancel SARTIME", to facilitate passage of "last-minute" messages relating to patient condition, ETA, etc. and to expedite raising the alarm in the event of a mishap on the HLS.

4.8.3 Turbulence



Raised Heliport Wind Turbulence Characteristics

FIGURE 7

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For surface level sites constructed alongside large buildings, lee-side mechanical turbulence may be a safety issue during windy conditions. For an HLS located on the highest part of a building, lee-side mechanical turbulence is unlikely to adversely affect helicopter operations – however introduction of exhaust ducts under the flight paths may be an issue. Furthermore, use of a "block" construction contributes to turbulence of the helipad. This can be minimised by allowing space between the deck and the subjacent structure. **Less effective in reducing turbulence than having a "void", safety "shelves" can be used instead of safety fences around the helipad.** See illustration above.

5. State Planning and Environmental Regulations

5.1 Planning Legislation

State planning legislation affecting helicopter landing sites includes the *Environmental Planning and Assessment Act, 1979 (NSW)* (EPAA) and Schedule 3 (Designated Development) to the *Environmental Planning and Assessment Rules, 1994* (EPAR). Provided the proposed facility will be used solely for urgent medical flights, it will be excluded from the definition of "aircraft facilities" which are otherwise "designated development" under the legislation.

5.2 Council Zoning

We assume the land upon which Wagga Wagga Base Hospital is built is zoned "Special Use – Hospital". We assume development consent has been issued to operate the hospital on that site.

The question of whether development by area health services is exempt from council planning controls has not, to our knowledge, been specifically answered in NSW. The Victorian Civil Appeals Tribunal has ruled that similar statutory authorities in that state are subject to planning controls.

We understand that, as a matter of policy, DA's are lodged for hospital development by area health services in NSW. "Development" in NSW is defined to include "building", "works" or the "use of land". Clearly the erection of an elevated HLS atop a new wing of the building will comprise a "building" and/or "works".

Helipads are almost always controversial – even emergency-service facilities. Arguably, in this case, the helicopter flights are ancillary to the dominant use of the land and should not be considered a separate use of land for planning purposes. In any event, an assessment of acoustic impact has been undertaken by Wilkinson Murray and they have not identified a significant impact flowing from the proposed helicopter operation.

5.3 Pollution Control Legislation

From about 1985 to 1999, helicopter landing sites constituted "scheduled premises" under the *Noise Control Act, 1975 (NSW)* and therefore required both a Noise Licence under that Act and a Pollution Control Approval under the *Pollution Control Act, 1970 (NSW).*

The *Protection of the Environment (Operations) Act, 1997 (NSW)* repealed both of the above acts and, while retaining the concept of "scheduled premises" exempted air medical and low-usage helipads from the schedule. Therefore, no environment protection license is required for a hospital HLS in NSW – PROVIDED their use is restricted to medical helicopters conducting patient transport or other emergency-service operations.

6.0 Concept Design of the HLS as currently developed

Annual wind roses for the Wagga Wagga Aviation Meteorological Office – 9am and 3pm observations are contained in Appendices 1 and 2. They indicate the prevailing morning winds are easterly; and the prevailing afternoon winds are westerly.

Figures 11 and 12 below depict the site with the proposed level 7 helipad. The proposed flight paths for that facility are 180 degrees apart and are oriented east/west.

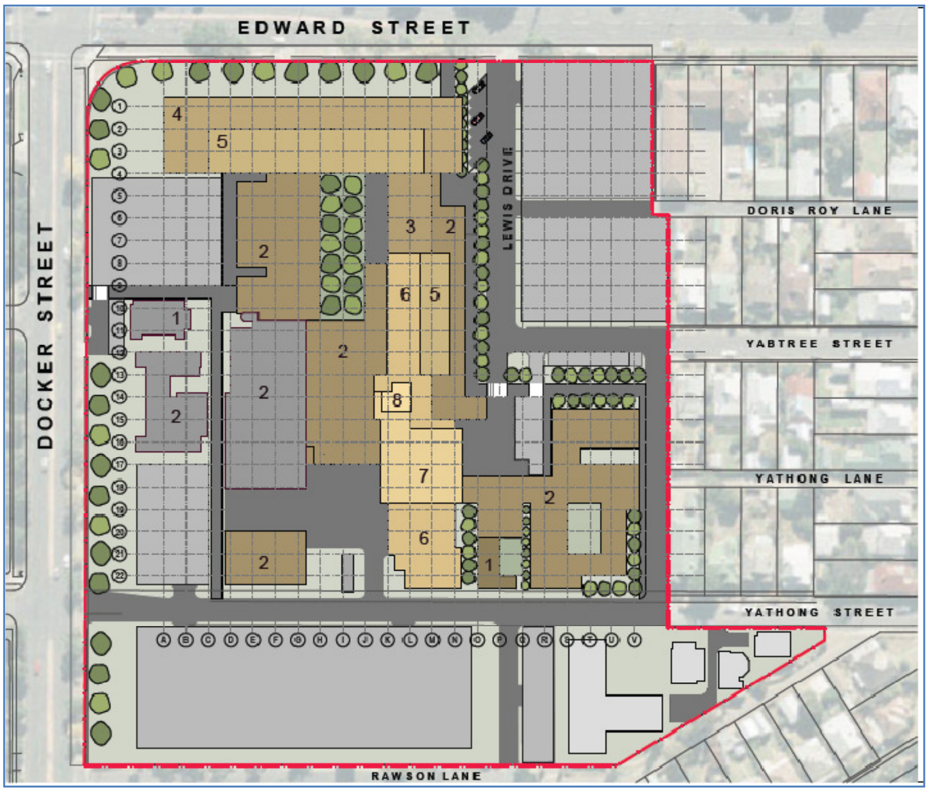


Figure 11 -- Plan view of Site -- Helipad shown as Level 7 (Level 8 is lift motor room)

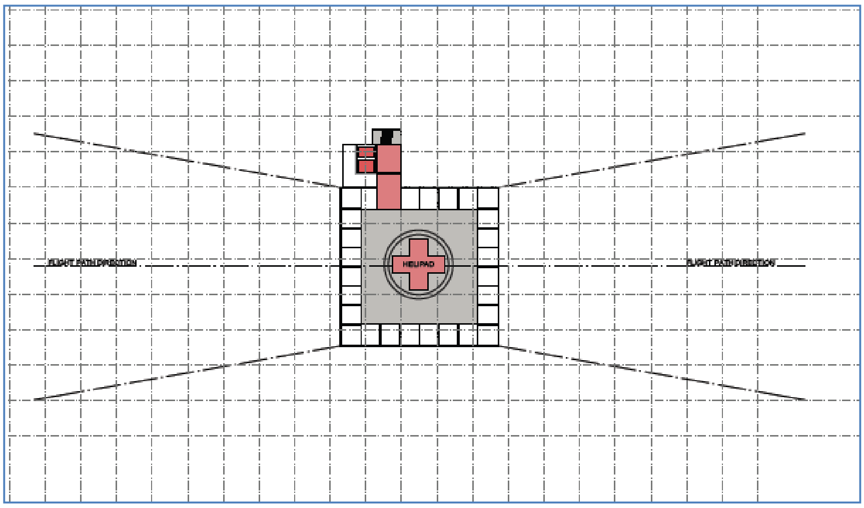


Figure 12 -- Plan view of Level 7 HLS and adjacent Lift Motor Room extending to Level 8

In our opinion, that flight path layout is viable in respect of its orientation into prevailing winds and the fact the flight paths run approximately parallel to the Sturt Highway (Edward Street -- being a transport corridor that we would expect to have a high ambient noise associated therewith).

Figures13-16 below are 3D renderings of the concept design of the campus with flight paths and transitional surfaces super-imposed. (The safety areas are not shown.) It will be noted that the flight paths above are currently unobstructed within the vicinity. Planning control over the subjacent lands should be sought to prevent the flight paths being built out. The transitional surface on the northern side of the flight path is infringed by the lift motor room. Plotting the flight paths using the alternate criteria illustrates compliance.

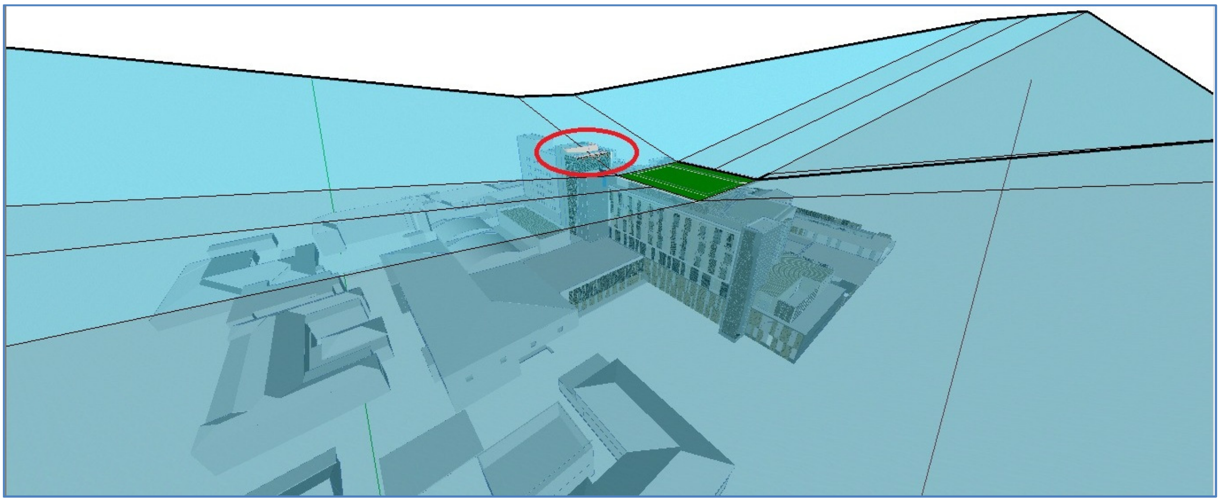


Figure 13 -- Flight Paths and Transitional Surfaces -- Note that lift motor room impinges one transitional surface.

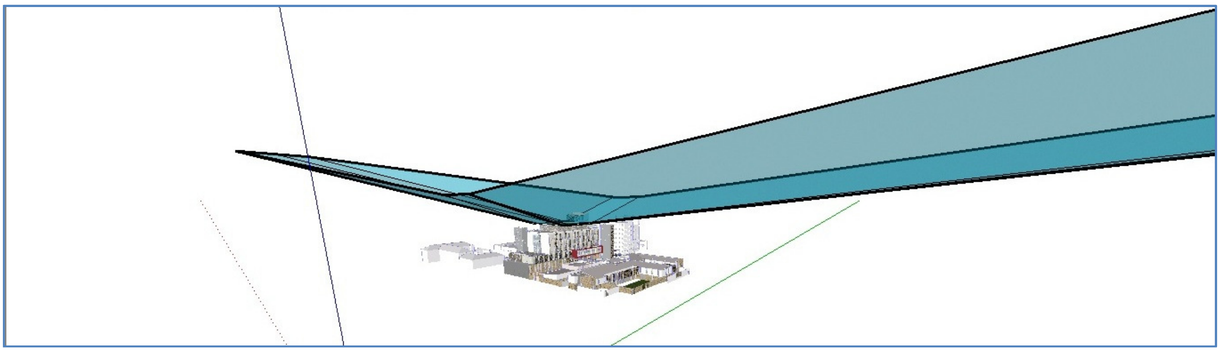


Figure 14 -- Protected surfaces shown in the context of the hospital buildings.

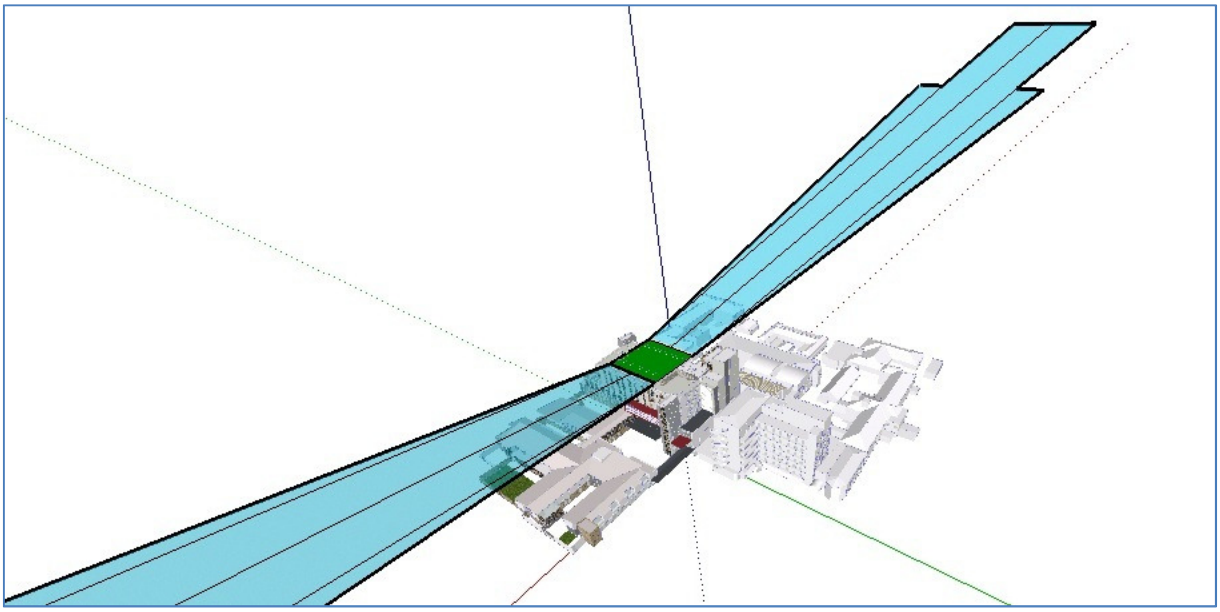


Figure 15 -- Flight Paths plotted in accordance with Alternate Criteria (wider flight path -- no 1:2 Transitional Surface.

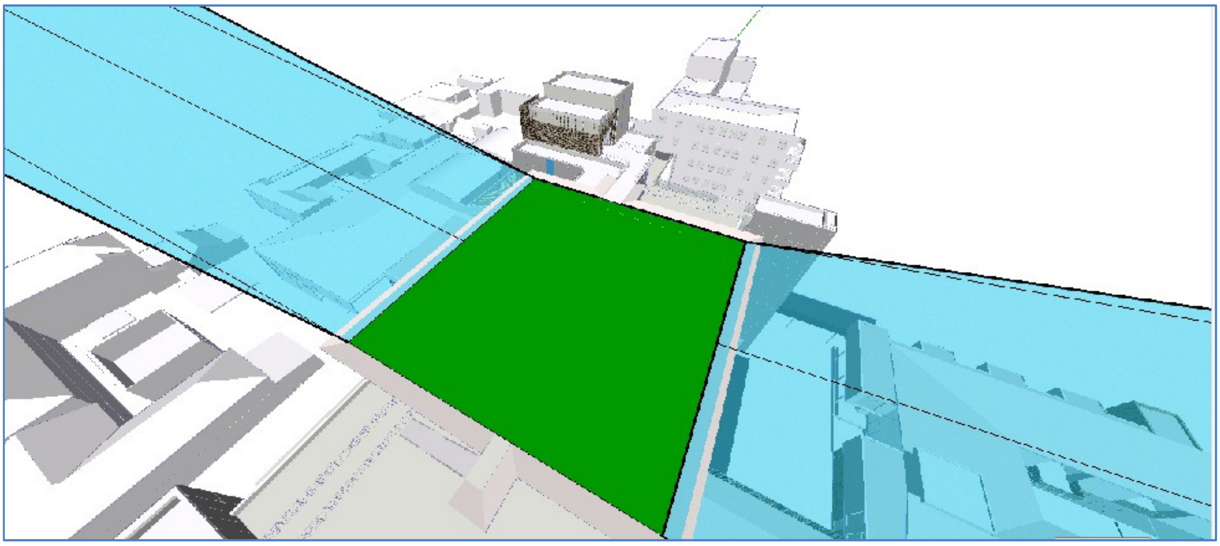
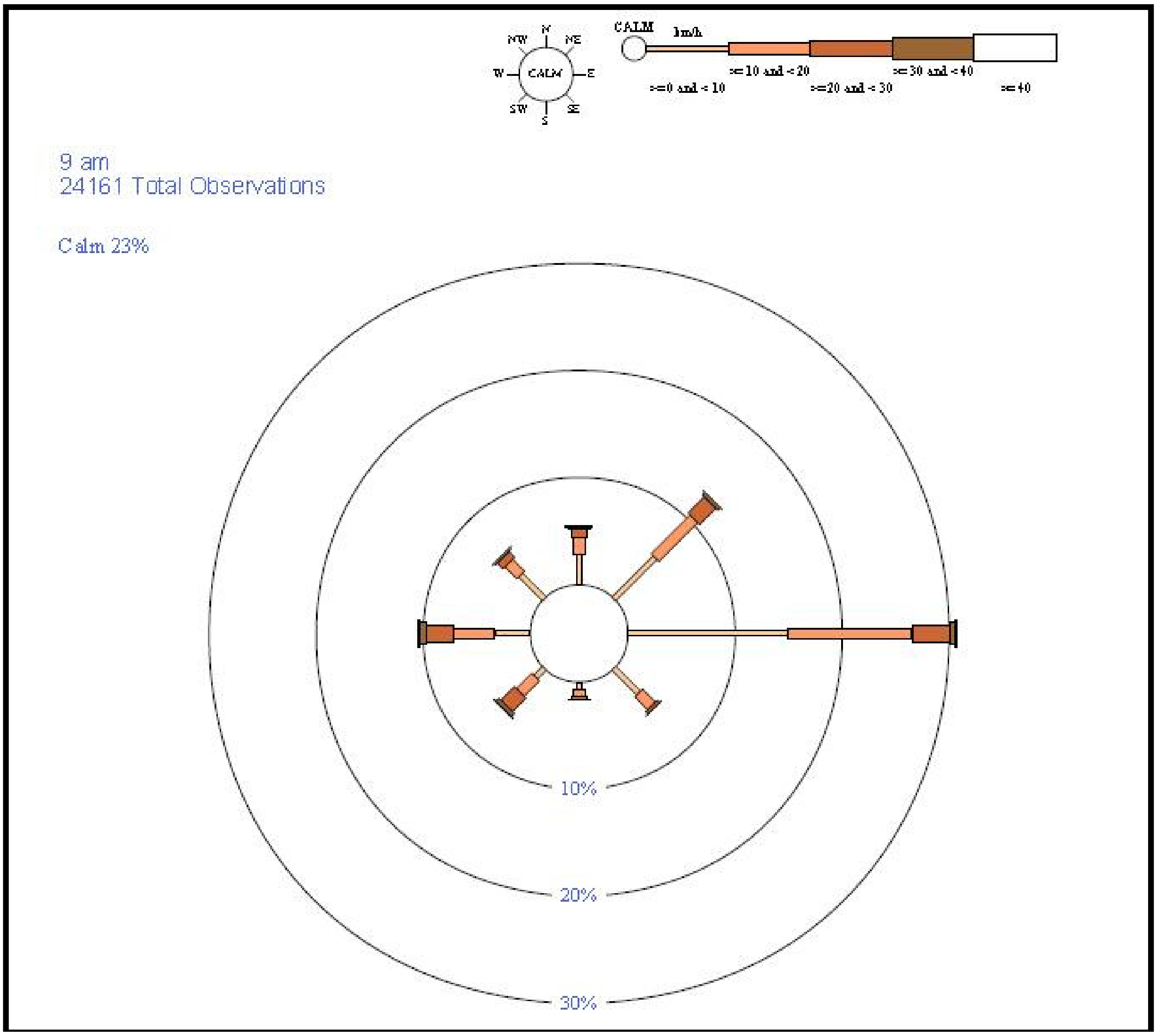


Figure 16 -- Alternate Flight Paths are viable -- No infringement within the near vicinity.

The above analysis only relates to obstacles identified within the Wagga Wagga Hospital campus and near vicinity. The 1:8 obstacle-free gradient must be available out to 1200 metres from the edge of the FATO at 500 feet above the level of the HLS.

Daniel E Tyler LLM
Heli-Consultants Pty Limited
July, 2011

Appendix 1 – 9am wind rose for Wagga Wagga Aviation Meteorological Office



Appendix 2 – 3pm wind rose for Wagga Wagga Aviation Meteorological Office